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CHAPTER 2.0

SITE CHARACTERISTICS

2.1 GEOGRAPHY AND DEMOGRAPHY

2.1.1 SITE LOCATION AND DESCRIPTION

2.1.1.1 Specification of Location

The site of the Callaway Plant is approximately 10 miles southeast of Fulton, Missouri, in Callaway County (Figure 2.1-1) and 80 miles west of the St. Louis metropolitan area. The Missouri River lies 5 miles south of the site within a flood plain about 2.4 miles wide.

The center of the Callaway Plant Unit 1 reactor is located at 38°-45'-40.7"N latitude and 91°-46'-50.5"W longitude. Universal Transverse Mercator Zone 15 Coordinates of the point are 4,290,786.0 meters north and 605,939.6 meters east. The Missouri State Plane Coordinates are X 705,108.0 feet and Y 1,066,832.9 feet.

Union Electric Company in October 1981, cancelled Unit 2 of the Callaway Plant, however the midpoint between the two reactors will still be used, this midpoint is located at 38°-45'-42.3"N latitude and 91°-46'-52.4"W longitude. Universal Transverse Mercator Zone 15 Coordinates of the point are 4,290,834.4 meters north and 605,893.2 meters east. The Missouri State Plane Coordinates are X 704,956.4 feet and Y 1,066,992.4 feet.

2.1.1.2 Site Area Map

2.1.1.2.1 Site Boundaries

Boundaries for the plant site area, the plant site peripheral area and the plant corridor area are described in the following sections and are shown on Figure 2.1-2.

2.1.1.2.1.1 Plant Site Area

The site area is described as beginning at a point in the South line of Section 1, Township 46 North, Range 8 West which point is located at the Southeast corner of the Southwest Quarter of the Southwest Quarter of said Section 1; thence running West along the South line of Sections 1, 2, and 3, Township 46 North, Range 8 West, a distance of 7350 feet, more or less, to a point in the West line of the East Half of the East Half of the Southeast Quarter of said Section 3; thence South along the West line of the East Half of the East Half of the Northeast Quarter and the West line of the East Half of the East Half of the Southeast Quarter of Section 10, Township 46 North, Range 8 West, and the West line of the East Half of the East Half of the Northeast Quarter and the West line of the East Half of the East Half of the Southeast Quarter of Section 15, Township 46 North, Range 8 West, a distance of 10,560 feet, more or less, to a point in the South line of said Section 15; thence East along the South line of Sections 15, 14, and 13,

Township 46 North, Range 8 West a distance of 11,200 feet, more or less, to the Southeast corner of said Section 13; thence North along the East line of said Section 13, a distance of 2,640 feet, more or less, to the point of intersecton of the East and West centerline of Section 18, Township 46 North, Range 7 West with the said East line of Section 13; thence East along the East and West centerline of said Section 18 a distance of 1,565 feet, more or less, to the East line of Lot 2 of the Northwest Quarter of said Section 18; thence North along the East line of said Lot 2 of the Northwest Quarter of Section 18 and the East line of Lot 2 of the Southwest Quarter of Section 7, Township 46 North, Range 7 West a distance of 5,280 feet, more or less, to a point in the East and West centerline of said Section 7; thence West along said East and West centerline and the East and West centerline of Section 12, Township 46 North, Range 8 West, a distance of 2,885 feet, more or less, to a point in the East line of the West Half of the Northeast Quarter of said Section 12; thence North along the East line of the West half of the Northeast Quarter of Section 12, a distance of 1,320 feet, more or less to the Southeast corner of the Northwest Quarter of the Northeast Quarter of said Section 12; thence West along the South line of said Northwest Quarter of the Northeast Quarter of Section 12 a distance of 1,320 feet, more or less, of the Southwest corner of said Northwest Quarter of the Northeast Quarter of Section 12; thence North along the West line of said Northwest Quarter of the Northeast Quarter of said Section 12, a distance of 1,320 feet, more or less, to a point in the North line of said Section 12; thence West along the North line of said Section 12, a distance of 1,320 feet, more or less, to the point of beginning.

EXCEPTING from the aove described property approximately 1.34 acres sold to Central Electric Power Cooperative by General Warranty Deed dated October 31, 1975, recorded in Book 234, Page 130 of the Callaway County Records described as: All that part of the Northeast ¼ of Section 10, Township 46 North, Range 8 West, Commencing at a stone at the Northwest corner of the Southwest ¼ of said Section 10 and run thence South 88º43’40” East 367.10 feet: thence South 85º43’40” East 522.03 feet; thence South 87º13’40” East 2,000.00 feet; thence South 88º13’40” East 2385.18 feet to a point in the centerline of relocated State Highway “CC” (proposed); thence North 3º23’ East along said relocated Highway “CC” centerline a distance of 1,894.30 feet to a point; thence West at right angles to said highway centerline a distance of 60 feet to a point on the West highway right of way line and the true point of beginning; thence West at right angles to said highway centerline a distance of 60 feet to a point of beginning; thence South 3º23’ minutes West along said West right of way line a distance of 220 feet to a point; thence North 3º23’ East a distance of 220 feet to a point; thence East at right angles to said last described line a distance of 265 feet, more or less, to the point of beginning.

Approximately 2765 acres are owned in fee in the above described site area.

The nature and source of authority to determine all activities on this property is by virtue of the rights of ownership thereof.

2.1.1.2.1.2 Plant Site Peripheral Area

In addition, the following described properties were acquired in our acquisition efforts prior to determination of the site boundaries to insure adequate coverage and to negotiate for part of the properties within the site area:

The Westerly 98 acres of the Southwest Quarter of Section 6, Township 46 North, Range 7 West.

Lots 1 and 2 of the Northwest Quarter and Lot 1 of the Southwest Quarter of Section 7, Township 46 North, Range 7 West.

The Southeast Quarter and the East 20 acres of the Southwest Quarter, and the West Half of the Southwest Quarter of Section 1, Township 46 North, Range 8 West.

All that part of the South Half of Section 2, Township 46 North, Range 8 West, which lies South of Highway "O" excepting approximately 1 1/2 acres in the East part of the Northeast Quarter of the Southwest Quarter of said Section 2 lying South of Highway "O", on which negotations are not in progress, pending or contemplated.

The Southeast Quarter, and the East Half of the Southwest Quarter of Section 3, Township 46 North, Range 8 West all lying South of Highway "O".

The West 40 acres of the North 50 acres of the Northeast Quarter, the West Half of the East Half of the Southeast Quarter, the West Half of the Southeast Quarter, and the Southeast Quarter of the Southwest Quarter of Section 10, Township 46 North, Range 8 West.

The East Half of the Northwest Quarter, the Northeast Quarter of the Southwest Quarter, the Southwest Quarter of the Northeast Quarter, the West 30 acres of the Southeast Quarter of the Northeast Quarter and the West 24 acres of the South 30 acres of the North One Half of the Northeast Quarter of Section 10, Township 46 North, Range 8 West.

4.67 acres lying North of the County Road in the Northeast Quarter of the Northwest Quarter, the West Half of the Northeast Quarter and the West Half of the East Half of the Northeast Quarter of Section 15, Township 46 North, Range 8 West.

The East Half of the Northwest Quarter of Section 18, Township 46 North, Range 7 West.

The West Half of the Southwest Quarter and the Southeast Quarter of the Southwest Quarter of Section 18, Township 46 North, Range 7 West.

The East Half of the Southwest Quarter of the Northeast Quarter and the East Half of tne Northeast Quarter of Section 22, Township 46 North, Range 8 West.

The Northwest Quarter of Section 23, Township 46 North, Range 8 West.

The Northwest Quarter of the Northwest Quarter of Section 19, Township 46 North, Range 7 West.

The East 16 acres of the Northeast Quarter of the Northwest Quarter of Section 15, Township 46 North, Range 8 West, lying South of the County Road.

The East Half of the Northeast Quarter and the Northwest Quarter of the Northeast Quarter of Section 12 and one acre in the Southwest corner of the East 20 acres of the East Half of the Southwest Quarter of Section 1, all in Township 46 North, Range 8 West.

These properties comprise a total of approximately 2,454 acres.

2.1.1.2.1.3 Plant Corridor Area

The corridor area is described as beginning at the point of intersection of the North and South centerline of Section 23, Township 46 North, Range 8 West and the North line of said Section 23 and running thence South along the North and South centerline of said Section 23 and Section 26 a distance of 9240 feet, more or less, to the South line of the Northwest Quarter of the Southeast Quarter of said Section 26; thence East along said South line a distance of 1320 feet, more or less, to the West line of the East half of the Southeast Quarter of said Section 26; thence South along the West line of the East Half of the Southeast Quarter of said Section 26 a distance of 1320 feet, more or less, to the South line of said Section 26; thence East along the South line of said Section 26 a distance of 660 feet, more or less, to the West line of the East half of the Northeast Quarter of the Northeast Quarter of Section 35, Township 46 North, Range 8 West; thence South along the West line of the East Half of the Northeast Quarter of the Northeast Quarter of said Section 35 a distance of 1320 feet, more or less, to the South line of the North Half of the Northeast Quarter of said Section 35; thence West along the South line of the North Half of the Northeast Quarter of said Section 35 a distance of 1980 feet, more or less, to the North and South centerline of said Section 35; thence South along the North and South centerline of said Section 35, a distance of 1320 feet, more or less, to the center of said Section 35; thence West along the East, and West centerline of said Section 35 a distance of 1500 feet, more or less, to the Easterly line of U.S. Survey 1712; thence Southeast along said survey line a distance of 1675 feet, more or less, to the North line of the MK & T Railroad Right of Way; thence Easterly along the North line of said Right of Way a distance of 2900 feet, more or less, to the centerline of Logan Creek; thence continuing Easterly downstream along the centerline of said creek a distance of 4200 feet, more or less, to the intersection of the centerline of said creek with the North and South centerline of Section 36, Township 46 North, Range 8 West; thence North along said centerline of Section 36 a distance of 4500 feet, more or less, to the North line of said Section 36; thence West along the North line of said Section 36 a distance of 1320 feet, more or less, to the Southeast corner of the Southwest Quarter of

the Southwest Quarter of Section 25, Township 46 North, Range 8 West; thence North along the East line of the Southwest Quarter of the Southwest Quarter of said Section 25 a distance of 1320 feet, more or less, to the North line of the Southwest Quarter of the Southwest Quarter of said Section 25; thence West along the North line of the Southwest Quarter of the Southwest Quarter of said Section 25 a distance of 660 feet, more or less, to the East line of the West Half of the Northwest Quarter of the Southwest Quarter of said Section 25; thence North along the East line of the West Half of the Northwest Quarter of the Southwest Quarter of said Section 25 a distance of 1320 feet, more or less, to the East and West centerline of said Section 25; thence East along the said East and West centerline of Section 25 a distance of 3300 feet, more or less, to the East line of the West Half of the Northeast Quarter of said Section 25; thence North along the East line of the West Half of the Northeast Quarter of said Section 25 and the East line of the West Half of the East Half of Section 24, Township 46 North, Range 8 West a distance of 7920 feet, more or less, to the North line of said Section 24; thence West along the North line of said Section 24 and said Section 23 a distance of 6600 feet, more or less, to the point of beginning.

ALSO the East Half of the Southeast Quarter of the Northwest Quarter of Section 26, Township 46 North, Range 8 West; and a 41.91 acre tract of land lying between M.K.T. R.R. right of way and Missouri State Highway 94 extending Easterly from the East line of U.S. Survey 1712 to Logan Creek as aforesaid being located in U.S. Survey 1736 and Fractional Section 35, Township 46 North, Range 8 West and 57 acres in Fractional Section 5, Township 45 North, Range 7 West and in Fractional Section 32, Township 46 North, Range 7 West and Toe Head Island together with all accretions thereto.

ALSO 16.20 acres in the Southwest Quarter of the Southwest Quarter of Section 32, Township 46 North, Range 7 West, lying South of Missouri State Highway 94 and North of the M.K.T. Railroad right of way. EXCEPTING from said property approximately 0.63 acre sold to the Missouri Highway and Transportation Commission on April 20, 2004 by Quit Claim Deed recorded as Document No. 404463 in Book M387, Page 949 of the Callaway County Records and more particularly described as: A tract of land located in the West Half of the Southwest Quarter of Section 32, Township 46 North, Range 7 West in the County of Callaway State of Missouri and being bound on the North by AmerenUE's Northerly property line, bounded on the West by AmerenUE's Westerly property line (also known as existing right of way); and bounded on the South and East by a line described as follows: Beginning at a point 80.60 feet radial distance Southeasterly of Station 1388+34.78; thence Southeasterly to a point 130.1 feet radial distance Southeasterly of Station 1388+43.60; thence Northeasterly to a point 53.68 feet radial distance Southeasterly of Station 1393+62.09; thence Northeasterly to a point 35 feet radial distance Southeasterly of Station 1394+51.21.

ALSO 12 acres more or less located in the West part of the Southwest Quarter of Section 32, Township 46 North, Range 7 West.

ALSO a 0.82 acre, more or less, tract of land in the Southeast Quarter of the Southeast Quarter of Section 31, Township 46 North, Range 7 West South of Logan Creek and

East of Missouri State Highway 94. EXCEPTING from said property approximately 0.20 acre sold to the Missouri Highway and Transportation Commission on April 20, 2004 by Quit Claim Deed recorded as Document No. 404463 in Book M387, Page 949 of the Callaway County Records and more particularly described as: A tract of land located in the Southeast Quarter of the Southeast Quarter of Section 31, Township 46 North, Range 7 West, in the County of Callaway, State of Missouri and being bound on the West by AmerenUE's Westerly property line (also known as existing right of way line), bounded on the South by AmerenUE's Southwesterly property line, and on the North and East by a line described as follows: Beginning at a point 88.96 feet radial distance Southeasterly of Route 94 Station 1374+00; thence Southeasterly to a point 185 feet radial distance Southeasterly of Station 1375+00; thence Northeasterly to a point 286.03 feet perpendicular distance Southeasterly of Station 1379+37.55; thence Northwesterly to a point 105 feet perpendicular distance Southeasterly of Station 1379+06.53.

ALSO an 11 acre tract of land in the Southwest Quarter of the Southwest Quarter of Section 31, Township 46 North, Range 7 West lying between Logan Creek and Missouri State Highway 94, bounded on the North and West by Logan Creek, on the South by Missouri State Highway 94 and on the East by the East line of the Southwest Quarter of the Southwest Quarter of said Section 31. EXCEPTING from said property approximately 0.34 acre sold to the State of Missouri acting by and through the County of Callaway County Commission on August 2, 1996 by Quit Claim Deed recorded in Book 335, Page 502 of the Callaway County Records and more particularly described as: Commencing from the South Quarter corner of Section 31, Township 46 North, Range 7 West; thence North 41° 26'28" West, 1,816.25 feet more or less to a point on the Missouri State Right of Way of State Highway 94; thence on a curve to the left the radius being 1,185.92 feet, an arc distance of 1,185.92 feet, the chord being South 72º09'21" seconds West, 12.31 feet; thence leaving said Missouri State Right of Way North 02°13' 57" East, 68.79 feet; thence on a curve to the left, having a radius of 233.00 feet, an arc distance of 109.24 feet; the chord being North 11º11'57" West, 108.25 feet; thence North 24º37'51" West, 155.76 feet; thence North 35º09"05" West, 33.94 feet; thence North 62º 11'6" East 71.29 feet; thence South 02º37'28" West, 231.48 feet to the point of beginning.

ALSO a 125.18 acre tract of land acquired from Cruz Properties, L.L.C. by Warranty Deed dated June 28, 2006, recorded as Document No. 605167 in Book M403, Page 293 of the Callaway County Records and according to Survey No. 701247 recorded in Book S4, Page 275 of the Callaway County Records is described as follows: Part of Lots 1 and 2 of the Southwest Fractional Quarter of Section 31, Township 46 North, Range 7 West; and part of the Southeast Quarter of Section 36, Township 46 North, Range 8 West, all in Callaway County, Missouri, being more particularly described as follows: From the Center of said Section 31; thence South 1º12'00" East, along the Quarter Section Line, 1,201.70 feet to the Southerly right-of-way line of the K.A.T.Y. Trail (formerly the MKT Railroad) and the Point of Beginning for this description; thence South 1º12'00" East, continuing along the Quarter Section Line, 274.79 feet to the center of Logan Creek, also being the Northerly line of the tract described in Book 113, Page 155, Callaway County Recorder's Office; thence along the center of Logan Creek and along the boundary of the

tract described in Book 113, Page 155 the following courses: North 59º49'46" West, 174.59 feet; thence North 54º57'31" West, 416.88 feet; thence North 66º33'33" West, 115.36 feet; thence North 71º46'21" West, 199.08 feet; thence North 87º42'07" West, 75.86 feet; thence South 75º08'20" West, 145.68 feet; thence South 70º48'10" West, 162.72 feet; thence leaving the center of Logan Creek, South 1º 08'46" West, 115.75 feet to the center of the county road as located in 1917 by the survey recorded in Survey Record Book P, Page 552, Callaway County Recorder's Office; thence leaving the boundary of said tract described in Book 113, Page155 and along the center of said County Road, also being the Northerly line of the tract described in Book 252, Page 835, the following courses: South 64º02'38" West, 384.10 feet; thence South 76º 17'38" West, 470.21 feet; thence South 61º32'38" West, 263.79 feet; thence South 41º32'38" West, 301.38 feet; thence South 36º02'38" West, 302.70 feet; thence South 43º02'38" West 245.99 feet; thence South 65º17'38" West, 244.01 feet to the Range Line; thence leaving the center of said County Road and the Northerly line of said tract described in Book 252, Page 835, North 1º 07'26" East, along the Range Line, 96.17 feet to the center of Logan Creek, also being the Northerly line of the tract described in Book 298, Page 773, Callaway County Recorder's Office; thence along the center of Logan Creek and the Northerly line of said tract described in Book 298, Page 773 the following courses: South 65º49'16" West, 44.31 feet; thence South 72º54'41" West, 416.02 feet; thence South 56º08'48" West 279.13 feet; thence South 52º36'07" West, 176.40 feet; thence South 66º26'41" West, 100.94 feet; thence South 76º25'59" West, 107.53 feet; thence South 85º14'39" West, 207.90 feet; thence South 89º39'43" West, 199.67 feet; thence North 80º48'51" West, 144.08 feet; thence North 74º03'17" West, 230.34 feet; thence North 67º29'10" West, 162.13 feet; thence North 55º15'40" West, 447.13 feet; thence North 58º59'57" West, 221.40 feet; thence North 54º08'19" West, 75.34 feet; thence North 18º41'12" West, 118.62 feet; thence North 7º18'55" West, 202.51 feet; thence North 31º36'32" West, 181.13 feet to the Quarter Section Line of said Section 36; thence leaving the center of Logan Creek and the Northerly line of said tract described in Book 298, Page 773, North 1º25'01" East, along said Quarter Section Line, 559.90 feet to the Southerly right-of-way line of the K.A.T.Y. Trail (formerly the MKT Railroad); thence along said Southerly right-of-way line the following courses: South 82º55'54" East, 89.12 feet; thence Easterly, on a spiral curve to the left, a spiral distance of 203.49 feet (Ch=South 84º16'34" East, 203.45 feet); thence Easterly, on a simple curve to the left, having a radius of 1,482.69 feet, an arc distance of 31.10 feet (Ch=South 87º 31'54" East, 31.09 feet); thence Easterly, on a spiral curve to the left, a spiral distance of 203.49 feet (Ch=North 89º12'46" East, 203.45 feet); thence North 87º52'06" East, 961.60 feet; thence Easterly, on a spiral curve to the left, a spiral distance of 182.43 feet (Ch=North 86º56'03" East, 182.41 feet); thence Easterly, on a simple curve to the left, having a radius of 1,902.13 feet, an arc distance of 357.38 feet (Ch=North 79º42'06" East, 356.86 feet); thence Easterly, on a spiral curve to the left, a spiral distance of 182.43 feet (Ch=North 72º28'09" East, 182.41 feet); thence North 71º32'06" East, 489.90 feet; thence Easterly, on a spiral curve to the right, a spiral distance of 177.58 feet (Ch= North 72º27'13" East, 177.56 feet); thence Easterly, on a simple curve to the right, having a radius of 1,808.47 feet, an arc distance of 580.27 feet (Ch= North 83º30'06" East, 577.78 feet); thence Easterly, on a spiral curve to the right, a spiral distance of 177.58 feet (Ch=South 85º27'01" East, 177.56 feet); thence South 84º31'54" East, 525.80 feet;

thence easterly, on a spiral curve to the right, a spiral distance of 177.25 feet (Ch=South 83º29'24" East, 177.23 feet); thence on a simple curve to the right, having a radius of 1,587.28 feet, an arc distance of 104.16 feet (Ch= South 79º29'54" East, 104.14 feet); thence Easterly, on a spiral curve to the right, a spiral distance of 177.25 feet (Ch=South 75º30'24" East, 177.23 feet); thence South 74º27'54" East, 485.16 feet; thence Easterly on a spiral curve to the left, a spiral distance of 121.05 feet (Ch=South 74º52'00" East, 121.04 feet); thence on a simple curve to the left, having a radius of 2,914.93 feet, an arc distance of 174.68 feet (Ch= South 77º22'54" East, 174.65 feet); thence Easterly on a spiral curve to the left, a spiral distance of 121.05 feet (Ch=South 79º53'48" East, 121.04 feet); thence South 80º17'54" East, 221.32 feet to the point of beginning.

EXCEPTING THEREFROM the following tracts of land on which negotiations are not in progress, pending, or contemplated at this time.

1 acre being the Southwest 1 acre of the Southeast Quarter of the Southeast Quarter of Section 26, Township 46 North, Range 8 West.

1 1/2 acres being one acre wide on the East side of the county road and 1 1/2 acres deep to the East of said road and located in the Northwest corner of the Southeast Quarter of the Southeast Quarter of Section 26, Township 46 North, Range 8 West.

3 acres in the Northeast corner of the Northwest Quarter of the Southeast Quarter of Section 26, Township 46 North, Range 8 West.

Approximately 2135 acres of land are owned in fee within the corridor area.

The nature and source of authority to determine all activities on this property is by virtue of the rights of ownership thereof.

2.1.1.2.2 Site Description

The site, which contains approximately 2,765 acres of rural land owned by Union Electric, is located on a plateau which lies north of the Missouri River. Peripheral lands and access corridor comprise an additional 4,589 acres of land. The plateau has an area of about 8 square miles. The boundaries of the site, and the overall site layout are shown on Figures 2.1-2, 2.1-3, and 2.1-4. Mineral rights to the land in the site area have been obtained by Union Electric.

The site lies about 325 feet above the flood plain of the Missouri River. The area between the plateau and the Missouri River flood plain is highly dissected. Mud Creek and its intermittent stream branches have incised deeply into the southern flank of the plateau with steep stream gradients. Topographic relief varies from about 150 to 325 feet or more.

The character of the area is rural. The land is used for farming wherever the terrain is flat enough for cultivation and has suitable soil conditions. Such land generally lies on the

gently rolling terrain of the plateaus and on the flood plains of the nearby streams and rivers which comprises only 22 percent of the land lying within 5 miles of the site. Pasture land associated with farming occupies another 17 percent. The remainder, and predominant fraction of the land, lies in slopes unsuitable for farming and consequently is occupied by forest growth. These forests are not harvested commercially and occupy about 59 percent of the area within 5 miles of the site. Less than 2 percent of the available area is built-up or used for other purposes.

2.1.1.3 Boundaries for Establishing Effluent Release Limits

In addition to the 1,200-meter Exclusion Area and the Low Population Zone of 2.5-mile radius, a Protected Area and a Restricted Area are defined herein.

2.1.1.3.1 The Restricted Area

The Restricted Area is coincident with the plant site area described in Section 2.1.1.2.1.1 and shown on Figure 2.1-4 and will be controlled in accordance with 10 CFR 20. No residence or dairying operations are permitted in this area. Future developments may include public attractions without entry restrictions. Figure 2.1-5 shows the distance from the midpoint of the reactor buildings to various points on the Restricted Area boundary.

2.1.1.3.2 The Protected Area

The Protected Area is a fenced area surrounding the reactor buildings. The boundary of the Protected Area is at least 50 feet from any safety-related structure. This area is guarded and access is granted only to authorized personnel. The Protected Area is shown on Figures 2.1-4 and 2.1-5.

2.1.2 EXCLUSION AREA AUTHORITY AND CONTROL

2.1.2.1 Authority

The Exclusion Area encompasses the land area surrounding the plant to a radius of 1200 meters (3,937 feet) from the midpoint between the two reactor buildings (See Section 2.1.1.1). The Exclusion Area lies entirely within the plant site area described in Section 2.1.1.2.1.1. Control of access to the Exclusion Area is by virtue of ownership and is in accordance with 10 CFR 100. All property within the Exclusion Area is within Union Electric ownership. As the plant lands are owned in fee simple, Union Electric enjoys complete ownership of the minerals on or under their lands.

2.1.2.2 Control of Activities Unrelated to Plant Operation

Residence within the Exclusion Area will be prohibited. No developments attracting uncontrolled public activity in the area will be permitted.

Within the Union Electric ownership area, outside the plant site area, residence is permitted and developments may include public attractions.

In cooperation with Union Electric, the Missouri Department of Conservation in 1976 prepared a plan for the development and management of the forest, fish, and wildlife resources within the Callaway Plant property. Because of the zone controls and the need to effect evacuation procedures in the event of postulated accidental radiation releases, the land use programs ultimately recommended for the Callaway Plant site are of a low-intensity nature. Recommendations included the following: forest management, agriculture, research, wildlife management, hunting, fishing, picnicking, vistas and special areas. The plan is flexible, and recommended activities can be further emphasized or modified to accommodate additional priorities or restrictions.

In 1977, Union Electric and the Missouri Conservation Commission entered into an agreement for an initial 5-year management plan that could be self-supporting and less intensive than the original plan. This plan presently allows public recreational use on designated lands within the Callaway Plant property boundaries; however, camping and use of firearms (firing a single projectile) are not permitted. User data on the Reform Wildlife Management Area is given in FSAR Section 2.1.3.3.

2.1.2.3 Arrangements for Traffic Control

Union Electric has negotiated with the Callaway County Court with respect to traffic control on County Roads 448 and 459 traversing the Exclusion Area. Union Electric has received assurances that traffic on county roads traversing the Exclusion Area can be adequately controlled in case of emergency.

2.1.2.4 Abandonment or Relocation of Roads

There are no public roads presently within the Exclusion Area which, because of their location, have to be abandoned or relocated.

2.1.3 POPULATION AND POPULATION DISTRIBUTION

The land within 50 miles of the Callaway Plant (Figure 2.1-6) encompasses portions of 22 counties in east-central Missouri. Population studies are directed toward estimating the population distribution within 50 miles of the plant from 1990 to 2030 by 10-year increments, which effectively covers the life of the plant. Data from the 1980 Census (U.S. Bureau of Census, 1981) are presented for base-data comparison.

The total population distribution is allocated using a rose format. It is based upon a combination of rays and concentric circles which divides the 50-mile area around the plant into 160 segments. Circles are at 1-mile increments out to 5 miles and at 10-mile increments from 10 to 50 miles. The segments formed were centered about the 16 cardinal compass points.

The area within 5 miles of the plant was checked by aerial photography and field reconnaissance to determine if there were major changes of land use on population within 5 miles of the plant between 1973 and 1979. A second windshield survey was conducted in 1982 as part of the incorporation of 1980 census data. Other than the construction activities associated with the plant, no significant changes were found.

2.1.3.1 Population Within 10 Miles

The area within 10 miles of the plant is rural and includes portions of Callaway, Osage, Gasconade, and Montgomery Counties. Figure 2.1-6 shows that the only incorporated communities within 10 miles of the site are Chamois, part of Fulton, and Mokane. The 1970 and 1980 census populations for these locations are shown in Table 2.1-1.

The 1970 population distribution within 5 miles of the plant was obtained by a field survey (1973) that located each occupied house and tallied the number of residents. Within 5 miles of the plant, segments range in size from 0.1 to 4.5 square miles and are often comprised solely of uninhabited areas. The population in 1980 was estimated based on 1980 census data and a brief survey of the area conducted in 1982.

Beyond 5 miles, where the segment area is large enough to include both inhabited and vacant lands, the area distribution method is used uniformly. The area distribution method assumes that the population of a minor civil division (MCD) is distributed equally over the area of the MCD.

In 1980, the resident population within 5 miles of the plant totaled 882 with a resulting density of 11 people per square mile. The population within 10 miles was 8,996 in 1980, which is a density of 29 people per square mile and also reflects the rural nature of the area. The segment totals are shown on Figure 2.1-8.

Population projections were based on U.S. census projections (U.S. Bureau of the Census, 1977, 1978) stepped-down from the national and state levels to the county level. Projections selected from census reports for this study are of a Series II fertility rate (2.1 children per woman) for both the nation and the State of Missouri. Migration Assumption A was used, which assumes a continuation of 1965 to 1975 migration rates. The projections of state population were extended to the year 2030 using a step-down technique (Greenburg, et al., 1973). This method involved a reapportioning of state projections based on changes in the share of the state's overall population relative to the nation.

The fertility assumption is somewhat conservative. Demonstrated fertility trends in the U.S. have been less than 2.1 children per woman in the last few years. The average monthly fertility rate in 1978 was 66.5 live births per 1,000 women aged 15 to 45 years (National Center for Health Statistics, 1979). This fertility translates into an equivalent completed fertility of 2.0 children per woman. Therefore, the fertility assumption of 2.1 children per woman is slightly conservative.

Areas of growth within the state were recognized through use of county projections formulated by the University of Missouri in cooperation with the State Division of Budget and Planning, Office of Administration (1977).

Historic growth trends since 1930 were evaluated and extended for each MCD with a control or ceiling at the county level due to the step-down technique.

The projected populations were allocated to the rose sectors using the proportion found in the 1980 base population. The distributions are shown in Table 2.1-2. Figures 2.1-9 through 2.1-13 compare the 1980 population with the projections for the succeeding six decades.

Using the systematic projections based on historic trends, the area within 10 miles of the plant should experience slow growth through the year 2030 (0.21 percent per year or 10 percent from 1980 to 2030). This is considerably less than the national rate of about 0.7 percent per year in the same period (Series II).

2.1.3.2 Population Between 10 and 50 Miles

Incorporated cities, towns, and unincorporated places with more than 2,500 inhabitants within 50 miles of the Callaway Plant are located on Figure 2.1-6, and their populations are listed in Table 2.1-1.

The area from 10 to 50 miles in the population rose is divided into 64 segments ranging in size from 50 square miles to 177 square miles. The area distribution method, described in Section 2.1.3.1, was used for this division.

The projected populations for the 50-mile area were calculated using the step-down and historic growth trend procedure described above.

The projections were allocated to the population rose, and the results are shown in Table 2.1-3. Figures 2.1-14 through 2.1-19 compare the 1980 population with the populations for the succeeding five decades.

The total cumulative population for the area within 50 miles of the site was 367,079 in 1980. A comparison of accumulated population of this site and other nuclear plant sites is shown on Figure 2.1-20. The rural nature of the region is seen in the low profile of the curve.

In 1980, Jefferson City recorded a population of 33,554 residents, an increase of 3.5 percent over the 1970 population of 32,407 residents. Jefferson City will remain the population center for the life of the facility. No area closer to the Callaway Plant is projected to reach a population of 25,000.

2.1.3.3 Transient Population

There are two sources of seasonal or transient population within the Low Population Zone: the Reform Wildlife Management Area and Lost Canyon Lakes.

The Reform Wildlife Management Area was established jointly by the Missouri Department of Conservation and the Union Electric Company. The area includes all of the exclusion zone and the protected area, as well as immediately adjacent land surrounding the plant in all directions.

Permitted activities in specifically designated areas include hunting, fishing, and trapping. Camping is not permitted, and no Department of Conservation personnel reside on the area. Those activities which have any potential to interfere with the power production process would be excluded. All other activities will be reviewed and approved by Union Electric prior to implementation. The area was opened for public use in November 1977, and preliminary estimates indicated peak use occurs on weekends during the fall hunting season. Observations indicated 10 to 15 cars parked in the area during this period, translating to approximately 25 to 45 hunters using the area (Hutton, 1979).

Lost Canyon Lakes is a recreational vehicle and trailer park development located approximately 2.2 miles north of the site.

The total number of camper sites planned for Lost Canyon Lakes is 1,720. In January 1981 approximately 1,100 of the sites had been sold. The developer has plans for 110 3-acre homesites. However, he indicated in January, 1981 that the homesites are not selling.

Approximate 600 people use Lost Canyon Lakes on a typical weekend, while usage is about 200 people on an average weekday. Maximum usage on a holiday is about 1,400. From December 15 through February 15 there is very little usage (Lewis, 1981).

Roads in the Callaway Plant site area are local and primarily serve the residents. There are no commercial or industrial facilities in the LPZ that would attract transients (see Figure 2.1-27). As the area is rural, transient population within 50 miles would move primarily as vehicular traffic along main highways. Since the Callaway Plant site is located more than 70 miles from St. Charles, the closest suburb of St. Louis, no large-scale daily shifts of commuting transients will occur within 50 miles of the Callaway Plant site.

2.1.3.4 Low Population Zone

The radius of the Low Population Zone (LPZ), as defined in 10 CFR 100, is 2.5 miles. Figure 2.1-4 shows the extent of the zone and all transportation routes available for evacuation purposes. No commercial or industrial facilities are located within the LPZ. In

1970, 116 residents lived within the LPZ. By 1980, this population will decline to 76 people.

There are no sources of seasonal populations in the LPZ with the exception of Lost Canyon Lake, nor working-day concentration which would create significant transient population. Table 2.1-4 lists resident population by segment; Figure 2.1-27 and Table 2.1-5 show and list the public facilities within 10 miles, respectively.

As noted previously, the Reform Wildlife Management Area does attract hunters and fishermen into the Low Population Zone. The seasonal peak occurs during the fall hunting season. However, the numbers are not significant, with a peak seasonal use of less than 50 hunters per day during a fall weekend.

2.1.3.5 Population Center

The population center, or city closest to the site with a population greater than 25,000 persons, is Jefferson City, Missouri, 25 miles west-southwest as shown on Figure 2.1-6. This complies with 10 CFR 100 definitions, in that the population center distance exceeds one and one-third the radius of the LPZ, which is 2.5 miles.

In 1970, Jefferson City recorded a population of 32,407 residents, an increase of 14.8 percent over the l960 population of 28,228 residents. Jefferson City will remain the population center for the life of the facility. No area closer to the Callaway Plant is projected to reach a population of 25,000.

2.1.3.6 Population Density

Figure 2.1-21 compares the projected cumulative resident population in all directions for distances up to 50 miles from the Callaway Plant with cumulative populations resulting from uniform densities of 500 people per square mile and 1,000 people per square mile. This comparison is for the Series II (2.1 children per woman) fertility and Migration A assumptions (continuation of 1965 to 1975 rates) that are used in this document. The curves indicate clearly that at no time during the plant's operating life will the projected cumulative resident population approach those associated uniform densities of 500 people per square mile and 1,000 people per square mile.

The population projections indicate the highest projected cumulative population density would be approximately 76 persons per square mile (Table 2.1-6).

For comparative purposes, Figures 2.1-21 through 2.1-24 show the population curves for three other fertility and migration assumptions: Series II fertility and Migration C (no migration); Series I fertility (2.7 children per woman) and Migration A; and Series I fertility and Migration C (no migration). These cumulative populations are compared to those curves for the 500 and 1,000 people per square mile uniform density assumptions. The comparison clearly shows that even under the highest fertility assumption, Series I, the

projected cumulative resident populations would not approach those associated with the 500 and 1,000 people per square mile assumptions.

2.1.3.7 Projections of Industrial Growth

The Callaway Plant is located in a sparsely populated rural area, with little existing or projected urban or industrial development within a 5-mile radius.

The primary land use trend in Callaway County has been the continued abandonment and consolidation of farms. Approximately 7 percent of the county's land area went out of farm production within the 10-year period from 1964 to 1974.

No trends have been identified that would disturb the rural agriculture and forested characteristics present today within 5 miles of the Callaway Plant. This projection is based on population projections and trends observed over several years. A field reconnaissance by Dames & Moore in 1979 noted only minor new developments since 1973 within 5 miles of the Callaway Plant, not including site construction activities. New developments include approximately six homes, two taverns, four small trailer parks, two gas stations, a cafe, and two small trucking companies. A review of 1979 aerial photographs indicated a conversion of approximately 1,240 acres of pasture to cropland within 5 miles of the Callaway Plant since 1973. Changes in all other land use types were less than 1 percent during the same period.

REFERENCES: SECTION 2.1

Published References

Greenberg, M.R., and others, 1973, Long-range population projections for minor civil divisions: computer programs and user's manual. Center for Urban Policy Research, Rutgers University, New Brunswick, New Jersey (May).

State of Missouri, 1977, Estimates and projections of population in Missouri, 1970 to 1990. State of Missouri, Division of Budget and Planning, Office of Administration, in cooperation with Public Affairs Information Service, College of Business and Public Administration, University of Missouri, Columbia (September).

U.S. Bureau of the Census, 1971, Number of inhabitants, Missouri in U.S. census of population, 1970. U.S. Bureau of the Census, Final Report PC(1)-A27.

____, 1977, Projections of the population of the United States, 1977 to 2050. Current Population Reports, Series P-25, no. 704 (July).

____, 1978, Illustrative projections of state populations, 1975 to 2000. Current Population Reports, Series P-25, no. 735 (October).

U.S. Department of Health, Education, and Welfare, National Center for Health Statistics, 1979, Vital statistics report: births, marriages, divorces, and deaths for January 1979. DHEW Publication (PHS)79-1120, vol. 28, no. 1 (April 10).

Personal Communications

Frederickson, D., 1979, Manager, Reform Village Square, personal communication (March 30 and April 9).

Hodo, L., 1979, Manager and Groundskeeper of Harmony Hill Youth Camp, personal communication (April 9).

Hutton, T., 1979, Wildlife Biologist, Missouri Department of Conservation, personal communication (April 7).

Medley, P., 1979, Kingdom of Callaway Estates, written communication (April 3).

Lewis, R. L., 1981, written communication (January 28).

TABLE 2.1-1 POPULATION OF CITIES AND TOWNS WITHIN 50 MILES OF THE SITE

LOCATION	1980	1970	PERCENT CHANGE	MILES FROM SITE
Audrain County				
Benton City	155	121	28.1	25 N
Farber	503	470	7.0	38 NNE
Laddonia	726	745	2.6	34 NNE
Martinsburg	309	318	2.8	24 NNE
Mexico	12,276	11,807	4.0	28 N
Rush Hill	140	151	- 7.9	30 N
Vandalia	3,170	3,160	0.3	40 NNE
Vandiver	88	102	- 13.7	27 N
Boone County				
Ashland	1,021	769	32.8	25 W
Centralia[1]	3,537	3,623	- 2.4	36 NNW
Columbia[1]	62,061	58,812	5.5	30 WNW
Halleville	624	790	- 21.0	33 NW
Harrisburg	283	150	88.7	44 NW
Hartsburg	118	120	- 1.7	38 W
Rocheport	272	307	- 11.4	44 WNW
Sturgeon	901	787	14.5	41 NW
Callaway County				
Auxvasse	858	808	6.2	19 NNW
Cedar City	427	454	- 5.9	25 WSW
Fulton	11,046	12,248	- 9.8	10 WNW
Kingdom City	146	53	175.5	16 NW
Mokane	293	398	- 26.4	7 SW
New Bloomfield	519	427	21.5	17 W
Lake Mykee[2]	188	2	>1000.0	20 WSW
Holts Summit[2]	2,540	1,296	96.0	21 WSW
Cole County				
Centertown	304	277	9.7	35 WSW
Eugene	220	163	35.0	43 SW

TABLE 2.1-1 (Continued) (Sheet 2 of 4)

LOCATION	1980	1970	PERCENT CHANGE	MILES FROM SITE
Henley[3]	---	64	---	40 SW
Jefferson City	33,594	32,407	3.5	25 WSW
Lohman	168	109	54.1	35 WSW
Russellville	667	557	19.7	39 WSW
St. Martins[2]	739	431	71.0	33 WSW
St. Thomas[4]	337	195	73.0	36 SW
Taos[2]	759	528	44.0	24 SW
Wardsville	535	460	16.3	28 SW
Cooper County				
Prairie Home	279	231	20.8	43 SW
Woolridge	79	97	- 18.6	41 WNW
Franklin County				
Berger	214	226	- 5.3	25 ESE
Gerald	921	762	20.9	36 SE
Leslie	108	81	33.3	38 SE
New Haven	1,581	1,474	7.3	33 ESE
Oak Grove	386	340	13.5	49 SE
Union	5,506	5,183	6.2	47 ESE
Washington	9,251	8,499	8.8	42 ESE
Gasconade County				
Bland	662	621	6.6	32 SSE
Gasconade	250	235	6.4	15 ESE
Hermann	2,695	2,658	1.4	20 E
Morrison	169	234	- 27.8	10 SE
Owensville	2,241	2,416	- 7.2	32 SSE
Rosebud	326	305	6.9	32 SE
Lincoln County				
Hawk Point	386	354	9.0	38 ENE
Moscow Mills	484	399	21.3	49 ENE
Silex	287	306	- 6.2	47 ENE
Troy	2,624	2,538	3.4	46 ENE

TABLE 2.1-1 (Continued) (Sheet 3 of 4)

LOCATION	1980	1970	PERCENT CHANGE	MILES FROM SITE
Maries County				
Belle	1,099	1,042	5.5	34 S
Vienna	514	505	- 1.8	40 SSW
Miller County				
Olean	128	151	- 15.2	47 WSW
St. Elizabeth	312	287	8.7	43 SW
Moniteau County[5]				
California	3,381	3,105	8.9	43 W
Clarksburg	352	343	2.6	49 W
Jamestown	317	243	30.5	37 W
Lupus	50	68	- 26.5	37 W
Monroe County[3]				
Middle Grove	---	55	---	50 NNW
Paris	1,598	1,442	10.8	50 NNW
Montgomery County[5]				
Bellflower	403	360	11.9	29 NE
High Hill	254	192	32.3	23 ENE
Jonesburg	614	479	28.2	28 ENE
McKittrick	87	101	- 13.9	20 E
Middletown	268	235	14.0	32 NE
Montgomery City	2,101	2,187	- 3.9	22 NE
New Florence	731	635	15.1	21 ENE
Rhineland	172	190	- 9.5	15 E
Wellsville	1,546	1,565	1.2	25 ENE
Osage County				
Argyle	206	262	- 21.4	34 SSW
Chamois	546	615	- 11.2	6 SSE
Freeburg	554	577	- 4.0	32 SSW
Linn	1,211	1,289	- 6.1	20 S
Meta	336	387	- 13.2	37 SW

TABLE 2.1-1 (Continued) (Sheet 4 of 4)

LOCATION	1980	1970	PERCENT CHANGE	MILES FROM SITE
Westphalia	285	332	- 14.2	25 SSW
<u>Pike County</u>				
Bowling Green	3,022	2,936	2.9	50 NE
Curryville	323	337	- 4.2	47 NNE
<u>Ralls County</u>				
Perry	836	839	- 0.4	46 N
<u>Randolph County</u>				
Clark	304	271	12.2	47 NW
<u>St. Charles County</u>				
Flint Hill[2]	219	218	< 1.0	49 E
New Melle[2]	168	175	- 4.0	48 E
<u>Warren County</u>				
Marthasville	543	415	30.8	41 ESE
Truesdale	297	262	13.4	37 E
Warrenton	3,219	---	---	35 E
Wright City	1,179	943	25.0	41 E

1 The 1970 population was revised after publication of the 1970 Census report.

2 Towns were incorporated after 1970.

3 The towns of Henley and Middle Grove became inactive after 1970.

4 The town of St. Thomas was not returned in the 1970 Census report.

5 Lathan, Sandy Hook and Buell were erroneously defined in the 1970 Census report as incorporated towns, and have been removed from this table.

Source: U.S. Bureau of the Census, 1981.

(Sheet 1 of 5)

TABLE 2.1-2 RESIDENT POPULATION DISTRIBUTION BY SECTOR AND RADIAL DISTANCE UP TO 10 MILES FROM THE SITE

SECTOR/YEAR		RADIAL DISTANCE FROM REACTORS (miles) 0-1	1-2	2-3	3-4	4-5	5-10	10-MILE TOTAL
N	1980	0	7	2	0	0	160	169
	1990	0	7	2	0	0	160	169
	2000	0	7	2	0	0	151	160
	2010	0	7	0	0	0	142	149
	2020	0	7	0	0	0	133	140
	2030	0	7	0	0	0	124	131
NNE	1980	5	5	5 (400)	5	4	68	92
	1990	5	5	5 (700)	5	4	57	81
	2000	5	5	5 (700)	5	4	46	70
	2010	5	5	5 (700)	5	4	35	59
	2020	5	5	5 (700)	5	4	23	47
	2030	5	5	5 (700)	5	4	12	36
NE	1980	5	0	7	15	32	39	98
	1990	5	0	7	8	32	29	81
	2000	5	0	7	8	21	19	60
	2010	5	0	7	8	21	19	60
	2020	5	0	7	8	11	10	41
	2030	5	0	7	8	11	10	41
ENE	1980	5	0	5	2	7	71	90
	1990	5	0	5	2	7	71	90
	2000	5	0	5	2	7	61	80
	2010	5	0	5	0	7	51	68
	2020	5	0	5	0	7	41	58
	2030	5	0	5	0	7	31	48

TABLE 2.1-2 (Continued) (Sheet 2 of 5)

SECTOR/YEAR		RADIAL DISTANCE FROM REACTORS (miles) 0-1	1-2	2-3	3-4	4-5	5-10	10-MILE TOTAL
E	1980	0	2	0	5	2	108	117
	1990	0	2	0	5	2	98	107
	2000	0	2	0	5	2	88	97
	2010	0	0	0	5	0	68	73
	2020	0	0	0	5	0	58	63
	2030	0	0	0	5	0	48	53
ESE	1980	0	0	5	2	20	93	120
	1990	0	0	5	2	20	93	120
	2000	0	0	5	2	10	84	101
	2010	0	0	5	0	10	65	80
	2020	0	0	5	0	10	56	71
	2030	0	0	5	0	10	47	62
SE	1980	2	2	7	7	81	158	257
	1990	2	2	7	7	69	176	263
	2000	2	2	7	7	58	158	234
	2010	0	0	7	7	46	140	200
	2020	0	0	7	7	35	123	172
	2030	0	0	7	7	23	114	151
SSE	1980	2	2	5	15	2	198	224
	1990	2	2	5	8	2	215	234
	2000	2	2	5	8	2	198	217
	2010	0	0	5	8	0	172	185
	2020	0	0	5	8	0	146	159
	2030	0	0	5	8	0	129	142

TABLE 2.1-2 (Continued) (Sheet 3 of 5)

SECTOR/YEAR		RADIAL DISTANCE FROM REACTORS (miles) 0-1	1-2	2-3	3-4	4-5	5-10	10-MILE TOTAL
S	1980	2	2	7	5	7	183	206
	1990	2	2	7	5	7	200	223
	2000	2	2	7	5	7	183	206
	2010	0	0	7	5	7	166	185
	2020	0	0	7	5	7	140	159
	2030	0	0	7	5	7	114	133
SSW	1980	0	0	7	30	66	184	287
	1990	0	0	7	20	55	193	275
	2000	0	0	7	20	44	184	255
	2010	0	0	7	20	33	166	226
	2020	0	0	7	10	22	149	188
	2030	0	0	7	10	11	131	159
SW	1980	0	0	17	2	24	297	340
	1990	0	0	17	2	24	287	330
	2000	0	0	9	2	16	267	294
	2010	0	0	9	0	16	237	262
	2020	0	0	9	0	16	207	232
	2030	0	0	9	0	16	187	212
WSW	1980	2	5	7	0	33	347	394
	1990	2	5	7	0	33	337	384
	2000	2	5	7	0	25	317	356
	2010	0	5	7	0	25	277	314
	2020	0	5	7	0	25	237	274
	2030	0	5	7	0	25	198	235

TABLE 2.1-2 (Continued)

SECTOR/YEAR		RADIAL DISTANCE FROM REACTORS (miles) 0-1	1-2	2-3	3-4	4-5	5-10	10-MILE TOTAL
W	1980	2	20	0	37	51	460	570
	1990	2	20	0	37	43	470	572
	2000	2	10	0	28	43	460	543
	2010	0	10	0	28	34	431	503
	2020	0	10	0	19	34	393	456
	2030	0	10	0	10	34	364	418
WNW	1980	0	10	2	49	79	2252	2392
	1990	0	10	2	49	87	2586	2734
	2000	0	10	2	57	95	2836	3000
	2010	0	10	0	57	95	2919	3081
	2020	0	10	0	57	103	2919	3089
	2030	0	10	0	57	111	3002	3180
NW	1980	0	5	12	0	36	2823	2876
	1990	0	5	12	0	36	3238	3291
	2000	0	5	12	0	43	3570	3630
	2010	0	5	12	0	43	3736	3796
	2020	0	5	12	0	43	3819	3879
	2030	0	5	12	0	43	3985	4045
NNW	1980	0	2	10	0	79	673	764
	1990	0	2	10	0	87	759	858
	2000	0	2	10	0	95	819	926
	2010	0	0	10	0	95	845	950
	2020	0	0	10	0	95	854	959
	2030	0	0	10	0	95	871	976

TABLE 2.1-2 (Continued) (Sheet 5 of 5)

SECTOR/YEAR		RADIAL DISTANCE FROM REACTORS (miles) 0-1	1-2	2-3	3-4	4-5	5-10	10-MILE TOTAL
GRAND	1980	25	62	98	174	523	8115	8996
TOTAL	1990	25	62	98	150	508	8969	9812
	2000	25	52	90	149	472	9441	10229
	2010	15	42	86	143	436	9469	10191
	2020	15	42	86	124	412	9308	9987
	2030	15	42	86	115	397	9367	10022

NOTE: Figures in parentheses are the projected average summer weekend usage figures for the Lost Canyon Lakes development. No development plans beyond the present expansion to a total of 1,400 sites have been formulated.

(Sheet 1 of 5)

TABLE 2.1-3 RESIDENT POPULATION DISTRIBUTION BY SECTOR AND RADIAL DISTANCE BETWEEN 10 AND 50 MILES FROM THE SITE

		RADIAL DISTANCE FROM REACTORS (miles)					
SECTOR/YEAR		10-MILE TOTALS	10-20	20-30	30-40	40-50	50-MILE TOTAL
N	1980	169	1,200	5,641	6,137	2,238	15,385
	1990	169	1,200	5,923	6,338	2,496	16,126
	2000	160	1,200	6,205	6,439	2,410	16,414
	2010	149	1,080	6,205	6,238	2,152	15,824
	2020	140	960	6,111	5,936	1,980	15,127
	2030	131	840	6,111	5,735	1,980	14,797
NNE	1980	92	737	2,562	4,763	2,086	10,240
	1990	81	737	2,654	4,560	2,185	10,217
	2000	70	737	2,562	4,459	2,086	9,914
	2010	59	737	2,379	4,054	1,987	9,216
	2020	47	614	2,105	3,649	1,788	8.203
	2030	36	614	1,922	3,345	1,689	7,606
NE	1980	98	962	3,320	1,569	3,866	9,815
	1990	81	1,058	3,679	1,569	3,965	10,352
	2000	60	962	3,769	1,464	3,965	10,220
	2010	60	962	3,679	1,255	3,767	9,723
	2020	41	866	3,500	1,150	3,569	9,126
	2030	41	866	3,321	1,045	3,371	8,644
ENE	1980	90	804	2,229	3,294	8,329	14,746
	1990	90	804	2,441	4,323	10,035	17,693
	2000	80	704	2,335	4,735	10,938	18,792
	2010	68	704	2,229	5,044	11,440	19,485
	2020	58	604	2,017	5,250	11,741	19,670

TABLE 2.1-3 (Continued) (Sheet 2 of 5)

SECTOR/YEAR		RADIAL DISTANCE FROM REACTORS (miles) 10-MILE TOTALS	10-20	20-30	30-40	40-50	50-MILE TOTAL
	2030	48	604	1,911	5,559	12,142	20,264
E	1980	117	803	1,617	7,135	12,407	22,079
	1990	107	803	2,324	11,155	17,262	31,651
	2000	97	703	2,627	13,366	21,308	38,101
	2010	73	603	2,829	15,376	25,084	43,965
	2020	63	503	3,132	17,386	29,400	50,484
	2030	53	403	3,435	19,798	34,525	58,214
ESE	1980	120	2,182	3,100	5,171	21,881	32,454
	1990	120	2,444	3,488	6,309	28,029	40,390
	2000	101	2,444	3,488	6,930	32,911	45,874
	2010	80	2,357	3,391	7,137	36,708	49,673
	2020	71	2,270	3,197	7,447	40,596	53,581
	2030	62	2,183	3,100	7,757	45,117	58,219
SE	1980	257	962	1,575	5,095	9,911	17,800
	1990	263	1,049	1,800	6,135	12,701	21,948
	2000	234	962	1,800	6,551	14,914	24,461
	2010	200	875	1,688	6,655	16,550	25,968
	2020	172	788	1,575	6,759	18,282	27,576
	2030	151	700	1,463	6,863	20,206	29,383
SSE	1980	224	1,015	1,075	3,491	3,646	9,451
	1990	234	1,184	1,173	3,990	3,906	10,487
	2000	217	1,184	1,173	4,090	3,906	10,570
	2010	185	1,184	1,075	3,990	3,776	10,210
	2020	159	1,184	1,075	3,791	3,516	9,725
	2030	142	1,184	1,075	3,691	3,386	9.478

TABLE 2.1-3 (Continued) (Sheet 3 of 5)

SECTOR/YEAR		10-MILE TOTALS	10-20	20-30	30-40	40-50	50-MILE TOTAL
		RADIAL DISTANCE FROM REACTORS (miles)					
S	1980	206	1,235	2,189	2,716	2,812	9,158
	1990	223	1,482	2,778	3,007	2,924	10,414
	2000	206	1,564	2,862	3,007	2,812	10,451
	2010	185	1,564	2,862	2,813	2,587	10,011
	2020	159	1,564	2,862	2,619	2,362	9,566
	2030	133	1,564	2,862	2,425	2,137	9,121
SSW	1980	287	1,267	1,820	2,156	2,069	7,599
	1990	275	1,520	2,216	2,450	2,172	8,633
	2000	255	1,520	2,295	2,450	2,069	8,589
	2010	226	1,520	2,295	2,352	1,862	8,255
	2020	188	1,520	2,216	2,156	1,655	7,735
	2030	159	1,520	2,216	2,058	1,448	7,401
SW	1980	340	1,089	13,769	4,630	4,855	24,683
	1990	330	1,198	16,154	5,291	5,681	28,654
	2000	294	1,198	17,997	5,622	5,784	30,895
	2010	262	1,198	18,973	5,732	5,681	31,846
	2020	232	1,198	19,840	5,842	5,474	32,586
	2030	212	1,198	20,816	5,952	5,371	33,549
WSW	1980	394	2,374	31,594	11,095	5,232	50,689
	1990	384	2,691	37,052	12,770	6,037	58,934
	2000	356	2,849	41,251	13,921	6,138	64,515
	2010	314	3,007	43,770	14,444	5,836	67,371
	2020	274	3,007	45,869	14,758	5,534	69,442
	2030	235	3,165	48,388	15,177	5,232	72,197

TABLE 2.1-3 (Continued) (Sheet 4 of 5)

SECTOR/YEAR		RADIAL DISTANCE FROM REACTORS (miles) 10-MILE TOTALS	10-20	20-30	30-40	40-50	50-MILE TOTAL
W	1980	570	2,589	4,052	4,721	4,118	16,050
	1990	572	2,707	3,546	5,094	4,540	16,459
	2000	543	2,825	3,377	5,342	4,434	16,521
	2010	503	2,707	3,039	5,342	4,117	15,708
	2020	456	2,589	2,701	5,342	3,800	14,888
	2030	418	2,471	2,363	5,342	3,483	14,077
WNW	1980	2,392	3,380	21,198	39,998	12,089	79,057
	1990	2,734	3,718	21,419	45,092	13,308	86,271
	2000	3,000	3,943	24,290	56,884	16,254	104,371
	2010	3,081	3,943	25,946	68,110	18,997	120,077
	2020	3,089	3,830	27,381	80,185	21,943	136,428
	2030	3,180	3,830	29,037	95,184	25,499	156,730
NW	1980	2,876	5,039	12,127	8,268	3,986	32,296
	1990	3,291	5,669	12,354	8,017	4,411	33,742
	2000	3,630	6,029	13,827	8,769	4,358	36,613
	2010	3,796	6,209	14,734	9,145	4,119	38,003
	2020	3,879	6,209	15,527	9,396	3,853	38,864
	2030	4,045	6,299	16,434	9,772	3,614	40,164
NNW	1980	764	1,540	4,451	6,249	2,568	15,572
	1990	858	1,643	4,451	6,147	2,853	15,952
	2000	926	1,643	4,557	6,249	2,758	16,133
	2010	950	1,643	4,345	6,044	2,568	15,550
	2020	959	1,540	4,133	5,839	2,283	14,754
	2030	976	1,540	3,921	5,634	2,093	14,164

TABLE 2.1-3 (Continued) (Sheet 5 of 5)

SECTOR/YEAR		RADIAL DISTANCE FROM REACTORS (miles) 10-MILE TOTALS	10-20	20-30	30-40	40-50	50-MILE TOTAL
GRAND	1980	8,996	27,178	112,319	116,488	102,093	367,074
TOTAL	1990	9,812	29,907	123,452	132,247	122,505	417,923
	2000	10,229	30,467	134,415	150,278	137,045	462,434
	2010	10,191	30,293	139,439	163,731	147,231	490,885
	2020	9,987	29,246	143,241	177,505	157,776	517,755
	2030	10,022	28,981	148,375	195,337	171,293	554,008

TABLE 2.1-4 DISTRIBUTION OF POPULATION WITHIN THE LOW POPULATION ZONE 1970 AND 1980

SECTOR/YEAR		RADIAL DISTANCE FROM REACTORS (MILES) 0-1	1-2	2-2.5	TOTAL
N	1980	0	7	0	7
	1990	0	7	0	7
NNE	1980	5	5	0	10
	1990	5	5	0	10
NE	1980	5	0	0	5
	1990	5	0	0	5
ENE	1980	5	0	0	5
	1990	5	0	0	5
E	1980	0	2	0	2
	1990	0	2	0	2
ESE	1980	0	0	5	5
	1990	0	0	5	5
SE	1980	2	2	6	10
	1990	2	2	6	10
SSE	1980	2	2	0	4
	1990	2	2	0	4
S	1980	2	2	3	7
	1990	2	2	3	7
SSW	1980	0	0	0	0
	1990	0	0	0	0
SW	1980	0	0	5	5
	1990	0	0	5	5

TABLE 2.1-4 (Continued) (Sheet 2 of 2)

SECTOR/YEAR		RADIAL DISTANCE FROM REACTORS (MILES) 0-1	1-2	2-2.5	TOTAL
WSW	1980	2	5	0	7
	1990	2	5	0	7
W	1980	2	20	0	22
	1990	2	20	0	22
WNW	1980	0	10	0	10
	1990	0	10	0	10
NW	1980	0	5	6	11
	1990	0	5	6	11
NNW	1980	0	2	7	9
	1990	0	2	7	9
TOTAL	1980	25	62	32	119
	1990	25	62	32	119

(Sheet 1 of 1)

TABLE 2.1-5 PUBLIC FACILITIES WITHIN TEN MILES

FACILITY	LOCATION		CAPACITY OR ATTENDANCE			
	DISTANCE/DIRECTION		GRADES	CAPACITY	ENROLLMENT	STAFF
Schools						
1. Southern Callaway County R-2 School, Mokane	7.8	SW	K-12	630	630	47
2. Osage County R-1 School, Chamois	6.0	S	K-12	500	333	30
Health Facilities						
3. State Hospital No. 1, Fulton	10.0	NW		1,500		1,300
4. Riverview Nursing Home, Mokane	7.5	SW		60		28
Correctional Facilities						
5. Chamois Jail (Temporary Lockup)	6.0	S		2		
			VISITORS			
	DISTANCE/DIRECTION		YEARLY	PEAK DAY		STAFF
Recreation Facilities						
6. Riverside Park and Chamois Access	6.0	S	5,000-10,000	2,000-3,000		
			AVERAGE WEEKLY SUMMER			
7. Harmony Hill Youth Camp[a]	3.0	WNW	Peak Daily Capacity:	500		16
8. Lions Club Community Park, Mokane	7.5	SW	Attendance statistics currently unavailable			
9. Lions Ballfield, Mokane	7.5	SW	Attendance statistics currently unavailable			
10. Gun Club, Mokane	7.5	SW	Attendance statistics currently unavailable			
11. Mokane Access	9.0	SW	Attendance statistics currently unavailable			
12. Glover Spring Lake	8.0	NW	Attendance statistics currently unavailable			
13. Lost Canyon Lake	2.2	N	Peak Capacity: Presently 1,000 persons peak usage; 800 sites developed, 600 more planned.			
14. Thunderbird Lake	5.0	NW	1 Permanent Home; 7 Summer Homes			
15. Reform Wildlife Management Area[b]	--	--	Peak Use: 25-45 hunters on all fall weekends			

a Harmony Hill Youth Camp is open for summer activities and for weekend retreats with 50 adults in attendance the remainder of the year.

b The Reform Wildlife Management Area includes the exclusion and security zones, as well as immediately adjacent lands surrounding these zones.

SOURCES: Fredrickson, 1979; Hodo, 1979; Hutton, 1979; Medley, 1979; Utley, 1979.

(Sheet 1 of 1)

TABLE 2.1-6 PROJECTED CUMULATIVE POPULATION DENSITY (PERSONS PER SQUARE MILE)

)

	RADIAL DISTANCE (MILES FROM PLANT)									
YEAR	1	2	3	4	5	10	20	30	40	50
1980	8.0	6.9	6.5	7.1	11.2	28.6	28.8	52.5	52.7	46.8
1990	8.0	6.9	6.5	6.7	10.7	31.2	31.6	57.7	58.8	53.2
2000	8.0	6.1	5.9	6.3	10.0	32.6	32.4	62.0	64.8	58.9
2010	4.8	4.5	5.1	5.7	9.2	32.5	32.2	63.7	68.4	62.5
2020	4.8	4.5	5.1	5.3	8.6	31.8	31.2	64.6	71.7	66.0
2030	4.8	4.5	5.1	5.1	8.3	31.9	31.1	66.3	76.2	70.6

NOTE: These cumulative population densities are to be compared to the regulatory guidelines of 500 persons per square mile and 1,000 persons per square mile.

TABLE 2.1-7 DISTRIBUTION OF THE POPULATION WITHIN THE LOW POPULATION ZONE 1970 THROUGH 2030

		Radial Distance from Reactors (Miles)			
Sector	Year	0-1	1-2	2-2.5	Total
N	1970	0	7	0	7
	1980	0	10	0	10
	1990	0	10	0	10
	2000	0	10	0	10
	2010	0	10	0	10
	2020	0	10	0	10
	2030	0	10	0	10
NNE	1970	5	5	0	10
	1980	10	10	0	20
	1990	10	10	0	20
	2000	10	10	0	20
	2010	10	10	0	20
	2020	10	10	0	20
	2030	10	10	0	20
NE	1970	5	0	0	5
	1980	10	0	0	10
	1990	10	0	0	10
	2000	10	0	0	10
	2010	10	0	0	10
	2020	10	0	0	10
	2030	10	0	0	10
ENE	1970	5	0	0	5
	1980	10	0	0	10
	1990	10	0	0	10
	2000	10	0	0	10
	2010	10	0	0	10
	2020	10	0	0	10
	2030	10	0	0	10

TABLE 2.1-7 (Continued) (Sheet 2 of 4)

Sector	Year	0-1	1-2	2-2.5	Total
E	1970	0	2	0	2
	1980	0	10	0	10
	1990	0	10	0	10
	2000	0	10	0	10
	2010	0	0	0	0
	2020	0	0	0	0
	2030	0	0	0	0
ESE	1970	0	0	2	2
	1980	0	0	10	10
	1990	0	0	10	10
	2000	0	0	10	10
	2010	0	0	10	10
	2020	0	0	10	10
	2030	0	0	10	10
SE	1970	2	2	6	10
	1980	10	10	10	30
	1990	10	10	10	30
	2000	10	10	10	30
	2010	0	0	10	10
	2020	0	0	10	10
	2030	0	0	10	10
SSE	1970	2	2	0	4
	1980	10	10	0	20
	1990	10	10	0	20
	2000	10	10	0	20
	2010	0	0	0	0
	2020	0	0	0	0
	2030	0	0	0	0
S	1970	2	2	3	7
	1980	10	10	10	30
	1990	10	10	10	30
	2000	10	10	10	30
	2010	0	0	10	10

TABLE 2.1-7 (Continued) (Sheet 3 of 4)

Sector	Year	0-1	1-2	2-2.5	Total
	2020	0	0	10	10
	2030	0	0	10	10
SSW	1970	0	0	0	0
	1980	0	0	0	0
	1990	0	0	0	0
	2000	0	0	0	0
	2010	0	0	0	0
	2020	0	0	0	0
	2030	0	0	0	0
SW	1970	0	0	5	5
	1980	0	0	10	10
	1990	0	0	10	10
	2000	0	0	10	10
	2010	0	0	10	10
	2020	0	0	10	10
	2030	0	0	10	10
SW	1970	0	0	5	5
	1980	0	0	10	10
	1990	0	0	10	10
	2000	0	0	10	10
	2010	0	0	10	10
	2020	0	0	10	10
	2030	0	0	10	10
WSW	1970	2	5	0	7
	1980	10	10	0	20
	1990	10	10	0	20
	2000	10	10	0	20
	2010	0	10	0	10
	2020	0	10	0	10
	2030	0	10	0	10
W	1970	2	20	0	22
	1980	10	20	0	30

TABLE 2.1-7 (Continued) (Sheet 4 of 4)

Sector	Year	0-1	1-2	2-2.5	Total
	1990	10	20	0	30
	2000	10	10	0	20
	2010	0	10	0	10
	2020	0	10	0	10
	2030	0	10	0	10
WNW	1970	0	10	0	10
	1980	0	10	0	10
	1990	0	10	0	10
	2000	0	10	0	10
	2010	0	10	0	10
	2020	0	10	0	10
	2030	0	10	0	10
NW	1970	0	5	6	11
	1980	0	10	10	20
	1990	0	10	10	20
	2000	0	10	10	20
	2010	0	10	10	20
	2020	0	10	10	20
	2030	0	10	10	20
NNW	1970	0	2	7	9
	1980	0	10	10	20
	1990	0	10	10	20
	2000	0	10	10	20
	2010	0	0	10	10
	2020	0	0	10	10
	2030	0	0	10	10
Totals	1970	25	62	29	116
	1980	80	120	60	260
	1990	80	120	60	260
	2000	80	110	60	250
	2010	30	60	60	150
	2020	30	60	60	150
	2030	30	60	60	150

2.2 NEARBY INDUSTRIAL, TRANSPORTATION, AND MILITARY FACILITIES

2.2.1 LOCATIONS AND ROUTES

2.2.1.1 Military Facilities

No military bases, missile sites, or military firing ranges are within 5 miles of the site. The nearest military facility is a detachment of the Missouri National Guard, at Fulton, approximately 11 miles northwest, comprised of the 5th Army Advisory Group and the 175th M.P. Battalion Headquarters and Headquarters Detachment. There are 10 full-time armed services personnel, 10 civilian personnel, and approximately 58 National Guardsmen who use the facility one weekend per month.

2.2.1.2 Manufacturing Plants, Storage Facilities, and Mining

2.2.1.2.1 Manufacturing Plants

No manufacturing or chemical plants exist within 5 miles of the site. The nearest manufacturing facilities are the Langenberg hat factory (Hopps, 1979) and a 67-megawatt fossil-fueled power plant utilizing two coal-fired boilers at Chamois, 6 miles south of the site.

2.2.1.2.2 Off-Site Storage Facilities

Small quantities of gasoline and petroleum products are stored in underground tanks at local service stations within 5 miles of the site (Table 2.2-1).

2.2.1.2.3 On-Site Storage Facilities

The following chemicals will be stored on site in individual storage vessels:

Fuel Oil	Hydrogen	Sulfuric Acid
Nitrogen	Carbon Dioxide	Gasoline
Oxygen	Sodium Hydroxide	

A description of each commodity is given in the following sections:

2.2.1.2.3.1 Fuel Oil

Fuel oil is stored on site in a 300,000-gallon fuel oil storage tank, designed and constructed in accordance with the American Petroleum Institute Standards and applicable fire codes. The tank is located above ground and is surrounded by a dike designed to contain the contents of the tank.

The distance from the fuel oil storage tank to the Unit 1 control building is about 500 feet. The distance to the UHS cooling tower is 300 feet.

Fuel oil is delivered to the site by tank truck and is transferred to the storage tank by buried piping and a pump for fueling the auxiliary boilers.

A gravity feed line supplies oil to day tanks for two diesel engines that drive fire protection system pumps at the fire pumphouse. The capacity of these day tanks is 250 gallons each.

There is a 1,000-gallon underground diesel fuel storage tank located near the security diesel generator building. The tank is over 700 feet from the Unit 1 control building. A small (4-hour supply) diesel fuel tank is located within the generator building. The tanks will be filled from an over-the-road trailer. The generator building is provided with fire detection devices, automatic sprinklers, and two fire hydrants, within 190 feet. Fire fighting equipment is supplied by two mobile units.

There is a 1000-gallon above-ground diesel fuel storage tank located plant west of the stores building. The tank is divided into two compartments, with 700 gallons for #2 diesel fuel and 300 gallons for #1 diesel fuel. This diesel fuel is used for onsite vehicles and non-plant equipment and is dispensed through a fuel pump adjacent to the tank. The tank is adjacent to the 2000-gallon gasoline tank and about 860 feet from the control building and over 500 feet from the ESW Pump House. The tank is filled by an over-the-road trailer. A fire hydrant is located within 75 feet of the diesel fuel tank.

Two 100,000-gallon emergency fuel oil storge tanks are located 24 feet south from the diesel generator building. (See SNUPPS Standard Plant FSAR Section 9.5.4 for a detailed description.)

Additional quantities of bulk storage of fuel oil may be stored on site. These additional tanks will be evaluated by Engineering and will not be stored within 50 feet of any safety related structure.

2.2.1.2.3.2 Nitrogen

Nitrogen is stored on site in liquid form in a high pressure vessel. It is piped to the power block as a gas through Schedule 80 steel pipes laid in a vented masonry trench with the oxygen lines. The supply lines are fitted with pressure relief valves (PRVs).

Storage capacity, adequate to support plant requirements, is maintained. The storage vessels are refilled from an over-the-road trailer as required.

The liquid storage is in insulated vertical, cylindrical vessels located more than 300 feet from the nearest Category I structure.

2.2.1.2.3.3 Oxygen

Oxygen is stored on site (adjacent to the nitrogen storage area) in gaseous form in a tube trailer and eight 330 SCF cylinders. It is piped to the power block through Schedule 80 stainless steel pipes laid in a vented masonry trench with the nitrogen lines. Supply lines are fitted with pressure relief valves. The anticipated total storage quantity is 52,000 SCF.

The storage vessels are an over the road trailer and D.O.T. standard gas cylinders. The trailer is refilled at the vendor's factory approximately every 10 weeks.

[redacted]

2.2.1.2.3.4 Hydrogen

Refer to Section 2.2.2 for a description of the hydrogen system.

2.2.1.2.3.5 Carbon Dioxide

Carbon dioxide is stored on site as a pressurized refrigerated liquid in an insulated storage vessel. It is vaporized electrically as required and piped to the power block through Schedule 80 steel pipes laid in the same vented masonry trench as the hydrogen pipes. These supply lines are fitted with pressure relief valves.

The storage vessel is refilled with liquid from an over-the-road trailer as required. The anticipated refill cycle is four weeks.

The storage tank is of the horizontal cylindrical type. The axes are not directed towards any buildings within the plant site.

The total storage quantity is 6 tons at 0°F.

Carbon dioxide is a simple asphyxiant. A few minutes of exposure to an atmospheric concentration of 100,000 ppm (10 percent) can produce unconsciousness and death from oxygen deficiency. The immediately dangerous to life or health (IDLH) concentration specified for carbon dioxide by the National Institute for Occupational Safety and Health (NIOSH) is 40,000 ppm (NIOSH, 1997).

2.2.1.2.3.6 Sodium Hydroxide

[redacted]

[redacted]

Sodium hydroxide is delivered to the site by tank truck. Pumps transfer the sodium hydroxide from the storage tanks to the turbine building for regeneration of the condensate polisher and to the demineralized water building for regeneration of the make-up demineralizer.

Sodium hydroxide is extremely alkaline and very corrosive to body tissues. Dermatitis may result from repeated exposure to dilute solutions in the form of liquids, dusts, or mists. The Federal Standard for airborne sodium hydroxide is 2 mg/m^3 (NIOSH, 1997).

2.2.1.2.3.7 Sulfuric Acid

[redacted]

Sulfuric acid is delivered to the site by tank truck. Pumps or gravity transfer the sulfuric acid from the storage tanks to the point of use indicated above.

Sulfuric acid causes burning and charring of the skin as a result of its great affinity for and strong reaction with water. It is rapidly injurious to mucous membranes and exceedingly dangerous to the eyes. The Federal Standard for sulfuric acid is one milligram per cubic meter of air (1 mg/m^3) (NIOSH, 1997).

2.2.1.2.3.8 Gasoline

[redacted]

2.2.1.2.3.9 Deleted

2.2.1.2.4 Mining

The closest mining activity to the site is Mertens Quarry, a limestone quarry located 4.5 miles northwest of the plant site. The quarry employs 15 persons and has a potential reserve of 10 to 20 million tons of rock. The current rate of extraction is approximately 500,000 tons per year (Mertens, 1979).

[redacted]

An inactive limestone quarry owned by Union Electric is located approximately one mile east of the site. No explosives are stored at the quarry (Wilson, 1979).

Four miles south of the site and 0.5 miles east of Steedman is an abandoned quarry, which tree and shrub overgrowth indicates to have been dormant for at least 15 years. Fire clay was once mined in the vicinity, and a number of abandoned fire-clay pits have been located.

2.2.1.3 Airports and Air Routes

2.2.1.3.1 Airports

No airports are located within 5 miles of the site.

The nearest commercial airport, Fulton Memorial, is approximately 12.5 miles northwest of the site (Figure 2.2-1) and had three total operations (Instrument Flight Rules (IFR) and Visual Flight Rules (VFR) for their current peak day, April 3, 1979 (McQueen, 1979).

Two private airstrips are located near Williamsburg 12.2 miles northeast of the site (Figure 2.2-1), and each has approximately 100 operations per year (Eckert, 1979).

2.2.1.3.2 Air Routes

The center lines of eight federal airways pass within 10 miles of the plant site. Four of these are low altitude (below 18,000 feet) airways. Four are high altitude (18,000 feet MSL through 45,000 feet pressure altitude). Three transition routes which converge to one route are also within 10 miles of the plant site. No military routes pass within 10 miles of the plant site.

Low altitude federal air routes, also known as Victor air routes, are flown primarily by general aviation aircraft. These routes generally have a width of 8 nautical miles and occupy the airspace between 18,000 feet and the floor of controlled airspace, 700 to 1,200 feet. Traffic counts for these air routes were taken on the peak traffic day in 1978, and include only those aircraft operating under Instrument Flight Rules (IFR). No data are available on aircraft operating under Visual Flight Rules (VFR), which may also use these federal airways (Bumstead, 1979). Low Altitude Federal Airways within 10 miles of the site are shown on Figure 2.2-1 and their distance from the plant site and peak daily use is listed in Table 2.2-2.

High altitude jet routes are primarily used by commercial air carriers, the military, and high performance general aviation aircraft. These routes have a width of 8 nautical miles and are flown from 18,000 feet to the top of controlled airspace, 45,000 feet. All flights above 18,000 feet are required to be IFR flights; hence, all altitudes and routes are assigned by air traffic controllers. High Altitude Jet routes within 10 miles of the plant site are shown on Figure 2.2-2 and their distances from the plant site and peak daily use are listed in Table 2.2-2.

Arrival routes are used primarily by commercial air carriers, the military, and high performance general aviation aircraft. These routes generally are flown from 18,000 to 24,000 feet but the aircraft may go down to 5,000 feet on rare occasions (Pruitt, 1979). Arrival routes within 10 miles of the plant site are shown in Figure 2.2-2, and their distances to the plant site and peak daily use are listed in Table 2.2-2.

2.2.1.4 Land Transportation Routes

Six state roads are within 5 miles of the plant site and they are listed in Table 2.2-3 and shown on Figure 2.2-3.

Average daily traffic (ADT) counts in 1978 (Rankin, 1979) indicate traffic flow is primarily along Routes O, CC and Highway 94. One thousand five hundred and fifty (1,550) vehicles traveled Route O east of Fulton, and apparently most traffic turned south onto CC as only 410 vehicles were counted east of the junction of Routes CC and O (Figure 2.2-3). On Route CC, 2 miles south of Route O, at the immediate plant vicinity the ADT were 960 vehicles. One thousand one hundred and twenty (1,120) vehicles were

counted on Highway 94 southwest of Mokane. Apparently the bulk of the traffic turned north onto Route CC as the traffic decreased to 500 vehicles east of the Highway 94 and Route CC intersection. Further east (east of Route D), 420 vehicles were counted on Highway 94 (Rankin, 1979).

The majority of traffic noted is associated with construction of the plant. Upon completion of construction, the ADT counts will decrease substantially.

The most hazardous materials that may be shipped by highway are labeled Class A explosives and include such matrerials as dynamite, blasting caps, bombs, and other high explosives. The maximum amount of explosives that may be shipped by truck is 42,000 to 48,000 pounds. These shipments are routed through less populated areas to their destination. The closest route to the plant site that would be used by firms shipping such materials would be U.S. Highway 94. U.S. Highway 94 is located approximately 3.7 miles from the plant site at its closest point. The amount of explosives shipped along U.S. Highway 94 is unknown. There are no federal, state, or local agencies that are required by law to keep records of transportation of hazardous materials and no data are available (Doyle, 1978).

The roads nearest the plant site are County Roads 448 and 459, which are shown on Figure 2.2-3. County Road 448 is approximately 1,900 feet to the northeast of the reactor site and County Road 459 is approximately 2,300 feet to the southwest. Several gas companies use these roads when delivering propane to residences near the plant site. Deliveries on each of these roads may be expected to approach approximately 50 per year, and more frequent deliveries occur during winter months (Whyte, 1979; Bregg, 1979; Sundermeyer, 1979; Winingear, 1979; and Davis, 1979). Local propane delivery trucks are expected to range in size from 1,800 to 2,600 gallons (Davis, 1979).

2.2.1.5 Water Transportation

The Missouri River, approximately 5 miles southeast of the site, is a transportation artery for barge traffic. Maximum cargo loads are a function of barge size and river depth. The largest cargo load reported by Sioux City and New Orleans Barge Lines was 1,600 short tons during a period of seasonally high water levels. Maximum cargo loads are usually 1,200 short tons, and the maximum number of barges in a single tow as many as 8 to 10 depending on barge size and water levels (Hynes, 1979). Nine hundred fifty-five thousand four hundred and eighty-three (955,483) tons of hazardous commodities, listed in Table 2.2-5, were shipped on the Missouri River between Kansas City and St. Louis in 1979. Forty-one thousand nine hundred and seventy-four (41,974) passengers used the river between Kansas City and the mouth of the river in 1977 (U.S. Army Corps of Engineers, 1977).

2.2.1.6 Pipelines

No pipelines or tank farms are located within 5 miles of the site. The nearest pipeline, Williams Brothers' 8-inch diameter products pipeline, approximately 8 miles north of the

site, runs from St. Charles to Columbia, Missouri, and carries refined petroleum products. The pipeline route is shown on Figure 2.2-3 (Steuerwalz, 1979).

2.2.2 DESCRIPTIONS

The description of products (other than hydrogen) manufactured, stored, or transported offsite as well as the maximum quantities of hazardous materials likely to be processed, stored, or transported on site, are fully described in Section 2.2.1. Hazardous materials are listed in Tables 2.2-1, 2.2-4, and 2.2-5. The description of the hydrogen system follows.

2.2.2.1 Hydrogen System

The hydrogen system (HS) is designed to provide low pressure gaseous hydrogen continuously to the turbine and auxiliary buildings for volume control tank purge, generator fill and generator leakage make-up. This system description relates only to components of the site HS outside the Standard Power Blocks.

2.2.2.1.1 Design Basis

2.2.2.1.1.1 Safety Design Basis

The HS has no Safety Design Basis.

2.2.2.1.1.2 Power Generation Design Basis

The HS is designed to provide hydrogen continuously to the Standard Power Block as required for components related to power generation.

2.2.2.1.1.3 Codes and Standards

The following codes and standards are used as guidelines in the design of the Hydrogen System and equipment and, where required by law, the system and equipment conform to the applicable standards:

a. National Fire Protection Association (NFPA)

b. Occupational Safety and Health Standards (OSHA)

c. American Nuclear Insurers (ANI)

2.2.2.1.2 System Description

2.2.2.1.2.1 Location

The location of the HS bulk storage facility and the distribution piping outside the Standard Power Blocks are shown on Figure 2.2-4. A flow diagram of the HS is shown in Figure 2.2-5. The hydrogen storage system is located plant South of and approximately 350 feet away from the Power Block. The axes of the pressure vessels and tube trailer are oriented plant East-West and are not directed at any of the buildings within the plant site. Due to the distance between the Power Block and the hydrogen storage area a fire in the storage area does not pose any hazard to systems required for safe shut-down. The hydrogen storage system for each unit will sit on its own grade-level concrete foundation slab and the rest of the fenced gas storage area will be rock-covered and kept brush free to prevent any brush fire from impinging on the storage tanks. There is a fire hydrant and hose house within 160 feet of the storage facility.

2.2.2.1.2.2 Facilities

The HS consists of multiple pressure vessels and a tube trailer with appurtenances, pressure regulators, excess flow control valves, unloading facilities and distribution lines to each turbine building.

2.2.2.1.2.2.1 Storage

The hydrogen is stored in gaseous form at a maximum pressure of 2400 psig and the design usable storage capacity is 212,700 scf. This capacity is divided between two banks (secondary and reserve) of six high pressure tubes and a tube trailer. The secondary bank of tubes does not provide gas until the useful capacity of the trailer is consumed. Additional storage capacity is provided by the reserve bank during periods of high use of unanticipated delays in delivery. The two banks of high pressure tubes and the tube trailer are independent in the sense that a problem in one will not affect the operation of the other. Each high pressure storage tank is fitted with a rupture disc pressure relief device. There are two pressure relief valves in the high pressure header between the storage tanks and the pressure regulator, and two more in the low pressure piping downstream of the regulator.

2.2.2.1.2.2.2 Supply

The storage vessels and tube trailer will be refilled or replaced by an over-the-road tube trailer as required. The anticipated refill cycle is two weeks. The truck unloading stanchion will have equipment to electrically ground the trucks to the site grounding system to which also the control cabinet, piping, steel framing and the storage tubes are connected. The unloading stanchion will be provided with a check valve, a shut-off valve, a purge valve and a pressure regulator. The purge gas will be piped away from the operator and vented upwards to the atmosphere. The open end of the purge line will be protected against the entrance of the precipitation, dust and other debris.

2.2.2.1.2.2.3 Transfer and Distribution

The pressure regulators reduce the pressure of the gas to the levels required by the power blocks. The gas is piped to the power blocks in Schedule 80 carbon steel pipes laid in ventilated masonry surface trenches wherever possible but buried when it is necessary to cross roads, drainage ditches and other interferences. An excess flow valve is provided in the line to each unit to shut off the supply of hydrogen at excessively high flow rates. The pressure relief valves fitted to the supply lines are 200 feet from the oxygen pressure relief valves and vent 10.5 feet above ground. The hydrogen piping is laid in the same trench as the carbon dioxide piping.

2.2.2.1.2.2.4 Source

Union Electric has contracted with a reputable and qualified company, experienced in the handling of this product, to replenish the storage vessels as required.

2.2.3 EVALUATION OF POTENTIAL ACCIDENTS

On the basis of the information provided in Section 2.2.1 and 2.2.2, potential design basis accidents have been evaluated. As demonstrated in the following sections, there are no onsite or offsite hazards which have an adverse effect on the plant structures or control room habitability at the Callaway site.

2.2.3.1 Design Basis Events

Design basis events external to the nuclear power plant are defined as those accidents that have a probability of occurrence on the order of about 10^{-7} per year or greater and have potential consequences serious enough to affect the safety of the plant to the extent that Part 100 guidelines could be exceeded.

The occurrence of each accident was postulated to involve only a single chemical. The worst meteorological conditions for dispersion, low wind (1.5 m/s) and very stable stability, were used in the study. Accidents were assumed to occur at the shortest distance from the storage site or transportation route to the plant site. Evaluations of effects due to explosions used a mass equivalence of 240 percent of the vapor clouds (Reg. Guide 1.91).

2.2.3.1.1 Explosions

As described in Section 2.2.1.4, the closest land transportation route to the plant site that would be used by trucks carrying explosive materials through the area would be U.S. Highway 94. The maximum probable hazardous cargo for a single highway truck determined by the Department of Transportation is approximately 50,000 pounds (equivalent TNT). The distance beyond which an exploding truck will not prevent a safe shutdown is 1,700 ft. (0.32 miles) as indicated in Regulatory Guide 1.91, Revision 1, Feb.

1978, Figure 1. Since the closest point of U.S. Highway 94 to the Callaway plant site is approximately 3.7 miles, no hazard to the plant due to highway explosion is expected.

The abandoned Missouri-Kansas-Texas Railroad passes about 3.5 miles south of the plant site.

The nearest bank of the Missouri River is located 4.9 miles from the plant site. The hazardous materials that were transported on the Missouri River from Kansas City to the mouth in 1977 are listed in Table 2.2-5. The largest probable quantity of explosive material transported by ship or barge is about 5,000 tons (equivalent TNT). The distance beyond which an exploding ship or barge will not have an adverse effect on the plant operation or will not prevent a safe shutdown is about 9,000 ft. (1.7 miles) (Ref. 1). Therefore, physical distance of the plant from transport rights-of-way negates the explosives hazard.

The closest mining activity to the site is at Mertens Quarry, a limestone quarry located 4.7 miles from the plant site. As described in Section 2.2.1.2.4, the explosives stored at the quarry site are in small quantities. Therefore, no hazard to the plant exists due to mining or detonation of mine explosives.

A postulated onsite hydrogen storage vessel failure will not produce a hazard to the plant. The axis of the hydrogen storage tubes and trailer are pointed away from the plant buildings and an unconfined hydrogen release will not explode. Adequate fire equipment is located within 200 feet of the gas storage area.

There are no military bases, missile sites, military firing ranges, manufacturing or chemical plants, pipelines or tank farms, or major gasoline-storage areas within 5 miles of the Callaway site.

The pressure effect of potential explosions in the vicinity of the plant site are estimated to result in less than 1.0 psi overpressure on plant structures. Therefore, the effects of such explosions can be neglected.

2.2.3.1.2 Flammable Vapor Clouds (Delayed Ignition)

Flammable gases in the liquid or gaseous state can form a vapor cloud which can drift toward the plant before ignition occurs. The possibility of the cloud then exploding depends upon its concentration being within the flammability limits for the particular gas released.

[redacted]

[redacted]

<u>Analysis</u>

For both the railroad and truck accidents, the initial expansion of the liquid to a vapor cloud upon rupture of the tank is determined based on the model presented in Reference 2.

As the propane tank is initially ruptured, part of the liquid will flash to vapor and the rest will be entrained into the cloud in the form of droplets. The expansion to atmospheric pressure is assumed to be isentropic. For propane initially stored at 70°F, the amount vaporized is 30 percent (Ref. 2, Fig. 5 and Ref. 5, Fig. 1) and when the entire tank is dumped the cloud density will be approximately equal to the air density. The tank dump time is determined from Ref. 2, Fig. 7 and Ref. 5, Fig. 2 assuming the size of the tank rupture. The total momentum release is determined from Ref. 2, Fig. 7 and Ref. 5, Fig. 2 and the total weight of the propane. The radius of the propane cloud when all of the tank has been dumped is given by:

$$r = \left(\frac{2P}{\pi \rho_{air} \tau_D}\right)^{1/4} \tau_D^{1/2} \qquad \text{(Ref. 2)}$$

Where

r	=	radius (m)
P	=	total momentum (kg m/sec)
τ_D	=	tank dump time (sec)
ρ_{air}	=	density of air (kg/m)

Assuming a gaussian distribution of propane in the cloud, the intial standard deviation of the cloud, σ_I is 1/2 r, with the cloud center r meters from the initial release point.

The cloud is then dispersed according to the equation for an instantaneous ground level puff release:

$$\frac{\chi_I}{Q_I} = \frac{1}{7.87(\sigma_{x,y}^2 + \sigma_I^2)(\sigma_z^2 + \sigma_I^2)^{1/2}} \qquad \text{(Ref. 3)}$$

Where

Q_I	=	the mass of propane released (g)
χ_I	=	the puff center concentration g/m
$\sigma_{x,y,z}$	=	the standard deviation of pollutant concentration in the x, y, and z directions, (m)
σ_I	=	the initial standard deviation of the puff (m)

Puff center concentrations were calculated as the cloud moves towards the plant site under the worst meteorological conditions (G stability). The vapor cloud can be detonated when the concentration of propane is 2.2 to 9.5 percent by volume (Ref. 4); all of the propane is assumed to be involved in the explosion. To determine the blast effects, the equivalent TNT weight of the propane cloud is determined using a 240 percent mass equivalency (Ref. 1,5).

The distance to a peak overpressure of 1 psi from an explosion of a specific weight of TNT is then given by:

$$R_S = \left(18W_{TNT}\right)^{1/3} \qquad \text{(Rev. 1)}$$

Where

R_S	=	distance to peak overpressure of 1 psi (m)
W_{TNT}	=	equivalent TNT weight of propane (kg)

Results of these calculations are given in Table 2.2.3-1. For the propane truck accident, an explosion could not occur closer to the plant site than 420 m. The peak overpressure at this distance is less than 1 psi. It is also noted that as the land surrounding the site is level, no increased hazard is expected due to topographic channeling of the propane cloud.

2.2.3.1.3 Toxic Chemicals

Onsite and offsite accidents involving the release of the following toxic chemicals have been postulated and analyzed:

Benzene	Sulfuric Acid
Carbon Dioxide	

The toxic chemical analysis of a fuel oil fire is presented in Section 2.2.3.1.4. Chlorine has been shipped in the past on the Missouri-Kansas-Texas Railroad but this line has been abandoned.

Benzene

A postulated railroad accident producing a benzene spill was evaluated but deleted when the Missouri-Kansas-Texas line was abandoned.

Carbon Dioxide

A postulated onsite CO_2 storage tank failure will not produce a hazard to the plant as CO_2 is stored in a well-ventilated area.

Sulfuric Acid

A postulated sulfuric acid storage tank failure will not be a hazard to the plant as all of the tanks are enclosed by concrete retention dikes.

2.2.3.1.4 Fires

A 300,000 gallon No. 2 fuel oil storage tank is located on the site, above ground, 500 feet from the control building. As the tank is designed in accordance with applicable fire codes and No. 2 fuel oil is very stable, the probability of an accident occurring which would ignite the oil is extremely small. If the tank did fail and the oil was ignited, the oil would be contained by the surrounding dike and the only impact would be due to smoke and heat flux from the fire.

Because heat generated by the fire causes a very high plume rise, no danger to control room personnel would occur from smoke as the air intake for the control building is just 17.5 feet above the ground.

Temperatures imposed on surrounding buildings due to the fire were estimated; radiation is the only significant mode of heat transfer in this case. The Stefan-Boltzman law was used to determine heat flux from the fire, assuming a flame temperature of 1800°F and emissivity of 0.4. The temperature of surrounding buildings is maximum when heat flux from the fire to the building equals the heat flux away from the building. Surface temperatures of 115°F to 190°F were calculated for surrounding buildings. Buildings at 500 to 600 feet away from the fire would not experience surface temperature rise.

Because the land surrounding the plant site is relatively clear and adequate fire fighting equipment is available, no threat to the plant is posed from brush or forest fires.

2.2.3.1.5 Collisions With Intake Structure

The Callaway plant is located approximately five miles from, and 300 feet above, the Missouri River. An intake structure located on the Missouri River provides makeup water for the circulating water and service systems at the plant. This structure is not required for safe shutdown of the plant. Water required for emergency shutdown of the plant is provided by the essential service water system which draws from an excavated, onsite retention pond. This Category I retention pond and associated mechanical draft cooling towers and pumping facilities comprise the ultimate heat sink. It can be postulated that a barge or ship could damage the water intake structure to the extent that it could no longer provide adequate makeup to the plant. The normal circulating water cooling tower basins, however, contain enough water to allow approximately 6 to 9 hours of normal operation to continue without the addition of makeup water. If, in this period, the postulated damage of the makeup water intake structure cannot be rectified, the plant will then switch to the essential service water system for an orderly and safe shutdown.

2.2.3.1.6 Liquid Spills

The accidental release of petroleum products or corrosive liquids upstream of the Callaway water intake structure will not affect operation of the plant. Normal operation of the water intake structure pumps requires submergence. Liquids with a specific gravity less than unity, such as petroleum products, will float on the surface of the river and consequently are not likely to be drawn into the makeup water system. Liquids with a specific gravity greater than unity could be drawn into the intake pipes. However, such liquids would be diluted by the large quantity of river flow as they move toward the intake structure. In addition, makeup water is treated at the water treatment facility located at the plant site prior to entering the plant circulating water system. The circulating water system in turn is monitored; therefore, continued inflow of containments would be detected before any damage occurs.

REFERENCES - SECTION 2.2

Published References

Jeppesen Airway Manual, 1979. Jeppesen approach chart, standard terminal arrival, Jeppesen Sandersen, Inc., Denver (April 13).

National Oceanic and Atmospheric Administration (NOAA), 1978, Kansas City sectional aeronautical chart: U.S. Department of Commerce, Washington, D.C., 21st edition (December 28, 1978).

____, 1979, H-3 Northeast, H-4 Southeast enroute high altitude - U.S. Chart, U.S. Department of Commerce, Washington, D.C. (June 14).

NIOSH, "NIOSH Pocket Guide to Chemical Hazards," National Institute for Occupational Safety and Health, 1997..

United States Army Corps of Engineers, 1977, Waterborne commerce of the United States Calender year 1977, Part 2 Waterways and harbors gulf Coast, Mississippi River System and Antilles.

Personal Communications

Bregg, B.W., 1979, Manager, Empiregas, Inc., Cedar City, Missouri, personal communication (August 10).

Bumstead, C., 1979, Chief, Air Route Traffic Control Center, Federal Aviation Administration, Olathe, Kansas, personal communication (June 13).

Davis, D., 1979, Manager, Bouyer Oil & Gas Company, Fulton, Missouri, personal communication (August 3).

Doyle, D., 1979, Operating Department, Missouri-Kansas-Texas Railroad Company, Denison, Texas, Personal Communication (August 10).

Doyle, R., 1978, American Trucking Association, Safety and Security Department, Washington, D.C., personal communication (December 18).

Eckert, C., 1979, Owner, Eckert Ranch, Williamsburg, Missouri, personal communication (June 29).

Hopps, J., 1979, Research Department, Missouri Division of Commerce and Industrial Development, Jefferson City, Missouri, personal communication (May 22).

Hynes, J, 1979, Vice-President of Administration, Sioux City and New Orleans Barge Lines, Inc., St. Louis, Missouri, 12680, personal communication (June 5).

Janovec, M.L., 1979, General Manager, Missouri-Kansas-Texas Railroad Company, Denison, Texas, personal communication (June 22).

McQueen, R.W., 1979, Chief, Kansas City ARTC Center, Olathe, Kansas, personal communication (August 30).

REFERENCES - SECTION 2.2 (continued)

Mertens, K., 1979, President, Mertens Quarry, Fulton, Missouri, personal communication (June 1).

Pruitt, L., 1979, East Area Officer, Air Route Traffic Control Center, Olathe, Kansas, personal communication (June 21).

Rankin, J., 1979, Missouri State Highway Department, Division of Planning, Jefferson City, Missouri, personal communication (March 39).

Schnell, D.F., 1979, Manager - Nuclear Engineering, Union Electric Company, St. Louis, Missouri, personal communication (May 9).

Skinner, J., 1979, Train Master, Operating Department, Missouri-Kansas-Texas Railroad, St. Louis, Missouri, personal communication (June 4).

Steuerwalz, D., 1979, Terminal Superintendent, Williams Brothers Pipeline Company Terminal, Columbia, Missouri, personal communication (June 1).

Summer, J., 1979, Division of Planning, Missouri State Highway Department, Jefferson City, Missouri, personal communication (June 4).

Sundermeyer, W, 1979, Plant Manager, Williams Energy Company, Kingdom City, Missouri, personal communication (August 10).

Whyte, K., 1979, Driver, MFA Propane Company, Mokane, Missouri, personal communication (August 10).

Wilson, H., 1979, Senior Construction Engineer, Callaway Plant, Fulton, Missouri, personal communication (June 4).

Winingear, G., 1979, Driver, Empiregas, Inc., Fulton, Missouri, personal communication (August 10).

REFERENCES - SECTION 2.2.3

1. Regulatory Guide 1.91.
2. Hardee, H. C. and Lee, D. O., "Expansion of Clouds from Pressurized Liquids." Accident Analysis & Prevention; Vol. 7, pp 91-102. Pergamon Press, 1975.
3. Regulatory Guide 1.78.
4. Fire Protection Handbook. National Fire Protection Association, G. H. Tryon Editor NFPA NO. FPH 1359. 1969.
5. Eichler, T. V., Napadensky, H. S., "Accidental Vapor Phase Explosions on Transportation Routes Near Nuclear Power Plants." U.S. Nuclear Regulatory Commission, Division of Engineering Standards; NUREG/CR-007S. January-April 1977.
6. Wing, J., "Toxic Concentrations in the Control Room Following a Postulated Accidental Release," U.S. Nuclear Regulatory Commission, Division of Site Safety and Environmental Analysis; NUREG-0570. June 1969

TABLE 2.2-1 STORAGE FACILITIES FOR HAZARDOUS MATERIALS WITHIN 5 MILES OF THE CALLAWAY PLANT

COMMODITY DESCRIPTION	NAME	DISTANCE FROM PLANT MILES	DISTANCE FROM PLANT DIRECTION
[redacted]			

(Sheet 1 of 1)

TABLE 2.2-2 LOW AND HIGH ALTITUDE FEDERAL AIR ROUTES, ARRIVAL ROUTES, AND PEAK DAILY TRAFFIC WITHIN 10 MILES OF THE CALLAWAY PLANT SITE

ROUTE	SEGMENT[a]	DISTANCE AT CENTERLINE TO PLANT	NUMBER OF AIRCRAFT IN PEAK TRAFFIC DAY
Low Altitude			
V12[b]	Columbia-Foristell	6.2	52
V12 South	Jefferson City - Readsville Intersection	8.4	0
V175	Hallsville-Vichy	9.2	2
V44	Jefferson City - Foristell	9.7	20
High Altitude			
J105	Springfield-Bradford	9.6	42
J19/134/110	Butler-St. Louis (31/23/29)	4.7	83
Arrival			
TRAKE[c] Arrival	TRAKE Intersection-Foristell	4.7	98
Includes	Napoleon Transition-TRAKE Intersection		31
	Butler Transition-TRAKE Intersection		23
	Springfield Transition-TRAKE Intersection		43

a Between VORTAC's (navigational aid giving VHF and UHF course and distance information) or intersections.

b Aircraft file from the Columbia Regional (COU) Airport direct to Foristell, and have been included in that count.

c TRAKE Standard Terminal Arrival Route (STAR)

Source: Bumstead, 1979.

TABLE 2.2-3 LAND WATER TRANSPORTATION ROUTES WITHIN 5 MILES OF THE CALLAWAY PLANT

NAME	LOCATION FROM PLANT	
	MILES	DIRECTION
State Highway 94	3.7	S
State Route D	3.8	E
State Route O	1.8	N
State Route AD	0.9	NW
State Route CC	0.3	N
State Route VV	4.0	SW
Missouri-Kansas-Texas Railroad (abandoned in 1987)	3.5	S
Missouri River	4.9	SE

TABLE 2.2-4 DELETED.

TABLE 2.2-5 HAZARDOUS MATERIALS TRANSPORTED ON THE MISSOURI RIVER FROM KANSAS CITY TO THE MOUTH IN 1977

COMMODITY DESCRIPTION	SHORT TONS
Coal and Lignite	1,467
Sodium Hydroxide	14,520
Crude Tar, Oil, Gas Products	1,161
Alcohols	25,445
Benzene and Toluene	1,120
Basic Chemicals and Products	17,165
Nitrogenous Chemical Fertilizers	180,854
Potassic Chemical Fertilizers	2,394
Phosphatic Chemical Fertilizers	73,323
Insecticides, Disinfectants	457
Fertilizer and Materials	201,711
Gasoline	59,279
Distillate Fuel Oil	11,398
Residual Fuel Oil	15,501
Coke, Petroleum Coke	349,688
Total	955,483

Source: U.S. Army Corps of Engineers, 1977.

TABLE 2.2-6 PROPANE ACCIDENT

	Truck
Total Liquid (Gal)	2,600
Tank Rupture Size (m^2)	.04645
Dump Time τ_D (sec)	28
Total Momentum Release (kg m/sec)	0.243×10^5
Radius @ τ_D (m)	59.3
@ (100 m + r) I (% by Vol)	1.3
Distance from Explosion at (100 + r) Meters from Accident to Plant Site (m)	420
R_s (m)	412

2.3 METEOROLOGY

2.3.1 REGIONAL CLIMATOLOGY

The information used in the analyses contained in this section consisted of climatological summaries, meteorological data, and technical studies and reports. The regional climatology was based on climatological data summaries from National Weather Service (NWS) stations in Missouri. The locations of the NWS stations, which were used to characterize the regional climatology, are depicted on Figure 2.3-1.

2.3.1.1 General Climate

The climate of the region is continental and characterized by warm, humid summers with considerable convective rainfall and highly changeable winter weather with moderate amounts of rain and snow.

Maritime tropical air originating over the Gulf of Mexico is the dominant air mass from June through August when only infrequent incursions of continental polar air occur. The maritime tropical air is very humid, which results in warm nights, frequent daytime cloudiness, and considerable thunderstorm activity. From November through February, continental polar air passes over the region most frequently, although there are infrequent incursions of maritime tropical air and maritime polar air; the latter is a mild, dry air mass when it reaches Missouri. During the transition months (March, April, May, September, and October), either air mass may dominate during individual months.

High and low pressure systems pass over the region generally from west to east. They alternate every few days, except during late summer and autumn when high pressure systems occasionally stagnate over the region for a week or more. These stagnating high pressure conditions provide the worst macro-scale diffusion conditions. Locally, diffusion is worst during strong inversion situations and light winds. Such conditions, which commonly last only a few hours, occur most frequently during predawn hours of autumn and winter. The low pressure systems promote atmospheric mixing and provide favorable diffusion conditions. The path of low pressure systems is generally to the north of the region during summer and near or just to the south of the region during winter. Low pressure systems reach their maximum intensity during winter and spring but are weak during summer.

Frontal systems are frequently strong during all seasons except summer. A strong cold front is often preceded by a shower or thunderstorm and followed by a shift in wind direction from south to north and drops in temperature of as much as 11°C (20°F) in 2 hours. Warm fronts usually are preceded by general rainfall and followed by a shift from south to north winds and warmer temperatures. Frontal systems are usually weak and reach the region less frequently during the summer months.

Airflow is primarily from southwest to southeast during most of the year; however, during winter and spring months, winds from the west to northwest occur frequently and may

constitute the prevailing wind direction during some winter and spring months. Wind speeds are generally greatest during spring and lowest during summer.

In this region, summers are warm with the midsummer months averaging in the upper 20s°C (mid-70s°F); temperatures reach 32°C (90°F) on nearly half of all summer days and frequently do not drop below 21°C (70°F) at night. Temperatures average below freezing during midwinter, and several subzero nights generally occur each winter season. The transition seasons are characterized by rapid temperature changes.

Precipitation is moderate; heaviest amounts usually fall during late spring, and lightest amounts occur during midwinter. Summer precipitation and spring precipitation, to some extent, is commonly convective and occasionally very intense.

Autumn, winter, and some spring precipitation is lighter, but of greater duration which is characteristic of synopticscale precipitation producing systems. Snowfall is generally light to moderate but is heavy during some winters. Freezing rain and sleet may occur from November through March. On infrequent occasions, heavy accumulation of freezing rain causes substantial damage.

The Callaway Plant site is on a plateau between nearby shallow river valleys. The Missouri River flows in a 3.2-km (2-mile) wide, east-west valley approximately 8.0 km (5 miles) south of the site at an elevation of approximately 100 meters (328 feet) below the Callaway Plant site. During light wind situations, some air drainage from the Callaway Plant site into the Missouri River Valley may occur; however, such drainage is expected to be minimal due to the distance separating the site from the edge of the valley.

A prominent climatic feature of the region is the occurrence of severe thunderstorms and tornadoes. These storms may occur at any time of year but are most frequent during spring and early summer. Severe thunderstorm winds may gust in excess of 161 km/hr (100 mph), and tornadic winds, though they are rare, may be substantially higher (U.S. Dept. of Commerce, 1968, 1973).

2.3.1.2 Regional Meterological Conditions for Design and Operating Bases

2.3.1.2.1 Heavy Precipitation

Spring, summer, and early fall precipitation occurs largely in the form of heavy showers or thunderstorms. Table 2.3-1 presents the monthly variations of thunderstorm days at Columbia, Missouri and shows April through September as having the greatest thunderstorm frequency, averaging 44 thunderstorm days during these 6 months. Maximum short period rainfall for durations of 5 minutes to 24 hours at Columbia, Missouri (U.S. Weather Bureau, 1963) is presented in Table 2.3-2, and maximum rainfall, estimated by statistical analysis of regional precipitation data (Hershfield, 1961) and extrapolated for the Callaway Plant site area, is presented in Table 2.3-3 for recurrence intervals of 1 to 100 years and for rainfall durations of 1/2 hour to 1 day. Additional precipitation data are presented in Section 2.3.2.1.

2.3.1.2.2 Snow

Snowfall may occur in the region of the site from October through May. The extreme 24-hour and single-storm snowfall of 70.1 cm (27.6 inches) for the entire state of Missouri occurred March 16 to 17, 1970, at Neosho in the west Ozark Mountains. The extreme monthly snowfall of 120.7 cm (47.5 inches) occurred in January 1918 at Poplar Bluff, Missouri, in the east Ozark Mountains. The extreme seasonal snowfall of 178.6 cm (70.3 inches) occurred during the winter of 1911 to 1912 at Maryville, Missouri, 242 km (150 miles) northwest of the site area (American Meteorological Society, 1970). The extreme snowfalls for various durations and maximum observed snowpack for certain cities within the site region are presented in Table 2.3-4. Snow-on-ground data were obtained from the U.S. Department of Commerce (1949 to 1973, 1974 to 1978). Section 2.3.1.2.11 further discusses snowload for the 100-year return period combined with maximum 48-hour winter precipitation.

2.3.1.2.3 Hail

The most commonly reported hailstones are less than 1.9 cm (3/4 inch) in diameter and cause little or no property damage. Hailstones larger than 1.9 cm (3/4 inch) in diameter are associated with severe thunderstorms. From 1955 through 1967, 478 hailstorms having hailstones exceeded 1.9 cm (3/4 inch) in diameter were reported in 230 days in Missouri, according to Pautz (1969). Figure 2.3-2 shows the total number of reported hailstorms by 1-degree latitude-longitude squares for the site area. This figure indicates a total of 28 occurrences of hailstones greater than 1.9 cm (3/4 inch) in diameter for the 13-year period (1955 through 1967), or an average of slightly more than two per year for the site area. The diurnal distribution of these hailstorms indicates that most occurred between 1500 and 1800 Central Standard Time.

Based on data from the U.S. Department of Commerce (1959-1973) for the period 1959 through 1973, the hail appeared most frequent in late spring and early summer (May through July) within a 161-km (100-mile) radius of the plant. A secondary frequency peak exists in early fall. In the 15-year period surveyed, hail of golf-ball size and smaller appeared often. Hail of 7.6-cm (3-inch) diameter to baseball size has been recorded quite often, and the dates and places of some of these occurrences are as follows: Montgomery City (October 3, 1973); Columbia (May 6, 1971, and May 10, 1973); near St. Louis (June 27, 1972); near Fulton (July 15, 1971); in northeast Missouri (June 28, 1960); Marshall (May 16, 1960); and Franklin (September 26, 1959). Some reports of even largersized hail were noted. In southwest Randolph County, hailstones up to 12.7 cm (5 inches) in diameter fell on July 5, 1969. Again in Randolph County, hailstones greater than baseball size fell on July 20, 1971. In Montgomery City on October 3, 1973, one ice cluster was measured at 17.8 cm (7 inches) in diameter. Hail occasionally covered the ground to some depth and drifted in strong winds. For example, hail 15.2 cm (6 inches) deep was reported near Steelville on October 4, 1969.

In summary, the site area appears to be subject to frequent hail. Hailstones up to 7.6 cm (3 inches) in diameter are not infrequent. Occasionally, larger-sized hail may occur.

2.3.1.2.4 Ice Storms

Freezing rain may occur in the region of the Callaway Plant site from November through March. Table 2.3-5, based on a study by Bennett (1959), shows that during the 10-year period 1939 through 1948 there were 69 days of freezing rain in Columbia, Missouri.

For the 9-year period, 1928 to 1937, the extreme radial thickness of glaze on utility wires for the 1-degree latitude-longitude square encompassing the site area was between 2.5 cm (1.00 inch) and 3.1 cm (1.24 inches). The mean duration of ice on utility lines for the entire state was 32 hours (Bennett, 1959).

Tattleman and Gringorten (1973) evaluated probabilities of accretion of ice to various thicknesses and coincident maximum wind gusts based on glaze storm reports over a 50-year period. The evaluation must be considered tentative because of the absence of objective reporting of glaze thickness; nevertherless, it is the best available approximation. For any point in the site region, the probabilities of accretion of ice to various thicknesses during a single year are as follows:

RADIAL ICE THICKNESS (cm)	ANNUAL PROBABILITY
0.4	0.9
1.4	0.5
2.5	0.1
>7.5	0.01

For any point in the site region, the return periods of ice accretion to various radial thicknesses coincident with wind gusts of 20 m/sec (44.8 mph) or more are given in the following:

RADIAL ICE THICKNESS (cm)	RETURN PERIOD (YEARS)
<2.5	25
3.5	50
5.6	100

Approximately 25 percent of all ice storms in the region were exacerbated by wind gusts of 20 m/sec (44.8 mph) or more.

A mixture of freezing rain, sleet, and snow occurred in the entire state of Missouri on December 11 to 12, 1972. This was the worst ice storm at many locations in southwestern and central Missouri since 1949. Ice accumulation ranged from an

insignificant level in the southeastern portion of the state to over 2 inches in some central Missouri locations. Entire towns lost electrical and telephone services in southwestern Missouri. Considerable damage to utilities was reported in many areas of the Ozarks and the Missouri River Valley (U.S. Dept. of Commerce, 1972).

2.3.1.2.5 Thunderstorms

Thunderstorms are observed during every month of the year. During the summer they are most frequent, and usually occur on one day out of four. From November through February, they seldom occur. The most damaging thunderstorms are usually those associated with the passage of a cold front or a squall line. Table 2.3-1 presents the average monthly and annual number of days with thunderstorms for Columbia, Missouri. The annual average frequency of thunderstorms is 55 days per year.

2.3.1.2.6 Tornadoes and Waterspouts

The plant site is located in a region of relatively numerous and severe tornadoes. The region of maximum worldwide tornado occurrence is located just to the west in Kansas and Oklahoma. A total of 608 tornadoes were reported throughout the state of Missouri over the 13-year period, 1955 through 1967 (Pautz, 1969). Tornadoes have been observed during every month of the year, however, approximately 60 percent of the annual total occurred during April, May, and June, which is the period of greatest atmospheric instability. While tornadoes have occurred during all 24-hour increments of the day, 82 percent occur between noon and midnight, and the hours of greatest frequency are 4 to 6 p.m. (Poultney, 1973).

Over the 20-year period ending in 1968, the mean path length of Missouri tornadoes was 14.3 km (9.5 miles). The longest tornado path exceeded 161 km (100 miles), and four others exceeded 80 km (50 miles). Tornado path width has averaged slightly less than 274.5 meters (300 yards) (Pautz, 1969).

The occurrence of waterspouts requires a substantial body of warm water. Since such water bodies do not exist in the site region, waterspouts do not present a hazard.

2.3.1.2.6.1 Tornado Strike Probability

The annual probability, P_S , that a tornado will strike a particular point may be computed from the following formula (Thom, 1963):

$$P_S = \frac{2.821E}{A} \qquad (2.3\text{-}1)$$

where:

A = Area in square miles of a 1-degree longitude-latitude square centered on the point; and

E = Mean annual frequency of tornadoes in area A

Figure 2.3-3, presents tornado frequency by 1-degree latitude-longitude squares for the entire contiguous United States, and indicates the plant site experienced 13 tornadoes during the 13 years covered by the study (Pautz, 1969); thus, E = 1.0. Since A = 9,726 km^2 (3,752 mi), $P_S = 7.5x10^{-4}$. A more recent data base (Poultney, 1973) covering tornado frequency over the period, 1956 through 1971, indicates a greater annual tornado strike probability ($P_S = 1.21x10^{-3}$). This value is in close agreement with a U.S. Atomic Energy Commission study (Markee and Beckerly, 1974). Table 2.3-6 lists values of P for each month, based on the Poultney data.

Tornadoes that have occurred in the vicinity of the site since 1971 and estimates of the intensity and path area of each, along with a comparison of the strike probability for this period with that of previous periods of record are discussed below in the response to NRC Item 451.2C.

The publication Storm Data, published by the National Oceanic and Atmospheric Administration (NOAA), was consulted to obtain information concerning tornado strikes in the vicinity of the site for the period 1972 through 1980. The area comprising this vicinity was assumed to include Callaway County and the seven-county area surrounding Callaway County. The counties investigated are Audrain, Boone, Callaway, Cole, Gasconade, Montgomery, Osage, and Waren counties.

The tornadoes recorded in these counties are shown below, along with an estimate of the path area of each. No estimate of the maximum wind speed that occurred was available from this source. In order to provide some indication of the intensity of the tornado, an estimate of property and crop damage is included, also obtained from the NOAA publication. The parameters of the design basis tornado for the Callaway Plant, which were obtained from Regulatory Guide 1.76 (1974), are shown in Section 2.3.1.2.6.2 of the FSAR Addendum.

LOCATION (COUNTY)	DATE	PATH LENGTH (km)	PATH WIDTH (M)	ESTIMATED DAMAGE*	
				PROPERTY	CROPS
Boone	09/07/72	0.2	46	4	-
Boone	03/13/73	11.3	46	4	-
Boone	05/26/73	4.8	46	5	-
Callaway	07/20/73	1.6	46	3	?
Cole, Boone and Callaway	05/12/80	40.2	46	4	4
Montgomery	05/12/80	1.6	91	5	2

*Storm damages are placed in nine categories

1 - Less than $50
2 - $50 to $500
3 - $500 to $5,000
4 - $5,000 to $50,000
5 - $50,000 to $500,000
6 - $500,000 to $5 million
7 - $5 million to $50 million
8 - $50 million to $500 million
9 - $500 million to $5 billion

For this 9-year period, six tornadoes were recorded. Using this method of Section 2.3.1.2.6.1 and assuming that the eight-county area corresponds to the 1-degree, longitude-latitude square, the annual strike probability (P_S) is computed from the data period 1972 through 1980:

$$P_s = \frac{2.821E}{A} = 5.01 \times 10^{-4}$$

This figure is comparable to the strike probability computed using the Pautz (1969) data where $P_S = 7.5x10^{-4}$ and is somewhat less than the value determined by Poultney (1973) where the annual strike probability was found to be $1.21x10^{-3}$

2.3.1.2.6.2 Design Basis Tornado

The Design Basis Tornado is defined as the tornado that is exceeded in intensity no more than once per 10 million years (Markee and Beckerly, 1974). Regulatory Guide 1.76 (1974) indicates that the site is in Region I, the region with the greatest Design Basis Tornado intensity. The characteristics of the Region I Design Basis Tornado specified by Regulatory Guide 1.76 are the following:

PARAMETER DESCRIPTIONS	DESIGN VALUES
Maximum Wind Speed	580 km/hr (360 mph)
Maximum Rotational Speed	467 km/hr (290 mph)
Maximum Translational Speed	113 km/hr (70 mph)
Minimum Translational Speed	8 km/hr (5 mph)
Radius of Maximum Rotational Speed	45.7 m (150 ft)
Pressure Drop	236 g/cm^2 (3 lb/in^2)
Rate of Pressure Drop	156 g/cm^2 /sec (2 lb/in^2/sec)

2.3.1.2.7 Hurricanes

Hurricanes typically develop over tropical ocean waters and dissipate rapidly when passing over land masses and regions of cooler temperatures. Hence, the influence of hurricanes on the climatology of the site and the surrounding area is insignificant.

2.3.1.2.8 Extreme Wind Speeds

Except for tornadoes, which are discussed in Section 2.3.1.2.6, extreme winds occur in Missouri as a result of thunderstorms and, to a lesser extent, extratropical cyclones and tornadoes.

Maximum monthly fastest-mile wind speeds for Columbia, Missouri, are shown in Table 2.3-7. The direction of these winds is typically from the northwest. Extratropical cyclones usually produce their fastest wind speeds in winter, because they are energized by temperature contrasts between air masses.

According to Pautz (1969), there were 616 reports of wind gusts 50 knots and greater that occurred on 323 days in Missouri for the 13-year period of record, 1955 through 1967. The diurnal distribution of these wind gusts indicates a concentrated maximum in the evening-to-midnight period. The total number of windstorms 50 knots and greater for

the period, 1955 through 1967, by 1-degree, latitude-longitude squares is shown on Figure 2.3-4 (Pautz, 1969), which indicates that there were 31 such observations in the site area.

The extreme fastest-mile wind speed is defined as the highest wind speed sustained through 1 mile of wind at an elevation of 30 feet above ground level. Thom (1968) has chosen the annual extreme fastest-mile wind speed as the best available measure of wind for design purposes. From 21 years of annual extreme fastest-mile wind speeds, he calculated extreme fastest-mile wind speed values and mean recurrence intervals using the Frechet probability distribution.

Thom's probability calculations do not include the effect of tornadoes and assume that the surface friction is relatively uniform for a fetch of about 25 miles. Based upon these assumptions, the extreme fastest-mile wind speed intervals for the site are presented in Table 2.3-8. The fastest mile, 100-year return period wind speed is 85 mph (136 km/hr) at Columbia. For comparison, the greatest recorded fastest-mile wind speed over Columbia, which occurred in September 1952, was 63 mph (101 km/hr) (U.S. Department of Commerce, 1969). Fastest-mile wind speeds for several stations within a 403-km (250-mile) radius of the site are listed in Table 2.3-9.

The gust factor, G_F, is a function of exposure, height, and wind speed. The formula for the gust factor is presented in the following (ANSI, 1972):

$$G_F = \frac{q_F}{K_Z(0.00256\ V_{30}^2)} \qquad (2.3\text{-}2)$$

where:

q_F = Effective velocity pressure for flat open country (m^2/sec^2);

K_Z = Velocity pressure coefficient at height, Z; and

V = Extreme fastest-mile wind speed at 9.1 meters (30 feet) (m/sec).

The variation of wind speed with height follows a power law equation of the following form:

$$V_2 = V_1\left(\frac{z_2}{z}\right)^x \qquad (2.3\text{-}3)$$

where:

V_2	=	Wind speed at the upper level (m/sec);
V_1	=	Wind speed at the lower level (m/sec);
z_2	=	Height of the upper level (meters);.
z_1	=	Height of the lower level (meters); and
x	=	Exponent variable with surface friction. For open country, x = 0.14 (ANSI, 1972), which is representative of the site environs.

Based on the above equations, 100-year return period extreme wind speeds and the associated gust factor vary with height as shown in Table 2.3-10.

2.3.1.2.9 Dust

Since the region receives appreciable precipitation and is extensively cultivated, the land is well covered by vegetation. Accordingly, dust does not become airborne during windy conditions, except on a limited scale. Occasional convectively induced "dust devils" occur during the warm months; however, winds produced by these phenomena are rarely strong enough to cause damage and visibility is reduced only within the "dust devil" which constitutes a local hazard.

2.3.1.2.10 Air Pollution Potential

Meteorological conditions that favor high air pollution potential are light winds, surface inversions, and stable layers aloft. The surface-based inversion is generally a transient phenomenon and results from radiational cooling, prolonged fog, prolonged snow cover, and the cooling of the ground by a sudden shower. Surface heating on most days usually breaks up this type of inversion and creates a uniform mixing layer by midafternoon. If warming aloft (caused by subsiding air of warm, slow-moving anticyclones) occurs, a stable layer aloft, known as a subsidence inversion, may result. This condition limits the mixing depth, or the surface layer in which relatively intense vertical mixing occurs. Since both surface and subsidence inversions usually occur in conjunction with light winds, the air pollution potential is, therefore, amplified.

The plant site area is characterized by frequent storm passages, cloudiness, high winds, and thermal instability, all of which favor the rapid transport and dispersion of atmospheric pollutants. Hosler (1961) has presented a climatological study on the frequency of occurrence of low-level inversions in the contiguous United States based on radiosonde data. Based on data from Columbia, Missouri, for the period, June 1955 through May 1959, the seasonal summary of the percent frequency of inversions at selected times and for the total time is shown in Table 2.3-11. The annual inversion

frequency in the winter and spring is 31 percent and reaches a maximum of 43 percent in autumn.

Holzworth (1972) has computed mean seasonal and annual morning and afternoon mixing depths based on surface and upper air meteorological data from selected National Weather Service stations throughout the contiguous United States for the 5-year period, 1960 through 1964. Associated wind speeds throughout this layer were computed as arithmetic mean wind speeds observed at the surface and throughout the mixing layer. Table 2.3-12 presents mean seasonal and annual morning and afternoon mixing depths and associated wind speeds for Columbia, Missouri, from 1960 through 1964 (Holzworth, 1972). These data demonstrate that generally the greatest air pollution potential (lowest mixing depth and lowest wind speed) can be expected on summer mornings.

The critical limiting conditions used by Holzworth are as follows:

a. All mixing heights are 1,500 meters or less;

b. All mixing layer mean wind speeds are 4.0 meters per second or less;

c. No significant precipitation occurs; and

d. The above conditions are satisfied continuously for at least 2 days.

The total number of these episode days in the 5-year period, 1960 through 1964, for Columbia, Missouri, was 22. This is in qualitative agreement with objectively derived patterns and the actual forecast days of high air pollution potential for the region by NWS air pollution meteorologists.

2.3.1.2.11 Probable Maximum 48-Hour Winter Precipitation (PMP) and 100-Year Return Period Snowload

The probable maximum 48-hour winter precipitation (PMP) reported by U.S. Department of Commerce (1956) is as follows:

	PRECIPITATION	
MONTH	(mm)	(in.)
December	500.3	19.7
January	475.0	18.7
February	497.8	19.6

Since only winter (defined as December, January, and February) precipitation is relevant, November and March PMP values are not specified above. The weight of the

precipitation during the month with the greatest PMP, December, is 50.8 g/cm^2 (102.4 lb/cm^2).

The 100-year return period snowload, unadjusted, is 11.74 g/ cm^2 (21.0 lb/cm^2). The basic snowload coefficient of 0.8 (ANSI, 1972), applicable to flat-roofed unexposed buildings, may be applied to the unadjusted snowload to yield an effective snowload of 9.39 g/cm^2 (16.8 lb/cm^2).

As required by NRC Regulatory Guide 1.70, the 48-hour winter PMP is retained by the 100-year return period snowload to yield a combined weight of 60.2 g/cm^2 (119.2 lb/cm^2).

2.3.1.2.12 Meteorological Input to the Ultimate Heat Sink Analysis

An analysis of 3-hourly meteorological data (temperature, relative humidity, solar radiation, cloud cover) collected at Columbia, Missouri (NWS, 1945-69) over the period, 1945 through 1969, was performed to determine the meteorological conditions which would result in (1) the smallest heat transfer from the retention pond for a single day and for 30 consecutive days, and (2) the greatest evaporation from the retention pond over 30 consecutive days.

The minimum heat transfer rates and evaporation rates were determined by 3-hourly iterative calculations based on existing temperature, wind speed, relative humidity, solar precipitation, and cloud cover.

Table 2.3-13 presents the combination of historical meteorological conditions which would result in the smallest heat transfer from the retention pond for a single day and for 30 consecutive days. The most critical single day in the 26-year period was July 12, 1969. The period July 7 through August 5, 1955 was the most critical 30-day period. This period was used to calculate the maximum water temperature in the retention pond. The meteorological conditions 30 days prior to the most critical 30-day period were evaluated to determine the prior water temperature. The meteorological conditions during the antecedent 30-day period, June 7 through July 6, 1955, are presented in Table 2.3-14.

Table 2.3-15 provides the historical meteorological conditions during the 30-day period which would result in the greatest evaporative loss from the retention pond. This period was July 2 through 31, 1954. The wind speed is given as 20.44 km/hr (12.78 mph) in 2.3-15, because this is the value of the greatest average wind speed during the period. The greatest daily average wind speed during the period is used as input in the calculation of total evaporative water loss. The average wind speed during the 30-day period was 16.8 km/hr (10.5 mph).

The procedures used for determining the meteorological conditions which would result in the minimum heat transfer rates and the greatest evaporation from the retention pond are discussed in Section 2.3.1.2.13.

2.3.1.2.13 Local Meteorological Conditions for Design and Operating Bases

The design parameters for the plant site which were developed in Section 2.3.1, and the respective sections in which they are used, are listed below:

Wind Loadings (Refer to Section 3.3.1)

Callaway Design Parameters:

100-Year Return Period Fastest Mile of Wind: 85 mph

Variation of 100-Year Return Period Fastest Mile of Wind Speed and Total Structural Response Gust Factor with Height:)

HEIGHT (ft)	WIND SPEED (mph)	GUST FACTOR
30	85.0	1.30
100	100.6	1.20
200	110.9	1.15
300	117.3	1.12
400	122.2	1.11
500	126.0	1.10
600	129.3	1.09

Tornado Loadings (Refer to Section 3.3.2)

Callaway Design Parameters:

Annual Probability of Occurrence: 1.21×10^{-3}

Design Basis Tornado:

Maximum Wind Speed: 360 mph

Maximum Rotational Speed: 290 mph

Maximum Translational Speed: 70 mph

Radius of Maximum Rotational Speed: 150 ft

Maximum Pressure Drop Rate: 3 lb/in^2

Minimum Pressure Drop Rate:	2 lb/in^2
Minimum Translational Speed:	5 mph

Equipment Identification and Environmental Conditions (Refer to Section 3.11.1)

Floods (Refer to Section 2.4.2)

Probable Maximum Flood (PMF), Potential Dam Failures Seismically Induced (Refer to Section 2.4.3)

Probable Maximum Surge and Seiche Flooding (Refer to Section 2.4.5)

Callaway Design Parameters:

Weight of 100-Year Return Period Snowload and 48-Hour PMP:	119.2 lb/ft^2
100-Year Return Period Fastest Mile of Wind:	85 mph

Ultimate Heat Sink (Refer to Section 9.2.5)

Callaway Design Parameters:

Period of Meteorological Conditions Resulting in Minimum Heat Transfer from

Retention Pond:	Single Day:	July 12, 1969
	30 Days:	July 7 through August 5, 1955

Period of Meteorological Conditions Resulting in Maximum 30-Day Evaporation

from Retention Pond:	July 2 through July 31, 1954

Refer to Tables 2.3-13 through 2.3-15 for design values.

The following procedures were used to obtain the meteorological data required for the deisgn of the ultimate heat sink. All average and extreme values of meteorological parameters were based on 3-hourly data for Columbia, Missouri, for the 25-year period January 1, 1945 to October 31, 1969. The data were obtained from the U.S. Department

of Commerce, National Climatic Center, Asheville, North Caroline, on magnetic tapes in TDF-14 format.

Since many of the calculations are concerned with daily averages of meteorological parameters, an additional data file was compiled consisting of average values of the following meteorological parameters for each calendar day of the data period: cloud cover, wind speed, dry-bulb, wet-bulb, and dew point temperatures, and relative humidity. A separate dew point temperature value was calculated for each 3-hourly observation using dry-bulb and wet-bulb values, and the daily averages for the calculated dew point appear in the daily average data file, together with daily averages for the depression of the wet bulb and the depression of the calculated dew point.

The calculated dew point was used in the data analysis instead of the original dew point, since wet-bulb measurements are generally more reliable than direct measurements of dew point.

Where 30-day average values of a parameter were required, the 30-day periods were obtained by taking each consecutive day as the beginning of a particular 30-day period. For example, after June 1 - 30, the 30-day period of June 2 - July 1 was considered rather than July 1 - 30. The data set of daily average values was used in computing 30-day averages.

In computing averages, a minimum of four 3-hourly average values were considered necessary for a valid daily average, and 15 valid daily values were used as the minimum for a valid 30-day average.

After the highest 30-day average period for a given parameter was determined, the daily values of the parameter were determined, the daily values of the parameter were determined. The daily values of the parameter for the period were obtained by listing the required portion of the data set.

The vaporative heat flux for each day within the summer months of June to September was calculated using the following equation from "An Analytical and Experimental Study of Transient Cooling Pond Behavior" by P.O. Ryan and D.R.F. Harleman, Ralph Parsons Lab, MIT Report No. 161, January 1973:

$$\phi = f(w)(e_S - e)$$

where:

ϕ	=	evaporative heat flux (Btu/ft^2/day);
e_s	=	saturation vapor pressure (mm Hg);
e	=	actual vapor pressure (mm Hg); and

$f(w) = 70 + 0.7w^2$

where w = wind speed (mph).

The period of minimum heat transfer was determined by finding the period of highest equilibrium temperature for the retention pond. The equilibrium temperature, as defined by Ryan and Harleman, is a function of net radiation, wind speed, ambient temperature, and dew point temperature, in accordance with the following equation:

$$T_E = \frac{\phi_r + f(w)[\beta\, T_d + 0.255\, T_a] - 1600}{23 + f(w)\,(\beta + 0.255)}$$

where:

T_E = equilibrium temperature toward which the pond tends (°F);

ϕ = net radiation term (BTU/ft^2/day;

= $\phi sn + 1.16 \times 10^{-13}(460+T_a)^6\ (1+0.17c^2)$;

ϕsn = net incident solar radiation (BTU/ft^2/day);

= $(1 - 0.71c^2)\ H_O \times 24$;

H_O = average hourly absorbed solar radiation for clear sky (BTU/ft^2/hour);

= 68.362-40.982 x sin [2π x (DAY/366)+1.739] for 39° latitude;

DAY = sequential number of the day of the year beginning with 1 for January 1 and ending with 365 or 366 for December 31;

c = average cloud cover (in tenths);

f(w) = wind function (BTU/ft^2/day/mm Hg);

= $70 + 0.70 \times ws^2$;

The Brady form of f(w) instead of the Lake Hefner form [$f(w) = 12.4 \times ws^2$] in the above reference was used because the latter is physically unrealistic and gives excessive values of T_E for low wind speeds.

ws = wind speed (mph)

β	=	$0.255 - 0.0085\,T^* + 0.000204\,T^{*2}$ (mm Hg/°F);
T^*	=	$1/2\,(T_s + T_d)$ (°F);
T_d	=	dew point (°F);
T_a	=	ambient temperature (°F); and
T_s	=	surface temperature of the pond (°F).

The 3-hourly observations for ambient temperature, wet-bulb temperature, cloud cover, and wind speed were averaged to obtain daily values. The dew point temperature was then calculated from the ambient temperature and wet-bulb temperature.

The equilibrium temperature was calculated for each day using the above parameters. An initial value of T_s was assumed and T^* and β were calculated. Then, for given values of ϕ r, T_d, T_a, and f(w), the value of T_E was calculated. The difference, $(T_E - T_s)/2$, was then used as an improved estimate of the value of T_s and the process was repeated until the difference became less than or equal to 0.5 °F. Generally, the equilibrium temperatures are found within 4 to 5 iterations.

The 40 highest daily equilibrium temperatures were found, as well as the 40 highest 30-day equilibrium temperatures. The 30-day equilibrium temperature is the average of a 30-consecutive-day period between June 1 and September 30.

2.3.1.2.14 Lightning Strikes

The frequency of the lightning strikes to an area is related to the number of thunderstorm days in that area. In order to characterize the expected frequency of lightning strikes to the area of the Callaway Plant, data from Columbia, Missouri regarding the average number of thunderstorm days over a 30-year period were used. These data were presented in Table 2.3-1 of the FSAR and are summarized below.:

SEASON	THUNDERSTORM DAYS
Winter (January through March)	5
Spring (April through June)	22
Summer (July through September)	22
Fall (October through December)	6
Annual Total	55

The following discussion, which estimates the number of lightning strikes to safety-related structures at the site, was developed following the methodology presented by J. L. Marshall in Lightning Protection, published in 1973. The "attractive area" of the structures was determined for a lightning strike with an electrical current magnitude of 20,000 amperes, which corresponds to the current magnitude of 50 percent of lightning flashes. The attractive area (A) of a structure is:

$$A = LW + 4H(W + L + \pi H)$$

where:
- L = structure length, meters;
- W = structure width, meters; and
- H = structure height, meters.

The grouping of safety-related structures that maximizes the attractive area is composed of five structures. These are the reactor building, control building, auxiliary building, diesel generator building, and fuel building. For simplicity, this grouping has been assumed to have the following dimensions:

L = 99.1 m

W = 91.4 m

H = 63.4 m

The assumed dimensions are the maximum linear dimensions of this grouping and, thus, maximize the attractive area of the structures.

These dimensions yield an attractive area of 0.108 km^2. The number of lightning strikes to earth per thunderstorm day per square kilometer (N_E) is given by

$$N_E = (0.1 + 0.35 \sin x)(0.40 \pm 0.20)$$

where: x = the geographic latitude

Using the approximate plant latitude of 38°47', the value of N_E calculated from the above equation is N_E = 0.128. Then, the number of lightning strikes per square kilometer per year is:

$$N_E \times 55 \frac{\text{Thundersorm days}}{\text{years}} = 7.04 \quad \frac{\text{flashes}}{\text{km}^2\ \text{year}}$$

Since the safety-related structures of interest have an attractive area of 0.108 km , the probability is that there will be:

$$7.04\ \frac{\text{flashes}}{\text{km}^2\text{year}} \times 0.108\text{km}^2 = 0.76\ \frac{\text{flashes}}{\text{year}}$$

or one lightning flash every 1.32 years (480 days).

From the Wolf Creek FSAR, it was seen that the number of flashes to ground per square mile per year is between 0.05 and 0.8 times the number of thunderstorm days per year. For the Callaway Plant area, this is between 3 and 444 lightning strikes per square mile per year, or between 1 and 17 lightning strikes per square kilometer per year. The number previously calculated (7.04 lightning strikes per square kilometer per year) falls within this range.

The seasonal estimate of lightning strikes to safety-related structures considering their attractive area is presented below:

SEASON	FLASHES PER SEASON	NUMBER OF SEASONS FOR ONE FLASH
Winter	0.07	14.5
Spring	0.30	3.3
Summer	0.30	3.3
Fall	0.08	12.1

2.3.2 LOCAL METEOROLOGY

Meteorological data were collected from observing stations at the Fulton Airport, Columbia Municipal Airport, and Columbia Regional Airport. The meteorological observing station at Fulton Airport, 8 miles northwest of the Callaway Plant site, collects temperature and precipitation data only. The Columbia Municipal Airport (latitude, 38°58'N; longitude, 92°22'W; and elevation, 778 feet mean sea level (MSL) was a

first-order NWS observing station for central Missouri. In mid-1969, the NWS relocated this station to Columbia Regional Airport (latitude, 38°49'N; longitude, 92°13'W; and elevation, 887 feet MSL). At both the old location and the new location, the Columbia surface meteorological data are presented either in climatical summary form or on magnetic tape. There are no major terrain feature differences between Fulton Airport, Columbia Regional Airport, Columbia Municipal Airport, and the Callaway Plant site, Units 1 and 2. Hereafter, meteorological data from the two airports in Columbia are referred to as Columbia, Missouri.

Although these off-site data generally typify local meteorological conditions, local variations in the distributions of wind speed and wind direction probably exist. These local variations are identified in an on-site meteorological monitoring program, the results of which are analyzed in this section.

2.3.2.1 Normal and Extreme Values of Meteorological

Parameters

In the following sections, monthly and annual average and extreme summaries of wind speed and direction, temperature, water vapor, precipitation, fog, atmospheric stability and mixing height, as well as persistence of wind direction and atmospheric stability, are provided. The data summaries are based on both regional data (Columbia, Missouri, approximately 56 km (35 miles) west-northwest of the site) and on-site data. Three years of combined on-site data are used: May 4, 1973 to May 4, 1975; and March 16, 1978 to March 16, 1979. For a discussion of the on-site meteorological data monitoring program, refer to Section 2.3.3.

2.3.2.1.1 Wind Speed and Direction

2.3.2.1.1.1 Regional Wind Roses

Table 2.3-16 presents joint frequencies of wind speed and direction at Columbia, Missouri (1960 through 1969) on a monthly and annual basis. Wind speed and direction data are summarized on Figure 2.3-5 in the form of seasonal wind roses based on Columbia data, 1951 through 1959. The annual wind rose for Columbia, based on 3-hourly data (1960 through 1969) is provided on Figure 2.3-6. Winter and spring winds blow primarily from west-southwest through northwest and from south through southeast. During summer, the prevailing direction is markedly from south-southwest through south-southeast, while autumnal flow is primarily from the south-southwest through southeast with a secondary maximum from the west-northwest and northwest. On an annual basis, the prevailing direction is markedly from the south, and the least prevalent direction is from the north-northeast. Light winds occur most frequently during midsummer; calms occur 2.5 percent of the time during July, and only 1.3 percent of the time annually. The strongest winds blow during the spring, especially when the wind direction is from the west-northwest. The mean annual wind speed is 16.8 km/hr (10.5 mph).

2.3.2.1.1.2 On-Site Wind Roses

Monthly and annual wind roses at the 10- and 60-meter levels, based on the 3 years of combined on-site data are presented on Figure 2.3-7. Figures 2.3-8 and 2.3-9 present annual wind roses at 10 and 60 meters based on the periods May 4, 1973 to May 4, 1974 and May 4, 1974 to May 4, 1975, respectively. Figure 2.3-10 presents the annual wind rose at 10, 60, and 90 meters based on the period March 16, 1978 to March 16, 1979. The diurnal variation of monthly and annual on-site wind data based on 3 years of on-site data combined is presented in Table 2.3-17.

Based on 3 years of on-site data combined, the annual wind roses at 10 and 60 meters indicate that winds are predominantly southerly at the site, with a weak secondary peak in directional frequency from west to northwest. The direction with the lowest frequency is east-northeast. When winds do blow from the east-northeast, they are among the lowest in average speed, along with northeast and north-northeast winds. The direction from which winds blow at the greatest speeds is west-northwest. West to northwest winds predominate during winter (December through February). These directions become progressively less favored through the spring months so that winds are predominantly from south through southeast by May. Through the summer, southwest through southeast winds become increasingly frequent, reaching peak frequency during October. During the summer and early autumn months, east through northeast winds blow even less frequently than during winter and spring. A rapid transition to the winter pattern occurs during November as west through northwest winds become more prevalent at the expense of winds with southerly components. The greatest wind speeds occur during winter and early spring and the lowest during summer and early autumn. The lowest average monthly wind speed, based on the 3 years of combined data, was 1.47 m/sec from the northeast at the 10-meter level during June.

2.3.2.1.1.3 Interannual Variability

Annual variations of wind speed and direction among the 3 years of data were insignificant. The predominant direction at 10 meters was from the southeast during 1974 through 1975 and 1978 through 1979, while south-southeasterly winds predominated during 1973 through 1974. At the 60-meter level, the predominant direction also coincided during 2 years and differed by only 22.5 degrees during the remaining year. The secondary west through northwest frequency peak was evident in each of the years at both levels. The sector experiencing the lowest average speed at both levels was northeast in 1973 to 1974 and 1974 to 1975, and northnortheast in 1978 to 1979.

2.3.2.1.1.4 Regional Wind Persistence

Seasonal relative frequency distributions of wind direction persistence for Columbia, Missouri, for the period, 1959 to 1969 have been prepared and are presented in Table 2.3-18. The single sector analysis shows wind direction persistence in hours for all wind speed groups within that sector. Results of this analysis show the following:

a. The 50 percent wind direction persistence was less than 6 hours for all sectors and all seasons;

b. Calm conditions persisted no more than 6 hours in the winter and fall and no more than 9 hours in the summer and spring;

c. The maximum 5 percent wind direction persistence was the following:

SEASON	EXTRAPOLATED SECTOR	INTERPOLATED PERSISTENCE (HOURS)
Winter	ENE	25.0
	WNW	20.8
Spring	SE	21.4
	WNW	20.8
Summer	N	14.1
	WNW	14.6
Autumn	NW	20.2
	N	18.6

d. The maximum seasonal percentage frequency of occurrence of wind direction persistence for a single sector was as follows:

SEASON	SECTOR	PERSISTENCE (HOURS)	PERCENT
Winter	ENE	42	6.25
Spring	W	30	3.97
Summer	N	27	3.45
Autumn	S	39	1.73

2.3.2.1.1.5 On-Site Wind Persistence

Wind direction persistence data, based on the May 4, 1973 to May 4, 1974 on-site data at 10 and 60 meters, are presented in Tables 2.3-19 and 2.3-20, respectively. Wind direction persistence, based on March 16, 1978 to March 16, 1979 on-site data at 90 meters, is presented in Table 2.3-21. Each table provides wind persistence in hours by sector for each of the three stable Pasquill stability classes (E, F, and G) and for all

Pasquill stability classes combined. Each table also presents the average wind speed during each persistence episode.

Wind persistence at the site is greatest during conditions when winds blow from the southern quadrant. The greatest consecutive number of hours of wind blowing from a single direction during six stability conditions was 9 hours at 10 meters, 10 hours at 60 meters, and 8 hours at 90 meters. Isolated instances of persistence exceeding 24 hours during unstable or neutral conditions occurred at each of the three levels. At the 10-meter level, wind speeds averaged no lower than 1.75 m/sec during persistence episodes exceeding 7 hours and during stable conditions. At the 60- and 90-meter levels, wind speeds averaged 4 m/sec and 6 m/sec, respectively, under the same criteria.

2.3.2.1.2 Temperature

2.3.2.1.2.1 Regional Temperatures

Monthly and annual values of the regional daily mean temperature and the average and extreme daily maximum and minimum temperatures are shown in Tables 2.3-22 and 2.3-23, respectively. Values in these tables are based on data records from Columbia Municipal Airport and Fulton Airport and are considered to be representative of the Callaway Plant site area. The annual mean temperature at Columbia, Missouri is 12.4°C (54.4°F). The highest average daily maximum temperature, 30.8°C (87.4°F), occurs during the month of July, while the lowest average daily minimum temperature, -6.3°C (20.6°F), occurs during the month of January.

Temperatures over 37.8°C (100°F) are rare but have occurred in every section of the state. In the summer, temperatures rise to 32.2°C (90°F) or higher on the average of 35 days per year, while in the winter temperatures below -17.7°C (0°F) are observed on the average of 7 days per year. There are an average of 28 days per year when the daily maximum temperature is less than 0°C (32°F) and 103 days when the daily minimum temperature is less than 0°C (32°F).

2.3.2.1.2.2 On-Site Temperatures

The monthly and annual diurnal variation of temperature (measured at the 10-meter level) for the 3 years of on-site data combined is presented in Table 2.3-17. The mean maximum and minimum temperatures of the coldest month, February, were 3.4°C (38.1°F) and -5.6°C (22.1°F), respectively. The mean maximum and minimum temperatures of the warmest month, July, were 30.3°C (86.5°F) and 20.4°C (68.7°F), respectively. The average annual temperature was 13.1°C (55.6°F). The extremes for the 3 years of data were 35.9°C (96.6°F) and -24.0°C (-11.2°F).

2.3.2.1.3 Water Vapor

2.3.2.1.3.1 Regional Water Vapor

Monthly and annual average relative humidity for midnight, 6 a.m., noon, and 6 p.m. for Columbia from 1941 through 1970 are presented in Table 2.3-24. The lowest relative humidity values are found during the afternoon hours, while the highest occur in the early morning just before sunrise. The annual average relative humidity is 70 percent.

Monthly and annual average dew-point temperatures for Columbia (Environmental Data Service, 1968b) from 1946 through 1965 are shown in Table 2.3-25. Monthly and annual average wet-bulb temperatures for four different times per day for Columbia for the period 1951 through 1970 are shown in Table 2.3-26. For cooling tower design and efficiency criteria, the wet-bulb temperatures that were exceeded 5, 2.5, and 1 percent of the time are 25.0°C (77°F), 25.9°C (78°F), and 26.8°C (79°F), respectively (American Society of Heating, Refrigeration, and Air-Conditioning Engineers, 1965).

2.3.2.1.3.2 On-Site Water Vapor

Table 2.3-17 presents monthly and annual diurnal variability of dew-point and relative humidity for the 3 combined years of on-site data. The mean dew point was 6.1°C (43.0°F) at the 10-meter level and 3.5°C (38.3°F) at the 90-meter level. The highest dew point, which was recorded at the 10-meter level, was 27.5°C (81.5°F). The lowest dew point, also recorded at the 10-meter level, was -27.8°C (-18.0°F). Mean relative humidity for the period was 66.2 percent and varied from a minimum of 6.5 percent to a maximum of 100 percent.

2.3.2.1.4 Precipitation

Seasonal precipitation varies with the position of the polar front. The primary precipitation maximum occurs in May and June, when the mean position of the polar front is retreating northward from the region and water vapor content of the air is relatively high. As the polar front retreats north of the region, a secondary precipitation minimum occurs despite the high moisture content of the air. During September and October, a secondary maximum occurs as the mean position of the polar front passes southward through the region. The primary precipitation minimum occurs from December through February, when dry polar air frequently covers the region. Precipitation means and extremes for Columbia and Fulton, Missouri, are presented in Table 2.3-27.

Annual precipitation wind roses based on 1978 through 1979 data at 10, 60, and 90 meters are presented in tabular form in Table 2.3-39. Table 2.3-40 provides annual precipitation wind roses based on 1973 through 1974, 1974 through 1975, and all 3 years of data combined at 10 and 60 meters. Monthly precipitation wind roses based on the 3 years of data combined are provided in Table 2.3-41.

Snow may occur in the region from November through April and, rarely, in October and May; however, more than 90 percent of total snowfall occurs, on the average, between late November and the end of March. Although snowfall during most winter months is usually light, averaging 10 to 12 cm (4 to 5 inches) per month, as much as 60 cm (24 inches) has fallen during a single month and 168 cm (66 inches) during a single season. The maximum 24-hour snowfall of 32.9 cm (12.8 inches) fell in March, 1937. Means and extremes for snowfall at Columbia are shown in Table 2.3-27.

Due to instrument malfunctions, no on-site precipitation data are available (refer to Section 2.3.3). Table 2.3-28 presents monthly precipitation totals at Columbia coincident with the periods of on-site data collection. Since the terrain at the plant site and Columbia is only gently rolling and they are within 40 km (25 miles) of each other, Columbia is considered representative of on-site precipitation. Total amounts for each of the 3 years were as follows:

a.	June 1973 through May 1974	110.16 cm (43.37 in.)
b.	June 1974 through May 1975	104.60 cm (41.18 in.)
c.	March 16, 1978 through March 15, 1979	98.37 cm (38.73 in.)
d.	.30-Year Average	94.97 cm (37.39 in.)

The June 1973 through May 1974 period, the wettest of the 3 years, was 16 percent wetter than the long-term average; the remaining 2 years were also wetter than the long-term average, but by a smaller percentage. The wettest month during the 3-year period was May 1974, which had 19.69 cm (7.75 inches) of rainfall. This amount was only 7.8 cm (3.07 inches) above the 30-year average and far below the May record of 33.78 cm (13.30 inches). The greatest 24-hour amount, 7.57 cm (2.98 inches), occurred May 30, 1974. This amount was well below the record 24-hour rainfall of 11.1 cm (4.37 inches). The greatest 1-hour amount, 3.79 cm (1.50 inches), occurred during a thunderstorm on June 14, 1974 (U.S. Dept. of Commerce, 1973 through 1979). Table 2.3-29 presents the number of hours with precipitation and precipitation rate distributions at Columbia by month for all 3 years of data combined. Table 2.3-30 presents the number of hours with precipitation for each of the 36 months of data. The 12-month period, June 1973 through May 1974, had the greatest number of hours with precipitation: 615 hours.

2.3.2.1.5 Fog

The monthly average number of heavy fog days, based on 30 years of data (1931 through 1960) at Columbia, is given in Table 2.3-25. Heavy fog is fog that reduces visibility to 1/4 mile or less. The data indicate that the number of heavy fog days reaches a peak in January and that the annual average frequency of heavy fog days is 16. During the 4-year period ending in 1973, heavy fog days averaged 27 days per year (U.S. Dept. of Commerce, 1973).

2.3.2.1.6 Atmospheric Stability

2.3.2.1.6.1 Regional Atmospheric Stability

Stability Classes A through F used in this section are based on Pasquill's classification (Turner, 1964) defined in Table 2.3-31. The Turner-Pasquill classification is only crudely approximated by the criteria shown in Table 2.3-31. These definitions may be identified at least qualitatively with those given in Table 2 of Regulatory Guide 1.23 (U.S. Atomic Energy Commission, 1972), which is reproduced here as Table 2.3-32. However, in the Regulatory Guide 1.23 criteria, moderately stable and extremely stable categories are divided into Class F and Class G, respectively, rather than identified as one class. The NRC Regulatory Guide 1.23 criteria are used for the on-site data which include measurement of vertical temperature difference.

Based on 3-hourly observations from Columbia Municipal Airport for the period 1959 through 1969 (National Climatic Center, 1970), the monthly and annual percentage frequency distributions of stability classes are presented in Table 2.3-33. The stability was neutral 53.6 percent of the time and stable 29.8 percent of the time on an annual basis. Stable conditions ranged from a minimum of 19.1 percent of the time in April to a maximum of 38.7 percent of the time in October.

The annual joint frequency distribution of wind speed and direction at Columbia (Table 2.3-16) is further stratified with respect to thermal-stability classes and is presented in Table 2.3-34. Results show that the maximum frequency of inversion winds (Pasquill-Turner Stability Classes, E and F) was predominantly from the south-southeast and south sectors. Calm conditions comprised 27.6 percent of the extremely unstable class, and 72.4 percent of the wind speed observations in this class were less than 5 knots. Calm conditions comprised 5.9 percent of the moderately stable to extremely stable class; 56.3 percent of the wind speed observations within this class were less than 5 knots.

Seasonal relative frequency distribution of the persistence of Pasquill-Turner Stability Classes for Columbia for the period 1959 through 1969 have been prepared and are presented in Table 2.3-35. Results of this analysis show the following:

a. Neutral stability conditions persisted the longest, and their 95 percentile accumulations range from a minimum of 45 hours in summer to a maximum of 141 hours in fall;

b. Slightly stable conditions persisted no longer than 15 hours in any season;

c. Moderately stable to extremely stable conditions persisted no longer than 12 hours in spring and summer and no longer than 15 hours in fall and winter; and

d. In fall and winter, extremely unstable conditions persisted no longer than the 3-hour surface observations.

2.3.2.1.6.2 On-Site Atmospheric Stability

Monthly and annual summaries of on-site stability frequency are presented in Section 2.3.3 in the form of joint frequency distributions of wind speed, wind direction, and atmospheric stability. Annual and monthly percentages of stability occurrence by Pasquill stability class, based on each of the 3 years of data and on all 3 years combined, are provided in Table 2.3-36. Stability frequency by Pasquill class is quite consistent over the 3 years of observation. Approximately 2/3 of all hours fall in Pasquill classes D or E. Approximately 20 percent of all hours were classes F or G, and nearly 12 percent were unstable (Classes A, B, or C). F and G stabilities occurred most often during late summer and early autumn. Neutral stability (class D) occurred most frequently during midwinter.

On-site stability persistence, based on vertical temperature difference between 60- and 10-meter levels (backed by 90-meter minus 10-meter vertical temperature differences where necessary) for the period May 4, 1973 to May 4, 1975 is provided in Table 2.3-37, and for the period March 16, 1978 to March 16, 1979 in Table 2.3-38. Persistent stability conditions for greater than 12 hours for Classes F and G is discussed in the following response to NRC Item 451.4C.

Reanalysis of the two FSAR years 1973-1975 occurred after a portion of the 90-10m delta temperature values, which are misaligned and located in a data file used to calculate stability, were corrected. The results are shown in Table 2.3-32a, and the corresponding instances where F and G stability persisted for a period of greater than 12 hours are presented below. These were:

STABILITY	TIME PERIOD	HOURLY PERSISTENCE
F	05/27/73-1400 to 05/28/73-0900	20
F	07/05/73-1900 to 07/06/73-0700	13
G	10/25/73-2100 to 10/26/73-0900	13

STABILITY	TIME PERIOD	HOURLY PERSISTENCE
F	12/21/73-2000 to 12/22/73-1000	14
F	02/12/74-1800 to 02/13/74-0700	14
F	11/01/74-1900 to 11/02/74-0800	14

Stability persistence time periods ending on 12/22/73 at 1000 and on 11/02/74 at 0800 occurred in advance of a low pressure system. Prevalent meteorological conditions were cloudy skies with very little surface heating, all of which increased stability of the surrounding air. There was no evidence of instrument malfunction.

Stability persistence time periods ending on 07/06/73 at 0700, 10/26/73 at 0900, and 02/13/74 at 0700 occurred during strong high pressure system passage. Meteorological conditions were clear skies, which promoted radiational cooling and thereby increased stability. Again, there was no evidence of an instrument malfunction.

Finally, the most persistent stability time period of 20 hours occurred between May 27 and May 28, 1973. Although the stability classes determined by the two delta temperature sensors differ, this could be accounted for by the weather system that passed through Missouri over that 2-day period. During that time period, a slow-moving cold front from a deep low pressure system moved through Missouri. A low-level inversion does occur during these episodes and causes fog. Because this slow-moving low pressure system traveled almost directly over Fulton, Missouri, the large spread in delta temperature values was possible. Fog and light rain showers were reported from this system on May 27, 1973 in Springfield, Missouri and Omaha, Nebraska. Although the weather map data only reproduce conditions at one time period on May 27, it is probably safe to assume that fog did occur before the advancing cold front. If this is the case, then a low-level inversion would have occurred and caused the great difference in delta temperature values. The slow movement of the system would have caused a persistent F stability for the 60-10m delta temperature.

The greatest hourly persistence of a single stability class occurred during Pasquill Class D conditions, because Class D is the dominant class. Class E persisted for more than 24 consecutive hours during both the 1973 to 1975 and 1978 to 1979 data periods. Class F persisted a maximum of 20 consecutive hours during the earlier data period and 13 consecutive hours during the later data period. Class G maximum persistence was 19 and 12 consecutive hours, based on the earlier and later data periods, respectively.

2.3.2.2 Potential Influence of the Plant and Its Facilities on Local Meteorology

The only element of the Callaway Plant which could significantly affect the local meteorology is the operation of the natural draft cooling tower.

The following discussions are based on the operation of two natural drift cooling towers. With the cancellation of Callaway Plant Unit 2, only one natural drift cooling tower will be constructed and operated. Thus, the effects described below will generally be less for one tower operation.

2.3.2.2.1 Regional Topography

The site is located on a slight plateau; there is no significantly higher ground within 5 miles of the site. Figures 2.3-11 and 2.3-12 provide maps of the regional topography within 8 km (5 miles) and 80 km (50 miles) of the site, respectively. To further specify the regional topography, Figure 2.3-13 provides cross sections of elevation in each of eight sectors radiating from the plant out to a distance of 8 km (5 miles). Figure 2.3-14 provides elevation cross sections in 16 sectors to a distance of 80 km (50 miles).

2.3.2.2.2 Cooling Tower Effluents Analysis

A computer model is used to estimate the frequency of occur-rence of the following phenomena as a function of direction and distance from the natural draft cooling towers:

a. The length of visible plumes downwind of the tower(s);

b. Ground-level fogging;

c. Ground-level icing;

d. Increase in ground-level ambient relative humidity; and

e. Increase in ground-level ambient temperature.

The model uses surface meteorological observations from either NWS first-order weather stations or on-site meteorological monitoring installations as input. The meteorological parameters required are wind speed, wind direction, ambient temperature, ambient pressure, dew point, and atmospheric stability class. On-site meteorological data for 3 years combined were used: May 4, 1973 to May 4, 1975; and March 16, 1978 to March 16, 1979.

The design parameters of the system are as follows:

a. Tower height, 555 feet;

b. Diameter of top of tower, 252.7 feet;

c. Heat rejection rate, 8.04×10^9 Btu/hr per tower; and

d. Water flow rate, 568,000 gpm per tower.

2.3.2.2.2.1 Validation of Cooling Tower Effluents Program - Comparison with Full-Scale Field Observations of Natural and Mechanical Draft Cooling Tower Plumes

The cooling tower effluents computer program has been compared with and tuned to a limited number of full-scale field observations of large cooling tower plumes of both the natural and mechanical draft type. These observations were made by ground-based photographic methods that were designed to provide quantitative information on visible plume length and vertical plume trajectory. Observations on natural draft plume behavior were made in the winter of 1973 by the Tennessee Valley Authority (TVA) at the Paradise Steam Plant in Paradise, Kentucky. Mechanical draft plume observations were made in the winter of 1975 by Southern Company Services, Inc., at Alabama Power's Gaston Plant near Childersburg, Alabama. Specifications for each of the observed types are given below.

SPECIFICATION	NATURAL DRAFT	MECHANICAL DRAFT
Tower Height (ft)	435	55.3
Diameter (ft)	203	30 (per cell)
Number of Towers	3	2
Cells per Tower	-	9
Length (ft)	-	324
Width (ft)	-	72.7
Water Flow per Tower (gpm, approx.)	285,000	193,000
Typical Heat Rejection per Tower (Btu/hr)	$1.902x10^9$	$3.004x10^9$

Although the Union Electric towers will have considerably larger water flow rates and heat rejection rates than the Paradise Steam Plant tower, validation of the cooling tower plume model (as described below) indicates that the model is reasonable and that it may be reasonably applied to a cooling tower operating with greater water flow and heat rejection rates, based on the specifications of the Paradise Steam Plant tower. The site will have two 555-foot towers with an exit diameter of 252.7 feet, a water flow rate of 568,000 gpm per tower, and a heat rejection rate of 8.04×10^9 Btu/hr per tower.

The results of the comparisons between the plume lengths predicted by the program and the observed plume lengths are shown on Figure 2.3-15. A total of ten comparisons were made: six for natural draft plumes and four for mechanical draft plumes. The quality of fit is generally good, and most predictions were within 20 percent of the observed lengths.

The error bars denoted in the figure refer to a range of predictions of which the variability is determined by atmospheric stability. If the stability criteria indicated that the atmospheric stability classification was between 4 and 5, then the range of predicted plume lengths will vary accordingly between those obtained with stability class 4 and stability class 5.

Table 2.3-42 summarizes the results of both the observations and the model predictions. Shown in the table are the estimated stability category (based on the NRC criteria and observations of on-site vertical temperature gradient) and the observed visible plume length for each of the ten observational periods. Also shown is the predicted visible plume length based on the estimated stability category. Where a fractional category is shown, such as 4.5, the predicted value is that obtained when the results for categories 4 and 5 are averaged. Also included is the range of predictions (+ or -) that would be obtained if the next higher (or lower) stability category been used (i.e., for the case of 4.5, the "+" will refer to category 5 and the "-" will refer to category 4).

In addition to the comparisons of predicted and observed plume lengths, a comparison was made of the predicted and observed plume rise (above tower top) as a function of downwind distance for the natural draft tower case. All plume rise predictions were made using the theory of Briggs (1969). The results of the comparisons between the predicted and observed plume trajectories were in agreement.

2.3.2.2.2.2 Methods of Calculation

The following parameters are generated by the model for 16 sectors at 20 downwind distances:

a. Plume centerline water vapor concentration - x_i (g/m^3);

b. Ground-level water vapor concentration - x_g (g/m^3); and

c. Ground-level temperature - x_g (g/m^3) (degrees C).

The calculations assume Gaussian diffusion of the moisture plume. In addition to the basic Gaussian point source model, the model computes the following adjustments:

a. Adjustment of wind speed to tower height through a power law equation (the wind direction at the top of the tower was assumed to be the same as at the 60-meter level);

b. Calculation of the buoyant rise of the plume, based on a Briggs equation; and

c. Due to large initial exit diameters often encountered, the initial finite size of the plume is calculated.

The rationale for using measurements from the 60m level is discussed in the following response to NRC for Item 451.6C.

A. <u>Wind Speed and Wind Direction</u>

In the analysis of cooling system impacts, the results of an on-site meteorological monitoring program were utilized. The information available for use in the cooling tower model (TOWER 1 as described in the FSAR) consisted (in part) of the following:

PARAMETER	LEVEL
Wind speed/direction	10 m
Wind speed/direction	60 m
Wind speed/direction	90 m
Temperature	10 m
Dew Point	10 m
ΔT	90/10 m
ΔT	60/10 m

Wind speed and direction measurements were available at three levels, namely, 10, 60, and 90 m AGL. Temperature lapse (ΔT) measurements were available over two intervals, 90-10 and 60-10 m. For the analysis of cooling system impacts, wind speed and direction measurements from the 60 m level were used in conjunction with temperature and dew point measurements at the 10 m level at ΔT measurements over the 90-10 m interval. The rationale for using wind speed and direction measurements from the 60 m level as opposed to the 90 or 10 m levels was based primarily on comptability with ΔT measurements and data recovery. Inasmuch as the 90-10 m ΔT measurements span essentially the entre surface layer (assumed to be the lowest 100 m of the friction layer), they are ideally suited for the determination of stability in the lowest layers of the atmosphere. In addition to a more favorable data recovery for the 60 m wind measurements, it was felt that it would be more appropriate to use wind measurements that were bracketed by the temperature lapse measurements rather than to have wind speed and direction measurements at the upper or lower end of the temperature lapse measurement interval. Presumably, this approach will be more representative of average conditions in the layer over which atmospheric stability was calculated.

2.3.2.2.2.2.1 Wind Speed Power Law

The wind speed used in the Gaussian diffusion equations was computed by:

$$U_h = U_{60}\left(\frac{h}{h_{60}}\right)^s \qquad (2.3\text{-}4)$$

where:

where:	U_h	=	Wind speed at the height of the cooling tower exit (m/sec);
	U_o	=	Wind speed (m/sec) at 60-meter height;
	h	=	Height of cooling tower (meters);
	h_o	=	Height of wind sensor (60 meters); and
	s	=	0.25 for unstable and neutral conditions and
			0.50 for stable conditions (E and F).

The speed at the tower height is assumed to be a good approximation to the mean speed through the vertical extent of the plume. The validity of the wind speed power law is discussed in the following response to NRC for Item 451.6C.

B. Wind Speed Power Law

In order to extrapolate wind speed measurements at the 60 m level to represent conditions at the top of the cooling tower (170 m), a simple power law was used. The power law as used in TOWER 1 was as follows:

$$U_h = U_o\left(\frac{h}{h_o}\right)^s$$

where:	U_h	=	wind speed at cooling tower height (m/s);
	U_o	=	wind speed at 60 m (m/s);
	h	=	height of cooling tower (170 m);
	h_o	=	height of wind sensor (60 m); and
	s	=	power law exponent

= 0.25 for unstable/neutral

= 0.50 for stable conditions.

The use of the power law is consistent with current theories on the vertical structure of wind speed in the surface layer. This formulation has been used by many investigators such as Frost (1948) and Sutton (1953). Frost estimated that the value of the power law exponent should vary between 0.1 for extremely unstable atmospheric conditions and 0.8 for extremely stable conditions. Inasmuch as the atmosphere rarely exhibits extreme behavior, it is more reasonable to assume values for the exponents that are more representative of the typical atmospheric stability conditions. The values used of s=0.25 (unstable/neutral) and s=0.5 (stable) are within the range of values used by these earlier researchers. The results obtained with the predictive model TOWER 1 should be less sensitive to choice of power law exponent in the power law extrapolation than to the choice of criteria used in the determination of atmospheric stability.

2.3.2.2.2.2.2 Plume Rise

The buoyant rise of the plume above the tower height is computed by the following equation (Briggs, 1969):

$$\Delta h = 1.6\, F^{1/3}\, U^{-1}\, X^{2/3} \qquad (2.3\text{-}5)$$

where:

Δh = Plume rise (meters) above stack height;

F = Buoyancy flux parameter (m^4/sec^3);

U = Wind speed at tower height (m/sec); and

X = Downwind distance (meters) (lesser of (X, 10h) in calculation procedure).

The buoyancy flux parameter, F, is given by the following:

$$F = 3.7 \times 10^{-5} \frac{(m^4/sec^3)}{cal/sec} Q_H \qquad (2.3\text{-}6)$$

where:

Q_H = Heat emission rate (cal/sec).

The constant 3.7×10^{-5} is an approximation to $g/(\pi c_p \rho P T)$ for air.

2.3.2.2.2.2.3 Multiple-Source Plume Rise Enhancement

The ratio of the plume rise from N sources to the plume rise from a single source ($E_N = \Delta h/\Delta h_1$) is given in the following equation by Briggs (1975):

$$E_N = \left(\frac{N+S}{1+S}\right)^{1/2} \quad (2.3\text{-}7)$$

where:

N = Number of towers;

and

$$S = 6\left[\frac{(N-1)s}{N^{1/3}\Delta h}\right]^{3/2} \quad (2.3\text{-}8)$$

where:

s = Spacing between adjacent sources; and

Δh_1 = Plume rise for a single source.

The corrected plume rise, Δh_N may then be calculated by $\Delta h_N = E_N\ \Delta h_1$.

2.3.2.2.2.2.4 Topography Correction

The height of the plume is computed by the following:

$$H = h + \Delta h_N - h_T \quad (2.3\text{-}9)$$

where:

h = Height of tower (meters);

Δh_N = Plume rise for N sources; and

h_T = Height of terrain above tower base level.

2.3.2.2.2.2.5 Gaussian Diffusion Equations

The generalized equation for Gaussian dispersion of a plume is as follows:

$$X(x, y, z;H) = \frac{Q}{2\pi\sigma_y\sigma_z u} \exp\left[-1/2\left(\frac{y}{\sigma_y}\right)^2\right]\left(\exp\left[-1/2\left(\frac{z-H}{\sigma_z}\right)^2\right] + \exp\left[-1/2\left(\frac{z+H}{\sigma_z}\right)\right]\right) \tag{2.3-10}$$

where:

X	=	Water vapor concentration at (x,y,z) in g/m^3;
Q	=	Source strength (g/sec) of water;
u	=	Mean wind speed through the vertical extent of the plume (m/sec);
σ_y, σ_z	=	Horizontal and vertical dispersion coefficients at distance X; and
H	=	Effective release height.

To compute water vapor concentration at the plume centerline, y = 0 and z = H, and the equation reduces to:

$$X_c = \frac{Q}{2\pi\sigma_y\sigma_z u}\left(\exp\left[-1/2\left(\frac{Q}{\sigma_z}\right)^2\right] + \exp\left[-1/2\left(\frac{2H}{\sigma_z}\right)^2\right]\right)$$

$$= \frac{Q}{2\pi\sigma_y\sigma_z u}\left(1 + \exp\left[-2\left(\frac{H}{\sigma_z}\right)^2\right]\right) \tag{2.3-11}$$

This centerline water vapor concentration (as a function of distance) is used to compute the length of the visible plume.

The method is based upon the assumption that the plume reaches the specified conditions of ambient temperature and moisture density (T_a, X_a) linearly from the exit conditions (T_e, X_e) as shown on Figure 2.3-16. The visible plume is presumed to terminate when the moisture density in the plume falls below the saturated conditions (T_s, X_s) as shown on Figure 2.3-16.

For the calculation of T_x and X_s, an iterative procedure is employed. The exit moisture density, X_e, corresponding to exit temperature, T_e, is used as a first estimate of the temperature T_s, denoted by T_s, and is obtained from the following:

$$T_s^1 = 0.5(T_e + T_a) \qquad (2.3\text{-}12)$$

This estimate of T_s is then used to calculate the saturation moisture density for the air, $X_{s,a}$, and also the moisture density for the plume, $X_{s,p}$, from linear interpolation between the exit and ambient conditions. If the two values of X_s agree within 0.001, then the procedure is terminated; otherwise, a second iteration is performed, etc.

2.3.2.2.2.2.6 Ground-Level Concentrations

To compute water vapor ground-level concentration, y=z=0. Therefore, Equation 2.3-8 reduces to the following:

$$X_G = \frac{Q}{2\pi\sigma_y\sigma_z u}\exp\left[-1/2\left(\frac{-H}{\sigma_Z}\right)^2\right] + \exp\left[-1/2\left(\frac{H}{\sigma_Z}\right)^2\right]$$

$$= \frac{Q}{\pi\sigma_y\sigma_z u}\exp\left[-1/2\left(\frac{H}{\sigma_Z}\right)^2\right] \qquad (2.3\text{-}13)$$

In order to compute the temperature at ground level downwind of the tower, a linear relationship is assumed between temperature (T) and moisture content of air (X) as shown on Figure 2.3-17.

The predicted ground-level temperature is then compared with the ambient temperature, T_a, to check for an increase in ground-level temperature.

The prediction of ground-level fogging is made by determining if the ground-level moisture content, X_G, is equal to or greater than the end of plume moisture content. If this is the case, ground-level fogging is assumed to occur. Groundlevel icing is assumed to occur if the ambient temperature is 0°C or lower and ground-level fogging is predicted. An increase in ground-level humidity is predicted by comparing X_G (ground-level plume moisture content) to the moisture content corresponding to the ambient humidity.

2.3.2.2.3 Fogging, Icing, and Drift

In the following sections, the effects of the operation of the Callaway Plant site cooling towers on the local environment, surrounding agriculture, housing, highway safety, recreation, air and water traffic, and nearby airports are discussed. Factors discussed

are visible plumes, fogging, icing, precipitation modification, humidity and temperature changes, drift, and noise.

Emissions from cooling towers consist of water vapor formed as a result of the evaporative cooling process and very small water droplets called "drift." The water vapor often recondenses (depending on the prevailing meteorological conditions) to liquid form after leaving the tower, producing visible plumes of various lengths. Drift from the tower normally contains dissolved particles that can contribute to ambient ground-level particulate concentrations and to particle deposition.

2.3.2.2.3.1 Fogging and Icing Effects of Natural Draft Cooling Tower Vapor Plumes

A general discussion of the program used to evaluate the extent of cooling tower plumes, including a mathematical description of the model, its specific input requirements, and the results of a detailed comparison and validation with full-scale field observations of cooling tower plumes, is presented in Section 2.3.2.2.2.

The model (Dames & Moore TOWER 1) estimates the frequency of occurrence of the following phenomena as a function of both direction (16 sectors) and distance (1,000-foot intervals to a distance of 20,000 feet) from natural draft cooling towers:

a. The length of visible plumes downwind of the towers;

b. Ground-level fogging;

c. Ground-level icing;

d. Increases in ground-level ambient relative humidity; and

e. Increases in ground-level ambient temperature.

On-site meteorological instrumentation provided hourly data on wind speed, wind direction, ambient temperature, and ambient dew point at the 10-meter level of the tower, as well as the vertical temperature gradient between 10 and 90 meters. Hourly Pasquill stability class was using the measured vertical temperature gradient in accordance with the NRC stability criteria (Regulatory Guide 1.23, 1972). Data accumulated over a 3-year monitoring period were used as input to the model. The periods of data collection were May 4, 1973 to May 4, 1975 and March 16, 1978 to March 16, 1979.

The physical characteristics of the cooling towers used in the present investigation are as follows:

NATURAL DRAFT TOWER DESIGN CHARACTERISTICS FOR CALLAWAY PLANT

Tower height (ft):	555
Exit diameter (ft):	252.7
Number of towers:	2
Water flow per tower (gpm):	568,000
Design heat rejection rate	
per tower (Btu/hr):	8.04×10^9

The primary assumptions used in the modeling analysis were the following:

a. No plume rise enhancement effects occur due to the multiple-tower configuration. Buoyancy effects of the two towers were not considered to be additive. This is a conservative assumption which results in a slightly lower predicted plume rise (therefore, a greater frequency of fogging and icing) than would be predicted if muiltiple-source plume rise enhancement were accounted for.

b. No significant terrain features exist within 5 miles of the site.

The results of the modeling analysis are presented in Tables 2.3-43 and 2.3-44. These tables illustrate the total number of predicted occurrences as well as the percent frequency distribution of visible plume length and ground-level fogging for the 3-year data period. Ground-level icing, ground-level relative humitidy increases of 1 percent or greater, and ground-level temperature increases of 1 percent or greater were also calculated by the model. Each of the two tables has a similar format; the number and percent frequency of occurrence (of each phenomenon) projected by the model are listed for the affected sector directions at each of 20 distances (1,000 through 20,000 feet at 1,000-foot intervals) and for any predicted occurrences beyond 2,000 feet. The final column of each table lists the total predicted occurrences for each sector. Since a visible plume, for example, may extend over several distance intervals for the same hour, the "total" column is not the sum of the frequencies for the 21 distance columns. One hour is never counted more than once in the total column, although it may be counted in the occurrences for two or more distance intervals.

Table 2.3-43 indicates that the cooling tower plumes are not expected to have a significant effect on the environment. The maximum frequency of occurrence of visible plumes in the tower vicinity (up to 1,000 feet downwind) is 11.4 percent of the time in the north sector. Visible plumes beyond the approximate site boundary distance occur no

greater than 5 percent of the time in any sector. Visible plume frequency beyond 20,000 feet from the tower decreases to less than 0.8 percent frequency in any one sector.

Table 2.3-44 shows that only six ground-fogging conditions are projected. Ground-level icing occurs during below freezing temperatures accompanied by wind speeds high enough to bring the plume to the ground. During the six instances of projected ground fogging, high winds were present, but temperatures were above freezing; therefore, no instances of ground icing were projected.

Minimal increases in ground-level relative humidity were projected (increases were projected less than 1 percent of the time in 3 years) and no ground-level temperature increases were projected. The reason the model predicts a low frequency of occurrence for these phenomena is primarily due to the great tower height (555 feet) and the large heat flux per tower (8.04×10^9 Btu/hr). These conditions result in elevated plumes that rarely reach the ground downwind of the towers. Although the overall rise of the vapor plume will be reduced under conditions of partial load, there will be a corresponding reduction of water vapor content in the plume. At 50 percent load, eight instances of ground fogging were calculated compared to six instances at 100 percent load. Ground fogging instances at 50 percent load are provided in Table 2.3-45. No instances of ground icing were calculated at either 50 percent or 100 percent load.

2.3.2.2.3.2 Drift Effects

A conservative method of estimating the solids fraction of the total drift emissions is to assume that the total dissolved and suspended solid content of drift droplets is equivalent to levels found in cooling tower blowdown discharges. Blowdown from the Callaway cooling towers is expected to contain a maximum of 0.015 lb/gal total dissolved solids. Combined drift emissions from the two natural draft towers are estimated to be 227.2 gpm, based on a circulatory water flow of 568,000 gpm per tower and a drift loss of 0.02 percent. Combining the 0.015 lb/gal solids content with the 227.2 gpm total drift emissions from both towers, it is estimated conservatively that the total maximum solids equivalent emission rate from both cooling towers is 3.408 lb/min (or 25.73 g/sec). The chemical composition of the dissolved solids is as follows:

CATIONS	
Calcium	552 ppm
Magnesium	304 ppm
Sodium	385 ppm
Potassium	29 ppm
ANIONS	
Bicarbonate	80 ppm

Sulfate	1,080 ppm
Chloride	96 ppm
Phosphates	2 ppm
Nitrates	12 ppm

The method used to establish ground-level total dissolved solids concentrations and deposition arising from the natural draft towers at the plant was suggested, in part, by Hanna (1978). This model has been shown by Hanna to give reasonable results when compared to the Chalk Point data given by Meyer and Stanbro (1977a). The model first determines the radius, rise, and trajectory of the vapor plume. Drift droplets are assumed to fall out of the vapor plume at a rate dependent upon the size of the droplets. The horizontal component of the droplets' horizontal motion is assumed equal to the ambient wind speed. Further, the model makes the following assumptions:

a. No aerodynamic downwash. This is a conservative assumption which will effectively allow a greater predicted deposition of droplets beyond the plant boundary. Downwash effects have been shown to cause a larger droplet deposition within 1 km of natural draft towers (Slawson, 1976).

b. No droplet evaporation. This is also a conservative assumption for two reasons. First, when a droplet evaporates, its mass decreases hence, it has a significantly smaller settling velocity, which decreases the chance of ground-level impact. Secondly, this assumption implies a relatively high ambient humidity. As indicated on Figure 2.3-17, a greater percentage of the drift droplets may be expected to fall directly to ground level during high ambient humidity.

c. Ground-level particulate concentrations and deposition due to diffusion effects are negligible when compared to drift droplet trajectory-type fallout. It is assumed that all solids are carried out of the tower within the larger droplets.

The centerline trajectory of a vapor plume as given by Briggs (1975) in the following equation:

$$z = H_T + 1.6 F^{1/3} x^{2/3} U^{-1} \qquad (2.3\text{-}14)$$

where:

z = Vertical plume elevation above ground;

x = Downwind distance;

U = Average wind speed; and

H_T = Tower height.

According to Briggs (1975), the above plume rise equation is applicable for all distances during neutral and stable conditions and at distances within the droplet settling region during stable conditions.

The initial buoyancy flux, F, is given by Briggs (1969) in the following equation:

$$F = 2.59 \times 10^{-5} Q_h \tag{2.3-15}$$

where:

Q_h = Heat rejection rate in Btu/hr.

The assumed radius of the vapor plume is given in the following equation:

$$R = R_o + \alpha_z \tag{2.3-16}$$

where:

R_o = Initial plume radius (i.e., the radius of the tower); and

α_z = An entrainment coefficient, generally estimated to be of order 0.5 (Briggs, 1975).

The upper and lower boundaries of the plume can therefore be written as follows:

$$z_{pu} = Z + R \tag{2.3-17}$$

$$z_{pl} = Z - R \tag{2.3-18}$$

Since the upper and lower boundaries of the vapor plume are known as a function of distance (refer to Equation 2.3-1), it is possible to determine the upper and lower boundaries of the drift droplet plume by considering the settling velocities of the drift droplets.

Settling velocities as a function of drift droplet size used herein are those given by Englemann (1968) and Slawson (1976). Table 2.3-46 provides settling velocities for each of the seven droplet size categories. These data are based on measurements obtained during the Chalk Point dye tracer experiment (Environmental Systems Corporation,

1977). Mass fractions for each of the seven size categories as given by Slawson (1976) and Hanna (1978) are also included in Table 2.3-46.

It has further been demonstrated by Wigley (1975) and Slawson (1976) that drift droplet impaction and evaporation is a function of relative humidity. The results of the Wigley and Slawson studies are shown on Figure 2.3-17 and are valid for a plume or source height of 300 meters at 25°C. (A plume height of 300 meters is realistic for a tower height of 555 feet such as that constructed by Union Electric for the Callaway Plant.) The implication of the results shown on this figure is that only droplets larger than approximately 60 m can reach the ground by direct trajectory-type fallout, except during extremely high ambient relative humidities. The remainder will usually stay airborne for extended periods of time. Although these smaller droplets represent a large fraction of the drift mass, they do not contribute significantly to ground-level particulate concentrations or deposition.

Given the droplet size distribution shown in Table 2.3-46, droplets will reach the ground at different distances from the source (as a function of their initial size). Calculations were performed for all of the droplet size ranges given in Table 2.3-46 to determine the maximum and minimum distances of impact for each range of droplet sizes. These calculations were based on the appropriate settling velocitiy for each droplet size range and the determination of plume radius and plume rise given by equations 2.3-14 through 2.3-18.

Tables 2.3-47 and 2.3-48 provide the maximum and minimum impact distances for each droplet size range and the area of impact for each distance increment based on a sector width of 22.5 degrees. Based on the droplet emission rate from the cooling tower and the information provided in Table 2.3-47 and 2.3-48, the instantaneous volumetric ground-level concentration of total dissolved solids, C, was calculated for each distance increment as follows:

$$C = \frac{Rm}{Av} \qquad (2.3\text{-}19)$$

where:

R = Droplet emission rate (25.73 grams/sec);

m = Mass fraction;

A = Area of impact bounded by the appropriate distance increments over a 22.5-degree sector radiating from the tower (m^2); and

v = Settling velocity (m/sec).

Separate concentration calculations were made for each distance increment and also for each of two wind speeds. Table 2.3-47 shows concentrations based on the mean wind

speed at the site over the 3-year period of data collection (5.17 m/sec). Table 2.3-48 shows concentrations based on a wind speed of 10 m/sec, which was exceeded on site only 2.7 percent of the time.

The maximum off-site concentration (assuming a site boundary radius of 1,200 meters) is obtained by adding the concentrations occurring in each distance increment shown in Tables 2.3-47 and 2.3-48, where these distance increments overlap. For the case of a wind speed of 5.17 m/sec (Table 2.3-47), the maximum concentration is 0.96 μg/m. This concentration occurs at 2,000 to 3,000 meters from the cooling towers, because of the overlapping of the second, third, fourth and fifth distance increments and also at 3,400 to 4,600 meters where the third, fourth, fifth and sixth distance increments overlap. For the case of a 10 m/sec wind speed (Table 2.3-48), the maximum off-site concentration is 2.93 μg/m at a distance of 1,400 to 1,800 meters from the site where the third, fourth, and fifth distance increments overlap.

Maximum off-site annual total dissolved solids deposition for each of 16 affected sectors is provided inTable 2.3-49. Separate deposition rates were determined for the mean on-site wind speed rate of 5.17 m/sec and the on-site wind speed which is exceeded 2.7 percent of the time (10 m/sec). The deposition, D, was calculated as follows:

$$D = \sum_{i=1}^{i=7} c_i v_i f_s \qquad (2.3\text{-}20)$$

where:

C_i	=	Instantaneous total dissolved solids concentration at ground level for distance increment i (mg/μg/m^3);
v_i	=	Settling velocity for increment i (m/sec);and
f_s	=	Frequency of wind direction for sector s.

Wind direction frequency by sector, f_s was determined from on-site wind direction measurements at the 60-meter level over the periods May 4, 1973 to May 4, 1975, and March 16, 1978 to March 16, 1979.

The maximum off-site deposition rates occur at the same distances from the cooling towers as the maximum off-site concentrations. Table 2.3-49 shows that the maximum off-site deposition rate for the mean site wind speed of 5.17 m/sec is 28.84 grams per year per square meter (g/yr/m^2) and occurs in the north sector due to the prevailing southerly winds. The maximum off-site deposition rate, based on a 10-m/sec wind, is 0.51 g/yr/m^2 and occurs in the east-southeast sector, since the greatest frequency of

high wind speeds is from the west-northwest. The 10-m/sec rate is much smaller because winds equal or exceed 10 m/sec only 2.7 percent of the time.

2.3.2.2.3.3 Other Effects

In this section, plume shadowing effects, noise, possible synergistic effects as a result of the mixing of fog and drift with other effluents, and the modification of local precipitation patterns are discussed.

The area surrounding the site is used primarily for agricultural purposes. The results of the previous analyses indicate that the only significant effect from operation of the towers will be the aesthetic effect of visible vapor plumes at high altitude. The only possible adverse effect of these visible plumes would then be a shadowing of direct sunlight by the plume itself. Bogh (1975); Junod, et al. (1975); and Bantels and Casper (1975) investigated the problem of plume shadowing using analytical and numerical modeling techniques; and predicted reductions of up to 20 minutes per day of sunshine in the immediate vicinity of cooling tower installations similar to the type described herein. At distances of 5 to 6 miles from the towers, sunlight reductions of approximately 1 min/day were predicted. These reductions of direct sunlight by plume shadowing are similar to those expected from natural cloud formations; therefore, plume shadowing effects on local agriculture are not expected to be a significant factor.

The noise characteristics of the proposed towers are not expected to have any noticeable impact on the area near the plant. Noise levels of 65 to 75 dB have been measured at a distance of 100 meters from a group of eight natural draft towers in England. Even though these towers are in the vicinity of dwellings, this noise level has been accepted by the public (Leason, 1974). At Callaway, the nearest residence is approximately 1,770 meters away from the towers.

There are no proposed or existing continuous combustion sources of significant size in the area immediately surrounding the site that could contribute to any synergistic effects, such as acid mist. The only sources of combustion at the plant will be the auxiliary boiler and diesel generators used periodically for start-up/shut-down operations, tests, and emergency purposes.

The effect of the proposed towers upon local cloud and precipitation patterns is expected to be negligible. Plumes have been observed to evaporate and then reappear as cumulus clouds downwind from cooling towers; however, such effects are localized. Cases of minor initiation or augmentation of precipitation have been documented, for example, Agee, 1971; however, these effects occur only under exceptional meteorological conditions. Hanna and Gifford (1975) conclude that the atmospheric effects of cooling tower heat and moisture dissipation rates, including precipitation effects, are not serious problems.

2.3.2.2.3.4 Local Meteorological Conditions for Design and Operating Bases

The design parameters and sections of the plant site where they are used, which were developed in Sections 2.3.1 and 2.3.2, are listed below.

Wind Loadings (Refer to Section 3.3.1)

Callaway Design Parameters:

100-Year Return Period Fastest Mile of Wind: 85 mph

Variation of 100-Year Return Period Fastest Mile of Wind Speed and Total Structural Response Gust Factor with Height:

HEIGHT (ft)	WIND SPEED (mph)	GUST FACTOR
30	85.0	1.30
100	100.6	1.20
200	110.9	1.15
300	117.3	1.12
400	122.2	1.11
500	126.0	1.10
600	129.3	1.09

Tornado Loadings (Refer to Section 3.3.2)

Callaway FSAR Design Parameters:

Annual Probability of Occurrence: 1.21×10^{-3}

Design Basis Tornado:

Maximum Wind Speed:	360 mph
Maximum Rotational Speed:	290 mph
Maximum Translational Speed:	70 mph
Radius of Maximum Rotational Speed:	150 ft
Maximum Pressure Drop Rate:	3 lb/in^2

Minimum Pressure Drop Rate:	2 lb/in^2
Minimum Translational Speed:	5 mph

Equipment Identification and Environmental Conditions (Refer to Section 3.11.1)

Floods (Refer to Section 2.4.2)

Probable Maximum Flood (PMF), Potential Dam Failures Seismically Induced (Refer to Section 2.4.3)

Probable Maximum Surge and Seiche Flooding (Refer to Section 2.4.5)

Callaway Design Parameters:

Weight of 100-Year Return Period Snowload and 48-Hour PMP:		119.2 lb/ft^2
100-Year Return Period Fastest Mile of Wind:		85 mph
Regional Recorded Temperature Extremes:		
Hottest:		116°F
Coldest:		-26°F
Maximum Recorded 1-Hour Precipitation:		2.73 in.
Maximum Recorded 24-Hour Precipitation:		6.61 in.
Maximum Radial Icing:	25-Year Return Period	2.5 cm
	50-Year Return Period:	3.5 cm
	100-Year Return Period:	5.6 cm

Ultimate Heat Sink (Refer to Section 9.2.5)

Callaway Design Parameters:

Period of Meteorological Conditions Resulting in Minimum Heat Transfer from

Retention Pond:	Single Day:	July 12, 1969
	30 Days:	July 7 through August 5, 1955

Period of Meteorological Conditions Resulting in Maximum 30-Day Evaporation from Retention Pond:

July 2 through

July 31, 1954

Refer to Tables 2.3-13 through 2.3-15 for design values.

2.3.3 ON-SITE METEOROLOGICAL MEASUREMENT PROGRAMS

2.3.3.1 Preoperational and Operational Monitoring Programs

On-site meteorological measurement programs began with the installation of a temporary mechanical weather station on site on March 27, 1972, as part of a multisite data acquisition system. At that time, this particular temporary station was located on the Callaway site, the designated Site C-5 (refer to Figure 2.3-18) in the northeast quarter of Section 14, approximately 3,000 feet southwest of Reform, Missouri. The mechanical weather station was operated continuously until its dismantling on September 24, 1973. The data from this station were valuable in determining the layout and orientation of the permanent meteorological tower. No further use was made of these data.

The preoperational program was initiated when the permanent meteorological monitoring system was started on May 4, 1973. The monitoring continued until May 4, 1975, when the construction permit requirements for on-site meteorological data were satisfied. However, the on-site monitoring was reinstituted on March 16, 1978. Three years of data have been analyzed for the following meteorological record periods: May 4, 1973 to May 4, 1975 and March 16, 1978 to March 16, 1979.

In July of 1981, two instruments were installed at the permanent tower. A tipping bucket rain gauge replaced the previously used weighing rain gauge. In addition, a battery operated event recorder was added to record precipitation.

A secondary meteorological tower was constructed in October of 1982 for the purpose of obtaining back-up data. It became operational in July of 1983 when sensors were installed on the tower and translating and recording equipment was set up in the Emergency Operations Facility (EOF) to monitor the secondary tower. Additionally, equipment at the permanent tower was replaced at that time. New sensors, translators, and analog recorders were installed, tested, and put into operation. In October 2007, the permanent 90 meter tower was destacked to become a 60 meter meteorological tower. Also, the secondary meteorological tower and meteorological equipment located at the EOF was removed.

2.3.3.1.1 Description of Meteorological Instruments

Meteorological measurements at the plant site include redundant A and B channels of wind speed, wind direction, wind direction variability, temperature, temperature difference between 10 meter and 60 meter elevations, relative humidity (only one at 60 meter and one at 10 meter), and precipitation (one at 1 meter). The types of measurements made, the elevations of the sensors, and the types of instrumentation used are described in Sections 2.3.3.1.2 and 2.3.3.1.3.

2.3.3.1.2 Locations and Elevations of Instruments

The 60 meter permanent meteorological tower is located in an open field approximately 1.4 miles east-northeast of the site at latitude, 38°45'54.3"N; longitude, 91°45'27.4"W. The tower is on a plateau that has flat to undulating terrain (Figure 2.3-18). The meteorlogical tower was sited according to the guidance provided in Safety Guide 23.

The meteorological tower is located on level, open terrain at a distance equal to at least 10 times the height of any nearby obstruction that exceeds one-half the height of the wind measurement. The tower is located far enough away from Callaway Unit 1 structures and topographical features to avoid airflow modifications. The terrain height difference between the meteorological tower and the Callaway Unit 1 reactor area is approximately 16 ft (5 m). The terrain profile has a very fentle slope and therefore, has an insignificant impact on site dispersion conditions.

There are two instrument elevators located on two faces of the meteorological tower. Each face has a 10 meter and 60 meter instrument carriage boom which comprises the A and B channels. Each carriage boom has a wind speed, wind direction, and temperature sensor. One relative humidity sensor is located on the 10 meter A channel and the 60 meter B channel boom each. The instrument carriage booms are at least two tower widths (6’10” or 2.1 meters) from the tower’s nearest side rail.

The permanent tower, a Rohn Series 80, is 197 feet (60 meters) high and has a base grade at an elevation of 824 feet. It is constructed of well-grounded OSHA-approved galvanized steel pipe. The shed, 15 feet long by 12 feet wide by 8 feet high, is located 92 feet from the tower base; it is constructed of steel with fiberglass insulation. A plot plan of the permanent (primary) tower facility is shown on Figure 2.3-19. The wiring that leads from the tower to the instrument shed is housed in an overhead conduit anchored by special waveguide supports.

The entire area is surrounded by a 6-foot high, chain-link fence. Tower yard facilities and shed gates are locked at all times.

The precipitation sensor is located in a small, locked, fenced enclosure just east of the shed.

All the sensors feed a main data logger located in a panel inside the instrument shed. The main data logger computes the standard deviation (sigma theta) of the wind direction, temperature difference between the 60-meter and 10-meter levels, and dewpoints from the relative humidity and temperature. The main data logger meteorological data is sent to the plant process computer via a communication system and to a secondary logger.

2.3.3.1.3 Description of Instruments

The manufacturer, model number, accuracy, threshold, and range of operation of the instrumentation installed on the tower for the first two data acquisition periods appear in Tables 2.3-50 and 2.3-51. Information on the instruments installed in July of 1983 can be found in Table 2.3-51A. Information on the instruments installed in October 2007 can be found in Table 2.3-51A. Accuracy of the instrument systems measuring wind direction, wind speed and temperature conform with NRC Regulatory Guide 1.23. The MetOne wind speed transmitter has a threshold of 0.6 mph and has a calibrated range of up to 100 mph. Temperature measurements are made with an accuracy for time averaged values of ±0.1°C. All temperature difference measurements are made with an accuracy of ±0.05°C, since each RTD is matched to its RTD curve in the data logger.

In case of a power failure at the tower, there is an emergency electric generator that starts automatically and provides power to the meteorological instruments within 40 seconds.

2.3.3.1.4 Calibration and Maintenance of Instruments

2.3.3.1.4.1 Calibration

Each instrument is calibrated in the laboratory and checked to verify that it performs according to the manufacturer specifications prior to installation. A second calibration is made at the site after system installation to correct any problems that may arise due to installation and initial operation. The precipitation gauge is calibrated on an annual basis. Calibrations are performed on all other sensors at 6-month intervals. During calibration, the instruments are checked and cleaned. Parts are replaced as necessary. The instruments are then recalibrated using NBS-traceable standards and using procedures based on vendor recommendations.

Calibrations are always conducted in three phases. The performance of each system is checked first against standards before any adjustments are made. Then adjustments and/or repairs are made as needed. Finally, the system performance is checked again, as in the first step. Records of repairs and calibrations are carefully maintained.

2.3.3.1.4.2 Maintenance

The meteorlogical tower is inspected daily. Additional trips are made to the site whenever repairs are required. On each visit, all instruments are inspected to ensure that sensors

are functioning correctly. Spares are kept for immediate replacement in the event of complete failure of a part of the system.

2.3.3.1.5 Data Recording Systems

To ensure the desired 90 percent data recovery, redundant digital data recording systems were installed at the meteorological tower and on the Plant Process Computer. A systems diagram of the dual recording system is shown on Figure 2.3-20.

2.3.3.1.6 Data Processing

Hourly averages with the exception of precipitation and wind direction of the digital minute-by-minute observations were calculated using the following scalar equation:

$$\bar{B} = \frac{r_j}{n} \sum_{i=1}^{n} B_{ji} \qquad (2.3\text{-}21)$$

where:

$\bar{B}$ = Average hourly value for the "j"th variable (in engineering units);

n = Total number of minute observations during the hour (normally 60), but if n is less than 20, data for that hour are considered to be missing;

Bji = "i"th minute observation on the "j"th variable (millivolts); and

rj = Conversion factor to change the "j"th variable into engineering units.

Whereas most of the averages are scalar in form, the average wind direction is determined by the following averaging techniques:

a. Each minute observation of wind vector (speed and direction) is broken into its components, U and V, according to the following:

$$U_i = S_i \sin(\theta_1 - \pi) \qquad (2.3\text{-}22)$$

$$V_i = S_i \cos(\theta_1 - \pi) \qquad (2.3\text{-}23)$$

where:

U_i = East-west component of wind speed for the minute (m/sec);

V_i = North-south component of wind for the minute (m/sec);

S_i = Scalar wind speed for the minute (m/sec); and

θ_1 = Wind direction for the minute (degrees from true north).

b. The U and V components are added separately, and the sums are divided by the total number of minute observations for the hour to establish the average components U and V, as follows:

$$\bar{U} = \frac{1}{n} \sum_{i=1}^{''} U_1 \tag{2.3-24}$$

$$\bar{V} = \frac{1}{n} \sum_{i=1}^{''} V_1 \tag{2.3-25}$$

where:

$\bar{U}$ = Average east-west component of wind for the hour (m/sec);

$\bar{V}$ = Average north-south component of wind for the hour (m/sec); and

n = Number of valid minute observations for the hour.

c. The average wind direction is found by converting the average components into a vector direction as in the following equation:

$$\bar{\Theta} = \tan^{-1}(\bar{U} / \bar{V} + \pi) \tag{2.3-26}$$

where:

$\bar{\Theta}$ = Average vector wind direction during the hour.

The precipitation accumulated during the hour is established by subtracting the amount of precipitation measured by the rain gauge at the beginning of the hour from the amount at the end of the hour.

Data analysis for wind distribution and diffusion characteristics at the Callaway Plant site requires three basic atmospheric variables. These three variables, together with the primary and secondary (back-up) measurements for each, are as follows:

	MEASUREMENT	
PARAMETER	PRIMARY DATA	SECONDARY DATA
Horizontal	10 meters-’A’ Channel	10 meters-’B’ Channel
Wind Speed	60 meters-’A’ Channel	60 meters-’B’ Channel
Horizontal	10 meters-’A’ Channel	10 meters-’B’Channel
Wind Direction	60 meters-’A’ Channel	60 meters-’B’Channel
Vertical	10 meters and 60 meters	10 meters and 60 meters
Temperature Difference	’A’Channel	’B’Channel

The secondary measurement is necessary only during periods of outage of the primary system.

The final step in the data reduction program is the listing in sequential order of the concurrent, hourly averaged values of the weather elements observed at the site. A sequential listing of the hourly data for a full year constitutes an annual meteorological record of the site, which provides input data for all types of meteorological analyses necessary for establishing the site's atmospheric qualities. The sequential listing is used as input in computer programs to calculate doses for both routine and accidental releases of gaseous radionuclides to the atmosphere.

2.3.3.1.7 Operational Monitoring Program

During operation of Callaway Plant Unit 1, the meteorological monitoring program will be continued for the following purposes:

a. To provide real-time meteorological information in the plant control room to be used for decisions concerning routine plant operations;

b. To provide real-time meteorological information in the plant control room from which initial estimates of the radiological consequences of an

accidental release of radioactive material into the atmosphere can be made; and

c. To provide the meteorological summaries from which the concentrations of radionuclides due to atmospheric releases during normal plant operations can be established.

To accomplish these goals, the following meteorological parameters will be monitored in the control room during the operational phase of the plant:

a. Wind speed at two levels (10 and 60 meters ‘A’ and ‘B’ Channels);

b. Wind direction at two levels (10 and 60 meters ‘A’ and ‘B’ Channels);

c. Ambient reference temperature (10 meters);

d. Ambient dew-point temperature (10 meters, 60 meters);

e. Vertical temperature difference,T, for two height intervals (between 10 and 60 meters ‘A’ and ‘B’ Channels)

f. Precipitation at 1 meter level.

Meteorological measurements are transmitted to the plant computer and averaged over 15 minute intervals. These 15 minute averages are displayed in the control room and stored in the computer.

A long-term file of on-site meteorological data is maintained on the plant computer. Quality Assurance records are periodically prepared from this data.

2.3.3.1.8 System Performance

2.3.3.1.8.1 Data Recovery

Data recovery rates for concurrent meteorolgical data used for dispersion estimates (wind speed, wind direction, and vertical temperature difference) were greater than 90 percent, as required by Regulatory Guide 1.23. Concurrent data recovery rates were enhanced by (1) use of the wind power law described in Section 2.3.3.1.6 to estimate missing wind speed data at one level from existing data at another level; and (2) use of existing vertical temperature difference data at one level to estimate missing vertical temperature difference data at another level. Use of existing vertical temperature difference data assumes a constant lapse rate over both vertical temperature difference increments.

Table 2.3-52 provides data recovery rates for all parameters measured over the combined periods May 4, 1973 to May 4, 1975 and March 16, 1978 to March 16, 1979.

The data recovery rates provided in Table 2.3-52 are those which actually occurred before enhancement methods were applied. Table 2.3-53 provides concurrent data recovery rates based on the enhancement methods described above. All data recovery rates provided in Table 2.3-53 exceed 90 percent.

Due to occasional malfunctions of the precipitation sensing and recording system, overall (3 years combined) precipitation data recovery was below 90 percent. Since (1) precipitation totals are meaningless when even a small portion of the data are missing and (2) the site is separated by only 25 miles of nearly flat terrain from the NWS station at Columbia, Missouri, and (3) precipitation measurement techniques and instrumentation are nearly identical on site with techniques and instrumentation at Columbia. NWS precipitation data rather than on-site data were used for generation of climatological precipitation statistics and the precipitation wind roses.

Problems encountered with the data collection program are discussed in the following response to NRC Item 451.7C. The Union Electric Company's meteorological monitoring system consists of Climet wind systems located at the 10-, 60-, and 90-meter (m) levels; Climet delta temperature systems that measure temperature differences between the 10- and 60-m levels and also the 10- and 90-m levels; an EG&G cooled mirror dew point system at 10 m; a back-up Climet lithium chloride (LiCl) dew point system at 10 m; a Climet temperature sensor at 10 m; and a Climet weighing bucket rain gauge at 2 m.

All data as of March 1978 are recorded on Esterline Angus (EA) analog recorders. The sequential multipoint recorder, EA Model E1124E, records the reference temperature, LiCl dew point, and both delta temperatures. (In Phase I of this study, the multipoint also recorded the 90-m dew point.) Three EA E1102S side-by-side dual-pen analog recorders record the wind speed and wind direction at all three tower levels. The EG&G cooled mirror dew point is also recorded on a separate EA L1101S analog recorder. The weighing bucket rain gauge records precipitation on an EA 6016 analog recorder. Before March 1978, digital data were available to augment the analog data, but with the beginning of the last FSAR data collection year, this digital data system was jud unsuitable as a back-up system and, therefore, was not used in the final FSAR year.

The Union Electric 3-year data collection effort has been noteworthy because of the problems that the instruments and recorders have had. The dual-pen recorders that record wind speed and wind direction have capillary inking pens. The pens have had a tendency to accumulate ink at the tip; the ink dries, blocking ink flow and preventing data from being recorded on the analog charts. This occurrence does not take place at all recorders concurrently, and if it does happen at the 10-m primary data level, data from either the 60- or 90-m wind sensors are substituted after the data are adjusted to height.

The multipoint recorder has had numerous breakdowns over the 3-year period. Another multipoint recorder is used if the original recorder is not repairable at the site. The original recorder is placed on line after being repaired by the manufacturer.

The EG&G cooled mirror dew point, like the multipoint recorder, has been sent back to the manufacturer a number of times for repairs because of failures within the dew point system. In the event of the EG&G dew point failure, the LiCl dew point data are substituted until the EG&G dew point is back on line.

The 60-10m delta temperature displayed intermittent problems in the first 2 years of data collection. This problem appeared during periods of high humidity. Numerous tests were performed on the 60-10m delta temperature system to no avail. Finally, the problem was traced to a small crack in the tower cabling from the 60-m level. All tower cabling was replaced and the problem ceased. When the 60-10m data did appear suspect, it was invalidated and 90-10m delta temperature data substituted.

In addition to instrument and recorder problems, the Union Electric meteorological tower has been hit by lightning, ice storms, and freezing drizzle. Lightning has struck the tower at least three times, knocking out all instrumentation. Freezing drizzle and ice storms have frozen the wind sensors and stopped the sensors from functioning normally. In March 1981, heaters were installed on all three levels of wind sensors to prevent this icing problem.

The combination of recorder malfunctions, sensor malfunctions, and acts of God have worked together, yielding reduced data recovery rates at the 10-m primary level. Procedures have been implemented to increase the data recovery for all parameters. These procedures consist mainly of intensified inspection of the monitoring system operating parameters by Union Electric personnel performing site checks in order to more quickly identify potential problems and respond with remedial measures. It is expected that this increased attention to system operation, along with the new tower cabling and sensor heaters (where appropriate), will increase the valid data recovery of the meteorological monitoring system. As can be seen in the response to Item 451.8C, data recovery of meteorological parameters has been generally above the 90 percent rate of recovery specified for most such parameters.

Instrument operating difficulties were experienced with the precipitation gauge at the Callaway site. Since precipitation events can produce significant quantities of precipitation during short periods of time, even short periods of instrument outage can result in serious distortion of the data base. The Columbia National Weather Service is within 40 km (25 miles) of the Callaway site, and there are no intervening topographic features to suggest the two locations would have different precipitation climatologies. Therefore, it was decided that the Columbia precipitation data were probably more representative of the Callaway site than the short-term data available from the on-site sensor. Considering the seasonal and annual anomalies that can occur in precipitation data, the Columbia period of record is almost certainly more representative of the Callaway site than any 2- or 3-year period measured on site.

More emphasis has been placed on the careful operation of the on-site precipitation sensor since March 1979. Except for a 3-month period in 1980, it has been operating at better than 90 percent data recovery. During that 3-month period, an evaporation study

was conducted at the UHS retention pond that included the measurement of precipitation that can be substituted for missing data during that period. Also, the primary precipitation sensor at the on-site tower is being replaced to provide a more accurate, reliable data base. The replacement sensor will use the tipping bucket method of measurement. This method is considered superior, with respect to accuracy, reliability, and resolution, to the presently used method of determining precipitation, which is a weighing bucket.

Although it is recognized that in real time, precipitation data from Columbia may be skewed or may differ from that of the Callaway site, such as if a rainstorm should arrive at the two locations at different times or if it should arrive at one and not the other, it is expected that the Columbia data will be comparable to conditions at the Callaway site. Although the data since March 1979 have not been recovered from the strip chart recordings, they are available for making a real-time comparison between Columbia and Callaway or a longer-term comparison when a sufficiently large data base is available to average out seasonal and annual anomalies.

The status of the program since March, 1979 is discussed in the following response to NRC Item 451.8C. Since March 1979, the on-site meteorological monitoring program has continued to operate. The instruments are checked three times per week by Union Electric-Nuclear Operations and calibrated quarterly by Dames & Moore. The data are recorded on analog recorders. The strip charts records are reviewed to verify that the data are acceptable and then archived at the Dames & Moore office in the Chicago area. Estimated percentage data recovery rates for each parameter are as follows:

PARAMETER	04/79 to 12/79	01/80 to 12/80	01/81 to 02/81
Wind Speed, 10m	90	92	94
Wind Speed, 60m	91	94	98
Wind Speed, 90m	90	92	98
Wind Direction, 10m	89	93	85
Wind Direction, 60m	88	96	98
Wind Direction, 90m	83	91	97
Temperature, 10m	93	94	100
Delta Temperature, 60-10m	93	94	100
Delta Temperature, 90-10m	93	90	100
LiCl Dew Point, 10m	91	94	100
Cooled Mirror Dew Point, 10m	32	58	98
Precipitation, 1m	94	74	92

2.3.3.1.8.2 Dew-Point Correlation

During the second period of data collection (March 16, 1978 to March 16, 1979), dew-point accuracy of ±0.5°C was required. This accuracy is met at present only by the cooled-mirror dew-point sensor. A Climet CI-65 cooled-mirror dew-point system was installed at the beginning of the final year of data collection. However, repeated efforts to make the instrument function properly failed and an EG&G 220 cooled-mirror dew-point system was installed on December 22, 1978 and operated until the end of the data collection period on March 16, 1979. During the entire year of data collection, a lithium chloride (LiCl) dew-point system was operational, rated at an accuracy of ±1.1°C.

Over the period, December 22, 1978 through April 23, 1979, the difference in measured dew points between the two systems was plotted against temperature, as shown on Figure 2.3-21. At temperatures warmer than 0°C, the difference between the dew-point systems averaged 0.63°C with the cooled-mirror instrument measuring the higher dew point. This difference may be explained by the evaporation of lithium chloride from the LiCl sensor between applications of LiCl to the bobbin. Applications were made at 3-month intervals. From 0°C through approximately -10°C, a systematic increase in the difference between the two dew points is evident. This difference can be explained by:

a. The manufacturer's assumption that the relationship between the cavity temperature in the LiCl sensor and the dew-point temperature is linear, when it is not; and

b. The formation of two waters of hydration in the LiCl sensor at temperatures lower than approximately -10°C, which causes the instrument to sense lower dew-point temperatures than actually exist below -10°C.

Based on the above discussion, the LiCl dew point was corrected (increased) as shown by the curve on Figure 2.3-21 for the hours that the cooled-mirror sensor was inoperative over the period, March 16, 1978 to March 16, 1979.

Dew-point is presently measured using a Climatronics lithium chloride sensor. The accuracy of measurement with this equipment is ±1.8°C. It is on this point that the Callaway Meteorological Monitoring Program takes exception to Regulatory Guide 1.23; Regulatory Position 4d states that the accuracy for dew-point is to be ±0.5°C.

2.3.3.2 <u>Representativeness of the Data Base</u>

In order to determine the representativeness of the 3 years of on-site data of long-term climatological conditions at the site, means of meteorological parameters measured on site were compared with 30-year means of the same parameters based on data at Columbia, Missouri (Table 2.3-54). Monthly means of temperature and dew point vary little between the two data sets, particularly the dew-point means. The difference between annual means for temperature is 4.8 percent. Remarkably, the 30-year

Columbia annual mean and the 3-year annual mean site dew-point measurements are identical.

Monthly variation in wind direction amounted to no more than three 22.5-degree sectors, and the annual means of the two data sources (Columbia and on site) were within one 22.5degree sector. Mean monthly wind speed was as much as 1.7 m/sec lower on site than at Columbia (during the month of February) and was an average of 1.2 m/sec lower on site on an annual basis. Since the tendency toward significantly lower wind speed measurements on meteorological towers using stateof-the-art instrumentation compared with airport measurements has been noted in several cases, the disparity between the measurements may be attributed to difference in instrument accuracy rather than actual wind speed differences. On-site data were measured at 10 meters, while the anemometer height at Columbia was 6 meters. Whatever reason for the disparity, the lower speeds measured on site are conservative with respect to dispersion calculations.

The parameter of paramount importance other than wind speed and direction to dispersion calculations, atmospheric stability, is not routinely measured by the NWS. The NWS STAR computer program approximates stability measurements by computing Pasquill stability classes on the basis of cloudiness, sun angle, and time of day. This approximation of long-term regional stability, based on Columbia, Missouri, data, 1960 through 1969, is compared with stability measured on site in Table 2.3-55. It is apparent that the on-site data provide a somewhat greater frequency of stable conditions than does the STAR approximation. The difference is probably due to the crudeness of the STAR method of calculation. Again, the on-site data are conservative compared to the Columbia data with respect to dispersion calculation.

Annual joint frequency distributions (JFDs) of wind direction, wind speed, and atmospheric stability for the 10- and 60-meter wind levels and 60-10 meter ΔT (or 90-10 meter ΔT when 60-10 meter are missing) for the data periods, May 4, 1973 to May 4, 1974 and May 4, 1974 to May 4, 1975 are provided in Tables 2.3-56 and 2.3-57, respectively. Annual JFDs at 10, 60, and 90 meters for the period March 16, 1978 to March 16, 1979 are provided in Table 2.3-58. Table 2.3-59 provides annual JFDs at 10 and 60 meters for the three data periods combined. Monthly JFDs, at 10 and 60 meters, for the three data periods combined are provided in Table 2.3-60.

2.3.4 SHORT-TERM DIFFUSION ESTIMATES

2.3.4.1 Objective

Conservative and realistic estimates of atmospheric diffusion χ/Q at the site boundary (exclusion area) and the outer boundary of the LPZ were performed for time periods up to 30 days after an accident. Diffusion evaluations for short-term accidents are based on the assumption of release points or areas which are effectively lower than 2-1/2 times the height of adjacent solid structures. Description of models used and assumptions made are discussed in section 2.3.4.2.2.

2.3.4.2 Calculations

2.3.4.2.1 Diffusion Model

The analytical procedure for short-term diffusion estimates for the 0- to 2-hour accident period is based on atmospheric diffusion models described in NRC Regulatory Guide 1.4 (1974). Changes reflect variations in relative concentrations (χ/Q) which occur as a function of wind direction and site boundary distance. Allowances are made for meandering plumes during light winds and stable atmospheric conditions. This approach is described in U.S. NRC Draft Regulatory Guide 1.XXX (1978).

The model is distance and direction dependent. Variability of wind direction frequency was considered in calculating the (χ/Q) values. During neutral and stable conditions, when the wind speed at the lower (10-meter) level is less than 6 m/sec, relative concentrations are computed from the following equations:

$$\chi/Q = \frac{1}{\pi \bar{u} \Sigma_y \sigma_z} \qquad (2.3\text{-}28)$$

provided it is less than the greater value calculated from:

$$\chi/Q = \frac{1}{\bar{u}(\pi \sigma_y \sigma_z + cA)} \qquad (2.3\text{-}29)$$

or

$$\chi/Q = \frac{1}{\bar{u}(3\pi \sigma_y \sigma_z)} \qquad (2.3\text{-}30)$$

where:

χ/Q	=	concentration at ground level (sec/m^3);
π	=	3.14159;
$\bar{u}$	=	Hourly average wind speed at the 10-meter level above plant grade (m/sec);

Σy	=	Lateral plume spread (meters) with meander and building wake effects (meters) (a function of atmospheric stability; wind speed, $\bar{u}$; and downwind distance from the release). For distances up to 800 meters, $\Sigma y = M\sigma_y$, where M is a function of atmospheric stability and wind speed. For distances greater than 800 meters, $\Sigma y = (M-1)\ \sigma_{y\ (800m)} + \sigma_y$;
A	=	Smallest vertical-plane, cross-sectional area of the building from which the effluent is released (2,650 m^2);
c	=	Building shape factor (0.5);
σ_y	=	Lateral plume spread (meters) at a given distance and stability; and
σ_z	=	Vertical plume spread (meters) at a given distance and stability.

The values calculated from equations 2.3-29 and 2.3-30 are compared and the higher value is selected. This value is compared with Equation 2.3-28, and the lower of these two values is selected.

During all other atmospheric stability and/or wind speed conditions, χ/Q is the greater value calculated from Equations 2.3-29 and 2.3-30.

Plume meander was accounted for by modifying the lateral diffusion coefficient, χ/Q. The meander function (M) is evaluated as follows:

For Pasquill stability classes A, B, or C at all wind speeds or for all stability classes when the wind speed exceeds 6 m/sec, M = 1. When the wind speed is less than 2 m/sec, M varies with stability in the following manner:

STABILITY CLASS	M
D	2
E	3
F	4
G	6

For wind speeds between 2 and 6 m/sec, M is evaluated by a curve-fitting technique (Figure 3 of Draft Regulatory Guide 1.XXX).

An hourly observation is considered to be calm if the wind speed is less than the threshold of the wind instruments. For calm conditions a wind speed is assigned equal to the vane or anemometer starting speed, whichever is higher. Wind directions during calm conditions are assigned in proportion to the directional distributions of noncalm winds with speeds less than 1.5 m/sec.

2.3.4.2.1.1 Two-Hour Accident Calculations

χ/Q values at the EAB averaged over a 2-hour period are determined for each sector. These are defined as the χ/Q values exceeded 0.5 percent of the total time. To extract these value, the hourly χ/Q values are sorted according to sector and magnitude. A cumulative probability distribution of χ/Q values can easily be constructed as follows:

$$P(\chi/Q) = \frac{\text{rank of}\chi/Q}{\chi/Q\text{ population size}} \qquad (2.3\text{-}31)$$

where:

P(χ/Q) = Probability of being exceeded.

For example, the tenth largest value of a 100-value population has a probability of being exceeded of 10/100 or 10 percent. The highest of the ten sector χ/Q values is defined as the maximum sector χ/Q value.

2.3.4.2.1.2 Eight- through 624-Hour Calculations

Sector-averaged χ/Q values are determined for the LPZ for 8 and 16 hours and 3 and 26 days. The average χ/Q values for these time periods are approximated for each sector by a logarithmic interpolation between the two hourly sector χ/Q values (same general methods as in Section 2.3.4.2.1.1) and the annual average χ/Q (see Section 2.3.5) at the same point. The highest of the 16-sector χ/Q values is identified for each time period.

2.3.4.2.1.3 Five- and 50-Percent Overall Site χ/Q Value

χ/Q values exceeded no more than 5 and 50 percent of the total time around the EAB and the LPZ boundary are determined in a manner similar to the 0.5 percent sector χ/Q values. All hourly χ/Q values are sorted according to magnitude (independent of direction), and the 5- and 50-percent values are chosen from the list. For the time periods described in Section 2.3.4.2.1.2, the 5 percent χ/Q values are determined by logarithmic interpolation between (1) the maximum annual average χ/Q value at the LPZ distance and (2) the 5-percent χ/Q value averaged at the LPZ over a 2-hour period. The 50-percent χ/Q values are determined in an analagous manner.

2.3.4.2.2 Results

Accident χ/Q values (sec/m^3) are determined at the EAB (1,200-meter radius) over a 2-hour averaging period and at the LPZ (4,023-meter radius) over 2-, 8-, 16-, 72-, and 624-hour averaging periods. Separate calculations were made for the following data periods: May 4, 1973 to May 4, 1974; May 4, 1974 to May 4, 1975; March 16, 1978 to March 16, 1979; and the three periods combined. Sector-independent 5-percent χ/Q values over a 2-hour averaging period at the EAB were calculated at 1.5 x 10^{-4} sec/ m^3 for all data periods, except the first period (May 4, 1973 to May 4, 1974) when the value was 1.4 x 10^{-4} sec/ $m^{3.}$ Section-independent 5-percent χ/Q values over a 2-hour averaging period at the LPZ boundary were 4.5 x 10^{-5} sec/ m^3 for all data periods, except the second period (May 4, 1974 to May 4, 1975) when the value was 4.4 x 10^{-5} sec/ m^3.

Table 2.3-61 provides 2-hour sector χ/Q values at the EAB for each of 16 sectors of the four data periods. Over the four data periods, the greatest sector χ/Q value of 1.7 x 10^{-4} sec/ m^3 occurred in the southwest sector for the data period March 16, 1978 to March 16, 1979.

Table 2.3-62 provides χ/Q values for each of the averaging periods and each data period at the LPZ boundary. The absolute maximum χ/Q values at both the EAB and LPZ boundary for the 2-hour averaging period are also shown by sector in Table 2.6-63. Fifty-percent χ/Q values for the 2-hour averaging period at the EAB and LPZ boundary are shown, by sector, in Table 2.3-64. The same table also provides all sector 50-percent χ/Q values for each of the four data periods and at each distance.

The accident χ/Q values used in the Chapter 15 analyses were based on the first two years of on-site meteorological data and the NRC default recirculation factors given in Regulatory Guide 1.111, Revision 0.

Analyses made in this chapter are based on all three years of on-site meteorological data including site-specific recirculation factors generated using the "MESODIF-II" model.

2.3.4.3 Data Representativeness

Section 2.3.3.2 discusses the representativeness of the 3 years of on-site meteorological data, which form the basis for the diffusion estimates. In Section 2.3.3.2, the 3 years of on-site temperature, dew point, wind direction, wind speed, and atmospheric stability data are compared with similar long-term data collected by the National Weather Service at Columbia, Missouri over the period 1941 to 1970. It is concluded that temperature, dew point, and wind direction are very similar at Columbia and the site. Wind speed is slightly lower on site. This condition is conservative for diffusion estimates based on on-site data. Atmospheric stability measured on site is also conservative for diffusion estimates when compared to long-term data; however, the stability measurements on site cannot be directly compared with stability measurements at Columbia. Regional and

on-site wind direction persistence were discussed in Sections 2.3.2.2.2.4 and 2.3.2.2.2.5, respectively. It is concluded that on-site and regional persistence are similar.

The topography in the vicinity of the site is similar to that in the vicinity of Columbia. Low rolling hills without significant relief occur in both ares, as shown in Figure 2.3-12.

A direct comparison of diffusion estimates based on the on-site data and the long-term (Columbia, Missouri) data would be quite meaningless, because the long-term data do not contain measurements of vertical temperature difference or wind direction variability. In addition, long-term wind speed data are based on anemometer starting thresholds of approximately 2 to 2.5 mph versus starting thresholds of 0.75 mph for the on-site anemometers. The Pasquill-Turner approximation, used to obtain stability classification for long-term meteorology data based on sun angle, cloudiness, and time of day (described in Section 2.3.2 and in Table 2.3-31), is too crude to yield stability values comparable to those based on vertical temperature difference and low-threshold wind speed measurements for determination of stability classification for on-site meteorology data.

2.3.5 LONG-TERM DIFFUSION ESTIMATES

2.3.5.1 Objective

The objective of Section 2.3.5 is to provide realistic long-term diffusion estimates at distances up to 80 km (50 miles) from the plant for annual average release limit calculations and man-rem estimates. The terrain within 80 km (50 miles) of the site is gently rolling; no important ranges of hills or mountains are within the region. There are several small lakes and reservoirs in the region; however, no substantial water bodies are present, which are large enough to affect ambient dispersion parameters.

The analyses were based on on-site meteorological data over the periods, May 4, 1973 to May 4, 1975 and March 16, 1978 to March 16, 1979.

2.3.5.2 Calculations

Both the variable trajectory plume segment atmospheric transport model, MESODIF-II (NUREG/CR-0523), and the straight-line Gaussian dispersion model, XOQDOQ (NUREG/CR-2919), were used to determine for the long-term (annual average) diffusion estimates.

2.3.5.2.1 Plume Segment Atmospheric Transport Model

(MESODIF-II)

MESODIF-II is a variable trajectory plume segment atmospheric transport model. It is designed to predict relative atmospheric dispersion factors, χ/Q and deposition factors, D/Q, of radioactive, but otherwise non-reactive material. In such a model, calculated

particle trajectories vary as the synoptic scale wind varies. At all sampling times the particles are connected to form a segmented plume centerline. The lateral and vertical dimensions of the plume are determined by a parameterization of turbulence scale diffusion. The plume mass associated with each segment is assumed to be distributed in a Gaussian manner about the plume axis - subject to reflection by the surface and by a mixed layer lid above.

The Gaussian equation used in MESODIF-II for a plume with vertical distribution limited by reflections is written as

$$X(x, y, O) = \frac{Q^1}{\sqrt{2\pi}\ \sigma_y \overline{U}\ Z}\ e^{-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2} \qquad (2.3\text{-}31)$$

where z^{-1} takes on one of the following four forms:

$$Z^{-1} = \begin{cases} \frac{1}{\sqrt{\pi/2}\sigma_z}\left[e^{-\frac{1}{2}\left(\frac{H}{\sigma_z}\right)^2} + e^{-\frac{1}{2}\left(\frac{2L-H}{\sigma_z}\right)^2} + e^{-\frac{1}{2}\left(\frac{2L+H}{\sigma_z}\right)^2}\right] \\ \frac{1}{\sqrt{\pi/2}\sigma_z} e^{-\frac{1}{2}\left(\frac{H}{\sigma_z}\right)^2} \\ L^{-1} \\ O \end{cases}$$

and where:

- X = Atmospheric concentration of effluent at ground level;
- Q = Effluent emission over the time interval;
- H = Effective release height, (for ground level releases, H=0);
- L = Mixing height;
- $\overline{U}$ = Mean windspeed at the height of the effective release point;
- Y = Distance from plume centerline in the crossflow direction;
- σ_y = Lateral plume spread; and

σ_z = vertical plume spread

The enhancement of dispersion of a plume transported at ground level is modeled in the vertical dimension in MESODIF-II using an equation found in Slade (1969). Accordingly the vertical distribution factor z in Equation 2.3-32 with H = 0 is modified to equal the smallest of the following three forms::

$$z = \begin{cases} \sqrt{\pi 2}\left(\sigma_z^2 + \dfrac{A}{2\pi}\right)^{1/2} \\ 3\sqrt{\pi/2} \quad \sigma_z \\ L \end{cases}$$

where A is a measure of building cross-sectional area.

Concentration averages for long time intervals are calculated by summing the concentrations of individual elements for the grid of points over which they pass.

The data base used for the plume segment calculations consisted of one year of data: May 4, 1974 to May 4, 1975. This data period was selected because it provided excellent data recovery (96.9 percent). In the plume segment calculations, 10-meter level wind data were used. Analysis of climatological statistics has shown that the 1-year period selected is representative of the entire 3-year data base. This conclusion is based upon consideration of the following factors:

a. The percentage of occurence of each stability and mean wind speed for each class, and

b. The frequency distribution of wind speed and wind direction characteristics (i.e., the distribution of wind in each compass sector and associated mean wind speed).

The plume segment calculations require that the data base not contain any invalid or missing data. Futhermore, the data base must be sequential and not have time gaps (i.e., the data base should not be collapsed to eliminate missing data). To meet these requirements, all missing or invalid data were approximated by the following:

a. Estimation of missing parameters from data taken at another tower level (direct substitution for wind direction, proportional estimation for vertical temperature difference and use of the power law for wind speeds),

b. Linear temporal interpolation (missing data period generally short and/or limited variation of parameters) between interfacing valid data points,

c. Substitution of similar data periods as indicated by time of day, variation in and magnitude of valid parameters, and by continuity with interfacing valid data points.

A total of 3.9 percent of the data in the selected period was replaced by these means.

The generation of terrain/recirculation correction factors (TCF) required that the data base used in the plume segment calculation be identical to that used for the calculation of relative concentration values (χ/Q), using the straight-line Gaussian model. Calm wind directions in the selected data period were replaced using the distribution of the lowest wind speed class.

2.3.5.2.1.1 Model Input

The calculations using the plume segment model were performed at the following set of downwind distances: 0.75, 1.50, 2.5, 3.5, 4.5, 7.5, 15.0, 25.0, 35.0 and 45.0 miles.

For economic reasons, the terrain/recirculation correction factors for special points and standard distances not represented by the above distances were determined by a log-log interpolation of approximate concentrations. These approximations were validated by selectively comparing them to actual calculations.

Mixing heights for Columbia, Missouri, were used for the ground-level calculations. In these calculations, the mixing height was interpolated between the morning (7 a.m.) and afternoon (4 p.m.) mixing heights. The morning and afternoon mixing heights on a monthly basis were interpolated between seasonal values. The seasonal mixing heights used in these calculations are presented in Table 2.3-12 (see Section 2.3.1).

2.3.5.2.1.2 Terrain/Recirculation Correction Factors

The terrain/recirculation correction factors (TCF) for the ground-level releases were determined as the ratio between the plume segment χ/Q estimates and the straight-line χ/Q estimates in the following form:

$$TCF(r, e) = \frac{\left[\frac{X}{Q}(r, e)\right]_P}{\left[\frac{X}{Q}(r, e)\right]_S} \qquad (2.3\text{-}33)$$

where:

TCF (r,e) = Terrain/recirculation correction factor at distance, r, in sector, q;

$\frac{X}{Q}(r,e)_P$	=	Annual average relative concentration at a point (r,e) using the plume segment modeling scheme (sec/m^3); and
$\frac{X}{Q}(r,e)_S$	=	Annual average relative concentration at a point (r,e) using a straight-line modeling scheme (sec/m^3).

Terrain/recirculation correction factors at the 22 standard distances, based on the data period May 4, 1974 to May 4, 1975, are provided in Table 2.3-66. TCFs for the exclusion zone, the low population zone (LPZ) boundary, restricted area boundary, and the organic receptor (humans, animals, vegetation) distances are presented in Table 2.3-68.

The plume segment calculations were performed at the 22 standard distances (shown in Table 2.3-66) to obtain the required diffusion estimates. Diffusion estimates at the standard distances between the distances listed in Section 2.3.5.2.1.1 were estimated by logarithmic interpolation based on the diffusion estimates at the 10 calculated standard distances. The logarithmic interpolation procedure is defined by the following equation:

$$X = x_1\left(\frac{d}{d_1}\right)^B \qquad (2.3\text{-}34)$$

where:

B	=	$\ell n\,(X_2/X_1)\,/\,\ell n\,(d_2/d_1)$;
X	=	Concentration (sec/m^3) at a special point located a distance, d, away from the source; and
X_1,X_2	=	Concentrations (sec/m^3) at standard distances d_1 and d_2, respectively.

The distances d_1 and d_2 are selected such that they agree with the following relationship:

$$d_1 < d < d_2 \qquad (2.3\text{-}35)$$

The diffusion estimates based on the above interpolation procedure were compared with estimates obtained by direct calculation using the actual distances. The two sets of calculations were in agreement.

As shown in Table 2.3-66 the gradual overall decrease in TCF values at large downwind distances may be attributed to plume meander, accounted for in plume segment analysis

but not in the straight-line model. With wind directions varying hourly, plume elements actually cover a greater distance before arriving at a given receptor than is assumed in the straight-line model. They are, therefore, somewhat more attenuated on arrival at the receptor than the straight-line model algorithm would indicate.

Use of a single meteorological station as the data source for the plume segment analysis is justified by the absence of severe terrain within the region of interest and by the fact that only long-term average relative concentrations are evaluated. Absence of severe terrain implies that the deviations from straight-line flow that do occur are not strongly systematic. Effects of random plume meander and mesoscale recirculation on annual average χ/Q values are adequately represented via plume segment simulations with single-station on-site meteorological input.

2.3.5.2.2 Straight-Line Gaussian Dispersion Model

The U.S. Nuclear Regulatory Commission computer program XOQDOQ (NUREG/CR-2919) was used to determine the ground-level relative atmospheric dispersion factors, χ/Q, and deposition factors, D/Q, from the unit vent and from the radwaste building vent release points. The program is based on a straight-line trajectory Gaussian plume model in which diffusion of material released to the atmosphere is described by a Gaussian distribution within the plume and plume transport is described by a straight-line trajectory. The plume concentration was also depleted by dry deposition and radioactive decay. A brief description of the model, the portion of the XOQDOQ program used and the required input data is provided below.

2.3.5.2.2.1 Elevated Release Model

The unit vent and radwaste building vent releases are at elevations 66.5m and 20m above grade, respectively. The unit vent is equipped with a rain cap at the top. Both of the release points are within the building wake of the structures on which they are located, and are therefore considered ground-level releases. No diffusion estimates for elevated releases have been calculated.

2.3.5.2.2.2 Ground Level Release Model

In the calculation, releases both from the unit vent and the radwaste building vent were treated as ground-level releases.

Ground-level release concentrations are calculated using the following two equations modified from Slade (1968):

$$\frac{\bar{X}}{Q}(x, K) = \frac{2.032RF}{x}(x, K)\sum_{ij}^{N7} DEPL_{ij}(x, K)DEC_i(x)f_{ij}(K)$$

$$\left[\bar{U}_i \cdot \sigma_{zj}{}^2 x + CD_z 2/\pi^{1/2}\right]^{-1} \qquad (2.3\text{-}36)$$

and

$$\frac{\bar{X}}{Q}(x, K) = \frac{2.032RF}{X}(x, K)\sum_{ij}^{N7} DEPL_{ij}(x, K)DEC_i(x)f_{ij}(K)$$

$$\left[\sqrt{3\bar{U}_i}\sigma_{zj} \quad (x)\right]^{-1} \qquad (2.3\text{-}37)$$

where:

$\frac{\bar{X}}{Q}(x, K)$	=	average effluent concentration normalized by source strength at distance x in directional sector K (seconds/ cubic meter)
x	=	the downwind distance (meters)
i	=	the ith wind-speed class
j	=	the jth atmospheric stability class, grouped into seven classes according to Regulatory Guide 1.23
K	=	kth wind-direction class
$\bar{U}_i$	=	mid-point value of the ith wind-speed class
σz_j (x)	=	the vertical plume spread for stability class j at distance x (meters)
f_{ij}(k)	=	joint probability of occurrence of the ith wind speed class, jth stability class, and kth wind-direction class
DEC_i (x)	=	reduction factor due to radioactive decay at distance x for the ith wind-speed class
$DEPL_{ij}$(x,K)	=	reduction factor due to plume depletion at distance x for the ith wind-speed class, jth stability class, and Kth wind-direction class

RF(x,K)	=	terrain correction factor for recirculation and stagnation at downwind distance x and Kth wind-direction class. Site specific terrain/recirculation factors used are given in Tables 2.3-66 and 2.3-68.
D_z	=	building height used to compute additional atmospheric dispersion due to the building wake, based on Yanskey et al. (1966).

Equation 2.3-37 represents the maximum additional dispersion due to the building wake. The program compares the results from Equation 2.3-36 and 2.3-37 and retains the higher (most conservative) χ/Q value.

The required joint frequency distribution of meteorological data is based on the three years (5/4/73 - 5/4/75, 3/16/78 -3/16/79) of data collected onsite as reported in Table 2.3-59.

2.3.5.2.3 Method of Decay, Depletion and Deposition Calculations

Equations 2.3-36 and 2.3-37 require information on a reduction factor due to radioactive decay. That term, DEC (x), was calculated by the following relationship as given by Slade (1968):

$$DEC\ (x)_i = EXP\ (-0.693\ t_i/T) \quad (2.3\text{-}38)$$

where:

t_i	=	$x/(86400.\ U_i)$
T	=	half-life, in days, of the radioactive material
t_i	=	travel time, in days
x	=	downwind or travel distance, in meters
U_i	=	Midpoint of the ith wind-speed class in meters/ second.

Calculated concentrations also included the effect of plume depletion due to dry deposition, using data given in Figure 3 through 6 of Regulatory Guide 1.111 (USNRC, 1977).

For each directional sector, relative deposition was computed by the following relationship for a specific downwind distance:

$$\frac{\bar{D}}{Q}(x, K) = \frac{RF(x, K)\sum_{ij}^{N7} D_{ij} f_{ij}(K)}{(2\pi/16)x} \qquad (2.3\text{-}39)$$

where:

$\frac{\bar{D}}{Q}(x, K)$	=	average relative deposition per unit area distance x and direction K, in meters
D_{ij}	=	the relative deposition rate from Figures 7 through 10 of Regulatory Guide 1.111 (USNRC, 1977) for the ith wind-speed class (since plume height is dependent on wind speed) and the jth stability class, in meters.
$f_{ij}(K)$	=	joint probability of the ith wind-speed class, jth stability class, and kth wind-direction sector
x	=	downwind distance, in meters
π	=	3.1416
RF(x,K)	=	terrain correction factor for air recirculation and stagnation at distance x and Kth wind direction.

The resultant deposition amounts were modified according to site specific terrain/ recirculation factors as given in Tables 2.3-66 and 2.3-68.

2.3.5.2.4 Data Representativeness

In Section 2.3.3.3, the representativeness of the 3 years of on-site data, which form the basis for the dispersion analyses, is discussed. The conclusion reached is that the on-site data are reasonably representative of the long-term regional climatological data.

A direct comparison of dispersion parameters based on the on-site data and the long-term data would be quite meaningless, because the long-term data do not contain measurements of vertical temperature difference or wind direction variability. In addition, long-term wind speed data are based on anemometers with starting thresholds of approximately 2 to 2.5 mph versus starting thresholds of 0.75 mph for the on-site anemometer. The Pasquill-Turner approximation to stability classification, based on sun angle, cloudiness, and time of day (as described in Table 2.3-24), is too crude to yield

stability values comparable to stability values based on vertical temperature difference and low-threshold wind speed measurements.

2.3.5.2.5 Results

Annual average concentrations at the standard distances for the radwaste building vent and unit vent releases for the period May 4, 1973 to May 4, 1975 and March 16, 1978 to March 16, 1979 are provided in Tables 2.3-81 and 2.3-83, respectively. Annual average concentrations from the unit vent and radwaste building vent releases for the same data period at the exclusion area zone (1,200 meters); the LPZ (4,023 meters); the restricted area boundaries; and the historical nearest organic receptor distances are provided in Tables 2.3-82 and 2.3-84, respectively. For each sector and distance, seven concentrations are provided:

a. Relative concentration (χ/Q) (sec/m^3);

b. Depleted relative concentration (χ/Q) (sec/m^3);

c. Relative deposition (D/Q) (1/m^2);

d. Decayed relative concentration, half life 2.26 days (χ/Q) (sec/m^3);

e. Decayed relative concentration, half life 8 days (χ/Q) (sec/m^3);

f. Decayed and depleted relative concentration, half life 2.26 days (χ/Q) (sec/m^3); and

g. Decayed and depleted relative concentration, half life 8 days (χ/Q) (sec/m^3).

For each of the data periods, grazing season (April 15 through December 15) diffusion estimates, in the sectors containing the nearest grazing animals, are provided in Tables 2.3-85 and 2.3-86 for a unit vent release and a radwaste building vent release, respectively.

REFERENCES - SECTION 2.3

Agee, E.M., 1971, An artificially induced local snowfall. Bulletin of the American Meteorological Society (July).

American Meteorological Society, 1970, Extremes of snowfall in the United States. American Meteorological Society, Weatherwise, vol. 15, no. 6, p. 246-262 (December).

American National Standards Institute (ANSI), 1972, Building code requirements for minimum design loads in buildings and other structures. ANSI, New York.

American Society of Heating, Refrigeration, and Air-Conditioning Engineers, 1965, Air-conditioning cooling load, in ASHRAE guide and data book. ASHRAE, p. 490.

Bartels, H., and Caspar, J.W., 1975, Cooling tower experience and the meteorological consequences of thermal discharges from nuclear power plants in the Federal Republic of Germany, in Environmental effects of cooling systems at nuclear power plants. Oslo, Norway, August 26-30, 1974.

Bechtel Power Corporation, 1973, Tornado and extreme wind design criteria for nuclear power plants. Bechtel Power Corporation, San Francisco, California, BC-TOP-3, rev. 2 (December).

Bennett, I., 1959, Glaze -- its meteorology and climatology, geographical distribution and economic effects. U.S. Army, Headquarters, Quartermaster's Research and Engineering Command, Natick, Massachusetts, Technical Report EP-105.

Bogh, P., 1975, Experience with combined wind tunnel/plume model analysis of cooling tower environmental impact. ERDA Symposium Series, CONF-740302, Cooling Tower Environment (1974).

Briggs, G.A., 1969, Plume rise. U.S. Dept. of Commerce, Springfield, Virginia, TID-25075, NTIS.

_____, 1971, Some recent analyses of plume rise observations. National Oceanographic Atmospheric Administration, Atmospheric Turbulence and Diffusion Laboratory, Contribution No. 38.

_____, 1975, Plume rise predictions, in Lectures on air pollution and environmental impact analysis, D. Haugen, ed. American Meteorological Society, Boston, Massachusetts, p. 59-111.

Burt, E.W., 1977, Valley model user's guide. U.S. EPA, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, EPA-450/3-77-018 (September).

Daily Weather Maps, U.S. Department of Commerce.

REFERENCES - SECTION 2.3 (Continued)

Dames & Moore, 1980, Final safety analysis report, Wolf Creek, for Kansas Gas & Electric Co.

Dunn, W., Boughton, B., and Policastro, A., 1978, Evaluation of droplet evaporation formulations employed in drift deposition models. Proceedings of Symposium on Environmental Effects of Cooling Tower Emissions, University of Maryland (May 2-4).

Egan, B.A., 1975, Turbulent diffusion in complex terrain, in Lectures on air pollution and environmental impact analyses - AMS workshop on meteorology and environmental assessment, Hagen, D., Amer. Meteor. Soc., Boston, Massachusetts, p. 123-124.

Englemann, R.J., 1968, The calculation of precipitation scavenging, in Meteorology and atomic energy. U.S. Dept. of Commerce, Springfield, Virginia, p. 208-220.

Environmental Data Service, 1968a, Climatological data -national summary. U.S. Dept. of Commerce, Asheville, North Carolina, ESSA.

Environmental Systems Corporation, 1977, Cooling tower drift dye tracer experiment. PPSP-CPCTP, Prepared for Maryland Power Plant Siting Program by ESC, Knoxville, Tennessee, 103 p.

Frost, R., 1948, Quart. J. Roy. Met. Soc., vol. 74.

Gifford, F.A., Jr., 1969, Use of routine meteorological observations for estimating atmospheric dispersion: Nuclear Safety, vol. 2, no. 4 (June). Hanna, S.R., 1978, A simple drift deposition model applied to the chalk point dye tracer experiment. Proceedings of Symposium on Environmental Effects of Cooling Tower Emissions, University of Maryland (May 2-4).

Hanna, S.R., and Gifford, F.A., 1975, Meteorological effects of energy dissipation at large power parks, National Oceanographic and Atmospheric Administration, Oak Ri, Tennessee (March).

Hershfield, D.M., 1961, Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years. U.S. Government Printing Office.

Holzworth, 1972, Mixing heights, wind speeds and potential for urban air pollution throughout the contiguous United States. United States EPA, no. AP101.

Hosler, C.R., 1961, Low-level inversion frequency in the contiguous United States. Monthly Weather Review, 89, 379-339.

REFERENCES - SECTION 2.3 (Continued)

Jumod, A., et al., 1975, Meteorological differences on atmospheric cooling systems as projected in Switzerland. ERDA Symposium series, CONF-740302, Cooling Tower Environment (1974).

Leason, D.B., 1974, Planning aspects of cooling towers. Atmospheric Environment, vol. 8, p. 307-312.

Markee and Beckerly, 1974, Technical basis for interim regional tornado criteria. U.S. Atomic Energy Commission, Washington, D.C.

Marshall, J.L., 1973, Lightning protection: John Wiley and Sons.

Meyer, J.H., and Jenkins, W.R., 1977, Cooling tower drift dye tracer experiment, June 16 and 17, surface weather and ambient atmospheric profile data. Prepared for Maryland Power Plant Siting Program by the Johns Hopkins University Applied Physics Laboratory, Laurel, Maryland, PPSP-CPTP-16, vol. 3, 102 p.

Meyer, J.H., and Stanbro, W.D., 1977a, Cooling tower drift dye tracer experiment, June 16 and 17. Prepared for Maryland Power Plant Siting Program by the Johns Hopkins University Applied Physics, Laurel, Maryland, PPSP-CPTP-16, vol. 2, 102 p.

_____, 1977b, Fluorescent dye, a novel technique to trace cooling tower drift. Presented at 4th Joint Conference on Sensing Environmental Pollutants, November 6-11, 1977, New Orleans, Johns Hopkins University, Applied Physics Laboratory, Laurel, Maryland, 6 p.

National Climatic Center, no date, Summary of hourly observations, Columbia, Missouri, (1960-69).

National Weather Service, 1945-1969, Three hourly data, Columbia, Missouri. National Oceanographic and Atmospheric Administration.

Pautz, M.E., 1969, Severe local storm occurrences 1955-1967. Office of Meteorological Operations, Silver Spring, Maryland, ESSA Technical Memo, WBTM FCST 12.

Poultney, N.E., 1973, The tornado season of 1972. Weatherwise, 26, 22-27.

Ryan, P.J., and Harleman, D.R.F., 1973, An analytical and experimental study of transient cooling pond behavior. Ralph H. Parsons Laboratory, Department of Civil Engineering, MIT, Report no. 161 (January).

Sagendorf, J.F., 1974, A program for evaluating atmospheric dispersion from a nuclear power station. National Oceanic and Atmospheric Administration Technical Memorandum ERL-ARL-42.

Slade, D.H., 1968, Meteorology and atomic energy, National Technical Information Service, U.S. Department of Commerce, Springfield, Virginia.

REFERENCES - SECTION 2.3 (Continued)

Slawson, P.R., 1976, Cooling tower drift deposition - program guide to ENDRIFT II. Envirodyne Ltd. (April).

Start, G.E., and Wendell, L.L., 1974, Regional effluent dispersion calculations considering spatial and temporal meteorological variations. National Oceanic and Atmospheric Administration Technical Memorandum ERL-ARL-44.

Sutton, O.G., 1953, Micrometeorology. McGraw-Hill, New York.

Tattleman and Gringorten, 1973, Estimated glaze ice and wind loads at the earth's surface for the contiguous United States. Air Force, Cambri Research Laboratories, Aeronomy Laboratory Project 8624, Bedford, Massachusetts (October).

Thom, H.C.S., 1963, Tornado probability. Monthly Weather Review, 91, 730-736.

_____, 1968, New distributions of extreme winds in the United States, in Journal of the structural division, Proceedings of the American Society of Civil Engineers. ASCE, vol. 94, no. ST7, p. 1781-1801. U.S. Dept. of Commerce, 1949-1973, Climatological data, Missouri. U.S. Dept. of Commerce, Washington, D.C., vol. 53, no. 1 through vol. 77, no. 12.

_____, 1956, Seasonal variation of the probable maximum precipitation east of the 105th meridian. Hydrometeorological Report No. 33, Washington, DC (April).

_____, 1959-1973, Storm data. National Oceanic and Atmospheric Administration, National Climatic Center, Environmental Data Service, vol. 1, no. 1 through vol. 15, no. 12.

_____, 1968, Climatic atlas of the United States. Environmental Data Service, ESSA (June).

_____, 1969, Climates of the states - Missouri. Environmental Data Service, Washington, D.C.

U.S. Dept. of Commerce, 1972, Storm data. NOAA, Washington, DC, vol. 14, no. 12 (December).

U.S. Department of Commerce, 1972-1980, Storm data. NOAA, Washington, D.C., volumes 14 through 22.

_____, 1973, Local climatological data, Columbia, Missouri, National Oceanographic and Atmospheric Administration, National Climatic Center, Asheville, North Carolina.

_____, 1973-1979, Local climatological data, Columbia, Missouri. National Oceanic and Atmospheric Administration, Asheville, North Carolina.

REFERENCES - SECTION 2.3 (Continued)

_____, 1974-1978, Local climatological data, Columbia, Missouri. National Oceanic and Atmospheric Administration, Asheville, North Carolina.

U.S. Weather Bureau, 1963, Maximum recorded United States point rainfall for 5 minutes to 24 hours for 296 first order stations. U.S. Department of Commerce, Technical Paper No. 2.

Wigley, T.M.L., 1975, Condensation in jets, industrial plumes and cooling tower plumes. Journal of Applied Meteorology, vol. 14, p. 78-86.

Yanskey, G.R., E.H. Markee, Jr. and A.P. Richter, 1966. Climatography of the National Reactor Testing Station. Idaho Operations Office, USAEC, IDO-12048. Idaho Falls, Idaho.

TABLE 2.3-1 AVERAGE THUNDERSTORM DAYS FOR COLUMBIA, MISSOURI (PERIOD OF RECORD: 1941 TO 1970)

MONTH	THUNDERSTORM DAYS
January	*
February	1
March	4
April	7
May	8
June	7
July	9
August	6
September	7
October	3
November	2
December	1
Annual Total	55

* Less than 1/2 day.

Source: U.S. Dept. of Commerce, 1973.

TABLE 2.3-2 MAXIMUM SHORT-PERIOD RAINFALL FOR COLUMBIA, MISSOURI (PERIOD OF RECORD: 1898 TO 1961)

TIME INTERVAL	RAINFALL (inches)	DATE
5 minutes	0.82	05/27/45
10 minutes	1.31	05/27/45
15 minutes	1.63	05/27/45
30 minutes	2.11	07/30/43
60 minutes	2.73	06/29/09
2 hours	3.29	09/02/18
3 hours	4.37	09/02/18
6 hours	5.86	09/02/18
12 hours	6.61	09/02/18
24 hours	6.61	09/02/18

Source: U.S. Weather Bureau, 1963.

TABLE 2.3-3 ESTIMATED MAXIMUM POINT RAINFALL*
EXTRAPOLATED FOR THE CALLAWAY PLANT SITE, UNITS 1 AND 2

	RECURRENCE INTERVAL (YEARS)						
DURATION	1	2	5	10	25	50	100
30 minutes	1.14	1.32	1.63	2.06	2.20	2.41	2.70
1 hour	1.39	1.64	2.07	2.40	2.77	2.86	3.40
2 hours	1.70	2.00	2.50	2.85	3.30	3.75	4.15
3 hours	1.83	2.20	2.80	3.25	3.70	4.10	4.50
6 hours	2.25	2.60	3.30	3.80	4.35	4.80	5.20
12 hours	2.63	3.13	3.80	4.50	5.10	5.80	6.30
24 hours	2.97	3.50	4.50	5.20	5.90	6.75	7.30

* Rainfall in inches.

Source: Hershfield, 1961.

TABLE 2.3-4 EXTREME SNOWFALL* FOR STATIONS IN THE REGION OF THE CALLAWAY PLANT SITE

STATION	PERIOD 24 HOURS	PERIOD CALENDAR MONTH	PERIOD SEASON	MAXIMUM DEPTH (inches)
Columbia	12.8 (March 12-13, 1937)	24.5 (March 1960)	54.9 (1977-1978)	16.0 (March 16, 1960)
St. Louis	20.4 (March 30-31, 1890)	28.8 (March 1912)	67.6 (1911-1912)	20.4 (March 31, 1960)
Kansas City	25.0 (March 23-24, 1912)	40.2 (March 1912)	67.0 (1911-1912)	25.0 (March 24, 1912)

* Snowfall in inches.

Sources: American Meteorological Society, 1970; U.S. Dept. of Commerce, 1974-1978.

TABLE 2.3-5 TOTAL NUMBER OF DAYS WITH FREEZING PRECIPITATION IN COLUMBIA, MISSOURI

(Period of Record: 1939 to 1948)

MONTH	NUMBER OF DAYS
November	3
December	24
January	15
February	17
March	10
Total	69

Source: Bennett, 1959.

TABLE 2.3-6 ANNUAL NUMBER AND PROBABILITY OF TORNADO OCCURRENCES PER ONE-DEGREE, LATITUDE-LONGITUDE SQUARE IN MISSOURI

(Period of Record: 1956 to 1971)

MONTH	NUMBER	PROBABILITY
January	0.045	3.38×10^{-5}
February	0.054	4.06×10^{-5}
March	0.086	6.47×10^{-5}
April	0.286	2.15×10^{-4}
May	0.333	2.50×10^{-4}
June	0.316	2.38×10^{-4}
July	0.127	9.55×10^{-5}
August	0.038	2.85×10^{-5}
September	0.091	6.84×10^{-5}
October	0.079	5.95×10^{-5}
November	0.045	3.38×10^{-5}
December	0.108	8.12×10^{-5}
Annual	1.609	1.21×10^{-3}

Source: Poultney, 1973.

TABLE 2.3-7 EXTREME WIND SPEEDS COLUMBIA, MISSOURI

(Periods of Record: 1931 to 1960 and 1970 to 1973)

MONTH	PREVAILING DIRECTION	FASTEST MILE SPEED (mph)	FASTEST MILE DIRECTION	YEAR
January	S	56	NW	1951
February	NW	45	NW	1952
March	NW	59	NW	1964
April	S	57	NW	1953
May	SSE	58	SW	1950
June	SSE	58	NW	1951
July	SSE	61	NW	1958
August	SSE	56	NW	1954
September	SSE	63	NW	1952
October	SSE	49	NW	1959
November	S	49	NW	1955
December	S	58	SW	1971
Annual	---	63	NW	1952

Sources: U.S. Dept. of Commerce, 1969, 1974.

TABLE 2.3-8 FASTEST MILE QUANTITIES USING FISHER-TIPPET TYPE I (FRECHET) DISTRIBUTION

(Interpolated for Callaway Plant Site)

RECURRENCE INTERVAL (years)	EXTREME FASTEST MILE WIND SPEED (mph)
2	50
10	65
25	71
50	72
100	85
1,000	118

Source: Thom, 1968.

(Sheet 1 of 1)

TABLE 2.3-9 EXTREME FASTEST MILE WIND SPEEDS* FOR SOME METEOROLOGICAL STATIONS WITHIN A RADIUS OF 250 MILES OF THE CALLAWAY PLANT SITE, UNITS 1 AND 2

STATION	YEARS OF RECORD	EXTREME FASTEST MILE WIND SPEED (mph)	DIRECTION	BASED ON THOM'S METHOD
Columbia, MO	50	63	NW	85
Kansas City, MO	71	72	NW	89
St. Joseph, MO	48	64	S	84
St. Louis U., MO	45	82	SW	82
Springfield, MO	16	66	W	80
Topeka, KS	50	81	N	90
Wichita, KS	73	100	N	90
Des Moines, IA	30	76	NW	91
Springfield, IL	83	75	SW	80

* All wind speeds reduced to 30-foot level.

Source: U.S. Dept. of Commerce, 1968.

TABLE 2.3-10 VARIATION OF 100-YEAR RETURN PERIOD WIND SPEED AND ASSOCIATED GUST FACTORS WITH HEIGHT IN VICINITY OF CALLAWAY SITE

HEIGHT		FASTEST MILE WIND SPEED		GUST FACTOR
meters	feet	km/hr	mph	
9.1	30	136.9	85.0	1.30
30.5	100	162.0	100.6	1.20
61.0	200	178.5	110.9	1.15
91.5	300	188.9	117.3	1.12
122.0	400	196.7	122.2	1.11
152.4	500	202.9	126.0	1.10
182.9	600	208.2	129.3	1.09

Source: American National Standards Institute, 1972.

TABLE 2.3-11 PERCENT FREQUENCY OF SURFACE-BASED INVERSIONS BY SEASON AT SELECTED TIME PERIODS AND TOTAL TIME FOR COLUMBIA, MISSOURI

	LOCAL STANDARD TIME				
SEASON	2000[a]	0900[a]	1800[b]	0600[b]	TOTAL TIME
Winter	52	38	27	53	31
Spring	67	4	1	52	31
Summer	78	5	5	84	35
Autumn	66	24	20	80	43

a Observations at 2000 and 0900 Local Standard Time were from June 1955 through May 1957.

b Observations at 1800 and 0600 Local Standard Time were from June 1957 through May 1959.

Source: Hosler, 1961.

TABLE 2.3-12 MEAN SEASONAL AND ANNUAL MORNING AND AFTERNOON MIXING DEPTHS AND WIND SPEEDS FOR COLUMBIA, MISSOURI (1960 TO 1964)

	MORNING		AFTERNOON	
SEASON	MIXING DEPTH (meters)	WIND SPEED (m/sec)	MIXING DEPTH (meters)	WIND SPEED (m/sec)
Winter	448	6.5	872	7.5
Spring	477	7.3	1,599	8.8
Summer	321	5.0	1,723	5.8
Autumn	358	5.9	1,395	6.7
Annual	401	6.2	1,397	7.2

Source: Holzworth, 1972.

(Sheet 1 of 2)

TABLE 2.3-13 WORST CASE METEOROLOGY DATE FOR POND TEMPERATURE PERFORMANCE
(MINIMUM HEAT TRANSFER PERIOD)

DATE (YR-MO-DAY)	HOUR	DRY BULB TEMPERATURE (DEGREES F)	WIND SPEED* (MPH)	RELATIVE HUMIDITY (PERCENT)	NET SOLAR RADIATION (LANGLEYS/DAY)	CLOUD COVER (FRACTION)
69-07-12	0	78	7.3	91	0	0.10
	3	75	5.2	94	0	0
	6	76	4.1	91	306.5	0
	9	85	4.1	72	1450.6	0
	12	91	0	55	1898.1	0.20
	15	93	7.3	50	1450.6	0
	18	93	6.2	50	306.5	0
	21	85	3.1	69	0	0
55-07-08	--	85.1	8.4	65.9	701.1	0.04
09	--	83.6	7.1	69.2	652.9	0.31
10	--	83.5	5.8	73.7	648.9	0.32
11	--	81.4	6.2	68.2	688.0	0.14
12	--	78.5	7.4	61.1	696.3	0.0
13	--	79.1	5.2	61.2	627.4	0.37
14	--	75.7	5.9	85.1	362.5	0.82
15	--	77.7	7.1	66.9	683.1	0.13
16	--	78.0	3.0	65.4	671.7	0.19
17	--	77.4	3.8	74.0	601.8	0.42
18	--	77.6	4.8	75.5	325.8	0.86
19	--	77.1	3.2	82.9	254.4	0.94
20	--	80.9	2.0	75.6	615.6	0.37
21	--	81.2	3.8	75.1	613.7	0.37

TABLE 2.3-13 (Continued) (Sheet 2 of 2)

DATE (YR-MO-DAY)	HOUR	DRY BULB TEMPERATURE (DEGREES F)	WIND SPEED* (MPH)	RELATIVE HUMIDITY (PERCENT)	NET SOLAR RADIATION (LANGLEYS/DAY)	CLOUD COVER (FRACTION)
55-07-22	--	83.0	4.6	72.2	668.0	0.14
23	--	82.9	4.7	72.7	594.8	0.41
24	--	77.5	4.8	82.4	471.0	0.65
25	--	80.6	6.1	78.7	630.2	0.29
26	--	85.6	7.1	64.0	666.6	0.05
27	--	86.9	5.3	64.1	664.7	0.04
28	--	87.0	4.3	63.2	663.0	0.09
29	--	86.9	5.8	64.0	656.2	0.09
30	--	87.2	6.4	62.0	657.3	0.01
31	--	85.1	6.2	68.0	647.9	0.12
55-08-01	--	83.0	5.1	71.0	444.0	0.67
02	--	84.2	6.2	68.1	604.5	0.31
03	--	81.7	8.5	64.5	629.3	0.19
04	--	79.0	7.4	75.2	566.0	0.41
05	--	80.1	6.9	76.2	377.3	0.76

* Adjusted wind speed to 8-meter height.

TABLE 2.3-14 METEOROLOGICAL DATA FOR 30 DAYS ANTECEDENT TO WORST POND TEMPERATURE PERFORMANCE PERIOD

DATE (YR-MO-DAY)	DRY BULB TEMPERATURE (DEGREES F)	WIND SPEED* (MPH)	RELATIVE HUMIDITY (PERCENT)	NET SOLAR RADIATION (LANGLEYS/DAY)	CLOUD COVER (FRACTION)
55-06-07	63.7	12.1	60.9	660.4	0.29
08	66.6	12.3	52.7	681.9	0.21
09	63.2	8.4	52.2	643.4	0.35
10	56.0	7.8	82.6	290.8	0.91
11	57.4	13.2	88.0	300.3	0.90
12	59.1	11.1	77.5	205.2	1.00
13	61.2	7.8	66.9	521.3	0.61
14	63.6	2.7	63.2	702.5	0.11
15	67.6	4.7	64.6	699.6	0.14
16	70.5	6.8	60.9	678.1	0.25
17	71.4	9.0	63.9	497.4	0.65
18	74.5	7.8	62.9	484.1	0.67
19	73.4	5.8	72.4	354.9	0.84
20	74.9	3.7	68.6	708.5	0.07
21	77.4	4.5	64.5	630.4	0.40
22	73.1	6.1	71.9	498.1	0.65
23	73.0	4.3	63.9	579.9	0.51
24	64.7	9.8	84.9	216.3	0.99
25	68.4	9.0	80.2	411.8	0.77
26	71.2	7.9	67.2	590.1	0.49
27	72.0	9.0	61.2	434.2	0.74

TABLE 2.3-14 (Continued) (Sheet 2 of 2)

DATE (YR-MO-DAY)	DRY BULB TEMPERATURE (DEGREES F)	WIND SPEED* (MPH)	RELATIVE HUMIDITY (PERCENT)	NET SOLAR RADIATION (LANGLEYS/DAY)	CLOUD COVER (FRACTION)
28	73.4	9.4	60.7	598.7	0.47
29	78.6	9.3	67.6	545.8	0.57
30	80.9	10.7	69.4	694.3	0.17
55-07-01	81.0	7.9	63.6	695.8	0.16
02	82.0	8.5	69.0	705.0	0.08
03	81.2	6.3	68.6	664.6	0.29
04	79.4	7.1	68.0	525.4	0.60
05	76.2	7.4	79.4	594.4	0.47
06	74.0	5.1	87.1	334.5	0.86

* Adjusted wind speed to 8-meter height.

(Sheet 1 of 2)

TABLE 2.3-15 WORST CASE METEOROLOGY DATA FOR EVAPORATIVE WATER LOSS
(MAXIMUM EVAPORATION PERIOD)

DATE (YR-MO-DAY)	DRY BULB TEMPERATURE (DEGREES F)	WIND SPEED* (MPH)	RELATIVE HUMIDITY (PERCENT)	NET SOLAR RADIATION (LANGLEYS/DAY)	CLOUD COVER (FRACTION)
54-07-02	82.7	12.78	65.7	514.6	0.62
03	86.6	12.78	53.2	706.9	0.01
04	89.2	12.78	47.2	629.8	0.39
05	85.6	12.78	59.7	699.1	0.11
06	86.0	12.78	49.2	701.6	0.07
07	86.5	12.78	49.5	655.1	0.31
08	75.6	12.78	40.2	692.0	0.14
09	77.1	12.78	43.1	698.8	0.06
10	76.4	12.78	52.4	427.4	0.74
11	85.6	12.78	45.0	573.9	0.50
12	93.2	12.78	39.4	685.2	0.15
13	91.5	12.78	43.6	619.8	0.39
14	96.1	12.78	37.1	692.7	0.03
15	83.1	12.78	39.9	604.8	0.42
16	81.5	12.78	36.2	327.5	0.86
17	90.2	12.78	33.2	565.7	0.50
18	95.7	12.78	34.5	611.7	0.39
19	92.2	12.78	37.4	02.2	0.41
20	89.6	12.78	45.0	560.8	0.50
21	83.4	12.78	64.7	363.0	0.81
22	83.2	12.78	68.6	615.1	0.36
23	80.1	12.78	57.2	460.0	0.67
24	75.6	12.78	67.1	506.5	0.59

TABLE 2.3-15 (Continued) (Sheet 2 of 2)

DATE (YR-MO-DAY)	DRY BULB TEMPERATURE (DEGREES F)	WIND SPEED* (MPH)	RELATIVE HUMIDITY (PERCENT)	NET SOLAR RADIATION (LANGLEYS/DAY)	CLOUD COVER (FRACTION)
54-07-25	79.9	12.78	43.9	630.4	0.29
26	79.7	12.78	39.2	633.3	0.27
27	82.2	12.78	36.0	663.7	0.06
28	86.2	12.78	45.4	458.0	0.66
29	87.2	12.78	42.1	652.2	0.13
30	88.5	12.78	43.5	636.8	0.21
31	86.0	12.78	51.1	487.3	0.60

* Maximum one-day wind speed over the period adjusted to 8-meter height.

TABLE 2.3-16 JOINT WIND SPEED, WIND DIRECTION
FREQUENCY DISTRIBUTION (IN PERCENT)

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
UNION ELECTRIC COMPANY
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: JANUARY 1960-1969

SECTOR	UPPER CLASS INTERVALS OF WIND SPEED (KNOTS)									TOTAL	MEAN SPEED
	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	>20.0		
NNE	.0	.4	.6	1.2	.5	.7	.3	.3	.0	4.0	10.8
NE	.0	.5	.4	1.2	.3	.2	.2	.1	.1	3.0	9.7
ENE	.0	.6	1.1	1.7	.4	.2	.1	.1	.0	4.3	8.7
E	.0	.7	1.2	1.7	.2	.2	.0	.0	.0	4.0	7.9
ESE	.0	.4	1.3	1.6	.6	.7	.1	.1	.0	4.8	9.4
SE	.0	.6	.9	2.0	.8	1.2	.4	.1	.0	5.9	10.2
SSE	.0	.4	1.2	2.6	1.0	1.3	.2	.1	.0	6.9	9.9
S	.1	1.1	2.0	4.0	1.4	1.3	.5	.2	.0	10.6	9.5
SSW	.0	.7	1.7	2.1	.7	.7	.1	.0	.0	6.2	8.7
SW	.0	.9	1.5	1.6	.4	.3	.2	.1	.0	5.0	8.2
WSW	.0	.7	1.8	2.4	.8	.9	.4	.4	.0	7.5	9.7
W	.0	1.2	1.7	2.1	.6	.5	.3	.4	.0	6.7	9.0
WNW	.0	.9	1.2	2.3	1.4	1.7	.5	.6	.2	8.7	11.0
NW	.0	.4	.8	2.5	1.4	2.2	1.0	.9	.3	9.5	12.3
NNW	.0	.6	.7	1.2	.8	1.3	.4	.5	.1	5.6	11.3
N	.0	.8	1.0	1.3	.5	1.6	.5	.6	.1	6.3	11.2
CALM										1.0	
TOTAL	.3	11.0	19.0	31.3	11.6	15.1	5.1	4.6	.9	100.0	9.9

NUMBER OF INVALID OBSERVATIONS = 2

TABLE 2.3-16 (Continued) (Sheet 2 of 13)

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
UNION ELECTRIC COMPANY
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: FEBRUARY 1960-1969

	UPPER CLASS INTERVALS OF WIND SPEED (KNOTS)										
SECTOR	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	>20.0	TOTAL	MEAN SPEED
NNE	.0	.8	.8	1.6	.8	.8	.2	.1	.0	5.2	9.5
NE	.0	1.1	.7	1.0	.5	.5	.1	.0	.0	4.0	8.4
ENE	.0	.6	1.4	1.9	.9	.6	.1	.2	.0	5.7	9.0
E	.0	.9	.9	2.2	.8	.8	.2	.1	.0	6.0	9.3
ESE	.0	.3	1.0	1.7	.7	1.4	.2	.0	.0	5.4	10.2
SE	.0	‘.5	.8	1.4	.9	.8	.1	.0	.0	4.6	9.6
SSE	.0	.7	.9	2.3	1.1	.9	.2	.3	.0	6.4	9.9
S	.0	.9	1.6	2.6	1.2	1.1	.2	.2	.0	7.8	9.5
SSW	.0	.3	1.0	1.6	.4	.4	.1	.1	.0	3.8	9.2
SW	.0	.7	.9	1.5	.2	.4	.1	.0	.0	3.8	8.4
WSW	.0	.9	1.3	1.4	.1	.3	.2	.3	.0	4.6	9.0
W	.0	1.3	1.6	2.5	.4	.8	.1	.2	.1	6.9	8.9
WNW	.0	.6	1.2	2.6	1.0	2.1	.8	.5	.1	8.9	11.4
NW	.0	.8	1.1	2.4	1.3	2.5	1.6	1.4	.2	11.3	12.3
NNW	.0	.4	.6	1.3	.9	1.5	.8	.7	.1	6.5	12.2
N	.0	1.0	1.5	2.0	.9	1.3	.4	.6	.1	7.7	10.5
CALM										1.2	
TOTAL	.3	11.8	17.2	30.0	12.2	16.1	5.6	4.8	.7	100.0	10.0

NUMBER OF INVALID OBSERVATIONS = 1

TABLE 2.3-16 (Continued) (Sheet 3 of 13)

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
UNION ELECTRIC COMPANY
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: MARCH 1960-1969

	UPPER CLASS INTERVALS OF WIND SPEED (KNOTS)										
SECTOR	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	>20.0	TOTAL	MEAN SPEED
NNE	.0	.6	.6	1.9	.6	.6	.4	.4	.1	5.2	10.6
NE	.0	.7	1.0	1.2	.7	.6	.1	.2	.0	4.5	9.6
ENE	.0	.4	1.5	2.2	.7	.9	.2	.2	.0	6.1	9.8
E	.0	.6	.9	1.5	.4	.6	.2	.1	.0	4.2	9.3
ESE	.0	.5	.5	1.5	1.0	.8	.2	.3	.0	4.8	10.5
SE	.0	.5	.6	1.4	1.2	1.1	.3	.2	.0	5.2	10.7
SSE	.0	.4	.7	2.2	1.1	1.6	.6	.3	.1	7.1	11.1
S	.1	.6	1.6	3.5	1.3	1.9	.6	.6	.2	10.3	10.8
SSW	.0	.4	.8	1.5	.5	.7	.4	.3	.0	4.7	10.5
SW	.0	.7	.4	1.5	.4	.4	.2	.2	.0	3.8	9.6
WSW	.0	.8	.9	1.3	.8	.8	.5	.3	.2	5.5	0.8
W	.1	.7	.8	1.6	.8	1.3	.5	.4	.2	6.3	11.2
WNW	.0	.8	1.0	1.6	1.1	2.0	.9	1.3	.4	9.1	12.7
NW	.0	.7	.6	2.0	.8	1.9	1.1	1.2	.7	9.0	13.3
NNW	.0	.8	.6	1.3	.8	1.4	.6	.9	.1	6.6	11.7
N	.1	.6	1.1	1.5	1.1	.7	.4	.6	.0	6.2	10.6
CALM										1.4	
TOTAL	.4	9.9	13.6	27.6	13.3	17.2	7.0	7.4	2.2	100.0	10.9

NUMBER OF INVALID OBSERVATIONS = 4

TABLE 2.3-16 (Continued) (Sheet 4 of 13)

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
UNION ELECTRIC COMPANY
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: APRIL 1960-1969

	UPPER CLASS INTERVALS OF WIND SPEED (KNOTS)										
SECTOR	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	>20.0	TOTAL	MEAN SPEED
NNE	.0	.3	.5	.8	.6	.5	.0	.0	.0	2.8	9.7
NE	.0	.4	.5	.8	.5	.4	.1	.0	.0	2.8	9.2
ENE	.0	.7	.9	1.6	.8	.8	.0	.0	.0	4.8	9.2
E	.0	.8	1.2	2.5	1.0	.6	.2	.1	.1	6.8	9.8
ESE	.0	.5	1.2	2.2	1.2	1.5	.4	.1	.2	7.2	10.5
SE	.0	.5	.5	2.3	1.6	1.8	.9	.5	.1	8.4	11.8
SSE	.0	.3	1.1	2.8	1.4	2.0	.6	.3	.0	8.5	11.2
S	.0	.7	1.5	3.7	1.5	2.0	.6	.5	.1	10.6	10.7
SSW	.0	.6	1.0	1.8	.8	1.5	.3	.2	.0	6.2	10.4
SW	.0	.5	.8	1.0	.4	.8	.4	.2	.1	4.1	10.8
WSW	.0	1.1	1.0	1.3	.7	.6	.3	.4	.3	5.7	10.4
W	.0	.7	1.2	1.0	.8	1.2	.6	.5	.3	6.3	11.4
WNW	.0	.8	.5	1.6	.8	1.5	.7	1.0	.6	7.7	12.9
NW	.0	.4	.6	1.6	.6	1.4	.9	1.4	.9	7.8	13.8
NNW	.0	.5	.5	1.2	.4	.9	.5	.6	.3	4.8	12.0
N	.0	.7	.7	1.2	.6	.8	.4	.3	.0	4.6	10.3
CALM										1.0	
TOTAL	.2	9.4	13.8	27.3	13.5	18.7	7.0	6.2	3.0	100.0	11.0

NUMBER OF INVALID OBSERVATIONS = 1

TABLE 2.3-16 (Continued) (Sheet 5 of 13)

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
UNION ELECTRIC COMPANY
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: MAY 1960-1969

	UPPER CLASS INTERVALS OF WIND SPEED (KNOTS)										
SECTOR	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	>20.0	TOTAL	MEAN SPEED
NNE	.0	.5	.6	.8	.4	.5	.1	.1	.0	3.1	9.3
NE	.0	.8	.8	1.3	.9	.4	.0	.1	.0	4.5	8.9
ENE	.0	1.0	1.6	1.2	.5	.3	.0	.0	.0	4.6	7.7
E	.0	1.2	1.2	1.8	.8	.3	.2	.0	.0	5.4	8.4
ESE	.0	.4	1.1	2.2	.8	.6	.4	.1	.0	5.6	9.8
SE	.0	.7	1.6	2.8	1.4	1.3	.5	.1	.0	8.4	10.0
SSE	.0	.8	2.2	4.2	1.1	1.2	.2	.1	.0	9.8	9.2
S	.0	1.4	3.7	4.8	1.3	2.1	.3	.4	.0	14.0	9.3
SSW	.0	1.0	1.5	2.6	.8	1.1	.3	.1	.0	7.6	9.4
SW	.0	.9	1.3	2.1	.5	.4	.0	.2	.0	5.4	8.6
WSW	.0	1.0	1.9	2.1	.6	.8	.3	.1	.1	6.9	9.1
W	.0	.8	1.3	1.6	.4	.7	.1	.1	.0	5.1	8.9
WNW	.0	.8	1.4	1.5	.7	.6	.4	.3	.1	5.9	9.8
NW	.0	.6	.7	1.3	.8	.8	.7	.4	.2	5.4	11.6
NNW	.0	.4	.6	.7	.4	.8	.4	.1	.0	3.6	10.8
N	.0	.6	.8	1.2	.4	.4	.0	.0	.0	3.5	8.6
CALM										1.1	
TOTAL	.2	13.1	22.2	32.0	12.0	12.5	4.0	2.4	.5	100.0	9.2

NUMBER OF INVALID OBSERVATIONS = 1

TABLE 2.3-16 (Continued) (Sheet 6 of 13)

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
UNION ELECTRIC COMPANY
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: JUNE 1960-1969

	UPPER CLASS INTERVALS OF WIND SPEED (KNOTS)										
SECTOR	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	>20.0	TOTAL	MEAN SPEED
NNE	.1	1.2	.5	1.0	.4	.3	.1	.0	.0	3.7	7.8
NE	.1	1.1	1.0	1.5	.6	.2	.0	.0	.0	4.5	7.8
ENE	.0	1.8	1.3	1.5	.5	.3	.1	.0	.0	5.5	7.6
E	.0	1.8	2.0	1.7	.3	.1	.1	.0	.0	6.3	7.2
ESE	.0	.9	1.0	2.0	.7	.2	.0	.0	.0	4.8	8.2
SE	.0	1.2	1.7	3.5	.9	.5	.1	.0	.0	8.1	8.4
SSE	.0	1.6	3.4	4.7	.8	.8	.1	.0	.0	11.4	8.1
S	.2	3.1	5.2	6.5	1.5	1.5	.1	.3	.0	18.3	8.2
SSW	.0	1.7	2.3	3.3	.9	.7	.3	.0	.0	9.1	8.4
SW	.1	1.1	1.8	1.3	.3	.4	.1	.0	.0	5.2	7.6
WSW	.0	1.3	1.3	1.3	.5	.8	.1	.0	.0	5.4	8.3
W	.0	1.1	1.0	.9	.3	.2	.1	.0	.0	3.6	7.5
WNW	.0	.6	.9	.8	.4	.5	.2	.0	.1	3.5	9.3
NW	.0	.8	.5	.9	.4	.5	.3	.0	.0	3.5	9.3
NNW	.0	.4	.4	.5	.4	.3	.0	.0	.0	2.0	9.0
N	.0	1.1	.9	.8	.3	.2	.0	.0	.0	3.4	7.6
CALM										1.8	
TOTAL	.8	20.9	25.1	32.2	9.2	7.5	1.8	.7	.2	100.0	8.0

NUMBER OF INVALID OBSERVATIONS = 1

TABLE 2.3-16 (Continued) (Sheet 7 of 13)

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
UNION ELECTRIC COMPANY
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: JULY 1960-1969

	UPPER CLASS INTERVALS OF WIND SPEED (KNOTS)										
SECTOR	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	>20.0	TOTAL	MEAN SPEED
NNE	.0	1.3	1.1	1.3	.2	.2	.1	.0	.0	4.3	7.4
NE	.0	1.1	.8	.7	.1	.2	.0	.0	.0	3.1	7.2
ENE	.1	2.5	1.6	.8	.2	.2	.0	.0	.0	5.5	6.4
E	.1	2.1	1.6	1.0	.1	.0	.0	.0	.0	4.9	6.0
ESE	.0	1.9	1.9	2.9	.6	.1	.0	.0	.0	7.5	7.4
SE	.0	1.6	1.9	3.2	.7	.3	.1	.0	.0	7.9	7.9
SSE	.0	1.9	2.9	3.0	.4	.4	.0	.0	.0	8.6	7.4
S	.0	4.2	5.0	4.2	.6	.3	.0	.0	.0	14.4	7.0
SSW	.0	2.2	2.8	2.5	.4	.2	.0	.0	.0	8.1	7.0
SW	.0	1.6	1.7	‘2.0	.6	.2	.0	.0	.0	6.1	7.4
WSW	.0	1.5	2.1	2.4	.6	.2	.0	.0	.0	6.9	7.6
W	.1	1.3	1.2	1.0	.2	.2	.0	.0	.0	4.1	7.0
WNW	.0	1.1	.8	1.0	.4	.1	.0	.0	.0	3.5	7.4
NW	.0	.6	.6	.8	.5	.4	.3	.1	.0	3.4	9.8
NNW	.0	.6	.6	.9	.4	.2	.1	.0	.0	2.9	8.4
N	.0	2.1	1.6	1.7	.5	.2	.1	.2	.0	6.4	7.5
CALM										2.5	
TOTAL	.5	27.7	28.4	29.5	6.5	3.6	.8	.5	.1	100.0	7.1

NUMBER OF INVALID OBSERVATIONS = 2

TABLE 2.3-16 (Continued) (Sheet 8 of 13)

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
UNION ELECTRIC COMPANY
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: AUGUST 1960-1969

	UPPER CLASS INTERVALS OF WIND SPEED (KNOTS)										
SECTOR	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	>20.0	TOTAL	MEAN SPEED
NNE	.0	1.3	1.1	1.0	.3	.2	.0	.0	.0	4.0	7.5
NE	.0	1.4	1.1	1.1	.2	.1	.0	.0	.0	4.1	6.8
ENE	.0	2.3	1.8	1.5	.1	.2	.0	.0	.0	5.9	6.5
E	.0	2.7	2.2	1.3	.4	.1	.0	.0	.0	6.8	6.4
ESE	.0	1.7	2.1	2.9	.5	.3	.1	.0	.0	7.4	7.7
SE	.0	1.5	1.6	3.3	1.1	.5	.3	.0	.0	8.3	8.5
SSE	.1	1.5	4.1	3.8	.8	.3	.0	.0	.0	10.7	7.7
S	.1	2.9	4.8	4.2	.4	.3	.0	.0	.0	12.7	7.1
SSW	.0	2.1	2.3	2.1	.4	.3	.0	.0	.0	7.2	7.2
SW	.1	1.3	1.6	1.4	.3	.3	.0	.0	.0	5.1	7.5
WSW	.0	1.5	1.3	1.8	.7	.2	.0	.0	.0	5.6	7.7
W	.0	1.3	1.2	.9	.2	.2	.0	.0	.0	3.7	6.9
WNW	.0	.8	.8	1.0	.3	.3	.1	.0	.0	3.3	8.3
NW	.0	.9	.6	1.3	.3	.4	.2	.1	.0	3.8	8.9
NNW	.0	1.0	.6	.9	.4	.3	.2	.2	.0	3.6	8.9
N	.1	2.0	1.2	1.7	.6	.4	.1	.0	.0	6.0	7.5
CALM										1.7	
TOTAL	.6	25.9	28.5	30.2	6.9	4.5	1.1	.5	.1	100.0	7.4

NUMBER OF INVALID OBSERVATIONS = 1

TABLE 2.3-16 (Continued) (Sheet 9 of 13)

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
UNION ELECTRIC COMPANY
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: SEPTEMBER 1960-1969

SECTOR	UPPER CLASS INTERVALS OF WIND SPEED (KNOTS) 2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	>20.0	TOTAL	MEAN SPEED
NNE	.0	1.4	1.3	1.5	.6	.4	.0	.0	.0	5.2	7.9
NE	.0	.9	1.0	1.0	.4	.3	.1	.0	.0	3.7	8.0
ENE	.0	2.1	2.1	1.5	.3	.2	.1	.0	.0	6.3	7.0
E	.0	1.4	2.0	2.1	.0	.2	.0	.0	.0	5.8	7.1
ESE	.0	1.7	2.1	3.2	.8	.4	.0	.0	.0	8.3	7.9
SE	.0	1.2	1.9	3.6	.7	.5	.1	.1	.0	8.2	8.4
SSE	.0	1.5	3.4	4.4	1.0	.6	.1	.0	.0	11.0	8.1
S	.0	3.0	4.5	5.0	1.3	.7	.0	.1	.0	14.6	7.8
SSW	.0	1.2	2.0	1.2	.7	.5	.0	.0	.0	5.7	7.9
SW	.0	1.3	.9	1.0	.2	.2	.1	.0	.0	3.7	7.1
WSW	.0	1.6	1.0	1.2	.4	.1	.0	.0	.0	4.3	7.0
W	.1	1.3	.7	.5	.2	.1	.0	.0	.0	2.8	6.0
WNW	.0	1.1	.8	1.0	.3	.4	.1	.1	.1	4.0	8.6
NW	.0	.6	1.2	1.1	.5	.5	.2	.3	.0	4.5	9.4
NNW	.0	.9	.5	1.0	.4	.5	.2	.1	.1	3.6	9.4
N	.0	1.2	1.5	1.7	.9	.6	.2	.3	.1	6.6	9.2
CALM										1.4	
TOTAL	.4	22.5	26.9	31.1	8.6	6.2	1.5	1.2	.2	100.0	7.9

NUMBER OF INVALID OBSERVATIONS = 0

TABLE 2.3-16 (Continued) (Sheet 10 of 13)

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
UNION ELECTRIC COMPANY
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: OCTOBER 1960-1969

SECTOR	UPPER CLASS INTERVALS OF WIND SPEED (KNOTS) 2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	>20.0	TOTAL	MEAN SPEED
NNE	.0	.5	.8	.9	.2	.3	.1	.1	.0	2.8	8.7
NE	.0	.6	.7	1.0	.3	.2	.0	.0	.0	2.8	7.9
ENE	.0	.8	.9	.7	.1	.2	.0	.0	.0	2.9	7.3
E	.0	1.5	.9	.7	.2	.1	.0	.0	.0	3.5	6.5
ESE	.0	.8	1.1	1.8	.4	.1	.0	.0	.0	4.3	7.8
SE	.0	1.1	1.3	3.5	1.0	.7	.1	.0	.0	7.8	8.9
SSE	.0	.9	2.8	5.4	1.3	1.5	.3	.1	.0	12.4	9.3
S	.0	1.4	5.5	6.0	1.9	1.7	.5	.2	.0	17.3	8.9
SSW	.0	1.3	1.8	2.5	.6	.7	.1	.2	.0	7.3	8.4
SW	.0	1.6	1.5	1.4	.5	.3	.0	.0	.0	5.3	7.5
WSW	.0	1.4	1.5	1.3	.5	.6	.0	.1	.0	5.5	8.1
W	.0	1.2	.9	.9	.4	.3	.1	.2	.0	4.0	8.3
WNW	.0	1.0	1.4	1.5	.9	1.2	.4	.2	.2	6.8	10.1
NW	.0	.8	.9	2.0	.7	.8	.7	.6	.3	6.7	11.3
NNW	.0	.7	.5	1.3	.7	.8	.5	.3	.1	4.9	10.9
N	.0	.8	.8	1.5	.5	.8	.3	.2	.1	4.9	10.0
CALM										.8	
TOTAL	.3	16.3	23.3	32.4	10.1	10.4	3.3	2.2	.7	100.0	8.9

NUMBER OF INVALID OBSERVATIONS = 3

TABLE 2.3-16 (Continued) (Sheet 11 of 13)

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
UNION ELECTRIC COMPANY
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: OCTOBER 1960-1969

	UPPER CLASS INTERVALS OF WIND SPEED (KNOTS)										
SECTOR	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	>20.0	TOTAL	MEAN SPEED
NNE	.0	.7	.5	1.1	.5	.4	.0	.0	.0	3.3	8.7
NE	.0	.6	.5	.9	.2	.1	.0	.0	.0	2.4	7.9
ENE	.1	.7	.8	1.1	.3	.1	.0	.0	.0	3.1	7.6
E	.0	1.0	.8	.8	.1	.1	.0	.0	.0	2.9	6.6
ESE	.0	.5	1.0	1.4	.5	.3	.1	.0	.0	3.8	8.6
SE	.0	.9	1.0	2.8	.7	.8	.3	.1	.0	6.5	9.3
SSE	.0	.9	2.0	4.3	1.7	1.9	.3	.1	.0	11.1	9.7
S	.0	1.3	2.6	5.5	2.1	1.8	.4	.2	.0	13.9	9.5
SSW	.0	.8	1.5	2.9	.8	1.0	.1	.1	.0	7.3	9.2
SW	.0	1.0	.8	1.5	.4	.5	.2	.1	.0	4.5	8.9
WSW	.0	.9	1.3	2.0	.5	.5	.3	.3	.1	6.0	9.6
W	.0	1.2	1.4	1.2	.3	.6	.0	.3	.0	5.1	8.6
WNW	.0	1.1	1.6	2.1	.6	1.4	.6	.5	.3	8.3	10.6
NW	.0	.6	.9	2.0	1.3	1.8	1.2	.9	.4	9.0	12.5
NNW	.0	.5	.7	1.4	.9	1.1	.6	.5	.3	6.0	11.8
N	.0	.7	1.0	1.5	.8	1.1	.3	.1	.1	5.6	9.8
CALM										1.3	
TOTAL	.4	13.4	18.4	32.6	11.8	13.5	4.3	3.2	1.3	100.0	9.6

NUMBER OF INVALID OBSERVATIONS = 1

TABLE 2.3-16 (Continued) (Sheet 12 of 13)

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
UNION ELECTRIC COMPANY
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: OCTOBER 1960-1969

	UPPER CLASS INTERVALS OF WIND SPEED (KNOTS)										
SECTOR	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	>20.0	TOTAL	MEAN SPEED
NNE	.0	.8	.8	.6	.4	.7	.5	.0	.1	4.0	9.7
NE	.0	.9	.4	1.2	.5	.6	.1	.1	.0	3.7	9.1
ENE	.0	1.1	.8	.7	.4	.5	.0	.0	.0	3.5	8.0
E	.0	.8	1.1	.9	.1	.2	.0	.0	.0	3.2	7.4
ESE	.0	.4	1.0	1.2	.6	.6	.1	.1	.0	4.1	9.2
SE	.0	.4	.9	2.1	1.2	1.0	.2	.1	.0	5.9	10.2
SSE	.0	.7	1.0	2.9	1.3	1.2	.4	.3	.0	7.8	10.2
S	.0	1.2	2.2	5.0	1.4	1.6	.5	.2	.1	12.1	9.6
SSW	.0	.8	1.4	1.8	1.0	.5	.2	.1	.0	5.8	9.1
SW	.0	1.0	1.4	1.0	.3	.6	.0	.0	.0	4.5	8.1
WSW	.0	1.1	1.7	2.3	.7	.5	.2	.3	.2	7.0	9.2
W	.2	1.4	1.9	2.2	1.0	1.1	.4	.3	.1	8.5	9.3
WNW	.0	.9	1.2	2.3	1.4	2.2	.8	.9	.3	10.2	11.7
NW	.0	.6	.8	2.0	1.1	1.9	.7	.9	.2	8.2	12.0
NNW	.0	.7	.8	1.6	.4	.8	.5	.6	.0	5.3	10.8
N	.1	.7	.8	1.3	.8	.5	.3	.5	.1	5.2	10.5
CALM										1.0	
TOTAL	.5	13.5	18.2	29.2	12.7	14.5	5.0	4.4	1.1	100.0	9.8

NUMBER OF INVALID OBSERVATIONS = 0

TABLE 2.3-16 (Continued) (Sheet 13 of 13)

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
UNION ELECTRIC COMPANY
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: OCTOBER 1960-1969

	UPPER CLASS INTERVALS OF WIND SPEED (KNOTS)										
SECTOR	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	>20.0	TOTAL	MEAN SPEED
NNE	.0	.8	.8	1.1	.5	.5	.2	.1	.0	4.0	9.0
NE	.0	.9	.7	1.1	.4	.3	.1	.1	.0	3.6	8.4
ENE	.0	1.2	1.3	1.4	.4	.4	.1	.0	.0	4.9	7.9
E	.0	1.3	1.3	1.5	.4	.3	.1	.0	.0	5.0	7.7
ESE	.0	.8	1.3	2.1	.7	.6	.1	.1	.0	5.7	8.8
SE	.0	.9	1.2	2.7	1.0	.9	.3	.1	.0	7.1	9.4
SSE	.0	1.0	2.2	3.5	1.1	1.1	.3	.1	.0	9.3	9.2
S	.0	1.8	3.4	4.6	1.3	1.4	.3	.2	.0	13.1	8.8
SSW	.0	1.1	1.7	2.2	.7	.7	.2	.1	.0	6.6	8.7
SW	.0	1.0	1.2	1.4	.4	.4	.1	.1	.0	4.7	8.2
WSW	.0	1.1	1.4	1.7	.6	.5	.2	.2	.1	5.9	8.9
W	.1	1.1	1.2	1.4	.5	.6	.2	.2	.1	5.3	8.9
WNW	.0	.9	1.1	1.6	.8	1.2	.5	.5	.2	6.6	10.8
NW	.0	.7	.8	1.6	.8	1.2	.7	.7	.3	6.8	11.9
NNW	.0	.6	.6	1.1	.6	.8	.4	.4	.1	4.6	10.9
N	.0	1.0	1.1	1.4	.7	.7	.3	.3	.1	5.5	9.5
CALM										1.3	
TOTAL	.4	16.3	21.3	30.4	10.7	11.6	3.9	3.2	.9	100.0	9.1

NUMBER OF INVALID OBSERVATIONS = 17

TABLE 2.3-17 STATISTICS AND DIURNAL VARIATION OF METEOROLOGICAL PARAMETERS

STATISTICS AND DIURNAL VARIATION OF METEOROLOGICAL PARAMETERS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JANUARY

DATA SOURCE: ON-SITE
TABLE GENERATED: 05/31/79. 20.02.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677 - 093 - 07

METEOROLOGICAL PARAMETERS (HEIGHTS IN METERS)

	DRY BULB	DEW POINT	DEW POINT	REL HUMID	DELTA TEMP	STAB CLASS	DELTA TEMP	STAB CLASS	WIND SPEED	WIND DIR	WIND SPEED	WIND DIR	WIND SPEED	WIND DIR
					10.00	10.00	10.00	10.00						
	10.00	10.00	90.00	10.00	60.00	60.00	90.00	90.00	10.00	10.00	60.00	60.00	90.00	90.00
HOUR	DEG C	DEG C	DEG C	PCT	DEG C		DEG C		M/SEC		M/SEC		M/SEC	
1	.2	-6.2	-2.7	70.3	.3	E	.2	E	3.7	WSW	6.0	WSW	7.1	WSW
2	-.1	-6.3	-2.7	71.2	.3	E	.2	E	3.6	WSW	5.8	W	6.8	WSW
3	-.4	-6.4	-2.7	72.7	.4	E	.3	E	3.6	WSW	5.7	WSW	6.7	WSW
4	-.7	-6.5	-2.7	73.3	.3	E	.3	E	3.6	WSW	5.7	W	6.8	WSW
5	-1.0	-6.7	-2.8	73.7	.3	E	.3	E	3.6	WSW	5.7	W	6.8	WSW
6	-1.2	-6.7	-2.8	74.2	.3	E	.2	E	3.6	SW	5.7	WSW	6.8	WSW
7	-1.6	-6.9	-2.9	74.7	.3	E	.2	E	3.6	SW	5.6	WSW	6.7	WSW
8	-1.6	-6.8	-2.9	76.2	.2	E	.1	E	3.7	SW	5.6	WSW	6.6	WSW
9	-1.1	-6.4	-2.9	75.5	-.2	E	-.2	E	3.8	SW	5.3	SW	6.3	WSW
10	-.1	-6.0	-2.8	72.7	-.5	D	-.5	D	4.1	WSW	5.2	WSW	5.9	SW
11	1.0	-5.6	-2.6	69.0	-.6	D	-.6	D	4.2	SW	5.4	SW	5.9	SW
12	2.1	-5.2	-2.5	65.8	-.7	D	-.6	D	4.4	SW	5.5	WSW	5.8	WSW
13	2.9	-5.1	-2.6	62.5	-.7	D	-.6	D	4.4	SW	5.6	WSW	5.9	SW
14	3.2	-5.1	-2.6	61.0	-.6	D	-.6	D	4.5	SW	5.6	WSW	6.0	SW
15	3.4	-5.1	-2.6	60.8	-.5	D	-.6	D	4.4	WSW	5.5	WSW	5.9	WSW
16	3.3	-5.2	-2.6	60.8	-.4	D	-.5	D	4.1	W	5.2	WSW	5.6	WSW
17	2.9	-5.4	-2.7	61.1	-.2	E	-.4	E	3.8	WSW	5.1	WSW	5.6	WSW
18	2.3	-5.7	-2.7	62.5	-.0	E	-.2	E	3.6	SW	5.2	WSW	6.0	SW
19	1.6	-5.9	-2.7	64.0	.1	E	-.1	E	3.7	SW	5.6	SW	6.6	SSW
20	1.1	-5.9	-2.8	65.1	.2	E	-.1	E	3.7	SSW	5.8	SW	6.9	SW
21	.8	-6.0	-2.7	66.3	.2	E	-.0	E	3.8	SW	6.0	SW	7.2	SW
22	.6	-6.1	-2.7	67.9	.2	E	.0	E	3.8	SSW	6.1	SW	7.1	SW
23	.6	-6.1	-2.7	68.8	.3	E	.1	E	3.9	SW	6.2	SW	7.4	SW
24	.4	-6.1	-2.7	69.4	.3	E	.2	E	3.9	SW	6.2	WSW	7.4	WSW
ABSOLUTE MAX	17.2	15.0	16.2	100.0					13.5		16.6		17.9	
AVG DAILY MAX	4.8	-2.2	-.2	82.7					6.0		8.2		9.5	
MEAN	.8	-6.0	-2.7	68.3	-.0	E	-.1	E	3.9	SW	5.6	WSW	6.5	WSW
CLIMATIC MEAN	.6	-6.0	-2.6	68.6					4.0		5.6		6.5	
AVG DAILY MIN	-3.6	-9.8	-5.1	54.6					2.0		3.0		3.4	
ABSOLUTE MIN	-23.4	-27.8	-25.4	27.3					0.0		.4		.6	
STANDARD DEV	6.7	7.3	6.4	17.7					1.8		2.5		2.8	
VALID OBS	1309	2016	2048	1302	1305	1305	2007	2007	1986	1986	1646	1645	1599	1561
INVALID OBS	923	216	184	930	927	927	225	225	246	246	586	587	633	671
TOTAL OBS	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232
DATA RECOVERY	58.6	90.3	91.8	58.3	58.5	58.5	89.9	89.9	89.0	89.0	73.7	73.7	71.6	69.9

TABLE 2.3-17 (Continued) (Sheet 2 of 13)

STATISTICS AND DIURNAL VARIATION OF METEOROLOGICAL PARAMETERS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - FEBRUARY

DATA SOURCE: ON-SITE
TABLE GENERATED: 05/31/79. 20.02.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677 - 093 - 07

METEOROLOGICAL PARAMETERS (HEIGHTS IN METERS)

	DRY BULB	DEW POINT	DEW POINT	REL HUMID	DELTA TEMP 10.00	STAB CLASS 10.00	DELTA TEMP 10.00	STAB CLASS 10.00	WIND SPEED	WIND DIR	WIND SPEED	WIND DIR	WIND SPEED	WIND DIR
	10.00	10.00	90.00	10.00	60.00	60.00	90.00	90.00	10.00	10.00	60.00	60.00	90.00	90.00
HOUR	DEG C	DEG C	DEG C	PCT	DEG C		DEG C		M/SEC		M/SEC		M/SEC	
1	-2.2	-6.3	-3.8	70.2	.2	E	.3	E	4.0	E	6.2	SSW	7.2	SW
2	-2.5	-6.5	-3.9	70.4	.3	E	.4	E	3.9	ESE	6.3	SW	7.4	W
3	-2.9	-6.6	-4.0	71.2	.3	E	.4	E	3.9	WSW	6.3	SW	7.4	WSW
4	-3.2	-6.8	-4.1	71.4	.3	E	.4	E	4.0	SE	6.3	SW	7.5	WSW
5	-3.5	-6.9	-4.2	72.1	.3	E	.4	E	3.9	NNE	6.2	SW	7.3	W
6	-3.6	-7.0	-4.3	72.7	.3	E	.4	E	3.9	NNE	6.1	SSW	7.2	W
7	-3.7	-7.0	-4.2	73.7	.2	E	.3	E	3.9	ENE	6.0	WSW	7.1	WNW
8	-3.4	-6.7	-4.1	73.4	-.0	E	.1	E	4.0	N	5.8	W	6.8	WNW
9	-2.7	-6.5	-4.0	71.5	-.3	D	-.2	E	4.2	NW	5.6	W	6.4	W
10	-1.6	-6.0	-3.8	69.0	-.5	D	-.2	E	4.3	WNW	5.3	W	5.9	W
11	-.4	-5.9	-3.7	64.8	-.6	D	-.2	E	4.3	SW	5.3	SW	5.7	WSW
12	.5	-5.8	-3.7	61.7	-.6	D	-.1	E	4.5	SW	5.5	SW	5.7	SW
13	1.2	-5.6	-3.7	59.6	-.6	D	-.1	E	4.8	W	5.8	WSW	6.2	WSW
14	1.8	-5.5	-3.7	58.8	-.6	D	-.1	E	4.8	W	5.8	WSW	6.2	W
15	2.2	-5.6	-3.6	57.1	-.5	D	-.1	E	4.8	W	5.9	WSW	6.4	WSW
16	2.1	-5.6	-3.6	57.4	-.4	D	.0	E	4.5	WNW	5.8	W	6.3	W
17	1.8	-5.8	-3.6	57.6	-.3	D	.1	E	4.0	NW	5.4	WNW	6.0	NW
18	1.2	-5.6	-3.3	60.3	-.2	E	.2	E	3.7	NNW	5.4	WNW	6.1	NNW
19	.4	-5.8	-3.5	62.1	-.0	E	.1	E	3.7	N	5.6	NNW	6.4	N
20	-.2	-5.9	-3.6	64.0	.1	E	.2	E	3.7	NNE	5.7	NNE	6.6	NE
21	-.6	-5.9	-3.5	65.8	.2	E	.2	E	3.7	NNE	5.8	ENE	6.8	E
22	-1.1	-5.9	-3.5	67.2	.2	E	.3	E	3.8	NE	5.9	E	6.9	NE
23	-1.5	-6.1	-3.7	68.3	.2	E	.3	E	3.9	ENE	6.0	SSE	7.0	SSE
24	-1.8	-6.2	-3.8	69.3	.2	E	.3	E	3.9	E	6.1	SSE	7.2	SE
ABSOLUTE MAX	17.7	12.9	6.2	100.0					10.4		14.3		14.3	
AVG DAILY MAX	3.4	-2.8	-1.7	80.5					6.3		8.5		9.7	
MEAN	-1.0	-6.2	-3.8	66.3	-.1	E	.1	E	4.1	NNW	5.8	WSW	6.7	W
CLIMATIC MEAN	-1.1	-6.2	-3.7	66.2					4.1		5.8		6.6	
AVG DAILY MIN	-5.6	-9.6	-5.8	51.9					1.9		3.1		3.5	
ABSOLUTE MIN	-24.0	-25.9	-26.5	20.5					0.0		.6		.4	
STANDARD DEV	7.2	6.4	5.1	18.2					1.8		2.3		2.6	
VALID OBS	1974	1970	1988	1939	1841	1841	1970	1970	1834	1833	1783	1717	1713	1706
INVALID OBS	42	46	28	77	175	175	46	46	182	183	233	299	303	310
TOTAL OBS	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016	2016
DATA RECOVERY	97.9	97.7	98.6	96.2	91.3	91.3	97.7	97.7	91.0	90.9	88.4	85.2	85.0	84.6

TABLE 2.3-17 (Continued) (Sheet 3 of 13)

STATISTICS AND DIURNAL VARIATION OF METEOROLOGICAL PARAMETERS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - MARCH

DATA SOURCE: ON-SITE
TABLE GENERATED: 05/31/79. 20.02.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677 - 093 - 07

METEOROLOGICAL PARAMETERS (HEIGHTS IN METERS)

	DRY BULB 10.00	DEW POINT 10.00	DEW POINT 90.00	REL HUMID 10.00	DELTA TEMP 10.00 60.00	STAB CLASS 10.00 60.00	DELTA TEMP 10.00 90.00	STAB CLASS 10.00 90.00	WIND SPEED 10.00	WIND DIR 10.00	WIND SPEED 60.00	WIND DIR 60.00	WIND SPEED 90.00	WIND DIR 90.00
HOUR	DEG C	DEG C	DEG C	PCT	DEG C		DEG C		M/SEC		M/SEC		M/SEC	
1	3.9	-1.1	-1.3	67.9	.2	E	.3	E	3.9	SSE	6.3	SSW	7.2	S
2	3.6	-1.2	-1.3	69.4	.3	E	.4	E	3.9	SE	6.5	SSW	7.4	S
3	3.2	-1.3	-1.4	70.3	.3	E	.4	E	4.0	S	6.4	SW	7.4	SSW
4	2.8	-1.5	-1.6	70.7	.2	E	.4	E	4.0	SE	6.4	SSW	7.4	SSW
5	2.5	-1.6	-1.6	72.4	.2	E	.3	E	4.0	SE	6.4	SSE	7.3	SSE
6	2.3	-1.6	-1.7	73.2	.2	E	.2	E	3.9	SE	6.2	SSE	7.0	S
7	2.4	-1.5	-1.7	73.3	-.0	E	.1	E	4.0	ESE	6.0	SSE	6.8	SSE
8	3.1	-1.2	-1.6	71.4	-.3	D	-.2	E	4.4	SSE	6.0	S	6.6	S
9	4.4	-.9	-1.4	66.8	-.6	D	-.4	D	4.8	S	6.0	SSW	6.4	SSW
10	5.9	-.6	-1.2	62.2	-.8	C	-.5	D	5.1	SW	6.0	SW	6.3	SW
11	7.1	-.6	-1.1	57.9	-.8	C	-.5	D	5.3	SW	6.3	SW	6.5	SW
12	8.1	-.8	-1.3	53.7	-.8	C	-.6	D	5.3	SW	6.3	SW	6.5	SW
13	9.0	-.6	-1.3	51.5	-.8	C	-.5	D	5.4	SW	6.5	SW	6.7	SW
14	9.8	-.5	-1.3	50.4	-.8	C	-.5	D	5.5	SW	6.8	SW	6.9	SW
15	10.0	-.4	-1.3	49.9	-.7	D	-.5	D	5.5	WSW	6.9	WSW	7.1	WSW
16	10.0	-.5	-1.3	49.5	-.6	D	-.4	D	5.2	WSW	6.6	WSW	6.8	WSW
17	9.8	-.5	-1.2	50.8	-.5	D	-.3	E	4.9	WSW	6.4	W	6.6	WSW
18	9.2	-.3	-1.0	52.7	-.3	D	-.2	E	4.3	W	6.2	WNW	6.6	WNW
19	8.2	-.5	-1.1	55.6	-.1	E	-.0	E	4.0	NW	6.1	NW	6.8	NW
20	7.4	-.6	-1.2	58.0	-.0	E	.0	E	3.9	NNW	6.1	NNW	6.8	NNW
21	6.7	-.7	-1.2	60.1	.0	E	.1	E	4.0	N	6.2	N	7.0	N
22	6.0	-.7	-1.2	62.4	.1	E	.2	E	4.1	W	6.3	N	7.0	N
23	5.4	-.8	-1.1	64.1	.2	E	.2	E	4.1	ESE	6.3	SSE	7.1	ESE
24	4.9	-.9	-1.1	65.3	.2	E	.3	E	4.1	S	6.5	SSW	7.3	S
ABSOLUTE MAX	28.3	19.0	18.5	100.0					13.8		19.1		19.8	
AVG DAILY MAX	11.1	2.6	1.2	79.2					6.8		9.2		10.1	
MEAN	6.1	-.9	-1.3	61.7	-.2	E	-.1	E	4.5	SW	6.3	WSW	6.9	SW
CLIMATIC MEAN	6.0	-.8	-1.2	62.4					4.5		6.4		6.9	
AVG DAILY MIN	.9	-4.1	-3.6	45.6					2.2		3.5		3.8	
ABSOLUTE MIN	-14.5	-19.9	-20.1	20.7					.4		.5		.4	
STANDARD DEV	8.2	6.9	6.4	19.0					2.1		2.6		2.8	
VALID OBS	2029	2031	2232	1985	1997	1997	1954	1954	2156	2147	2146	2133	2145	2142
INVALID OBS	203	201	0	247	235	235	278	278	76	85	86	99	87	90
TOTAL OBS	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232
DATA RECOVERY	90.9	91.0	100.0	88.9	89.5	89.5	87.5	87.5	96.6	96.2	96.1	95.6	96.1	96.0

TABLE 2.3-17 (Continued) (Sheet 4 of 13)

STATISTICS AND DIURNAL VARIATION OF METEOROLOGICAL PARAMETERS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - APRIL

DATA SOURCE: ON-SITE
TABLE GENERATED: 05/31/79. 20.02.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677 - 093 - 07

METEOROLOGICAL PARAMETERS (HEIGHTS IN METERS)

	DRY BULB	DEW POINT	DEW POINT	REL HUMID	DELTA TEMP 10.00	STAB CLASS 10.00	DELTA TEMP 10.00	STAB CLASS 10.00	WIND SPEED	WIND DIR	WIND SPEED	WIND DIR	WIND SPEED	WIND DIR
	10.00	10.00	90.00	10.00	60.00	60.00	90.00	90.00	10.00	10.00	60.00	60.00	90.00	90.00
HOUR	DEG C	DEG C	DEG C	PCT	DEG C		DEG C		M/SEC		M/SEC		M/SEC	
1	11.4	3.8	1.7	61.0	.5	E	.5	E	3.9	SSE	6.2	S	7.1	SSE
2	10.9	3.9	1.7	63.0	.5	E	.5	E	3.9	S	6.3	S	7.1	S
3	10.5	3.9	1.7	64.6	.5	E	.6	E	3.8	S	6.3	S	7.2	S
4	10.0	3.9	1.7	66.6	.5	E	.6	E	3.9	S	6.4	S	7.4	S
5	9.6	3.9	1.8	68.6	.5	E	.6	E	3.8	SSE	6.3	S	7.3	S
6	9.3	4.0	1.8	70.2	.5	E	.5	E	3.8	SSE	6.1	S	7.1	S
7	9.6	4.2	1.9	65.8	.1	E	.2	E	4.1	SSE	6.0	S	7.0	S
8	10.6	4.5	2.1	67.0	-.3	D	-.2	E	4.7	SSE	6.2	S	6.9	SSE
9	11.7	4.6	2.2	62.7	-.6	D	-.3	E	5.1	SSE	6.3	S	6.7	S
10	12.9	4.6	2.2	58.7	-.6	D	-.4	D	5.4	S	6.6	S	6.9	S
11	14.0	4.5	2.1	54.3	-.7	D	-.5	D	5.5	S	6.7	SSW	7.0	S
12	15.0	4.3	1.8	50.7	-.7	D	-.5	D	5.4	S	6.8	SSW	7.1	SSW
13	15.9	4.2	1.7	48.0	-.7	D	-.5	D	5.6	SSW	6.9	SSW	7.2	S
14	16.6	4.0	1.5	45.9	-.7	D	-.4	E	5.7	SSW	7.0	SSW	7.5	SSW
15	17.1	3.8	1.4	44.3	-.6	D	-.4	E	5.5	SSW	6.8	SSW	7.3	SSW
16	17.2	3.8	1.4	43.8	-.5	D	-.3	E	5.4	SSW	6.7	SSW	7.2	S
17	17.0	3.7	1.5	44.0	-.4	D	-.2	E	5.3	S	6.7	SSW	7.0	S
18	16.4	3.6	1.4	45.4	-.3	D	-.1	E	4.9	S	6.5	SSW	7.0	S
19	15.3	3.6	1.4	47.9	-.1	E	-.0	E	4.1	WSW	6.2	SSW	6.7	SE
20	14.3	3.7	1.7	51.5	.1	E	.2	E	4.1	SE	6.3	SE	7.1	ESE
21	13.6	3.9	1.8	54.3	.2	E	.3	E	4.0	SE	6.2	SE	7.1	SE
22	12.8	3.9	1.9	56.6	.3	E	.3	E	3.7	SE	5.9	SSE	6.8	SE
23	12.2	3.9	1.9	58.6	.4	E	.4	E	3.8	SE	6.1	SSE	7.0	SSE
24	11.7	3.9	1.8	60.1	.5	E	.5	E	3.9	SSE	6.3	SSE	7.2	SE
ABSOLUTE MAX	29.0	17.2	16.6	95.8					15.4		18.9		17.8	
AVG DAILY MAX	18.1	7.3	4.2	76.7					7.1		9.2		10.2	
MEAN	13.1	4.0	1.8	56.7	-.1	E	.1	E	4.5	S	6.4	S	7.1	S
CLIMATIC MEAN	13.1	4.0	1.8	57.4					4.6		6.4		7.1	
AVG DAILY MIN	8.2	.7	-.6	38.1					2.1		3.6		4.1	
ABSOLUTE MIN	-6.0	-11.0	-13.9	16.2					.7		1.1		.9	
STANDARD DEV	6.5	6.1	5.6	19.5					2.1		2.4		2.6	
VALID OBS	2085	2081	2128	2080	1840	1840	1994	1994	2121	2121	2091	2091	2078	2077
INVALID OBS	75	79	32	80	320	320	166	166	39	39	69	69	82	83
TOTAL OBS	2160	2160	2160	2160	2160	2160	2160	2160	2160	2160	2160	2160	2160	2160
DATA RECOVERY	96.5	96.3	98.5	96.3	85.2	85.2	92.3	92.3	98.2	98.2	96.8	96.8	96.2	96.2

TABLE 2.3-17 (Continued) (Sheet 5 of 13)

STATISTICS AND DIURNAL VARIATION OF METEOROLOGICAL PARAMETERS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - MAY

DATA SOURCE: ON-SITE
TABLE GENERATED: 05/31/79. 20.02.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677 - 093 - 07

METEOROLOGICAL PARAMETERS (HEIGHTS IN METERS)

	DRY BULB	DEW POINT	DEW POINT	REL HUMID	DELTA TEMP 10.00	STAB CLASS 10.00	DELTA TEMP 10.00	STAB CLASS 10.00	WIND SPEED	WIND DIR	WIND SPEED	WIND DIR	WIND SPEED	WIND DIR
	10.00	10.00	90.00	10.00	60.00	60.00	90.00	90.00	10.00	10.00	60.00	60.00	90.00	90.00
HOUR	DEG C	DEG C	DEG C	PCT	DEG C		DEG C		M/SEC		M/SEC		M/SEC	
1	15.0	10.2	5.2	73.9	1.3	F	1.3	F	2.7	SSE	5.4	SSE	5.8	SSE
2	14.5	10.2	5.2	76.1	1.3	F	1.4	F	2.7	S	5.5	S	5.8	S
3	14.1	10.1	5.3	77.8	1.3	F	1.4	F	2.7	SSW	5.4	S	5.6	S
4	13.7	10.0	5.3	78.9	1.3	F	1.4	F	2.8	S	5.4	S	5.7	S
5	13.4	9.8	5.2	79.6	1.2	F	1.3	F	2.8	S	5.4	S	5.6	S
6	13.3	9.9	5.1	80.3	1.1	F	1.1	E	2.9	SSE	5.4	SSE	5.4	S
7	13.9	10.3	5.2	79.4	.5	E	.5	E	3.1	SSE	5.1	SSE	5.3	S
8	15.0	10.6	5.6	75.8	-.2	E	-.3	E	3.6	SSE	4.9	S	4.9	S
9	16.4	10.9	5.9	71.4	-.4	D	-.5	D	3.9	S	5.0	S	4.9	S
10	17.3	10.7	5.8	66.7	-.5	D	-.6	D	4.0	S	5.1	S	4.9	S
11	18.3	10.7	5.9	63.0	-.6	D	-.7	D	4.1	SSW	5.1	S	5.0	S
12	19.2	10.5	5.7	59.5	-.7	D	-.9	D	4.4	SSW	5.5	SSW	5.3	SSW
13	19.8	10.6	5.8	57.6	-.6	D	-.8	D	4.4	SW	5.5	SW	5.4	SSW
14	20.3	10.5	5.7	55.3	-.6	D	-.8	D	4.5	SW	5.6	SW	5.7	SSW
15	20.7	10.4	5.8	54.1	-.5	D	-.7	D	4.3	SW	5.5	SW	5.7	SSW
16	20.8	10.3	5.7	53.3	-.4	D	-.6	D	4.3	WSW	5.4	SW	5.6	SW
17	20.5	10.2	5.6	53.5	-.3	D	-.5	D	4.0	WSW	5.3	SW	5.5	SW
18	20.2	10.3	5.6	55.3	-.1	E	-.3	E	3.5	WSW	4.8	WSW	5.1	SW
19	19.5	10.3	5.5	57.6	.1	E	-.1	E	2.8	SW	4.5	SW	5.1	SSW
20	18.3	10.3	5.5	61.4	.5	E	.3	E	2.5	SE	4.6	SE	5.1	SE
21	17.5	10.4	5.4	64.9	.8	F	.7	E	2.5	ESE	5.0	ESE	5.6	ESE
22	16.8	10.4	5.4	67.6	1.0	F	.9	E	2.5	SE	5.1	SE	5.7	SE
23	16.2	10.4	5.3	70.1	1.0	F	1.1	E	2.5	SE	5.2	SE	5.8	SE
24	15.6	10.6	5.3	72.6	1.1	F	1.2	E	2.6	SSE	5.2	SE	5.7	SSE
ABSOLUTE MAX	30.6	22.8	21.7	100.0					12.1		15.9		17.7	
AVG DAILY MAX	21.5	13.0	7.6	84.5					5.5		7.9		8.5	
MEAN	17.1	10.4	5.5	66.9	.3	E	.2	E	3.3	S	5.2	S	5.4	S
CLIMATIC MEAN	17.0	10.3	5.7	66.5					3.4		5.2		5.6	
AVG DAILY MIN	12.5	7.5	3.7	48.4					1.4		2.6		2.6	
ABSOLUTE MIN	2.5	-5.0	-7.0	20.2					0.0		0.0		0.0	
STANDARD DEV	5.4	6.2	6.7	18.9					1.8		2.3		2.7	
VALID OBS	2131	2132	2055	2129	1404	1404	2103	2103	2017	2017	1974	1974	1800	1800
INVALID OBS	101	100	177	103	828	828	129	129	215	215	258	258	432	432
TOTAL OBS	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232
DATA RECOVERY	95.5	95.5	92.1	95.4	62.9	62.9	94.2	94.2	90.4	90.4	88.4	88.4	80.6	80.6

TABLE 2.3-17 (Continued) (Sheet 6 of 13)

STATISTICS AND DIURNAL VARIATION OF METEOROLOGICAL PARAMETERS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JUNE

DATA SOURCE: ON-SITE
TABLE GENERATED: 05/31/79. 20.02.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677 - 093 - 07

METEOROLOGICAL PARAMETERS (HEIGHTS IN METERS)

	DRY BULB	DEW POINT	DEW POINT	REL HUMID	DELTA TEMP	STAB CLASS	DELTA TEMP	STAB CLASS	WIND SPEED	WIND DIR	WIND SPEED	WIND DIR	WIND SPEED	WIND DIR
					10.00	10.00	10.00	10.00						
	10.00	10.00	90.00	10.00	60.00	60.00	90.00	90.00	10.00	10.00	60.00	60.00	90.00	90.00
HOUR	DEG C	DEG C	DEG C	PCT	DEG C		DEG C		M/SEC		M/SEC		M/SEC	
1	19.7	15.3	8.9	75.9	1.2	F	1.4	F	2.5	SSW	5.2	SSW	6.2	S
2	19.1	15.1	8.9	77.4	1.3	F	1.5	F	2.5	SSW	5.1	SSW	5.9	S
3	18.7	14.9	8.9	78.9	1.4	F	1.6	F	2.5	SSW	5.0	SSW	5.8	S
4	18.2	14.8	8.8	80.8	1.4	F	1.7	F	2.4	SSW	5.0	SSW	5.8	S
5	17.8	14.7	8.8	82.4	1.4	F	1.7	F	2.5	SSW	5.0	SSW	5.7	SSW
6	17.7	14.8	8.8	83.0	1.2	F	1.4	F	2.4	SSW	4.9	SSW	5.7	SSW
7	18.4	15.2	8.9	81.2	.3	E	.5	E	2.6	SSW	4.5	SSW	5.3	SSW
8	19.8	15.7	9.2	77.4	-.4	D	-.4	D	3.0	SSW	4.1	SW	4.5	SSW
9	21.2	16.1	9.8	72.9	-.6	D	-.6	D	3.1	SSW	3.9	SSW	4.3	SSW
10	22.4	16.2	9.8	68.3	-.6	D	-.8	D	3.3	SSW	4.1	SW	4.4	SSW
11	23.5	16.0	9.7	63.5	-.7	D	-.8	D	3.6	SW	4.4	SW	4.9	SSW
12	24.4	15.9	9.5	59.7	-.7	D	-.9	D	3.9	SW	4.7	SW	5.2	SW
13	25.3	16.0	9.5	57.3	-.7	D	-.8	D	3.9	SW	4.9	SW	5.3	SW
14	25.9	16.0	9.4	55.2	-.6	D	-.7	D	3.9	SW	4.8	SW	5.2	SW
15	26.2	16.0	9.4	54.0	-.6	D	-.7	D	3.9	SW	4.9	SW	5.3	SW
16	26.3	16.0	9.3	53.8	-.5	D	-.5	D	3.7	SW	4.8	SW	5.2	SSW
17	26.1	16.1	9.5	55.0	-.3	D	-.4	E	3.4	SSW	4.6	SSW	5.2	SSW
18	25.6	16.3	9.5	57.1	-.2	E	-.2	E	3.0	SSW	4.2	SSW	4.9	SSW
19	24.6	16.5	9.5	60.8	.0	E	.1	E	2.5	S	4.1	SSW	4.9	S
20	23.5	16.3	9.4	64.6	.4	E	.5	E	2.3	SSE	4.3	S	5.1	SSE
21	22.5	16.0	9.3	67.3	.7	E	.9	E	2.3	SSE	4.6	S	5.5	SSE
22	21.8	15.8	9.3	68.7	1.0	F	1.1	E	2.4	S	4.8	S	5.7	S
23	21.1	15.5	9.1	70.9	1.1	F	1.1	E	2.5	S	5.0	S	6.0	S
24	20.4	15.5	9.1	73.6	1.1	F	1.3	F	2.5	S	5.2	S	6.0	S
ABSOLUTE MAX	33.9	27.5	23.0	100.0					11.0		15.1		13.0	
AVG DAILY MAX	26.4	18.0	11.0	87.0					4.8		7.1		8.2	
MEAN	22.1	15.7	9.3	68.4	.3	E	.3	E	2.9	SSW	4.7	SSW	5.4	SSW
CLIMATIC MEAN	21.7	15.5	9.2	69.2					3.0		4.7		5.4	
AVG DAILY MIN	17.0	13.0	7.4	51.4					1.3		2.4		2.6	
ABSOLUTE MIN	10.1	5.8	-3.0	29.9					0.0		0.0		0.0	
STANDARD DEV	4.6	4.5	7.7	16.1					1.6		2.1		2.3	
VALID OBS	2096	2080	2096	2073	1529	1529	2110	2110	2099	2097	2071	2071	2120	1583
INVALID OBS	64	80	64	87	631	631	50	50	61	63	89	89	40	577
TOTAL OBS	2160	2160	2160	2160	2160	2160	2160	2160	2160	2160	2160	2160	2160	2160
DATA RECOVERY	97.0	96.3	97.0	96.0	70.8	70.8	97.7	97.7	97.2	97.1	95.9	95.9	98.1	73.3

STATISTICS AND DIURNAL VARIATION OF METEOROLOGICAL PARAMETERS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JULY

DATA SOURCE: ON-SITE
TABLE GENERATED: 05/31/79. 20.02.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677 - 093 - 07

METEOROLOGICAL PARAMETERS (HEIGHTS IN METERS)

	DRY BULB	DEW POINT	DEW POINT	REL HUMID	DELTA TEMP 10.00 60.00	STAB CLASS 10.00 60.00	DELTA TEMP 10.00 90.00	STAB CLASS 10.00 90.00	WIND SPEED	WIND DIR	WIND SPEED	WIND DIR	WIND SPEED	WIND DIR
	10.00	10.00	90.00	10.00					10.00	10.00	60.00	60.00	90.00	90.00
HOUR	DEG C	DEG C	DEG C	PCT	DEG C		DEG C		M/SEC		M/SEC		M/SEC	
1	22.8	18.4	10.5	76.3	1.3	F	1.1	E	2.5	SSE	4.9	S	6.1	S
2	22.2	18.3	10.5	78.9	1.3	F	1.1	E	2.3	SSE	4.8	S	6.1	S
3	21.8	18.2	10.4	80.2	1.3	F	1.1	E	2.3	S	4.8	S	6.1	S
4	21.4	18.0	10.4	81.3	1.3	F	1.0	E	2.3	S	4.8	S	6.1	SSW
5	21.0	17.9	10.2	82.6	1.3	F	1.1	E	2.4	S	4.8	S	6.2	SSW
6	20.8	17.9	10.2	83.5	1.2	F	1.0	E	2.2	SSE	4.5	S	6.0	S
7	21.4	18.4	10.2	82.9	.5	E	.6	E	2.4	S	4.2	S	5.6	SSW
8	22.7	19.0	10.7	79.1	-.4	D	-.1	E	2.6	S	3.7	S	4.8	SSW
9	24.3	19.5	11.1	74.7	-.6	D	-.4	D	2.8	S	3.5	SSW	4.2	SSW
10	26.0	19.7	11.3	68.5	-.7	C	-.5	D	3.0	SSW	3.6	SSW	4.2	SSW
11	27.3	19.8	11.3	64.2	-.7	D	-.6	D	3.1	SSW	3.8	SSW	4.4	SSW
12	28.3	19.5	11.0	59.7	-.8	C	-.6	D	3.2	SSW	3.8	SSW	4.5	SSW
13	29.0	19.2	10.8	56.3	-.7	D	-.6	D	3.3	SSW	3.8	SW	4.5	SSW
14	29.5	18.9	10.5	54.1	-.7	D	-.5	D	3.3	SSW	3.9	SSW	4.6	S
15	29.8	18.9	10.3	52.8	-.6	D	-.4	D	3.3	S	4.0	S	4.7	S
16	29.7	18.8	10.3	53.1	-.5	D	-.3	E	3.3	S	4.0	S	4.7	S
17	29.4	18.9	10.4	54.2	-.4	D	-.2	E	3.2	SSE	4.0	SSE	4.8	SE
18	28.8	19.2	10.6	57.2	-.2	E	-.1	E	2.8	SE	3.7	SE	4.6	SE
19	27.7	19.7	10.6	61.9	.1	E	.2	E	2.3	SE	3.7	SE	4.8	SE
20	26.3	19.3	10.7	65.6	.6	E	.3	E	2.3	ESE	4.1	SE	5.3	SE
21	25.2	18.9	10.6	68.2	1.0	F	.7	E	2.2	SE	4.5	SE	5.8	SE
22	24.5	18.7	10.5	70.3	1.1	F	.8	E	2.4	SE	4.8	SE	6.2	SE
23	23.8	18.6	10.5	72.6	1.1	F	.8	E	2.4	SSE	4.8	SSE	6.2	SSE
24	23.2	18.4	10.5	74.6	1.3	F	.9	E	2.4	SSE	4.8	SSE	6.1	S
ABSOLUTE MAX	35.9	26.6	23.6	100.0					9.8		14.4		15.2	
AVG DAILY MAX	30.3	21.1	12.3	87.5					4.4		6.5		8.3	
MEAN	25.3	18.8	10.6	69.0	.3	E	.3	E	2.7	SSE	4.2	S	5.3	S
CLIMATIC MEAN	25.4	18.7	10.6	69.0					2.8		4.4		5.6	
AVG DAILY MIN	20.4	16.4	8.8	50.5					1.3		2.3		2.9	
ABSOLUTE MIN	15.4	6.3	-0.0	24.3					0.0		0.0		.4	
STANDARD DEV	4.1	3.3	5.1	17.2					1.2		1.6		2.2	
VALID OBS	2208	2077	2212	2077	2127	2127	2111	2111	2187	2187	2185	2180	1993	1991
INVALID OBS	24	155	20	155	105	105	121	121	45	45	47	52	239	241
TOTAL OBS	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232
DATA RECOVERY	98.9	93.1	99.1	93.1	95.3	95.3	94.6	94.6	98.0	98.0	97.9	97.7	89.3	89.2

TABLE 2.3-17 (Continued) (Sheet 8 of 13)

STATISTICS AND DIURNAL VARIATION OF METEOROLOGICAL PARAMETERS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - AUGUST

DATA SOURCE: ON-SITE
TABLE GENERATED: 05/21/79. 20.02.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677 - 093 - 07

METEOROLOGICAL PARAMETERS (HEIGHTS IN METERS)

	DRY BULB	DEW POINT	DEW POINT	REL HUMID	DELTA TEMP 10.00	STAB CLASS 10.00	DELTA TEMP 10.00	STAB CLASS 10.00	WIND SPEED	WIND DIR	WIND SPEED	WIND DIR	WIND SPEED	WIND DIR
	10.00	10.00	90.00	10.00	60.00	60.00	90.00	90.00	10.00	10.00	60.00	60.00	90.00	90.00
HOUR	DEG C	DEG C	DEG C	PCT	DEG C		DEG C		M/SEC		M/SEC		M/SEC	
1	21.2	17.4	10.7	78.5	1.0	F	.8	E	2.5	SSE	4.4	SSE	6.3	SSE
2	20.8	17.3	10.7	79.5	1.0	F	.8	E	2.6	SSE	4.5	S	6.5	S
3	20.3	17.2	10.7	81.3	1.0	F	.8	E	2.6	SSE	4.4	S	6.3	S
4	19.9	17.1	10.7	82.8	1.0	F	.8	E	2.6	SSE	4.5	S	6.2	SSW
5	19.5	16.8	10.6	84.1	1.1	F	.9	E	2.5	SSE	4.6	S	6.4	SSW
6	19.2	16.8	10.6	85.6	1.1	F	.9	E	2.5	SSE	4.4	S	6.2	SSW
7	19.6	17.2	10.7	85.6	.7	E	.7	E	2.5	SSE	4.2	S	6.2	SSW
8	20.8	17.7	10.9	82.1	-.3	D	-.1	E	2.7	SSE	3.5	S	5.3	SSW
9	22.3	18.3	11.2	77.5	-.6	D	-.3	E	2.9	S	3.3	S	4.5	SSW
10	23.7	18.6	11.3	72.6	-.7	D	-.3	E	3.2	S	3.4	S	4.4	S
11	25.1	18.5	11.4	66.9	-.8	C	-.3	E	3.3	S	3.5	S	4.6	SSW
12	26.2	18.4	11.5	62.4	-.8	C	-.2	E	3.3	S	3.5	S	4.5	SSW
13	26.9	18.2	11.4	59.1	-.8	C	-.3	E	3.4	S	3.6	S	4.9	SSW
14	27.3	18.0	11.0	57.1	-.7	D	-.0	E	3.4	S	3.6	S	4.6	S
15	27.8	18.0	11.0	55.4	-.7	D	-.1	E	3.3	SSE	3.5	SSE	4.7	S
16	27.7	17.9	11.0	55.3	-.6	D	-.1	E	3.4	SE	3.7	SSE	5.2	SSE
17	27.5	18.0	11.2	56.5	-.4	D	.1	E	3.2	ESE	3.6	ESE	4.8	SE
18	26.7	18.2	11.1	59.8	-.1	E	.2	E	2.8	E	3.6	ESE	4.8	ESE
19	25.5	18.4	11.0	64.9	.2	E	.2	E	2.4	E	3.8	ESE	5.5	ESE
20	24.2	18.0	10.9	68.2	.7	E	.5	E	2.4	ESE	4.2	ESE	6.0	ESE
21	23.4	17.9	11.0	70.7	.9	F	.8	E	2.4	ESE	4.4	ESE	6.3	SE
22	22.8	17.7	11.1	72.7	1.0	F	.8	E	2.6	SE	4.5	SE	6.4	SE
23	22.2	17.6	11.1	74.9	1.0	F	.8	E	2.6	SE	4.5	SE	6.4	SSE
24	21.7	17.5	11.0	76.8	1.0	F	.8	E	2.6	SSE	4.5	SSE	6.3	SSE
ABSOLUTE MAX	35.5	24.3	22.2	100.0					10.4		11.6		13.0	
AVG DAILY MAX	28.3	19.7	12.4	88.5					4.5		6.2		8.3	
MEAN	23.4	17.8	11.0	71.3	.2	E	.4	E	2.8	SSE	4.0	SSE	5.6	S
CLIMATIC MEAN	23.5	17.7	11.0	70.4					2.9		4.1		5.7	
AVG DAILY MIN	18.8	15.7	9.6	52.4					1.3		1.9		3.1	
ABSOLUTE MIN	11.6	7.1	-0.0	32.4					0.0		0.0		0.0	
STANDARD DEV	4.3	3.0	8.3	15.3					1.7		1.5		2.4	
VALID OBS	2140	2042	2215	2042	2135	2135	1486	1486	2177	2173	2177	2165	1729	1714
INVALID OBS	92	190	17	190	97	97	746	746	55	59	55	67	503	518
TOTAL OBS	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232
DATA RECOVERY	95.9	91.5	99.2	91.5	95.7	95.7	66.6	66.6	97.5	97.4	97.5	97.0	77.5	76.8

TABLE 2.3-17 (Continued) (Sheet 9 of 13)

STATISTICS AND DIURNAL VARIATION OF METEOROLOGICAL PARAMETERS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - SEPTEMBER

DATA SOURCE: ON-SITE
TABLE GENERATED: 05/31/79. 20.02.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677 - 093 - 07

METEOROLOGICAL PARAMETERS (HEIGHTS IN METERS)

	DRY BULB	DEW POINT	DEW POINT	REL HUMID	DELTA TEMP	STAB CLASS	DELTA TEMP	STAB CLASS	WIND SPEED	WIND DIR	WIND SPEED	WIND DIR	WIND SPEED	WIND DIR
					10.00	10.00	10.00	10.00						
	10.00	10.00	90.00	10.00	60.00	60.00	90.00	90.00	10.00	10.00	60.00	60.00	90.00	90.00
HOUR	DEG C	DEG C	DEG C	PCT	DEG C		DEG C		M/SEC		M/SEC		M/SEC	
1	17.6	13.3	8.0	76.7	.9	F	.8	E	2.5	SSE	4.4	SSE	6.2	S
2	17.2	13.2	7.9	78.3	.9	F	.9	E	2.4	SE	4.4	SSE	6.1	S
3	16.7	13.0	7.8	79.5	1.0	F	1.0	E	2.4	SSE	4.4	SSE	6.0	S
4	16.4	12.9	7.8	80.6	1.0	F	1.0	E	2.3	SSE	4.2	SSE	5.9	S
5	16.0	12.8	7.7	81.9	1.1	F	1.1	E	2.2	SE	4.2	SSE	5.9	S
6	15.7	12.7	7.6	82.8	1.1	F	1.1	E	2.2	SSE	4.2	SSE	5.9	S
7	15.8	13.0	7.7	84.0	.9	F	1.0	E	2.3	SE	4.1	SSE	5.8	S
8	16.9	13.6	7.7	81.6	-.1	E	.3	E	2.6	SSE	3.6	SSE	5.3	S
9	18.5	14.0	8.2	76.2	-.6	D	-.4	E	3.0	SSE	3.3	SSE	4.4	S
10	20.1	14.3	8.4	70.9	-.7	D	-.5	D	3.1	S	3.2	SSE	4.1	S
11	21.4	14.4	8.5	65.8	-.8	C	-.6	D	3.2	S	3.4	S	4.2	S
12	22.5	14.2	8.4	61.2	-.8	C	-.6	D	3.4	S	3.6	S	4.4	S
13	23.1	14.0	8.4	58.1	-.8	C	-.4	D	3.5	S	3.7	SSE	4.7	S
14	23.7	14.0	8.4	56.3	-.7	D	-.5	D	3.4	S	3.7	SSE	4.5	S
15	23.9	13.8	8.5	55.1	-.7	D	-.5	D	3.4	SSE	3.7	SSE	4.6	SSE
16	24.0	13.8	8.4	54.8	-.6	D	-.4	D	3.3	SSE	3.6	SE	4.5	SSE
17	23.6	13.8	8.4	56.1	-.4	D	-.3	E	3.0	SE	3.6	SE	4.5	SSE
18	22.6	13.9	8.3	59.5	-.1	E	-.1	E	2.6	SE	3.6	SE	4.8	SE
19	21.2	13.7	8.0	63.2	.4	E	.3	E	2.3	ESE	4.0	ESE	5.3	SE
20	20.3	13.5	7.9	66.0	.7	E	.6	E	2.4	SE	4.4	SE	5.9	SSE
21	19.4	13.3	7.9	68.5	.8	F	.7	E	2.5	SE	4.7	SE	6.3	SSE
22	18.9	13.2	7.8	70.5	.8	F	.7	E	2.6	SE	4.6	SE	6.3	SSE
23	18.3	13.3	7.9	72.7	.9	F	.7	E	2.6	SE	4.6	SE	6.3	SSE
24	17.7	13.2	7.9	75.1	.9	F	.8	E	2.5	SE	4.5	SE	6.2	SSE
ABSOLUTE MAX	33.0	23.6	21.7	98.1					7.6		10.4		11.6	
AVG DAILY MAX	24.6	15.9	9.6	86.1					4.4		6.0		8.1	
MEAN	19.7	13.5	8.1	69.8	.2	E	.3	E	2.7	SSE	4.0	SE	5.3	SSE
CLIMATIC MEAN	19.8	13.5	8.0	68.8					2.9		4.1		5.5	
AVG DAILY MIN	15.1	11.1	6.4	51.5					1.3		2.2		2.8	
ABSOLUTE MIN	4.3	-.7	-3.0	27.8					0.0		0.0		0.0	
STANDARD DEV	5.8	5.4	7.4	16.3					1.3		1.7		2.1	
VALID OBS	1853	2160	2160	1853	2155	2155	1881	1881	2159	2158	2156	1858	1900	1900
INVALID OBS	307	0	0	307	5	5	279	279	1	2	4	302	260	260
TOTAL OBS	2160	2160	2160	2160	2160	2160	2160	2160	2160	2160	2160	2160	2160	2160
DATA RECOVERY	85.8	100.0	100.0	85.8	99.8	99.8	87.1	87.1	100.0	99.9	99.8	86.0	88.0	88.0

TABLE 2.3-17 (Continued) (Sheet 10 of 13)

STATISTICS AND DIURNAL VARIATION OF METEOROLOGICAL PARAMETERS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - OCTOBER

DATA SOURCE: ON-SITE
TABLE GENERATED: 05/31/79. 20.02.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677 - 093 - 07

METEOROLOGICAL PARAMETERS (HEIGHTS IN METERS)

	DRY BULB 10.00	DEW POINT 10.00	DEW POINT 90.00	REL HUMID 10.00	DELTA TEMP 10.00 60.00	STAB CLASS 10.00 60.00	DELTA TEMP 10.00 90.00	STAB CLASS 10.00 90.00	WIND SPEED 10.00	WIND DIR 10.00	WIND SPEED 60.00	WIND DIR 60.00	WIND SPEED 90.00	WIND DIR 90.00
HOUR	DEG C	DEG C	DEG C	PCT	DEG C		DEG C		M/SEC		M/SEC		M/SEC	
1	12.2	6.0	4.3	66.9	1.3	F	1.2	E	2.9	S	5.6	SSW	6.8	SSW
2	11.8	6.1	4.6	67.7	1.2	F	1.2	F	2.7	SSW	5.4	SSW	6.6	SSW
3	11.3	5.6	4.4	69.3	1.2	F	1.3	F	2.6	SSW	5.3	SSW	6.6	SSW
4	10.8	5.6	4.4	71.0	1.2	F	1.4	F	2.6	SSW	5.4	SSW	6.8	SSW
5	10.4	5.6	4.3	72.6	1.2	F	1.3	F	2.6	S	5.4	SSW	6.9	SSW
6	10.1	5.4	4.2	73.4	1.1	F	1.3	F	2.6	SSW	5.3	SW	7.0	SSW
7	9.9	5.6	4.2	75.0	1.1	F	1.2	E	2.6	S	5.1	SSW	6.6	SSW
8	10.5	6.1	4.4	74.6	.5	E	.8	E	2.8	S	4.8	SSW	6.2	SSW
9	12.2	6.6	4.6	69.2	-.3	D	-.1	E	3.3	S	4.4	SSW	5.4	SSW
10	14.2	7.0	5.1	62.9	-.6	D	-.5	D	3.6	SSW	4.3	SSW	4.9	SSW
11	15.9	7.0	5.3	56.8	-.7	D	-.6	D	3.8	SW	4.5	SW	5.0	SW
12	17.4	6.9	5.3	51.6	-.8	C	-.6	D	4.0	SW	4.8	SW	5.3	SW
13	18.4	6.6	4.9	47.8	-.7	D	-.6	D	4.1	SW	5.0	SW	5.4	SW
14	19.0	6.9	4.8	46.6	-.7	D	-.5	D	4.3	SW	5.1	SW	5.6	SW
15	19.2	6.7	4.9	45.2	-.6	D	-.5	D	4.1	SW	5.1	SW	5.6	SW
16	19.5	6.6	5.0	44.7	-.5	D	-.4	E	4.0	SW	5.0	SW	5.5	SSW
17	18.9	6.4	5.1	45.4	-.3	D	-.2	E	3.3	SW	4.7	SW	5.4	SW
18	17.6	6.1	4.8	48.1	.1	E	.2	E	2.6	SSW	4.8	SSW	5.5	SSW
19	16.3	6.1	4.8	51.9	.6	E	.7	E	2.6	S	5.1	SSW	6.1	SSW
20	15.3	6.0	4.6	55.1	.8	F	.9	E	2.7	S	5.4	SSW	6.7	S
21	14.5	6.1	4.7	58.3	.9	F	1.0	E	2.9	S	5.6	SSW	6.9	S
22	14.0	6.1	4.6	60.1	1.0	F	1.0	E	2.9	S	5.5	SSW	6.9	S
23	13.3	6.0	4.6	62.2	1.0	F	1.0	E	2.8	S	5.6	SSW	6.8	S
24	12.7	5.9	4.5	64.4	1.1	F	1.1	E	2.9	S	5.7	SSW	6.9	SSW
ABSOLUTE MAX	29.5	25.2	19.4	98.7					8.8		10.8		25.9	
AVG DAILY MAX	19.9	9.4	6.8	79.5					5.1		7.5		9.2	
MEAN	14.4	6.2	4.7	60.1	.4	E	.5	E	3.1	SSW	5.1	SSW	6.1	SSW
CLIMATIC MEAN	14.5	6.3	4.6	60.3					3.3		5.2		6.3	
AVG DAILY MIN	9.1	3.3	2.5	41.0					1.5		2.9		3.4	
ABSOLUTE MIN	-1.3	-13.7	-11.0	6.5					0.0		0.0		.4	
STANDARD DEV	5.8	5.7	6.2	17.6					1.4		1.8		2.2	
VALID OBS	2139	2136	2167	2132	1642	1642	2139	2139	2230	2230	2222	1917	2202	2202
INVALID OBS	93	96	65	100	590	590	93	93	2	2	10	315	30	30
TOTAL OBS	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232
DATA RECOVERY	95.8	95.7	97.1	95.5	73.6	73.6	95.8	95.8	99.9	99.9	99.6	85.9	98.7	98.7

TABLE 2.3-17 (Continued) (Sheet 11 of 13)

STATISTICS AND DIURNAL VARIATION OF METEOROLOGICAL PARAMETERS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - NOVEMBER

DATA SOURCE: ON-SITE
TABLE GENERATED: 05/31/79. 20.02.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677 - 093 - 07

METEOROLOGICAL PARAMETERS (HEIGHTS IN METERS)

	DRY BULB 10.00	DEW POINT 10.00	DEW POINT 90.00	REL HUMID 10.00	DELTA TEMP 10.00 60.00	STAB CLASS 10.00 60.00	DELTA TEMP 10.00 90.00	STAB CLASS 10.00 90.00	WIND SPEED 10.00	WIND DIR 10.00	WIND SPEED 60.00	WIND DIR 60.00	WIND SPEED 90.00	WIND DIR 90.00
HOUR	DEG C	DEG C	DEG C	PCT	DEG C		DEG C		M/SEC		M/SEC		M/SEC	
1	6.7	1.7	.5	70.6	.3	E	.6	E	3.4	S	5.7	SW	6.9	SW
2	6.3	1.6	.5	72.5	.4	E	.6	E	3.5	S	5.7	SW	7.0	SW
3	6.0	1.5	.4	73.5	.5	E	.7	E	3.5	S	5.7	SW	7.0	SW
4	5.7	1.5	.4	74.6	.5	E	.7	E	3.3	S	5.7	SW	6.8	SW
5	5.5	1.4	.5	75.1	.4	E	.7	E	3.4	S	5.7	SW	6.8	SSW
6	5.2	1.3	.5	75.6	.4	E	.7	E	3.3	S	5.6	SW	6.7	SSW
7	5.1	1.3	.5	76.4	.4	E	.7	E	3.3	S	5.7	SW	6.6	SSW
8	5.2	1.5	.4	77.0	.2	E	.5	E	3.4	S	5.5	SSW	6.4	SSW
9	6.1	1.8	.6	74.8	-.3	D	-.0	E	3.6	S	5.1	SSW	6.0	SSW
10	7.3	2.2	.8	70.7	-.6	D	-.3	E	4.0	S	5.1	SSW	5.7	SSW
11	8.5	2.2	.8	66.0	-.7	D	-.3	E	4.1	SSW	5.1	SSW	5.5	SSW
12	9.7	2.3	.7	62.0	-.7	D	-.2	E	4.2	SSW	5.1	SW	5.5	SW
13	10.6	2.3	.7	59.3	-.7	D	-.3	E	4.2	SW	5.1	SW	5.5	SW
14	11.1	2.2	.7	57.4	-.6	D	-.4	E	4.2	SW	5.2	WSW	5.6	WSW
15	11.2	2.2	.6	56.9	-.6	D	-.3	E	4.1	SW	5.2	WSW	5.6	WSW
16	11.1	2.1	.6	56.9	-.4	D	-.2	E	3.9	SW	5.1	WSW	5.5	SW
17	10.5	1.9	.5	58.4	-.2	E	.1	E	3.3	SW	4.8	WSW	5.3	WSW
18	9.7	1.8	.5	60.5	.1	E	.3	E	3.0	SE	5.0	SSW	5.7	S
19	8.9	1.6	.4	62.7	.2	E	.3	E	3.1	SE	5.3	SSW	6.1	S
20	8.4	1.5	.3	64.1	.3	E	.4	E	3.1	SE	5.4	S	6.4	S
21	7.8	1.5	.4	66.0	.3	E	.4	E	3.2	SSE	5.4	S	6.5	S
22	7.4	1.6	.6	67.6	.4	E	.4	E	3.3	SSE	5.6	SSW	6.7	S
23	7.1	1.7	.4	68.6	.3	E	.5	E	3.4	SSE	5.6	SSW	6.8	S
24	6.8	1.6	.5	70.1	.3	E	.5	E	3.4	SSE	5.7	SSW	6.9	SSW
ABSOLUTE MAX	26.5	17.0	20.0	99.3					8.6		12.4		13.3	
AVG DAILY MAX	12.3	4.8	2.8	82.7					5.5		7.8		8.9	
MEAN	7.8	1.8	.5	67.5	.0	E	.2	E	3.5	S	5.4	SW	6.2	SSW
CLIMATIC MEAN	8.0	1.8	.6	67.7					3.6		5.4		6.2	
AVG DAILY MIN	3.7	-1.2	-1.7	52.7					1.8		3.0		3.5	
ABSOLUTE MIN	-5.5	-12.2	-13.4	18.8					.4		0.0		0.0	
STANDARD DEV	6.1	5.7	5.2	18.9					1.6		2.1		2.4	
VALID OBS	2093	2083	2090	2071	1647	1647	2157	2157	2148	2147	2110	2069	2116	2116
INVALID OBS	67	77	70	89	513	513	3	3	12	13	50	91	44	44
TOTAL OBS	2160	2160	2160	2160	2160	2160	2160	2160	2160	2160	2160	2160	2160	2160
DATA RECOVERY	96.9	96.4	96.8	95.9	76.2	76.2	99.9	99.9	99.4	99.4	97.7	95.8	98.0	98.0

TABLE 2.3-17 (Continued) (Sheet 12 of 13)

STATISTICS AND DIURNAL VARIATION OF METEOROLOGICAL PARAMETERS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - DECEMBER

DATA SOURCE: ON-SITE
TABLE GENERATED: 05/31/79. 20.32.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677 - 093 - 07

METEOROLOGICAL PARAMETERS (HEIGHTS IN METERS)

	DRY BULB 10.00	DEW POINT 10.00	DEW POINT 90.00	REL HUMID 10.00	DELTA TEMP 10.00 60.00	STAB CLASS 10.00 60.00	DELTA TEMP 10.00 90.00	STAB CLASS 10.00 90.00	WIND SPEED 10.00	WIND DIR 10.00	WIND SPEED 60.00	WIND DIR 60.00	WIND SPEED 90.00	WIND DIR 90.00
HOUR	DEG C	DEG C	DEG C	PCT	DEG C		DEG C		M/SEC		M/SEC		M/SEC	
1	.2	-3.3	-2.4	73.2	.2	E	.2	E	3.7	SSW	5.7	SW	6.8	SW
2	.1	-3.7	-2.6	74.0	.2	E	.3	E	3.6	SW	5.7	SW	6.9	SW
3	-.4	-3.8	-2.7	75.1	.2	E	.3	E	3.7	SW	5.7	SW	6.7	WSW
4	-.7	-4.0	-2.7	75.8	.2	E	.3	E	3.8	SSW	5.7	SW	6.9	SW
5	-.9	-4.2	-2.8	75.8	.2	E	.3	E	3.7	SSW	5.6	SW	6.8	SW
6	-1.2	-4.2	-2.8	76.3	.2	E	.3	E	3.7	SSW	5.6	SW	6.7	SW
7	-1.3	-4.4	-2.9	75.9	.2	E	.4	E	3.7	SSW	5.6	SSW	6.7	SW
8	-1.5	-4.3	-2.9	77.2	.2	E	.3	E	3.8	SSW	5.7	SSW	6.7	SW
9	-1.0	-3.9	-2.8	77.2	-.2	E	.0	E	4.0	SSW	5.6	SW	6.5	SW
10	-.3	-3.8	-2.7	74.3	-.6	D	-.4	E	4.4	SW	5.5	SW	6.3	SW
11	.7	-3.6	-2.6	70.7	-.7	D	-.6	D	4.6	SW	5.6	SW	6.1	SW
12	1.6	-3.6	-2.5	66.7	-.8	C	-.6	D	4.6	SW	5.7	SW	6.0	SW
13	2.2	-3.6	-2.4	64.2	-.8	C	-.6	D	4.8	SW	5.9	SW	6.3	SW
14	2.9	-3.5	-2.2	62.1	-.7	D	-.6	D	4.7	SW	5.7	SW	6.1	SW
15	3.2	-3.5	-2.2	61.1	-.6	D	-.5	D	4.6	SW	5.7	SW	6.2	SW
16	3.2	-3.4	-2.2	61.7	-.5	D	-.3	E	4.2	SW	5.4	SW	6.0	SW
17	2.8	-3.5	-2.2	62.7	-.3	D	-.2	E	3.7	SW	5.3	SW	5.8	SW
18	2.2	-3.5	-2.2	64.7	-.0	E	-.0	E	3.6	SW	5.4	SW	6.2	SW
19	1.9	-3.4	-2.1	67.0	.1	E	.1	E	3.5	SW	5.6	SW	6.5	SW
20	1.5	-3.3	-2.0	69.1	.1	E	.1	E	3.6	WSW	5.6	SW	6.7	WSW
21	1.2	-3.3	-2.1	70.1	.1	E	.2	E	3.6	WSW	5.8	WSW	6.9	WSW
22	.9	-3.3	-2.2	71.5	.2	E	.2	E	3.7	WSW	5.8	WSW	6.9	WSW
23	.6	-3.4	-2.3	71.7	.2	E	.2	E	3.7	SW	5.7	SW	6.8	WSW
24	.4	-3.5	-2.4	72.2	.2	E	.2	E	3.6	SW	5.7	SW	6.6	WSW
ABSOLUTE MAX	21.7	20.4	12.0	99.3					10.7		11.6		15.8	
AVG DAILY MAX	5.1	-.4	-.3	83.4					6.0		8.0		9.1	
MEAN	.8	-3.7	-2.5	70.4	-.1	E	-.0	E	3.9	SW	5.6	SW	6.5	SW
CLIMATIC MEAN	1.3	-3.2	-2.3	69.8					4.0		5.6		6.4	
AVG DAILY MIN	-2.5	-5.9	-4.2	56.2					2.0		3.3		3.7	
ABSOLUTE MIN	-17.7	-19.0	-20.2	28.6					0.0		0.0		0.0	
STANDARD DEV	5.9	5.1	4.8	15.6					1.7		2.1		2.4	
VALID OBS	1775	1976	2106	1721	1161	1161	2050	2050	2064	2062	2031	2030	1879	1658
INVALID OBS	457	256	126	511	1071	1071	182	182	168	170	201	202	353	574
TOTAL OBS	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232	2232
DATA RECOVERY	79.5	88.5	94.4	77.1	52.0	52.0	91.8	91.8	92.5	92.4	91.0	90.9	84.2	74.3

TABLE 2.3-17 (Continued) (Sheet 13 of 13)

STATISTICS AND DIURNAL VARIATION OF METEOROLOGICAL PARAMETERS
DATA PERIOD: THREE YEARS COMBINED

DATA SOURCE: ON-SITE
TABLE GENERATED: 06/15/79. 20.06.18.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677 - 093 - 07

METEOROLOGICAL PARAMETERS (HEIGHTS IN METERS)

	DRY BULB	DEW POINT	DEW POINT	REL HUMID	DELTA TEMP 10.00	STAB CLASS 10.00	DELTA TEMP 10.00	STAB CLASS 10.00	WIND SPEED	WIND DIR	WIND SPEED	WIND DIR	WIND SPEED	WIND DIR
	10.00	10.00	90.00	10.00	60.00	60.00	90.00	90.00	10.00	10.00	60.00	60.00	90.00	90.00
HOUR	DEG C	DEG C	DEG C	PCT	DEG C		DEG C		M/SEC		M/SEC		M/SEC	
1	11.3	5.9	3.4	71.8	.8	F	.7	E	3.2	S	5.5	S	6.7	S
2	10.9	5.8	3.4	73.2	.8	F	.8	E	3.1	S	5.5	SSW	6.6	SSW
3	10.5	5.7	3.3	74.5	.8	F	.8	E	3.1	S	5.4	SSW	6.6	SSW
4	10.1	5.6	3.3	75.7	.8	F	.8	E	3.1	S	5.4	SSW	6.6	SSW
5	9.8	5.5	3.2	76.8	.8	F	.8	E	3.1	S	5.4	SSW	6.6	SSW
6	9.5	5.4	3.2	77.6	.7	E	.8	E	3.1	S	5.3	SSW	6.5	SSW
7	9.7	5.6	3.2	77.7	.4	E	.5	E	3.2	S	5.1	S	6.3	SSW
8	10.5	5.9	3.4	76.0	-.1	E	.1	E	3.4	S	4.9	SSW	5.9	SSW
9	11.7	6.3	3.6	72.3	-.5	D	-.3	E	3.7	S	4.7	SSW	5.5	SSW
10	13.0	6.6	3.8	67.8	-.6	D	-.5	D	3.9	SSW	4.8	SSW	5.3	SSW
11	14.3	6.6	3.8	63.3	-.7	D	-.5	D	4.1	SSW	4.9	SSW	5.4	SSW
12	15.3	6.6	3.8	59.2	-.7	D	-.5	D	4.2	SSW	5.0	SSW	5.5	SSW
13	16.1	6.6	3.7	56.4	-.7	D	-.5	D	4.3	SW	5.1	SW	5.7	SW
14	16.7	6.5	3.6	54.7	-.7	D	-.5	D	4.3	SW	5.2	SW	5.7	SSW
15	16.9	6.4	3.6	53.5	-.6	D	-.4	D	4.3	SW	5.2	SW	5.8	SSW
16	17.0	6.4	3.6	53.4	-.5	D	-.3	E	4.1	SSW	5.1	SW	5.7	SSW
17	16.6	6.3	3.6	54.2	-.4	D	-.2	E	3.8	SSW	4.9	SSW	5.6	SSW
18	15.9	6.3	3.6	56.6	-.1	E	-.0	E	3.4	S	4.9	SSW	5.6	S
19	14.9	6.3	3.6	59.7	.1	E	.1	E	3.1	SSE	5.0	S	5.9	SSE
20	14.0	6.2	3.5	62.5	.4	E	.3	E	3.0	SE	5.1	SSE	6.2	SSE
21	13.3	6.2	3.5	64.9	.6	E	.5	E	3.1	SE	5.3	SSE	6.5	SSE
22	12.7	6.1	3.6	66.8	.6	E	.6	E	3.1	SSE	5.4	SSE	6.6	SSE
23	12.2	6.1	3.5	68.5	.7	E	.6	E	3.2	SSE	5.4	SSE	6.6	S
24	11.7	6.0	3.5	70.3	.7	E	.7	E	3.2	SSE	5.5	S	6.6	S
ABSOLUTE MAX	35.9	27.5	23.6	100.0					15.4		19.1		25.9	
AVG DAILY MAX	17.8	9.0	5.5	83.2					5.5		7.6		9.0	
MEAN	13.1	6.1	3.5	66.2	.1	E	.2	E	3.5	S	5.2	SSW	6.1	SSW
CLIMATIC MEAN	13.1	6.1	3.5	66.2					3.6		5.2		6.2	
AVG DAILY MIN	8.4	3.3	1.5	49.2					1.7		2.8		3.3	
ABSOLUTE MIN	-24.0	-27.8	-20.5	6.5					0.0		0.0		0.0	
STANDARD DEV	10.7	10.4	4.4	18.2					1.8		2.2		2.5	
VALID OBS	23832	24784	25497	23404	20783	20783	23962	23962	25178	25158	24592	23850	23274	22450
INVALID OBS	2448	1496	783	2876	5497	5497	2318	2318	1102	1122	1688	2430	3006	3830
TOTAL OBS	26280	26280	26280	26280	26280	26280	26280	26280	26280	26280	26280	26280	26280	26280
DATA RECOVERY	90.7	94.3	97.0	89.1	79.1	79.1	91.2	91.2	95.8	95.7	93.6	90.8	88.6	85.4

(Sheet 1 of 4)

TABLE 2.3-18 PERSISTENCE OF WIND DIRECTION FREQUENCY DISTRIBUTION (IN PERCENT)

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: WINTER 1959-1969

HOURS OF PERSISTENCE	WIND DIRECTION																
	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	CALM
3	43.6	47.6	36.1	41.5	38.6	39.0	39.0	31.2	56.0	61.7	43.7	43.8	39.2	37.0	51.5	41.4	82.3
6	19.2	16.9	27.6	27.0	20.4	33.3	28.6	21.6	29.2	22.2	28.2	31.8	21.9	25.9	25.1	27.4	17.6
9	19.8	16.1	10.7	12.0	15.3	14.6	16.4	18.9	10.6	11.1	13.4	10.7	15.0	16.2	13.4	14.3	0.0
12	10.1	6.1	7.1	4.0	9.3	6.5	9.7	8.9	4.0	4.9	11.0	7.7	5.7	8.6	7.1	9.5	0.0
15	0.0	7.6	8.9	7.5	0.0	4.0	6.1	7.1	0.0	0.0	3.4	1.6	5.9	3.2	0.0	0.0	0.0
18	3.0	0.0	0.0	0.0	5.5	2.4	0.0	7.3	0.0	0.0	0.0	1.9	5.7	2.6	2.6	2.0	0.0
21	0.0	5.3	3.1	3.5	6.5	0.0	0.0	2.8	0.0	0.0	0.0	2.2	1.6	4.5	0.0	2.4	0.0
24	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	2.7	0.0
27	0.0	0.0	0.0	4.5	4.1	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE 2.3-18 (Continued) (Sheet 2 of 4)

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: WINTER 1959-1969

HOURS OF PERSISTENCE	WIND DIRECTION																
	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	CALM
3	61.0	56.3	43.4	47.3	42.2	44.8	47.9	37.5	64.7	60.2	51.6	44.0	39.0	39.7	51.2	50.9	68.0
6	24.1	29.8	24.4	24.6	31.8	21.9	25.3	28.2	25.5	25.7	24.1	32.5	26.2	27.9	28.2	23.8	12.7
9	6.0	5.1	13.9	17.3	16.6	17.8	9.9	16.9	7.9	8.7	10.9	9.5	7.6	15.8	8.7	17.1	19.1
12	5.3	2.3	13.5	1.5	1.4	2.5	7.7	7.7	1.7	2.3	7.3	7.9	10.2	11.1	11.7	5.7	0.0
15	3.3	2.8	2.1	1.9	5.5	1.5	5.5	7.0	0.0	2.9	3.6	1.9	2.8	3.1	0.0	2.3	0.0
18	0.0	3.4	2.5	4.6	2.2	3.7	1.6	1.0	0.0	0.0	2.2	0.0	5.1	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	2.6	0.0	2.1	1.9	0.0	0.0	0.0	0.0	0.0	3.9	2.1	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	2.5	0.0	1.4	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0

TABLE 2.3-18 (Continued) (Sheet 3 of 4)

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: WINTER 1959-1969

HOURS OF PERSISTENCE	WIND DIRECTION																
	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	CALM
3	63.7	69.6	‘55.5	50.9	45.4	54.9	49.8	38.2	57.7	66.8	62.3	75.1	58.8	51.6	63.8	48.6	64.3
6	29.5	18.0	22.0	24.9	20.9	21.9	27.0	27.7	24.7	26.7	23.0	13.7	20.5	28.1	24.7	26.8	32.1
9	4.0	9.6	12.7	11.3	22.0	10.1	10.6	19.5	13.3	2.7	11.5	8.2	8.8	14.0	11.4	11.4	3.4
12	2.6	2.5	5.0	9.0	5.5	4.5	7.1	9.6	2.5	3.6	3.0	2.7	2.9	2.6	0.0	7.6	0.0
15	0.0	0.0	2.1	3.7	1.7	4.2	3.3	0.7	1.5	0.0	0.0	0.0	0.0	3.3	0.0	1.9	0.0
18	0.0	0.0	2.5	0.0	4.2	1.6	0.0	1.7	0.0	0.0	0.0	0.0	8.8	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	2.5	2.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.4	0.0

TABLE 2.3-18 (Continued) (Sheet 4 of 4)

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: WINTER 1959-1969

HOURS OF PERSISTENCE	WIND DIRECTION																
	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	CALM
3	46.2	50.0	47.4	60.3	51.2	42.5	40.7	28.8	63.3	75.1	53.8	60.6	43.3	44.4	47.4	35.9	75.5
6	32.9	23.7	27.7	17.2	28.5	28.7	21.1	26.2	23.2	21.3	37.6	27.5	22.2	17.3	32.9	29.6	24.4
9	9.4	22.8	13.8	15.5	10.0	17.4	19.0	18.7	6.4	3.5	6.7	6.2	12.2	17.7	6.1	13.3	0.0
12	5.0	3.3	2.3	6.9	3.3	6.1	6.1	12.2	6.9	0.0	1.7	5.5	16.3	11.1	10.3	7.4	0.0
15	6.3	0.0	8.6	0.0	4.2	3.0	4.8	7.3	0.0	0.0	0.0	0.0	3.7	1.5	0.0	3.7	0.0
18	0.0	0.0	0.0	0.0	2.5	0.0	8.0	2.3	0.0	0.0	0.0	0.0	2.2	1.8	3.0	4.4	0.0
21	0.0	0.0	0.0	0.0	0.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	2.4	0.0	2.9	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.0	0.0	0.0	0.0	3.4	0.0	0.0	0.0
36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE 2.3-19 WIND DIRECTION PERSISTENCE - 10 METERS

WIND DIRECTION PERSISTENCE - PASQUILL *E*
1 SECTOR PERSISTENCE

CONSECUTIVE HOURS

SECTOR	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>24
NNE	34	5	3	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NE	15	4	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ENE	18	1	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E	22	8	2	5	2	2	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
ESE	40	9	7	2	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	77	32	16	13	2	3	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
SSE	71	27	18	15	5	7	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S	66	32	9	10	4	5	2	1	1	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0
SSW	62	18	15	2	3	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SW	44	10	2	4	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WSW	25	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W	22	9	5	5	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WNW	27	10	1	1	1	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
NW	30	5	4	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NNW	22	8	5	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N	30	7	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

AVERAGE WIND SPEED (M/SEC)

CONSECUTIVE HOURS

SECTOR	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>24
NNE	2.35	1.78	3.18	2.32	0.	0.	0.	4.12	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NE	2.51	2.52	2.09	0.	2.65	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ENE	3.11	2.32	1.95	0.	0.	0.	0.	0.	0.	3.74	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
E	2.62	3.54	2.65	3.58	4.87	4.20	4.51	0.	0.	0.	0.	4.64	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ESE	2.94	3.07	3.50	3.68	3.62	0.	0.	3.81	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SE	3.36	3.22	4.16	3.60	3.21	4.29	3.81	2.98	0.	4.46	5.49	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SSE	3.42	3.72	3.80	3.98	3.71	3.97	3.82	4.09	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
S	3.66	4.37	3.64	4.73	4.46	4.39	4.88	2.85	4.57	5.31	5.14	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SSW	3.66	3.93	4.37	3.02	4.19	3.84	4.50	5.39	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SW	4.02	4.87	2.12	4.82	6.10	0.	0.	4.58	0.	4.71	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WSW	4.64	3.83	4.53	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
W	3.72	4.32	2.19	3.94	0.	0.	0.	2.19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WNW	3.47	2.68	3.37	2.95	3.79	8.83	2.93	0.	0.	0.	0.	0.	0.	5.11	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW	2.74	2.60	3.13	1.43	0.	0.	3.31	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NNW	2.88	2.28	2.80	2.17	0.	2.96	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
N	2.52	3.45	2.12	4.05	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TOTAL NO. OF OBSERVATIONS = 17520
TOTAL NO. OF INVALID OBSERVATIONS = 681

TABLE 2.3-19 (Continued)

WIND DIRECTION PERSISTENCE - PASQUILL "F"
1 SECTOR PERSISTENCE

CONSECUTIVE HOURS

SECTOR	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>24
NNE	11	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NE	14	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ENE	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E	8	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	11	3	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	41	18	7	3	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SSE	59	17	12	4	3	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S	46	9	7	1	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SSW	32	12	3	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SW	25	7	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WSW	19	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W	12	7	5	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WNW	13	2	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NW	11	5	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NNW	9	3	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N	8	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

AVERAGE WIND SPEED (M/SEC)

CONSECUTIVE HOURS

SECTOR	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>24
NNE	1.71	1.45	.32	2.10	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NE	1.39	1.64	1.73	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ENE	2.83	2.22	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
E	1.75	1.86	1.68	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ESE	1.95	1.92	99.99	0.	1.80	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SE	2.55	3.09	2.76	2.90	2.06	0.	0.	0.	4.29	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SSE	2.65	2.83	3.10	2.58	3.47	2.99	0.	0.	0.	99.99	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
S	2.79	3.27	3.80	4.38	4.12	3.40	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SSW	3.16	3.05	3.36	3.87	0.	3.15	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SW	2.64	3.79	3.71	0.	2.82	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WSW	2.28	2.72	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
W	2.24	2.34	2.18	3.35	3.39	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WNW	2.36	1.91	2.34	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW	1.65	1.77	0.	2.85	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NNW	1.72	2.25	0.	1.79	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
N	2.29	2.63	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TOTAL NO. OF OBSERVATIONS = 17520
TOTAL NO. OF INVALID OBSERVATIONS = 681

TABLE 2.3-19 (Continued) (Sheet 3 of 4)

WIND DIRECTION PERSISTENCE - PASQUILL #G#
1 SECTOR PERSISTENCE

CONSECUTIVE HOURS

SECTOR	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>24
NNE	11	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NE	10	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ENE	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	13	1	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SSE	15	7	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S	9	9	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SSW	8	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SW	15	5	4	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WSW	5	5	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W	5	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WNW	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NW	6	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NNW	5	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N	7	2	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

AVERAGE WIND SPEED (M/SEC)

CONSECUTIVE HOURS

SECTOR	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>24
NNE	1.73	99.99	0.	2.36	0.	0.	1.75	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NE	1.34	1.34	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ENE	1.95	99.99	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
E	1.44	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ESE	1.97	1.19	99.99	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SE	2.70	3.10	3.13	2.83	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SSE	3.04	2.56	2.57	8.78	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
S	2.27	2.02	2.60	3.59	2.38	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SSW	2.13	2.50	2.49	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SW	2.34	2.22	2.76	2.06	0.	1.07	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WSW	2.15	2.06	2.35	0.	1.80	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
W	2.01	1.97	1.85	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WNW	1.97	0.	99.99	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW	1.76	1.99	3.77	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NNW	1.87	2.31	0.	0.	1.50	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
N	1.67	1.95	1.40	1.42	0.	0.	0.	1.45	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TOTAL NO. OF OBSERVATIONS = 17520
TOTAL NO. OF INVALID OBSERVATIONS = 681

TABLE 2.3-19 (Continued) (Sheet 4 of 4)

WIND DIRECTION PERSISTENCE - PASQUILL ALL
1 SECTOR PERSISTENCE

CONSECUTIVE HOURS

SECTOR	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>24
NNE	87	40	22	9	7	2	2	2	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NE	76	25	16	4	4	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ENE	66	18	11	3	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
E	80	36	12	11	7	3	0	3	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
ESE	89	32	17	9	12	7	4	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
SE	158	59	40	28	24	16	13	8	3	3	5	0	0	0	1	0	0	1	0	0	0	0	0	1
SSE	170	90	46	30	17	20	8	1	6	3	0	1	1	0	0	1	0	0	1	0	0	0	0	0
S	162	89	41	27	17	10	9	9	5	3	1	2	0	1	0	1	0	0	0	0	0	0	0	0
SSW	160	74	40	24	16	8	2	3	2	3	2	0	1	0	0	1	0	0	0	0	0	0	0	0
SW	129	51	17	19	8	7	4	0	1	2	0	2	0	0	0	0	0	0	1	0	0	0	0	0
WSW	78	41	12	4	4	3	0	1	2	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0
W	92	44	30	21	6	8	4	5	3	3	0	1	1	0	1	0	0	0	0	0	0	0	0	0
WNW	100	42	30	25	5	9	2	4	3	3	3	1	0	1	1	1	0	0	0	0	1	0	0	0
NW	92	38	29	13	4	9	9	3	1	0	2	1	0	1	0	0	1	1	0	0	0	0	0	0
NNW	72	42	18	12	10	9	4	1	2	2	2	1	1	0	1	0	0	0	0	0	0	0	0	0
N	71	37	27	14	10	5	4	2	0	2	2	0	1	2	1	0	0	0	0	0	0	0	0	0

AVERAGE WIND SPEED (M/SEC)

CONSECUTIVE HOURS

SECTOR	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>24
NNE	2.50	3.41	2.90	3.41	3.09	4.33	3.41	3.09	2.92	2.81	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NE	2.42	2.42	3.37	2.74	2.96	2.03	2.68	3.53	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ENE	2.82	2.46	2.43	4.67	0.	4.58	5.00	5.62	5.21	3.74	6.13	4.47	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
E	2.99	3.11	3.83	3.42	4.34	4.06	0.	4.60	5.02	3.64	0.	0.	4.66	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ESE	2.97	3.36	3.60	3.34	4.08	4.12	6.61	8.27	4.96	0.	0.	0.	0.	4.64	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SE	3.09	3.30	3.66	3.48	3.30	3.88	4.14	3.84	3.29	5.10	4.14	0.	0.	0.	4.61	0.	0.	6.53	0.	0.	0.	0.	0.	4.03
SSE	3.39	3.11	3.60	4.38	3.64	3.63	4.35	5.45	3.90	3.72	0.	4.42	3.05	0.	0.	8.07	0.	0.	4.28	0.	0.	0.	0.	0.
S	3.43	3.82	3.76	4.34	4.44	4.67	5.34	5.28	3.76	5.68	5.46	5.02	0.	7.85	0.	5.69	0.	0.	0.	0.	0.	0.	0.	0.
SSW	3.79	3.84	4.28	3.95	4.94	3.65	3.31	5.84	4.00	4.47	5.40	0.	4.98	0.	0.	7.88	0.	0.	0.	0.	0.	0.	0.	0.
SW	3.64	3.73	3.66	4.08	5.34	4.19	2.77	0.	2.57	4.99	0.	5.80	0.	0.	0.	0.	0.	0.	4.28	0.	0.	0.	0.	0.
WSW	3.33	3.47	4.73	5.74	3.15	6.26	0.	7.02	3.30	0.	9.50	0.	0.	0.	0.	6.49	0.	0.	0.	0.	0.	0.	0.	0.
W	3.05	3.89	3.79	3.73	4.03	6.42	5.71	5.78	5.38	3.56	0.	5.54	6.98	0.	99.99	0.	0.	0.	0.	0.	0.	0.	0.	0.
WNW	3.42	4.05	4.98	4.18	5.15	5.37	3.85	6.26	4.49	4.95	4.98	5.95	0.	7.95	5.05	5.36	0.	0.	0.	0.	5.63	0.	0.	0.
NW	3.26	3.49	3.72	3.62	4.04	5.12	4.66	4.60	5.19	0.	4.54	6.40	0.	4.26	0.	0.	7.52	5.67	0.	0.	0.	0.	0.	0.
NNW	3.11	3.48	4.20	3.74	3.88	3.57	4.92	6.21	4.68	4.24	4.48	3.05	99.99	0.	5.65	0.	0.	0.	0.	0.	0.	0.	0.	0.
N	3.04	3.03	4.00	4.00	3.14	5.21	3.31	5.79	0.	4.91	2.61	0.	5.94	3.35	7.74	0.	0.	0.	0.	0.	0.	0.	0.	0.

TOTAL NO. OF OBSERVATIONS = 17520
TOTAL NO. OF INVALID OBSERVATIONS = 275

TABLE 2.3-20 WIND DIRECTION PERSISTENCE - 60 METERS

WIND DIRECTION PERSISTENCE - PASQUILL #E#
1 SECTOR PERSISTENCE

CONSECUTIVE HOURS

SECTOR	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>24
NNE	20	4	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NE	21	8	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ENE	16	4	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E	31	7	3	3	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
ESE	33	16	6	4	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	60	21	16	11	5	2	5	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SSE	67	23	16	11	6	3	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
S	64	29	14	14	8	2	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SSW	66	25	10	9	4	5	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SW	37	19	9	4	3	1	0	1	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
WSW	28	9	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W	18	9	1	2	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WNW	30	12	6	2	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0
NW	27	8	5	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NNW	21	8	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N	17	5	1	4	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

AVERAGE WIND SPEED (M/SEC)

CONSECUTIVE HOURS

SECTOR	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>24
NNE	4.15	4.37	4.64	6.66	4.16	2.64	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NE	3.17	4.37	4.30	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ENE	4.23	4.77	3.65	0.	0.	0.	0.	0.	0.	4.45	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
E	4.20	5.17	7.04	4.52	6.27	0.	0.	0.	0.	0.	6.33	5.46	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ESE	5.03	5.68	5.93	4.93	5.28	0.	0.	5.55	6.04	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SE	4.91	6.05	6.04	5.42	5.26	4.52	6.26	0.	5.56	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SSE	5.23	6.23	5.62	5.65	5.49	6.49	0.	0.	0.	0.	0.	4.82	0.	5.24	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
S	5.55	5.56	6.38	6.99	6.42	7.48	7.47	0.	9.63	7.06	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SSW	5.95	6.18	5.79	6.20	6.67	7.59	6.76	6.96	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SW	6.10	6.62	5.18	7.89	6.53	7.73	0.	6.81	0.	6.61	8.88	0.	7.78	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WSW	6.20	6.00	7.83	9.28	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
W	5.24	5.63	99.99	99.99	6.50	6.87	0.	5.87	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WNW	5.68	5.36	6.73	7.46	0.	0.	0.	5.66	0.	7.95	0.	13.19	0.	7.09	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW	5.34	5.78	4.92	0.	0.	0.	0.	6.62	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NNW	4.66	4.94	5.32	6.18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
N	4.97	4.41	7.42	5.70	0.	3.98	0.	0.	0.	6.56	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TOTAL NO. OF OBSERVATIONS = 17520
TOTAL NO. OF INVALID OBSERVATIONS = 1473

TABLE 2.3-20 (Continued) (Sheet 2 of 4)

WIND DIRECTION PERSISTENCE - PASQUILL #F#
1 SECTOR PERSISTENCE

CONSECUTIVE HOURS

SECTOR	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>24
NNE	8	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NE	6	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ENE	10	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E	14	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	9	6	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	23	10	3	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SSE	25	20	10	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S	38	21	8	0	1	5	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SSW	36	23	11	8	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SW	35	14	10	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WSW	19	5	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W	17	8	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WNW	7	4	3	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NW	14	4	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NNW	6	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N	11	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

AVERAGE WIND SPEED (M/SEC)

CONSECUTIVE HOURS

SECTOR	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>24
NNE	3.61	3.91	5.50	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NE	3.84	4.18	4.11	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ENE	4.72	5.02	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
E	4.02	4.66	5.58	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ESE	4.45	4.67	4.83	0.	4.10	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SE	4.55	4.36	4.89	5.59	5.02	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SSE	5.42	5.67	5.72	5.66	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
S	5.05	4.97	5.52	0.	4.58	5.35	0.	0.	99.99	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SSW	5.31	5.82	5.39	6.49	7.16	7.03	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SW	5.83	6.52	6.33	8.66	6.72	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WSW	5.30	6.10	7.40	0.	8.40	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
W	4.93	5.41	7.59	7.28	5.60	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WNW	5.96	6.36	7.15	0.	7.26	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW	4.70	5.43	5.78	0.	6.38	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NNW	5.42	5.66	0.	0.	0.	3.49	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
N	5.46	5.45	3.91	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TOTAL NO. OF OBSERVATIONS = 17520
TOTAL NO. OF INVALID OBSERVATIONS = 1473

TABLE 2.3-20 (Continued)

WIND DIRECTION PERSISTENCE - PASQUILL #G#
1 SECTOR PERSISTENCE

CONSECUTIVE HOURS

SECTOR	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>24
NNE	1	3	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NE	5	3	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ENE	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	2	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SSE	4	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S	12	6	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SSW	10	5	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SW	8	6	1	4	0	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WSW	4	3	1	3	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W	11	6	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WNW	4	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NW	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NNW	2	3	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N	4	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

AVERAGE WIND SPEED (M/SEC)

CONSECUTIVE HOURS

SECTOR	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>24
NNE	4.45	3.21	0.	0.	0.	0.	4.28	0.	0.	3.36	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NE	4.16	4.10	5.03	4.85	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ENE	5.14	0.	5.48	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
E	4.39	3.09	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ESE	4.10	6.03	2.94	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SE	4.81	4.50	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SSE	4.79	5.10	4.67	6.04	6.83	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
S	4.81	4.46	4.82	5.28	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SSW	4.73	5.47	5.68	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SW	6.91	5.90	6.20	7.48	0.	3.23	5.75	0.	4.37	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WSW	7.38	4.51	7.12	6.10	7.05	0.	0.	7.08	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
W	5.16	3.72	3.22	0.	0.	0.	4.74	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WNW	4.63	4.13	8.15	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW	5.05	4.19	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NNW	5.69	4.84	0.	5.35	5.13	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
N	6.11	5.39	0.	0.	0.	0.	5.16	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TOTAL NO. OF OBSERVATIONS = 17520
TOTAL NO. OF INVALID OBSERVATIONS = 1473

TABLE 2.3-20 (Continued) (Sheet 4 of 4)

WIND DIRECTION PERSISTENCE - PASQUILL ALL
1 SECTOR PERSISTENCE

CONSECUTIVE HOURS

CTOR	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>24
NNE	63	37	22	6	5	10	1	5	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
NE	56	35	18	10	3	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
ENE	58	19	17	6	0	0	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E	74	33	15	7	4	3	3	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0
ESE	78	40	23	8	9	9	3	1	3	2	4	0	0	0	0	0	0	0	0	0	0	1	0	0
SE	101	56	31	20	21	8	8	8	6	2	1	0	0	0	2	0	1	0	0	0	0	0	0	0
SSE	127	67	49	29	14	11	5	5	3	0	4	2	0	0	0	1	1	0	0	0	0	0	0	0
S	117	75	48	29	27	17	11	4	4	2	4	0	2	1	0	1	0	0	0	0	0	0	0	0
SSW	162	86	40	34	15	15	10	9	4	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0
SW	107	64	32	24	13	5	7	8	6	2	0	0	4	2	0	0	0	0	1	0	0	1	0	1
WSW	79	35	16	8	10	2	0	4	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
W	76	53	26	19	12	7	7	3	1	1	1	1	0	0	0	0	1	0	0	1	0	0	0	0
WNW	89	51	33	21	10	10	1	7	4	1	1	0	0	1	1	0	1	1	0	1	0	0	0	1
NW	100	37	22	14	6	6	5	3	5	0	3	3	2	0	1	0	1	1	0	1	0	0	0	0
NNW	60	36	23	16	4	4	9	4	1	5	1	0	0	0	1	0	0	0	0	0	0	0	0	0
N	55	26	25	19	9	8	1	6	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0

AVERAGE WIND SPEED (M/SEC)

CONSECUTIVE HOURS

CTOR	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>24
NNE	3.75	4.08	4.74	3.59	4.58	4.69	4.28	4.20	0.	3.28	4.53	0.	3.21	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NE	3.77	3.80	4.45	3.76	4.19	4.34	4.75	0.	0.	0.	0.	0.	0.	0.	3.11	0.	0.	0.	0.	0.	0.	0.	0.	0.
ENE	3.63	4.37	4.06	4.75	0.	0.	0.	5.72	6.67	4.45	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
E	4.11	3.63	4.86	4.72	5.62	4.71	5.63	0.	0.	0.	0.	6.42	0.	0.	0.	0.	5.20	0.	0.	0.	0.	0.	0.	0.
ESE	4.37	4.74	4.72	4.70	4.57	6.45	4.75	5.55	5.71	5.55	6.69	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	7.50	0.	0.
SE	4.84	4.97	5.27	5.26	5.11	7.35	5.52	6.14	4.03	3.77	5.81	0.	0.	0.	6.23	0.	6.42	0.	0.	0.	0.	0.	0.	0.
SSE	4.74	4.96	5.13	5.87	6.06	5.66	5.66	6.80	5.93	0.	5.38	5.99	0.	0.	0.	5.01	5.15	0.	0.	0.	0.	0.	0.	0.
S	4.89	5.08	5.58	5.71	6.39	6.39	5.48	8.06	6.26	6.85	4.85	0.	7.96	4.95	0.	8.80	0.	0.	0.	0.	0.	0.	0.	0.
SSW	4.98	5.67	5.57	6.27	6.08	7.10	6.11	6.39	5.43	5.98	0.	8.39	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SW	5.31	5.57	5.79	6.98	6.57	6.53	5.51	6.36	6.22	5.93	0.	0.	6.92	5.36	0.	0.	0.	0.	6.72	0.	0.	6.21	0.	9.07
WSW	5.07	5.37	6.05	5.84	6.88	6.00	0.	10.16	10.19	15.31	5.20	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
W	5.09	6.06	5.17	5.51	6.30	7.37	6.83	6.43	9.26	8.15	7.04	3.60	0.	0.	0.	0.	8.91	0.	0.	99.99	0.	0.	0.	0.
WNW	5.18	5.78	6.47	7.12	6.01	7.47	8.21	6.90	8.52	7.07	5.78	0.	0.	8.63	7.02	0.	13.76	11.06	0.	6.99	0.	0.	0.	8.50
NW	5.20	5.14	5.56	7.14	6.10	6.32	6.41	7.83	7.25	0.	5.68	6.98	7.48	0.	8.51	0.	10.24	5.41	0.	7.32	0.	0.	0.	0.
NNW	4.93	5.11	5.51	5.79	5.60	5.35	5.69	5.63	9.47	4.74	7.94	0.	0.	0.	5.36	0.	0.	0.	0.	0.	0.	0.	0.	0.
N	4.65	4.72	5.04	6.01	4.60	6.25	6.55	4.25	5.18	5.79	0.	6.58	0.	8.73	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TAL NO. OF OBSERVATIONS = 17520
TAL NO. OF INVALID OBSERVATIONS = 1099

TABLE 2.3-21 WIND DIRECTION PERSISTENCE - 90 METERS

WIND DIRECTION PERSISTENCE - PASQUILL *E*
1 SECTOR PERSISTENCE

CONSECUTIVE HOURS

SECTOR	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>24
NNE	10	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NE	20	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ENE	9	6	2	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E	19	5	2	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	15	8	5	4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	31	13	3	5	7	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SSE	34	18	6	3	0	1	1	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0
S	38	14	10	6	5	2	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
SSW	22	11	4	2	0	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SW	16	7	4	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WSW	20	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W	15	7	2	1	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WNW	11	7	4	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NW	13	4	4	1	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NNW	7	3	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N	17	6	7	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

AVERAGE WIND SPEED (M/SEC)

CONSECUTIVE HOURS

SECTOR	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>24
NNE	3.71	4.25	4.35	4.81	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NE	4.64	4.43	5.38	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ENE	5.60	7.34	7.30	0.	0.	0.	6.00	0.	0.	13.25	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
E	6.45	5.04	5.70	7.90	0.	6.41	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ESE	5.37	6.59	6.84	6.74	0.	0.	0.	0.	7.98	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SE	5.61	7.08	7.30	7.43	6.79	6.78	7.06	6.38	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SSE	5.68	6.61	5.37	7.48	0.	7.45	99.99	5.88	0.	0.	7.64	0.	0.	7.66	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
S	6.58	6.97	6.27	7.25	7.38	7.18	8.79	8.79	6.80	7.27	7.01	8.26	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SSW	6.31	7.51	8.46	8.60	0.	6.78	9.47	0.	8.29	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SW	6.81	7.62	8.56	6.32	0.	0.	0.	0.	99.99	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WSW	6.00	7.46	7.42	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
W	8.18	5.31	7.65	7.73	6.58	0.	7.66	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WNW	6.16	5.89	5.19	8.11	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW	5.23	7.39	8.09	6.45	0.	7.98	8.57	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NNW	6.54	7.20	7.17	0.	7.94	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
N	5.38	6.13	6.84	0.	4.48	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TOTAL NO. OF OBSERVATIONS = 8760
TOTAL NO. OF INVALID OBSERVATIONS = 589

TABLE 2.3-21 (Continued)

WIND DIRECTION PERSISTENCE - PASQUILL #F#
1 SECTOR PERSISTENCE

CONSECUTIVE HOURS

SECTOR	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>24
NNE	4	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NE	8	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ENE	5	4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E	8	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	7	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	19	4	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SSE	22	6	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S	31	12	12	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SSW	14	8	4	2	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SW	14	8	5	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WSW	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W	11	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WNW	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NW	4	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NNW	8	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N	6	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

AVERAGE WIND SPEED (M/SEC)

CONSECUTIVE HOURS

SECTOR	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>24
NNE	3.94	4.59	7.48	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NE	5.28	5.08	4.53	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ENE	7.08	6.64	0.	6.35	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
E	5.53	6.97	4.83	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ESE	7.16	6.31	8.07	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SE	6.03	6.73	6.91	5.96	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SSE	6.22	5.79	6.06	7.12	7.72	6.89	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
S	6.12	6.62	6.30	6.79	5.71	7.27	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SSW	5.96	6.82	6.88	6.79	8.46	8.19	0.	7.38	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SW	5.63	6.32	9.43	7.88	6.10	0.	0.	0.	9.51	7.93	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WSW	5.99	5.81	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
W	6.96	6.42	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WNW	7.84	6.64	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW	2.95	8.42	9.00	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NNW	6.77	0.	0.	8.76	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
N	6.17	5.50	0.	6.11	8.07	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TOTAL NO. OF OBSERVATIONS = 8760
TOTAL NO. OF INVALID OBSERVATIONS = 589

TABLE 2.3-21 (Continued) (Sheet 3 of 4)

WIND DIRECTION PERSISTENCE - PASQUILL #G#
1 SECTOR PERSISTENCE

CONSECUTIVE HOURS

SECTOR	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>24
NNE	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NE	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ENE	3	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SE	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SSE	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S	11	4	2	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SSW	9	0	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SW	5	3	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WSW	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
WNW	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NW	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NNW	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

AVERAGE WIND SPEED (M/SEC)

CONSECUTIVE HOURS

SECTOR	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>24
NNE	3.22	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NE	4.75	2.65	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ENE	6.85	0.	3.84	8.90	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
E	4.89	6.41	7.12	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ESE	4.10	4.06	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SE	6.70	0.	0.	0.	4.39	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SSE	5.67	5.97	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
S	6.25	5.25	6.64	8.92	0.	0.	6.24	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SSW	6.12	0.	6.03	7.44	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SW	7.31	5.07	5.53	0.	0.	8.61	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WSW	7.96	0.	0.	8.60	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
W	8.45	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
WNW	0.	0.	0.	0.	4.92	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW	6.10	6.75	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NNW	5.10	5.36	0.	2.55	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
N	5.54	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TOTAL NO. OF OBSERVATIONS = 8760
TOTAL NO. OF INVALID OBSERVATIONS = 589

TABLE 2.3-21 (Continued) (Sheet 4 of 4)

WIND DIRECTION PERSISTENCE - PASQUILL ALL
1 SECTOR PERSISTENCE

CONSECUTIVE HOURS

SECTOR	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>24
NNE	33	15	12	6	5	1	2	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0
NE	40	15	13	5	9	2	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
ENE	31	13	14	7	2	3	2	2	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0
E	43	17	10	9	3	5	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ESE	40	20	18	6	5	1	0	2	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
SE	49	35	20	18	12	5	5	5	2	1	0	1	0	1	1	0	0	0	0	0	0	1	0	0
SSE	67	27	11	11	6	5	5	2	3	3	1	1	0	1	0	1	0	0	0	0	0	0	0	0
S	68	39	31	21	9	10	4	2	3	3	5	1	1	1	2	1	0	0	0	0	0	0	0	1
SSW	67	33	16	17	10	7	2	1	3	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
SW	44	21	20	14	4	4	0	3	2	1	1	0	2	0	0	1	0	0	0	0	0	0	0	0
WSW	35	16	9	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
W	50	27	9	7	6	1	1	2	0	2	2	1	0	0	1	0	0	0	0	1	0	0	0	0
WNW	35	22	15	12	4	3	2	1	0	3	0	2	0	0	0	0	0	0	0	0	0	0	0	0
NW	31	18	14	15	7	4	2	2	2	1	0	4	1	0	0	1	1	0	0	0	1	0	0	0
NNW	29	19	11	10	2	3	2	1	3	1	0	0	0	0	1	1	0	0	0	0	0	1	0	0
N	45	15	15	7	5	5	5	0	2	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0

AVERAGE WIND SPEED (M/SEC)

CONSECUTIVE HOURS

SECTOR	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	>24
NNE	3.63	3.57	5.08	5.33	3.48	4.23	5.45	0.	5.40	0.	0.	5.23	6.75	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NE	4.20	4.22	4.52	4.00	5.06	2.95	0.	4.69	0.	0.	0.	5.90	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ENE	4.83	5.29	6.27	5.84	5.32	7.06	5.55	5.58	0.	0.	0.	0.	0.	7.16	7.84	0.	0.	0.	0.	0.	0.	0.	0.	0.
E	5.18	5.61	6.08	6.88	5.13	6.18	7.68	6.44	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ESE	5.52	4.94	5.78	6.42	6.42	7.23	0.	9.40	7.98	0.	0.	0.	0.	0.	5.89	0.	0.	0.	0.	0.	0.	0.	0.	0.
SE	4.62	5.99	5.75	5.57	5.27	6.67	6.76	6.83	5.65	5.01	0.	6.99	0.	6.34	6.58	0.	0.	0.	0.	0.	0.	8.66	0.	0.
SSE	5.05	5.11	5.76	5.85	5.88	6.61	6.34	5.60	7.04	6.41	6.77	8.26	0.	7.66	0.	7.28	0.	0.	0.	0.	0.	0.	0.	0.
S	5.72	6.01	5.95	6.10	6.52	7.01	5.96	7.85	7.59	6.09	5.64	8.83	6.91	7.18	8.02	7.65	0.	0.	0.	0.	0.	0.	0.	7.
SSW	5.90	6.62	6.70	6.15	5.46	6.68	6.99	7.38	7.82	8.18	0.	8.11	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
SW	5.72	6.30	7.53	6.32	5.24	7.32	0.	6.65	8.85	9.04	8.82	0.	7.50	0.	0.	7.69	0.	0.	0.	0.	0.	0.	0.	0.
WSW	5.78	6.09	5.82	7.94	0.	5.79	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	7.95	0.	0.	0.	0.
W	6.19	6.56	6.74	6.21	5.65	4.92	6.96	5.45	0.	8.65	8.69	13.01	0.	0.	8.75	0.	0.	0.	0.	6.26	0.	0.	0.	0.
WNW	6.45	5.67	6.58	8.83	7.13	7.71	6.14	99.99	0.	7.74	0.	8.76	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
NW	4.69	7.19	6.63	6.03	8.74	7.77	10.83	7.02	7.64	7.94	0.	8.44	99.99	0.	0.	6.03	7.89	0.	0.	0.	10.42	0.	0.	0.
NNW	4.72	5.51	5.28	6.29	6.57	5.91	7.30	6.82	7.05	99.99	0.	0.	0.	0.	99.99	9.38	0.	0.	0.	0.	0.	6.30	0.	0.
N	4.91	5.74	6.43	5.59	6.93	6.36	4.92	0.	6.12	0.	0.	8.04	8.00	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

TOTAL NO. OF OBSERVATIONS = 8760
TOTAL NO. OF INVALID OBSERVATIONS = 149

(Sheet 1 of 1)

TABLE 2.3-22 TEMPERATURE SUMMARY FOR COLUMBIA, MISSOURI

(Temperature in Degrees Fahrenheit)

MONTH	AVERAGE (1941-1970)[a] DAILY MAXIMUM	DAILY MINIMUM	MEAN MONTHLY	EXTREMES (1931-1960)[b] HIGH	LOW[c]
January	38.0	20.6	29.3	77 (1950)	-18 (1940)
February	42.7	24.5	33.6	77 (1962)	- 9 (1951)
March	51.3	32.0	41.7	85 (1956)	- 9 (1960)
April	65.3	44.6	55.0	91 (1965)	20 (1940)
May	74.5	54.3	64.4	93 (1956)	33 (1966)
June	82.7	63.3	73.0	102 (1954)	41 (1945)
July	87.4	67.1	77.3	113 (1954)	49 (1959)
August	86.4	65.5	76.0	103 (1964)	46 (1967)
September	79.4	57.2	68.3	102 (1954)	29 (1942)
October	69.2	46.7	58.0	92 (1963)	21 (1952)
November	53.6	34.2	43.9	82 (1949)	1 (1964)
December	41.1	24.5	32.8	75 (1948)	-12 (1933)
Annual Average	65.3	44.7	54.4	116	-18

a U.S. Dept. of Commerce, 1973.

b Environmental Data Service, 1969.

c The extreme minimum temperature was -26°F in February 1899 at a nearby site in the locality.

TABLE 2.3-23 TEMPERATURE SUMMARY FOR FULTON AIRPORT

(Temperature in Degrees Fahrenheit)

	LONG-TERM MEANS			EXTREMES[a]	
MONTH	DAILY[a] MAXIMUM	DAILY[a] MINIMUM	MEAN[b] MONTHLY	HIGH	LOW
January	40.1	19.8	29.6	83	-25
February	43.2	21.9	33.0	81	-26
March	54.4	31.5	43.0	93	-12
April	66.0	42.5	54.3	94	13
May	75.7	53.6	64.4	101	27
June	84.6	62.1	73.5	106	39
July	88.9	65.8	78.0	116	47
August	81.8	64.5	76.6	109	39
September	70.7	56.3	69.0	106	30
October	55.0	44.7	57.6	96	18
November	42.7	32.2	43.6	85	- 7
December	66.1	23.1	33.3	76	-18
Annual Average	66.1	43.1	54.7	116	-26

a Based upon 58 years of record ending in 1960.

b Based upon 72 years of record ending in 1960.

Source: U.S. Weather Bureau, 1965.

TABLE 2.3-24 RELATIVE HUMIDITY SUMMARY FOR COLUMBIA, MISSOURI

(Period of Record: 1941 to 1970)

MONTH	LOCAL STANDARD TIME (HOURS) 0000	0600	1200	1800
January	74	77	66	67
February	74	78	65	64
March	72	78	60	57
April	67	76	55	54
May	75	81	56	55
June	77	82	56	57
July	76	83	55	54
August	79	85	56	57
September	81	85	63	67
October	78	84	61	66
November	78	83	66	71
December	79	80	71	73
Yearly Average	76	81	61	62

Source: U.S. Dept. of Commerce, 1973.

TABLE 2.3-25 DEW-POINT TEMPERATURE AND HEAVY FOG SUMMARY FOR COLUMBIA, MISSOURI

MONTH	MEAN DEW-POINT TEMPERATURE[a] (Degrees F)	MEAN NUMBER OF HEAVY FOG DAYS[b,c]
January	21	3
February	24	2
March	29	1
April	40	1
May	52	1
June	62	1
July	66	1
August	64	1
September	55	1
October	45	1
November	32	1
December	25	2
Annual	43	16

a Dew-point period of record: 1946 to 1965.

b Heavy fog day period of record: 1931 to 1960.

c Heavy fog is defined as visibility 1/4 mile or less.

Source: Environmental Data Service, 1968.

TABLE 2.3-26 MEAN WET-BULB TEMPERATURE SUMMARY FOR COLUMBIA, MISSOURI

(Period of Record: 1951 to 1970)
(Temperature in Degrees Fahrenheit)

MONTH	LOCAL STANDARD TIME (HOURS) 0000	0600	1200	1800
January	24.8	22.8	28.9	28.2
February	28.8	26.3	32.9	32.8
March	34.3	32.0	39.3	39.3
April	46.0	43.8	50.6	50.6
May	55.4	53.9	60.2	60.1
June	64.0	62.9	68.4	68.3
July	67.8	66.6	71.5	71.6
August	66.2	64.2	69.9	69.8
September	58.9	56.5	63.5	62.7
October	48.6	46.2	53.8	52.2
November	37.5	35.2	42.0	40.0
December	29.0	27.3	32.8	31.6
Annual Average	46.7	44.8	51.1	50.6

Source: Horner, 1973.

(Sheet 1 of 1)

TABLE 2.3-27 PRECIPITATION SUMMARY FOR FULTON AND COLUMBIA, MISSOURI

Periods of Record:
Averages - 1941 to 1970
Extremes - 1941 to 1978

	PRECIPITATION (INCHES)					SNOW/SLEET (INCHES)		
MONTH	MEAN TOTAL (FULTON)	MEAN TOTAL (COLUMBIA)	MAXIMUM MONTHLY[a] (COLUMBIA)	MINIMUM MONTHLY[b] (COLUMBIA)	MAXIMUM IN 24 HOURS[c] (COLUMBIA)	MEAN TOTAL (COLUMBIA)	MAXIMUM MONTHLY (COLUMBIA)	MAXIMUM IN 24 HOURS[d] (COLUMBIA)
January	1.53	1.57	5.96	0.21	1.90 (1951)	4.40	23.5	10.30 (1958)
February	1.73	1.72	4.15	0.18	1.84 (1959)	4.70	17.5	11.8 (1975)
March	2.62	2.58	10.09	0.51	2.40 (1962)	5.00	24.5	7.80 (1958)
April	3.78	3.83	9.53	0.61	2.51 (1964)	0.50	4.5	4.5 (1973)
May	4.30	4.68	13.30	2.12	2.98 (1974)	T[e]	T[e]	T[e] (1953)
June	4.75	4.59	8.93	0.12	4.37 (1968)	0.00	0.0	0.0
July	3.95	3.89	11.45	0.24	3.86 (1957)	0.00	0.0	0.0
August	3.32	3.19	8.18	0.21	3.98 (1975)	0.00	0.0	0.0
September	4.08	4.39	11.80	0.09	3.47 (1961)	0.00	0.0	0.0
October	3.49	3.38	12.67	0.16	4.05 (1955)	T[e]	0.40	0.40 (1954)
November	1.99	1.79	5.26	0.21	2.17 (1972)	1.10	8.3	8.1 (1975)
December	1.90	1.78	4.55	0.19	2.07 (1949)	3.70	17.8	11.20 (1973)
Annual	37.44	37.39	13.30	0.09	4.37 (1968)	19.40	24.50	11.8 (1975)

a At other proximal locations, the maximum monthly precipitation was 14.86 inches in June 1928.

b At other proximal locations, the minimum monthly precipitation was 0.06 inch in August 1909.

c At other proximal locations, the maximum precipitation in 24 hours was 6.61 inches in September 1918.

d At other proximal locations, the maximum snowfall in 24 hours was 12.8 inches in March 1937.

e Trace.

Source: Environmental Data Service, 1969; U.S. Dept. of Commerce, 1971-79.

TABLE 2.3-28 PRECIPITATION (INCHES) AT COLUMBIA, MISSOURI COINCIDENT WITH THE PERIOD OF ON-SITE DATA COLLECTION

MONTH	1973	1974	1975	1978	1979
January		3.58	3.38		2.43
February		2.70	2.96		1.40
March		3.03	3.23	3.68[a]	0.99[b]
April		3.55	4.29	5.80	
May		7.75	4.00	6.77	
June	4.15	5.89		2.50	
July	1.60	1.43		4.56	
August	5.89	7.57		2.01	
September	2.54	1.77		1.11	
October	3.83	1.20		1.73	
November	2.96	3.81		3.24	
December	1.79	1.65		2.51	
Total	43.37 (5/73-5/74)		41.18 (6/74-5/75)		38.73 (3/78-3/79)

a March 16, 1978 through March 31, 1978.

b March 1, 1979 through March 15, 1979.

Source: U.S. Dept. of Commerce, 1973, 1974, 1975, 1978, and 1979.

TABLE 2.3-29 FREQUENCY DISTRIBUTION OF PRECIPITATION

FREQUENCY DISTRIBUTION OF PRECIPITATION
DATA PERIOD: THREE YEARS COMBINED

DATA SOURCE: ON-SITE
TABLE GENERATED: 06/05/79. 20.06.18.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677 - 093 - 07

PRECIPITATION CLASS INTERVAL (INCHES)	FREQUENCY DISTRIBUTION OF PRECIPITATION 1 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 2 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 3 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 6 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 12 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 24 HOUR DURATION	
	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.
.0 TO .1	1457	81.81	384	54.24	121	32.10	5	4.90	0	0.00	0	0.00
.1 TO .2	192	10.78	162	22.88	105	27.85	15	14.71	0	0.00	0	0.00
.2 TO .3	72	4.04	69	9.75	52	13.79	17	16.67	0	0.00	0	0.00
.3 TO .4	22	1.24	44	6.21	40	10.61	20	19.61	0	0.00	0	0.00
.4 TO .5	13	.73	15	2.12	19	5.04	13	12.75	2	15.38	0	0.00
.5 TO .6	8	.45	8	1.13	12	3.18	8	7.84	0	0.00	0	0.00
.6 TO .7	4	.22	6	.85	6	1.59	7	6.86	1	7.69	0	0.00
.7 TO .8	4	.22	4	.56	3	.80	3	2.94	3	23.08	0	0.00
.8 TO .9	1	.06	4	.56	2	.53	1	.98	1	7.69	0	0.00
.9 TO 1.0	2	.11	3	.42	4	1.06	4	3.92	1	7.69	0	0.00
1.0 TO 1.1	0	0.00	1	.14	3	.80	0	0.00	1	7.69	0	0.00
1.1 TO 1.2	3	.17	2	.28	2	.53	1	.98	0	0.00	0	0.00
1.2 TO 1.3	1	.06	1	.14	2	.53	1	.98	1	7.69	0	0.00
1.3 TO 1.4	0	0.00	2	.28	1	.27	2	1.96	0	0.00	0	0.00
1.4 TO 1.5	2	.11	2	.28	2	.53	2	1.96	1	7.69	1	50.00
1.5 TO 1.6	0	0.00	0	0.00	1	.27	1	.98	0	0.00	0	0.00
1.6 TO 1.7	0	0.00	1	.14	0	0.00	0	0.00	0	0.00	0	0.00
1.7 TO 1.8	0	0.00	0	0.00	0	0.00	0	0.00	1	7.69	0	0.00
1.8 TO 1.9	0	0.00	0	0.00	0	0.00	1	.98	0	0.00	0	0.00
1.9 TO 2.0	0	0.00	0	0.00	1	.27	0	0.00	0	0.00	0	0.00
2.0 TO 2.2	0	0.00	0	0.00	0	0.00	0	0.00	1	7.69	0	0.00
2.2 TO 2.4	0	0.00	0	0.00	1	.27	0	0.00	0	0.00	1	50.00
2.4 TO 2.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.6 TO 2.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.8 TO 3.0	0	0.00	0	0.00	0	0.00	1	.98	0	0.00	0	0.00
3.0 TO 3.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.2 TO 3.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.4 TO 3.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.6 TO 3.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.8 TO 4.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4.0 TO 4.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4.5 TO 5.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5.0 TO 5.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5.5 TO 6.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6.0 TO 6.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6.5 TO 7.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7.0 TO 7.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7.5 TO 8.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
8.0 TO 9.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
9.0 TO 10.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
10.0 TO 11.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
11.0 TO 12.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
GT 12.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
TOTAL	1781	100.00	708	100.00	377	100.00	102	100.00	13	100.00	2	100.00
MAXIMUM AMT.	1.50		1.67		2.35		2.94		2.01		2.31	

TOTAL PRECIPITATION FOR DATA PERIOD 126.92 INCHES

TABLE 2.3-29 (Continued) (Sheet 2 of 13)

FREQUENCY DISTRIBUTION OF PRECIPITATION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JANUARY

DATA SOURCE: ON-SITE
TABLE GENERATED: 05/31/79. 20.02.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677 - 093 - 07

PRECIPITATION CLASS INTERVAL (INCHES)	FREQUENCY DISTRIBUTION OF PRECIPITATION 1 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 2 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 3 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 6 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 12 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 24 HOUR DURATION	
	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.
.0 TO .1	201	91.78	68	72.34	20	40.00	2	11.11	0	0.00	0	0.00
.1 TO .2	15	6.85	14	14.89	18	36.00	3	16.67	0	0.00	0	0.00
.2 TO .3	3	1.37	11	11.70	5	10.00	4	22.22	0	0.00	0	0.00
.3 TO .4	0	0.00	1	1.06	6	12.00	3	16.67	0	0.00	0	0.00
.4 TO .5	0	0.00	0	0.00	1	2.00	0	0.00	1	33.33	0	0.00
.5 TO .6	0	0.00	0	0.00	0	0.00	3	16.67	0	0.00	0	0.00
.6 TO .7	0	0.00	0	0.00	0	0.00	2	11.11	0	0.00	0	0.00
.7 TO .8	0	0.00	0	0.00	0	0.00	1	5.56	0	0.00	0	0.00
.8 TO .9	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
.9 TO 1.0	0	0.00	0	0.00	0	0.00	0	0.00	1	33.33	0	0.00
1.0 TO 1.1	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.1 TO 1.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.2 TO 1.3	0	0.00	0	0.00	0	0.00	0	0.00	1	33.33	0	0.00
1.3 TO 1.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.4 TO 1.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	100.00
1.5 TO 1.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.6 TO 1.7	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.7 TO 1.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.8 TO 1.9	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.9 TO 2.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.0 TO 2.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.2 TO 2.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.4 TO 2.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.6 TO 2.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.8 TO 3.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.0 TO 3.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.2 TO 3.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.4 TO 3.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.6 TO 3.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.8 TO 4.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4.0 TO 4.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4.5 TO 5.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5.0 TO 5.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5.5 TO 6.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6.0 TO 6.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6.5 TO 7.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7.0 TO 7.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7.5 TO 8.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
8.0 TO 9.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
9.0 TO 10.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
10.0 TO 11.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
11.0 TO 12.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
GT 12.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
TOTAL	219	100.00	94	100.00	50	100.00	18	100.00	3	100.00	1	100.00
MAXIMUM AMT.	.27		.33		.46		.75		1.23		1.48	

TOTAL PRECIPITATION FOR DATA PERIOD 9.26 INCHES

TABLE 2.3-29 (Continued) (Sheet 3 of 13)

FREQUENCY DISTRIBUTION OF PRECIPITATION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - FEBRUARY

DATA SOURCE: ON-SITE
TABLE GENERATED: 05/31/79. 20.02.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677 - 093 - 07

PRECIPITATION CLASS INTERVAL (INCHES)	FREQUENCY DISTRIBUTION OF PRECIPITATION 1 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 2 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 3 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 6 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 12 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 24 HOUR DURATION	
	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.
.0 TO .1	140	89.17	41	62.12	8	23.53	0	0.00	0	0.00	0	0.00
.1 TO .2	13	8.28	19	28.79	16	47.06	1	8.33	0	0.00	0	0.00
.2 TO .3	3	1.91	5	7.58	5	14.71	5	41.67	0	0.00	0	0.00
.3 TO .4	0	0.00	1	1.52	5	14.71	1	8.33	0	0.00	0	0.00
.4 TO .5	1	.64	0	0.00	0	0.00	3	25.00	0	0.00	0	0.00
.5 TO .6	0	0.00	0	0.00	0	0.00	2	16.67	0	0.00	0	0.00
.6 TO .7	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
.7 TO .8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
.8 TO .9	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
.9 TO 1.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.0 TO 1.1	0	0.00	0	0.00	0	0.00	0	0.00	1	100.00	0	0.00
1.1 TO 1.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.2 TO 1.3	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.3 TO 1.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.4 TO 1.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.5 TO 1.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.6 TO 1.7	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.7 TO 1.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.8 TO 1.9	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.9 TO 2.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.0 TO 2.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.2 TO 2.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.4 TO 2.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.6 TO 2.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.8 TO 3.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.0 TO 3.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.2 TO 3.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.4 TO 3.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.6 TO 3.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.8 TO 4.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4.0 TO 4.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4.5 TO 5.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5.0 TO 5.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5.5 TO 6.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6.0 TO 6.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6.5 TO 7.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7.0 TO 7.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7.5 TO 8.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
8.0 TO 9.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
9.0 TO 10.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
10.0 TO 11.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
11.0 TO 12.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
GT 12.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
TOTAL	157	100.00	66	100.00	34	100.00	12	100.00	1	100.00	0	0.00
MAXIMUM AMT.	.41		.32		.37		.60		1.04		0.00	

TOTAL PRECIPITATION FOR DATA PERIOD 7.35 INCHES

TABLE 2.3-29 (Continued) (Sheet 4 of 13)

FREQUENCY DISTRIBUTION OF PRECIPITATION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - MARCH

DATA SOURCE: ON-SITE
TABLE GENERATED: 05/31/79. 20.02.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677 - 093 - 07

PRECIPITATION CLASS INTERVAL (INCHES)	FREQUENCY DISTRIBUTION OF PRECIPITATION 1 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 2 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 3 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 6 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 12 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 24 HOUR DURATION	
	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.
.0 TO .1	128	78.05	33	48.53	10	23.81	0	0.00	0	0.00	0	0.00
.1 TO .2	24	14.63	15	22.06	14	33.33	4	26.67	0	0.00	0	0.00
.2 TO .3	11	6.71	9	13.24	7	16.67	1	6.67	0	0.00	0	0.00
.3 TO .4	1	.61	7	10.29	1	2.38	4	26.67	0	0.00	0	0.00
.4 TO .5	0	0.00	4	5.88	6	14.29	2	13.33	1	33.33	0	0.00
.5 TO .6	0	0.00	0	0.00	4	9.52	0	0.00	0	0.00	0	0.00
.6 TO .7	0	0.00	0	0.00	0	0.00	1	6.67	0	0.00	0	0.00
.7 TO .8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
.8 TO .9	0	0.00	0	0.00	0	0.00	0	0.00	1	33.33	0	0.00
.9 TO 1.0	0	0.00	0	0.00	0	0.00	2	13.33	0	0.00	0	0.00
1.0 TO 1.1	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.1 TO 1.2	0	0.00	0	0.00	0	0.00	1	6.67	0	0.00	0	0.00
1.2 TO 1.3	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.3 TO 1.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.4 TO 1.5	0	0.00	0	0.00	0	0.00	0	0.00	1	33.33	0	0.00
1.5 TO 1.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.6 TO 1.7	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.7 TO 1.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.8 TO 1.9	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.9 TO 2.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.0 TO 2.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.2 TO 2.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	1	100.00
2.4 TO 2.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.6 TO 2.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.8 TO 3.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.0 TO 3.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.2 TO 3.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.4 TO 3.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.6 TO 3.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.8 TO 4.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4.0 TO 4.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4.5 TO 5.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5.0 TO 5.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5.5 TO 6.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6.0 TO 6.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6.5 TO 7.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7.0 TO 7.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7.5 TO 8.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
8.0 TO 9.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
9.0 TO 10.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
10.0 TO 11.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
11.0 TO 12.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
GT 12.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
TOTAL	164	100.00	68	100.00	42	100.00	15	100.00	3	100.00	1	100.00
MAXIMUM AMT.	.31		.47		.58		1.13		1.48		2.31	

TOTAL PRECIPITATION FOR DATA PERIOD 10.83 INCHES

TABLE 2.3-29 (Continued) (Sheet 5 of 13)

FREQUENCY DISTRIBUTION OF PRECIPITATION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - APRIL

DATA SOURCE: ON-SITE
TABLE GENERATED: 05/31/79. 20.02.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677 - 093 - 07

PRECIPITATION CLASS INTERVAL (INCHES)	FREQUENCY DISTRIBUTION OF PRECIPITATION 1 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 2 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 3 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 6 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 12 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 24 HOUR DURATION	
	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.
.0 TO .1	147	77.78	41	53.25	13	32.50	0	0.00	0	0.00	0	0.00
.1 TO .2	27	14.29	19	24.68	8	20.00	2	28.57	0	0.00	0	0.00
.2 TO .3	8	4.23	9	11.69	9	22.50	0	0.00	0	0.00	0	0.00
.3 TO .4	2	1.06	5	6.49	3	7.50	3	42.86	0	0.00	0	0.00
.4 TO .5	4	2.12	1	1.30	1	2.50	0	0.00	0	0.00	0	0.00
.5 TO .6	1	.53	1	1.30	2	5.00	1	14.29	0	0.00	0	0.00
.6 TO .7	0	0.00	0	0.00	1	2.50	0	0.00	0	0.00	0	0.00
.7 TO .8	0	0.00	0	0.00	1	2.50	0	0.00	0	0.00	0	0.00
.8 TO .9	0	0.00	1	1.30	1	2.50	0	0.00	0	0.00	0	0.00
.9 TO 1.0	0	0.00	0	0.00	1	2.50	0	0.00	0	0.00	0	0.00
1.0 TO 1.1	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.1 TO 1.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.2 TO 1.3	0	0.00	0	0.00	0	0.00	1	14.29	0	0.00	0	0.00
1.3 TO 1.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.4 TO 1.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.5 TO 1.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.6 TO 1.7	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.7 TO 1.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.8 TO 1.9	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.9 TO 2.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.0 TO 2.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.2 TO 2.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.4 TO 2.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.6 TO 2.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.8 TO 3.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.0 TO 3.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.2 TO 3.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.4 TO 3.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.6 TO 3.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.8 TO 4.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4.0 TO 4.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4.5 TO 5.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5.0 TO 5.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5.5 TO 6.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6.0 TO 6.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6.5 TO 7.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7.0 TO 7.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7.5 TO 8.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
8.0 TO 9.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
9.0 TO 10.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
10.0 TO 11.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
11.0 TO 12.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
GT 12.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
TOTAL	189	100.00	77	100.00	40	100.00	7	100.00	0	0.00	0	0.00
MAXIMUM AMT.	.51		.86		.91		1.24		0.00		0.00	

TOTAL PRECIPITATION FOR DATA PERIOD 13.26 INCHES

TABLE 2.3-29 (Continued) (Sheet 6 of 13)

FREQUENCY DISTRIBUTION OF PRECIPITATION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - MAY

DATA SOURCE: ON-SITE
TABLE GENERATED: 05/31/79. 20.02.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677 - 093 - 07

PRECIPITATION CLASS INTERVAL (INCHES)	FREQUENCY DISTRIBUTION OF PRECIPITATION 1 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 2 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 3 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 6 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 12 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 24 HOUR DURATION	
	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.
.0 TO .1	142	75.13	31	46.27	11	30.56	1	14.29	0	0.00	0	0.00
.1 TO .2	26	13.76	14	20.90	4	11.11	0	0.00	0	0.00	0	0.00
.2 TO .3	9	4.76	5	7.46	6	16.67	0	0.00	0	0.00	0	0.00
.3 TO .4	3	1.59	8	11.94	6	16.67	1	14.29	0	0.00	0	0.00
.4 TO .5	2	1.06	1	1.49	1	2.78	0	0.00	0	0.00	0	0.00
.5 TO .6	2	1.06	3	4.48	3	8.33	0	0.00	0	0.00	0	0.00
.6 TO .7	0	0.00	1	1.49	0	0.00	2	28.57	0	0.00	0	0.00
.7 TO .8	2	1.06	0	0.00	1	2.78	1	14.29	0	0.00	0	0.00
.8 TO .9	0	0.00	0	0.00	0	0.00	1	14.29	0	0.00	0	0.00
.9 TO 1.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.0 TO 1.1	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.1 TO 1.2	2	1.06	2	2.99	0	0.00	0	0.00	0	0.00	0	0.00
1.2 TO 1.3	0	0.00	0	0.00	1	2.78	0	0.00	0	0.00	0	0.00
1.3 TO 1.4	0	0.00	1	1.49	0	0.00	0	0.00	0	0.00	0	0.00
1.4 TO 1.5	1	.53	1	1.49	2	5.56	0	0.00	0	0.00	0	0.00
1.5 TO 1.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.6 TO 1.7	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.7 TO 1.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.8 TO 1.9	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.9 TO 2.0	0	0.00	0	0.00	1	2.78	0	0.00	0	0.00	0	0.00
2.0 TO 2.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.2 TO 2.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.4 TO 2.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.6 TO 2.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.8 TO 3.0	0	0.00	0	0.00	0	0.00	1	14.29	0	0.00	0	0.00
3.0 TO 3.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.2 TO 3.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.4 TO 3.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.6 TO 3.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.8 TO 4.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4.0 TO 4.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4.5 TO 5.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5.0 TO 5.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5.5 TO 6.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6.0 TO 6.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6.5 TO 7.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7.0 TO 7.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7.5 TO 8.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
8.0 TO 9.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
9.0 TO 10.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
10.0 TO 11.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
11.0 TO 12.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
GT 12.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
TOTAL	189	100.00	67	100.00	36	100.00	7	100.00	0	0.00	0	0.00
MAXIMUM AMT.	1.47		1.48		1.99		2.94		0.00		0.00	

TOTAL PRECIPITATION FOR DATA PERIOD 18.20 INCHES

TABLE 2.3-29 (Continued) (Sheet 7 of 13)

FREQUENCY DISTRIBUTION OF PRECIPITATION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JUNE

DATA SOURCE: ON-SITE
TABLE GENERATED: 05/31/79. 20.02.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677 - 093 - 07

PRECIPITATION CLASS INTERVAL (INCHES)	FREQUENCY DISTRIBUTION OF PRECIPITATION 1 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 2 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 3 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 6 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 12 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 24 HOUR DURATION	
	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.
.0 TO .1	70	72.16	8	25.00	2	11.11	0	0.00	0	0.00	0	0.00
.1 TO .2	9	9.28	10	31.25	3	16.67	0	0.00	0	0.00	0	0.00
.2 TO .3	9	9.28	3	9.38	1	5.56	0	0.00	0	0.00	0	0.00
.3 TO .4	4	4.12	4	12.50	6	33.33	0	0.00	0	0.00	0	0.00
.4 TO .5	0	0.00	3	9.38	3	16.67	0	0.00	0	0.00	0	0.00
.5 TO .6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
.6 TO .7	2	2.06	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
.7 TO .8	1	1.03	1	3.13	0	0.00	0	0.00	0	0.00	0	0.00
.8 TO .9	1	1.03	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
.9 TO 1.0	0	0.00	2	6.25	0	0.00	0	0.00	0	0.00	0	0.00
1.0 TO 1.1	0	0.00	0	0.00	1	5.56	0	0.00	0	0.00	0	0.00
1.1 TO 1.2	0	0.00	0	0.00	1	5.56	0	0.00	0	0.00	0	0.00
1.2 TO 1.3	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.3 TO 1.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.4 TO 1.5	1	1.03	0	0.00	0	0.00	2	100.00	0	0.00	0	0.00
1.5 TO 1.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.6 TO 1.7	0	0.00	1	3.13	0	0.00	0	0.00	0	0.00	0	0.00
1.7 TO 1.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.8 TO 1.9	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.9 TO 2.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.0 TO 2.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.2 TO 2.4	0	0.00	0	0.00	1	5.56	0	0.00	0	0.00	0	0.00
2.4 TO 2.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.6 TO 2.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.8 TO 3.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.0 TO 3.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.2 TO 3.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.4 TO 3.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.6 TO 3.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.8 TO 4.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4.0 TO 4.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4.5 TO 5.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5.0 TO 5.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5.5 TO 6.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6.0 TO 6.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6.5 TO 7.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7.0 TO 7.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7.5 TO 8.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
8.0 TO 9.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
9.0 TO 10.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
10.0 TO 11.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
11.0 TO 12.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
GT 12.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
TOTAL	97	100.00	32	100.00	18	100.00	2	100.00	0	0.00	0	0.00
MAXIMUM AMT.	1.50		1.67		2.35		1.49		0.00		0.00	

TOTAL PRECIPITATION FOR DATA PERIOD 12.24 INCHES

TABLE 2.3-29 (Continued) (Sheet 8 of 13)

FREQUENCY DISTRIBUTION OF PRECIPITATION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JULY

DATA SOURCE: ON-SITE
TABLE GENERATED: 05/31/79. 20.02.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677 - 093 - 07

PRECIPITATION CLASS INTERVAL	FREQUENCY DISTRIBUTION OF PRECIPITATION		FREQUENCY DISTRIBUTION OF PRECIPITATION		FREQUENCY DISTRIBUTION OF PRECIPITATION		FREQUENCY DISTRIBUTION OF PRECIPITATION		FREQUENCY DISTRIBUTION OF PRECIPITATION		FREQUENCY DISTRIBUTION OF PRECIPITATION	
(INCHES)	1 HOUR DURATION		2 HOUR DURATION		3 HOUR DURATION		6 HOUR DURATION		12 HOUR DURATION		24 HOUR DURATION	
	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.
.0 TO .1	47	59.49	12	38.71	5	41.67	0	0.00	0	0.00	0	0.00
.1 TO .2	13	16.45	3	9.68	0	0.00	0	0.00	0	0.00	0	0.00
.2 TO .3	8	10.13	3	9.68	0	0.00	0	0.00	0	0.00	0	0.00
.3 TO .4	5	6.33	4	12.90	1	8.33	0	0.00	0	0.00	0	0.00
.4 TO .5	2	2.53	1	3.23	1	8.33	0	0.00	0	0.00	0	0.00
.5 TO .6	3	3.80	3	9.68	0	0.00	0	0.00	0	0.00	0	0.00
.6 TO .7	0	0.00	2	6.45	2	16.67	0	0.00	0	0.00	0	0.00
.7 TO .8	0	0.00	1	3.23	0	0.00	0	0.00	0	0.00	0	0.00
.8 TO .9	0	0.00	1	3.23	0	0.00	0	0.00	0	0.00	0	0.00
.9 TO 1.0	1	1.27	0	0.00	1	8.33	1	100.00	0	0.00	0	0.00
1.0 TO 1.1	0	0.00	1	3.23	1	8.33	0	0.00	0	0.00	0	0.00
1.1 TO 1.2	0	0.00	0	0.00	1	8.33	0	0.00	0	0.00	0	0.00
1.2 TO 1.3	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.3 TO 1.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.4 TO 1.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.5 TO 1.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.6 TO 1.7	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.7 TO 1.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.8 TO 1.9	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.9 TO 2.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.0 TO 2.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.2 TO 2.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.4 TO 2.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.6 TO 2.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.8 TO 3.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.0 TO 3.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.2 TO 3.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.4 TO 3.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.6 TO 3.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.8 TO 4.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4.0 TO 4.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4.5 TO 5.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5.0 TO 5.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5.5 TO 6.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6.0 TO 6.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6.5 TO 7.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7.0 TO 7.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7.5 TO 8.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
8.0 TO 9.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
9.0 TO 10.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
10.0 TO 11.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
11.0 TO 12.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
GT 12.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
TOTAL	79	100.00	31	100.00	12	100.00	1	100.00	0	0.00	0	0.00
MAXIMUM AMT.	.98		1.08		1.12		.95		0.00		0.00	

TOTAL PRECIPITATION FOR DATA PERIOD 10.77 INCHES

FREQUENCY DISTRIBUTION OF PRECIPITATION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - AUGUST

DATA SOURCE: ON-SITE
TABLE GENERATED: 05/31/79. 20.02.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677 - 093 - 07

PRECIPITATION CLASS INTERVAL (INCHES)	FREQUENCY DISTRIBUTION OF PRECIPITATION 1 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 2 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 3 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 6 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 12 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 24 HOUR DURATION	
	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.
.0 TO .1	83	74.77	18	42.86	6	28.57	0	0.00	0	0.00	0	0.00
.1 TO .2	17	15.32	9	21.43	7	33.33	2	40.00	0	0.00	0	0.00
.2 TO .3	5	4.50	7	16.67	1	4.76	0	0.00	0	0.00	0	0.00
.3 TO .4	1	.90	2	4.76	3	14.29	1	20.00	0	0.00	0	0.00
.4 TO .5	1	.90	1	2.38	0	0.00	1	20.00	0	0.00	0	0.00
.5 TO .6	1	.90	0	0.00	1	4.76	0	0.00	0	0.00	0	0.00
.6 TO .7	1	.90	1	2.38	0	0.00	0	0.00	0	0.00	0	0.00
.7 TO .8	0	0.00	1	2.38	0	0.00	0	0.00	0	0.00	0	0.00
.8 TO .9	0	0.00	1	2.38	0	0.00	0	0.00	0	0.00	0	0.00
.9 TO 1.0	1	.90	1	2.38	1	4.76	0	0.00	0	0.00	0	0.00
1.0 TO 1.1	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.1 TO 1.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.2 TO 1.3	1	.90	0	0.00	1	4.76	0	0.00	0	0.00	0	0.00
1.3 TO 1.4	0	0.00	1	2.38	1	4.76	0	0.00	0	0.00	0	0.00
1.4 TO 1.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.5 TO 1.6	0	0.00	0	0.00	0	0.00	1	20.00	0	0.00	0	0.00
1.6 TO 1.7	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.7 TO 1.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.8 TO 1.9	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.9 TO 2.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.0 TO 2.2	0	0.00	0	0.00	0	0.00	0	0.00	1	100.00	0	0.00
2.2 TO 2.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.4 TO 2.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.6 TO 2.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.8 TO 3.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.0 TO 3.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.2 TO 3.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.4 TO 3.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.6 TO 3.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.8 TO 4.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4.0 TO 4.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4.5 TO 5.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5.0 TO 5.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5.5 TO 6.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6.0 TO 6.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6.5 TO 7.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7.0 TO 7.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7.5 TO 8.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
8.0 TO 9.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
9.0 TO 10.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
10.0 TO 11.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
11.0 TO 12.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
GT 12.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
TOTAL	111	100.00	42	100.00	21	100.00	5	100.00	1	100.00	0	0.00
MAXIMUM AMT.	1.23		1.36		1.37		1.58		2.01		0.00	

TOTAL PRECIPITATION FOR DATA PERIOD 10.48 INCHES

TABLE 2.3-29 (Continued) (Sheet 10 of 13)

FREQUENCY DISTRIBUTION OF PRECIPITATION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - SEPTEMBER

DATA SOURCE: ON-SITE
TABLE GENERATED: 05/31/79. 20.02.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677 - 093 - 07

PRECIPITATION CLASS INTERVAL (INCHES)	FREQUENCY DISTRIBUTION OF PRECIPITATION 1 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 2 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 3 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 6 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 12 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 24 HOUR DURATION	
	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.
.0 TO .1	84	80.00	19	55.88	3	18.75	0	0.00	0	0.00	0	0.00
.1 TO .2	10	9.52	3	8.82	6	37.50	0	0.00	0	0.00	0	0.00
.2 TO .3	5	4.76	6	17.65	1	6.25	2	100.00	0	0.00	0	0.00
.3 TO .4	3	2.86	3	8.82	2	12.50	0	0.00	0	0.00	0	0.00
.4 TO .5	2	1.90	0	0.00	1	6.25	0	0.00	0	0.00	0	0.00
.5 TO .6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
.6 TO .7	0	0.00	1	2.94	1	6.25	0	0.00	0	0.00	0	0.00
.7 TO .8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
.8 TO .9	0	0.00	1	2.94	1	6.25	0	0.00	0	0.00	0	0.00
.9 TO 1.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.0 TO 1.1	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.1 TO 1.2	1	.95	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.2 TO 1.3	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.3 TO 1.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.4 TO 1.5	0	0.00	1	2.94	0	0.00	0	0.00	0	0.00	0	0.00
1.5 TO 1.6	0	0.00	0	0.00	1	6.25	0	0.00	0	0.00	0	0.00
1.6 TO 1.7	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.7 TO 1.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.8 TO 1.9	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.9 TO 2.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.0 TO 2.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.2 TO 2.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.4 TO 2.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.6 TO 2.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.8 TO 3.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.0 TO 3.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.2 TO 3.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.4 TO 3.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.6 TO 3.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.8 TO 4.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4.0 TO 4.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4.5 TO 5.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5.0 TO 5.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5.5 TO 6.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6.0 TO 6.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6.5 TO 7.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7.0 TO 7.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7.5 TO 8.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
8.0 TO 9.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
9.0 TO 10.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
10.0 TO 11.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
11.0 TO 12.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
GT 12.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
TOTAL	105	100.00	34	100.00	16	100.00	2	100.00	0	0.00	0	0.00
MAXIMUM AMT.	1.16		1.50		1.57		.29		0.00		0.00	

TOTAL PRECIPITATION FOR DATA PERIOD 8.54 INCHES

TABLE 2.3-29 (Continued) (Sheet 11 of 13)

FREQUENCY DISTRIBUTION OF PRECIPITATION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - OCTOBER

DATA SOURCE: ON-SITE
TABLE GENERATED: 05/31/79. 20.02.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677 - 093 - 07

PRECIPITATION CLASS INTERVAL (INCHES)	FREQUENCY DISTRIBUTION OF PRECIPITATION 1 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 2 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 3 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 6 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 12 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 24 HOUR DURATION	
	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.
.0 TO .1	83	83.00	15	37.50	6	30.00	0	0.00	0	0.00	0	0.00
.1 TO .2	8	8.00	15	37.50	5	25.00	0	0.00	0	0.00	0	0.00
.2 TO .3	4	4.00	3	7.50	2	10.00	0	0.00	0	0.00	0	0.00
.3 TO .4	2	2.00	3	7.50	2	10.00	1	20.00	0	0.00	0	0.00
.4 TO .5	0	0.00	1	2.50	2	10.00	1	20.00	0	0.00	0	0.00
.5 TO .6	1	1.00	1	2.50	0	0.00	0	0.00	0	0.00	0	0.00
.6 TO .7	1	1.00	0	0.00	0	0.00	1	20.00	0	0.00	0	0.00
.7 TO .8	1	1.00	1	2.50	1	5.00	0	0.00	0	0.00	0	0.00
.8 TO .9	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
.9 TO 1.0	0	0.00	0	0.00	1	5.00	0	0.00	0	0.00	0	0.00
1.0 TO 1.1	0	0.00	0	0.00	1	5.00	0	0.00	0	0.00	0	0.00
1.1 TO 1.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.2 TO 1.3	0	0.00	1	2.50	0	0.00	0	0.00	0	0.00	0	0.00
1.3 TO 1.4	0	0.00	0	0.00	0	0.00	1	20.00	0	0.00	0	0.00
1.4 TO 1.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.5 TO 1.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.6 TO 1.7	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.7 TO 1.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.8 TO 1.9	0	0.00	0	0.00	0	0.00	1	20.00	0	0.00	0	0.00
1.9 TO 2.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.0 TO 2.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.2 TO 2.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.4 TO 2.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.6 TO 2.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.8 TO 3.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.0 TO 3.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.2 TO 3.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.4 TO 3.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.6 TO 3.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.8 TO 4.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4.0 TO 4.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4.5 TO 5.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5.0 TO 5.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5.5 TO 6.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6.0 TO 6.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6.5 TO 7.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7.0 TO 7.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7.5 TO 8.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
8.0 TO 9.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
9.0 TO 10.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
10.0 TO 11.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
11.0 TO 12.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
GT 12.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
TOTAL	100	100.00	40	100.00	20	100.00	5	100.00	0	0.00	0	0.00
MAXIMUM AMT.	.74		1.30		1.10		1.85		0.00		0.00	

TOTAL PRECIPITATION FOR DATA PERIOD 8.33 INCHES

TABLE 2.3-29 (Continued) (Sheet 12 of 13)

FREQUENCY DISTRIBUTION OF PRECIPITATION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - NOVEMBER

DATA SOURCE: ON-SITE
TABLE GENERATED: 05/31/79. 26.02.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677 - 093 - 07

PRECIPITATION CLASS INTERVAL (INCHES)	FREQUENCY DISTRIBUTION OF PRECIPITATION 1 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 2 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 3 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 6 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 12 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 24 HOUR DURATION	
	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.
.0 TO .1	163	86.70	52	63.41	22	47.83	2	13.33	0	0.00	0	0.00
.1 TO .2	20	10.64	19	23.17	10	21.74	3	20.00	0	0.00	0	0.00
.2 TO .3	5	2.66	6	7.32	7	15.22	2	13.33	0	0.00	0	0.00
.3 TO .4	0	0.00	3	3.66	4	8.70	3	20.00	0	0.00	0	0.00
.4 TO .5	0	0.00	2	2.44	2	4.35	2	13.33	0	0.00	0	0.00
.5 TO .6	0	0.00	0	0.00	1	2.17	2	13.33	0	0.00	0	0.00
.6 TO .7	0	0.00	0	0.00	0	0.00	0	0.00	1	100.00	0	0.00
.7 TO .8	0	0.00	0	0.00	0	0.00	1	6.67	0	0.00	0	0.00
.8 TO .9	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
.9 TO 1.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.0 TO 1.1	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.1 TO 1.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.2 TO 1.3	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.3 TO 1.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.4 TO 1.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.5 TO 1.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.6 TO 1.7	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.7 TO 1.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.8 TO 1.9	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.9 TO 2.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.0 TO 2.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.2 TO 2.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.4 TO 2.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.6 TO 2.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.8 TO 3.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.0 TO 3.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.2 TO 3.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.4 TO 3.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.6 TO 3.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.8 TO 4.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4.0 TO 4.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4.5 TO 5.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5.0 TO 5.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5.5 TO 6.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6.0 TO 6.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6.5 TO 7.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7.0 TO 7.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7.5 TO 8.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
8.0 TO 9.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
9.0 TO 10.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
10.0 TO 11.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
11.0 TO 12.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
GT 12.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
TOTAL	188	100.00	82	100.00	46	100.00	15	100.00	1	100.00	0	0.00
MAXIMUM AMT.	.26		.42		.60		.76		.69		0.00	

TOTAL PRECIPITATION FOR DATA PERIOD 9.29 INCHES

TABLE 2.3-29 (Continued) (Sheet 13 of 13)

FREQUENCY DISTRIBUTION OF PRECIPITATION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - DECEMBER

DATA SOURCE: ON-SITE
TABLE GENERATED: 05/31/79. 20.02.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677 - 093 - 07

PRECIPITATION CLASS INTERVAL (INCHES)	FREQUENCY DISTRIBUTION OF PRECIPITATION 1 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 2 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 3 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 6 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 12 HOUR DURATION		FREQUENCY DISTRIBUTION OF PRECIPITATION 24 HOUR DURATION	
	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.	NO.	PCT.
.0 TO .1	169	92.35	46	62.16	15	36.59	0	0.00	0	0.00	0	0.00
.1 TO .2	10	5.46	20	27.03	14	34.15	0	0.00	0	0.00	0	0.00
.2 TO .3	2	1.09	4	5.41	7	17.07	3	25.00	0	0.00	0	0.00
.3 TO .4	1	.55	2	2.70	2	4.88	3	25.00	0	0.00	0	0.00
.4 TO .5	1	.55	1	1.35	0	0.00	4	33.33	0	0.00	0	0.00
.5 TO .6	0	0.00	0	0.00	1	2.44	0	0.00	0	0.00	0	0.00
.6 TO .7	0	0.00	1	1.35	2	4.88	0	0.00	0	0.00	0	0.00
.7 TO .8	0	0.00	0	0.00	0	0.00	0	0.00	3	75.00	0	0.00
.8 TO .9	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
.9 TO 1.0	0	0.00	0	0.00	0	0.00	1	8.33	0	0.00	0	0.00
1.0 TO 1.1	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.1 TO 1.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.2 TO 1.3	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.3 TO 1.4	0	0.00	0	0.00	0	0.00	1	8.33	0	0.00	0	0.00
1.4 TO 1.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.5 TO 1.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.6 TO 1.7	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.7 TO 1.8	0	0.00	0	0.00	0	0.00	0	0.00	1	25.00	0	0.00
1.8 TO 1.9	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
1.9 TO 2.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.0 TO 2.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.2 TO 2.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.4 TO 2.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.6 TO 2.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
2.8 TO 3.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.0 TO 3.2	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.2 TO 3.4	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.4 TO 3.6	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.6 TO 3.8	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
3.8 TO 4.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4.0 TO 4.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
4.5 TO 5.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5.0 TO 5.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
5.5 TO 6.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6.0 TO 6.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
6.5 TO 7.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7.0 TO 7.5	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
7.5 TO 8.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
8.0 TO 9.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
9.0 TO 10.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
10.0 TO 11.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
11.0 TO 12.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
GT 12.0	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
TOTAL	183	100.00	74	100.00	41	100.00	12	100.00	4	100.00	0	0.00
MAXIMUM AMT.	.45		.65		.68		1.31		1.80		0.00	

TOTAL PRECIPITATION FOR DATA PERIOD 8.67 INCHES

TABLE 2.3-30 NUMBER OF HOURS WITH MEASURABLE PRECIPITATION AT COLUMBIA, MISSOURI COINCIDENT WITH THE PERIODS OF ON-SITE DATA COLLECTION

MONTH	1973	1974	1975	1978	1979
January		65	64		90
February		57	70		30
March		52	38	54[a]	19[b]
April		62	49	74	
May		65	44	80	
June	41	29		29	
July	40	12		27	
August	6	71		29	
September	61	28		17	
October	52	27		21	
November	31	79		95	
December	83	56		42	
Total	615 (6/73-5/74)		567 (6/74-5/75)		578 (3/78-3/79)

a March 16, 1978 through March 31, 1978.

b March 1, 1979 through March 15, 1979.

Source: U.S. Dept. of Commerce, 1973, 1974, 1975, 1978, and 1979.

Note: Precipitation amounts of 0.01 inch or greater.

(Sheet 1 of 1)

TABLE 2.3-31 RELATION OF PASQUILL STABILITY CLASSES TO WEATHER CONDITIONS

SURFACE WIND SPEED AT 10m (m/sec)	DAYTIME CONDITIONS INCOMING SOLAR RADIATION			NIGHTTIME CONDITIONS*	
	STRONG	MODERATE	SLIGHT	THIN OVERCAST OR ≥ 4/8 CLOUDINESS	≤ 3/8 CLOUDINESS
< 2	A	A-B	B	F	F
2 - 3	A-B	B	C	E	F
3 - 5	B	B-C	C	D	E
5 - 6	C	C-D	D	D	D
> 6	C	D	D	D	D

* The degree of cloudiness is defined as that fraction of the sky above the local horizon that is covered by clouds.

Note: Pasquill Stability Classes labeled as follows:

A - Extremely unstable; B - Moderately unstable; C - Slightly unstable;

D - Neutral; E - Slightly stable; F - Moderately stable.

TABLE 2.3-32 ATMOSPHERIC STABILITY CLASSES

CLASSIFICATION	U.S. AEC STABILITY CLASS	TEMPERATURE CHANGE WITH HEIGHT (°C per 100 meters)
Extremely Unstable	A	< - 1.9
Moderately Unstable	B	-1.9 to -1.7
Slightly Unstable	C	-1.7 to -1.5
Neutral	D	-1.5 to -0.5
Slightly Stable	E	-0.5 to 1.5
Moderately Stable	F	1.5 to 4.0
Extremely Stable	G	> 4.0

Source: Turner, 1964; U.S. Atomic Energy Commission, 1972.

TABLE 2.3-32A CALLAWAY GENERATING STATION REFORM, MISSOURI UNION ELECTRIC COMPANY DAMES AND MOORE JOB NO. 7677-066-07

DATA PERIOD FROM 5/4/73 TO 5/4/75
DATE AND TIME OF RUN 06/15/81 14 34 59

NUMBER OF HOURS

NUMBER OF CONSECUTIVE HOURS	PASQUILL STABILITY CLASS						
	-A-	-B-	-C-	-D-	-E-	-F-	-G-
2	392	198	292	4999	3778	1656	670
3	251	66	113	4050	2919	1130	486
4	153	22	48	3377	2313	777	354
5	91	6	20	2897	1872	531	250
6	50	0	8	2516	1524	371	168
7	27	0	2	2209	1242	260	110
8	15	0	0	1954	1008	176	71
9	7	0	0	1740	814	114	41
10	2	0	0	1559	641	73	22
11	0	0	0	1413	500	44	10
12	0	0	0	1296	382	25	4
13	0	0	0	1199	279	16	1
14	0	0	0	1112	202	11	0
15	0	0	0	1034	140	7	0
16	0	0	0	964	93	5	0
17	0	0	0	900	63	4	0
18	0	0	0	843	42	3	0
19	0	0	0	792	32	2	0
20	0	0	0	747	25	1	0
21	0	0	0	702	19	0	0
22	0	0	0	659	14	0	0
23	0	0	0	621	11	0	0
24	0	0	0	586	8	0	0
25	0	0	0	551	5	0	0

671 INVALID HOUR(S).

TABLE 2.3-33 MONTHLY STABILITY CLASS FREQUENCY DISTRIBUTIONS (IN PERCENT)

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: (1959-1969)

PASQUILL-TURNER STABILITY CLASS	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	ANNUAL
A	.0	.1	.1	.2	.6	1.0	1.3	1.1	.1	.2	.0	.0	.4
B	.3	1.3	2.4	3.2	6.1	9.2	11.5	10.3	6.3	4.0	.6	.6	4.7
C	5.1	6.6	6.0	9.2	16.0	18.6	21.6	21.5	13.0	9.8	5.0	5.1	11.5
D	67.1	67.5	68.5	68.2	51.2	39.0	28.5	30.0	47.3	47.3	63.1	66.1	53.6
E	18.7	14.7	14.7	12.6	15.8	17.1	17.7	19.0	18.9	23.1	20.4	18.3	17.6
F	8.7	10.0	8.2	6.5	10.2	15.1	19.4	18.0	14.4	15.6	10.9	9.9	12.2

SOURCE:

NATIONAL CLIMATIC CENTER, UNDATED, SUMMARY OF HOURLY OBSERVATIONS, COLUMBIA MISSOURI (1959-1969):
NATIONAL CLIMATIC CENTER, ASHEVILLE, NORTH CAROLINA, MAGNETIC TAPE FOR STATION NO. 13983.

TABLE 2.3-34 JOINT WIND SPEED, WIND DIRECTION
FREQUENCY DISTRIBUTION (IN PERCENT)

STABILITY CLASS A

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
UNION ELECTRIC COMPANY
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: ANNUAL, (1960-1969)

	UPPER CLASS INTERVALS OF WIND SPEED (KNOTS)										
SECTOR	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	>20.0	TOTAL	MEAN SPEED
NNE	.0	3.4	.0	.0	.0	.0	.0	.0	.0	3.4	4.5
NE	.0	1.7	.0	.0	.0	.0	.0	.0	.0	1.7	4.0
ENE	.0	7.8	.0	.0	.0	.0	.0	.0	.0	7.8	3.9
E	.0	4.3	.0	.0	.0	.0	.0	.0	.0	4.3	3.8
ESE	.0	3.4	.0	.0	.0	.0	.0	.0	.0	3.4	3.8
SE	.0	2.6	.0	.0	.0	.0	.0	.0	.0	2.6	4.3
SSE	.0	4.3	.0	.0	.0	.0	.0	.0	.0	4.3	4.4
S	.9	5.2	.0	.0	.0	.0	.0	.0	.0	6.0	4.0
SSW	.0	6.0	.0	.0	.0	.0	.0	.0	.0	6.0	4.6
SW	.9	4.3	.0	.0	.0	.0	.0	.0	.0	5.2	3.5
WSW	.0	6.0	.0	.0	.0	.0	.0	.0	.0	6.0	4.3
W	.9	2.6	.0	.0	.0	.0	.0	.0	.0	3.4	3.5
WNW	.0	4.3	.0	.0	.0	.0	.0	.0	.0	4.3	4.0
NW	.0	4.3	.0	.0	.0	.0	.0	.0	.0	4.3	4.2
NNW	.0	1.7	.0	.0	.0	.0	.0	.0	.0	1.7	4.5
N	.0	7.8	.0	.0	.0	.0	.0	.0	.0	7.8	4.6
CALM										27.6	
TOTAL	2.6	69.8	.0	.0	.0	.0	.0	.0	.0	100.0	3.0

NUMBER OF INVALID OBSERVATIONS = 0

TABLE 2.3-34 (Continued) (Sheet 2 of 6)

STABILITY CLASS B

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
UNION ELECTRIC COMPANY
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: ANNUAL, (1960-1969)

	UPPER CLASS INTERVALS OF WIND SPEED (KNOTS)										
SECTOR	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	>20.0	TOTAL	MEAN SPEED
NNE	.0	1.3	1.0	.4	.0	.0	.0	.0	.0	2.7	5.5
NE	.1	1.2	1.1	.2	.0	.0	.0	.0	.0	2.6	5.2
ENE	.1	2.4	2.0	.6	.0	.0	.0	.0	.0	5.1	5.5
E	.1	1.9	3.0	.2	.0	.0	.0	.0	.0	5.3	5.6
ESE	.1	2.1	2.2	.4	.0	.0	.0	.0	.0	4.7	5.6
SE	.1	1.6	2.3	.5	.0	.0	.0	.0	.0	4.6	5.7
SSE	.1	1.9	3.5	1.0	.0	.0	.0	.0	.0	6.5	5.8
S	.2	3.3	6.0	1.3	.0	.0	.0	.0	.0	10.8	5.9
SSW	.1	2.5	5.0	1.1	.0	.0	.0	.0	.0	8.6	6.1
SW	.0	2.9	4.8	1.4	.0	.0	.0	.0	.0	9.2	5.9
WSW	.0	4.1	5.2	1.5	.0	.0	.0	.0	.0	10.8	5.9
W	.3	2.6	3.4	.4	.0	.0	.0	.0	.0	6.7	5.4
WNW	.1	2.5	2.4	.4	.0	.0	.0	.0	.0	5.4	5.5
NW	.1	1.8	1.9	.6	.0	.0	.0	.0	.0	4.4	5.6
NNW	.0	1.6	1.0	.3	.0	.0	.0	.0	.0	2.9	5.2
N	.4	2.1	1.8	.5	.0	.0	.0	.0	.0	4.8	5.2
CALM										4.9	
TOTAL	1.8	35.9	46.7	10.8	.0	.0	.0	.0	.0	100.0	5.4

NUMBER OF INVALID OBSERVATIONS = 0

TABLE 2.3-34 (Continued) (Sheet 3 of 6)

STABILITY CLASS C

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
UNION ELECTRIC COMPANY
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: ANNUAL, (1960-1969)

	UPPER CLASS INTERVALS OF WIND SPEED (KNOTS)										
SECTOR	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	>20.0	TOTAL	MEAN SPEED
NNE	.0	.7	.7	1.6	.2	.1	.0	.0	.0	3.5	7.7
NE	.0	.9	.5	1.2	.2	.0	.0	.0	.0	2.7	7.2
ENE	.0	1.0	1.2	1.7	.3	.1	.0	.0	.0	4.3	7.5
E	.0	1.0	.9	2.3	.1	.0	.0	.0	.0	4.4	7.3
ESE	.0	1.0	.7	2.8	.2	.1	.0	.0	.0	4.8	7.6
SE	.0	1.4	1.3	2.9	.6	.1	.1	.0	.0	6.4	7.9
SSE	.0	1.0	2.0	5.0	.6	.1	.0	.0	.0	8.7	8.0
S	.0	1.9	3.5	7.4	.9	.4	.1	.1	.0	14.4	8.1
SSW	.0	1.5	2.2	5.1	.8	.2	.0	.0	.0	9.7	8.0
SW	.1	1.2	1.6	4.0	.4	.2	.0	.0	.0	7.5	8.0
WSW	.0	1.4	1.8	4.5	.8	.4	.1	.1	.0	9.0	8.3
W	.0	1.3	1.6	2.7	.3	.2	.0	.0	.0	6.2	7.6
WNW	.0	.6	1.2	2.6	.4	.2	.0	.0	.0	5.1	8.3
NW	.0	1.0	.7	2.2	.3	.1	.1	.0	.0	4.7	8.3
NNW	.0	.8	.5	1.2	.2	.1	.1	.0	.0	3.0	8.0
N	.0	1.0	1.1	2.2	.4	.1	.0	.0	.0	4.8	7.7
CALM										.7	
TOTAL	.2	17.7	21.5	49.5	6.6	2.5	.8	.4	.1	100.0	7.9

NUMBER OF INVALID OBSERVATIONS = 0

TABLE 2.3-34 (Continued) (Sheet 4 of 6)

STABILITY CLASS D

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
UNION ELECTRIC COMPANY
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: ANNUAL, (1960-1969)

SECTOR	UPPER CLASS INTERVALS OF WIND SPEED (KNOTS) 2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	>20.0	TOTAL	MEAN SPEED
NNE	.0	.3	.4	1.3	.8	.8	.3	.2	.0	4.2	11.0
NE	.0	.4	.5	1.4	.8	.6	.1	.1	.0	3.9	10.2
ENE	.0	.4	.8	1.8	.7	.7	.1	.1	.0	4.7	9.6
E	.0	.5	.8	1.7	.7	.6	.1	.1	.0	4.4	9.6
ESE	.0	.4	.9	2.1	1.3	1.1	.3	.1	.0	6.1	10.3
SE	.0	.4	.8	2.6	1.8	1.6	.5	.2	.0	7.8	11.0
SSE	.0	.4	1.0	3.1	1.9	2.1	.5	.2	.0	9.3	10.9
S	.0	.6	1.8	3.6	2.3	2.5	.6	.4	.1	11.8	10.8
SSW	.0	.4	.7	1.6	1.1	1.2	.3	.2	.0	5.5	10.8
SW	.0	.4	.5	.9	.6	.7	.2	.1	.0	3.5	10.5
WSW	.0	.4	.7	1.1	.9	1.0	.4	.3	.1	4.9	11.4
W	.0	.4	.5	1.1	.8	1.1	.3	.4	.1	4.7	11.6
WNW	.0	.4	.5	1.3	1.4	2.1	.9	.9	.4	7.9	13.1
NW	.0	.2	.4	1.4	1.4	2.3	1.3	1.3	.5	8.8	13.9
NNW	.0	.3	.4	1.0	1.0	1.5	.7	.7	.2	5.8	12.9
N	.0	.4	.7	1.6	1.1	1.3	.5	.5	.1	6.2	11.6
CALM										.4	
TOTAL	.1	6.3	11.4	27.6	18.5	21.2	7.1	5.8	1.7	100.0	11.3

NUMBER OF INVALID OBSERVATIONS = 17

TABLE 2.3-34 (Continued) (Sheet 5 of 6)

STABILITY CLASS E

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
UNION ELECTRIC COMPANY
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: ANNUAL, (1960-1969)

	UPPER CLASS INTERVALS OF WIND SPEED (KNOTS)										
SECTOR	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	>20.0	TOTAL	MEAN SPEED
NNE	.0	.5	1.3	1.5	.0	.0	.0	.0	.0	3.2	7.3
NE	.0	.6	1.0	1.1	.0	.0	.0	.0	.0	2.8	7.0
ENE	.0	1.1	2.0	1.1	.0	.0	.0	.0	.0	4.2	6.7
E	.0	1.3	1.8	1.9	.0	.0	.0	.0	.0	5.0	6.9
ESE	.0	.7	2.0	3.4	.0	.0	.0	.0	.0	6.1	7.7
SE	.0	.7	2.1	5.3	.0	.0	.0	.0	.0	8.2	7.9
SSE	.0	.9	4.0	7.1	.0	.0	.0	.0	.0	12.0	7.9
S	.0	1.7	6.1	9.9	.0	.0	.0	.0	.0	17.6	7.7
SSW	.0	.9	2.9	3.7	.0	.0	.0	.0	.0	7.4	7.5
SW	.0	.6	1.4	2.4	.0	.0	.0	.0	.0	4.3	7.5
WSW	.0	.7	1.9	3.1	.0	.0	.0	.0	.0	5.7	7.6
W	.0	.9	1.9	2.4	.0	.0	.0	.0	.0	5.3	7.2
WNW	.0	.6	1.7	3.3	.0	.0	.0	.0	.0	5.5	7.8
NW	.0	.4	1.0	3.6	.0	.0	.0	.0	.0	5.1	8.2
NNW	.0	.4	.9	2.3	.0	.0	.0	.0	.0	3.6	7.8
N	.0	.7	1.4	1.8	.0	.0	.0	.0	.0	4.0	7.3
CALM										.0	
TOTAL	.0	12.8	33.3	53.9	.0	.0	.0	.0	.0	100.0	7.6

NUMBER OF INVALID OBSERVATIONS = 0

TABLE 2.3-34 (Continued) (Sheet 6 of 6)

STABILITY CLASS F

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
UNION ELECTRIC COMPANY
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: ANNUAL, (1960-1969)

	UPPER CLASS INTERVALS OF WIND SPEED (KNOTS)										
SECTOR	2.5	5.0	7.5	10.0	12.5	15.0	17.5	20.0	>20.0	TOTAL	MEAN SPEED
NNE	.1	3.2	1.5	.0	.0	.0	.0	.0	.0	4.9	4.7
NE	.1	3.1	1.7	.0	.0	.0	.0	.0	.0	4.9	4.8
ENE	.2	4.3	2.3	.0	.0	.0	.0	.0	.0	6.8	4.8
E	.2	4.8	2.9	.0	.0	.0	.0	.0	.0	7.9	4.9
ESE	.1	2.4	2.0	.0	.0	.0	.0	.0	.0	4.5	5.1
SE	.1	2.6	1.6	.0	.0	.0	.0	.0	.0	4.3	4.9
SSE	.1	3.0	4.1	.0	.0	.0	.0	.0	.0	7.2	5.3
S	.2	6.5	5.3	.0	.0	.0	.0	.0	.0	12.0	5.1
SSW	.1	3.5	2.7	.0	.0	.0	.0	.0	.0	6.3	5.1
SW	.1	3.6	2.3	.0	.0	.0	.0	.0	.0	6.0	4.9
WSW	.1	3.4	2.4	.0	.0	.0	.0	.0	.0	5.9	4.9
W	.2	3.5	2.4	.0	.0	.0	.0	.0	.0	6.1	4.9
WNW	.0	3.0	1.9	.0	.0	.0	.0	.0	.0	5.0	4.9
NW	.1	2.0	1.5	.0	.0	.0	.0	.0	.0	3.6	4.8
NNW	.1	1.9	1.0	.0	.0	.0	.0	.0	.0	3.0	4.6
N	.0	3.7	2.1	.0	.0	.0	.0	.0	.0	5.8	4.9
CALM										5.9	
TOTAL	1.7	54.6	37.8	.0	.0	.0	.0	.0	.0	100.0	4.6

NUMBER OF INVALID OBSERVATIONS = 0

TABLE 2.3-35 PERSISTENCE OF STABILITY FREQUENCY DISTRIBUTION (IN PERCENT)

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: WINTER (1959-1969)

HOURS OF PERSISTENCE	PASQUILL - TURNER STABILITY CLASS					
	A	B	C	D	E	F
3	100.0	68.4	61.2	3.2	30.0	34.8
6	0.0	31.5	35.9	3.4	31.1	30.2
9	0.0	0.0	2.7	3.8	22.4	21.3
12	0.0	0.0	0.0	4.8	10.3	10.0
15	0.0	0.0	0.0	4.0	6.1	3.4
18	0.0	0.0	0.0	3.5	0.0	0.0
21	0.0	0.0	0.0	3.7	0.0	0.0
24	0.0	0.0	0.0	3.0	0.0	0.0
27	0.0	0.0	0.0	1.8	0.0	0.0
30	0.0	0.0	0.0	3.8	0.0	0.0
33	0.0	0.0	0.0	3.4	0.0	0.0
36	0.0	0.0	0.0	3.2	0.0	0.0
39	0.0	0.0	0.0	3.8	0.0	0.0
42	0.0	0.0	0.0	3.1	0.0	0.0
45	0.0	0.0	0.0	3.0	0.0	0.0
48	0.0	0.0	0.0	1.8	0.0	0.0
51	0.0	0.0	0.0	3.0	0.0	0.0
54	0.0	0.0	0.0	0.8	0.0	0.0
57	0.0	0.0	0.0	5.5	0.0	0.0
60	0.0	0.0	0.0	1.3	0.0	0.0
63	0.0	0.0	0.0	2.8	0.0	0.0
66	0.0	0.0	0.0	3.4	0.0	0.0
69	0.0	0.0	0.0	2.5	0.0	0.0
72	0.0	0.0	0.0	1.6	0.0	0.0
75	0.0	0.0	0.0	0.5	0.0	0.0
78	0.0	0.0	0.0	0.5	0.0	0.0
81	0.0	0.0	0.0	1.8	0.0	0.0
84	0.0	0.0	0.0	2.5	0.0	0.0
87	0.0	0.0	0.0	1.3	0.0	0.0
90	0.0	0.0	0.0	1.3	0.0	0.0
93	0.0	0.0	0.0	1.3	0.0	0.0
96	0.0	0.0	0.0	2.1	0.0	0.0
99	0.0	0.0	0.0	0.7	0.0	0.0

TABLE 2.3-35 (Continued) (Sheet 2 of 7)

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: WINTER (1959-1969)

HOURS OF PERSISTENCE	PASQUILL - TURNER STABILITY CLASS					
	A	B	C	D	E	F
102	0.0	0.0	0.0	0.0	0.0	0.0
105	0.0	0.0	0.0	1.5	0.0	0.0
108	0.0	0.0	0.0	3.2	0.0	0.0
111	0.0	0.0	0.0	2.5	0.0	0.0
114	0.0	0.0	0.0	0.8	0.0	0.0
117	0.0	0.0	0.0	0.0	0.0	0.0
120	0.0	0.0	0.0	0.0	0.0	0.0
123	0.0	0.0	0.0	0.0	0.0	0.0
126	0.0	0.0	0.0	0.0	0.0	0.0
129	0.0	0.0	0.0	0.9	0.0	0.0
132	0.0	0.0	0.0	0.9	0.0	0.0
135	0.0	0.0	0.0	0.0	0.0	0.0
138	0.0	0.0	0.0	0.0	0.0	0.0
141	0.0	0.0	0.0	1.0	0.0	0.0
144	0.0	0.0	0.0	0.0	0.0	0.0
147	0.0	0.0	0.0	0.0	0.0	0.0
150	0.0	0.0	0.0	0.0	0.0	0.0
153	0.0	0.0	0.0	0.0	0.0	0.0
156	0.0	0.0	0.0	1.1	0.0	0.0

TABLE 2.3-35 (Continued) (Sheet 3 of 7)

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: WINTER (1959-1969)

HOURS OF PERSISTENCE	PASQUILL - TURNER STABILITY CLASS					
	A	B	C	D	E	F
3	33.3	39.7	46.5	4.9	39.2	29.1
6	66.6	45.7	31.0	5.2	35.6	29.8
9	0.0	14.4	19.2	5.1	16.3	35.0
12	0.0	0.0	3.2	5.2	5.0	5.9
15	0.0	0.0	0.0	4.3	3.6	0.0
18	0.0	0.0	0.0	5.1	0.0	0.0
21	0.0	0.0	0.0	3.5	0.0	0.0
24	0.0	0.0	0.0	2.8	0.0	0.0
27	0.0	0.0	0.0	2.5	0.0	0.0
30	0.0	0.0	0.0	5.0	0.0	0.0
33	0.0	0.0	0.0	2.6	0.0	0.0
36	0.0	0.0	0.0	3.4	0.0	0.0
39	0.0	0.0	0.0	2.8	0.0	0.0
42	0.0	0.0	0.0	5.0	0.0	0.0
45	0.0	0.0	0.0	4.6	0.0	0.0
48	0.0	0.0	0.0	1.1	0.0	0.0
51	0.0	0.0	0.0	3.2	0.0	0.0
54	0.0	0.0	0.0	2.1	0.0	0.0
57	0.0	0.0	0.0	2.7	0.0	0.0
60	0.0	0.0	0.0	1.9	0.0	0.0
63	0.0	0.0	0.0	1.0	0.0	0.0
66	0.0	0.0	0.0	2.6	0.0	0.0
69	0.0	0.0	0.0	1.6	0.0	0.0
72	0.0	0.0	0.0	1.7	0.0	0.0
75	0.0	0.0	0.0	1.7	0.0	0.0
78	0.0	0.0	0.0	0.0	0.0	0.0
81	0.0	0.0	0.0	1.2	0.0	0.0
84	0.0	0.0	0.0	1.3	0.0	0.0
87	0.0	0.0	0.0	0.6	0.0	0.0
90	0.0	0.0	0.0	2.1	0.0	0.0
93	0.0	0.0	0.0	0.7	0.0	0.0
96	0.0	0.0	0.0	1.5	0.0	0.0
99	0.0	0.0	0.0	0.7	0.0	0.0

TABLE 2.3-35 (Continued) (Sheet 4 of 7)

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: WINTER (1959-1969)

HOURS OF PERSISTENCE	PASQUILL - TURNER STABILITY CLASS					
	A	B	C	D	E	F
102	0.0	0.0	0.0	0.8	0.0	0.0
105	0.0	0.0	0.0	2.5	0.0	0.0
108	0.0	0.0	0.0	0.0	0.0	0.0
111	0.0	0.0	0.0	0.8	0.0	0.0
114	0.0	0.0	0.0	0.0	0.0	0.0
117	0.0	0.0	0.0	0.0	0.0	0.0
120	0.0	0.0	0.0	0.0	0.0	0.0
123	0.0	0.0	0.0	1.9	0.0	0.0
126	0.0	0.0	0.0	0.0	0.0	0.0
129	0.0	0.0	0.0	0.0	0.0	0.0
132	0.0	0.0	0.0	0.0	0.0	0.0
135	0.0	0.0	0.0	0.0	0.0	0.0
138	0.0	0.0	0.0	0.0	0.0	0.0
141	0.0	0.0	0.0	0.0	0.0	0.0
144	0.0	0.0	0.0	0.0	0.0	0.0
147	0.0	0.0	0.0	0.0	0.0	0.0
150	0.0	0.0	0.0	0.0	0.0	0.0
153	0.0	0.0	0.0	0.0	0.0	0.0
156	0.0	0.0	0.0	0.0	0.0	0.0
159	0.0	0.0	0.0	1.2	0.0	0.0
162	0.0	0.0	0.0	0.0	0.0	0.0
165	0.0	0.0	0.0	0.0	0.0	0.0
168	0.0	0.0	0.0	0.0	0.0	0.0
171	0.0	0.0	0.0	0.0	0.0	0.0
174	0.0	0.0	0.0	0.0	0.0	0.0
177	0.0	0.0	0.0	1.4	0.0	0.0

TABLE 2.3-35 (Continued) (Sheet 5 of 7)

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: WINTER (1959-1969)

HOURS OF PERSISTENCE	PASQUILL - TURNER STABILITY CLASS					
	A	B	C	D	E	F
3	65.2	54.3	49.3	18.0	42.5	26.8
6	34.7	27.4	27.1	18.5	30.9	26.2
9	0.0	17.2	18.4	11.7	22.5	39.4
12	0.0	0.8	5.1	10.1	3.9	7.4
15	0.0	0.0	0.0	7.8	0.0	0.0
18	0.0	0.0	0.0	5.3	0.0	0.0
21	0.0	0.0	0.0	5.5	0.0	0.0
24	0.0	0.0	0.0	4.0	0.0	0.0
27	0.0	0.0	0.0	4.5	0.0	0.0
30	0.0	0.0	0.0	2.8	0.0	0.0
33	0.0	0.0	0.0	2.4	0.0	0.0
36	0.0	0.0	0.0	1.3	0.0	0.0
39	0.0	0.0	0.0	2.1	0.0	0.0
42	0.0	0.0	0.0	1.5	0.0	0.0
45	0.0	0.0	0.0	0.8	0.0	0.0
48	0.0	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.9	0.0	0.0
54	0.0	0.0	0.0	1.0	0.0	0.0
57	0.0	0.0	0.0	1.0	0.0	0.0

TABLE 2.3-35 (Continued) (Sheet 6 of 7)

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: WINTER (1959-1969)

HOURS OF PERSISTENCE	PASQUILL - TURNER STABILITY CLASS					
	A	B	C	D	E	F
3	100.0	60.4	56.6	7.2	30.6	29.9
6	0.0	39.5	29.4	8.1	28.9	25.4
9	0.0	0.0	13.8	7.3	22.3	23.0
12	0.0	0.0	0.0	8.8	12.3	14.7
15	0.0	0.0	0.0	5.3	5.7	6.9
18	0.0	0.0	0.0	7.1	0.0	0.0
21	0.0	0.0	0.0	4.3	0.0	0.0
24	0.0	0.0	0.0	2.5	0.0	0.0
27	0.0	0.0	0.0	2.2	0.0	0.0
30	0.0	0.0	0.0	3.7	0.0	0.0
33	0.0	0.0	0.0	3.0	0.0	0.0
36	0.0	0.0	0.0	2.6	0.0	0.0
39	0.0	0.0	0.0	2.4	0.0	0.0
42	0.0	0.0	0.0	3.5	0.0	0.0
45	0.0	0.0	0.0	2.8	0.0	0.0
48	0.0	0.0	0.0	1.0	0.0	0.0
51	0.0	0.0	0.0	1.5	0.0	0.0
54	0.0	0.0	0.0	1.6	0.0	0.0
57	0.0	0.0	0.0	1.1	0.0	0.0
60	0.0	0.0	0.0	1.8	0.0	0.0
63	0.0	0.0	0.0	2.6	0.0	0.0
66	0.0	0.0	0.0	0.6	0.0	0.0
69	0.0	0.0	0.0	0.7	0.0	0.0
72	0.0	0.0	0.0	0.0	0.0	0.0
75	0.0	0.0	0.0	0.0	0.0	0.0
78	0.0	0.0	0.0	1.6	0.0	0.0
81	0.0	0.0	0.0	0.8	0.0	0.0
84	0.0	0.0	0.0	0.8	0.0	0.0
87	0.0	0.0	0.0	0.0	0.0	0.0
90	0.0	0.0	0.0	1.8	0.0	0.0
93	0.0	0.0	0.0	0.0	0.0	0.0
96	0.0	0.0	0.0	0.0	0.0	0.0
99	0.0	0.0	0.0	0.0	0.0	0.0
102	0.0	0.0	0.0	0.0	0.0	0.0

TABLE 2.3-35 (Continued) (Sheet 7 of 7)

CALLAWAY PLANT UNITS 1 AND 2, REFORM, MISSOURI
DATA SITE: COLUMBIA, MISSOURI
DATA PERIOD: WINTER (1959-1969)

HOURS OF PERSISTENCE	PASQUILL - TURNER STABILITY CLASS					
	A	B	C	D	E	F
105	0.0	0.0	0.0	0.0	0.0	0.0
108	0.0	0.0	0.0	0.0	0.0	0.0
111	0.0	0.0	0.0	0.0	0.0	0.0
114	0.0	0.0	0.0	1.1	0.0	0.0
117	0.0	0.0	0.0	0.0	0.0	0.0
120	0.0	0.0	0.0	1.2	0.0	0.0
123	0.0	0.0	0.0	0.0	0.0	0.0
126	0.0	0.0	0.0	0.0	0.0	0.0
129	0.0	0.0	0.0	0.0	0.0	0.0
132	0.0	0.0	0.0	0.0	0.0	0.0
135	0.0	0.0	0.0	1.4	0.0	0.0
138	0.0	0.0	0.0	1.4	0.0	0.0
141	0.0	0.0	0.0	1.4	0.0	0.0
144	0.0	0.0	0.0	0.0	0.0	0.0
147	0.0	0.0	0.0	1.5	0.0	0.0
150	0.0	0.0	0.0	0.0	0.0	0.0
153	0.0	0.0	0.0	0.0	0.0	0.0
156	0.0	0.0	0.0	1.6	0.0	0.0
159	0.0	0.0	0.0	0.0	0.0	0.0
162	0.0	0.0	0.0	0.0	0.0	0.0
165	0.0	0.0	0.0	0.0	0.0	0.0
168	0.0	0.0	0.0	0.0	0.0	0.0
171	0.0	0.0	0.0	0.0	0.0	0.0
174	0.0	0.0	0.0	0.0	0.0	0.0
177	0.0	0.0	0.0	0.0	0.0	0.0
180	0.0	0.0	0.0	0.0	0.0	0.0
183	0.0	0.0	0.0	0.0	0.0	0.0
186	0.0	0.0	0.0	0.0	0.0	0.0
189	0.0	0.0	0.0	0.0	0.0	0.0
192	0.0	0.0	0.0	0.0	0.0	0.0
195	0.0	0.0	0.0	0.0	0.0	0.0
198	0.0	0.0	0.0	0.0	0.0	0.0
201	0.0	0.0	0.0	0.0	0.0	0.0
204	0.0	0.0	0.0	0.0	0.0	0.0
207	0.0	0.0	0.0	0.0	0.0	0.0
210	0.0	0.0	0.0	2.1	0.0	0.0

(Sheet 1 of 1)

TABLE 2.3-36 ON-SITE ATMOSPHERIC STABILITY*

	ANNUAL PERCENT OCCURRENCE				MONTHLY PERCENT OCCURRENCE - 3 YEARS COMBINED											
PASQUILL CLASS	1973-74	1974-75	1978-79	3 YEARS COMBINED	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
A	4.4	3.3	2.4	3.4	1.6	2.4	8.2	3.1	3.2	1.7	4.0	4.4	4.6	2.5	2.3	2.2
B	3.4	3.9	2.4	3.3	2.1	2.2	5.0	2.9	2.3	3.5	5.4	4.9	3.3	2.1	2.8	2.2
C	5.0	5.8	4.2	5.0	2.4	3.1	6.7	4.2	4.0	6.5	7.3	8.8	5.4	4.2	2.9	3.5
D	35.1	38.8	37.7	37.2	49.3	46.0	42.7	40.8	34.0	33.2	25.2	25.3	33.2	29.8	42.3	49.2
E	30.5	29.9	31.7	30.1	30.1	33.1	28.7	35.4	34.5	28.7	27.2	28.1	28.4	31.2	32.3	30.1
F	15.7	13.0	16.4	15.0	10.9	10.0	7.1	9.1	15.6	17.7	23.8	23.1	16.7	19.7	13.6	10.6
G	6.0	5.1	5.2	5.4	3.7	3.2	1.6	3.5	6.4	8.8	7.1	5.5	8.4	10.5	3.9	2.2

* Based on 60-10m ΔT supplemented by 90-10m ΔT, coincident with 60m wind data.

TABLE 2.3-37 STABILITY PERSISTENCE SUMMARY MAY 1973 TO MAY 1974

NUMBER OF CONSECUTIVE HOURS	PASQUILL STABILITY CLASS						
	-A-	-B-	-C-	-D-	-E-	-F-	-G-
2	391	198	292	4992	3787	1655	746
3	251	66	113	4046	2929	1130	552
4	153	22	48	3376	2323	777	413
5	91	6	20	2897	1882	531	303
6	50	0	8	2516	1533	371	215
7	27	0	2	2209	1250	260	151
8	15	0	0	1954	1015	176	106
9	7	0	0	1740	821	114	70
10	2	0	0	1559	648	73	46
11	0	0	0	1413	507	44	29
12	0	0	0	1296	388	25	20
13	0	0	0	1199	284	16	14
14	0	0	0	1112	206	11	11
15	0	0	0	1034	143	7	9
16	0	0	0	964	95	5	7
17	0	0	0	900	64	4	5
18	0	0	0	843	42	3	3
19	0	0	0	792	32	2	1
20	0	0	0	747	25	1	0
21	0	0	0	702	19	0	0
22	0	0	0	659	14	0	0
23	0	0	0	621	11	0	0
24	0	0	0	586	8	0	0
>24	0	0	0	551	5	0	0

575 INVALID HOUR(S).

TABLE 2.3-38 STABILITY PERSISTENCE SUMMARY MARCH 1978 TO MARCH 1979

NUMBER OF CONSECUTIVE HOURS	PASQUILL STABILITY CLASS						
	-A-	-B-	-C-	-D-	-E-	-F-	-G-
2	85	40	86	2696	1883	873	290
3	40	9	25	2238	1444	605	220
4	19	1	12	1875	1130	426	168
5	7	0	4	1590	893	295	128
6	1	0	1	1397	704	202	94
7	0	0	0	1254	552	139	68
8	0	0	0	1129	431	92	44
9	0	0	0	1024	339	59	24
10	0	0	0	936	259	35	13
11	0	0	0	853	194	17	7
12	0	0	0	780	146	7	2
13	0	0	0	719	106	2	0
14	0	0	0	668	79	0	0
15	0	0	0	619	63	0	0
16	0	0	0	575	54	0	0
17	0	0	0	533	48	0	0
18	0	0	0	497	44	0	0
19	0	0	0	465	40	0	0
20	0	0	0	435	36	0	0
21	0	0	0	408	32	0	0
22	0	0	0	382	28	0	0
23	0	0	0	357	24	0	0
24	0	0	0	332	21	0	0
>24	0	0	0	311	18	0	0

532 INVALID HOUR(S).

TABLE 2.3-39 ANNUAL PRECIPITATION WIND ROSES

(Data Period: March 16, 1978 to March 16, 1979)

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: MARCH 16, 1978 1700 TO MARCH 16, 1979 1600

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 11.54.15.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7577-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	2 .37	26 4.80	23 4.24	2 .37	0 0.00	0 0.00	53 9.78	3.76
NE	3 .55	27 4.98	24 4.43	6 1.11	11 2.03	0 0.00	71 13.10	4.14
ENE	3 .55	4 .74	21 3.87	3 .55	0 0.00	0 0.00	31 5.72	3.71
E	0 0.00	14 2.58	25 4.61	11 2.03	0 0.00	0 0.00	50 9.23	3.99
ESE	4 .74	15 2.77	27 4.98	3 .55	0 0.00	0 0.00	49 9.04	3.24
SE	0 0.00	9 1.66	19 3.51	5 .92	0 0.00	0 0.00	33 6.09	3.62
SSE	2 .37	8 1.48	23 4.24	2 .37	0 0.00	0 0.00	35 6.46	3.56
S	3 .55	6 1.11	16 2.95	5 .92	0 0.00	0 0.00	30 5.54	3.64
SSW	1 .18	4 .74	13 2.40	3 .55	2 .37	0 0.00	23 4.24	4.23
SW	1 .18	4 .74	6 1.11	7 1.29	2 .37	0 0.00	20 3.69	4.59
WSW	0 0.00	5 .92	6 1.11	6 1.11	0 0.00	0 0.00	17 3.14	4.78
W	2 .37	4 .74	9 1.66	5 .92	3 .55	0 0.00	23 4.24	4.56
WNW	1 .18	5 .92	3 .55	4 .74	1 .18	1 .18	15 2.77	4.49
NW	1 .18	6 1.11	12 2.21	6 1.11	4 .74	0 0.00	29 5.35	4.59
NNW	1 .18	6 1.11	8 1.48	6 1.11	0 0.00	0 0.00	21 3.87	3.97
N	1 .18	7 1.29	29 5.35	5 .92	0 0.00	0 0.00	42 7.75	3.34
CALM	0 0.00						0 0.00	CALM
TOTAL	25 4.61	150 27.68	264 48.71	79 14.58	23 4.24	1 .18	542 100.00	3.84

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION	542	6.19 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION	7857	89.69 PCT.
NUMBER OF INVALID OBSERVATIONS	361	4.12 PCT.
TOTAL NUMBER OF OBSERVATIONS	8760	100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD		35.19 INCHES

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: MARCH 16, 1978 1700 TO MARCH 16, 1979 1600

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 90.00 METERS
TABLE GENERATED: 05/22/79. 13.41.43.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7577-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 0.00	5 1.01	15 3.03	20 4.04	1 .20	0 0.00	41 8.28	5.00
NE	0 0.00	3 .60	20 4.04	11 2.22	0 0.00	1 .20	35 7.07	4.79
ENE	1 .20	0 0.00	14 2.82	15 3.03	13 2.62	8 1.61	51 10.30	7.13
E	1 .20	1 .20	9 1.81	23 4.64	5 1.01	4 .80	43 8.68	6.47
ESE	0 0.00	5 1.01	9 1.81	23 4.64	6 1.21	2 .40	45 9.09	5.82
SE	0 0.00	2 .40	10 2.02	19 3.83	4 .80	0 0.00	35 7.07	5.61
SSE	0 0.00	0 0.00	3 .60	19 3.83	13 2.62	0 0.00	35 7.07	6.74
S	1 .20	0 0.00	1 .20	11 2.22	9 1.81	1 .20	23 4.64	7.10
SSW	0 0.00	0 0.00	7 1.41	10 2.02	12 2.42	2 .40	31 6.26	7.27
SW	0 0.00	1 .20	3 .60	7 1.41	8 1.61	5 1.01	24 4.84	7.67
WSW	0 0.00	1 .20	4 .80	7 1.41	6 1.21	0 0.00	18 3.63	6.29
W	0 0.00	5 1.01	1 .20	3 .60	12 2.42	6 1.21	27 5.45	9.10
WNW	0 0.00	1 .20	3 .60	6 1.21	3 .60	2 .40	15 3.02	7.27
NW	0 0.00	0 0.00	0 0.00	9 1.81	2 .40	2 .40	13 2.62	7.44
NNW	0 0.00	1 .20	4 .81	11 2.22	5 1.01	1 .20	22 4.44	6.37
N	0 0.00	5 1.01	13 2.62	15 3.03	4 .81	0 0.00	37 7.47	5.25
CALM	0 0.00						[illegible]	CALM
TOTAL	3 .60	29 5.85	116 23.43	210 42.42	103 20.80	34 6.86	495 100.00	[illegible]

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION	495	5.65 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION	7615	86.93 PCT.
NUMBER OF INVALID OBSERVATIONS	[illegible]	7.42 PCT.
TOTAL NUMBER OF OBSERVATIONS	8760	100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD		33.03 INCHES

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: MARCH 16, 1978 1700 TO MARCH 16, 1979 1600

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 13.41.43.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7577-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 0.00	8 1.64	27 5.54	12 2.46	2 .41	0 0.00	49 10.06	4.39
NE	0 0.00	7 1.44	18 3.70	13 2.67	2 .41	1 .21	41 8.42	4.75
ENE	1 .21	6 1.23	11 2.26	17 3.49	4 .82	5 1.03	44 9.03	5.46
E	1 .21	7 1.44	13 2.67	19 3.90	5 1.03	0 0.00	45 9.24	5.14
ESE	0 0.00	4 .82	21 4.31	16 3.29	0 0.00	0 0.00	41 8.42	4.59
SE	1 .21	2 .41	20 4.11	8 1.64	2 .41	0 0.00	33 6.78	4.60
SSE	1 .21	1 .21	8 1.64	27 5.54	2 .41	0 0.00	39 8.01	5.64
S	1 .21	1 .21	9 1.85	17 3.49	5 1.03	0 0.00	33 6.78	5.46
SSW	0 0.00	0 0.00	6 1.23	7 1.44	6 1.23	3 .62	22 4.52	7.12
SW	2 .41	1 .21	4 .82	7 1.44	8 1.64	2 .41	24 4.93	6.47
WSW	0 0.00	1 .21	7 1.44	5 1.03	5 1.03	0 0.00	18 3.70	5.34
W	0 0.00	7 1.44	4 .82	6 1.23	6 1.23	3 .62	26 5.34	[illegible]
WNW	0 0.00	1 .21	6 1.23	6 1.23	2 .41	1 .21	16 3.29	[illegible]
NW	0 0.00	1 .21	2 .41	10 2.05	2 .41	1 .21	16 3.29	6.15
NNW	0 0.00	3 .62	6 1.23	4 .82	3 .62	0 0.00	16 3.29	5.17
N	1 .21	2 .41	11 2.26	9 1.85	1 .21	0 0.00	24 4.93	4.78
CALM	0 0.00						0.00	CALM
TOTAL	8 1.64	52 10.68	173 35.52	183 37.58	55 11.29	16 3.29	487 100.00	[illegible]

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION	487	5.56 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION	7552	86.21 PCT.
NUMBER OF INVALID OBSERVATIONS	721	8.23 PCT.
TOTAL NUMBER OF OBSERVATIONS	8760	100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD		32.29 INCHES

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCE

TABLE 2.3-40 ANNUAL PRECIPITATION WIND ROSES

Data Periods:
May 4, 1973 to May 4, 1974;
May 4, 1974 to May 4, 1975;
and 3 Years Combined

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: MAY 4, 1973 1200 TO MAY 4, 1974 1100

PRECIPITATION WIND ROSE — CALLAWAY GENERATING STATION
DATA SOURCE: ON SITE — REFORM, MISSOURI
WIND SENSOR HEIGHT: 10.00 METERS — UNION ELECTRIC COMPANY
TABLE GENERATED: 05/22/79. 11.54.13. — DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	1 .18	9 1.64	15 2.74	8 1.46	4 .73	0 0.00	38 6.93	4.41
NE	2 .36	11 2.01	11 2.01	6 1.09	0 0.00	0 0.00	30 5.47	3.41
ENE	5 .91	7 1.28	8 1.46	12 2.19	0 0.00	0 0.00	32 5.84	3.44
E	5 .91	14 2.55	13 2.37	5 .91	2 .36	1 .18	40 7.30	3.75
ESE	0 0.00	9 1.64	14 2.55	6 1.09	0 0.00	0 0.00	29 5.29	3.79
SE	1 .18	17 3.10	17 3.10	10 1.82	1 .18	0 0.00	46 8.39	3.46
SSE	2 .36	12 2.19	26 4.74	7 1.28	3 .55	0 0.00	50 9.12	4.00
S	5 .91	17 3.10	11 2.01	13 2.37	5 .91	1 .18	52 9.49	4.37
SSW	1 .18	7 1.28	8 1.46	3 .55	2 .36	0 0.00	21 3.83	3.95
SW	3 .55	10 1.82	10 1.82	8 1.46	3 .55	0 0.00	34 6.20	4.49
WSW	2 .36	6 1.09	8 1.46	6 1.09	2 .36	0 0.00	24 4.38	4.17
W	0 0.00	2 .36	5 .91	5 .91	2 .36	0 0.00	14 2.55	4.90
WNW	2 .36	8 1.46	9 1.64	2 .36	6 1.09	0 0.00	27 4.93	4.41
NW	1 .18	7 1.28	15 2.74	2 .36	1 .18	0 0.00	26 4.74	3.72
NNW	0 0.00	12 2.19	13 2.37	9 1.64	1 .18	0 0.00	35 6.39	4.22
N	5 .91	6 1.09	16 2.92	15 2.74	6 1.09	2 .36	50 9.12	5.01
CALM	0 0.00						0 0.00	CALM
TOTAL	35 6.39	154 28.10	199 36.31	118 21.53	33 5.93	4 .73	548 100.00	4.14

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 548 6.26 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 7630 87.10 PCT.
NUMBER OF INVALID OBSERVATIONS 582 6.64 PCT.
TOTAL NUMBER OF OBSERVATIONS 8760 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 42.86 INCHES

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: MAY 4, 1973 1200 TO MAY 4, 1974 1100

PRECIPITATION WIND ROSE — CALLAWAY GENERATING STATION
DATA SOURCE: ON SITE — REFORM, MISSOURI
WIND SENSOR HEIGHT: 60.00 METERS — UNION ELECTRIC COMPANY
TABLE GENERATED: 05/22/79. 11.54.15. — DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	3 .57	6 1.13	13 2.45	11 2.08	6 1.13	2 .38	41 7.74	5.19
NE	3 .57	3 .57	10 1.89	9 1.70	1 .19	0 0.00	26 4.91	4.42
ENE	0 0.00	5 .94	11 2.08	10 1.89	5 .94	0 0.00	31 5.85	5.13
E	2 .38	4 .75	17 3.21	10 1.89	3 .57	2 .38	38 7.17	5.12
ESE	2 .38	7 1.32	19 3.58	5 .94	4 .75	0 0.00	37 6.98	4.33
SE	1 .19	5 .94	18 3.40	19 3.58	10 1.89	2 .38	55 10.38	5.47
SSE	0 0.00	1 .19	12 2.26	10 1.89	7 1.32	0 0.00	30 5.66	5.59
S	0 0.00	9 1.70	11 2.08	18 3.40	7 1.32	7 1.32	52 9.81	6.12
SSW	2 .38	3 .57	10 1.89	8 1.51	5 .94	2 .38	30 5.66	5.43
SW	1 .19	2 .38	9 1.70	6 1.13	5 .94	4 .75	27 5.09	[illegible]
WSW	0 0.00	2 .38	5 .94	7 1.32	5 .94	2 .38	21 3.96	6.27
W	0 0.00	1 .19	6 1.13	3 .57	5 .94	1 .19	16 3.02	6.16
WNW	0 0.00	1 .19	11 2.08	9 1.70	3 .57	7 1.32	31 5.85	6.73
NW	1 .19	2 .38	11 2.08	7 1.32	2 .38	2 .38	25 4.72	5.49
NNW	0 0.00	5 .94	5 .94	7 1.32	6 1.13	3 .57	26 4.91	6.14
N	0 0.00	5 .94	13 2.45	13 2.45	7 1.32	6 1.13	44 8.30	[illegible]
CALM	0 0.00						0 0.00	CALM
TOTAL	15 2.83	61 11.51	191 36.04	152 28.68	81 15.28	40 7.55	530 100.00	5.42

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 530 6.05 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 7388 84.34 PCT.
NUMBER OF INVALID OBSERVATIONS 842 9.61 PCT.
TOTAL NUMBER OF OBSERVATIONS 8760 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 40.59 INCHES

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: MAY 4, 1974 1200 TO MAY 4, 1975 1100

PRECIPITATION WIND ROSE — CALLAWAY GENERATING STATION
DATA SOURCE: ON SITE — REFORM, MISSOURI
WIND SENSOR HEIGHT: 10.00 METERS — UNION ELECTRIC COMPANY
TABLE GENERATED: 05/22/79. 11.54.15. — DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	4 .72	25 4.51	22 3.97	6 1.08	0 0.00	0 0.00	57 10.29	3.23
NE	4 .72	14 2.53	18 3.25	2 .36	0 0.00	0 0.00	38 6.86	2.99
ENE	0 0.00	19 3.43	7 1.26	5 .90	0 0.00	0 0.00	31 5.60	3.21
E	4 .72	20 3.61	15 2.71	7 1.26	4 .72	0 0.00	50 9.03	3.71
ESE	1 .18	13 2.35	17 3.07	9 1.62	5 .90	0 0.00	45 8.12	4.47
SE	5 .90	15 2.71	19 3.43	3 .54	2 .36	0 0.00	44 7.94	3.42
SSE	2 .36	10 1.81	15 2.71	11 1.99	3 .54	0 0.00	41 7.40	4.13
S	4 .72	7 1.26	10 1.81	8 1.44	3 .54	0 0.00	32 5.78	4.27
SSW	2 .36	7 1.26	14 2.53	8 1.44	2 .36	0 0.00	33 5.96	4.27
SW	2 .36	8 1.44	4 .72	2 .36	0 0.00	0 0.00	16 2.89	3.16
WSW	2 .36	9 1.62	6 1.08	0 0.00	0 0.00	0 0.00	17 3.07	[illegible]
W	1 .18	9 1.62	10 1.81	3 .54	0 0.00	0 0.00	23 4.15	3.55
WNW	3 .54	8 1.44	10 1.81	6 1.08	0 0.00	0 0.00	27 4.87	3.59
NW	3 .54	5 .90	9 1.62	1 .18	0 0.00	0 0.00	18 3.25	3.12
NNW	0 0.00	5 .90	17 3.07	11 1.99	0 0.00	0 0.00	33 5.96	4.43
N	3 .54	13 2.35	17 3.07	12 2.17	3 .54	0 0.00	48 8.66	4.19
CALM	1 .18						1 .18	CALM
TOTAL	41 7.40	187 33.75	210 37.91	94 16.97	22 3.97	0 0.00	554 100.00	3.73

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 554 6.32 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 7966 90.94 PCT.
NUMBER OF INVALID OBSERVATIONS 240 2.74 PCT.
TOTAL NUMBER OF OBSERVATIONS 8760 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 42.84 INCHES

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: MAY 4, 1974 1200 TO MAY 4, 1975 1100

PRECIPITATION WIND ROSE — CALLAWAY GENERATING STATION
DATA SOURCE: ON SITE — REFORM, MISSOURI
WIND SENSOR HEIGHT: 60.00 METERS — UNION ELECTRIC COMPANY
TABLE GENERATED: 05/22/79. 11.54.15. — DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 0.00	11 2.14	22 4.28	15 2.92	1 .19	0 0.00	49 9.53	4.41
NE	0 0.00	6 1.17	16 3.11	2 .39	2 .39	1 .19	27 5.25	4.40
ENE	1 .19	5 .97	20 3.89	3 .58	1 .19	0 0.00	30 5.84	3.44
E	0 0.00	3 .58	14 2.72	10 1.95	2 .39	2 .39	31 6.03	5.25
ESE	0 0.00	4 .78	17 3.31	15 2.92	5 .97	5 .97	46 8.95	5.96
SE	1 .19	2 .39	17 3.31	20 3.89	2 .39	0 0.00	42 8.17	5.23
SSE	0 0.00	7 1.36	21 4.09	11 2.14	6 1.17	1 .19	46 8.95	5.18
S	6 1.17	0 0.00	12 2.33	11 2.14	5 .97	0 0.00	34 6.61	4.90
SSW	1 .19	3 .58	9 1.75	16 3.11	3 .58	4 .78	36 7.00	5.91
SW	0 0.00	3 .58	3 .58	15 2.92	6 1.17	1 .19	28 5.45	6.24
WSW	1 .19	1 .19	6 1.17	4 .78	3 .58	0 0.00	15 2.92	5.17
W	0 0.00	4 .78	8 1.56	5 .97	1 .19	0 0.00	18 3.50	4.49
WNW	2 .39	2 .39	14 2.72	7 1.36	6 1.17	1 .19	32 6.23	5.24
NW	1 .19	3 .58	4 .78	6 1.17	1 .19	0 0.00	15 2.92	4.62
NNW	0 0.00	4 .78	3 .58	7 1.36	6 1.17	0 0.00	20 3.89	5.79
N	0 0.00	2 .39	14 2.72	19 3.70	8 1.56	2 .39	45 8.75	6.14
CALM	0 0.00						0 0.00	CALM
TOTAL	13 2.53	60 11.67	200 38.91	166 32.30	58 11.28	17 3.31	514 100.00	5.23

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 514 5.87 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 7379 84.24 PCT.
NUMBER OF INVALID OBSERVATIONS 867 9.90 PCT.
TOTAL NUMBER OF OBSERVATIONS 8760 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 40.85 INCHES

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-40 (Continued) (Sheet 2 of 2)

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS COMBINED

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 13.58.09.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	7 .43	60 3.65	60 3.65	17 1.03	4 .24	0 0.00	148 9.00	3.59
NE	9 .55	52 3.16	53 3.22	14 .85	11 .67	0 0.00	139 8.45	3.47
ENE	8 .49	30 1.82	36 2.19	20 1.22	0 0.00	0 0.00	94 5.72	3.50
E	9 .55	48 2.92	53 3.22	23 1.40	6 .36	1 .06	140 8.52	3.42
ESE	5 .30	37 2.25	58 3.53	18 1.09	5 .30	0 0.00	123 7.48	3.40
SE	6 .36	41 2.49	55 3.35	18 1.09	3 .18	0 0.00	123 7.48	3.43
SSE	6 .36	30 1.82	64 3.89	20 1.22	6 .36	0 0.00	126 7.66	3.91
S	12 .73	30 1.82	37 2.25	26 1.58	8 .49	1 .06	114 6.93	4.10
SSW	4 .24	18 1.09	35 2.13	14 .85	6 .36	0 0.00	77 4.68	4.17
SW	6 .36	22 1.34	20 1.22	17 1.03	5 .30	0 0.00	70 4.26	4.15
WSW	4 .24	20 1.22	20 1.22	12 .73	2 .12	0 0.00	58 3.53	3.99
W	3 .18	15 .91	24 1.46	13 .79	5 .30	0 0.00	60 3.65	4.27
WNW	6 .36	21 1.28	22 1.34	12 .73	7 .43	1 .06	69 4.20	4.11
NW	5 .30	18 1.09	36 2.19	9 .55	5 .30	0 0.00	73 4.44	3.95
NNW	1 .06	23 1.40	38 2.31	26 1.58	1 .06	0 0.00	89 5.41	4.11
N	9 .55	26 1.58	62 3.77	32 1.95	9 .55	2 .12	140 8.52	4.38
CALM	1 .06						1 .06	CALM
TOTAL	101 6.14	491 29.87	673 40.94	291 17.70	83 5.05	5 .30	1644 100.00	3.92

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION	1644	6.26 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION	23453	89.24 PCT.
NUMBER OF INVALID OBSERVATIONS	1183	4.50 PCT.
TOTAL NUMBER OF OBSERVATIONS	26280	100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD		120.89 INCHES

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS COMBINED

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 13.58.04.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	3 .20	25 1.63	62 4.05	38 2.48	9 .59	2 .13	139 9.08	4.83
NE	3 .20	16 1.05	44 2.87	24 1.57	5 .33	2 .13	94 6.14	4.58
ENE	2 .13	16 1.05	42 2.74	30 1.96	10 .65	5 .33	105 6.86	5.14
E	3 .20	14 .91	44 2.87	39 2.55	10 .65	4 .26	114 7.45	5.10
ESE	2 .13	15 .98	57 3.72	36 2.35	9 .59	5 .33	124 8.10	5.45
SE	3 .20	9 .59	55 3.59	47 3.07	14 .91	2 .13	130 8.49	5.25
SSE	1 .07	9 .59	41 2.68	48 3.14	15 .98	1 .07	115 7.51	5.42
S	7 .46	10 .65	32 2.09	46 3.00	17 1.11	7 .46	119 7.77	5.70
SSW	3 .20	6 .39	25 1.63	31 2.02	14 .91	9 .59	88 5.75	6. 2
SW	3 .20	6 .39	16 1.05	28 1.83	19 1.24	7 .46	79 5.16	6.30
WSW	1 .07	4 .26	18 1.18	16 1.05	13 .85	2 .13	54 3.53	5.82
W	0 0.00	12 .78	18 1.18	14 .91	12 .78	4 .26	60 3.92	5.76
WNW	2 .13	4 .26	31 2.02	22 1.44	11 .72	9 .59	79 5.16	5.94
NW	2 .13	6 .39	17 1.11	23 1.50	5 .33	3 .20	56 3.66	5.65
NNW	0 0.00	12 .78	14 .91	18 1.18	15 .98	3 .20	62 4.05	5.78
N	1 .07	9 .59	38 2.48	41 2.68	19 1.24	8 .52	113 7.38	5.91
CALM	0 0.00						0 0.00	CALM
TOTAL	36 2.35	173 11.30	554 36.19	501 32.72	194 12.67	73 4.77	1531 100.00	5.42

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION	1531	5.43 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION	22319	84.93 PCT.
NUMBER OF INVALID OBSERVATIONS	2430	9.25 PCT.
TOTAL NUMBER OF OBSERVATIONS	26280	100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD		113.83 INCHES

TABLE 2.3-41 MONTHLY PRECIPITATION WIND ROSES

(Data Period: 3 Years Combined)

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JANUARY

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 14.25.37.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7577-043-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	1 .53	16 8.42	10 5.26	0 0.00	0 0.00	0 0.00	27 14.21	2.43
NE	0 0.00	11 5.79	6 3.16	0 0.00	0 0.00	0 0.00	17 8.95	2.75
ENE	1 .53	9 4.74	2 1.05	0 0.00	0 0.00	0 0.00	12 6.32	2.47
E	0 0.00	14 7.37	7 3.68	0 0.00	0 0.00	0 0.00	21 11.05	2.43
ESE	1 .53	4 2.11	15 7.89	3 1.58	0 0.00	0 0.00	23 12.11	3.56
SE	0 0.00	6 3.16	8 4.21	0 0.00	0 0.00	0 0.00	14 7.37	3.40
SSE	1 .53	1 .53	2 1.05	0 0.00	0 0.00	0 0.00	4 2.11	3.27
S	1 .53	0 0.00	5 2.63	3 1.58	0 0.00	0 0.00	9 4.74	4.50
SSW	0 0.00	1 .53	2 1.05	1 .53	0 0.00	0 0.00	4 2.11	4.47
SW	0 0.00	0 0.00	0 0.00	2 1.05	0 0.00	0 0.00	2 1.05	6.20
WSW	0 0.00	0 0.00	0 0.00	4 2.11	0 0.00	0 0.00	4 2.11	6.15
W	0 0.00	1 .53	0 0.00	4 2.11	0 0.00	0 0.00	5 2.63	[illegible]
WNW	0 0.00	1 .53	2 1.05	2 1.05	0 0.00	0 0.00	5 2.63	4.15
NW	0 0.00	2 1.05	5 2.63	4 2.11	4 2.11	0 0.00	15 7.89	5.71
NNW	0 0.00	4 2.11	3 1.58	4 2.11	0 0.00	0 0.00	11 5.79	4.24
N	1 .53	3 1.58	9 4.74	2 1.05	2 1.05	0 0.00	17 8.95	4.25
CALM	0 0.00						0 0.00	CALM
TOTAL	6 3.16	73 38.42	76 40.00	29 15.26	6 3.16	0 0.00	190 100.00	3.56

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 190 8.51 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 1793 80.33 PCT.
NUMBER OF INVALID OBSERVATIONS 249 11.16 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 7.47 INCHES

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JANUARY

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 14.25.37.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7577-043-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 0.00	6 4.14	12 8.28	3 2.07	1 .69	0 0.00	22 15.17	3.79
NE	0 0.00	6 4.14	9 6.21	0 0.00	0 0.00	0 0.00	15 10.34	3.36
ENE	1 .69	2 1.38	3 2.07	0 0.00	0 0.00	0 0.00	6 4.14	2.77
E	1 .69	1 .69	7 4.83	0 0.00	0 0.00	0 0.00	9 6.21	3.36
ESE	0 0.00	2 1.38	14 9.66	7 4.83	0 0.00	0 0.00	23 15.86	4.73
SE	1 .69	1 .69	3 2.07	5 3.45	0 0.00	0 0.00	10 6.90	4.50
SSE	0 0.00	0 0.00	1 .69	3 2.07	0 0.00	0 0.00	4 2.76	5.70
S	0 0.00	0 0.00	1 .69	5 3.45	1 .69	0 0.00	7 4.83	6.33
SSW	0 0.00	1 .69	3 2.07	4 2.76	0 0.00	0 0.00	8 5.52	[illegible]
SW	0 0.00	0 0.00	0 0.00	1 .69	2 1.38	0 0.00	3 2.07	7.83
WSW	0 0.00	1 .69	0 0.00	1 .69	3 2.07	1 .69	6 4.14	7.63
W	0 0.00	0 0.00	2 1.38	1 .69	1 .69	0 0.00	4 2.76	5.62
WNW	0 0.00	0 0.00	0 0.00	1 .69	1 .69	1 .69	3 2.07	[illegible]
NW	0 0.00	0 0.00	0 0.00	6 4.14	1 .69	0 0.00	7 4.83	6.56
NNW	0 0.00	1 .69	1 .69	1 .69	0 0.00	0 0.00	3 2.07	3.77
N	0 0.00	1 .69	9 6.21	1 .69	3 2.07	1 .69	15 10.34	5.47
CALM	0 0.00						0 0.00	CALM
TOTAL	3 2.07	22 15.17	63 43.45	39 26.90	13 8.97	3 2.07	145 100.00	[illegible]

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 145 6.50 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 1500 67.20 PCT.
NUMBER OF INVALID OBSERVATIONS 587 26.30 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 6.19 INCHES

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - FEBRUARY

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 15.04.15.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7577-043-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 0.00	0 0.00	5 4.03	3 2.42	1 .81	0 0.00	9 7.26	5.37
NE	2 1.61	8 6.45	2 1.61	0 0.00	0 0.00	0 0.00	12 9.68	2.74
ENE	2 1.61	3 2.42	1 .81	6 4.84	0 0.00	0 0.00	12 9.68	4.18
E	1 .81	5 4.03	3 2.42	1 .81	1 .81	0 0.00	11 8.87	3.65
ESE	1 .81	2 1.61	3 2.42	0 0.00	0 0.00	0 0.00	6 4.84	2.75
SE	0 0.00	0 0.00	2 1.61	1 .81	0 0.00	0 0.00	3 2.42	4.47
SSE	0 0.00	1 .81	8 6.45	0 0.00	0 0.00	0 0.00	9 7.26	3.69
S	0 0.00	2 1.61	2 1.61	0 0.00	0 0.00	0 0.00	4 3.23	3.10
SSW	0 0.00	1 .81	0 0.00	0 0.00	0 0.00	0 0.00	1 .81	[illegible]
SW	0 0.00	1 .81	0 0.00	0 0.00	0 0.00	0 0.00	1 .81	2.70
WSW	1 .81	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	1 .81	1.10
W	0 0.00	0 0.00	1 .81	0 0.00	2 1.61	0 0.00	3 2.42	[illegible]
WNW	2 1.61	2 1.61	6 4.84	2 1.61	4 3.23	0 0.00	16 12.90	[illegible]
NW	0 0.00	2 1.61	4 3.23	1 .81	1 .81	0 0.00	8 6.45	[illegible]
NNW	0 0.00	5 4.03	3 2.42	3 2.42	1 .81	0 0.00	12 9.68	[illegible]
N	1 .81	2 1.61	6 4.84	1 .81	4 3.23	2 1.61	16 12.90	5.47
CALM	0 0.00						0 0.00	CALM
TOTAL	10 8.06	34 27.42	46 37.10	18 14.52	14 11.29	2 1.61	124 100.00	4.23

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 124 6.15 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 1663 82.44 PCT.
NUMBER OF INVALID OBSERVATIONS 229 11.36 PCT.
TOTAL NUMBER OF OBSERVATIONS 2016 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 5.34 INCHES

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - FEBRUARY

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 15.04.15.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7577-043-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 0.00	0 0.00	5 4.35	4 3.48	1 .87	1 .87	11 9.57	[illegible]
NE	0 0.00	1 .87	1 .87	3 2.61	0 0.00	0 0.00	5 4.35	[illegible]
ENE	0 0.00	2 1.74	1 .87	1 .87	1 .87	0 0.00	5 4.35	[illegible]
E	0 0.00	2 1.74	5 4.35	4 3.48	2 1.74	1 .87	14 12.17	[illegible]
ESE	0 0.00	1 .87	6 5.22	2 1.74	0 0.00	0 0.00	9 7.83	[illegible]
SE	0 0.00	1 .87	2 1.74	0 0.00	1 .87	0 0.00	4 3.48	[illegible]
SSE	0 0.00	0 0.00	0 0.00	5 4.35	0 0.00	0 0.00	5 4.35	[illegible]
S	1 .87	0 0.00	1 .87	7 6.09	0 0.00	0 0.00	9 7.83	[illegible]
SSW	1 .87	0 0.00	2 1.74	0 0.00	1 .87	0 0.00	4 3.48	[illegible]
SW	0 0.00	0 0.00	1 .87	0 0.00	1 .87	0 0.00	2 1.74	[illegible]
WSW	0 0.00	2 1.74	0 0.00	0 0.00	0 0.00	0 0.00	2 1.74	[illegible]
W	0 0.00	2 1.74	0 0.00	1 .87	0 0.00	0 0.00	3 2.61	3.13
WNW	0 0.00	2 1.74	3 2.61	3 2.61	2 1.74	5 4.35	15 13.04	[illegible]
NW	1 .87	0 0.00	2 1.74	1 .87	1 .87	2 1.74	7 6.09	7.21
NNW	0 0.00	0 0.00	1 .87	1 .87	2 1.74	1 .87	5 4.35	[illegible]
N	0 0.00	3 2.61	0 0.00	4 3.48	[illegible]	[illegible]	[illegible]	[illegible]
CALM	0 0.00						0 0.00	CALM
TOTAL	3 2.61	15 13.04	[illegible]	[illegible]	16 13.91	14 12.17	115 100.00	[illegible]

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 115 5.70 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION [illegible]
NUMBER OF INVALID OBSERVATIONS [illegible]
TOTAL NUMBER OF OBSERVATIONS [illegible] 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD [illegible] INCHES

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-41 (Continued) (Sheet 2 of 6)

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - MARCH

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 11.03.45.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 / 0.00	0 / 0.00	8 / 5.97	0 / 0.00	0 / 0.00	0 / 0.00	8 / 5.97	3.79
NE	1 / .75	3 / 2.24	5 / 3.73	6 / 4.48	11 / 8.21	0 / 0.00	26 / 19.40	6.36
ENE	1 / .75	0 / 0.00	2 / 1.49	8 / 5.97	0 / 0.00	0 / 0.00	11 / 8.21	5.16
E	0 / 0.00	5 / 3.73	7 / 5.22	3 / 2.24	3 / 2.24	0 / 0.00	18 / 13.43	4.74
ESE	1 / .75	2 / 1.49	6 / 4.48	6 / 4.48	4 / 2.99	0 / 0.00	19 / 14.18	5.41
SE	1 / .75	1 / .75	3 / 2.24	2 / 1.49	0 / 0.00	0 / 0.00	7 / 5.22	4.29
SSE	1 / .75	2 / 1.49	0 / 0.00	1 / .75	0 / 0.00	0 / 0.00	4 / 2.99	3.25
S	0 / 0.00	1 / .75	0 / 0.00	0 / 0.00	0 / 0.00	0 / 0.00	1 / .75	2.20
SSW	0 / 0.00	0 / 0.00	1 / .75	1 / .75	0 / 0.00	0 / 0.00	2 / 1.49	4.65
SW	0 / 0.00	0 / 0.00	0 / 0.00	1 / .75	0 / 0.00	0 / 0.00	1 / .75	5.80
WSW	0 / 0.00	1 / .75	2 / 1.49	3 / 2.24	0 / 0.00	0 / 0.00	6 / 4.48	4.75
W	0 / 0.00	0 / 0.00	2 / 1.49	0 / 0.00	0 / 0.00	0 / 0.00	2 / 1.49	4.30
WNW	0 / 0.00	1 / .75	1 / .75	0 / 0.00	0 / 0.00	0 / 0.00	2 / 1.49	3.54
NW	0 / 0.00	2 / 1.49	0 / 0.00	1 / .75	0 / 0.00	0 / 0.00	3 / 2.24	3.17
NNW	0 / 0.00	4 / 2.99	8 / 5.97	1 / .75	0 / 0.00	0 / 0.00	13 / 9.70	3.74
N	0 / 0.00	0 / 0.00	6 / 4.48	5 / 3.73	0 / 0.00	0 / 0.00	11 / 8.21	5.13
CALM	0 / 0.00						0 / 0.00	CALM
TOTAL	5 / 3.73	22 / 16.42	51 / 38.06	38 / 28.36	18 / 13.43	0 / 0.00	134 / 100.00	4.91

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 134 6.00 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 2001 89.65 PCT.
NUMBER OF INVALID OBSERVATIONS 97 4.35 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 9.79 INCHES

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - MARCH

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 14.09.30.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 / 0.00	0 / 0.00	4 / 3.13	6 / 4.69	1 / .78	0 / 0.00	11 / 8.59	5.54
NE	0 / 0.00	0 / 0.00	1 / .78	6 / 4.69	2 / 1.56	1 / .78	10 / 7.81	6.78
ENE	0 / 0.00	0 / 0.00	1 / .78	5 / 3.91	5 / 3.91	5 / 3.91	16 / 12.50	8.61
E	1 / .78	3 / 2.34	1 / .78	10 / 7.81	1 / .78	1 / .78	17 / 13.28	5.46
ESE	0 / 0.00	0 / 0.00	4 / 3.13	7 / 5.47	7 / 5.47	5 / 3.91	23 / 17.97	7.54
SE	1 / .78	0 / 0.00	5 / 3.91	3 / 2.34	1 / .78	0 / 0.00	10 / 7.81	4.72
SSE	0 / 0.00	0 / 0.00	2 / 1.56	1 / .78	1 / .78	0 / 0.00	4 / 3.13	5.67
S	0 / 0.00	1 / .78	0 / 0.00	1 / .78	0 / 0.00	0 / 0.00	2 / 1.56	4.00
SSW	0 / 0.00	0 / 0.00	1 / .78	0 / 0.00	1 / .78	0 / 0.00	2 / 1.56	5.60
SW	0 / 0.00	0 / 0.00	0 / 0.00	0 / 0.00	0 / 0.00	0 / 0.00	0 / 0.00	0.00
WSW	0 / 0.00	0 / 0.00	1 / .78	1 / .78	4 / 3.13	0 / 0.00	6 / 4.69	7.52
W	0 / 0.00	1 / .78	0 / 0.00	2 / 1.56	1 / .78	0 / 0.00	4 / 3.13	6.17
WNW	0 / 0.00	0 / 0.00	1 / .78	1 / .78	0 / 0.00	0 / 0.00	2 / 1.56	5.45
NW	0 / 0.00	1 / .78	0 / 0.00	0 / 0.00	0 / 0.00	0 / 0.00	1 / .78	2.10
NNW	0 / 0.00	3 / 2.34	1 / .78	7 / 5.47	1 / .78	0 / 0.00	12 / 9.38	5.47
N	0 / 0.00	0 / 0.00	3 / 2.34	4 / 3.13	1 / .78	0 / 0.00	8 / 6.25	5.44
CALM	0 / 0.00						0 / 0.00	CALM
TOTAL	2 / 1.56	9 / 7.03	25 / 19.53	54 / 42.19	26 / 20.31	12 / 9.38	128 / 100.00	6.35

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 128 5.73 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 2005 89.83 PCT.
NUMBER OF INVALID OBSERVATIONS 99 4.44 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 8.73 INCHES

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - APRIL

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 16.46.47.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	1 / .53	3 / 1.59	1 / .53	3 / 1.59	3 / 1.59	0 / 0.00	11 / 5.82	4.42
NE	0 / 0.00	7 / 3.70	8 / 4.23	2 / 1.06	0 / 0.00	0 / 0.00	17 / 8.99	3.46
ENE	1 / .53	3 / 1.59	9 / 4.76	3 / 1.59	0 / 0.00	0 / 0.00	16 / 8.47	3.97
E	0 / 0.00	4 / 2.12	3 / 1.59	5 / 2.65	0 / 0.00	0 / 0.00	12 / 6.35	4.42
ESE	0 / 0.00	3 / 1.59	12 / 6.35	1 / .53	0 / 0.00	0 / 0.00	16 / 8.47	4.05
SE	0 / 0.00	1 / .53	3 / 1.59	4 / 2.12	0 / 0.00	0 / 0.00	8 / 4.23	4.97
SSE	0 / 0.00	0 / 0.00	5 / 2.65	2 / 1.06	2 / 1.06	0 / 0.00	9 / 4.76	5.56
S	2 / 1.06	1 / .53	2 / 1.06	9 / 4.76	7 / 3.70	1 / .53	22 / 11.64	6.46
SSW	0 / 0.00	3 / 1.59	5 / 2.65	5 / 2.65	4 / 2.12	0 / 0.00	17 / 8.99	5.32
SW	0 / 0.00	2 / 1.06	3 / 1.59	5 / 2.65	2 / 1.06	0 / 0.00	12 / 6.35	5.57
WSW	0 / 0.00	0 / 0.00	4 / 2.12	3 / 1.59	0 / 0.00	0 / 0.00	7 / 3.70	4.83
W	0 / 0.00	0 / 0.00	6 / 3.17	1 / .53	0 / 0.00	0 / 0.00	7 / 3.70	3.83
WNW	1 / .53	2 / 1.06	1 / .53	6 / 3.17	1 / .53	0 / 0.00	11 / 5.82	5.01
NW	0 / 0.00	1 / .53	3 / 1.59	2 / 1.06	0 / 0.00	0 / 0.00	6 / 3.17	4.52
NNW	0 / 0.00	3 / 1.59	5 / 2.65	2 / 1.06	0 / 0.00	0 / 0.00	10 / 5.29	4.02
N	0 / 0.00	3 / 1.59	3 / 1.59	1 / .53	1 / .53	0 / 0.00	8 / 4.23	3.82
CALM	0 / 0.00						0 / 0.00	CALM
TOTAL	5 / 2.65	36 / 19.05	73 / 38.62	54 / 28.57	20 / 10.58	1 / .53	189 / 100.00	4.74

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 189 8.75 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 1932 89.44 PCT.
NUMBER OF INVALID OBSERVATIONS 39 1.81 PCT.
TOTAL NUMBER OF OBSERVATIONS 2160 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 13.26 INCHES

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - APRIL

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 16.46.47.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 / 0.00	0 / 0.00	3 / 1.61	0 / 0.00	4 / 2.15	1 / .54	8 / 4.30	7.51
NE	0 / 0.00	1 / .54	2 / 1.08	3 / 1.61	2 / 1.08	0 / 0.00	8 / 4.30	5.86
ENE	0 / 0.00	1 / .54	14 / 7.53	7 / 3.76	2 / 1.08	0 / 0.00	24 / 12.90	5.41
E	0 / 0.00	0 / 0.00	3 / 1.61	2 / 1.08	5 / 2.69	0 / 0.00	10 / 5.38	6.78
ESE	0 / 0.00	0 / 0.00	5 / 2.69	7 / 3.76	0 / 0.00	0 / 0.00	12 / 6.45	5.70
SE	0 / 0.00	0 / 0.00	7 / 3.76	6 / 3.23	2 / 1.08	1 / .54	16 / 8.60	6.13
SSE	0 / 0.00	1 / .54	0 / 0.00	4 / 2.15	3 / 1.61	0 / 0.00	8 / 4.30	6.35
S	0 / 0.00	0 / 0.00	1 / .54	4 / 2.15	8 / 4.30	6 / 3.23	19 / 10.22	8.86
SSW	0 / 0.00	1 / .54	2 / 1.08	5 / 2.69	4 / 2.15	6 / 3.23	18 / 9.68	7.91
SW	0 / 0.00	0 / 0.00	3 / 1.61	4 / 2.15	8 / 4.30	4 / 2.15	19 / 10.22	7.94
WSW	0 / 0.00	0 / 0.00	0 / 0.00	5 / 2.69	1 / .54	0 / 0.00	6 / 3.23	6.63
W	0 / 0.00	0 / 0.00	1 / .54	5 / 2.69	1 / .54	0 / 0.00	7 / 3.76	6.40
WNW	0 / 0.00	1 / .54	2 / 1.08	2 / 1.08	2 / 1.08	1 / .54	8 / 4.30	6.21
NW	0 / 0.00	1 / .54	1 / .54	2 / 1.08	1 / .54	1 / .54	6 / 3.23	6.10
NNW	0 / 0.00	1 / .54	2 / 1.08	2 / 1.08	2 / 1.08	0 / 0.00	7 / 3.76	6.10
N	0 / 0.00	1 / .54	4 / 2.15	4 / 2.15	1 / .54	0 / 0.00	10 / 5.38	5.04
CALM	0 / 0.00						0 / 0.00	CALM
TOTAL	0 / 0.00	8 / 4.30	50 / 26.88	62 / 33.33	46 / 24.73	20 / 10.75	186 / 100.00	6.66

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 186 8.61 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 1905 88.19 PCT.
NUMBER OF INVALID OBSERVATIONS 69 3.19 PCT.
TOTAL NUMBER OF OBSERVATIONS 2160 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 13.29 INCHES

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-41 (Continued) (Sheet 3 of 6)

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - MAY

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 09.32.25.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00	8 4.65	3 1.74	1 .58	0 0.00	0 0.00	12 6.98	3.06
NE	0 0.00	5 2.91	5 2.91	2 1.16	0 0.00	0 0.00	12 6.98	3.79
ENE	0 0.00	1 .58	8 4.65	1 .58	0 0.00	0 0.00	10 5.81	3.76
E	1 .58	5 2.91	8 4.65	4 2.33	0 0.00	0 0.00	18 10.47	3.64
ESE	0 0.00	4 2.33	6 3.49	2 1.16	0 0.00	0 0.00	12 6.98	3.38
SE	2 1.16	3 1.74	11 6.40	5 2.91	0 0.00	0 0.00	21 12.21	3.98
SSE	1 .58	3 1.74	10 5.81	4 2.33	2 1.16	0 0.00	20 11.63	4.38
S	1 .58	2 1.16	10 5.81	2 1.16	0 0.00	0 0.00	15 8.72	3.73
SSW	1 .58	2 1.16	4 2.33	2 1.16	0 0.00	0 0.00	9 5.23	3.82
SW	1 .58	3 1.74	3 1.74	2 1.16	1 .58	0 0.00	10 5.81	4.53
WSW	0 0.00	1 .58	3 1.74	0 0.00	0 0.00	0 0.00	4 2.33	3.50
W	1 .58	0 0.00	2 1.16	4 2.33	3 1.74	0 0.00	10 5.81	6.34
WNW	3 1.74	1 .58	4 2.33	0 0.00	1 .58	1 .58	10 5.81	4.20
NW	0 0.00	2 1.16	3 1.74	1 .58	0 0.00	0 0.00	6 3.49	3.40
NNW	0 0.00	0 0.00	2 1.16	0 0.00	0 0.00	0 0.00	2 1.16	4.65
N	0 0.00	0 0.00	0 0.00	1 .58	0 0.00	0 0.00	1 .58	6.60
CALM	0 0.00						0 0.00	CALM
TOTAL	11 6.40	40 23.26	82 47.67	31 18.02	7 4.07	1 .58	172 100.00	3.99

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 172 7.71 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 1845 82.66 PCT.
NUMBER OF INVALID OBSERVATIONS 215 9.63 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 17.02 INCHES

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - MAY

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 09.32.25.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00	1 .59	3 1.76	2 1.18	0 0.00	0 0.00	6 3.53	4.65
NE	0 0.00	2 1.18	6 3.53	4 2.35	1 .59	1 .59	14 8.24	5.03
ENE	1 .59	1 .59	5 2.94	8 4.71	0 0.00	0 0.00	15 8.82	5.01
E	0 0.00	0 0.00	8 4.71	4 2.35	0 0.00	0 0.00	12 7.06	4.72
ESE	0 0.00	3 1.76	7 4.12	2 1.18	1 .59	0 0.00	13 7.65	4.54
SE	0 0.00	0 0.00	6 3.53	13 7.65	3 1.76	0 0.00	22 12.94	6.03
SSE	0 0.00	0 0.00	2 1.18	9 5.29	3 1.76	1 .59	15 8.82	6.67
S	2 1.18	1 .59	6 3.53	9 5.29	1 .59	0 0.00	19 11.18	5.19
SSW	0 0.00	2 1.18	3 1.76	6 3.53	2 1.18	1 .59	14 8.24	5.89
SW	0 0.00	0 0.00	4 2.35	5 2.94	2 1.18	0 0.00	11 6.47	6.04
WSW	0 0.00	0 0.00	3 1.76	1 .59	1 .59	0 0.00	5 2.94	5.32
W	0 0.00	1 .59	1 .59	0 0.00	5 2.94	3 1.76	10 5.88	9.20
WNW	2 1.18	0 0.00	1 .59	2 1.18	1 .59	1 .59	7 4.12	5.8[illegible]
NW	0 0.00	2 1.18	0 0.00	3 1.76	1 .59	0 0.00	6 3.53	5.35
NNW	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0.00
N	0 0.00	0 0.00	0 0.00	0 0.00	1 .59	0 0.00	1 .59	[illegible]
CALM	0 0.00						0 0.00	CALM
TOTAL	5 2.94	13 7.65	55 32.35	68 40.00	22 12.94	7 4.12	170 100.00	5.71

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 170 7.62 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 1804 80.82 PCT.
NUMBER OF INVALID OBSERVATIONS 258 11.56 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 16.96 INCHES

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JUNE

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 10.29.27.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	1 1.03	4 4.12	0 0.00	0 0.00	0 0.00	0 0.00	5 5.15	1.90
NE	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0.00
ENE	0 0.00	1 1.03	2 2.06	2 2.06	0 0.00	0 0.00	5 5.15	4.24
E	0 0.00	4 4.12	3 3.09	2 2.06	0 0.00	0 0.00	9 9.28	3.70
ESE	2 2.06	2 2.06	0 0.00	0 0.00	0 0.00	0 0.00	4 4.12	1.42
SE	1 1.03	6 6.19	3 3.09	2 2.06	0 0.00	0 0.00	12 12.37	3.24
SSE	1 1.03	2 2.06	5 5.15	4 4.12	0 0.00	0 0.00	12 12.37	4.08
S	1 1.03	3 3.09	3 3.09	3 3.09	0 0.00	0 0.00	10 10.31	3.72
SSW	1 1.03	6 6.19	4 4.12	2 2.06	0 0.00	0 0.00	13 13.40	3.53
SW	1 1.03	4 4.12	2 2.06	0 0.00	0 0.00	0 0.00	7 7.22	2.77
WSW	0 0.00	3 3.09	3 3.09	0 0.00	0 0.00	0 0.00	6 6.19	3.33
W	0 0.00	1 1.03	2 2.06	2 2.06	0 0.00	0 0.00	5 5.15	4.42
WNW	0 0.00	3 3.09	1 1.03	1 1.03	0 0.00	0 0.00	5 5.15	3.46
NW	0 0.00	1 1.03	0 0.00	0 0.00	0 0.00	0 0.00	1 1.03	2.20
NNW	1 1.03	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	1 1.03	1.30
N	0 0.00	1 1.03	1 1.03	0 0.00	0 0.00	0 0.00	2 2.06	3.45
CALM	0 0.00						0 0.00	CALM
TOTAL	9 9.28	41 42.27	29 29.90	18 18.56	0 0.00	0 0.00	97 100.00	3.40

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 97 4.49 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 2000 92.59 PCT.
NUMBER OF INVALID OBSERVATIONS 63 2.92 PCT.
TOTAL NUMBER OF OBSERVATIONS 2160 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 12.24 INCHES

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JUNE

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 10.29.27.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00	2 2.13	3 3.19	0 0.00	0 0.00	0 0.00	5 5.32	3.10
NE	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0.00
ENE	0 0.00	0 0.00	2 2.13	1 1.06	2 2.13	0 0.00	5 5.32	6.04
E	0 0.00	2 2.13	1 1.06	2 2.13	0 0.00	0 0.00	5 5.32	4.52
ESE	0 0.00	2 2.13	4 4.26	0 0.00	0 0.00	0 0.00	6 6.38	3.38
SE	0 0.00	3 3.19	5 5.32	3 3.19	1 1.06	0 0.00	12 12.77	4.65
SSE	0 0.00	0 0.00	2 2.13	4 4.26	3 3.19	0 0.00	9 9.57	6.36
S	1 1.06	1 1.06	5 5.32	1 1.06	2 2.13	0 0.00	10 10.64	4.55
SSW	0 0.00	1 1.06	3 3.19	4 4.26	1 1.06	0 0.00	9 9.57	5.40
SW	1 1.06	2 2.13	2 2.13	7 7.45	1 1.06	0 0.00	13 13.83	5.25
WSW	0 0.00	0 0.00	2 2.13	2 2.13	2 2.13	0 0.00	6 6.38	5.97
W	0 0.00	1 1.06	1 1.06	2 2.13	2 2.13	0 0.00	6 6.38	5.87
WNW	0 0.00	0 0.00	3 3.19	0 0.00	1 1.06	0 0.00	4 4.26	5.85
NW	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0.00
NNW	0 0.00	1 1.06	1 1.06	0 0.00	0 0.00	0 0.00	2 2.13	3.10
N	0 0.00	0 0.00	1 1.06	1 1.06	0 0.00	0 0.00	2 2.13	4.70
CALM	0 0.00						0 0.00	CALM
TOTAL	2 2.13	15 15.96	35 37.23	27 28.72	15 15.96	0 0.00	94 100.00	5.04

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 94 4.35 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 1977 91.53 PCT.
NUMBER OF INVALID OBSERVATIONS 89 4.12 PCT.
TOTAL NUMBER OF OBSERVATIONS 2160 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 12.14 INCHES

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-41 (Continued) (Sheet 4 of 6)

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JULY

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 09.45.20.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	2 / 2.53	3 / 3.80	0 / 0.00	0 / 0.00	0 / 0.00	0 / 0.00	5 / 6.33	1.46
NE	1 / 1.27	3 / 3.80	1 / 1.27	1 / 1.27	0 / 0.00	0 / 0.00	6 / 7.59	2.92
ENE	1 / 1.27	2 / 2.53	0 / 0.00	0 / 0.00	0 / 0.00	0 / 0.00	3 / 3.80	2.07
E	0 / 0.00	0 / 0.00	0 / 0.00	0 / 0.00	0 / 0.00	0 / 0.00	0 / 0.00	0.00
ESE	0 / 0.00	3 / 3.80	0 / 0.00	1 / 1.27	0 / 0.00	0 / 0.00	4 / 5.06	3.17
SE	1 / 1.27	3 / 3.80	2 / 2.53	0 / 0.00	0 / 0.00	0 / 0.00	6 / 7.59	2.87
SSE	0 / 0.00	4 / 5.06	1 / 1.27	0 / 0.00	0 / 0.00	0 / 0.00	5 / 6.33	2.96
S	1 / 1.27	6 / 7.59	3 / 3.80	1 / 1.27	0 / 0.00	0 / 0.00	11 / 13.92	2.73
SSW	0 / 0.00	0 / 0.00	3 / 3.80	1 / 1.27	0 / 0.00	0 / 0.00	4 / 5.06	4.62
SW	2 / 2.53	1 / 1.27	4 / 5.06	3 / 3.80	0 / 0.00	0 / 0.00	10 / 12.66	3.81
WSW	1 / 1.27	3 / 3.80	4 / 5.06	0 / 0.00	0 / 0.00	0 / 0.00	8 / 10.13	2.75
W	0 / 0.00	1 / 1.27	1 / 1.27	0 / 0.00	0 / 0.00	0 / 0.00	2 / 2.53	3.15
WNW	0 / 0.00	1 / 1.27	1 / 1.27	0 / 0.00	0 / 0.00	0 / 0.00	2 / 2.53	3.20
NW	1 / 1.27	1 / 1.27	1 / 1.27	0 / 0.00	0 / 0.00	0 / 0.00	3 / 3.80	2.97
NNW	0 / 0.00	2 / 2.53	2 / 2.53	2 / 2.53	0 / 0.00	0 / 0.00	6 / 7.59	4.67
N	1 / 1.27	1 / 1.27	2 / 2.53	0 / 0.00	0 / 0.00	0 / 0.00	4 / 5.06	2.82
CALM	0 / 0.00						0 / 0.00	CALM
TOTAL	11 / 13.92	34 / 43.04	25 / 31.65	9 / 11.39	0 / 0.00	0 / 0.00	79 / 100.00	3.11

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 79 3.54 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 2108 94.44 PCT.
NUMBER OF INVALID OBSERVATIONS 45 2.02 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 10.77 INCHES

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JULY

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 09.45.20.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 / 0.00	3 / 3.80	2 / 2.53	1 / 1.27	0 / 0.00	0 / 0.00	6 / 7.59	3.75
NE	1 / 1.27	1 / 1.27	1 / 1.27	0 / 0.00	0 / 0.00	0 / 0.00	3 / 3.80	2.87
ENE	0 / 0.00	2 / 2.53	1 / 1.27	2 / 2.53	0 / 0.00	0 / 0.00	5 / 6.33	4.08
E	0 / 0.00	0 / 0.00	1 / 1.27	1 / 1.27	0 / 0.00	0 / 0.00	2 / 2.53	4.85
ESE	1 / 1.27	0 / 0.00	2 / 2.53	0 / 0.00	0 / 0.00	0 / 0.00	3 / 3.80	2.87
SE	0 / 0.00	0 / 0.00	4 / 5.06	1 / 1.27	0 / 0.00	0 / 0.00	5 / 6.33	4.66
SSE	0 / 0.00	2 / 2.53	3 / 3.80	2 / 2.53	0 / 0.00	0 / 0.00	7 / 8.86	4.31
S	0 / 0.00	1 / 1.27	5 / 6.33	3 / 3.80	0 / 0.00	0 / 0.00	9 / 11.39	4.47
SSW	0 / 0.00	0 / 0.00	1 / 1.27	5 / 6.33	1 / 1.27	0 / 0.00	7 / 8.86	5.96
SW	0 / 0.00	0 / 0.00	2 / 2.53	1 / 1.27	2 / 2.53	0 / 0.00	5 / 6.33	6.68
WSW	0 / 0.00	0 / 0.00	7 / 8.86	2 / 2.53	0 / 0.00	0 / 0.00	9 / 11.39	4.33
W	0 / 0.00	0 / 0.00	1 / 1.27	0 / 0.00	1 / 1.27	0 / 0.00	2 / 2.53	6.30
WNW	0 / 0.00	1 / 1.27	1 / 1.27	1 / 1.27	1 / 1.27	0 / 0.00	4 / 5.06	5.20
NW	0 / 0.00	0 / 0.00	0 / 0.00	2 / 2.53	1 / 1.27	0 / 0.00	3 / 3.80	6.43
NNW	0 / 0.00	0 / 0.00	1 / 1.27	1 / 1.27	1 / 1.27	1 / 1.27	4 / 5.06	7.17
N	1 / 1.27	0 / 0.00	2 / 2.53	2 / 2.53	0 / 0.00	0 / 0.00	5 / 6.33	4.36
CALM	0 / 0.00						0 / 0.00	CALM
TOTAL	3 / 3.80	10 / 12.66	34 / 43.04	24 / 30.38	7 / 8.86	1 / 1.27	79 / 100.00	4.83

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 79 3.54 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 2101 94.13 PCT.
NUMBER OF INVALID OBSERVATIONS 52 2.33 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 10.77 INCHES

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - AUGUST

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 10.45.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 / 0.00	14 / 12.84	8 / 7.34	0 / 0.00	0 / 0.00	0 / 0.00	22 / 20.18	2.75
NE	3 / 2.75	6 / 5.50	2 / 1.83	0 / 0.00	0 / 0.00	0 / 0.00	11 / 10.09	2.22
ENE	0 / 0.00	3 / 2.75	1 / .92	0 / 0.00	0 / 0.00	0 / 0.00	4 / 3.67	2.59
E	1 / .92	1 / .92	1 / .92	0 / 0.00	0 / 0.00	0 / 0.00	3 / 2.75	2.17
ESE	0 / 0.00	2 / 1.83	1 / .92	0 / 0.00	1 / .92	0 / 0.00	4 / 3.67	3.72
SE	0 / 0.00	4 / 3.67	7 / 6.42	0 / 0.00	2 / 1.83	0 / 0.00	13 / 11.93	3.92
SSE	0 / 0.00	3 / 2.75	4 / 3.67	0 / 0.00	1 / .92	0 / 0.00	8 / 7.34	3.65
S	1 / .92	2 / 1.83	1 / .92	0 / 0.00	0 / 0.00	0 / 0.00	4 / 3.67	2.70
SSW	1 / .92	3 / 2.75	4 / 3.67	0 / 0.00	0 / 0.00	0 / 0.00	8 / 7.34	2.82
SW	0 / 0.00	1 / .92	1 / .92	0 / 0.00	0 / 0.00	0 / 0.00	2 / 1.83	2.49
WSW	0 / 0.00	4 / 3.67	0 / 0.00	0 / 0.00	0 / 0.00	0 / 0.00	4 / 3.67	2.07
W	1 / .92	3 / 2.75	0 / 0.00	1 / .92	0 / 0.00	0 / 0.00	5 / 4.59	2.74
WNW	0 / 0.00	3 / 2.75	0 / 0.00	0 / 0.00	0 / 0.00	0 / 0.00	3 / 2.75	2.13
NW	0 / 0.00	0 / 0.00	1 / .92	0 / 0.00	0 / 0.00	0 / 0.00	1 / .92	4.20
NNW	0 / 0.00	2 / 1.83	0 / 0.00	2 / 1.83	0 / 0.00	0 / 0.00	4 / 3.67	4.32
N	2 / 1.83	7 / 6.42	3 / 2.75	0 / 0.00	1 / .92	0 / 0.00	13 / 11.93	3.02
CALM	0 / 0.00						0 / 0.00	CALM
TOTAL	9 / 8.26	58 / 53.21	34 / 31.19	3 / 2.75	5 / 4.59	0 / 0.00	109 / 100.00	2.98

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 109 4.88 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 2064 92.47 PCT.
NUMBER OF INVALID OBSERVATIONS 59 2.64 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 10.44 INCHES

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - AUGUST

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 10.45.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 / 0.00	7 / 6.36	13 / 11.82	2 / 1.82	0 / 0.00	0 / 0.00	22 / 20.00	3.66
NE	0 / 0.00	3 / 2.73	6 / 5.45	0 / 0.00	0 / 0.00	0 / 0.00	9 / 8.18	3.81
ENE	0 / 0.00	1 / .91	4 / 3.64	0 / 0.00	0 / 0.00	0 / 0.00	5 / 4.55	3.48
E	0 / 0.00	2 / 1.82	2 / 1.82	1 / .91	0 / 0.00	0 / 0.00	5 / 4.55	3.72
ESE	0 / 0.00	1 / .91	3 / 2.73	0 / 0.00	0 / 0.00	0 / 0.00	4 / 3.64	3.52
SE	0 / 0.00	0 / 0.00	5 / 4.55	2 / 1.82	0 / 0.00	0 / 0.00	7 / 6.36	4.73
SSE	0 / 0.00	3 / 2.73	8 / 7.27	1 / .91	0 / 0.00	0 / 0.00	12 / 10.91	4.04
S	0 / 0.00	1 / .91	4 / 3.64	2 / 1.82	0 / 0.00	0 / 0.00	7 / 6.36	4.47
SSW	0 / 0.00	0 / 0.00	2 / 1.82	1 / .91	0 / 0.00	0 / 0.00	3 / 2.73	4.53
SW	1 / .91	2 / 1.82	1 / .91	1 / .91	1 / .91	0 / 0.00	6 / 5.45	3.88
WSW	0 / 0.00	1 / .91	2 / 1.82	0 / 0.00	0 / 0.00	0 / 0.00	3 / 2.73	3.23
W	0 / 0.00	4 / 3.64	3 / 2.73	0 / 0.00	0 / 0.00	0 / 0.00	7 / 6.36	3.16
WNW	0 / 0.00	0 / 0.00	3 / 2.73	1 / .91	0 / 0.00	0 / 0.00	4 / 3.64	4.47
NW	0 / 0.00	0 / 0.00	1 / .91	1 / .91	0 / 0.00	0 / 0.00	2 / 1.82	5.30
NNW	0 / 0.00	1 / .91	1 / .91	0 / 0.00	1 / .91	0 / 0.00	3 / 2.73	4.87
N	0 / 0.00	3 / 2.73	5 / 4.55	2 / 1.82	0 / 0.00	1 / .91	11 / 10.00	4.90
CALM	0 / 0.00						0 / 0.00	CALM
TOTAL	1 / .91	29 / 26.36	63 / 57.27	14 / 12.73	2 / 1.82	1 / .91	110 / 100.00	4.04

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 110 4.93 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 2055 92.07 PCT.
NUMBER OF INVALID OBSERVATIONS 67 3.00 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 10.46 INCHES

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-41 (Continued) (Sheet 5 of 6)

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - SEPTEMBER

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 11.18.40.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00	2 1.90	6 5.71	3 2.86	0 0.00	0 0.00	11 10.48	4.56
NE	1 .95	1 .95	1 .95	0 0.00	0 0.00	0 0.00	3 2.86	2.47
ENE	1 .95	1 .95	2 1.90	0 0.00	0 0.00	0 0.00	4 3.81	2.72
E	3 2.86	2 1.90	0 0.00	0 0.00	0 0.00	0 0.00	5 4.76	1.62
ESE	0 0.00	2 1.90	2 1.90	0 0.00	0 0.00	0 0.00	4 3.81	3.07
SE	0 0.00	5 4.76	2 1.90	1 .95	0 0.00	0 0.00	8 7.62	2.97
SSE	1 .95	4 3.81	13 12.38	3 2.86	0 0.00	0 0.00	21 20.00	3.59
S	1 .95	7 6.67	3 2.86	3 2.86	0 0.00	0 0.00	14 13.33	3.57
SSW	1 .95	1 .95	5 4.76	0 0.00	0 0.00	0 0.00	7 6.67	3.20
SW	0 0.00	3 2.86	4 3.81	0 0.00	0 0.00	0 0.00	7 6.67	3.13
WSW	0 0.00	0 0.00	1 .95	1 .95	0 0.00	0 0.00	2 1.90	4.25
W	0 0.00	0 0.00	4 3.81	0 0.00	0 0.00	0 0.00	4 3.81	4.17
WNW	0 0.00	1 .95	1 .95	0 0.00	0 0.00	0 0.00	2 1.90	3.05
NW	0 0.00	1 .95	1 .95	0 0.00	0 0.00	0 0.00	2 1.90	2.85
NNW	0 0.00	0 0.00	2 1.90	0 0.00	0 0.00	0 0.00	2 1.90	4.25
N	0 0.00	4 3.81	4 3.81	1 .95	0 0.00	0 0.00	9 8.57	3.57
CALM	0 0.00						0 0.00	CALM
TOTAL	8 7.62	34 32.38	51 48.57	12 11.43	0 0.00	0 0.00	105 100.00	3.43

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 105 4.86 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 2053 95.05 PCT.
NUMBER OF INVALID OBSERVATIONS 2 .09 PCT.
TOTAL NUMBER OF OBSERVATIONS 2160 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 8.54 INCHES

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - SEPTEMBER

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 11.18.40.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00	2 2.22	2 2.22	8 8.89	0 0.00	0 0.00	12 13.33	5.07
NE	2 2.22	1 1.11	1 1.11	0 0.00	0 0.00	0 0.00	4 4.44	2.15
ENE	0 0.00	3 3.33	0 0.00	1 1.11	0 0.00	0 0.00	4 4.44	3.10
E	0 0.00	2 2.22	2 2.22	0 0.00	0 0.00	0 0.00	4 4.44	3.17
ESE	1 1.11	4 4.44	1 1.11	2 2.22	0 0.00	0 0.00	8 8.89	3.19
SE	0 0.00	3 3.33	7 7.78	0 0.00	0 0.00	0 0.00	10 11.11	3.43
SSE	0 0.00	1 1.11	8 8.89	5 5.56	0 0.00	0 0.00	14 15.56	4.59
S	0 0.00	3 3.33	1 1.11	1 1.11	0 0.00	0 0.00	5 5.56	3.42
SSW	1 1.11	1 1.11	2 2.22	0 0.00	1 1.11	0 0.00	5 5.56	4.24
SW	1 1.11	1 1.11	1 1.11	3 3.33	0 0.00	0 0.00	6 6.67	4.28
WSW	0 0.00	0 0.00	1 1.11	1 1.11	0 0.00	0 0.00	2 2.22	4.50
W	0 0.00	0 0.00	0 0.00	1 1.11	0 0.00	0 0.00	1 1.11	6.90
WNW	0 0.00	0 0.00	3 3.33	1 1.11	0 0.00	0 0.00	4 4.44	4.57
NW	0 0.00	0 0.00	3 3.33	0 0.00	0 0.00	0 0.00	3 3.33	4.13
NNW	0 0.00	1 1.11	1 1.11	0 0.00	0 0.00	0 0.00	2 2.22	2.90
N	0 0.00	1 1.11	2 2.22	3 3.33	0 0.00	0 0.00	6 6.67	4.98
CALM	0 0.00						0 0.00	CALM
TOTAL	5 5.56	23 25.56	35 38.89	26 28.89	1 1.11	0 0.00	90 100.00	4.05

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 90 4.17 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 1768 81.85 PCT.
NUMBER OF INVALID OBSERVATIONS 302 13.98 PCT.
TOTAL NUMBER OF OBSERVATIONS 2160 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 6.56 INCHES

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - OCTOBER

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 11.50.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00	4 4.00	1 1.00	2 2.00	0 0.00	0 0.00	7 7.00	3.57
NE	1 1.00	1 1.00	1 1.00	0 0.00	0 0.00	0 0.00	3 3.00	2.33
ENE	1 1.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	1 1.00	1.30
E	0 0.00	0 0.00	1 1.00	0 0.00	0 0.00	0 0.00	1 1.00	3.30
ESE	0 0.00	2 2.00	0 0.00	0 0.00	0 0.00	0 0.00	2 2.00	2.15
SE	0 0.00	1 1.00	1 1.00	0 0.00	0 0.00	0 0.00	2 2.00	2.35
SSE	0 0.00	4 4.00	8 8.00	1 1.00	0 0.00	0 0.00	13 13.00	3.49
S	2 2.00	2 2.00	7 7.00	2 2.00	1 1.00	0 0.00	14 14.00	4.18
SSW	0 0.00	0 0.00	4 4.00	2 2.00	0 0.00	0 0.00	6 6.00	4.77
SW	2 2.00	3 3.00	3 3.00	1 1.00	0 0.00	0 0.00	9 9.00	2.96
WSW	1 1.00	4 4.00	3 3.00	0 0.00	0 0.00	0 0.00	8 8.00	2.76
W	0 0.00	3 3.00	2 2.00	0 0.00	0 0.00	0 0.00	5 5.00	3.50
WNW	0 0.00	1 1.00	3 3.00	0 0.00	0 0.00	0 0.00	4 4.00	3.77
NW	0 0.00	1 1.00	8 8.00	0 0.00	0 0.00	0 0.00	9 9.00	3.73
NNW	0 0.00	0 0.00	3 3.00	2 2.00	0 0.00	0 0.00	5 5.00	4.26
N	1 1.00	1 1.00	4 4.00	5 5.00	0 0.00	0 0.00	11 11.00	4.36
CALM	0 0.00						0 0.00	CALM
TOTAL	8 8.00	27 27.00	49 49.00	15 15.00	1 1.00	0 0.00	100 100.00	3.61

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 100 4.48 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 2130 95.43 PCT.
NUMBER OF INVALID OBSERVATIONS 2 .09 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 8.03 INCHES

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - OCTOBER

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 11.50.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	1 1.06	1 1.06	3 3.19	1 1.06	1 1.06	0 0.00	7 7.45	4.46
NE	0 0.00	0 0.00	2 2.13	0 0.00	0 0.00	0 0.00	2 2.13	4.35
ENE	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0.00
E	0 0.00	0 0.00	1 1.06	0 0.00	0 0.00	0 0.00	1 1.06	3.80
ESE	0 0.00	1 1.06	1 1.06	0 0.00	0 0.00	0 0.00	2 2.13	2.70
SE	0 0.00	0 0.00	1 1.06	0 0.00	0 0.00	0 0.00	1 1.06	3.30
SSE	1 1.06	0 0.00	3 3.19	2 2.13	1 1.06	0 0.00	7 7.45	4.59
S	0 0.00	2 2.13	4 4.26	12 12.77	3 3.19	0 0.00	21 22.34	5.68
SSW	1 1.06	0 0.00	2 2.13	5 5.32	2 2.13	0 0.00	10 10.64	5.65
SW	0 0.00	0 0.00	1 1.06	2 2.13	2 2.13	0 0.00	5 5.32	6.70
WSW	0 0.00	0 0.00	0 0.00	2 2.13	0 0.00	0 0.00	2 2.13	6.90
W	0 0.00	1 1.06	3 3.19	0 0.00	1 1.06	0 0.00	5 5.32	4.94
WNW	0 0.00	0 0.00	4 4.26	8 8.51	1 1.06	0 0.00	13 13.83	5.73
NW	1 1.06	1 1.06	4 4.26	2 2.13	0 0.00	0 0.00	8 8.51	4.74
NNW	0 0.00	0 0.00	0 0.00	1 1.06	4 4.26	0 0.00	5 5.32	7.66
N	0 0.00	0 0.00	2 2.13	3 3.19	0 0.00	0 0.00	5 5.32	5.64
CALM	0 0.00						0 0.00	CALM
TOTAL	4 4.25	6 6.38	31 32.98	38 40.43	15 15.96	0 0.00	94 100.00	5.40

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 94 4.21 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 1823 81.68 PCT.
NUMBER OF INVALID OBSERVATIONS 315 14.11 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 7.61 INCHES

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-41 (Continued) (Sheet 6 of 6)

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - NOVEMBER

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 13.23.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 / 0.00	6 / 3.19	13 / 6.91	3 / 1.60	0 / 0.00	0 / 0.00	22 / 11.70	4.17
NE	0 / 0.00	4 / 2.13	19 / 10.11	0 / 0.00	0 / 0.00	0 / 0.00	23 / 12.23	3.22
ENE	0 / 0.00	1 / .53	6 / 3.19	0 / 0.00	0 / 0.00	0 / 0.00	7 / 3.72	3.71
E	1 / .53	2 / 1.06	12 / 6.38	5 / 2.66	0 / 0.00	0 / 0.00	20 / 10.64	4.35
ESE	0 / 0.00	5 / 2.66	7 / 3.72	3 / 1.60	0 / 0.00	0 / 0.00	15 / 7.98	3.86
SE	1 / .53	9 / 4.79	10 / 5.32	1 / .53	1 / .53	0 / 0.00	22 / 11.70	3.40
SSE	1 / .53	4 / 2.13	2 / 1.06	1 / .53	0 / 0.00	0 / 0.00	8 / 4.26	3.21
S	1 / .53	2 / 1.06	1 / .53	0 / 0.00	0 / 0.00	0 / 0.00	4 / 2.13	2.65
SSW	0 / 0.00	0 / 0.00	2 / 1.06	0 / 0.00	0 / 0.00	0 / 0.00	2 / 1.06	3.95
SW	0 / 0.00	3 / 1.60	0 / 0.00	1 / .53	0 / 0.00	0 / 0.00	4 / 2.13	2.47
WSW	1 / .53	4 / 2.13	0 / 0.00	0 / 0.00	0 / 0.00	0 / 0.00	5 / 2.66	1.86
W	1 / .53	5 / 2.66	1 / .53	1 / .53	0 / 0.00	0 / 0.00	8 / 4.26	2.77
WNW	0 / 0.00	4 / 2.13	2 / 1.06	0 / 0.00	0 / 0.00	0 / 0.00	6 / 3.19	2.48
NW	3 / 1.60	5 / 2.66	8 / 4.26	0 / 0.00	0 / 0.00	0 / 0.00	16 / 8.51	2.74
NNW	0 / 0.00	2 / 1.06	6 / 3.19	3 / 1.60	0 / 0.00	0 / 0.00	11 / 5.85	4.53
N	0 / 0.00	1 / .53	7 / 3.72	6 / 3.19	1 / .53	0 / 0.00	15 / 7.98	4.85
CALM	0 / 0.00						0 / 0.00	CALM
TOTAL	9 / 4.79	57 / 30.32	96 / 51.06	24 / 12.77	2 / 1.06	0 / 0.00	188 / 100.00	3.62

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 188 8.70 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 1959 90.69 PCT.
NUMBER OF INVALID OBSERVATIONS 13 .60 PCT.
TOTAL NUMBER OF OBSERVATIONS 2160 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 9.29 INCHES

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - NOVEMBER

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 13.23.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 / 0.00	0 / 0.00	10 / 5.46	6 / 3.28	1 / .55	0 / 0.00	17 / 9.29	5.09
NE	0 / 0.00	0 / 0.00	13 / 7.10	4 / 2.19	0 / 0.00	0 / 0.00	17 / 9.29	4.46
ENE	0 / 0.00	1 / .55	5 / 2.73	4 / 2.19	0 / 0.00	0 / 0.00	10 / 5.46	4.90
E	0 / 0.00	1 / .55	5 / 2.73	13 / 7.10	0 / 0.00	0 / 0.00	19 / 10.38	5.54
ESE	0 / 0.00	0 / 0.00	4 / 2.19	7 / 3.83	0 / 0.00	0 / 0.00	11 / 6.01	5.35
SE	1 / .55	1 / .55	5 / 2.73	6 / 3.28	2 / 1.09	1 / .55	16 / 8.74	5.51
SSE	0 / 0.00	1 / .55	8 / 4.37	6 / 3.28	1 / .55	0 / 0.00	16 / 8.74	5.62
S	1 / .55	0 / 0.00	4 / 2.19	1 / .55	0 / 0.00	0 / 0.00	6 / 3.28	4.40
SSW	0 / 0.00	0 / 0.00	1 / .55	1 / .55	0 / 0.00	0 / 0.00	2 / 1.09	5.35
SW	0 / 0.00	1 / .55	0 / 0.00	2 / 1.09	0 / 0.00	0 / 0.00	3 / 1.64	5.23
WSW	1 / .55	0 / 0.00	2 / 1.09	1 / .55	0 / 0.00	0 / 0.00	4 / 2.19	3.52
W	0 / 0.00	2 / 1.09	4 / 2.19	0 / 0.00	0 / 0.00	0 / 0.00	6 / 3.28	3.40
WNW	0 / 0.00	0 / 0.00	9 / 4.92	2 / 1.09	1 / .55	0 / 0.00	12 / 6.56	4.66
NW	0 / 0.00	0 / 0.00	4 / 2.19	6 / 3.28	0 / 0.00	0 / 0.00	10 / 5.46	4.98
NNW	0 / 0.00	3 / 1.64	3 / 1.64	4 / 2.19	1 / .55	1 / .55	12 / 6.56	5.17
N	0 / 0.00	0 / 0.00	6 / 3.28	11 / 6.01	3 / 1.64	2 / 1.09	22 / 12.02	6.39
CALM	0 / 0.00						0 / 0.00	CALM
TOTAL	3 / 1.64	10 / 5.46	83 / 45.36	74 / 40.44	9 / 4.92	4 / 2.19	183 / 100.00	5.13

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 183 8.47 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 1886 87.31 PCT.
NUMBER OF INVALID OBSERVATIONS 91 4.21 PCT.
TOTAL NUMBER OF OBSERVATIONS 2160 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 6.73 INCHES

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - DECEMBER

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 13.50.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	2 / 1.27	0 / 0.00	5 / 3.18	2 / 1.27	0 / 0.00	0 / 0.00	9 / 5.73	3.78
NE	0 / 0.00	3 / 1.91	3 / 1.91	3 / 1.91	0 / 0.00	0 / 0.00	9 / 5.73	3.91
ENE	0 / 0.00	6 / 3.82	3 / 1.91	0 / 0.00	0 / 0.00	0 / 0.00	9 / 5.73	2.73
E	2 / 1.27	6 / 3.82	8 / 5.10	3 / 1.91	2 / 1.27	1 / .64	22 / 14.01	4.36
ESE	0 / 0.00	6 / 3.82	6 / 3.82	2 / 1.27	0 / 0.00	0 / 0.00	14 / 8.92	3.78
SE	0 / 0.00	2 / 1.27	3 / 1.91	2 / 1.27	0 / 0.00	0 / 0.00	7 / 4.46	3.96
SSE	0 / 0.00	2 / 1.27	6 / 3.82	4 / 2.55	1 / .64	0 / 0.00	13 / 8.28	4.35
S	1 / .64	2 / 1.27	0 / 0.00	3 / 1.91	0 / 0.00	0 / 0.00	6 / 3.82	4.28
SSW	0 / 0.00	1 / .64	1 / .64	0 / 0.00	2 / 1.27	0 / 0.00	4 / 2.55	5.82
SW	0 / 0.00	1 / .64	0 / 0.00	2 / 1.27	2 / 1.27	0 / 0.00	5 / 3.18	6.40
WSW	0 / 0.00	0 / 0.00	0 / 0.00	1 / .64	2 / 1.27	0 / 0.00	3 / 1.91	7.43
W	0 / 0.00	1 / .64	3 / 1.91	0 / 0.00	0 / 0.00	0 / 0.00	4 / 2.55	3.27
WNW	0 / 0.00	1 / .64	0 / 0.00	1 / .64	1 / .64	0 / 0.00	3 / 1.91	5.93
NW	1 / .64	0 / 0.00	2 / 1.27	0 / 0.00	0 / 0.00	0 / 0.00	3 / 1.91	2.87
NNW	0 / 0.00	1 / .64	4 / 2.55	7 / 4.46	0 / 0.00	0 / 0.00	12 / 7.64	5.03
N	3 / 1.91	3 / 1.91	17 / 10.83	10 / 6.37	0 / 0.00	0 / 0.00	33 / 21.02	4.30
CALM	1 / .64						1 / .64	CALM
TOTAL	10 / 6.37	35 / 22.29	61 / 38.85	40 / 25.48	10 / 6.37	1 / .64	157 / 100.00	4.29

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 157 7.03 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 1905 85.35 PCT.
NUMBER OF INVALID OBSERVATIONS 170 7.62 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 7.25 INCHES

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - DECEMBER

PRECIPITATION WIND ROSE
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 13.50.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	2 / 1.46	3 / 2.19	2 / 1.46	5 / 3.65	0 / 0.00	0 / 0.00	12 / 8.76	4.07
NE	0 / 0.00	1 / .73	2 / 1.46	4 / 2.92	0 / 0.00	0 / 0.00	7 / 5.11	4.94
ENE	0 / 0.00	3 / 2.19	6 / 4.38	1 / .73	0 / 0.00	0 / 0.00	10 / 7.30	3.76
E	1 / .73	1 / .73	8 / 5.84	2 / 1.46	2 / 1.46	2 / 1.46	16 / 11.68	5.73
ESE	0 / 0.00	1 / .73	6 / 4.38	2 / 1.46	1 / .73	0 / 0.00	10 / 7.30	4.76
SE	0 / 0.00	0 / 0.00	5 / 3.65	8 / 5.84	4 / 2.92	0 / 0.00	17 / 12.41	6.19
SSE	0 / 0.00	1 / .73	4 / 2.92	6 / 4.38	3 / 2.19	0 / 0.00	14 / 10.22	5.72
S	2 / 1.46	0 / 0.00	0 / 0.00	0 / 0.00	2 / 1.46	1 / .73	5 / 3.65	6.46
SSW	0 / 0.00	0 / 0.00	3 / 2.19	0 / 0.00	1 / .73	2 / 1.46	6 / 4.38	7.32
SW	0 / 0.00	0 / 0.00	1 / .73	2 / 1.46	0 / 0.00	3 / 2.19	6 / 4.38	7.78
WSW	0 / 0.00	0 / 0.00	0 / 0.00	0 / 0.00	2 / 1.46	1 / .73	3 / 2.19	10.27
W	0 / 0.00	0 / 0.00	2 / 1.46	2 / 1.46	0 / 0.00	1 / .73	5 / 3.65	6.12
WNW	0 / 0.00	0 / 0.00	1 / .73	0 / 0.00	1 / .73	1 / .73	3 / 2.19	7.63
NW	0 / 0.00	1 / .73	2 / 1.46	0 / 0.00	0 / 0.00	0 / 0.00	3 / 2.19	3.70
NNW	0 / 0.00	1 / .73	2 / 1.46	1 / .73	3 / 2.19	0 / 0.00	7 / 5.11	5.99
N	0 / 0.00	0 / 0.00	4 / 2.92	6 / 4.38	3 / 2.19	0 / 0.00	13 / 9.49	6.27
CALM	0 / 0.00						0 / 0.00	CALM
TOTAL	5 / 3.65	12 / 8.76	48 / 35.04	39 / 28.47	22 / 16.06	11 / 8.03	137 / 100.00	5.73

NUMBER OF VALID OBSERVATIONS WITH PRECIPITATION 137 6.14 PCT.
NUMBER OF VALID OBSERVATIONS WITHOUT PRECIPITATION 1893 84.81 PCT.
NUMBER OF INVALID OBSERVATIONS 202 9.05 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.
TOTAL AMOUNT OF PRECIPITATION FOR DATA PERIOD 6.28 INCHES

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

(Sheet 1 of 1)

TABLE 2.3-42 SUMMARY OF OBSERVED AND PREDICTED COOLING TOWER PLUME LENGTHS

PERIOD	DATE	TOWER TYPE	OBSERVED[a] STABILITY CLASS	OBSERVED[b] LENGTH (feet)	PREDICTED LENGTH (feet)	RANGE OF PREDICTIONS[c] (feet) (+)	(-)
1	03/03/73	N.D.	4.5	9,184	9,000	8,000	10,000
2	03/09/73 (am)	N.D.	5.0	5,904	7,000	5,500	8,000
3	03/09/73 (pm)	N.D.	4.5	7,872	7,500	6,000	9,000
4	03/10/73 (am)	N.D.	4.0	3,936	4,000	4,000	6,000
5	03/10/73 (pm)	N.D.	4.0	5,576	5,000	5,000	7,000
6	01/13/73	N.D.	4.0	1,312	2,500	2,500	3,500
10	03/07/75	M.D.	4.5	2,732	2,500	2,000	3,000
11	03/12/75	M.D.	4.5	4,870	1,750	1,500	2,000
12	03/13/75	M.D.	4.5	8,200	9,000	8,000	10,000
13	03/11/75	M.D.	5.0	1,640	3,000	2,000	3,000

a Estimated stability class using on-site vertical temperature soundings and the NRC stability criteria. Note that fractional categories are used - see explanation in text.

b Predicted length based on "observed" stability category.

c Range gives predicted plume lengths for next higher and next lower stability classification for fractional stabilities. For whole numbered stabilities, the plume length for the next higher stability is used.

TABLE 2.3-43 FREQUENCY DISTRIBUTION OF VISIBLE PLUMES PER AFFECTED SECTOR (100 PERCENT LOAD)

UPPER CLASS INTERVAL OF PLUME LENGTH (HUNDREDS OF FEET)

SECTOR	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	>200	TOTAL
NNE	1794	1163	815	620	509	428	348	289	253	220	204	192	174	152	136	122	116	101	93	82	76	1794
	8.2	5.3	3.7	2.8	2.3	2.0	1.6	1.3	1.2	1.0	.9	.9	.8	.7	.6	.6	.5	.5	.4	.4	.3	8.2
NE	1863	1323	1007	793	657	558	474	398	346	296	259	233	203	183	169	159	144	128	118	109	103	1863
	8.5	6.1	4.6	3.6	3.0	2.6	2.2	1.8	1.6	1.4	1.2	1.1	.9	.8	.8	.7	.7	.6	.5	.5	.5	8.5
ENE	907	724	590	497	403	324	277	245	216	180	161	147	138	126	116	102	93	85	76	69	63	907
	4.2	3.3	2.7	2.3	1.8	1.5	1.3	1.1	1.0	.8	.7	.7	.6	.6	.5	.5	.4	.4	.3	.3	.3	4.2
E	1133	951	797	671	580	496	434	369	316	273	245	228	215	197	178	160	147	133	119	106	89	1133
	5.2	4.4	3.7	3.1	2.7	2.3	2.0	1.7	1.4	1.3	1.1	1.0	1.0	.9	.8	.7	.7	.6	.5	.5	.4	5.2
ESE	1286	1075	909	768	656	577	496	420	362	323	276	242	224	208	187	171	158	148	140	130	122	1286
	5.9	4.9	4.2	3.5	3.0	2.6	2.3	1.9	1.7	1.5	1.3	1.1	1.0	1.0	.9	.8	.7	.7	.6	.6	.6	5.9
SE	1523	1299	1107	1001	885	747	617	533	478	415	351	316	286	264	235	209	198	176	162	148	134	1523
	7.0	6.0	5.1	4.6	4.1	3.4	2.8	2.4	2.2	1.9	1.6	1.4	1.3	1.2	1.1	1.0	.9	.8	.7	.7	.6	7.0
SSE	1053	948	832	752	664	577	490	435	360	311	272	236	215	191	172	156	139	125	112	99	95	1053
	4.8	4.3	3.8	3.5	3.0	2.6	2.2	2.0	1.7	1.4	1.2	1.1	1.0	.9	.8	.7	.6	.6	.5	.5	.4	4.8
S	1126	1023	890	794	676	584	517	439	379	310	267	243	225	207	180	167	154	142	129	120	104	1126
	5.2	4.7	4.1	3.6	3.1	2.7	2.4	2.0	1.7	1.4	1.2	1.1	1.0	.9	.8	.8	.7	.7	.6	.6	.5	5.2
SSW	1009	935	846	756	696	600	539	465	384	324	274	237	212	194	177	155	138	127	114	102	98	1009
	4.6	4.3	3.9	3.5	3.2	2.8	2.5	2.1	1.8	1.5	1.3	1.1	1.0	.9	.8	.7	.6	.6	.5	.5	.4	4.6
SW	912	855	781	721	655	601	537	463	410	374	330	305	284	257	233	205	186	172	158	146	132	912
	4.2	3.9	3.6	3.3	3.0	2.8	2.5	2.1	1.9	1.7	1.5	1.4	1.3	1.2	1.1	.9	.9	.8	.7	.7	.6	4.2
WSW	693	646	564	502	459	426	387	346	316	279	250	229	211	191	167	154	142	132	119	106	99	693
	3.2	3.0	2.6	2.3	2.1	2.0	1.8	1.6	1.4	1.3	1.1	1.1	1.0	.9	.8	.7	.7	.6	.5	.5	.5	3.2
W	846	768	643	546	480	422	359	329	295	262	225	201	179	165	147	134	122	108	98	89	80	846
	3.9	3.5	2.9	2.5	2.2	1.9	1.6	1.5	1.4	1.2	1.0	.9	.8	.8	.7	.6	.6	.5	.4	.4	.4	3.9
WNW	1031	875	735	630	518	438	362	321	280	246	210	186	162	145	131	117	108	96	84	76	72	1031
	4.7	4.0	3.4	2.9	2.4	2.0	1.7	1.5	1.3	1.1	1.0	.9	.7	.7	.6	.5	.5	.4	.4	.3	.3	4.7
NW	1663	1472	1196	959	791	677	582	500	424	350	309	279	253	224	206	182	169	159	148	139	127	1663
	7.6	6.8	5.5	4.4	3.6	3.1	2.7	2.3	1.9	1.6	1.4	1.3	1.2	1.0	.9	.8	.8	.7	.7	.6	.6	7.6
NNW	2388	2051	1639	1341	1089	878	734	617	527	453	381	349	315	283	256	230	214	200	185	176	164	2388
	11.0	9.4	7.5	6.2	5.0	4.0	3.4	2.8	2.4	2.1	1.7	1.6	1.4	1.3	1.2	1.1	1.0	.9	.8	.8	.8	11.0
N	2477	1776	1293	978	788	636	514	425	374	326	281	247	226	201	183	169	155	145	133	120	108	2477
	11.4	8.1	5.9	4.5	3.6	2.9	2.4	1.9	1.7	1.5	1.3	1.1	1.0	.9	.8	.8	.7	.7	.6	.6	.5	11.4
CALM	93																					93
	.4																					.4
TOTAL	21797	17884	14644	12329	10506	8969	7667	6594	5720	4942	4295	3870	3522	3188	2873	2592	2383	2177	1988	1817	1666	21797
	100.0	82.0	67.2	56.6	48.2	41.1	35.2	30.3	26.2	22.7	19.7	17.8	16.2	14.6	13.2	11.9	10.9	10.0	9.1	8.3	7.6	100.0

NUMBER OF VALID OBSERVATIONS 21797 82.94 PCT.
NUMBER OF INVALID OBSERVATIONS 4483 17.06 PCT.
TOTAL NUMBER OF OBSERVATIONS 26280 100.00 PCT.

TABLE 2.3-44 FREQUENCY DISTRIBUTION OF GROUND FOGGING PER AFFECTED DIRECTION SECTOR (100 PERCENT LOAD)

UPPER CLASS INTERVAL OF PLUME LENGTH (HUNDREDS OF FEET)

SECTOR	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	>200	TOTAL
NNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ESE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SSE	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1
S	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1
SSW	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1
SW	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1	.1
WSW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WNW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NNW	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2	.2
N	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CALM	0.0																					0.0
TOTAL	.6	.6	.6	.6	.6	.6	.5	.6	.6	.6	.6	.6	.6	.6	.6	.6	.6	.6	.6	.6	.6	.6

NUMBER OF VALID OBSERVATIONS 21797 82.94 PCT.
NUMBER OF INVALID OBSERVATIONS 4483 17.06 PCT.
TOTAL NUMBER OF OBSERVATIONS 26280 100.00 PCT.

TABLE 2.3-45 FREQUENCY DISTRIBUTION OF GROUND FOGGING PER AFFECTED DIRECTION SECTOR (50 PERCENT LOAD)

UPPER CLASS INTERVAL OF PLUME LENGTH (HUNDREDS OF FEET)

SECTOR	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	>200	TOTAL
NNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0
NE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0
ENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ESE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SSE	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
S	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
SSW	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
SW	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
WSW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WNW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NNW	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
N	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CALM	0.0																					0.0
TOTAL	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	7.0	8.0	8.0	8.0

NUMBER OF VALID OBSERVATIONS 21797 82.94 PCT.
NUMBER OF INVALID OBSERVATIONS 4483 17.06 PCT.
TOTAL NUMBER OF OBSERVATIONS 26280 100.00 PCT.

(Sheet 1 of 1)

TABLE 2.3-46 DRIFT DROP SIZE SPECTRUM FOR NATURAL DRAFT COOLING TOWERS

	DROPLET SIZE RANGE (mm)						
	10-60	60-120	120-180	180-225	225-325	325-580	>580
Mass Fraction[a] (Slawson, 1976)	0.51	0.07	0.03	0.04	0.11	0.24	Nil
Mass Fraction[b] (Hanna, 1978)	0.49	0.24	0.093	0.04	0.05	0.037	0.043
Droplet Settling Velocity (m/sec) (Englemann, 1968; Slawson, 1976)	0.08	0.30	0.50	0.70	1.17	1.62	3.0

a Mass fraction estimated from manufacturers data for a 600-foot tower.

b Mass fraction estimated from measurements during the Chalk Point dye tracer experiment (Environmental Systems Corporation, 1977).

(Sheet 1 of 1)

TABLE 2.3-47 INSTANTANEOUS TOTAL DISSOLVED SOLIDS DRIFT DROPLET CONCENTRATION AT GROUND LEVEL BASED ON WIND SPEED OF 5.17M/SEC

DRIFT DROPLET SIZE RANGE (μ)	WIND SPEED (m/sec)	MASS FRACTION	SETTLING VELOCITY (m/sec)	DISTANCE FROM TOWER (m)		IMPACT AREA (m^2)	CONCENTRATION IMPACT AREA ($\mu g/m^3$)
				MINIMUM	MAXIMUM		
>580	5.17	0.043	3.0	200	600	6.3×10^4	5.86[a]
325-580	5.17	0.037	1.62	500	3,000	1.7×10^6	0.34
225-325	5.17	0.050	1.17	700	4,600	4.1×10^6	0.27
180-225	5.17	0.040	0.70	1,400	7,600	1.1×10^7	0.13
120-180	5.17	0.093	0.50	2,000	10,800	2.2×10^7	0.22
60-120	5.17	0.240	0.30	3,400	18,000	6.1×10^7	0.34
10-60[b]	5.17	0.490	0.08	13,500	>30,000	---	---

a Entire impact occurs on site.

b This size range not expected to reach ground level by direct impact (Wigley, 1975).

(Sheet 1 of 1)

TABLE 2.3-48 INSTANTANEOUS TOTAL DISSOLVED SOLIDS DRIFT DROPLET CONCENTRATION AT GROUND LEVEL BASED ON WIND SPEED OF 10M/SEC

DRIFT DROPLET SIZE RANGE (μ)	WIND SPEED (m/sec)	MASS FRACTION	SETTLING VELOCITY (m/sec)	DISTANCE FROM TOWER (m)		IMPACT AREA (m^2)	CONCENTRATION IMPACT AREA (μg/m^3)
				MINIMUM	MAXIMUM		
>580	10	0.043	3.0	100	400	2.9×10^4	12.5[a]
325-580	10	0.037	1.62	300	1,000	1.8×10^5	3.28[a]
225-325	10	0.050	1.17	500	1,800	5.9×10^5	1.87
180-225	10	0.040	0.70	1,000	4,500	3.8×10^6	0.39
120-180	10	0.093	0.50	1,400	6,200	7.2×10^6	0.67
60-120	10	0.240	0.30	2,500	10,300	1.9×10^7	1.05
10-60[b]	10	0.490	0.08	10,000	>20,000	---	---

a Entire impact occurs on site.

b This size range not expected to reach ground level by direct impact (Wigley, 1975).

TABLE 2.3-49 MAXIMUM OFF-SITE ANNUAL TOTAL DISSOLVED SOLIDS DEPOSITION

AFFECTED SECTOR	DEPOSITION $g/y/m^2$ WIND SPEED 5.17 m/SEC	DEPOSITION $g/y/m^2$ WIND SPEED 10 m/SEC
SSW	10.01	0.01
SW	8.94	0.01
WSW	7.61	0.02
W	9.57	0.03
WNW	12.66	0.04
NW	19.77	0.07
NNW	21.03	0.07
N	28.84	0.20
NNE	22.11	0.23
NE	17.60	0.26
ENE	10.00	0.27
E	14.06	0.32
ESE	15.39	0.51
SE	14.24	0.28
SSE	11.01	0.03
S	11.05	0.09

(Sheet 1 of 1)

TABLE 2.3-50 ON-SITE METEOROLOGICAL INSTRUMENTATION PROGRAM MAY 4, 1973 TO MAY 4, 1975

MEASUREMENT	HEIGHT (meters)	SENSOR TYPE	MANUFACTURER	MODEL NUMBER	ACCURACY	THRESHOLD	CALIBRATED RANGE
Wind Speed*	10, 60, 90	Precision cup Anemometer	Climet	011-1	± 1% or 0.15 mph	0.6 mph	1 to 100 mph
Wind Direction	10, 60, 90	Precision wind vane	Climet	012-10	± 1% or ± 3°	0.75 mph	0° to 540°
Wind Direction Variability	10, 60, 90	Precision wind vane	Climet	030-5	± 3°	075 mph	0° to 40°
Temperature	10	Shielded, aspirated thermistor	Climet	015-3	± 0.15°C	N/A	-30°C to +45°C
Dew Point	10, 90	Lithium chloride, shielded, aspirated dewcell	Climet	015-12	± 1.1°C	N/A	-50°C to +45°C
Temperature Difference, ΔT	10-60 and 10-90	Shielded, aspirated thermistor	Climet	015-3	± 0.15°C/100m	N/A	-5°C to +10°C
Precipitation	Surface	Weighing rain gauge	Climet	0501-1	± 0.02 in.	N/A	0 to 10 in.

* A redundant wind run system uses these sensors.

(Sheet 1 of 1)

TABLE 2.3-51 ON-SITE METEOROLOGICAL INSTRUMENTATION PROGRAM MARCH 16, 1978 TO MARCH 16, 1979

MEASUREMENT	HEIGHT (meters)	SENSOR TYPE	MANUFACTURER	MODEL NUMBER	ACCURACY	THRESHOLD	CALIBRATED RANGE
Wind Speed	10, 35, 60	Precision cup Anemometer	Climet	011-1	± 1% or 0.15 mph	0.6 mph	1 to 100 mph
Wind Direction	10, 35, 60	Precision wind vane	Climet	012-10	± 1% or ± 3°	0.75 mph	0° to 540°
Wind Direction Variability	10, 35, 60	Precision wind vane	Climet	030-5	± 3°	0.75 mph	0° to 40°
Temperature	10	Shielded, aspirated thermistor	Climet	015-3	± 0.15°C	N/A	-30°C to +45°C
Dew Point	10	Lithium chloride, shielded, aspirated dew cell	Climet	015-12	± 1.1°C	N/A	-50°C to +45°C
Dew Point	10	Cooled mirror, shielded, aspirated dew cell	Climet[a]	CI-65	± 0.5°C	N/A	-50°C to +50°C
Dew Point	10	Cooled mirror, shielded, aspirated dew cell	EG&G[b]	220	± 0.4°C	N/A	-50°C to +50°C
Temperature Difference, ΔT	35-10, 60-10, 85-10	Shielded, aspirated thermistor	Climet	015-3	± 0.15°C/100m	N/A	-5°C to +10°C
Precipitation	Surface	Weighing rain gauge	Climet	0501-1	± 0.02 in.	N/A	0 to 10 in.

a Operated from March 16, 1978 through December 22, 1978 (no data recovered).

b Operated from December 22, 1979, replacing Climet CI-65; both units operating concurrently with lithium chloride sensor.

TABLE 2.3-51A ON-SITE METEOROLOGICAL INSTRUMENTATION PROGRAM JULY 1983

MEASUREMENT	HEIGHT (meters)	SENSOR TYPE	MANUFACTURER	MODEL NUMBER	ACCURACY	THRESHOLD	CALIBRATED RANGE
Wind Speed	10S, 10P, 60P, 90P	Precision cup Anemometer	Climatronics	100083	± 0.07 m/s	0.45 m/s	0-50 m/s
Wind Direction	10S, 10P, 60P, 90P	Precision wind vane	Climatronics	100084	± 2.0	0.45 m/s	0-540
Temperature	10S, 10P Shelter S, Shelter P	Thermistor (Shielded and aspirated on tower)	Climatronics	100093	± 0.24°C	N/A	-30 to +50°C
Delta Temperature	10-60P, 10-90P	Shielded, aspirated thernister	Climatronics	100093	± 025°C	N/A	-5 to +15°C
Dew Point	10P, 90P	Shielded, Lithium Chloride	Climatronics	101197	± 1.5°C	N/A	-30 to +42°C
Precipitation	1P	Tipping Bucket Rain Gauge	Weather Measure	P511-E	± 0.5% at .5 in/hr	N/A	N/A

P indicates Primary Meteorological Tower

S indicates Secondary Meteorological Tower

(Sheet 1 of 1)

TABLE 2.3-51B ON-SITE METEOROLOGICAL INSTRUMENTATION PROGRAM OCTOBER 2007

MEASUREMENT	HEIGHT (meters) - Note 2	SENSOR TYPE	MANUFACTURER	MODEL NUMBER	ACCURACY	THRESHOLD	CALIBRATED RANGE
Wind Speed	10A & B, 60A & B	Precision cup Anemometer	MetOne	010C	±1% or 0.15mph	0.6 mph	0-100 mph
Wind Direction	10A & B, 60A & B	Precision wind vane	MetOne	020C	± 3°	0.6 mph	0-360°
Temperature	10A & B, 60A & B	RTD (Shielded and aspirated on tower)	MetOne	T200A	±0.1°C	N/A	-50 to +50°C
Delta Temperature	10-60A, 10-60B	Shielded, aspirated RTD	MetOne	T200A	± 0.05°C - Note 1	N/A	-50 to +50°C
Relative Humidity	10, 60	Shielded,Capacitive Thin Film	MetOne	083V	± 3%	N/A	0-100%
Precipitation	1	Tipping Bucket Rain Gauge	MetOne	375	± 1% at 1-3 in/hr	N/A	0-1 inch

Note: 1. The Delta-T measurement has greater accuracy than each temperature because each RTD is matched to its RTD curve in the data logger.

2. A = A Channel or tower face and B = B Channel or tower face.

TABLE 2.3-52 DATA RECOVERY RATE DATA PERIODS MAY 4, 1973 TO MAY 4, 1975 AND MARCH 16, 1978 TO MARCH 16, 1979 COMBINED

PARAMETERS	LEVEL (meters)	RECOVERY RATE (percent)
Temperature	10	90.7
Temperature	60-10	79.2
Temperature	90-10	91.2
Wind Speed	10	95.8
Wind Direction	10	95.7
Wind Speed	60	93.6
Wind Direction	60	90.8
Wind Speed	90	88.6
Wind Direction	90	85.4
Dew Point	10	94.3[a]
Dew Point (LiCl)	90[b]	97.0

a For lithium chloride and cooled-mirror dew-point measurements combined.

b For data period May 4, 1973 to May 4, 1975 only.

TABLE 2.3-53 CONCURRENT DATA RECOVERY RATES: WIND SPEED, WIND DIRECTION, AND TEMPERATURE DIFFERENCE COMBINED

DATA PERIOD	LEVEL (meters)[a]	CONCURRENT DATA RECOVERY (percent)[b]	CONCURRENT DATA RECOVERY (percent)[c]
5/4/73 - 5/4/74	10	91.8	92.0
5/4/74 - 5/4/75	10	96.8	96.8
3/16/78 - 3/16/79	10	91.2	91.2
3 years combined	10	93.3	93.3
5/4/73 - 5/4/74	60	92.3	92.3
5/4/74 - 5/4/75	60	89.5	93.3
3/16/78 - 3/16/79	60	86.9	90.2
3 years combined	60	89.6	92.3
3/16/78 - 3/16/79	90	87.6	90.3

a Refers to wind speed level; temperature difference increment is 90-10 meters and 60-10 meters combined.

b Based on combining 90-10 meters and 60-10 meters temperature difference increments.

c Based on note b plus use of wind power law to estimate wind speeds at mixing levels.

(Sheet 1 of 1)

TABLE 2.3-54 COMPARISON OF ON-SITE DATA WITH LONG-TERM CONDITIONS AT COLUMBIA, MISSOURI

	MEAN TEMPERATURE (degrees C)		MEAN DEW POINT (degrees C)		MEAN WIND DIRECTION		MEAN WIND SPEED (m/sec)	
MONTH	COLUMBIA	ON-SITE	COLUMBIA	ON-SITE	COLUMBIA	ON-SITE	COLUMBIA	ON-SITE
Jan.	-1.5	0.8	-6.1	- 6.0	S	SW	5.2	3.9
Feb.	0.9	-1 .0	-4.4	- 3.8	NW	NNW	5.8	4.1
Mar.	5.4	6.1	-1.7	- 0.9	WNW	SW	5.9	4.5
Apr.	12.8	13.1	4.4	4.0	S	S	5.5	4.5
May	18.0	17.1	11.1	10.4	SSE	S	4.5	3.3
June	22.8	22.1	16.7	15.7	SSE	SSW	4.2	2.9
July	25.2	25.3	18.9	18.8	SSE	SSE	3.9	2.7
Aug.	24.5	23.4	17.8	17.8	SSE	SSE	3.8	2.8
Sep.	20.2	19.7	12.8	13.5	SSE	SSE	4.2	2.7
Oct.	14.5	14.4	7.2	6.2	SSE	SSW	4.3	3.1
Nov.	6.6	7.8	0.0	1.8	S	S	4.9	3.5
Dec.	0.4	0.8	3.9	3.7	S	SW	4.9	3.9
Annual	12.5	13.1	6.1	6.1	SSW	S	4.7	3.5

Source: U.S. Department of Commerce, 1973.

Note: Columbia, Missouri data based on period 1941 through 1970; on-site data based on periods May 4, 1973 to May 4, 1975 and March 16, 1978 to March 16, 1979.

TABLE 2.3-55 COMPARISON OF ON-SITE STABILITY MEASUREMENTS WITH LONG-TERM STABILITY AT COLUMBIA, MISSOURI

PASQUILL STABILITY CLASS	PERCENTAGE STABILITY OCCURRENCE	
	ON-SITE DATA[a]	NWS STAR DATA[b,c]
A	3.4	0.4
B	3.3	4.7
C	5.0	11.5
D	37.2	53.6
E	30.1	17.6
F	15.0	12.2
G	5.4	--[d]

a May 4, 1973 to May 4, 1975 and March 16, 1978 to March 16, 1979.

b Columbia, Missouri, 1960 through 1969.

c National Climatic Center, no date.

d Class G stability is not approximated by STAR program.

TABLE 2.3-56 JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS (DATA PERIOD: MAY 4, 1973 TO MAY 4, 1974)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: MAY 4, 1973 1200 TO MAY 4, 1974 1100

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79, 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-043-07

WIND SPEED CATEGORIES (METERS PER SECOND)

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 / 0.00 / 0.00	3 / .88 / .04	4 / 1.18 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	7 / 2.06 / .09	3.40
NE	0 / 0.00 / 0.00	3 / .88 / .04	1 / .29 / .01	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 1.18 / .05	3.17
ENE	1 / .29 / .01	0 / 0.00 / 0.00	10 / 2.95 / .13	4 / 1.18 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	15 / 4.42 / .19	[illegible]
E	0 / 0.00 / 0.00	2 / .59 / .03	1 / .29 / .01	6 / 1.77 / .08	0 / 0.00 / 0.00	0 / 0.00 / 0.00	9 / 2.65 / .11	[illegible]
ESE	0 / 0.00 / 0.00	1 / .29 / .01	0 / 0.00 / 0.00	2 / .59 / .03	3 / .88 / .04	0 / 0.00 / 0.00	6 / 1.77 / .08	[illegible]
SE	0 / 0.00 / 0.00	1 / .29 / .01	2 / .59 / .03	2 / .59 / .03	1 / .29 / .01	2 / .59 / .03	8 / 2.36 / .10	[illegible]
SSE	0 / 0.00 / 0.00	2 / .59 / .03	12 / 3.54 / .15	1 / .29 / .01	0 / 0.00 / 0.00	0 / 0.00 / 0.00	15 / 4.42 / .19	3.74
S	0 / 0.00 / 0.00	2 / .59 / .03	8 / 2.36 / .10	9 / 2.65 / .11	1 / .29 / .01	0 / 0.00 / 0.00	20 / 5.90 / .25	[illegible]
SSW	1 / .29 / .01	7 / 2.06 / .09	9 / 2.65 / .11	9 / 2.65 / .11	4 / 1.18 / .05	1 / .29 / .01	31 / 9.14 / .39	[illegible]
SW	2 / .59 / .03	5 / 1.47 / .06	8 / 2.36 / .10	11 / 3.24 / .14	5 / 1.47 / .06	0 / 0.00 / 0.00	31 / 9.14 / .39	[illegible]
WSW	0 / 0.00 / 0.00	10 / 2.95 / .13	3 / .88 / .04	1 / .29 / .01	1 / .29 / .01	4 / 1.18 / .05	19 / 5.60 / .24	[illegible]
W	0 / 0.00 / 0.00	10 / 2.95 / .13	32 / 9.44 / .41	11 / 3.24 / .14	5 / 1.47 / .06	2 / .59 / .03	60 / 17.70 / .76	4.47
WNW	1 / .29 / .01	6 / 1.77 / .08	20 / 5.90 / .25	9 / 2.65 / .11	11 / 3.24 / .14	0 / 0.00 / 0.00	47 / 13.86 / .60	[illegible]
NW	0 / 0.00 / 0.00	2 / .59 / .03	10 / 2.95 / .13	23 / 6.78 / .29	2 / .59 / .03	0 / 0.00 / 0.00	37 / 10.91 / .47	5.37
NNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	19 / 5.60 / .24	2 / .59 / .03	0 / 0.00 / 0.00	0 / 0.00 / 0.00	21 / 6.19 / .27	4.14
N	0 / 0.00 / 0.00	0 / 0.00 / 0.00	8 / 2.36 / .10	1 / .29 / .01	0 / 0.00 / 0.00	0 / 0.00 / 0.00	9 / 2.65 / .11	4.42
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	5 / 1.47 / .06	54 / 15.93 / .69	147 / 43.36 / 1.87	91 / 26.84 / 1.15	33 / 9.73 / .42	9 / 2.65 / .11	339 / 100.00 / 4.31	[illegible]

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: MAY 4, 1973 1200 TO MAY 4, 1974 1100

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79, 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-043-07

WIND SPEED CATEGORIES (METERS PER SECOND)

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 / 0.00 / 0.00	3 / 1.14 / .04	5 / 1.90 / .06	1 / .38 / .01	0 / 0.00 / 0.00	0 / 0.00 / 0.00	9 / 3.42 / .11	[illegible]
NE	0 / 0.00 / 0.00	1 / .38 / .01	2 / .76 / .03	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 1.14 / .04	[illegible]
ENE	0 / 0.00 / 0.00	4 / 1.52 / .05	3 / 1.14 / .04	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	7 / 2.66 / .09	3.16
E	0 / 0.00 / 0.00	2 / .76 / .03	4 / 1.52 / .05	2 / .76 / .03	0 / 0.00 / 0.00	0 / 0.00 / 0.00	8 / 3.04 / .10	[illegible]
ESE	0 / 0.00 / 0.00	2 / .76 / .03	3 / 1.14 / .04	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 1.90 / .06	[illegible]
SE	0 / 0.00 / 0.00	4 / 1.52 / .05	10 / 3.80 / .13	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	14 / 5.32 / .18	3.26
SSE	1 / .38 / .01	2 / .76 / .03	2 / .76 / .03	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 1.90 / .06	[illegible]
S	0 / 0.00 / 0.00	9 / 3.42 / .11	7 / 2.66 / .09	8 / 3.04 / .10	1 / .38 / .01	0 / 0.00 / 0.00	25 / 9.51 / .32	4.26
SSW	0 / 0.00 / 0.00	6 / 2.28 / .08	17 / 6.46 / .22	3 / 1.14 / .04	8 / 3.04 / .10	0 / 0.00 / 0.00	34 / 12.93 / .43	4.74
SW	2 / .76 / .03	4 / 1.52 / .05	7 / 2.66 / .09	9 / 3.42 / .11	1 / .38 / .01	1 / .38 / .01	24 / 9.13 / .30	[illegible]
WSW	0 / 0.00 / 0.00	4 / 1.52 / .05	7 / 2.66 / .09	2 / .76 / .03	0 / 0.00 / 0.00	0 / 0.00 / 0.00	13 / 4.94 / .16	[illegible]
W	1 / .38 / .01	8 / 3.04 / .10	10 / 3.80 / .13	2 / .76 / .03	1 / .38 / .01	0 / 0.00 / 0.00	22 / 8.37 / .28	3.56
WNW	1 / .38 / .01	4 / 1.52 / .05	13 / 4.94 / .16	8 / 3.04 / .10	1 / .38 / .01	0 / 0.00 / 0.00	27 / 10.27 / .34	[illegible]
NW	1 / .38 / .01	5 / 1.90 / .06	8 / 3.04 / .10	7 / 2.66 / .09	3 / 1.14 / .04	1 / .38 / .01	25 / 9.51 / .32	5.07
NNW	1 / .38 / .01	1 / .38 / .01	6 / 2.28 / .08	4 / 1.52 / .05	2 / .76 / .03	0 / 0.00 / 0.00	14 / 5.32 / .18	[illegible]
N	1 / .38 / .01	4 / 1.52 / .05	19 / 7.22 / .24	4 / 1.52 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	28 / 10.65 / .36	[illegible]
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	8 / 3.04 / .10	63 / 23.95 / .80	123 / 46.77 / 1.56	[illegible]	17 / 6.46 / .22	2 / .76 / .03	263 / 100.00 / 3.34	[illegible]

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79, 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-043-07

WIND SPEED CATEGORIES (METERS PER SECOND)

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ENE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
E	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ESE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SSE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
S	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
W	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WNW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NNW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CALM	[illegible]						[illegible]	CALM
TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79, 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-043-07

WIND SPEED CATEGORIES (METERS PER SECOND)

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	14 / .51 / [illegible]	36 / 1.30 / [illegible]	61 / 2.21 / [illegible]	16 / .58 / [illegible]	4 / .14 / [illegible]	0 / 0.00 / [illegible]	131 / 4.74 / [illegible]	[illegible]
NE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ENE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
E	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ESE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SSE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
S	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
W	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WNW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NNW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CALM	[illegible]						[illegible]	CALM
TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

KEY: XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCE THIS CLASS
XXX PERCENT OCCURRENCE ALL CLASSES

TABLE 2.3-56 (Continued) (Sheet 2 of 4)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: MAY 4, 1973 1200 TO MAY 4, 1974 1100

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79, 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	20 .82 .25	48 1.97 .61	20 .82 .25	3 .12 .04	0 0.00 0.00	0 0.00 0.00	91 3.74 1.15	2.54
NE	12 .49 .15	28 1.15 .36	10 .41 .13	2 .08 .03	0 0.00 0.00	0 0.00 0.00	52 2.14 .66	2.41
ENE	11 .45 .14	34 1.40 .43	6 .25 .08	6 .25 .08	0 0.00 0.00	0 0.00 0.00	57 2.34 .72	2.68
E	16 .66 .20	32 1.32 .41	23 .95 .29	6 .25 .08	2 .08 .03	1 .04 .01	80 3.29 1.02	2.97
ESE	24 .99 .30	46 1.89 .58	46 1.89 .58	12 .49 .15	0 0.00 0.00	0 0.00 0.00	128 5.27 1.62	3.00
SE	21 .86 .27	124 5.10 1.57	119 4.90 1.51	24 .99 .30	5 .21 .06	0 0.00 0.00	293 12.05 3.72	3.29
SSE	11 .45 .14	130 5.35 1.65	199 8.19 2.53	32 1.32 .41	8 .33 .10	0 0.00 0.00	380 15.63 4.82	3.60
S	19 .78 .24	99 4.07 1.26	148 6.09 1.88	72 2.96 .91	11 .45 .14	2 .08 .03	351 14.44 4.45	3.46
SSW	16 .66 .20	60 2.47 .76	120 4.94 1.52	42 1.73 .53	9 .37 .11	1 .04 .01	248 10.20 3.15	3.44
SW	13 .53 .16	52 2.14 .66	66 2.71 .84	43 1.77 .55	6 .25 .08	0 0.00 0.00	180 7.40 2.28	3.41
WSW	20 .82 .25	29 1.19 .37	23 .95 .29	8 .33 .10	2 .08 .03	1 .04 .01	83 3.41 1.05	3.11
W	22 .90 .28	31 1.28 .39	26 1.07 .33	8 .33 .10	4 .16 .05	0 0.00 0.00	91 3.74 1.15	2.73
WNW	15 .62 .19	53 2.18 .67	37 1.52 .47	12 .49 .15	1 .04 .01	0 0.00 0.00	118 4.85 1.50	2.98
NW	27 1.11 .34	42 1.73 .53	26 1.07 .33	5 .21 .06	0 0.00 0.00	0 0.00 0.00	100 4.11 1.27	2.59
NNW	20 .82 .25	45 1.85 .57	25 1.03 .32	7 .29 .09	0 0.00 0.00	0 0.00 0.00	97 3.99 1.23	2.79
N	10 .41 .13	39 1.60 .49	28 1.15 .36	7 .29 .09	1 .04 .01	0 0.00 0.00	80 3.29 1.02	3.13
CALM	2 .08 .03						2 .08 .03	CALM
TOTAL	279 11.48 3.54	887 36.49 11.25	922 37.93 11.70	289 11.89 3.67	49 2.02 .62	5 .21 .06	2431 100.00 30.84	3.15

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: MAY 4, 1973 1200 TO MAY 4, 1974 1100

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79, 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	15 1.22 .19	14 1.14 .18	2 .16 .03	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	31 2.52 .39	1.62
NE	19 1.54 .24	16 1.30 .20	1 .08 .01	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	36 2.92 .46	1.44
ENE	10 .81 .13	14 1.14 .18	1 .08 .01	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	25 2.03 .32	1.79
E	18 1.46 .23	19 1.54 .24	1 .08 .01	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	38 3.09 .48	1.72
ESE	19 1.54 .24	24 1.95 .30	2 .16 .03	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	45 3.66 .57	1.72
SE	20 1.62 .25	76 6.17 .96	40 3.25 .51	1 .08 .01	0 0.00 0.00	0 0.00 0.00	137 11.13 1.74	2.54
SSE	19 1.54 .24	119 9.67 1.51	65 5.28 .82	2 .16 .03	0 0.00 0.00	0 0.00 0.00	205 16.65 2.60	2.73
S	10 .81 .13	92 7.47 1.17	72 5.85 .91	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	174 14.13 2.21	[illegible]
SSW	8 .65 .10	57 4.63 .72	63 5.12 .80	1 .08 .01	0 0.00 0.00	0 0.00 0.00	129 10.48 1.64	[illegible]
SW	14 1.14 .18	48 3.90 .61	37 3.01 .47	1 .08 .01	0 0.00 0.00	0 0.00 0.00	100 8.12 1.27	2.43
WSW	21 1.71 .27	35 2.84 .44	8 .65 .10	1 .08 .01	0 0.00 0.00	0 0.00 0.00	65 5.28 .82	2.07
W	18 1.46 .23	37 3.01 .47	12 .97 .15	1 .08 .01	0 0.00 0.00	0 0.00 0.00	68 5.52 .86	2.17
WNW	15 1.22 .19	32 2.60 .41	10 .81 .13	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	57 4.63 .72	2.15
NW	23 1.87 .29	22 1.79 .28	2 .16 .03	2 .16 .03	0 0.00 0.00	0 0.00 0.00	49 3.98 .62	1.86
NNW	10 .81 .13	18 1.46 .23	3 .24 .04	1 .08 .01	0 0.00 0.00	0 0.00 0.00	32 2.60 .41	2.08
N	13 1.06 .16	16 1.30 .20	3 .24 .04	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	32 2.60 .41	1.94
CALM	8 .65 .10						8 .65 .10	CALM
TOTAL	260 21.12 3.30	639 51.91 8.11	322 26.15 4.09	10 .81 .13	0 0.00 0.00	0 0.00 0.00	1231 100.00 15.62	2.45

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79, 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	6 1.30 .08	16 3.47 .20	2 .43 .03	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	24 5.21 .30	2.00
NE	14 3.04 .18	7 1.52 .09	1 .22 .01	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	22 4.77 .28	1.44
ENE	5 1.08 .06	6 1.30 .08	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	11 2.39 .14	1.49
E	5 1.08 .06	3 .65 .04	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 1.74 .10	1.45
ESE	4 .87 .05	4 .87 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 1.74 .10	1.32
SE	5 1.08 .06	10 2.17 .13	8 1.74 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	23 4.99 .29	2.42
SSE	8 1.74 .10	28 6.07 .36	22 4.77 .28	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	58 12.58 .74	2.75
S	14 3.04 .18	32 6.94 .41	10 2.17 .13	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	56 12.15 .71	2.33
SSW	10 2.17 .13	20 4.34 .25	12 2.60 .15	1 .22 .01	0 0.00 0.00	0 0.00 0.00	43 9.33 .55	2.39
SW	20 4.34 .25	41 8.89 .52	7 1.52 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	68 14.75 .87	2.11
WSW	12 2.60 .15	29 6.29 .37	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	41 8.89 .52	1.71
W	14 3.04 .18	15 3.25 .19	1 .22 .01	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	30 6.51 .38	1.54
WNW	7 1.52 .09	10 2.17 .13	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	17 3.69 .22	1.42
NW	5 1.08 .06	10 2.17 .13	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	15 3.25 .19	1.59
NNW	1 .22 .01	8 1.74 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 1.95 .11	1.49
N	10 2.17 .13	14 3.04 .18	1 .22 .01	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	25 5.42 .32	1.87
CALM	3 .65 .04						3 .65 .04	CALM
TOTAL	143 31.02 1.81	253 54.88 3.21	64 13.88 .81	1 .22 .01	0 0.00 0.00	0 0.00 0.00	461 100.00 5.85	[illegible]

KEY *** NUMBER OF OCCURRENCES
*** PERCENT OCCURRENCES THIS CLASS
*** PERCENT OCCURRENCES ALL CLASSES

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79, 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	62 .76	125 1.53	103 1.26	28 .34	4 .05	0 0.00	322 3.94	2.96
NE	66 .81	105 1.28	67 .82	11 .13	0 0.00	0 0.00	249 3.04	2.57
ENE	40 .49	100 1.22	64 .78	32 .39	0 0.00	0 0.00	236 2.89	3.00
E	62 .76	120 1.47	98 1.20	23 .28	2 .02	1 .01	306 3.74	2.90
ESE	59 .72	127 1.55	136 1.66	40 .49	4 .05	0 0.00	366 4.48	3.19
SE	61 .75	272 3.33	321 3.93	63 .77	14 .17	2 .02	733 8.96	3.39
SSE	51 .62	363 4.44	417 5.10	103 1.26	22 .27	6 .07	962 11.76	3.55
S	58 .71	304 3.72	374 4.57	189 2.31	37 .45	4 .05	966 11.81	3.91
SSW	45 .55	215 2.63	327 4.00	126 1.54	38 .46	4 .05	755 9.23	[illegible]
SW	[illegible] .73	215 2.63	205 2.51	111 1.36	24 .29	7 .09	627 7.67	3.74
WSW	63 .77	147 1.80	78 .95	25 .31	13 .16	10 .12	336 4.11	3.23
W	76 .93	150 1.83	135 1.65	36 .44	23 .28	6 .07	459 5.62	3.34
WNW	52 .64	156 1.91	181 2.21	102 1.25	50 .61	4 .05	545 6.66	4.19
NW	67 .82	119 1.46	169 2.07	117 1.43	15 .18	1 .01	488 5.97	3.46
NNW	42 .51	129 1.58	154 1.89	64 .78	4 .05	0 0.00	393 4.81	3.57
N	57 .70	109 1.33	154 1.88	79 .97	17 .21	2 .02	418 5.11	3.72
CALM	19 .23						19 .23	CALM
TOTAL	941 11.51	2757 33.71	2984 36.49	1182 14.45	267 3.26	47 .57	8178 100.00	3.55

NUMBER OF VALID OBSERVATIONS 8178 93.35 PCT.
NUMBER OF INVALID OBSERVATIONS 582 6.65 PCT.
TOTAL NUMBER OF OBSERVATIONS 8760 100.00 PCT.

KEY *** NUMBER OF OCCURRENCES
*** PERCENT OCCURRENCES

TABLE 2.3-56 (Continued) (Sheet 3 of 4)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: MAY 5, 1973 1200 TO MAY 4, 1974 1100

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	1 .30 .01	4 1.19 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 1.49 .06	3.40
NE	0 0.00 0.00	1 .30 .01	2 .60 .03	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 .90 .04	3.53
ENE	0 0.00 0.00	2 .60 .03	6 1.79 .08	6 1.79 .08	0 0.00 0.00	0 0.00 0.00	14 4.18 .18	4.55
E	1 .30 .01	2 .60 .03	4 1.19 .05	1 .30 .01	1 .30 .01	0 0.00 0.00	9 2.69 .12	4.13
ESE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 1.79 .08	0 0.00 0.00	0 0.00 0.00	6 1.79 .08	6.78
SE	0 0.00 0.00	0 0.00 0.00	2 .60 .03	0 0.00 0.00	3 .90 .04	2 .60 .03	7 2.09 .09	8.16
SSE	0 0.00 0.00	1 .30 .01	8 2.39 .10	1 .30 .01	0 0.00 0.00	2 .60 .03	12 3.58 .15	5.59
S	0 0.00 0.00	3 .90 .04	9 2.69 .12	7 2.09 .09	3 .90 .04	0 0.00 0.00	22 6.57 .29	5.?7
SSW	0 0.00 0.00	8 2.39 .10	4 1.19 .05	14 4.18 .18	1 .30 .01	1 .30 .01	28 8.36 .36	5.?3
SW	1 .30 .01	3 .90 .04	5 1.49 .06	11 3.28 .14	9 2.69 .12	5 1.49 .06	34 10.15 .44	7.?3
WSW	0 0.00 0.00	7 2.09 .09	4 1.19 .05	6 1.79 .08	2 .60 .03	4 1.19 .05	23 6.87 .30	6.24
W	0 0.00 0.00	7 2.09 .09	16 4.78 .21	25 7.46 .32	2 .60 .03	7 2.09 .09	57 17.01 .74	5.86
WNW	0 0.00 0.00	5 1.49 .06	7 2.09 .09	16 4.78 .21	10 2.99 .13	9 2.69 .12	47 14.03 .61	7.23
NW	0 0.00 0.00	1 .30 .01	3 .90 .04	10 2.99 .13	14 4.18 .18	6 1.79 .08	34 10.15 .44	7.80
NNW	0 0.00 0.00	0 0.00 0.00	12 3.58 .16	11 3.28 .14	5 1.49 .06	0 0.00 0.00	28 8.36 .36	5.77
N	0 0.00 0.00	0 0.00 0.00	2 .60 .03	4 1.19 .05	0 0.00 0.00	0 0.00 0.00	6 1.79 .08	5.?3
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	2 .60 .03	41 12.24 .53	88 26.27 1.14	118 35.22 1.53	50 14.93 .65	36 10.75 .47	335 100.00 4.35	6.19

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	2 .76 .03	3 1.15 .04	4 1.53 .05	0 0.00 0.00	0 0.00 0.00	9 3.44 .12	4.33
NE	0 0.00 0.00	2 .76 .03	3 1.15 .04	1 .38 .01	0 0.00 0.00	0 0.00 0.00	6 2.29 .08	3.47
ENE	0 0.00 0.00	3 1.15 .04	4 1.53 .05	1 .38 .01	0 0.00 0.00	0 0.00 0.00	8 3.05 .10	3.44
E	1 .38 .01	1 .38 .01	1 .38 .01	1 .38 .01	1 .38 .01	0 0.00 0.00	5 1.91 .06	4.12
ESE	0 0.00 0.00	1 .38 .01	3 1.15 .04	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 1.53 .05	3.35
SE	0 0.00 0.00	1 .38 .01	8 3.05 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 3.44 .12	3.48
SSE	0 0.00 0.00	6 2.29 .08	4 1.53 .05	2 .76 .03	0 0.00 0.00	0 0.00 0.00	12 4.58 .16	3.?9
S	0 0.00 0.00	5 1.91 .06	3 1.15 .04	5 1.91 .06	3 1.15 .04	0 0.00 0.00	16 6.11 .21	5.00
SSW	1 .38 .01	11 4.20 .14	8 3.05 .10	7 2.67 .09	1 .38 .01	1 .38 .01	29 11.07 .38	4.11
SW	2 .76 .03	4 1.53 .05	9 3.44 .12	9 3.44 .12	10 3.82 .13	5 1.91 .06	39 14.89 .51	6.55
WSW	0 0.00 0.00	2 .76 .03	5 1.91 .06	3 1.15 .04	0 0.00 0.00	0 0.00 0.00	10 3.82 .13	4.51
W	0 0.00 0.00	3 1.15 .04	15 5.73 .19	6 2.29 .08	2 .76 .03	1 .38 .01	27 10.31 .35	4.89
WNW	0 0.00 0.00	3 1.15 .04	9 3.44 .12	8 3.05 .10	4 1.53 .05	1 .38 .01	25 9.54 .32	5.42
NW	0 0.00 0.00	4 1.53 .05	2 .76 .03	9 3.44 .12	5 1.91 .06	3 1.15 .04	23 8.78 .30	6.59
NNW	0 0.00 0.00	3 1.15 .04	7 2.67 .09	8 3.05 .10	3 1.15 .04	1 .38 .01	22 8.40 .29	5.50
N	1 .38 .01	1 .38 .01	8 3.05 .10	6 2.29 .08	1 .38 .01	1 .38 .01	18 6.87 .23	4.89
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	5 1.91 .06	52 19.85 .68	92 35.11 1.20	70 26.72 .91	30 11.45 .39	13 4.96 .17	262 100.00 3.40	5.05

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	2 .52 .03	4 1.04 .05	6 1.55 .08	3 .78 .04	3 .78 .04	0 0.00 0.00	18 4.66 .23	4.69
NE	1 .26 .01	3 .78 .04	3 .78 .04	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 1.81 .09	3.13
ENE	0 0.00 0.00	2 .52 .03	4 1.04 .05	6 1.55 .08	1 .26 .01	0 0.00 0.00	13 3.37 .17	5.?8
E	1 .26 .01	2 .52 .03	3 .78 .04	1 .26 .01	1 .26 .01	0 0.00 0.00	8 2.07 .10	4.?1
ESE	1 .26 .01	2 .52 .03	6 1.55 .08	2 .52 .03	0 0.00 0.00	0 0.00 0.00	11 2.85 .14	3.96
SE	0 0.00 0.00	2 .52 .03	12 3.11 .16	2 .52 .03	1 .26 .01	0 0.00 0.00	17 4.40 .22	4.26
SSE	3 .78 .04	7 1.81 .09	9 2.33 .12	5 1.30 .06	2 .52 .03	1 .26 .01	27 6.99 .35	4.28
S	0 0.00 0.00	10 2.59 .13	10 2.59 .13	13 3.37 .17	2 .52 .03	3 .78 .04	38 9.84 .49	5.15
SSW	1 .26 .01	9 2.33 .12	8 2.07 .10	15 3.89 .19	4 1.04 .05	1 .26 .01	38 9.84 .49	5.?2
SW	0 0.00 0.00	5 1.30 .06	15 3.89 .19	13 3.37 .17	5 1.30 .06	3 .78 .04	41 10.62 .53	5.69
WSW	0 0.00 0.00	7 1.81 .09	6 1.55 .08	2 .52 .03	1 .26 .01	1 .26 .01	17 4.40 .22	4.?0
W	3 .78 .04	5 1.30 .06	9 2.33 .12	4 1.04 .05	1 .26 .01	1 .26 .01	23 5.96 .30	4.14
WNW	1 .26 .01	3 .78 .04	8 2.07 .10	10 2.59 .13	4 1.04 .05	3 .78 .04	29 7.51 .38	6.23
NW	0 0.00 0.00	3 .78 .04	13 3.37 .17	12 3.11 .16	10 2.59 .13	3 .78 .04	41 10.62 .53	6.14
NNW	1 .26 .01	3 .78 .04	6 1.55 .08	5 1.30 .06	4 1.04 .05	0 0.00 0.00	19 4.92 .25	5.22
N	0 0.00 0.00	11 2.85 .14	6 1.55 .08	16 4.15 .21	5 1.30 .06	0 0.00 0.00	38 9.84 .49	5.12
CALM	1 .26 .01						1 .26 .01	CALM
TOTAL	15 3.89 .19	78 20.21 1.01	124 32.12 1.61	109 28.24 1.42	44 11.40 .57	16 4.15 .21	386 100.00 5.01	5.?5

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	14 .52 .18	30 1.11 .39	49 1.81 .64	27 1.00 .35	7 .26 .09	2 .07 .03	129 4.78 1.68	4.16
NE	9 .33 .12	36 1.33 .47	53 1.96 .69	13 .48 .17	4 .15 .05	0 0.00 0.00	115 4.26 1.49	3.58
ENE	8 .30 .10	25 .93 .32	28 1.04 .36	20 .74 .26	6 .22 .08	0 0.00 0.00	87 3.22 1.13	3.97
E	9 .33 .12	42 1.55 .55	28 1.04 .36	22 .81 .29	1 .04 .01	0 0.00 0.00	102 3.78 1.33	3.57
ESE	5 .19 .06	25 .93 .32	50 1.85 .65	41 1.52 .53	7 .26 .09	0 0.00 0.00	129 4.78 1.68	4.39
SE	4 .15 .05	45 1.67 .58	78 2.89 1.01	85 3.15 1.10	21 .78 .27	9 .33 .12	243 9.00 3.16	5.?6
SSE	6 .22 .08	47 1.74 .61	76 2.81 .99	64 2.37 .83	24 .89 .31	4 .15 .05	221 8.18 2.87	4.82
S	10 .37 .13	52 1.93 .68	75 2.78 .97	67 2.48 .87	43 1.59 .56	22 .81 .29	267 9.89 3.47	5.59
SSW	3 .11 .04	32 1.18 .42	52 1.93 .68	71 2.63 .92	31 1.15 .40	14 .52 .18	203 7.52 2.64	5.65
SW	5 .19 .06	25 .93 .32	66 2.44 .86	[illegible]	26 .96 .34	13 .48 .17	187 6.92 2.43	5.52
WSW	4 .15 .05	14 .52 .18	27 1.00 .35	18 .67 .23	7 .26 .09	13 .48 .17	83 3.07 1.08	5.94
W	5 .19 .06	25 .93 .32	30 1.11 .39	23 .85 .30	48 1.78 .62	11 .41 .14	142 5.26 1.84	6.1?
WNW	6 .22 .08	17 .63 .22	35 1.30 .45	69 2.55 .90	39 1.44 .51	31 1.15 .40	197 7.29 2.56	6.71
NW	4 .15 .05	15 .56 .19	64 2.37 .83	94 3.48 1.22	38 1.41 .49	18 .67 .23	233 8.63 3.03	6.11
NNW	8 .30 .10	25 .93 .32	59 2.18 .77	51 1.89 .66	30 1.11 .39	3 .11 .04	176 6.52 2.29	5.17
N	11 .41 .14	26 .96 .34	58 2.15 .75	60 2.22 .78	23 .85 .30	8 .30 .10	186 6.89 2.42	5.23
CALM	1 .04 .01						1 .04 .01	CALM
TOTAL	112 4.15 1.46	482 17.85 6.26	827 30.62 10.74	777 28.77 10.09	355 13.14 4.61	144 [illegible]	2701 100.00 35.09	5.?4

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-56 (Continued) (Sheet 4 of 4)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: MAY 4, 1973 1200 TO MAY 4,1974 1100

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	2 .09 .03	25 1.07 .32	33 1.41 .43	14 .60 .18	2 .09 .03	0 0.00 0.00	76 3.24 .99	3.98
NE	9 .38 .12	16 .68 .21	33 1.41 .43	9 .38 .12	0 0.00 0.00	0 0.00 0.00	67 2.86 .87	3.41
ENE	2 .09 .03	17 .73 .22	22 .94 .29	15 .64 .19	2 .09 .03	0 0.00 0.00	58 2.47 .75	4.14
E	5 .21 .06	17 .73 .22	27 1.15 .35	20 .85 .26	2 .09 .03	2 .09 .03	73 3.11 .95	4.36
ESE	7 .30 .09	15 .64 .19	54 2.30 .70	44 1.88 .57	4 .17 .05	0 0.00 0.00	124 5.29 1.61	4.52
SE	4 .17 .05	50 2.13 .65	80 3.41 1.04	111 4.74 1.44	21 .90 .27	4 .17 .05	270 11.52 3.51	5.08
SSE	1 .04 .01	22 .94 .29	121 5.16 1.57	128 5.46 1.66	22 .94 .29	6 .26 .08	300 12.80 3.90	5.33
S	5 .21 .06	40 1.71 .52	78 3.33 1.01	118 5.03 1.53	65 2.77 .84	13 .55 .17	319 13.61 4.14	5.47
SSW	5 .21 .06	19 .81 .25	59 2.52 .77	128 5.46 1.66	52 2.22 .68	9 .38 .12	272 11.60 3.53	6.05
SW	2 .09 .03	20 .85 .26	50 2.13 .65	97 4.14 1.26	53 2.26 .69	10 .43 .13	232 9.90 3.01	6.18
WSW	5 .21 .06	13 .55 .17	24 1.02 .31	15 .64 .19	19 .81 .25	4 .17 .05	80 3.41 1.04	5.50
W	4 .17 .05	10 .43 .13	29 1.24 .38	23 .98 .30	10 .43 .13	3 .13 .04	79 3.37 1.03	5.16
WNW	4 .17 .05	17 .73 .22	36 1.54 .47	45 1.92 .58	14 .60 .18	1 .04 .01	117 4.99 1.52	5.15
NW	2 .09 .03	10 .43 .13	33 1.41 .43	51 2.18 .66	5 .21 .06	1 .04 .01	102 4.35 1.32	5.21
NNW	2 .09 .03	13 .55 .17	35 1.49 .45	37 1.58 .48	7 .30 .09	1 .04 .01	95 4.05 1.23	4.95
N	4 .17 .05	10 .43 .13	28 1.19 .36	33 1.41 .43	2 .09 .03	2 .09 .03	79 3.37 1.03	4.43
CALM	1 .04 .01						1 .04 .01	CALM
TOTAL	64 2.73 .83	316 13.48 4.10	742 31.66 9.64	888 37.88 11.54	280 11.95 3.64	56 2.39 .73	2344 100.00 30.45	5.29

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	2 .43 .03	5 1.09 .06	15 3.26 .19	1 .22 .01	0 0.00 0.00	0 0.00 0.00	23 5.00 .30	3.43
NE	0 0.00 0.00	5 1.09 .06	11 2.39 .14	4 .87 .05	5 1.09 .06	0 0.00 0.00	25 5.43 .32	4.77
ENE	3 .65 .04	1 .22 .01	7 1.52 .09	3 .65 .04	1 .22 .01	0 0.00 0.00	15 3.26 .19	4.04
E	0 0.00 0.00	3 .65 .04	8 1.74 .10	2 .43 .03	0 0.00 0.00	0 0.00 0.00	13 2.83 .17	3.75
ESE	4 .87 .05	2 .43 .03	3 .65 .04	2 .43 .03	0 0.00 0.00	0 0.00 0.00	11 2.39 .14	3.16
SE	0 0.00 0.00	3 .65 .04	2 .43 .03	3 .65 .04	0 0.00 0.00	0 0.00 0.00	8 1.74 .10	3.42
SSE	1 .22 .01	4 .87 .05	4 .87 .05	7 1.52 .09	3 .65 .04	0 0.00 0.00	19 4.13 .25	4.59
S	1 .22 .01	13 2.83 .17	20 4.35 .26	26 5.65 .34	2 .43 .03	0 0.00 0.00	62 13.48 .81	4.66
SSW	1 .22 .01	2 .43 .03	10 2.17 .13	26 5.65 .34	3 .65 .04	0 0.00 0.00	42 9.13 .55	5.56
SW	2 .43 .03	3 .65 .04	20 4.35 .26	34 7.39 .44	12 2.61 .16	3 .65 .04	74 16.09 .96	5.93
WSW	1 .22 .01	5 1.09 .06	9 1.96 .12	25 5.43 .32	8 1.74 .10	0 0.00 0.00	48 10.43 .62	5.40
W	2 .43 .03	7 1.52 .09	20 4.35 .26	22 4.78 .29	0 0.00 0.00	0 0.00 0.00	51 11.09 .66	4.56
WNW	0 0.00 0.00	1 .22 .01	12 2.61 .16	5 1.09 .06	5 1.09 .06	0 0.00 0.00	23 5.00 .30	5.50
NW	0 0.00 0.00	1 .22 .01	6 1.30 .08	7 1.52 .09	1 .22 .01	0 0.00 0.00	15 3.26 .19	5.25
NNW	1 .22 .01	1 .22 .01	6 1.30 .08	9 1.96 .12	0 0.00 0.00	0 0.00 0.00	17 3.70 .22	4.88
N	1 .22 .01	1 .22 .01	5 1.09 .06	5 1.09 .06	2 .43 .03	0 0.00 0.00	14 3.04 .18	5.04
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	19 4.13 .25	57 12.39 .74	158 34.35 2.05	181 39.35 2.35	42 9.13 .55	3 .65 .04	460 100.00 5.98	5.07

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: MAY 4, 1973 1200 TO MAY 4,1974 1100

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	1 .08 .01	12 .99 .16	15 1.24 .19	7 .58 .09	0 0.00 0.00	0 0.00 0.00	35 2.89 .45	3.67
NE	2 .17 .03	7 .58 .09	14 1.16 .18	8 .66 .10	0 0.00 0.00	0 0.00 0.00	31 2.56 .40	3.42
ENE	2 .17 .03	3 .25 .04	11 .91 .14	11 .91 .14	1 .08 .01	0 0.00 0.00	28 2.32 .36	4.46
E	1 .08 .01	7 .58 .09	11 .91 .14	13 1.08 .17	0 0.00 0.00	0 0.00 0.00	32 2.65 .42	4.13
ESE	2 .17 .03	6 .50 .08	20 1.65 .25	14 1.16 .18	0 0.00 0.00	0 0.00 0.00	42 3.47 .55	4.20
SE	2 .17 .03	11 .91 .14	37 3.06 .48	30 2.48 .39	1 .08 .01	0 0.00 0.00	81 6.70 1.05	4.65
SSE	5 .41 .06	10 .83 .13	25 2.07 .32	71 5.87 .92	6 .50 .08	0 0.00 0.00	117 9.68 1.52	5.31
S	3 .25 .04	23 1.90 .30	81 6.70 1.05	76 6.29 .99	17 1.41 .22	0 0.00 0.00	200 16.54 2.60	5.45
SSW	3 .25 .04	12 .99 .16	50 4.14 .65	98 8.11 1.27	33 2.73 .43	0 0.00 0.00	196 16.21 2.55	5.72
SW	1 .08 .01	10 .83 .13	25 2.07 .32	57 4.71 .74	44 3.64 .57	0 0.00 0.00	137 11.33 1.78	6.33
WSW	3 .25 .04	15 1.24 .19	22 1.82 .29	17 1.41 .22	8 .66 .10	0 0.00 0.00	65 5.38 .84	4.76
W	1 .08 .01	12 .99 .16	25 2.07 .32	36 2.98 .47	9 .74 .12	0 0.00 0.00	83 6.87 1.08	5.13
WNW	1 .08 .01	5 .41 .06	13 1.08 .17	24 1.99 .31	7 .58 .09	0 0.00 0.00	50 4.14 .65	5.53
NW	2 .17 .03	8 .66 .10	8 .66 .10	22 1.82 .29	3 .25 .04	0 0.00 0.00	43 3.56 .56	5.16
NNW	3 .25 .04	6 .50 .08	14 1.16 .18	8 .66 .10	1 .08 .01	0 0.00 0.00	32 2.65 .42	4.12
N	2 .17 .03	10 .83 .13	12 .99 .16	11 .91 .14	1 .08 .01	0 0.00 0.00	36 2.98 .47	4.07
CALM	1 .08 .01						1 .08 .01	CALM
TOTAL	35 2.89 .45	157 12.99 2.04	383 31.68 4.98	503 41.60 6.54	131 10.84 1.70	0 0.00 0.00	1209 100.00 15.71	5.12

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	21 .27	81 1.02	126 1.59	59 .75	12 .15	2 .03	301 3.80	3.49
NE	21 .27	72 .91	122 1.54	38 .48	9 .11	0 0.00	262 3.31	3.67
ENE	15 .19	56 .71	93 1.17	63 .80	11 .14	0 0.00	238 3.01	4.15
E	20 .25	76 .96	91 1.15	63 .80	6 .08	2 .03	258 3.26	3.95
ESE	20 .25	55 .69	143 1.81	111 1.40	11 .14	0 0.00	340 4.29	4.36
SE	10 .13	117 1.48	233 2.94	235 2.97	47 .59	15 .19	657 8.30	4.47
SSE	16 .20	102 1.29	250 3.16	282 3.56	61 .77	13 .16	724 9.14	5.08
S	19 .24	149 1.88	280 3.54	313 3.95	137 1.73	38 .48	936 11.82	5.43
SSW	14 .18	99 1.25	196 2.48	362 4.57	127 1.60	26 .33	824 10.41	5.57
SW	14 .18	74 .93	194 2.45	274 3.46	160 2.02	40 .51	756 9.55	6.02
WSW	15 .19	64 .81	98 1.24	90 1.14	47 .59	23 .29	337 4.26	5.48
W	15 .19	70 .88	146 1.84	145 1.83	79 1.00	23 .29	478 6.04	5.47
WNW	12 .15	51 .64	125 1.58	182 2.30	83 1.05	45 .57	498 6.29	6.09
NW	8 .10	44 .56	134 1.69	206 2.60	76 .96	31 .39	499 6.30	5.93
NNW	15 .19	55 .69	147 1.86	141 1.78	50 .63	5 .06	413 5.22	5.03
N	19 .24	61 .77	125 1.58	142 1.79	35 .44	11 .14	393 4.96	4.44
CALM	4 .05						4 .05	CALM
TOTAL	258 3.26	1226 15.48	2503 31.61	2706 34.18	951 12.01	274 3.46	7918 100.00	5.23

NUMBER OF VALID OBSERVATIONS 7918 90.39 PCT.
NUMBER OF INVALID OBSERVATIONS 842 9.61 PCT.
TOTAL NUMBER OF OBSERVATIONS 8760 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-57 JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS (DATA PERIOD: MAY 4, 1974 TO MAY 4, 1975)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: MAY 4, 1974 1200 TO MAY 4, 1975 1100

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	WIND SPEED CATEGORIES (METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	3 1.12 .04	3 1.12 .04	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 2.23 .07	3.59
NE	0 0.00 0.00	3 1.12 .04	2 .74 .02	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 1.86 .06	2.84
ENE	0 0.00 0.00	0 0.00 0.00	2 .74 .02	3 1.12 .04	0 0.00 0.00	0 0.00 0.00	5 1.86 .06	4.40
E	0 0.00 0.00	0 0.00 0.00	3 1.12 .04	4 1.49 .05	2 .74 .02	0 0.00 0.00	9 3.35 .11	6.11
ESE	0 0.00 0.00	1 .37 .01	6 2.23 .07	3 1.12 .04	2 .74 .02	0 0.00 0.00	12 4.46 .14	5.02
SE	0 0.00 0.00	2 .74 .02	6 2.23 .07	2 .74 .02	0 0.00 0.00	0 0.00 0.00	10 3.72 .12	3.54
SSE	0 0.00 0.00	1 .37 .01	5 1.86 .06	1 .37 .01	2 .74 .02	0 0.00 0.00	9 3.35 .11	5.13
S	0 0.00 0.00	1 .37 .01	9 3.35 .11	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	10 3.72 .12	3.88
SSW	0 0.00 0.00	2 .74 .02	9 3.35 .11	3 1.12 .04	0 0.00 0.00	0 0.00 0.00	14 5.20 .17	3.96
SW	0 0.00 0.00	9 3.35 .11	13 4.83 .15	2 .74 .02	0 0.00 0.00	0 0.00 0.00	24 8.92 .28	3.47
WSW	1 .37 .01	3 1.12 .04	12 4.46 .14	2 .74 .02	3 1.12 .04	1 .37 .01	22 8.18 .25	4.72
W	1 .37 .01	8 2.97 .09	24 8.92 .28	17 6.32 .20	16 5.95 .19	1 .37 .01	67 24.91 .79	5.55
WNW	0 0.00 0.00	7 2.60 .08	12 4.46 .14	18 6.69 .21	3 1.12 .04	1 .37 .01	41 15.24 .48	5.19
NW	0 0.00 0.00	0 0.00 0.00	13 4.83 .15	3 1.12 .04	0 0.00 0.00	0 0.00 0.00	16 5.95 .19	4.50
NNW	0 0.00 0.00	1 .37 .01	11 4.09 .13	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	12 4.46 .14	3.43
N	0 0.00 0.00	2 .74 .02	4 1.49 .05	1 .37 .01	0 0.00 0.00	0 0.00 0.00	7 2.60 .08	3.40
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	2 .74 .02	43 15.99 .51	134 49.81 1.58	59 21.93 .70	28 10.41 .33	3 1.12 .04	269 100.00 3.17	4.7[illegible]

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	WIND SPEED CATEGORIES (METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	5 1.46 .06	8 2.34 .09	1 .29 .01	0 0.00 0.00	0 0.00 0.00	14 4.09 .17	3.29
NE	0 0.00 0.00	1 .29 .01	1 .29 .01	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 .58 .02	3.19
ENE	0 0.00 0.00	3 .88 .04	2 .58 .02	3 .88 .04	0 0.00 0.00	0 0.00 0.00	8 2.34 .09	3.41
E	1 .29 .01	1 .29 .01	3 .88 .04	4 1.17 .05	1 .29 .01	0 0.00 0.00	10 2.92 .12	4.46
ESE	0 0.00 0.00	4 1.17 .05	5 1.46 .06	2 .58 .02	0 0.00 0.00	0 0.00 0.00	11 3.22 .13	3.70
SE	1 .29 .01	4 1.17 .05	11 3.22 .13	4 1.17 .05	0 0.00 0.00	0 0.00 0.00	20 5.85 .24	3.77
SSE	1 .29 .01	9 2.63 .11	13 3.80 .15	1 .29 .01	3 .88 .04	0 0.00 0.00	27 7.89 .32	3.43
S	0 0.00 0.00	3 .88 .04	8 2.34 .09	3 .88 .04	0 0.00 0.00	1 .29 .01	15 4.39 .18	4.25
SSW	2 .58 .02	10 2.92 .12	16 4.68 .19	9 2.63 .11	1 .29 .01	1 .29 .01	39 11.40 .46	4.33
SW	2 .58 .02	5 1.46 .06	16 4.68 .19	2 .58 .02	2 .58 .02	0 0.00 0.00	27 7.89 .32	4.00
WSW	1 .29 .01	7 2.05 .08	8 2.34 .09	1 .29 .01	1 .29 .01	1 .29 .01	19 5.56 .22	4.05
W	0 0.00 0.00	11 3.22 .13	11 3.22 .13	10 2.92 .12	3 .88 .04	0 0.00 0.00	35 10.23 .41	4.47
WNW	0 0.00 0.00	13 3.80 .15	22 6.43 .26	12 3.51 .14	8 2.34 .09	0 0.00 0.00	55 16.08 .65	4.77
NW	1 .29 .01	7 2.05 .08	17 4.97 .20	6 1.75 .07	1 .29 .01	0 0.00 0.00	32 9.36 .38	3.99
NNW	0 0.00 0.00	3 .88 .04	12 3.51 .14	5 1.46 .06	0 0.00 0.00	0 0.00 0.00	20 5.85 .24	4.10
N	0 0.00 0.00	2 .58 .02	5 1.46 .06	1 .29 .01	0 0.00 0.00	0 0.00 0.00	8 2.34 .09	3.46
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	9 2.63 .11	88 25.73 1.04	158 46.20 1.86	64 18.71 .75	20 5.85 .24	3 .88 .04	342 100.00 4.03	4.17

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	WIND SPEED CATEGORIES (METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	6 1.19 .07	15 2.98 .19	1 .20 .01	0 0.00 0.00	0 0.00 0.00	22 4.37 .26	3.49
NE	1 .20 .01	7 1.39 .08	2 .40 .02	1 .20 .01	0 0.00 0.00	0 0.00 0.00	11 2.19 .13	2.88
ENE	0 0.00 0.00	6 1.19 .07	4 .80 .05	1 .20 .01	0 0.00 0.00	0 0.00 0.00	11 2.19 .13	3.41
E	[illegible] .40 .02	[illegible] 1.19 .07	[illegible] 1.39 .08	[illegible]	0 0.00 0.00	0 0.00 0.00	[illegible]	[illegible]
ESE	0 0.00 0.00	[illegible] .60 .04	[illegible]	[illegible]	0 0.00 0.00	0 0.00 0.00	[illegible] 4.77 .29	4.55
SE	[illegible] .40 .02	[illegible] 1.19 .07	[illegible] 3.18 .19	[illegible] 2.19 .13	[illegible] .40 .02	0 0.00 0.00	[illegible] 7.36 .44	4.17
SSE	[illegible] .20 .01	[illegible] 1.79 .11	[illegible] 3.58 .21	[illegible]	[illegible] .20 .01	0 0.00 0.00	[illegible]	3.80
S	[illegible] .20 .01	[illegible] 1.59 .09	[illegible] 3.38 .20	[illegible] 1.79 .11	[illegible]	0 0.00 0.00	[illegible] 7.36 .44	4.44
SSW	0 0.00 0.00	[illegible] 1.19 .07	[illegible] 5.17 .31	[illegible]	[illegible] 1.19 .07	[illegible]	[illegible]	[illegible]
SW	0 0.00 0.00	[illegible] 1.19 .07	[illegible] 3.18 .19	[illegible]	[illegible] .80 .05	[illegible]	[illegible]	4.41
WSW	[illegible] .20 .01	[illegible] 1.19 .07	[illegible] 1.99 .12	[illegible]	[illegible] .60 .04	[illegible]	[illegible]	5.21
W	[illegible] .20 .01	[illegible]	[illegible] 3.18 .19	[illegible]	[illegible] .60 .04	[illegible] .20 .01	[illegible]	4.15
WNW	[illegible] .20 .01	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.41
NW	0 0.00 0.00	[illegible]	[illegible]	[illegible]	[illegible]	0 0.00 0.00	[illegible]	[illegible]
NNW	0 0.00 0.00	[illegible] 1.39 .08	[illegible] 3.18 .19	[illegible]	[illegible]	0 0.00 0.00	[illegible]	[illegible]
N	0 0.00 0.00	[illegible] .99 .06	[illegible]	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	[illegible]	[illegible]
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	10 1.99 .12	121 [illegible] 1.43	227 45.13 2.69	[illegible]	[illegible] 5.57 .33	[illegible] 1.79 .11	[illegible] 100.00 [illegible]	[illegible]

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	WIND SPEED CATEGORIES (METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	15 .46 .18	90 2.76 1.06	86 2.64 1.01	17 .52 .20	0 0.00 0.00	0 0.00 0.00	208 6.38 2.45	3.19
NE	5 .15 .06	68 2.09 .80	60 1.84 .71	8 .25 .09	0 0.00 0.00	0 0.00 0.00	141 4.33 1.66	3.06
ENE	10 .31 .12	49 1.50 .58	38 1.17 .45	12 .37 .14	0 0.00 0.00	0 0.00 0.00	109 3.35 1.29	3.14
E	10 .31 .12	45 1.38 .53	60 1.84 .71	36 1.10 .42	3 .09 .04	0 0.00 0.00	154 4.73 1.82	3.94
ESE	4 .12 .05	49 1.50 .58	74 2.27 .87	51 1.57 .60	15 .46 .18	1 .03 .01	194 5.95 2.29	4.45
SE	11 .34 .13	64 1.96 .75	120 3.68 1.42	75 2.30 .88	9 .28 .11	0 0.00 0.00	279 8.56 3.29	4.16
SSE	15 .46 .18	53 1.63 .62	80 2.45 .94	55 1.69 .65	14 .43 .17	0 0.00 0.00	217 6.66 2.56	4.19
S	15 .46 .18	46 1.41 .54	96 2.95 1.13	66 2.03 .78	29 .89 .34	1 .03 .01	253 7.77 2.98	4.52
SSW	15 .46 .18	61 1.87 .72	80 2.46 .94	60 1.84 .71	25 .77 .29	3 .09 .04	244 7.49 2.88	4.50
SW	8 .25 .09	44 1.35 .52	54 1.66 .64	29 .89 .34	2 .06 .02	7 .21 .08	144 4.42 1.70	4.12
WSW	12 .37 .14	38 1.17 .45	40 1.23 .47	41 1.26 .48	11 .34 .13	5 .15 .06	147 4.51 1.73	4.53
W	7 .21 .08	50 1.53 .59	85 2.61 1.00	42 1.29 .50	13 .40 .15	13 .40 .15	210 6.45 2.48	4.62
WNW	13 .40 .15	57 1.75 .67	122 3.74 1.44	88 2.70 1.04	21 .64 .25	0 0.00 0.00	301 9.24 3.55	4.47
NW	10 .31 .12	38 1.17 .45	80 2.46 .94	80 2.46 .94	14 .43 .17	0 0.00 0.00	222 6.81 2.62	4.59
NNW	5 .15 .06	30 .92 .35	103 3.16 1.21	72 2.21 .85	0 0.00 0.00	0 0.00 0.00	210 6.45 2.48	4.36
N	10 .31 .12	62 1.90 .73	90 2.76 1.06	52 1.60 .61	6 .18 .07	0 0.00 0.00	220 6.75 2.59	3.95
CALM	5 .15 .06						5 .15 .06	CALM
TOTAL	170 5.22 2.00	844 25.91 9.95	1268 38.92 14.95	794 24.36 9.36	162 4.97 1.91	30 .92 .35	3258 100.00 38.42	4.18

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-57 (Continued) (Sheet 2 of 4)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: MAY 4, 1974 1200 TO MAY 4, 1975 1100

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	24 .95 .28	56 2.21 .66	19 .75 .22	2 .08 .02	0 0.00 0.00	0 0.00 0.00	101 3.99 1.19	2.27
NE	22 .87 .26	53 2.09 .62	5 .20 .06	2 .08 .02	0 0.00 0.00	0 0.00 0.00	82 3.24 .97	2.19
ENE	18 .71 .21	35 1.38 .41	32 1.26 .38	1 .04 .01	0 0.00 0.00	0 0.00 0.00	86 3.39 1.01	2.50
E	23 .91 .27	67 2.64 .79	68 2.69 .80	16 .63 .19	2 .08 .02	0 0.00 0.00	176 6.95 2.08	3.19
ESE	18 .71 .21	86 3.39 1.01	61 2.41 .72	14 .55 .17	0 0.00 0.00	0 0.00 0.00	179 7.06 2.11	3.14
SE	25 .99 .29	132 5.21 1.56	165 6.51 1.95	36 1.42 .42	3 .12 .04	0 0.00 0.00	361 14.25 4.25	3.42
SSE	21 .83 .25	91 3.59 1.07	136 5.37 1.60	37 1.46 .44	4 .16 .05	0 0.00 0.00	289 11.40 3.41	3.56
S	13 .51 .15	77 3.04 .91	162 6.39 1.91	59 2.33 .70	6 .24 .07	0 0.00 0.00	317 12.51 3.74	3.46
SSW	14 .55 .17	59 2.33 .70	92 3.63 1.08	29 1.14 .34	14 .55 .17	0 0.00 0.00	208 8.21 2.45	3.88
SW	13 .51 .15	40 1.58 .47	43 1.70 .51	17 .67 .20	5 .20 .06	1 .04 .01	119 4.70 1.40	3.74
WSW	11 .43 .13	30 1.18 .35	28 1.10 .33	14 .55 .17	7 .28 .08	3 .12 .04	93 3.67 1.10	4.03
W	15 .59 .18	45 1.78 .53	53 2.09 .62	13 .51 .15	8 .32 .09	3 .12 .04	137 5.41 1.62	3.59
WNW	15 .59 .18	39 1.54 .46	41 1.62 .48	14 .55 .17	5 .20 .06	2 .08 .02	116 4.58 1.37	3.61
NW	14 .55 .17	60 2.37 .71	25 .99 .29	0 0.00 0.00	1 .04 .01	0 0.00 0.00	100 3.95 1.18	2.50
NNW	7 .28 .08	42 1.66 .50	22 .87 .26	1 .04 .01	0 0.00 0.00	0 0.00 0.00	72 2.84 .85	2.74
N	24 .95 .28	43 1.70 .51	16 .63 .19	5 .20 .06	0 0.00 0.00	0 0.00 0.00	88 3.47 1.04	2.50
CALM	10 .39 .12						10 .39 .12	CALM
TOTAL	287 11.33 3.38	955 37.69 11.26	968 38.20 11.42	260 10.26 3.07	55 2.17 .65	9 .36 .11	2534 100.00 29.88	3.35

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	14 3.04 .17	9 1.96 .11	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	23 5.00 .27	1.57
NE	17 3.70 .20	9 1.96 .11	1 .22 .01	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	27 5.87 .32	1.66
ENE	8 1.74 .09	5 1.09 .06	2 .43 .02	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	15 3.26 .18	1.63
E	5 1.09 .06	3 .65 .04	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 1.74 .09	1.17
ESE	6 1.30 .07	4 .87 .05	1 .22 .01	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	11 2.39 .13	1.67
SE	8 1.74 .09	53 11.52 .62	19 4.13 .22	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	80 17.39 .94	2.55
SSE	6 1.30 .07	43 9.35 .51	8 1.74 .09	0 0.00 0.00	5 1.09 .06	0 0.00 0.00	62 13.48 .73	2.47
S	9 1.96 .11	24 5.22 .28	3 .65 .04	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	36 7.83 .42	2.21
SSW	5 1.09 .06	23 5.00 .27	7 1.52 .08	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	35 7.61 .41	2.44
SW	5 1.09 .06	20 4.35 .24	9 1.96 .11	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	34 7.39 .40	2.46
WSW	4 .87 .05	6 1.30 .07	5 1.09 .06	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	15 3.26 .18	2.37
W	6 1.30 .07	8 1.74 .09	1 .22 .01	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	15 3.26 .18	1.47
WNW	4 .87 .05	9 1.96 .11	1 .22 .01	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	14 3.04 .17	1.94
NW	7 1.52 .08	18 3.91 .21	3 .65 .04	2 .43 .02	0 0.00 0.00	0 0.00 0.00	30 6.52 .35	2.35
NNW	11 2.39 .13	15 3.26 .18	1 .22 .01	1 .22 .01	0 0.00 0.00	0 0.00 0.00	28 6.09 .33	1.96
N	16 3.48 .19	9 1.96 .11	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	25 5.43 .29	1.34
CALM	2 .43 .02						2 .43 .02	CALM
TOTAL	133 28.91 1.57	258 56.09 3.04	61 13.26 .72	3 .65 .04	5 1.09 .06	0 0.00 0.00	460 100.00 5.42	2.13

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: MAY 4, 1974 1200 TO MAY 4, 1975 1100

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	20 1.80 .24	18 1.62 .21	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	38 3.41 .45	1.56
NE	25 2.24 .29	14 1.26 .17	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	39 3.50 .46	1.39
ENE	14 1.25 .17	20 1.80 .24	0 0.00 0.00	2 .18 .02	0 0.00 0.00	0 0.00 0.00	36 3.23 .42	1.47
E	14 1.26 .17	26 2.33 .31	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	40 3.59 .47	1.78
ESE	8 .72 .09	31 2.78 .37	1 .09 .01	1 .09 .01	0 0.00 0.00	0 0.00 0.00	41 3.68 .48	2.15
SE	10 .90 .12	90 8.08 1.06	62 5.57 .73	5 .45 .06	0 0.00 0.00	0 0.00 0.00	167 14.99 1.97	2.94
SSE	15 1.35 .18	101 9.07 1.19	64 5.75 .75	3 .27 .04	0 0.00 0.00	0 0.00 0.00	183 16.43 2.16	2.43
S	8 .72 .09	51 4.58 .60	37 3.32 .44	4 .36 .05	4 .36 .05	0 0.00 0.00	104 9.34 1.23	3.07
SSW	10 .90 .12	52 4.67 .61	28 2.51 .33	6 .54 .07	4 .36 .05	0 0.00 0.00	100 8.98 1.18	3.01
SW	14 1.26 .17	44 3.95 .52	16 1.44 .19	2 .18 .02	3 .27 .04	0 0.00 0.00	79 7.09 .93	2.82
WSW	10 .90 .12	18 1.62 .21	9 .81 .11	1 .09 .01	0 0.00 0.00	0 0.00 0.00	38 3.41 .45	2.52
W	13 1.17 .15	29 2.60 .34	15 1.35 .18	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	57 5.12 .67	2.32
WNW	8 .72 .09	30 2.69 .35	4 .36 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	42 3.77 .50	2.12
NW	12 1.08 .14	34 3.05 .40	8 .72 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	54 4.85 .64	2.07
NNW	13 1.17 .15	27 2.42 .32	6 .54 .07	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	46 4.13 .54	2.03
N	18 1.62 .21	20 1.80 .24	7 .63 .08	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	45 4.04 .53	1.99
CALM	5 .45 .06						5 .45 .06	CALM
TOTAL	217 19.48 2.56	605 54.31 7.13	257 23.07 3.03	24 2.15 .28	11 .99 .13	0 0.00 0.00	1114 100.00 13.14	2.52

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	73 .86	190 2.23	134 1.57	22 .26	0 0.00	0 0.00	419 4.92	2.75
NE	70 .82	155 1.82	71 .83	11 .13	0 0.00	0 0.00	307 3.60	2.46
ENE	50 .59	119 1.40	80 .94	22 .26	0 0.00	0 0.00	271 3.18	2.49
E	55 .65	150 1.76	144 1.69	64 .75	8 .09	0 0.00	421 4.94	3.40
ESE	36 .42	178 2.09	161 1.89	78 .92	18 .21	1 .01	472 5.54	3.06
SE	57 .67	359 4.21	404 4.74	135 1.58	14 .16	0 0.00	969 11.37	3.51
SSE	59 .69	310 3.64	325 3.81	100 1.17	30 .35	0 0.00	824 9.67	3.55
S	46 .54	212 2.49	332 3.90	141 1.65	41 .48	2 .02	774 9.08	3.49
SSW	46 .54	218 2.56	258 3.03	124 1.46	50 .59	7 .08	703 8.25	4.03
SW	42 .49	168 1.97	167 1.96	56 .66	16 .19	10 .12	459 5.39	3.69
WSW	40 .47	108 1.27	112 1.31	61 .72	25 .29	13 .15	359 4.21	4.12
W	43 .50	169 1.98	205 2.41	90 1.06	43 .50	18 .21	568 6.67	4.16
WNW	41 .48	162 1.90	217 2.55	153 1.80	39 .46	3 .04	615 7.22	4.19
NW	44 .52	169 1.98	166 1.95	99 1.16	19 .22	0 0.00	497 5.83	3.72
NNW	36 .42	125 1.47	171 2.01	91 1.07	1 .01	0 0.00	424 4.98	3.65
N	68 .80	145 1.70	135 1.58	62 .73	6 .07	0 0.00	416 4.88	3.24
CALM	22 .26						22 .26	CALM
TOTAL	828 9.72	2937 34.47	3082 36.17	1309 15.36	310 3.64	54 .63	8520 100.00	3.43

NUMBER OF VALID OBSERVATIONS 8520 97.26 PCT.
NUMBER OF INVALID OBSERVATIONS 240 2.74 PCT.
TOTAL NUMBER OF OBSERVATIONS 8760 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-57 (Continued) (Sheet 3 of 4)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: MAY 4, 1974 1200 TO MAY 4, 1975 1100

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79, 11.54.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-043-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0	2	4	3	0	0	9	3.44
	0.00	.77	1.53	1.15	0.00	0.00	3.45	
	0.00	.03	.05	.04	0.00	0.00	.11	
NE	0	1	1	0	0	0	2	3.10
	0.00	.38	.38	0.00	0.00	0.00	.77	
	0.00	.01	.01	0.00	0.00	0.00	.03	
ENE	0	1	1	3	0	0	5	4.72
	0.00	.38	.38	1.15	0.00	0.00	1.92	
	0.00	.01	.01	.04	0.00	0.00	.06	
E	0	0	1	5	1	1	8	5.77
	0.00	0.00	.38	1.92	.38	.38	3.07	
	0.00	0.00	.01	.06	.01	.01	.10	
ESE	0	1	3	6	1	1	12	5.42
	0.00	.38	1.15	2.30	.38	.38	4.60	
	0.00	.01	.04	.08	.01	.01	.15	
SE	0	0	2	2	0	0	4	4.47
	0.00	0.00	.77	.77	0.00	0.00	1.53	
	0.00	0.00	.03	.03	0.00	0.00	.05	
SSE	0	2	4	1	2	1	10	5.39
	0.00	.77	1.53	.38	.77	.38	3.83	
	0.00	.03	.05	.01	.03	.01	.13	
S	0	0	6	4	0	0	10	4.47
	0.00	0.00	2.30	1.53	0.00	0.00	3.83	
	0.00	0.00	.08	.05	0.00	0.00	.13	
SSW	0	3	7	4	0	0	14	4.10
	0.00	1.15	2.68	1.53	0.00	0.00	5.36	
	0.00	.04	.09	.05	0.00	0.00	.18	
SW	0	6	12	4	1	0	23	4.25
	0.00	2.30	4.60	1.53	.38	0.00	8.81	
	0.00	.08	.15	.05	.01	0.00	.29	
WSW	1	3	11	2	2	0	19	4.54
	.38	1.15	4.21	.77	.77	0.00	7.28	
	.01	.04	.14	.03	.03	0.00	.24	
W	0	6	22	12	12	14	66	6.49
	0.00	2.30	8.43	4.60	4.60	5.36	25.29	
	0.00	.08	.28	.15	.15	.18	.84	
WNW	0	3	10	16	8	4	41	6.48
	0.00	1.15	3.83	6.13	3.07	1.53	15.71	
	0.00	.04	.13	.20	.10	.05	.52	
NW	0	2	6	9	3	0	20	5.49
	0.00	.77	2.30	3.45	1.15	0.00	7.66	
	0.00	.03	.08	.11	.04	0.00	.25	
NNW	0	0	10	2	0	0	12	4.50
	0.00	0.00	3.83	.77	0.00	0.00	4.60	
	0.00	0.00	.13	.03	0.00	0.00	.15	
N	0	1	2	3	0	0	6	4.77
	0.00	.38	.77	1.15	0.00	0.00	2.30	
	0.00	.01	.03	.04	0.00	0.00	.08	
CALM	0						0	CALM
	0.00						0.00	
	0.00						0.00	
TOTAL	1	31	102	76	31	21	261	5.61
	.38	11.88	39.08	29.12	11.88	8.05	100.00	
	.01	.40	1.30	.97	.38	.27	3.33	

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: MAY 4, 1974 1200 TO MAY 4, 1975 1100

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79, 11.54.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-043-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ENE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
E	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ESE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SSE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
S	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
W	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WNW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NNW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CALM	0						0	CALM
	0.00						0.00	
	0.00						0.00	
TOTAL	7	54	135	76	23	14	309	4.44
	2.27	17.48	43.69	24.60	7.44	4.53	100.00	
	.09	.69	1.72	.97	.29	.18	3.94	

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79, 11.54.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-043-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	1	6	12	1	0	0	20	3.63
	.22	1.31	2.62	.22	0.00	0.00	4.37	
	.01	.08	.15	.01	0.00	0.00	.25	
NE	0	5	5	1	0	0	11	3.66
	0.00	1.09	1.09	.22	0.00	0.00	2.40	
	0.00	.06	.06	.01	0.00	0.00	.14	
ENE	0	3	5	2	0	0	10	3.65
	0.00	.66	1.09	.44	0.00	0.00	2.18	
	0.00	.04	.06	.03	0.00	0.00	.13	
E	0	6	3	1	1	0	11	3.61
	0.00	1.31	.66	.22	.22	0.00	2.40	
	0.00	.08	.04	.01	.01	0.00	.14	
ESE	0	4	15	8	2	1	30	4.45
	0.00	.87	3.28	1.75	.44	.22	6.55	
	0.00	.05	.19	.10	.03	.01	.38	
SE	0	4	13	5	0	1	23	4.25
	0.00	.87	2.84	1.09	0.00	.22	5.02	
	0.00	.05	.17	.06	0.00	.01	.29	
SSE	1	8	11	3	4	0	27	4.49
	.22	1.75	2.40	.66	.87	0.00	5.90	
	.01	.10	.14	.04	.05	0.00	.34	
S	2	11	17	6	6	0	42	4.51
	.44	2.40	3.71	1.31	1.31	0.00	9.17	
	.03	.14	.22	.08	.08	0.00	.53	
SSW	2	5	19	15	9	0	50	5.26
	.44	1.09	4.15	3.28	1.97	0.00	10.92	
	.03	.06	.24	.19	.11	0.00	.63	
SW	1	7	13	12	3	0	36	4.78
	.22	1.53	2.84	2.62	.66	0.00	7.86	
	.01	.09	.17	.15	.04	0.00	.46	
WSW	0	4	12	3	1	3	23	5.41
	0.00	.87	2.62	.66	.22	.66	5.02	
	0.00	.05	.15	.04	.01	.04	.29	
W	1	11	17	6	4	7	46	5.58
	.22	2.40	3.71	1.31	.87	1.53	10.04	
	.01	.14	.22	.08	.05	.09	.58	
WNW	0	11	11	9	11	3	45	5.72
	0.00	2.40	2.40	1.97	2.40	.65	9.83	
	0.00	.14	.14	.11	.14	.04	.57	
NW	0	4	12	15	9	3	43	6.25
	0.00	.87	2.62	3.28	1.97	.66	9.39	
	0.00	.05	.15	.19	.11	.04	.55	
NNW	0	5	9	9	4	0	27	5.31
	0.00	1.09	1.97	1.97	.87	0.00	5.90	
	0.00	.06	.11	.11	.05	0.00	.34	
N	0	1	9	4	0	0	14	4.27
	0.00	.22	1.97	.87	0.00	0.00	3.06	
	0.00	.01	.11	.05	0.00	0.00	.18	
CALM	0						0	CALM
	0.00						0.00	
	0.00						0.00	
TOTAL	8	95	181	100	54	18	458	5.01
	1.75	20.74	39.52	21.83	11.79	3.93	100.00	
	.10	1.21	2.33	1.27	.69	.23	5.84	

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79, 11.54.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-043-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	4	44	93	45	3	0	189	4.12
	.13	1.45	3.06	1.48	.10	0.00	6.22	
	.05	.56	1.18	.57	.04	0.00	2.41	
NE	6	43	79	16	2	1	147	3.71
	.20	1.41	2.60	.53	.07	.03	4.83	
	.08	.55	1.01	.20	.03	.01	1.87	
ENE	10	23	41	14	1	0	[illegible]	3.53
	.33	.76	1.35	.46	.03	0.00	[illegible]	
	.13	.29	.52	.18	.01	0.00	1.13	
E	2	33	40	32	4	1	112	4.33
	.07	1.08	1.31	1.05	.13	.03	3.68	
	.03	.42	.51	.41	.05	.01	1.43	
ESE	5	28	72	72	31	10	[illegible]	5.44
	.16	.92	2.37	2.37	1.02	.33	7.17	
	.06	.36	.92	.92	.40	.13	2.78	
SE	7	21	73	61	32	2	[illegible]	5.22
	.23	.69	2.40	2.01	1.05	.07	6.44	
	.09	.27	.93	.78	.41	.03	2.50	
SSE	7	33	78	74	32	4	233	5.12
	.23	1.09	2.56	2.43	1.05	.13	7.66	
	.09	.42	.99	.94	.41	.05	2.97	
S	11	27	67	67	45	13	230	5.42
	.36	.89	2.20	2.20	1.48	.43	7.56	
	.14	.34	.85	.85	.57	.17	2.93	
SSW	6	38	72	75	32	13	236	5.51
	.20	1.25	2.37	2.47	1.05	.43	7.76	
	.08	.48	.92	.96	.41	.17	3.01	
SW	4	33	65	48	25	13	[illegible]	[illegible]
	.13	1.08	2.14	1.58	.82	.43	6.18	
	.05	.42	.83	.61	.32	.17	2.40	
WSW	4	22	28	25	23	21	123	6.51
	.13	.72	.92	.82	.76	.69	4.04	
	.05	.28	.36	.32	.29	.27	1.57	
W	6	19	47	58	27	15	172	6.12
	.20	.62	1.55	1.91	.89	.49	5.65	
	.08	.24	.60	.74	.34	.19	2.19	
WNW	9	17	56	114	61	35	292	6.55
	.30	.56	1.84	3.75	2.01	1.15	9.60	
	.11	.22	.71	1.45	.78	.45	3.72	
NW	7	24	50	67	64	16	234	6.11
	.23	.79	1.64	2.20	2.10	.53	7.69	
	.09	.31	.64	.85	.82	.20	2.98	
NNW	4	18	48	[illegible]	38	1	200	[illegible]
	.13	.59	1.58	2.49	1.25	.03	6.57	
	.05	.23	.61	.97	.48	.01	2.55	
N	3	25	51	71	25	2	177	5.35
	.10	.82	1.68	2.33	.82	.07	5.82	
	.04	.32	.65	.91	.32	.03	2.26	
CALM	6						6	CALM
	.20						.20	
	.08						.08	
TOTAL	101	448	966	915	445	147	3042	5.41
	3.32	14.73	31.76	30.08	14.63	4.83	100.00	
	1.29	5.71	12.31	11.66	5.67	1.87	38.78	

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-57 (Continued) (Sheet 4 of 4)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: MAY 4, 1974 1200 TO MAY 4, 1975 1100

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79, 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ENE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
E	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ESE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SSE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
S	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
W	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WNW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NNW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CALM	11 1.08 .14						11 1.08 .14	CALM
TOTAL	41 4.01 .52	93 9.10 1.19	354 34.64 4.51	457 44.72 5.83	76 7.44 .97	1 .10 .01	1022 100.00 13.03	5.02

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79, 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	2 .50 .03	4 1.99 .10	11 2.73 .14	1 .25 .01	0 0.00 0.00	0 0.00 0.00	22 5.46 .28	3.18
NE	1 .25 .01	5 1.24 .06	10 2.48 .13	7 1.74 .09	0 0.00 0.00	0 0.00 0.00	23 5.71 .29	3.43
ENE	0 0.00 0.00	1 .25 .01	8 1.99 .10	5 1.24 .06	1 .25 .01	0 0.00 0.00	15 3.72 .19	4.07
E	6 1.49 .08	10 2.48 .13	7 1.74 .09	7 1.74 .09	0 0.00 0.00	0 0.00 0.00	30 7.44 .38	3.43
ESE	4 .99 .05	7 1.74 .09	15 3.72 .19	2 .50 .03	0 0.00 0.00	0 0.00 0.00	28 6.95 .36	3.26
SE	1 .25 .01	1 .25 .01	10 2.48 .13	7 1.74 .09	0 0.00 0.00	0 0.00 0.00	19 4.71 .24	4.41
SSE	0 0.00 0.00	3 .74 .04	11 2.73 .14	13 3.23 .17	0 0.00 0.00	0 0.00 0.00	27 6.70 .34	4.47
S	1 .25 .01	1 .25 .01	22 5.46 .28	20 4.96 .25	1 .25 .01	0 0.00 0.00	45 11.17 .57	4.41
SSW	2 .50 .03	8 1.99 .10	17 4.22 .22	13 3.23 .17	1 .25 .01	0 0.00 0.00	41 10.17 .52	4.43
SW	0 0.00 0.00	6 1.49 .08	17 4.22 .22	21 5.21 .27	5 1.24 .06	0 0.00 0.00	49 12.15 .62	5.13
WSW	0 0.00 0.00	4 .99 .05	2 .50 .03	15 3.72 .19	5 1.24 .06	0 0.00 0.00	27 6.70 .34	5.19
W	2 .50 .03	0 0.00 0.00	4 .99 .05	10 2.48 .13	2 .50 .03	0 0.00 0.00	18 4.47 .23	5.40
WNW	1 .25 .01	0 0.00 0.00	2 .50 .03	2 .50 .03	3 .74 .04	0 0.00 0.00	8 1.99 .10	5.44
NW	1 .25 .01	3 .74 .04	2 .50 .03	7 1.74 .09	0 0.00 0.00	0 0.00 0.00	13 3.23 .17	4.59
NNW	0 0.00 0.00	1 .25 .01	5 1.24 .06	6 1.49 .08	0 0.00 0.00	0 0.00 0.00	14 3.47 .18	5.22
N	2 .50 .03	0 0.00 0.00	4 .99 .05	9 2.23 .11	0 0.00 0.00	0 0.00 0.00	15 3.72 .19	4.45
CALM	9 2.23 .11						9 2.23 .11	CALM
TOTAL	32 7.94 .41	58 14.39 .74	147 36.48 1.87	144 35.73 1.84	18 4.47 .23	0 0.00 0.00	403 100.00 5.14	4.64

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: MAY 4, 1974 1200 TO MAY 4, 1975 1100

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79, 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	2 .09 .03	24 1.02 .31	32 1.36 .41	19 .81 .24	0 0.00 0.00	0 0.00 0.00	77 3.28 .98	3.93
NE	2 .09 .03	13 .55 .17	46 1.96 .59	12 .51 .15	2 .09 .03	0 0.00 0.00	75 3.19 .96	3.98
ENE	3 .13 .04	13 .55 .17	45 1.91 .57	15 .64 .19	1 .04 .01	0 0.00 0.00	77 3.28 .98	4.17
E	5 .21 .06	14 .60 .18	49 2.09 .62	63 2.68 .80	2 .09 .03	1 .04 .01	134 5.70 1.71	4.41
ESE	5 .21 .06	12 .51 .15	66 2.81 .84	72 3.06 .92	10 .43 .13	1 .04 .01	166 7.06 2.12	5.05
SE	5 .21 .06	19 .81 .24	81 3.45 1.03	137 5.83 1.75	24 1.02 .31	0 0.00 0.00	266 11.32 3.39	5.40
SSE	4 .17 .05	16 .68 .20	76 3.23 .97	126 5.36 1.61	37 1.57 .47	0 0.00 0.00	259 11.02 3.30	5.58
S	7 .30 .09	12 .51 .15	56 2.38 .71	162 6.89 2.07	37 1.57 .47	3 .13 .04	277 11.79 3.53	5.61
SSW	4 .17 .05	13 .55 .17	62 2.64 .79	142 6.04 1.81	36 1.53 .46	7 .30 .09	264 11.23 3.37	5.42
SW	4 .17 .05	6 .26 .08	45 1.91 .57	72 3.06 .92	34 1.45 .43	5 .21 .06	166 7.06 2.12	6.06
WSW	2 .09 .03	11 .47 .14	37 1.57 .47	38 1.62 .48	23 .98 .29	10 .43 .13	121 5.15 1.54	6.19
W	3 .13 .04	9 .38 .11	29 1.23 .37	34 1.45 .43	20 .85 .25	3 .13 .04	98 4.17 1.25	5.74
WNW	2 .09 .03	13 .55 .17	23 .98 .29	64 2.72 .82	27 1.15 .34	17 .72 .22	146 6.21 1.86	6.75
NW	6 .26 .08	12 .51 .15	22 .94 .28	46 1.96 .59	2 .09 .03	0 0.00 0.00	88 3.74 1.12	4.41
NNW	0 0.00 0.00	8 .34 .10	19 .81 .24	27 1.15 .34	1 .04 .01	0 0.00 0.00	55 2.34 .70	4.43
N	1 .04 .01	11 .47 .14	39 1.66 .50	15 .64 .19	4 .17 .05	0 0.00 0.00	70 2.98 .89	4.69
CALM	11 .47 .14						11 .47 .14	CALM
TOTAL	66 2.81 .84	206 8.77 2.63	727 30.94 9.27	1044 44.43 13.31	260 11.06 3.31	47 2.00 .60	2350 100.00 29.96	5.45

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79, 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	11 .14	95 1.20	179 2.27	84 1.06	3 .04	0 0.00	375 4.75	3.46
NE	11 .14	76 .96	153 1.94	43 .54	4 .05	1 .01	288 3.65	3.79
ENE	15 .19	46 .58	117 1.48	50 .63	3 .04	0 0.00	231 2.93	3.46
E	16 .20	75 .95	125 1.58	123 1.56	8 .10	3 .04	350 4.43	4.40
ESE	15 .19	62 .79	201 2.55	180 2.28	47 .60	13 .16	518 6.56	5.05
SE	16 .20	61 .77	214 2.71	257 3.26	58 .73	3 .04	609 7.72	5.14
SSE	13 .16	68 .86	246 3.12	283 3.59	86 1.09	6 .08	702 8.89	5.27
S	24 .30	57 .72	227 2.88	307 3.89	93 1.18	17 .22	725 9.19	5.44
SSW	20 .25	92 1.17	243 3.08	326 4.13	95 1.20	20 .25	786 [illegible]	5.45
SW	13 .16	68 .86	199 2.52	215 2.72	88 1.11	19 .24	603 7.64	5.50
WSW	8 .10	56 .71	115 1.46	120 1.52	67 .85	35 .44	401 5.08	6.01
W	13 .16	59 .75	138 1.75	152 1.93	75 .95	42 .53	479 6.07	5.94
WNW	12 .15	55 .70	124 1.57	216 2.74	124 1.58	67 .85	619 7.84	6.02
NW	15 .19	51 .65	120 1.52	196 2.48	80 1.01	20 .25	482 6.11	5.73
NNW	5 .06	35 .44	112 1.42	154 1.95	44 .56	3 .04	353 4.47	5.36
N	8 .10	42 .53	125 1.58	127 1.61	31 .39	2 .03	335 4.24	5.05
CALM	37 .47						37 .47	CALM
TOTAL	255 3.24	989 12.53	2634 33.42	2868 36.34	907 11.49	244 3.15	7893 100.00	5.24

NUMBER OF VALID OBSERVATIONS 7893 90.10 PCT.
NUMBER OF INVALID OBSERVATIONS 867 9.90 PCT.
TOTAL NUMBER OF OBSERVATIONS 8760 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-58 JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS (DATA PERIOD: MARCH 16, 1978 TO MARCH 16, 1979)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: MARCH 16, 1978 1700 TO MARCH 16, 1979 1600

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79, 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
JAMES AND MOORE JOB NO: 7677-043-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	1 .55 .01	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .55 .01	2.21
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	1 .55 .01	0 0.00 0.00	2 1.10 .03	0 0.00 0.00	0 0.00 0.00	3 1.65 .04	4.47
E	0 0.00 0.00	0 0.00 0.00	2 1.10 .03	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.10 .03	3.45
ESE	0 0.00 0.00	0 0.00 0.00	1 .55 .01	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .55 .01	4.03
SE	0 0.00 0.00	1 .55 .01	12 6.59 .15	4 2.20 .05	0 0.00 0.00	0 0.00 0.00	17 9.34 .21	4.43
SSE	0 0.00 0.00	5 2.75 .06	1 .55 .01	3 1.65 .04	0 0.00 0.00	0 0.00 0.00	9 4.95 .11	3.61
S	0 0.00 0.00	5 2.75 .06	8 4.40 .10	2 1.10 .03	0 0.00 0.00	0 0.00 0.00	15 8.24 .19	3.44
SSW	1 .55 .01	7 3.85 .09	10 5.49 .13	14 7.69 .18	3 1.65 .04	0 0.00 0.00	35 19.23 .44	4.44
SW	2 1.10 .03	4 2.20 .05	15 8.24 .19	7 3.85 .09	0 0.00 0.00	0 0.00 0.00	28 15.38 .35	4.00
WSW	3 1.65 .04	3 1.65 .04	3 1.65 .04	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 4.95 .11	2.97
W	5 2.75 .06	3 1.65 [illegible]	7 3.85 [illegible]	[illegible] 3.45 [illegible]	1 .55 [illegible]	[illegible] 0.00 [illegible]	23 12.64 [illegible]	3.99
WNW	1 .55 .01	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5.13
NW	0 0.00 0.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NNW	0 0.00 0.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N	0 0.00 0.00	[illegible]	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	[illegible]	[illegible]
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	[illegible] 6.59 .15	[illegible] 18.13 .41	[illegible] 43.41 [illegible]	[illegible] 26.92 [illegible]	[illegible] 4.95 .11	0 0.00 0.00	[illegible] 100.00 [illegible]	4.12

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: MARCH 16, 1978 1700 TO MARCH 16, 1979 1600

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79, 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
JAMES AND MOORE JOB NO: 7677-043-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	5 2.75 .06	1 .55 .01	1 .55 .01	0 0.00 0.00	0 0.00 0.00	7 3.85 .09	2.41
E	0 0.00 0.00	0 0.00 0.00	1 .55 .01	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .55 .01	3.46
ESE	0 0.00 0.00	1 .55 .01	3 1.65 .04	1 .55 .01	0 0.00 0.00	0 0.00 0.00	5 2.75 .06	4.12
SE	0 0.00 0.00	5 2.75 .06	6 3.30 .08	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	11 6.04 .14	3.52
SSE	0 0.00 0.00	1 .55 .01	4 2.20 .05	1 .55 .01	1 .55 .01	0 0.00 0.00	7 3.85 .09	4.17
S	1 .55 .01	6 3.30 .08	12 6.59 .15	6 3.30 .08	0 0.00 0.00	0 0.00 0.00	25 13.74 .31	3.92
SSW	3 1.65 .04	8 4.40 .10	12 6.59 .15	10 5.49 .13	0 0.00 0.00	0 0.00 0.00	33 18.13 .41	3.95
SW	4 2.20 .05	7 3.85 .09	2 1.10 .03	5 2.75 .06	1 .55 .01	0 0.00 0.00	19 10.44 .24	3.43
WSW	1 .55 .01	2 1.10 .03	4 2.20 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 3.85 .09	3.45
W	1 .55 .01	6 3.30 .08	8 4.40 .10	7 3.85 .09	3 1.65 .04	0 0.00 0.00	25 13.74 .31	4.44
WNW	2 1.10 .03	2 1.10 .03	5 2.75 .06	4 2.20 .05	2 1.10 .03	0 0.00 0.00	15 8.24 .19	4.29
NW	0 0.00 0.00	3 1.65 .04	3 1.65 .04	7 3.85 .09	1 .55 .01	0 0.00 0.00	14 7.69 .18	5.40
NNW	1 .55 .01	2 1.10 .03	3 1.65 .04	3 1.65 .04	1 .55 .01	0 0.00 0.00	10 5.49 .13	4.51
N	0 0.00 0.00	2 1.10 .03	1 .55 .01	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 1.65 .04	2.97
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	13 7.14 .16	50 27.47 .63	65 35.71 .81	45 24.73 .56	9 4.95 .11	0 0.00 0.00	182 100.00 2.28	4.05

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79, 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
JAMES AND MOORE JOB NO: 7677-043-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.47
NE	0 0.00 0.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ENE	0 0.00 0.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
E	0 0.00 0.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ESE	0 0.00 0.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.52
SE	0 0.00 0.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SSE	0 0.00 0.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
S	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.14
SW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.79
WSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
W	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WNW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NW	0 0.00 0.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NNW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CALM	0 0.00 0.00						[illegible]	CALM
TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] 100.00 [illegible]	[illegible]

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79, 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
JAMES AND MOORE JOB NO: 7677-043-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	17 [illegible] .21	110 [illegible] 1.38	66 2.[illegible] .83	13 .41 .16	0 0.00 0.00	0 0.00 0.00	206 6.[illegible] [illegible]	2.49
NE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.14
ENE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.39
E	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.42
ESE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.79
SSE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.32
S	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.14
W	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.33
WNW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.73
NW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NNW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] 100.00 [illegible]	[illegible]

KEY: XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-58 (Continued) (Sheet 2 of 6)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: MARCH 15, 1978 1700 TO MARCH 15, 1979 1600

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	22 .87 .28	30 1.19 .38	2 .08 .03	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	54 2.15 .68	1.44
NE	25 .99 .31	46 1.83 .58	14 .56 .18	1 .04 .01	10 .40 .13	0 0.00 0.00	96 3.82 1.20	2.44
ENE	17 .68 .21	37 1.47 .46	33 1.31 .41	9 .36 .11	0 0.00 0.00	0 0.00 0.00	96 3.82 1.20	2.44
E	19 .76 .24	76 3.02 .95	56 2.23 .70	19 .76 .24	2 .08 .03	0 0.00 0.00	172 6.84 2.15	3.12
ESE	25 .99 .31	82 3.26 1.03	60 2.39 .75	6 .24 .08	0 0.00 0.00	0 0.00 0.00	173 6.88 2.17	2.79
SE	21 .83 .26	159 6.32 1.99	134 5.33 1.68	14 .56 .18	0 0.00 0.00	0 0.00 0.00	328 13.04 4.11	2.94
SSE	18 .72 .23	100 3.98 1.25	128 5.09 1.60	13 .52 .16	0 0.00 0.00	0 0.00 0.00	259 10.30 3.24	3.18
S	16 .64 .20	109 4.33 1.36	220 8.75 2.75	33 1.31 .41	2 .08 .03	0 0.00 0.00	380 15.11 4.75	3.51
SSW	6 .24 .08	36 1.43 .45	98 3.90 1.23	21 .83 .26	2 .08 .03	0 0.00 0.00	163 6.48 2.04	3.75
SW	6 .24 .08	54 2.15 .68	43 1.71 .54	17 .68 .21	0 0.00 0.00	0 0.00 0.00	120 4.77 1.50	3.36
WSW	12 .48 .15	41 1.63 .51	28 1.11 .35	7 .28 .09	1 .04 .01	0 0.00 0.00	89 3.54 1.11	3.00
W	17 .68 .21	64 2.54 .80	57 2.27 .71	8 .32 .10	3 .12 .04	0 0.00 0.00	149 5.92 1.86	3.42
WNW	14 .56 .18	49 1.95 .61	43 1.71 .54	16 .64 .20	0 0.00 0.00	0 0.00 0.00	122 4.85 1.53	3.11
NW	11 .44 .14	42 1.67 .53	47 1.87 .59	2 .08 .03	2 .08 .03	0 0.00 0.00	104 4.14 1.30	3.02
NNW	10 .40 .13	43 1.71 .54	24 .95 .30	3 .12 .04	1 .04 .01	0 0.00 0.00	81 3.22 1.01	2.72
N	20 .80 .25	82 3.26 1.03	20 .80 .25	1 .04 .01	0 0.00 0.00	0 0.00 0.00	123 4.89 1.54	2.37
CALM	6 .24 .08						6 .24 .08	CALM
TOTAL	265 10.54 3.32	1050 41.75 13.14	1007 40.04 12.60	170 6.76 2.13	23 .91 .29	0 0.00 0.00	2515 100.00 31.49	3.07

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	18 4.52 .23	5 1.26 .06	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	23 5.78 .29	1.13
NE	21 5.28 .26	3 .75 .04	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	24 6.03 .30	1.12
ENE	8 2.01 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 2.01 .10	1.01
E	6 1.51 .08	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 1.51 .08	.95
ESE	7 1.76 .09	2 .50 .03	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 2.26 .11	1.14
SE	6 1.51 .08	48 12.06 .60	22 5.53 .28	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	76 19.10 .95	2.41
SSE	11 2.76 .14	42 10.55 .53	27 6.78 .34	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	80 20.10 1.00	2.48
S	4 1.01 .05	20 5.03 .25	4 1.01 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	28 7.04 .35	2.37
SSW	9 2.26 .11	11 2.76 .14	4 1.01 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	24 6.03 .30	1.93
SW	9 2.26 .11	10 2.51 .13	6 1.51 .08	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	25 6.28 .31	2.10
WSW	2 .50 .03	1 .25 .01	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 .75 .04	1.20
W	11 2.76 .14	3 .75 .04	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	14 3.52 .18	1.11
WNW	11 2.76 .14	7 1.76 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	18 4.52 .23	1.35
NW	2 .50 .03	2 .50 .03	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 1.01 .05	1.47
NNW	13 3.27 .16	13 3.27 .16	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	26 6.53 .33	1.46
N	10 2.51 .13	14 3.52 .18	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	24 6.03 .30	1.65
CALM	6 1.51 .08						6 1.51 .08	CALM
TOTAL	154 38.69 1.93	181 45.48 2.27	63 15.83 .79	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	398 100.00 4.98	1.90

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: MARCH 15, 1978 1700 TO MARCH 15, 1979 1600

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	17 1.35 .21	31 2.46 .39	2 .16 .03	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	50 3.97 .63	1.79
NE	28 2.22 .35	20 1.59 .25	1 .08 .01	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	49 3.89 .61	1.36
ENE	22 1.74 .28	11 .87 .14	3 .24 .04	1 .08 .01	0 0.00 0.00	0 0.00 0.00	37 2.93 .46	1.67
E	25 1.98 .31	22 1.74 .28	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	47 3.73 .59	1.47
ESE	17 1.35 .21	36 2.85 .45	5 .40 .06	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	58 4.60 .73	1.49
SE	30 2.38 .38	130 10.31 1.63	58 4.60 .73	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	218 17.29 2.73	2.42
SSE	21 1.67 .26	146 11.58 1.83	75 5.95 .94	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	242 19.19 3.03	2.54
S	11 .87 .14	98 7.77 1.23	54 4.28 .68	1 .08 .01	0 0.00 0.00	0 0.00 0.00	164 13.01 2.05	2.67
SSW	8 .63 .10	22 1.74 .28	37 2.93 .46	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	67 5.31 .84	2.90
SW	12 .95 .15	36 2.85 .45	27 2.14 .34	2 .16 .03	0 0.00 0.00	0 0.00 0.00	77 6.11 .96	2.82
WSW	12 .95 .15	16 1.27 .20	3 .24 .04	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	31 2.46 .39	1.84
W	19 1.51 .24	23 1.82 .29	4 .32 .05	2 .16 .03	2 .16 .03	0 0.00 0.00	50 3.97 .63	2.24
WNW	7 .56 .09	24 1.90 .30	5 .40 .06	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	36 2.85 .45	2.11
NW	5 .40 .06	43 3.41 .54	3 .24 .04	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	51 4.04 .64	2.19
NNW	14 1.11 .18	18 1.43 .23	1 .08 .01	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	33 2.62 .41	1.76
N	14 1.11 .18	25 1.98 .31	5 .40 .06	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	44 3.49 .55	1.93
CALM	7 .56 .09						7 .56 .09	CALM
TOTAL	269 21.33 3.37	701 55.59 8.77	283 22.44 3.54	6 .48 .08	2 .16 .03	0 0.00 0.00	1261 100.00 15.78	2.29

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 11.54.15.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	75 .89	184 2.19	74 .88	14 .17	0 0.00	0 0.00	347 4.13	2.48
NE	95 1.13	175 2.08	106 1.26	25 .30	11 .13	0 0.00	412 4.91	2.76
ENE	57 .68	111 1.32	103 1.23	36 .43	0 0.00	0 0.00	307 3.66	2.99
E	59 .70	161 1.92	138 1.64	40 .48	3 .04	0 0.00	401 4.77	3.05
ESE	59 .70	191 2.27	189 2.25	32 .38	0 0.00	0 0.00	471 5.61	3.00
SE	66 .79	418 4.98	412 4.91	60 .71	1 .01	0 0.00	957 11.39	[illegible]
SSE	63 .75	367 4.37	328 3.91	39 .46	2 .02	0 0.00	799 9.51	2.98
S	47 .56	341 4.06	399 4.75	107 1.27	8 .10	0 0.00	902 10.74	3.41
SSW	39 .46	150 1.79	259 3.08	89 1.06	13 .15	0 0.00	550 6.55	3.69
SW	44 .52	150 1.79	181 2.15	78 .93	14 .17	0 0.00	467 5.56	3.61
WSW	42 .50	104 1.24	96 1.14	45 .54	8 .10	0 0.00	295 3.51	3.40
W	64 .76	158 1.88	204 2.43	86 1.02	26 .31	1 .01	539 6.42	3.62
WNW	52 .62	130 1.55	163 1.94	140 1.67	29 .35	6 .07	520 6.19	4.10
NW	30 .36	144 1.71	220 2.62	120 1.43	16 .19	3 .04	533 6.35	3.94
NNW	56 .67	137 1.63	163 1.94	53 .63	17 .20	0 0.00	426 5.07	3.43
N	61 .73	203 2.42	152 1.81	35 .42	3 .04	0 0.00	454 5.41	2.97
CALM	19 .23						19 .23	CALM
TOTAL	928 11.05	3124 37.19	3187 37.94	999 11.89	151 1.80	[illegible] .12	8399 100.00	3.31

NUMBER OF VALID OBSERVATIONS 8399 95.88 PCT.
NUMBER OF INVALID OBSERVATIONS 361 4.12 PCT.
TOTAL NUMBER OF OBSERVATIONS 8760 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-58 (Continued) (Sheet 3 of 6)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: MARCH 16, 1978 1700 TO MARCH 16, 1979 1600

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79, 13.41.43.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0	0	0	0	0	0	0	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
NE	0	1	0	0	0	0	1	2.77
	0.00	.54	0.00	0.00	0.00	0.00	.54	
	0.00	.01	0.00	0.00	0.00	0.00	.01	
ENE	0	0	0	2	0	0	2	6.35
	0.00	0.00	0.00	1.09	0.00	0.00	1.09	
	0.00	0.00	0.00	.03	0.00	0.00	.03	
E	0	0	2	0	0	0	2	3.44
	0.00	0.00	1.09	0.00	0.00	0.00	1.09	
	0.00	0.00	.03	0.00	0.00	0.00	.03	
ESE	0	0	2	0	0	0	2	4.15
	0.00	0.00	1.09	0.00	0.00	0.00	1.09	
	0.00	0.00	.03	0.00	0.00	0.00	.03	
SE	0	1	8	6	0	0	15	5.21
	0.00	.54	4.35	3.26	0.00	0.00	8.15	
	0.00	.01	.11	.08	0.00	0.00	.20	
SSE	0	5	2	3	0	0	10	4.18
	0.00	2.72	1.09	1.63	0.00	0.00	5.43	
	0.00	.07	.03	.04	0.00	0.00	.13	
S	0	4	11	6	6	0	27	5.12
	0.00	2.17	5.98	3.26	3.26	0.00	14.67	
	0.00	.05	.15	.08	.08	0.00	.35	
SSW	1	4	12	14	7	2	40	5.59
	.54	2.17	6.52	7.61	3.80	1.09	21.74	
	.01	.05	.16	.18	.09	.03	.53	
SW	1	5	4	2	1	0	13	3.42
	.54	2.72	2.17	1.09	.54	0.00	7.07	
	.01	.07	.05	.03	.01	0.00	.17	
WSW	0	7	1	2	0	0	10	2.90
	0.00	3.80	.54	1.09	0.00	0.00	5.43	
	0.00	.09	.01	.03	0.00	0.00	.13	
W	3	2	4	5	6	1	21	5.84
	1.63	1.09	2.17	2.72	3.26	.54	11.41	
	.04	.03	.05	.07	.08	.01	.28	
WNW	0	1	2	9	8	1	21	6.49
	0.00	.54	1.09	4.89	4.35	.54	11.41	
	0.00	.01	.03	.12	.11	.01	.28	
NW	0	2	2	9	1	2	16	6.11
	0.00	1.09	1.09	4.89	.54	1.09	8.70	
	0.00	.03	.03	.12	.01	.03	.21	
NNW	0	0	0	2	0	0	2	5.45
	0.00	0.00	0.00	1.09	0.00	0.00	1.09	
	0.00	0.00	0.00	.03	0.00	0.00	.03	
N	0	2	0	0	0	0	2	2.70
	0.00	1.09	0.00	0.00	0.00	0.00	1.09	
	0.00	.03	0.00	0.00	0.00	0.00	.03	
CALM	0						0	CALM
	0.00						0.00	
	0.00						0.00	
TOTAL	5	36	50	60	26	4	184	5.24
	2.72	19.57	27.17	32.61	14.13	3.26	100.00	
	.07	.45	.66	.79	.38	.09	2.42	

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: MARCH 16, 1978 1700 TO MARCH 16, 1979 1600

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79, 13.41.43.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0	0	0	0	0	0	0	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
NE	0	0	0	0	0	0	0	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
ENE	0	3	2	0	0	0	5	3.14
	0.00	1.62	1.08	0.00	0.00	0.00	2.70	
	0.00	.04	.03	0.00	0.00	0.00	.07	
E	0	0	4	0	0	0	4	3.45
	0.00	0.00	2.16	0.00	0.00	0.00	2.16	
	0.00	0.00	.05	0.00	0.00	0.00	.05	
ESE	0	0	0	0	1	0	1	8.00
	0.00	0.00	0.00	0.00	.54	0.00	.54	
	0.00	0.00	0.00	0.00	.01	0.00	.01	
SE	0	1	11	2	0	0	14	3.94
	0.00	.54	5.95	1.08	0.00	0.00	7.57	
	0.00	.01	.14	.03	0.00	0.00	.18	
SSE	0	2	1	5	0	0	8	5.11
	0.00	1.08	.54	2.70	0.00	0.00	4.32	
	0.00	.03	.01	.07	0.00	0.00	.11	
S	0	2	15	9	4	1	31	5.29
	0.00	1.08	8.11	4.86	2.16	.54	16.76	
	0.00	.03	.20	.12	.05	.01	.41	
SSW	1	5	8	9	2	0	25	4.50
	.54	2.70	4.32	4.86	1.08	0.00	13.51	
	.01	.07	.11	.12	.03	0.00	.33	
SW	3	4	3	5	2	0	17	4.26
	1.62	2.16	1.62	2.70	1.08	0.00	9.19	
	.04	.05	.04	.07	.03	0.00	.22	
WSW	2	3	0	1	0	0	6	2.45
	1.08	1.62	0.00	.54	0.00	0.00	3.24	
	.03	.04	0.00	.01	0.00	0.00	.08	
W	2	4	8	7	8	2	31	5.74
	1.08	2.16	4.32	3.78	4.32	1.08	16.76	
	.03	.05	.11	.09	.11	.03	.41	
WNW	1	2	2	5	2	2	14	6.08
	.54	1.08	1.08	2.70	1.08	1.08	7.57	
	.01	.03	.03	.07	.03	.03	.18	
NW	0	1	4	4	4	2	15	6.42
	0.00	.54	2.16	2.16	2.16	1.08	8.11	
	0.00	.01	.05	.05	.05	.03	.20	
NNW	1	1	3	4	0	0	9	4.57
	.54	.54	1.62	2.16	0.00	0.00	4.86	
	.01	.01	.04	.05	0.00	0.00	.12	
N	0	2	0	2	0	1	5	5.5
	0.00	1.08	0.00	1.08	0.00	.54	2.70	
	0.00	.03	0.00	.03	0.00	.01	.07	
CALM	0						0	CALM
	0.00						0.00	
	0.00						0.00	
TOTAL	10	30	61	53	23	8	185	5.4
	5.41	16.22	32.97	28.65	12.43	4.32	100.00	
	.13	.39	.80	.70	.30	.11	2.43	

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79, 13.41.43.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0	2	1	1	0	0	4	3.71
	0.00	.62	.31	.31	0.00	0.00	1.25	
	0.00	.03	.01	.01	0.00	0.00	.05	
NE	0	2	3	3	0	0	8	4.40
	0.00	.62	.94	.94	0.00	0.00	2.50	
	0.00	.03	.04	.04	0.00	0.00	.11	
ENE	0	1	2	1	0	0	4	4.12
	0.00	.31	.62	.31	0.00	0.00	1.25	
	0.00	.01	.03	.01	0.00	0.00	.05	
E	0	0	2	0	0	0	2	3.29
	0.00	0.00	.62	0.00	0.00	0.00	.62	
	0.00	0.00	.03	0.00	0.00	0.00	.03	
ESE	0	1	9	2	1	0	13	4.58
	0.00	.31	2.81	.62	.31	0.00	4.06	
	0.00	.01	.12	.03	.01	0.00	.17	
SE	0	3	11	5	0	0	19	4.23
	0.00	.94	3.44	1.56	0.00	0.00	5.94	
	0.00	.04	.14	.07	0.00	0.00	.25	
SSE	0	4	5	2	0	0	12	3.55
	0.00	1.25	1.67	.62	0.00	0.00	3.75	
	0.00	.05	.08	.03	0.00	0.00	.15	
S	1	12	19	14	11	0	57	5.14
	.31	3.75	5.94	4.37	3.44	0.00	17.81	
	.01	.16	.25	.18	.14	0.00	.75	
SSW	1	7	15	15	3	1	42	4.43
	.31	2.19	4.69	4.69	.94	.31	13.12	
	.01	.09	.20	.20	.04	.01	.55	
SW	0	7	17	6	3	0	33	4.41
	0.00	2.19	5.31	1.87	.94	0.00	10.31	
	0.00	.09	.22	.08	.04	0.00	.43	
WSW	1	7	2	5	1	0	16	3.76
	.31	2.19	.62	1.56	.31	0.00	5.00	
	.01	.09	.03	.07	.01	0.00	.21	
W	2	3	10	8	2	0	25	4.17
	.62	.94	3.12	2.50	.62	0.00	7.81	
	.03	.04	.13	.11	.03	0.00	.33	
WNW	2	1	7	9	7	3	29	6.25
	.62	.31	2.19	2.81	2.19	.94	9.06	
	.03	.01	.09	.12	.09	.04	.38	
NW	1	1	8	9	5	1	25	5.44
	.31	.31	2.50	2.81	1.56	.31	7.81	
	.01	.01	.11	.12	.07	.01	.34	
NNW	1	1	9	7	0	0	18	4.72
	.31	.31	2.81	2.19	0.00	0.00	5.62	
	.01	.01	.12	.09	0.00	0.00	.24	
N	1	5	0	3	0	3	12	5.23
	.31	1.56	0.00	.94	0.00	.94	3.75	
	.01	.07	0.00	.04	0.00	.04	.16	
CALM	0						0	CALM
	0.00						0.00	
	0.00						0.00	
TOTAL	10	57	121	90	34	8	320	4.45
	3.12	17.81	37.81	28.12	10.62	2.50	100.00	
	.13	.75	1.59	1.18	.45	.11	4.20	

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79, 13.41.43.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	5	62	92	38	6	0	203	3.97
	.17	2.16	3.21	1.32	.21	0.00	7.08	
	.07	.81	1.21	.50	.08	0.00	2.67	
NE	8	61	73	40	2	0	184	3.79
	.28	2.13	2.55	1.39	.07	0.00	6.42	
	.11	.80	.96	.53	.03	0.00	2.42	
ENE	7	46	49	42	3	2	149	4.14
	.24	1.60	1.71	1.46	.10	.07	5.20	
	.09	.60	.64	.55	.04	.03	1.96	
E	4	24	44	47	10	0	129	4.72
	.14	.84	1.53	1.64	.35	0.00	4.50	
	.05	.32	.58	.62	.13	0.00	1.69	
ESE	4	30	71	40	7	1	151	4.41
	.16	1.05	2.48	1.39	.24	0.00	5.26	
	.05	.39	.92	.53	.09	0.00	1.98	
SE	3	43	98	64	13	1	222	4.55
	.10	1.50	3.42	2.23	.45	.03	7.74	
	.04	.57	1.29	.84	.17	.01	2.92	
SSE	6	47	75	54	5	0	187	4.19
	.21	1.64	2.62	1.88	.17	0.00	6.52	
	.08	.62	.99	.71	.07	0.00	2.46	
S	9	42	87	67	31	0	236	4.77
	.31	1.46	3.03	2.34	1.08	0.00	8.23	
	.12	.55	1.14	.88	.41	0.00	3.10	
SSW	7	36	61	55	21	6	186	4.47
	.24	1.26	2.13	1.92	.73	.21	6.49	
	.09	.47	.80	.72	.28	.08	2.44	
SW	5	16	43	34	17	4	123	5.11
	.17	.56	1.50	1.19	.59	.14	4.29	
	.07	.21	.56	.45	.22	.05	1.62	
WSW	4	14	26	40	26	9	115	5.48
	.14	.49	.91	1.39	.91	.31	4.01	
	.05	.18	.34	.53	.34	.12	1.51	
W	6	19	43	79	33	12	192	5.45
	.21	.66	1.50	2.75	1.15	.42	6.69	
	.08	.25	.56	1.04	.43	.15	2.52	
WNW	6	15	35	61	47	8	165	6.12
	.21	.52	1.22	2.13	1.63	.28	5.74	
	.08	.20	.46	.80	.56	.11	2.16	
NW	7	18	51	75	50	12	214	6.17
	.24	.63	1.78	2.62	1.74	.42	7.46	
	.09	.24	.67	.99	.66	.15	2.81	
NNW	5	25	86	68	27	1	212	5.03
	.17	.87	3.00	2.37	.94	.03	7.39	
	.07	.33	1.13	.89	.35	.01	2.78	
N	12	31	92	45	14	6	199	4.6
	.42	1.08	3.21	1.57	.49	.21	6.94	
	.16	.39	1.21	.59	.18	.08	2.61	
CALM	0						0	CALM
	0.00						0.00	
	0.00						0.00	
TOTAL	98	529	1023	850	316	65	2868	4.59
	3.42	18.41	35.67	29.64	11.02	2.27	100.00	
	1.29	6.93	13.43	11.16	4.15	.85	37.64	

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-58 (Continued) (Sheet 4 of 6)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: MARCH 15, 1978 1700 TO MARCH 15, 1979 1600

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 13.41.43.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	2	15	56	7	0	0	78	3.81
	.08	.62	2.24	.29	0.00	0.00	3.23	
	.03	.20	.71	.09	0.00	0.00	1.02	
NE	1	23	53	8	0	1	86	[illegible]
	.04	.95	2.19	.33	0.00	.04	3.56	
	.01	.30	.70	.11	0.00	.01	1.13	
ENE	2	10	33	30	7	3	85	[illegible]
	.08	.41	1.37	1.24	.29	.12	3.52	
	.03	.13	.43	.39	.09	.04	1.12	
E	0	14	73	28	12	1	128	4.49
	0.00	.58	3.02	1.16	.50	.04	5.30	
	0.00	.18	.96	.37	.16	.01	1.68	
ESE	7	16	79	65	3	0	170	4.57
	.29	.66	3.27	2.69	.12	0.00	7.04	
	.09	.21	1.04	.85	.04	0.00	2.23	
SE	4	34	118	131	9	0	296	4.86
	.17	1.41	4.88	5.42	.37	0.00	12.25	
	.05	.45	1.55	1.72	.12	0.00	3.89	
SSE	4	32	81	132	19	0	268	5.18
	.17	1.32	3.35	5.46	.79	0.00	11.09	
	.05	.42	1.06	1.73	.25	0.00	3.52	
S	6	36	92	242	30	0	406	5.49
	.25	1.49	3.81	10.02	1.24	0.00	16.80	
	.08	.47	1.21	3.18	.39	0.00	5.33	
SSW	2	11	37	78	40	3	171	[illegible]
	.08	.46	1.53	3.23	1.66	.12	7.08	
	.03	.14	.49	1.02	.53	.04	2.25	
SW	3	7	43	47	23	1	124	5.52
	.12	.29	1.78	1.95	.95	.04	5.13	
	.04	.09	.56	.62	.30	.01	1.63	
WSW	1	9	26	25	12	2	75	5.42
	.04	.37	1.08	1.03	.50	.08	3.10	
	.01	.12	.34	.33	.16	.03	.98	
W	1	8	48	59	21	3	140	5.65
	.04	.33	1.99	2.44	.87	.12	5.79	
	.01	.11	.63	.77	.28	.04	1.84	
WNW	5	8	34	54	16	2	119	5.53
	.21	.33	1.41	2.24	.66	.08	4.93	
	.07	.11	.45	.71	.21	.03	1.56	
NW	3	8	27	51	11	2	102	5.52
	.12	.33	1.12	2.11	.46	.08	4.22	
	.04	.11	.35	.67	.14	.03	1.34	
NNW	0	8	25	30	1	0	64	4.30
	0.00	.33	1.03	1.24	.04	0.00	2.65	
	0.00	.11	.33	.39	.01	0.00	.84	
N	4	12	54	32	1	0	103	4.39
	.17	.50	2.24	1.32	.04	0.00	4.26	
	.05	.16	.71	.42	.01	0.00	1.35	
CALM	1						1	CALM
	.04						.04	
	.01						.01	
TOTAL	46	251	877	1019	205	18	2416	5.14
	1.90	10.39	36.30	42.18	8.49	.75	100.00	
	.60	3.30	11.52	13.38	2.69	.24	31.73	

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 13.41.43.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0	4	5	3	0	0	12	3.45
	0.00	1.02	1.27	.76	0.00	0.00	3.05	
	0.00	.05	.07	.04	0.00	0.00	.16	
NE	1	6	12	7	0	0	26	[illegible]
	.25	1.53	3.05	1.78	0.00	0.00	6.62	
	.01	.08	.16	.09	0.00	0.00	.34	
ENE	2	2	7	6	0	0	17	4.22
	.51	.51	1.78	1.53	0.00	0.00	4.33	
	.03	.03	.09	.08	0.00	0.00	.22	
E	0	6	11	6	0	0	23	4.03
	0.00	1.53	2.80	1.53	0.00	0.00	5.85	
	0.00	.08	.14	.08	0.00	0.00	.30	
ESE	0	4	7	2	0	0	13	3.78
	0.00	1.02	1.78	.51	0.00	0.00	3.31	
	0.00	.05	.09	.03	0.00	0.00	.17	
SE	0	3	11	4	1	0	19	4.44
	0.00	.76	2.80	1.02	.25	0.00	4.83	
	0.00	.04	.14	.05	.01	0.00	.25	
SSE	0	2	20	21	2	0	45	[illegible]
	0.00	.51	[illegible]	5.34	.51	0.00	11.45	
	0.00	.03	.26	.28	.03	0.00	.59	
S	0	7	39	30	2	0	78	[illegible]
	0.00	1.78	9.92	7.63	.51	0.00	19.85	
	0.00	.09	.51	.39	.03	0.00	1.02	
SSW	0	6	17	25	2	0	50	[illegible]
	0.00	1.53	4.33	6.36	.51	0.00	12.72	
	0.00	.08	.22	.33	.03	0.00	.66	
SW	1	3	7	19	8	0	38	5.74
	.25	.76	1.78	4.83	2.04	0.00	9.67	
	.01	.04	.09	.25	.11	0.00	.50	
WSW	0	1	2	2	0	0	5	[illegible]
	0.00	.25	.51	.51	0.00	0.00	1.27	
	0.00	.01	.03	.03	0.00	0.00	.07	
W	0	1	4	0	0	0	5	3.66
	0.00	.25	1.02	0.00	0.00	0.00	1.27	
	0.00	.01	.05	0.00	0.00	0.00	.07	
WNW	1	1	6	6	0	0	14	[illegible]
	.25	.25	1.53	1.53	0.00	0.00	3.56	
	.01	.01	.08	.08	0.00	0.00	.18	
NW	0	4	7	7	0	0	18	4.19
	0.00	1.02	1.78	1.78	0.00	0.00	4.58	
	0.00	.05	.09	.09	0.00	0.00	.24	
NNW	0	1	2	1	0	0	4	[illegible]
	0.00	.25	.51	.25	0.00	0.00	1.02	
	0.00	.01	.03	.01	0.00	0.00	.05	
N	1	5	12	8	0	0	26	4.33
	.25	1.27	3.05	2.04	0.00	0.00	6.62	
	.01	.07	.16	.11	0.00	0.00	.34	
CALM	0						0	CALM
	0.00						0.00	
	0.00						0.00	
TOTAL	6	56	169	147	15	0	393	4.55
	1.53	14.25	43.00	37.40	3.82	0.00	100.00	
	.08	.74	2.22	1.93	.20	0.00	5.16	

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: MARCH 15, 1978 1700 TO MARCH 15, 1979 1600

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 13.41.43.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	2	6	20	7	1	0	36	3.99
	.16	.48	1.60	.56	.08	0.00	2.88	
	.03	.08	.25	.09	.01	0.00	.47	
NE	1	5	26	15	0	0	47	4.50
	.08	.40	2.08	1.20	0.00	0.00	3.76	
	.01	.07	.34	.20	0.00	0.00	.62	
ENE	2	4	24	8	1	0	39	4.33
	.16	.32	1.92	.64	.08	0.00	3.12	
	.03	.05	.32	.11	.01	0.00	.51	
E	2	4	28	17	0	0	51	4.34
	.16	.32	2.24	1.36	0.00	0.00	4.08	
	.03	.05	.37	.22	0.00	0.00	.67	
ESE	2	5	40	21	1	0	69	4.50
	.16	.40	3.20	1.68	.08	0.00	5.52	
	.03	.07	.53	.28	.01	0.00	.91	
SE	1	13	53	68	0	0	135	4.83
	.08	1.04	4.24	5.44	0.00	0.00	10.81	
	.01	.17	.70	.89	0.00	0.00	1.77	
SSE	2	14	75	90	6	0	187	4.92
	.16	1.12	6.00	7.21	.48	0.00	14.97	
	.03	.18	.98	1.18	.08	0.00	2.46	
S	1	11	81	129	6	0	228	5.14
	.08	.88	6.49	10.33	.48	0.00	18.25	
	.01	.14	1.06	1.69	.08	0.00	2.99	
SSW	3	15	44	63	8	0	133	5.15
	.24	1.20	3.52	5.04	.64	0.00	10.65	
	.04	.20	.58	.83	.11	0.00	1.75	
SW	2	6	24	33	28	0	93	6.10
	.16	.48	1.92	2.64	2.24	0.00	7.45	
	.03	.08	.32	.43	.37	0.00	1.22	
WSW	0	2	10	28	0	1	41	5.33
	0.00	.16	.80	2.24	0.00	.08	3.28	
	0.00	.03	.13	.37	0.00	.01	.54	
W	3	3	18	18	2	1	45	5.02
	.24	.24	1.44	1.44	.16	.08	3.60	
	.04	.04	.24	.24	.03	.01	.59	
WNW	1	2	7	18	2	0	30	5.39
	.08	.16	.56	1.44	.16	0.00	2.40	
	.01	.03	.09	.24	.03	0.00	.39	
NW	0	9	5	22	2	0	38	5.24
	0.00	.72	.40	1.76	.16	0.00	3.04	
	0.00	.12	.07	.29	.03	0.00	.50	
NNW	0	5	5	24	1	0	35	5.43
	0.00	.40	.40	1.92	.08	0.00	2.80	
	0.00	.07	.07	.32	.01	0.00	.46	
N	3	4	12	22	1	0	42	4.70
	.24	.32	.96	1.76	.08	0.00	3.36	
	.04	.05	.16	.29	.01	0.00	.55	
CALM	0						0	CALM
	0.00						0.00	
	0.00						0.00	
TOTAL	25	108	472	583	59	2	1249	5.00
	2.00	8.65	37.79	46.68	4.72	.16	100.00	
	.33	1.42	6.20	7.66	.77	.03	16.40	

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 13.41.43.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	10	92	184	56	7	0	349	3.85
	.12	1.14	2.29	.70	.09	0.00	4.34	
NE	11	100	172	80	6	1	370	3.99
	.14	1.24	2.14	1.00	.07	.01	4.60	
ENE	13	67	126	100	15	5	326	4.52
	.16	.83	1.57	1.24	.19	.06	4.06	
E	7	52	175	102	22	1	359	4.42
	.09	.65	2.18	1.27	.27	.01	4.47	
ESE	14	58	225	136	13	0	446	4.50
	.17	.72	2.80	1.69	.16	0.00	5.55	
SE	8	103	324	294	23	1	753	4.72
	.10	1.28	4.03	3.66	.29	.01	9.37	
SSE	13	113	271	321	32	0	750	4.79
	.16	1.41	3.37	3.99	.40	0.00	9.33	
S	19	118	348	508	93	1	1087	5.17
	.24	1.47	4.33	6.32	1.16	.01	13.52	
SSW	15	91	200	263	85	15	669	5.30
	.19	1.13	2.49	3.27	1.06	.19	8.32	
SW	15	50	147	151	85	9	457	5.66
	.19	.62	1.83	1.88	1.06	.11	5.68	
WSW	8	45	67	110	38	13	281	5.36
	.10	.56	.83	1.37	.47	.16	3.50	
W	17	41	144	165	77	20	484	5.65
	.21	.51	1.79	2.05	.96	.25	6.02	
WNW	16	31	99	189	90	27	452	6.09
	.20	.39	1.23	2.35	1.12	.34	5.62	
NW	11	43	114	191	83	25	467	5.92
	.14	.53	1.42	2.38	1.03	.31	5.81	
NNW	9	44	144	151	33	1	381	[illegible]
	.11	.55	1.79	1.88	.41	.01	4.74	
N	21	61	181	116	18	10	407	4.59
	.26	.76	2.25	1.44	.22	.12	5.06	
CALM	1						1	CALM
	.01						.01	
TOTAL	207	[illegible]	2921	2953	720	129	8039	5.01
	2.57	[illegible]	36.34	36.73	[illegible]	1.60	100.00	

NUMBER OF VALID OBSERVATIONS 8039 91.77 PCT.
NUMBER OF INVALID OBSERVATIONS 721 8.23 PCT.
TOTAL NUMBER OF OBSERVATIONS 8760 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-58 (Continued) (Sheet 5 of 6)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: MARCH 16, 1978 1700 TO MARCH 16, 1979 1600

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 90.00 METERS
TABLE GENERATED: 05/22/79, 13.41.43.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-043-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 / 0.00 / 0.00	1 / .55 / .01	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / .55 / .01	3.00
NE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
ENE	0 / 0.00 / 0.00	1 / .55 / .01	0 / 0.00 / 0.00	2 / 1.10 / .03	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 1.65 / .04	5.50
E	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / .55 / .01	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / .55 / .01	4.20
ESE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 1.10 / .03	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 1.10 / .03	4.73
SE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 1.65 / .04	11 / 6.04 / .14	2 / 1.10 / .03	0 / 0.00 / 0.00	16 / 8.79 / .21	5.39
SSE	0 / 0.00 / 0.00	2 / 1.10 / .03	4 / 2.20 / .05	1 / .55 / .01	2 / 1.10 / .03	0 / 0.00 / 0.00	9 / 4.95 / .12	4.73
S	0 / 0.00 / 0.00	2 / 1.10 / .03	8 / 4.40 / .10	3 / 1.65 / .04	5 / 2.75 / .07	0 / 0.00 / 0.00	18 / 9.89 / .23	5.42
SSW	0 / 0.00 / 0.00	4 / 2.20 / .05	12 / 6.59 / .15	8 / 4.40 / .10	10 / 5.49 / .13	3 / 1.65 / .04	37 / 20.33 / .48	6.15
SW	0 / 0.00 / 0.00	2 / 1.10 / .03	8 / 4.40 / .10	8 / 4.40 / .10	4 / 2.20 / .05	0 / 0.00 / 0.00	22 / 12.09 / .29	5.72
WSW	0 / 0.00 / 0.00	5 / 2.75 / .07	3 / 1.65 / .04	1 / .55 / .01	0 / 0.00 / 0.00	0 / 0.00 / 0.00	9 / 4.95 / .12	3.12
W	1 / .55 / .01	5 / 2.75 / .07	2 / 1.10 / .03	10 / 5.49 / .13	5 / 2.75 / .07	1 / .55 / .01	24 / 13.19 / .31	5.79
WNW	0 / 0.00 / 0.00	2 / 1.10 / .03	1 / .55 / .01	7 / 3.85 / .09	6 / 3.30 / .08	2 / 1.10 / .03	18 / 9.89 / .23	7.12
NW	0 / 0.00 / 0.00	1 / .55 / .01	0 / 0.00 / 0.00	6 / 3.30 / .08	2 / 1.10 / .03	6 / 3.30 / .08	15 / 8.24 / .20	8.45
NNW	0 / 0.00 / 0.00	1 / .55 / .01	1 / .55 / .01	3 / 1.65 / .04	1 / .55 / .01	0 / 0.00 / 0.00	6 / 3.30 / .08	5.48
N	0 / 0.00 / 0.00	1 / .55 / .01	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / .55 / .01	2.90
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	1 / .55 / .01	27 / 14.84 / .35	45 / 24.73 / .59	60 / 32.97 / .78	37 / 20.33 / .48	12 / 6.59 / .16	182 / 100.00 / 2.37	5.91

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: MARCH 16, 1978 1700 TO MARCH 16, 1979 1600

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 90.00 METERS
TABLE GENERATED: 05/22/79, 13.41.43.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-043-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3.00
NE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
ENE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 2.21 / .05	1 / .55 / .01	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 2.76 / .07	4.50
E	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 1.66 / .04	0 / 0.00 / 0.00	1 / .55 / .01	0 / 0.00 / 0.00	4 / 2.21 / .05	[illegible]
ESE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / .55 / .01	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / .55 / .01	4.90
SE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	8 / 4.42 / .10	5 / 2.76 / .07	0 / 0.00 / 0.00	1 / .55 / .01	14 / 7.73 / .18	5.20
SSE	0 / 0.00 / 0.00	1 / .55 / .01	2 / 1.10 / .03	2 / 1.10 / .03	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 2.76 / .07	4.54
S	0 / 0.00 / 0.00	1 / .55 / .01	10 / 5.52 / .13	10 / 5.52 / .13	5 / 2.76 / .07	1 / .55 / .01	27 / 14.92 / .35	5.81
SSW	2 / 1.10 / .03	3 / 1.66 / .04	10 / 5.52 / .13	8 / 4.42 / .10	9 / 4.97 / .12	0 / 0.00 / 0.00	32 / 17.68 / .42	5.37
SW	0 / 0.00 / 0.00	4 / 2.21 / .05	5 / 2.76 / .07	6 / 3.31 / .08	2 / 1.10 / .03	1 / .55 / .01	18 / 9.94 / .23	5.29
WSW	0 / 0.00 / 0.00	3 / 1.66 / .04	3 / 1.66 / .04	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	6 / 3.31 / .08	2.78
W	2 / 1.10 / .03	2 / 1.10 / .03	5 / 2.76 / .07	9 / 4.97 / .12	4 / 2.21 / .05	4 / 2.21 / .05	26 / 14.36 / .34	[illegible]
WNW	0 / 0.00 / 0.00	3 / 1.66 / .04	3 / 1.66 / .04	1 / .55 / .01	3 / 1.66 / .04	3 / 1.66 / .04	13 / 7.18 / .17	6.47
NW	0 / 0.00 / 0.00	2 / 1.10 / .03	5 / 2.76 / .07	3 / 1.66 / .04	5 / 2.76 / .07	4 / 2.21 / .05	19 / 10.50 / .25	7.16
NNW	0 / 0.00 / 0.00	1 / .55 / .01	1 / .55 / .01	3 / 1.66 / .04	3 / 1.66 / .04	0 / 0.00 / 0.00	8 / 4.42 / .10	[illegible]
N	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / .55 / .01	1 / .55 / .01	0 / 0.00 / 0.00	1 / .55 / .01	3 / 1.66 / .04	7.47
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	4 / 2.21 / .05	20 / 11.05 / .26	61 / 33.70 / .80	49 / 27.07 / .64	32 / 17.68 / .42	15 / 8.29 / .20	181 / 100.00 / 2.36	[illegible]

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 90.00 METERS
TABLE GENERATED: 05/22/79, 13.41.43.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-043-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 / 0.00 / 0.00	7 / 2.23 / .09	0 / 0.00 / 0.00	1 / .32 / .01	0 / 0.00 / 0.00	0 / 0.00 / 0.00	8 / 2.55 / .10	[illegible]
NE	0 / 0.00 / 0.00	1 / .32 / .01	2 / .64 / .03	3 / .96 / .04	0 / 0.00 / 0.00	0 / 0.00 / 0.00	6 / 1.91 / .08	4.42
ENE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / .96 / .04	2 / .64 / .03	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 1.59 / .07	4.46
E	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / .96 / .04	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / .96 / .04	3.37
ESE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	6 / 1.91 / .08	3 / .96 / .04	0 / 0.00 / 0.00	0 / 0.00 / 0.00	9 / 2.87 / .12	4.66
SE	0 / 0.00 / 0.00	1 / .32 / .01	9 / 2.87 / .12	8 / 2.55 / .10	0 / 0.00 / 0.00	1 / .32 / .01	19 / 6.05 / .25	5.06
SSE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	11 / 3.50 / .14	4 / 1.27 / .05	2 / .64 / .03	0 / 0.00 / 0.00	17 / 5.41 / .22	5.11
S	0 / 0.00 / 0.00	7 / 2.23 / .09	16 / 5.10 / .21	[illegible] / 5.1[illegible] / [illegible]	11 / 3.50 / .14	2 / .64 / .03	46 / 14.65 / .60	5.47
SSW	0 / 0.00 / 0.00	2 / .64 / .03	13 / 4.14 / .17	19 / 6.05 / .25	3 / .96 / .04	2 / .64 / .03	39 / 12.42 / .51	5.73
SW	0 / 0.00 / 0.00	4 / 1.27 / .05	14 / 4.46 / .18	13 / 4.14 / .17	5 / 1.59 / .07	0 / 0.00 / 0.00	36 / 11.46 / .47	5.14
WSW	1 / .32 / .01	8 / 2.55 / .10	4 / 1.27 / .05	3 / .96 / .04	2 / .64 / .03	0 / 0.00 / 0.00	18 / 5.73 / .23	3.44
W	1 / .32 / .01	3 / .96 / .04	3 / .96 / .04	5 / 1.59 / .07	2 / .64 / .03	2 / .64 / .03	16 / 5.10 / .21	5.79
WNW	0 / 0.00 / 0.00	3 / .96 / .04	10 / 3.18 / .13	10 / 3.18 / .13	6 / 1.91 / .08	2 / .64 / .03	31 / 9.87 / .40	5.49
NW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 1.27 / .05	8 / 2.55 / .10	8 / 2.55 / .10	3 / .96 / .04	23 / 7.32 / .30	7.42
NNW	1 / .32 / .01	1 / .32 / .01	8 / 2.55 / .10	7 / 2.23 / .09	4 / 1.27 / .05	1 / .32 / .01	22 / 7.01 / .29	5.47
N	0 / 0.00 / 0.00	3 / .96 / .04	1 / .32 / .01	4 / 1.27 / .05	0 / 0.00 / 0.00	2 / .64 / .03	10 / 3.18 / .13	6.07
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	3 / .96 / .04	40 / 12.74 / .52	107 / 34.08 / 1.39	106 / 33.76 / 1.38	43 / 13.69 / .56	15 / 4.78 / .20	314 / 100.00 / 4.09	5.43

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 90.00 METERS
TABLE GENERATED: 05/22/79, 13.41.43.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-043-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	2 / .07 / .03	44 / 1.49 / .57	89 / 3.01 / 1.16	57 / 1.93 / .74	11 / .37 / .14	0 / 0.00 / 0.00	203 / 6.87 / 2.65	[illegible]
NE	3 / .10 / .04	[illegible] / [illegible] / .74	72 / 2.44 / .94	38 / 1.29 / .50	2 / .07 / .03	1 / .03 / .01	176 / [illegible] / 2.29	[illegible]
ENE	1 / .03 / .01	[illegible] / 1.12 / .34	[illegible]	[illegible]	[illegible] / .72 / [illegible]	[illegible]	[illegible]	[illegible]
E	2 / .07 / .03	[illegible] / .47 / .18	44 / 1.49 / .57	43 / 1.46 / .56	28 / .95 / .36	[illegible]	[illegible]	[illegible]
ESE	1 / .03 / .01	23 / [illegible] / [illegible]	46 / 1.56 / .60	[illegible]	23 / .78 / .30	1 / [illegible] / [illegible]	[illegible]	[illegible]
SE	0 / 0.00 / 0.00	31 / 1.05 / .40	84 / 2.84 / 1.09	[illegible] / 2.[illegible] / [illegible]	27 / .91 / .35	[illegible]	227 / 7.68 / 2.95	5.22
SSE	2 / .07 / .03	[illegible]	[illegible] / 2.3[illegible] / [illegible]	[illegible]	17 / .58 / .22	1 / .03 / .01	[illegible]	[illegible]
S	3 / .10 / .04	41 / 1.39 / .53	64 / 2.17 / .83	[illegible]	39 / 1.32 / .51	7 / [illegible] / [illegible]	[illegible]	5.32
SSW	5 / .17 / .07	[illegible]	70 / 2.37 / .91	[illegible]	29 / .98 / .38	[illegible]	[illegible]	[illegible]
SW	5 / .17 / .07	13 / .44 / .17	39 / 1.32 / .51	[illegible]	25 / .85 / .33	[illegible]	151 / [illegible] / [illegible]	[illegible]
WSW	3 / .10 / .04	[illegible]	27 / .91 / .35	[illegible]	33 / 1.12 / .43	[illegible]	[illegible]	[illegible]
W	5 / [illegible] / [illegible]	[illegible] / .47 / [illegible]	44 / 1.49 / .57	[illegible]	42 / 1.42 / [illegible]	[illegible] / .54 / [illegible]	[illegible]	[illegible]
WNW	[illegible] / 0.00 / 0.00	12 / .41 / .16	23 / .78 / .30	[illegible] / 1.49 / [illegible]	41 / 1.39 / .53	[illegible]	[illegible]	[illegible]
NW	2 / .07 / .03	13 / .44 / .17	47 / 1.59 / .61	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NNW	2 / .07 / .03	[illegible]	[illegible] / 1.46 / .56	[illegible]	33 / 1.12 / .43	[illegible]	[illegible]	[illegible]
N	3 / .10 / .04	[illegible]	[illegible] / [illegible] / 1.17	[illegible] / [illegible] / 1.11	[illegible]	[illegible]	[illegible]	[illegible]
CALM	[illegible] / [illegible] / .13						[illegible]	CALM
TOTAL	[illegible]	[illegible] / 13.[illegible] / [illegible]	[illegible] / 31.3[illegible] / 12.[illegible]	[illegible] / [illegible] / 12.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

KEY: XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-58 (Continued) (Sheet 6 of 6)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: MARCH 16, 1978 1700 TO MARCH 15, 1979 1600

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 90.00 METERS
TABLE GENERATED: 05/22/79. 13.41.43.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 0.00 0.00	14 .58 .18	47 1.95 .61	9 .37 .12	2 .08 .03	0 0.00 0.00	72 2.99 .94	[illegible]
NE	0 0.00 0.00	11 .46 .14	42 1.74 .55	19 .79 .25	2 .08 .03	0 0.00 0.00	74 3.07 .96	4.49
ENE	1 .04 .01	7 .29 .09	18 .75 .23	42 1.74 .55	16 .66 .21	8 .33 .10	92 3.82 1.20	6.33
E	0 0.00 0.00	5 .21 .07	28 1.16 .36	76 3.15 .99	17 .71 .22	6 .25 .08	132 5.47 1.72	6.17
ESE	2 .08 .03	6 .25 .08	31 1.29 .40	85 3.53 1.11	23 .95 .30	3 .12 .04	150 6.22 1.96	6.05
SE	3 .12 .04	18 .75 .23	50 2.07 .65	137 5.68 1.79	59 2.45 .77	2 .08 .03	269 11.16 3.51	[illegible]
SSE	0 0.00 0.00	14 .58 .18	65 2.70 .85	104 4.31 1.36	81 3.36 1.06	2 .08 .03	266 11.03 3.47	6.14
S	2 .08 .03	14 .58 .18	66 2.74 .86	145 6.01 1.89	148 6.14 1.93	6 .25 .08	381 15.80 4.97	6.70
SSW	3 .12 .04	9 .37 .12	28 1.16 .36	68 2.82 .89	93 3.86 1.21	7 .29 .09	208 8.63 2.71	6.94
SW	0 0.00 0.00	6 .25 .08	31 1.29 .40	38 1.58 .50	65 2.70 .85	4 .17 .05	144 5.97 1.88	6.89
WSW	1 .04 .01	9 .37 .12	23 .95 .30	29 1.20 .38	22 .91 .29	4 .17 .05	88 3.65 1.15	[illegible]
W	0 0.00 0.00	6 .25 .08	20 .83 .26	58 2.41 .76	40 1.66 .52	8 .33 .10	132 5.47 1.72	6.82
WNW	2 .08 .03	6 .25 .08	20 .83 .26	46 1.91 .60	34 1.41 .44	5 .21 .07	113 4.69 1.47	6.43
NW	2 .08 .03	5 .21 .07	14 .58 .18	50 2.07 .65	38 1.58 .50	6 .25 .08	115 4.77 1.50	6.76
NNW	1 .04 .01	3 .12 .04	14 .58 .18	20 .83 .26	22 .91 .29	0 0.00 0.00	60 2.49 .78	6.26
N	4 .17 .05	7 .29 .09	33 1.37 .43	45 1.87 .59	25 1.04 .33	1 .04 .01	115 4.77 1.50	5.75
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	21 .87 .27	140 5.81 1.82	530 21.98 6.91	971 40.27 12.66	687 28.49 8.95	62 2.57 .81	2411 100.00 31.43	6.30

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 90.00 METERS
TABLE GENERATED: 05/22/79. 13.41.43.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	1 .25 .01	2 .50 .03	9 2.01 .10	3 .75 .04	0 0.00 0.00	0 0.00 0.00	14 3.51 .18	[illegible]
NE	1 .25 .01	6 1.50 .08	7 1.75 .09	4 1.00 .05	2 .50 .03	0 0.00 0.00	20 5.01 .26	4.32
ENE	0 0.00 0.00	2 .50 .03	5 1.25 .07	7 1.75 .09	6 1.50 .08	1 .25 .01	21 5.26 .27	[illegible]
E	0 0.00 0.00	2 .50 .03	5 1.25 .07	9 2.26 .12	3 .75 .04	0 0.00 0.00	19 4.76 .25	5.63
ESE	1 .25 .01	3 .75 .04	9 2.26 .12	2 .50 .03	2 .50 .03	0 0.00 0.00	17 4.26 .22	4.23
SE	0 0.00 0.00	1 .25 .01	10 2.51 .13	4 1.00 .05	1 .25 .01	0 0.00 0.00	16 4.01 .21	[illegible]
SSE	0 0.00 0.00	2 .50 .03	4 1.00 .05	23 5.76 .30	3 .75 .04	0 0.00 0.00	32 8.02 .42	[illegible]
S	0 0.00 0.00	4 1.00 .05	15 3.76 .20	43 10.78 .56	16 4.01 .21	0 0.00 0.00	78 19.55 1.02	6.14
SSW	0 0.00 0.00	2 .50 .03	16 4.01 .21	27 6.77 .35	9 2.26 .12	0 0.00 0.00	54 13.53 .70	5.96
SW	1 .25 .01	2 .50 .03	7 1.75 .09	12 3.01 .16	22 5.51 .29	1 .25 .01	45 11.28 .59	6.79
WSW	0 0.00 0.00	3 .75 .04	4 1.00 .05	4 1.00 .05	9 2.26 .12	0 0.00 0.00	20 5.01 .26	[illegible]
W	0 0.00 0.00	2 .50 .03	3 .75 .04	2 .50 .03	2 .50 .03	0 0.00 0.00	9 2.26 .12	5.22
WNW	0 0.00 0.00	1 .25 .01	5 1.25 .07	2 .50 .03	0 0.00 0.00	0 0.00 0.00	8 2.01 .10	4.76
NW	0 0.00 0.00	2 .50 .03	2 .50 .03	7 1.75 .09	3 .75 .04	0 0.00 0.00	14 3.51 .18	5.94
NNW	2 .50 .03	2 .50 .03	6 1.50 .08	8 2.01 .10	0 0.00 0.00	0 0.00 0.00	18 4.51 .23	4.39
N	1 .25 .01	1 .25 .01	4 1.00 .05	5 1.25 .07	2 .50 .03	0 0.00 0.00	13 3.26 .17	[illegible]
CALM	1 .25 .01						1 .25 .01	CALM
TOTAL	8 2.01 .10	37 9.27 .48	110 27.57 1.43	162 40.60 2.11	80 20.05 1.04	2 .50 .03	399 100.00 5.20	[illegible]

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: MARCH 16, 1978 1700 TO MARCH 15, 1979 1600

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 90.00 METERS
TABLE GENERATED: 05/22/79. 13.41.43.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	2 .16 .03	5 .41 .07	12 .97 .16	9 .73 .12	5 .41 .07	0 0.00 0.00	33 2.68 .43	4.46
NE	2 .16 .03	4 .32 .05	19 1.54 .25	15 1.22 .20	1 .08 .01	0 0.00 0.00	41 3.33 .53	4.74
ENE	0 0.00 0.00	1 .08 .01	13 1.06 .17	20 1.62 .26	12 .97 .16	1 .08 .01	47 3.82 .61	6.20
E	0 0.00 0.00	3 .24 .04	15 1.22 .20	24 1.95 .31	4 .32 .05	0 0.00 0.00	46 3.74 .60	5.53
ESE	0 0.00 0.00	3 .24 .04	13 1.06 .17	25 2.03 .33	11 .89 .14	0 0.00 0.00	52 4.22 .68	5.97
SE	0 0.00 0.00	9 .73 .12	28 2.27 .36	61 4.96 .80	26 2.11 .34	0 0.00 0.00	124 10.07 1.62	6.03
SSE	1 .08 .01	9 .73 .12	25 2.03 .33	72 5.85 .94	34 2.76 .44	0 0.00 0.00	141 11.45 1.84	6.14
S	1 .08 .01	7 .57 .09	32 2.60 .42	158 12.84 2.06	37 3.01 .48	0 0.00 0.00	235 19.09 3.06	6.22
SSW	1 .08 .01	3 .24 .04	20 1.62 .26	73 5.93 .95	56 4.55 .73	1 .08 .01	154 12.51 2.01	6.68
SW	4 .32 .05	6 .49 .08	16 1.30 .21	37 3.01 .48	54 4.39 .70	12 .97 .16	129 10.48 1.68	7.16
WSW	0 0.00 0.00	1 .08 .01	10 .81 .13	16 1.30 .21	6 .49 .08	0 0.00 0.00	33 2.68 .43	5.80
W	0 0.00 0.00	1 .08 .01	8 .65 .10	26 2.11 .34	15 1.22 .20	3 .24 .04	53 4.31 .69	6.74
WNW	1 .08 .01	0 0.00 0.00	4 .32 .05	16 1.30 .21	9 .73 .12	1 .08 .01	31 2.52 .40	6.73
NW	0 0.00 0.00	3 .24 .04	9 .73 .12	7 .57 .09	13 1.06 .17	2 .16 .03	34 2.76 .44	6.50
NNW	0 0.00 0.00	4 .32 .05	7 .57 .09	9 .73 .12	16 1.30 .21	2 .16 .03	38 3.09 .50	6.82
N	2 .16 .03	5 .41 .07	5 .41 .07	18 1.46 .23	9 .73 .12	0 0.00 0.00	39 3.17 .51	5.82
CALM	1 .08 .01						1 .08 .01	CALM
TOTAL	15 1.22 .20	64 5.20 .83	236 19.17 3.08	586 47.60 7.64	308 25.02 4.01	22 1.79 .29	1231 100.00 16.05	6.26

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 90.00 METERS
TABLE GENERATED: 05/22/79. 13.41.43.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	5 .06	78 .96	168 2.07	81 1.00	18 .22	0 0.00	350 4.31	4.31
NE	7 .09	84 1.04	148 1.82	84 1.04	14 .17	1 .01	338 4.17	4.27
ENE	2 .02	43 .53	110 1.36	122 1.50	62 .76	13 .16	352 4.34	5.64
E	2 .02	26 .32	105 1.29	168 2.07	54 .67	8 .10	363 4.47	5.77
ESE	5 .06	35 .43	124 1.53	169 2.08	60 .74	6 .07	399 4.92	5.56
SE	3 .04	64 .79	203 2.50	324 3.99	119 1.47	6 .07	719 8.86	5.69
SSE	4 .05	54 .67	189 2.33	273 3.37	141 1.74	3 .04	664 8.19	5.75
S	6 .07	81 1.00	212 2.61	451 5.56	270 3.33	16 .20	1036 12.77	6.15
SSW	11 .14	57 .70	176 2.17	263 3.24	211 2.60	23 .28	741 9.13	6.17
SW	10 .12	39 .48	124 1.53	175 2.16	182 2.24	33 .41	563 6.94	6.47
WSW	5 .06	41 .51	75 .92	96 1.18	74 .91	12 .15	301 3.71	5.83
W	10 .12	34 .42	87 1.07	194 2.39	119 1.47	39 .48	482 5.94	6.56
WNW	4 .05	28 .35	68 .84	156 1.92	125 1.54	35 .43	416 5.13	6.78
NW	4 .05	27 .33	87 1.07	188 2.32	157 1.94	57 .70	520 6.41	7.01
NNW	6 .07	39 .48	104 1.28	156 1.92	85 1.05	13 .16	403 4.97	5.91
N	10 .12	45 .55	142 1.75	169 2.08	76 .94	19 .23	461 5.68	5.86
CALM	4 .05						4 .05	CALM
TOTAL	98 1.21	775 9.55	2122 26.16	3067 37.81	1766 21.77	284 3.50	8112 100.00	[illegible]

NUMBER OF VALID OBSERVATIONS 8112 92.60 PCT.
NUMBER OF INVALID OBSERVATIONS 648 7.40 PCT.
TOTAL NUMBER OF OBSERVATIONS 8760 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-59 JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS [DATA PERIOD: 3 YEARS COMBINED (ANNUAL)]

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS COMBINED

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 13.58.09.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 0.00 0.00	7 .89 .03	7 .89 .03	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	14 1.77 .06	3.39
NE	0 0.00 0.00	6 .76 .02	3 .38 .01	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 1.14 .04	2.99
ENE	1 .13 .00	1 .13 .00	12 1.52 .05	9 1.14 .04	0 0.00 0.00	0 0.00 0.00	23 2.91 .09	4.47
E	0 0.00 0.00	2 .25 .01	6 .76 .02	10 1.27 .04	2 .25 .01	0 0.00 0.00	20 2.53 .08	5.34
ESE	0 0.00 0.00	2 .25 .01	7 .89 .03	5 .63 .02	5 .63 .02	0 0.00 0.00	19 2.41 .08	5.57
SE	0 0.00 0.00	4 .51 .02	20 2.53 .08	8 1.01 .03	1 .13 .00	2 .25 .01	35 4.43 .14	4.73
SSE	0 0.00 0.00	8 1.01 .03	18 2.28 .07	5 .63 .02	2 .25 .01	0 0.00 0.00	33 4.18 .14	4.14
S	0 0.00 0.00	8 1.01 .03	25 3.16 .10	11 1.39 .05	1 .13 .00	0 0.00 0.00	45 5.70 .18	4.28
SSW	2 .25 .01	16 2.03 .07	28 3.54 .11	26 3.29 .11	7 .89 .03	1 .13 .00	80 10.13 .33	4.79
SW	4 .51 .02	18 2.28 .07	36 4.56 .15	20 2.53 .08	5 .63 .02	0 0.00 0.00	83 10.51 .34	4.19
WSW	4 .51 .02	16 2.03 .07	18 2.28 .07	3 .38 .01	4 .51 .02	5 .63 .02	50 6.33 .21	4.65
W	6 .76 .02	21 2.66 .09	63 7.97 .26	35 4.43 .14	22 2.78 .09	3 .38 .01	150 18.99 .62	5.04
WNW	2 .25 .01	14 1.77 .06	41 5.19 .17	35 4.43 .14	16 2.03 .07	1 .13 .00	109 13.80 .45	5.24
NW	0 0.00 0.00	3 .38 .01	33 4.18 .14	28 3.54 .11	5 .63 .02	0 0.00 0.00	69 8.73 .28	5.38
NNW	0 0.00 0.00	1 .13 .00	31 3.92 .13	2 .25 .01	0 0.00 0.00	0 0.00 0.00	34 4.30 .14	4.14
N	0 0.00 0.00	3 .38 .01	12 1.52 .05	2 .25 .01	0 0.00 0.00	0 0.00 0.00	17 2.15 .07	4.06
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	19 2.41 .08	130 16.46 .53	360 45.57 1.48	199 25.19 .82	70 8.86 .29	12 1.52 .05	790 100.00 3.24	4.74

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 13.58.09.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 0.00 0.00	8 1.02 .03	13 1.65 .05	2 .25 .01	0 0.00 0.00	0 0.00 0.00	23 2.92 .09	3.34
NE	0 0.00 0.00	2 .25 .01	3 .38 .01	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 .64 .02	3.52
ENE	0 0.00 0.00	12 1.52 .05	6 .76 .02	4 .51 .02	0 0.00 0.00	0 0.00 0.00	22 2.80 .09	3.31
E	1 .13 .00	3 .38 .01	8 1.02 .03	6 .76 .02	1 .13 .00	0 0.00 0.00	19 2.41 .08	4.46
ESE	0 0.00 0.00	7 .89 .03	11 1.40 .05	3 .38 .01	0 0.00 0.00	0 0.00 0.00	21 2.67 .09	3.72
SE	1 .13 .00	13 1.65 .05	27 3.43 .11	4 .51 .02	0 0.00 0.00	0 0.00 0.00	45 5.72 .18	3.55
SSE	2 .25 .01	12 1.52 .05	19 2.41 .08	2 .25 .01	4 .51 .02	0 0.00 0.00	39 4.96 .16	3.92
S	1 .13 .00	18 2.29 .07	27 3.43 .11	17 2.16 .07	1 .13 .00	1 .13 .00	65 8.26 .27	4.13
SSW	5 .64 .02	24 3.05 .10	45 5.72 .19	22 2.80 .09	9 1.14 .04	1 .13 .00	106 13.47 .44	4.34
SW	8 1.02 .03	16 2.03 .07	25 3.18 .10	16 2.03 .07	4 .51 .02	1 .13 .00	70 8.89 .29	4.14
WSW	2 .25 .01	13 1.65 .05	19 2.41 .08	3 .38 .01	1 .13 .00	1 .13 .00	39 4.96 .16	3.75
W	2 .25 .01	25 3.18 .10	29 3.68 .12	19 2.41 .08	7 .89 .03	0 0.00 0.00	82 10.42 .34	4.26
WNW	3 .38 .01	19 2.41 .08	40 5.08 .16	24 3.05 .10	11 1.40 .05	0 0.00 0.00	97 12.33 .40	4.61
NW	2 .25 .01	15 1.91 .06	28 3.56 .12	20 2.54 .08	5 .64 .02	1 .13 .00	71 9.02 .29	4.65
NNW	2 .25 .01	6 .76 .02	21 2.67 .09	12 1.52 .05	3 .38 .01	0 0.00 0.00	44 5.59 .18	4.44
N	1 .13 .00	8 1.02 .03	25 3.18 .10	5 .64 .02	0 0.00 0.00	0 0.00 0.00	39 4.96 .16	3.87
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	30 3.81 .12	201 25.54 .83	346 43.96 1.42	159 20.20 .65	46 5.84 .19	5 .64 .02	787 100.00 3.23	4.17

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 13.58.09.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	4 .33 .02	11 .91 .05	25 2.06 .10	8 .66 .03	0 0.00 0.00	0 0.00 0.00	48 3.96 .20	3.55
NE	1 .08 .00	12 .99 .05	6 .50 .02	4 .33 .02	0 0.00 0.00	0 0.00 0.00	23 1.90 .09	3.24
ENE	2 .17 .01	12 .99 .05	12 .99 .05	7 .58 .03	0 0.00 0.00	0 0.00 0.00	33 2.72 .14	3.75
E	2 .17 .01	10 .83 .04	18 1.49 .07	5 .41 .02	0 0.00 0.00	0 0.00 0.00	35 2.89 .14	3.63
ESE	2 .17 .01	14 1.16 .06	17 1.40 .07	9 .74 .04	1 .08 .00	0 0.00 0.00	43 3.55 .18	4.73
SE	3 .25 .01	13 1.07 .05	45 3.71 .18	12 .99 .05	3 .25 .01	0 0.00 0.00	76 6.27 .31	4.12
SSE	2 .17 .01	26 2.15 .11	35 2.89 .14	7 .58 .03	4 .33 .02	2 .17 .01	76 6.27 .31	3.96
S	4 .33 .02	31 2.56 .13	53 4.37 .22	32 2.64 .13	5 .41 .02	0 0.00 0.00	125 10.31 .51	4.24
SSW	5 .41 .02	27 2.23 .11	59 4.87 .24	38 3.14 .16	11 .91 .05	3 .25 .01	143 11.80 .59	4.57
SW	2 .17 .01	19 1.57 .08	53 4.37 .22	22 1.82 .09	6 .50 .02	3 .25 .01	105 8.66 .43	4.42
WSW	6 .50 .02	17 1.40 .07	23 1.90 .09	4 .33 .02	5 .41 .02	3 .25 .01	58 4.79 .24	4.22
W	6 .50 .02	36 2.97 .15	35 2.89 .14	11 .91 .05	4 .33 .02	1 .08 .00	93 7.67 .38	3.69
WNW	7 .58 .03	18 1.49 .07	37 3.05 .15	42 3.47 .17	6 .50 .02	1 .08 .00	111 9.16 .46	4.63
NW	1 .08 .00	19 1.57 .08	45 3.71 .19	37 3.05 .15	6 .50 .02	0 0.00 0.00	108 8.91 .44	4.50
NNW	3 .25 .01	15 1.24 .06	32 2.64 .13	22 1.82 .09	4 .33 .02	0 0.00 0.00	76 6.27 .31	4.42
N	2 .17 .01	15 1.24 .06	26 2.15 .11	15 1.24 .06	1 .08 .00	0 0.00 0.00	59 4.87 .24	[illegible]
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	52 4.29 .21	295 24.34 1.21	521 42.99 2.14	275 22.69 1.13	56 4.62 .23	13 1.07 .05	1212 100.00 4.98	4.20

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 13.58.09.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	46 .50 .19	236 2.58 .97	213 2.33 .87	46 .50 .19	4 .04 .02	0 0.00 0.00	545 5.95 2.24	3.19
NE	38 .41 .16	201 2.20 .83	190 2.07 .78	27 .29 .11	1 .01 .00	0 0.00 0.00	457 4.99 1.88	3.07
ENE	26 .28 .11	131 1.43 .54	132 1.44 .54	47 .51 .19	0 0.00 0.00	0 0.00 0.00	336 3.67 1.38	3.31
E	37 .40 .15	146 1.59 .60	170 1.86 .70	65 .71 .27	4 .04 .02	0 0.00 0.00	422 4.61 1.73	3.53
ESE	21 .23 .09	143 1.56 .59	252 2.75 1.03	100 1.09 .41	16 .17 .07	1 .01 .00	533 5.82 2.19	3.96
SE	29 .32 .12	169 1.85 .69	377 4.12 1.55	150 1.64 .62	17 .19 .07	0 0.00 0.00	742 8.10 3.05	3.94
SSE	35 .38 .14	172 1.88 .71	252 2.75 1.03	137 1.50 .56	26 .28 .11	6 .07 .02	628 6.86 2.58	4.11
S	40 .44 .16	194 2.12 .79	285 3.11 1.17	203 2.22 .83	47 .51 .19	3 .03 .01	772 8.43 3.17	4.35
SSW	30 .33 .12	156 1.70 .64	242 2.64 .99	151 1.65 .62	43 .47 .18	5 .05 .02	627 6.85 2.57	4.31
SW	29 .32 .12	121 1.32 .50	179 1.95 .74	102 1.11 .42	22 .24 .09	12 .13 .05	465 5.08 1.91	4.23
WSW	28 .31 .11	95 1.04 .39	115 1.26 .47	83 .91 .34	26 .28 .11	10 .11 .04	357 3.90 1.47	4.33
W	31 .34 .13	120 1.31 .49	211 2.30 .87	133 1.45 .55	41 .45 .17	18 .20 .07	554 6.05 2.28	4.49
WNW	33 .36 .14	132 1.44 .54	268 2.93 1.10	234 2.56 .96	67 .73 .28	9 .10 .04	743 8.11 3.05	4.72
NW	29 .32 .12	105 1.15 .43	315 3.44 1.30	232 2.53 .95	30 .33 .12	4 .04 .02	715 7.81 2.94	4.53
NNW	30 .33 .12	125 1.37 .51	304 3.32 1.25	153 1.67 .63	13 .14 .05	0 0.00 0.00	625 6.83 2.57	4.12
N	45 .49 .19	151 1.65 .62	289 3.16 1.19	122 1.33 .50	23 .25 .09	2 .02 .01	632 6.90 2.60	3.93
CALM	7 .08 .03						7 .08 .03	CALM
TOTAL	534 5.83 2.19	2346 25.62 9.64	3745 40.90 15.39	1985 21.68 8.15	[illegible]	67 .73 [illegible]	9157 100.00 37.64	[illegible]

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-59 (Continued) (Sheet 2 of 4)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS COMBINED

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 13.59.09.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	66	134	41	5	0	0	246	2.27
	.88	1.79	.55	.07	0.00	0.00	3.29	
	.27	.55	.17	.02	0.00	0.00	1.01	
NE	59	127	29	5	10	0	230	2.52
	.79	1.70	.39	.07	.13	0.00	3.07	
	.24	.52	.12	.02	.04	0.00	.94	
ENE	46	106	71	16	0	0	239	2.74
	.61	1.42	.95	.21	0.00	0.00	3.20	
	.19	.44	.29	.07	0.00	0.00	.98	
E	58	175	147	41	6	1	428	3.11
	.78	2.34	1.97	.55	.08	.01	5.72	
	.24	.72	.60	.17	.02	.00	1.76	
ESE	67	214	167	32	0	0	480	2.92
	.90	2.86	2.23	.43	0.00	0.00	6.42	
	.28	.88	.69	.13	0.00	0.00	1.97	
SE	67	415	419	74	8	0	982	3.22
	.90	5.55	5.59	.99	.11	0.00	13.13	
	.28	1.70	1.72	.30	.03	0.00	4.03	
SSE	50	321	463	82	12	0	928	3.47
	.67	4.29	6.19	1.10	.16	0.00	12.41	
	.21	1.32	1.90	.34	.05	0.00	3.81	
S	48	285	330	164	19	2	1048	3.40
	.64	3.81	[illegible]	2.19	.25	.03	14.01	
	.20	1.17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
SSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.44
SW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.7?
WSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.38
W	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.24
WNW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.23
NW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.73
NNW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.75
N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.59
CALM	18						18	CALM
	.24						.24	
	.07						.07	
TOTAL	831	2892	2897	719	127	14	7480	3.26
	11.11	38.66	38.73	9.61	1.70	.19	100.00	
	3.41	11.88	11.90	2.95	.52	.06	30.72	

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 13.58.09.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	38	30	2	0	0	0	70	1.57
	2.88	2.27	.15	0.00	0.00	0.00	5.31	
	.15	.12	.01	0.00	0.00	0.00	.29	
NE	52	19	2	0	0	0	73	1.35
	3.94	1.44	.15	0.00	0.00	0.00	5.53	
	.21	.08	.01	0.00	0.00	0.00	.30	
ENE	21	11	2	0	0	0	34	1.47
	1.59	.83	.15	0.00	0.00	0.00	2.58	
	.09	.05	.01	0.00	0.00	0.00	.14	
E	16	6	0	0	0	0	22	1.22
	1.21	.45	0.00	0.00	0.00	0.00	1.67	
	.07	.02	0.00	0.00	0.00	0.00	.09	
ESE	17	10	1	0	0	0	28	1.44
	1.29	.76	.08	0.00	0.00	0.00	2.12	
	.07	.04	.00	0.00	0.00	0.00	.11	
SE	19	111	49	0	0	0	179	2.54
	1.44	8.42	3.71	0.00	0.00	0.00	13.57	
	.08	.46	.20	0.00	0.00	0.00	.74	
SSE	25	113	57	0	5	0	200	2.44
	1.90	8.57	4.32	0.00	.38	0.00	15.16	
	.10	.46	.23	0.00	.02	0.00	.82	
S	27	76	17	0	0	0	120	2.24
	2.05	5.76	1.29	0.00	0.00	0.00	9.10	
	.11	.31	.07	0.00	0.00	0.00	.49	
SSW	24	54	23	1	0	0	102	2.31
	1.82	4.09	1.74	.08	0.00	0.00	7.73	
	.10	.22	.09	.00	0.00	0.00	.42	
SW	34	71	22	0	0	0	127	2.20
	2.58	5.38	1.67	0.00	0.00	0.00	9.63	
	.14	.29	.09	0.00	0.00	0.00	.52	
WSW	18	36	5	0	0	0	59	1.99
	1.36	2.73	.38	0.00	0.00	0.00	4.47	
	.07	.15	.02	0.00	0.00	0.00	.24	
W	31	26	2	0	0	0	59	1.60
	2.35	1.97	.15	0.00	0.00	0.00	4.47	
	.13	.11	.01	0.00	0.00	0.00	.24	
WNW	22	26	1	0	0	0	49	1.63
	1.67	1.97	.08	0.00	0.00	0.00	3.71	
	.09	.11	.00	0.00	0.00	0.00	.20	
NW	14	30	3	2	0	0	49	2.08
	1.06	2.27	.23	.15	0.00	0.00	3.71	
	.06	.12	.01	.01	0.00	0.00	.20	
NNW	25	36	1	1	0	0	63	1.73
	1.90	2.73	.08	.08	0.00	0.00	4.78	
	.10	.15	.00	.00	0.00	0.00	.26	
N	36	37	1	0	0	0	74	1.55
	2.73	2.81	.08	0.00	0.00	0.00	5.61	
	.15	.15	.00	0.00	0.00	0.00	.30	
CALM	11						11	CALM
	.83						.83	
	.05						.05	
TOTAL	430	692	188	4	5	0	1319	2.06
	32.60	52.46	14.25	.30	.38	0.00	100.00	
	1.77	2.84	.77	.02	.02	0.00	5.42	

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS COMBINED

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 13.58.09.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	52	63	4	0	0	0	119	1.67
	1.44	1.75	.11	0.00	0.00	0.00	3.30	
	.21	.26	.02	0.00	0.00	0.00	.49	
NE	[illegible]	[illegible]	2	0	0	0	124	1.66
	2.08	1.39	.06	0.00	0.00	0.00	3.44	
	.30	.21	.01	0.00	0.00	0.00	.51	
ENE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.61
E	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.65
ESE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.91
SE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.62
SSE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.69
S	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.87
SSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.49
SW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.42
WSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.15
W	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.24
WNW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.13
NW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.04
NNW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.96
N	[illegible]	[illegible]	[illegible]	0	0	0	[illegible]	1.93
	1.25	1.69	.42	0.00	0.00	0.00	3.36	
	.18	.25	.06	0.00	0.00	0.00	.50	
CALM	20						20	CALM
	.55						.55	
	.08						.08	
TOTAL	746	1945	962	40	13	0	3606	2.41
	20.69	53.94	23.90	1.11	.36	0.00	100.00	
	3.06	7.99	3.54	.16	.05	0.00	14.81	

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 13.58.08.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	210	499	311	66	4	0	1088	2.73
	.84	1.99	1.24	.26	.02	0.00	4.34	
NE	231	435	244	47	11	0	968	2.62
	.92	1.73	.97	.19	.04	0.00	3.86	
ENE	147	330	247	90	0	0	814	2.93
	.59	1.31	.98	.36	0.00	0.00	3.24	
E	176	431	380	127	13	1	1128	3.14
	.70	1.72	1.51	.51	.05	.00	4.49	
ESE	154	496	486	150	22	1	1309	3.29
	.61	1.98	1.94	.60	.09	.00	5.22	
SE	184	1049	1137	258	29	2	2659	3.32
	.73	4.18	4.53	1.03	.12	.01	10.59	
SSE	173	1040	1070	242	54	6	2585	3.37
	.69	4.14	4.26	.96	.22	.02	10.30	
S	151	857	1105	437	86	6	2642	3.76
	.60	3.41	4.40	1.74	.34	.02	10.53	
SSW	130	583	844	339	101	11	2008	3.89
	.52	2.32	3.36	1.35	.40	.04	8.00	
SW	150	534	553	245	54	17	1553	3.69
	.60	2.13	2.20	.98	.22	.07	6.19	
WSW	145	359	286	131	46	23	990	3.60
	.58	1.43	1.14	.52	.18	.09	3.94	
W	183	477	545	245	92	25	1567	3.74
	.73	1.90	2.17	.98	.37	.10	6.24	
WNW	145	448	561	395	118	13	1680	4.13
	.58	1.79	2.24	1.57	.47	.05	6.69	
NW	141	432	555	336	50	4	1518	3.46
	.56	1.72	2.21	1.34	.20	.02	6.05	
NNW	134	391	488	208	22	0	1243	3.55
	.53	1.56	1.94	.83	.09	0.00	4.95	
N	185	457	441	175	26	2	1286	3.30
	.74	1.82	1.76	.70	.10	.01	5.13	
CALM	57						57	CALM
	.23						.23	
TOTAL	2697	8818	9253	3490	729	111	25097	3.49
	10.75	35.14	36.87	13.91	2.90	.44	100.00	

NUMBER OF VALID OBSERVATIONS 25097 95.50 PCT.
NUMBER OF INVALID OBSERVATIONS 1183 4.50 PCT.
TOTAL NUMBER OF OBSERVATIONS 26280 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-59 (Continued) (Sheet 3 of 4)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS COMBINED

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 13.58.03.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-043-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0	3	8	3	0	0	14	3.96
	0.00	.38	1.03	.38	0.00	0.00	1.79	
	0.00	.01	.03	.01	0.00	0.00	.05	
NE	0	3	3	0	0	0	6	3.30
	0.00	.38	.38	0.00	0.00	0.00	.77	
	0.00	.01	.01	0.00	0.00	0.00	.03	
ENE	0	3	7	11	0	0	21	4.76
	0.00	.38	.90	1.41	0.00	0.00	2.69	
	0.00	.01	.03	.05	0.00	0.00	.09	
E	1	2	7	6	2	1	19	5.21
	.13	.26	.90	.77	.26	.13	2.44	
	.00	.01	.03	.03	.01	.00	.08	
ESE	0	1	5	12	1	1	20	5.43
	0.00	.13	.64	1.54	.13	.13	2.56	
	0.00	.00	.02	.05	.00	.00	.09	
SE	0	1	12	8	3	2	26	5.47
	0.00	.13	1.54	1.03	.38	.26	3.33	
	0.00	.00	.05	.03	.01	.01	.11	
SSE	0	8	14	5	2	3	32	5.19
	0.00	1.03	1.79	.64	.26	.38	4.10	
	0.00	.03	.06	.02	.01	.01	.14	
S	0	7	26	17	9	0	59	4.98
	0.00	.90	3.33	2.18	1.15	0.00	7.56	
	0.00	.03	.11	.07	.04	0.00	.25	
SSW	1	15	23	32	8	3	82	5.14
	.13	1.92	2.95	4.10	1.03	.38	10.51	
	.00	.06	.10	.14	.03	.01	.35	
SW	2	14	21	17	11	5	70	5.54
	.26	1.79	2.69	2.18	1.41	.64	8.97	
	.01	.06	.09	.07	.05	.02	.30	
WSW	1	17	16	10	4	4	52	5.00
	.13	2.18	2.05	1.28	.51	.51	6.67	
	.00	.07	.07	.04	.02	.02	.22	
W	3	15	42	42	20	22	144	6.30
	.38	1.92	5.38	5.38	2.56	2.82	18.46	
	.01	.06	.18	.18	.09	.10	.62	
WNW	0	9	19	41	26	14	109	6.49
	0.00	1.15	2.44	5.26	3.33	1.79	13.97	
	0.00	.04	.08	.18	.11	.06	.47	
NW	0	5	11	28	18	8	70	6.75
	0.00	.64	1.41	3.59	2.31	1.03	8.97	
	0.00	.02	.05	.12	.08	.03	.30	
NNW	0	0	22	15	5	0	42	5.41
	0.00	0.00	2.82	1.92	.64	0.00	5.38	
	0.00	0.00	.10	.06	.02	0.00	.18	
N	0	3	4	7	0	0	14	4.59
	0.00	.38	.51	.90	0.00	0.00	1.79	
	0.00	.01	.02	.03	0.00	0.00	.05	
CALM	0						0	CALM
	0.00						0.00	
	0.00						0.00	
TOTAL	8	106	240	254	109	63	780	5.76
	1.03	13.59	30.77	32.56	13.97	8.08	100.00	
	.03	.46	1.04	1.10	.47	.27	3.37	

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 13.54.08.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-043-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	3	12	19	5	3	0	42	3.96
	.26	1.03	1.63	.43	.26	0.00	3.61	
	.01	.05	.08	.02	.01	0.00	.18	
NE	1	10	11	4	0	0	26	3.62
	.09	.86	.95	.34	0.00	0.00	2.23	
	.00	.04	.05	.02	0.00	0.00	.11	
ENE	0	6	11	9	1	0	27	4.47
	0.00	.52	.95	.77	.09	0.00	2.32	
	0.00	.03	.05	.04	.00	0.00	.12	
E	1	8	8	2	2	0	21	3.43
	.09	.69	.69	.17	.17	0.00	1.80	
	.00	.03	.03	.01	.01	0.00	.09	
ESE	1	7	30	12	3	1	54	4.59
	.09	.60	2.58	1.03	.26	.09	4.64	
	.00	.03	.13	.05	.01	.00	.23	
SE	0	9	36	12	1	1	59	4.24
	0.00	.77	3.09	1.03	.09	.09	5.07	
	0.00	.04	.15	.05	.00	.00	.25	
SSE	4	19	26	10	6	1	66	4.15
	.34	1.63	2.23	.86	.52	.09	5.67	
	.02	.08	.11	.04	.03	.00	.28	
S	3	33	46	33	19	3	137	4.95
	.26	2.84	3.95	2.84	1.63	.26	11.77	
	.01	.14	.20	.14	.08	.01	.59	
SSW	4	21	42	45	16	2	130	5.11
	.34	1.80	3.61	3.87	1.37	.17	11.17	
	.02	.09	.18	.19	.07	.01	.56	
SW	1	19	45	31	11	3	110	5.07
	.09	1.63	3.87	2.66	.95	.26	9.45	
	.00	.08	.19	.13	.05	.01	.47	
WSW	1	18	20	10	3	4	56	4.40
	.09	1.55	1.72	.86	.26	.34	4.81	
	.00	.08	.09	.04	.01	.02	.24	
W	6	19	36	18	7	8	94	4.93
	.52	1.63	3.09	1.55	.60	.69	8.08	
	.03	.08	.15	.08	.03	.03	.40	
WNW	3	15	26	28	22	9	103	5.91
	.26	1.29	2.23	2.41	1.89	.77	8.85	
	.01	.06	.11	.12	.10	.04	.44	
NW	1	8	33	36	25	7	110	6.11
	.09	.69	2.84	3.09	2.15	.60	9.45	
	.00	.03	.14	.15	.11	.03	.47	
NNW	2	9	24	21	8	0	64	5.12
	.17	.77	2.06	1.80	.69	0.00	5.50	
	.01	.04	.10	.09	.03	0.00	.27	
N	1	17	15	23	5	3	64	4.94
	.09	1.46	1.29	1.98	.43	.26	5.50	
	.00	.07	.06	.10	.02	.01	.27	
CALM	1						1	CALM
	.09						.09	
	.00						.00	
TOTAL	33	230	428	299	132	42	1164	4.94
	2.84	19.76	36.77	25.69	11.34	3.61	100.00	
	.14	.99	1.84	1.29	.57	.18	5.03	

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS COMBINED

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 13.58.03.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-043-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0	7	11	5	0	0	23	3.43
	0.00	.93	1.45	.66	0.00	0.00	3.04	
	0.00	.03	.05	.02	0.00	0.00	.10	
NE	0	4	4	2	0	0	10	3.44
	0.00	.53	.53	.26	0.00	0.00	1.32	
	0.00	.02	.02	.01	0.00	0.00	.04	
ENE	0	6	9	3	0	0	18	3.79
	0.00	.79	1.19	.40	0.00	0.00	2.38	
	0.00	.03	.04	.01	0.00	0.00	.08	
E	1	3	7	3	1	0	15	4.21
	.13	.40	.93	.40	.13	0.00	1.98	
	.00	.01	.03	.01	.00	0.00	.06	
ESE	0	2	7	3	3	0	15	5.07
	0.00	.26	.93	.40	.40	0.00	1.98	
	0.00	.01	.03	.01	.01	0.00	.06	
SE	1	7	22	3	1	0	34	3.42
	.13	.93	2.91	.40	.13	0.00	4.50	
	.00	.03	.10	.01	.00	0.00	.15	
SSE	0	11	19	11	2	0	43	4.22
	0.00	1.46	2.51	1.46	.26	0.00	5.69	
	0.00	.05	.08	.05	.01	0.00	.19	
S	1	9	28	19	7	2	66	5.03
	.13	1.19	3.70	2.51	.93	.26	8.73	
	.00	.04	.12	.08	.03	.01	.29	
SSW	5	20	29	26	5	1	86	4.90
	.66	2.65	3.84	3.44	.66	.13	11.38	
	.02	.09	.13	.11	.02	.00	.37	
SW	5	12	31	19	16	5	88	5.44
	.66	1.59	4.10	2.51	2.12	.66	11.64	
	.02	.05	.13	.08	.07	.02	.38	
WSW	3	12	12	7	0	1	35	4.00
	.40	1.59	1.59	.93	0.00	.13	4.63	
	.01	.05	.05	.03	0.00	.00	.15	
W	2	16	34	21	12	6	91	5.24
	.26	2.12	4.50	2.78	1.59	.79	12.04	
	.01	.07	.15	.09	.05	.03	.39	
WNW	1	13	23	23	14	11	85	6.49
	.13	1.72	3.04	3.04	1.85	1.46	11.24	
	.00	.06	.10	.10	.06	.05	.37	
NW	1	7	16	30	10	6	70	5.12
	.13	.93	2.12	3.97	1.32	.79	9.26	
	.00	.03	.07	.13	.04	.03	.30	
NNW	1	4	21	15	4	1	46	5.19
	.13	.53	2.78	1.98	.53	.13	6.08	
	.00	.02	.09	.06	.02	.00	.20	
N	1	3	15	9	1	2	31	4.77
	.13	.40	1.98	1.19	.13	.26	4.10	
	.00	.01	.06	.04	.00	.01	.13	
CALM	0						0	CALM
	0.00						0.00	
	0.00						0.00	
TOTAL	22	136	288	199	76	35	756	4.99
	2.91	17.99	38.10	26.32	10.05	4.63	100.00	
	.10	.59	1.24	.86	.33	.15	3.26	

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 13.58.03.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-043-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	23	136	234	110	16	2	521	4.30
	.27	1.58	2.72	1.28	.19	.02	6.06	
	.10	.59	1.01	.48	.07	.01	2.25	
NE	23	140	204	69	8	1	445	[illegible]
	.27	1.63	2.38	.80	.09	.01	5.18	
	.10	.60	.88	.30	.03	.00	1.92	
ENE	25	94	118	76	10	2	325	3.88
	.29	1.09	1.37	.88	.12	.02	3.78	
	.11	.41	.51	.33	.04	.01	1.40	
E	15	99	112	101	15	1	343	4.25
	.17	1.15	1.30	1.17	.17	.01	3.99	
	.06	.43	.48	.44	.06	.00	1.48	
ESE	14	84	192	151	45	10	496	[illegible]
	.16	.98	2.23	1.76	.52	.12	5.77	
	.06	.36	.83	.65	.19	.04	2.14	
SE	[illegible]	[illegible]	250	[illegible]	[illegible]	12	[illegible]	4.33
	[illegible]	1.27	[illegible]	2.44	.77	[illegible]	[illegible]	
	[illegible]	[illegible]	[illegible]	.91	[illegible]	[illegible]	[illegible]	
SSE	19	127	229	[illegible]	[illegible]	8	[illegible]	[illegible]
	.22	1.47	2.65	2.24	[illegible]	[illegible]	[illegible]	
	[illegible]	[illegible]	.99	[illegible]	[illegible]	.03	[illegible]	
S	[illegible]	121	227	[illegible]	119	35	733	5.30
	.35	1.41	2.64	2.33	1.38	[illegible]	[illegible]	
	.13	.52	[illegible]	[illegible]	.51	.15	[illegible]	
SSW	[illegible]	106	185	[illegible]	[illegible]	33	625	5.41
	[illegible]	1.23	2.15	2.33	[illegible]	.38	[illegible]	
	.07	[illegible]	[illegible]	[illegible]	[illegible]	.14	[illegible]	
SW	[illegible]	74	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	[illegible]	.32	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
WSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	[illegible]	.22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
W	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	.73	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	[illegible]	.27	.52	[illegible]	.67	.16	[illegible]	
WNW	21	49	[illegible]	[illegible]	141	[illegible]	[illegible]	[illegible]
	.24	.57	1.46	[illegible]	1.64	[illegible]	[illegible]	
	[illegible]	.21	[illegible]	[illegible]	[illegible]	.32	[illegible]	
NW	[illegible]	[illegible]	[illegible]	[illegible]	152	[illegible]	[illegible]	[illegible]
	.21	.66	1.99	[illegible]	[illegible]	[illegible]	[illegible]	
	[illegible]	.25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
NNW	17	[illegible]	193	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
CALM	[illegible]						[illegible]	CALM
	[illegible]						[illegible]	
	[illegible]						[illegible]	
TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

KEY: XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCE (THIS CLASS)
XXX PERCENT OCCURRENCE (ALL CLASSES)

TABLE 2.3-59 (Continued) (Sheet 4 of 4)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS COMBINED

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 13.59.09.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	6	64	119	40	2	1	231	3.41
	.08	.90	1.67	.56	.03	0.00	3.25	
	.03	.29	.51	.17	.01	0.00	1.00	
NE	12	52	132	29	2	1	228	3.72
	.17	.73	1.86	.41	.03	.01	3.21	
	.05	.22	.57	.13	.01	.00	.98	
ENE	7	40	100	60	10	3	220	4.51
	.10	.56	1.41	.84	.14	.04	3.09	
	.03	.17	.43	.26	.04	.01	.95	
E	10	45	149	111	16	4	335	4.74
	.14	.63	2.10	1.56	.23	.06	4.71	
	.04	.19	.64	.48	.07	.02	1.45	
ESE	19	43	199	181	17	1	460	4.77
	.27	.60	2.80	2.55	.24	.01	6.47	
	.08	.19	.86	.78	.07	.00	1.99	
SE	13	103	279	379	54	4	832	5.11
	.18	1.45	3.92	5.33	.76	.06	11.70	
	.06	.44	1.20	1.64	.23	.02	3.59	
SSE	9	70	278	386	78	6	827	5.36
	.13	.98	3.91	5.43	1.10	.08	11.63	
	.04	.30	1.20	1.67	.34	.03	3.57	
S	18	88	226	522	132	16	1002	5.73
	.25	1.24	3.18	7.34	1.86	.23	14.09	
	.08	.38	.98	2.25	.57	.07	4.33	
SSW	11	43	158	348	128	19	707	5.49
	.15	.60	2.22	4.89	1.80	.27	9.94	
	.05	.19	.68	1.50	.55	.08	3.05	
SW	9	33	138	216	110	16	522	5.49
	.13	.46	1.94	3.04	1.55	.23	7.34	
	.04	.14	.60	.93	.48	.07	2.25	
WSW	8	33	87	78	54	16	276	5.74
	.11	.46	1.22	1.10	.76	.23	3.88	
	.03	.14	.38	.34	.23	.07	1.19	
W	8	27	106	116	51	9	317	5.56
	.11	.38	1.49	1.63	.72	.13	4.46	
	.03	.12	.46	.50	.22	.04	1.37	
WNW	11	38	93	163	57	20	382	5.84
	.15	.53	1.31	2.29	.80	.28	5.37	
	.05	.16	.40	.70	.25	.09	1.65	
NW	11	30	82	148	18	3	292	5.23
	.15	.42	1.15	2.08	.25	.04	4.11	
	.05	.13	.35	.64	.08	.01	1.26	
NNW	2	29	79	94	9	1	214	4.41
	.03	.41	1.11	1.32	.13	.01	3.01	
	.01	.13	.34	.41	.04	.00	.92	
N	9	33	121	80	7	2	252	4.59
	.13	.46	1.70	1.13	.10	.03	3.54	
	.04	.14	.52	.35	.03	.01	1.09	
CALM	13						13	CALM
	.18						.18	
	.06						.06	
TOTAL	176	771	2346	2951	745	121	7110	5.29
	2.48	10.84	33.00	41.50	10.48	1.70	100.00	
	.76	3.33	10.13	12.74	3.22	.52	30.70	

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 13.58.08.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	4	17	31	5	0	0	57	3.42
	.32	1.35	2.47	.40	0.00	0.00	4.54	
	.02	.07	.13	.02	0.00	0.00	.25	
NE	2	16	33	18	5	0	74	4.24
	.16	1.27	2.63	1.43	.40	0.00	5.89	
	.01	.07	.14	.08	.02	0.00	.32	
ENE	5	4	22	14	2	0	47	4.38
	.40	.32	1.75	1.11	.16	0.00	3.74	
	.02	.02	.10	.06	.01	0.00	.20	
E	6	19	26	15	0	0	66	3.61
	.48	1.51	2.07	1.19	0.00	0.00	5.25	
	.03	.08	.11	.06	0.00	0.00	.29	
ESE	8	13	25	6	0	0	52	3.34
	.64	1.04	1.99	.48	0.00	0.00	4.14	
	.03	.06	.11	.03	0.00	0.00	.22	
SE	1	7	23	14	1	0	46	4.38
	.08	.56	1.83	1.11	.08	0.00	3.66	
	.00	.03	.10	.06	.00	0.00	.20	
SSE	1	9	35	41	5	0	91	4.94
	.08	.72	2.79	3.26	.40	0.00	7.25	
	.00	.04	.15	.18	.02	0.00	.39	
S	2	21	81	76	5	0	185	4.76
	.16	1.67	6.45	6.05	.40	0.00	14.73	
	.01	.09	.35	.33	.02	0.00	.80	
SSW	3	16	44	64	6	0	133	4.97
	.24	1.27	3.50	5.10	.48	0.00	10.59	
	.01	.07	.19	.28	.03	0.00	.57	
SW	3	12	44	74	25	3	161	5.71
	.24	.96	3.50	5.89	1.99	.24	12.82	
	.01	.05	.19	.32	.11	.01	.70	
WSW	1	10	13	43	13	0	80	5.81
	.08	.80	1.04	3.42	1.04	0.00	6.37	
	.00	.04	.06	.19	.05	0.00	.35	
W	4	8	28	32	2	0	74	4.71
	.32	.64	2.23	2.55	.16	0.00	5.89	
	.02	.03	.12	.14	.01	0.00	.32	
WNW	2	2	20	13	8	0	45	5.29
	.16	.16	1.59	1.04	.64	0.00	3.59	
	.01	.01	.09	.06	.03	0.00	.19	
NW	1	8	15	21	1	0	46	4.65
	.08	.64	1.19	1.67	.08	0.00	3.66	
	.00	.03	.06	.09	.00	0.00	.20	
NNW	1	3	13	18	0	0	35	4.45
	.08	.24	1.04	1.43	0.00	0.00	2.79	
	.00	.01	.06	.08	0.00	0.00	.15	
N	4	6	21	22	2	0	55	4.65
	.32	.48	1.67	1.75	.16	0.00	4.38	
	.02	.03	.09	.10	.01	0.00	.24	
CALM	9						9	CALM
	.72						.72	
	.04						.04	
TOTAL	57	171	474	476	75	3	1255	4.72
	4.54	13.61	37.76	37.90	5.97	.24	100.00	
	.25	.74	2.05	2.06	.32	.01	5.42	

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS COMBINED

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 13.58.03.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	8	24	46	23	1	0	102	3.40
	.23	.69	1.32	.66	.03	0.00	2.93	
	.03	.10	.20	.10	.00	0.00	.44	
NE	5	18	51	27	0	0	101	4.15
	.14	.52	1.47	.78	0.00	0.00	2.90	
	.02	.08	.22	.12	0.00	0.00	.44	
ENE	6	12	49	28	2	0	97	4.26
	.17	.34	1.41	.80	.06	0.00	2.79	
	.03	.05	.21	.12	.01	0.00	.42	
E	6	21	59	43	0	0	129	4.17
	.17	.60	1.70	1.24	0.00	0.00	3.71	
	.03	.09	.25	.19	0.00	0.00	.56	
ESE	5	20	86	52	2	0	165	4.38
	.14	.57	2.47	1.49	.06	0.00	4.74	
	.02	.09	.37	.22	.01	0.00	.71	
SE	5	35	120	140	2	0	302	4.76
	.14	1.01	3.45	4.02	.06	0.00	8.68	
	.02	.15	.52	.60	.01	0.00	1.30	
SSE	8	27	144	214	20	0	413	5.14
	.23	.78	4.14	6.15	.57	0.00	11.87	
	.03	.12	.62	.92	.09	0.00	1.79	
S	6	37	209	248	27	0	525	5.09
	.17	1.06	5.99	7.13	.78	0.00	15.11	
	.03	.16	.90	1.07	.12	0.00	2.27	
SSW	9	36	147	227	56	0	475	5.44
	.26	1.03	4.22	6.52	1.61	0.00	13.65	
	.04	.16	.63	.98	.24	0.00	2.05	
SW	7	22	77	144	88	1	339	6.05
	.20	.63	2.21	4.14	2.53	.03	9.74	
	.03	.10	.33	.62	.38	.00	1.46	
WSW	3	22	50	78	21	1	175	5.26
	.09	.63	1.44	2.24	.60	.03	5.03	
	.01	.10	.22	.34	.09	.00	.76	
W	5	20	51	78	19	1	174	5.23
	.14	.57	1.47	2.24	.55	.03	5.00	
	.02	.09	.22	.34	.08	.00	.75	
WNW	2	10	30	63	16	0	121	5.63
	.06	.29	.86	1.81	.46	0.00	3.48	
	.01	.04	.13	.27	.07	0.00	.52	
NW	2	21	25	79	6	0	133	5.31
	.06	.60	.72	2.27	.17	0.00	3.82	
	.01	.09	.11	.34	.03	0.00	.57	
NNW	5	15	29	46	2	0	97	4.70
	.14	.43	.83	1.32	.06	0.00	2.79	
	.02	.06	.13	.20	.01	0.00	.42	
N	7	18	37	53	4	0	119	4.59
	.20	.52	1.06	1.52	.11	0.00	3.42	
	.03	.08	.14	.23	.02	0.00	.51	
CALM	12						12	CALM
	.34						.34	
	.05						.05	
TOTAL	101	358	1209	1543	266	3	3480	5.05
	2.90	10.29	34.74	44.34	7.64	.09	100.00	
	.44	1.55	5.22	6.66	1.15	.01	15.03	

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 13.58.09.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	45	268	489	199	22	2	1025	3.93
	.19	1.12	2.05	.83	.09	.01	4.30	
NE	43	248	447	161	19	2	920	3.83
	.18	1.04	1.87	.68	.08	.01	3.86	
ENE	43	169	336	213	29	5	795	4.25
	.18	.71	1.41	.89	.12	.02	3.33	
E	43	203	391	288	36	6	967	4.36
	.18	.85	1.64	1.21	.15	.03	4.05	
ESE	49	175	569	427	71	13	1304	4.59
	.21	.73	2.39	1.79	.30	.05	5.47	
SE	34	291	771	785	129	19	2019	4.93
	.14	1.19	3.23	3.30	.54	.08	8.47	
SSE	42	283	767	886	179	19	2176	5.04
	.18	1.19	3.22	3.71	.75	.08	9.12	
S	62	324	855	1128	323	56	2748	5.34
	.26	1.36	3.58	4.73	1.35	.23	11.52	
SSW	49	272	639	951	307	61	2279	5.49
	.21	1.14	2.68	3.99	1.29	.26	9.56	
SW	42	192	537	641	333	68	1816	5.70
	.18	.81	2.25	2.69	1.40	.29	7.61	
WSW	31	165	280	320	152	71	1019	5.65
	.13	.69	1.17	1.34	.64	.30	4.27	
W	45	170	428	482	231	85	1441	5.49
	.19	.71	1.79	2.02	.97	.36	6.04	
WNW	40	137	348	607	294	139	1565	6.26
	.17	.57	1.46	2.55	1.23	.58	6.56	
NW	34	138	369	593	239	76	1449	5.46
	.14	.58	1.55	2.49	1.00	.32	6.07	
NNW	29	135	403	446	127	7	1147	5.13
	.12	.57	1.69	1.87	.53	.03	4.81	
N	48	164	431	365	84	23	1135	4.65
	.20	.69	1.81	1.53	.35	.10	4.76	
CALM	42						42	CALM
	.18						.18	
TOTAL	721	3324	8062	8513	2578	652	23850	5.17
	3.02	13.94	33.80	35.69	10.81	2.73	100.00	

NUMBER OF VALID OBSERVATIONS 23850 90.75 PCT.
NUMBER OF INVALID OBSERVATIONS 2430 9.25 PCT.
TOTAL NUMBER OF OBSERVATIONS 26280 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-60 JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS [DATA PERIOD: 3 YEARS COMBINED (MONTHLY)]

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JANUARY

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 14.25.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
NE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
ENE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
E	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
ESE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
SE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
SSE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
S	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
SSW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 4.00 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 4.00 / .05	[illegible]
SW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 12.00 / .15	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 12.00 / .15	[illegible]
WSW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 12.00 / .15	0 / 0.00 / 0.00	2 / 8.00 / .10	0 / 0.00 / 0.00	5 / 20.00 / .26	6.45
W	0 / 0.00 / 0.00	1 / 4.00 / .05	5 / 20.00 / .26	3 / 12.00 / .16	4 / 16.00 / .21	0 / 0.00 / 0.00	13 / 52.00 / .68	5.76
WNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 8.00 / .10	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 8.00 / .10	6.10
NW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 4.00 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 4.00 / .05	6.40
NNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
N	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	0 / 0.00 / 0.00	1 / 4.00 / .05	12 / 48.00 / .63	6 / 24.00 / .31	6 / 24.00 / .31	0 / 0.00 / 0.00	25 / 100.00 / 1.31	5.58

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JANUARY

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 14.25.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 6.06 / .10	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 6.06 / .10	3.15
NE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
ENE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
E	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 3.03 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 3.03 / .05	3.70
ESE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
SE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
SSE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 9.09 / .16	1 / 3.03 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 12.12 / .21	4.75
S	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
SSW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 12.12 / .21	1 / 3.03 / .05	1 / 3.03 / .05	0 / 0.00 / 0.00	6 / 18.18 / .31	5.42
SW	0 / 0.00 / 0.00	2 / 6.06 / .10	3 / 9.09 / .16	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 15.15 / .26	3.22
WSW	0 / 0.00 / 0.00	1 / 3.03 / .05	2 / 6.06 / .10	1 / 3.03 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 12.12 / .21	4.47
W	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 3.03 / .05	1 / 3.03 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 6.06 / .10	4.45
WNW	0 / 0.00 / 0.00	1 / 3.03 / .05	4 / 12.12 / .21	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 15.15 / .26	3.98
NW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
NNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 3.03 / .05	1 / 3.03 / .05	1 / 3.03 / .05	0 / 0.00 / 0.00	3 / 9.09 / .16	[illegible]
N	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 3.03 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 3.03 / .05	3.20
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	0 / 0.00 / 0.00	4 / 12.12 / .21	22 / 66.67 / 1.15	5 / 15.15 / .26	2 / 6.06 / .10	0 / 0.00 / 0.00	33 / 100.00 / 1.73	4.45

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 14.25.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 2.56 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 2.56 / .05	4.80
NE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
ENE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
E	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
ESE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 2.56 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 2.56 / .05	[illegible]
SE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 5.13 / .10	2 / 5.13 / .10	0 / 0.00 / 0.00	4 / 10.26 / .21	6.77
SSE	0 / 0.00 / 0.00	1 / 2.56 / .05	0 / 0.00 / 0.00	1 / 2.56 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 5.13 / .10	4.35
S	0 / 0.00 / 0.00	1 / 2.56 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 2.56 / .05	2.30
SSW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 5.13 / .10	7 / 17.95 / .37	0 / 0.00 / 0.00	0 / 0.00 / 0.00	9 / 23.08 / .47	5.56
SW	0 / 0.00 / 0.00	1 / 2.56 / .05	2 / 5.13 / .10	1 / 2.56 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 10.26 / .21	3.60
WSW	0 / 0.00 / 0.00	1 / 2.56 / .05	1 / 2.56 / .05	1 / 2.56 / .05	1 / 2.56 / .05	0 / 0.00 / 0.00	4 / 10.26 / .21	5.62
W	1 / 2.56 / .05	0 / 0.00 / 0.00	2 / 5.13 / .10	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 7.69 / .16	3.13
WNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 5.13 / .10	2 / 5.13 / .10	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 10.26 / .21	5.17
NW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 2.56 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 2.56 / .05	3.30
NNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 5.13 / .10	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 5.13 / .10	7.20
N	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 5.13 / .10	1 / 2.56 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 7.69 / .16	4.43
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	1 / 2.56 / .05	4 / 10.26 / .21	14 / 35.90 / .73	17 / 43.59 / .89	3 / 7.69 / .15	0 / 0.00 / 0.00	39 / 100.00 / 2.05	[illegible]

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 14.25.37.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	2 / .20 / .10	44 / 4.41 / 2.31	17 / 1.71 / .89	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	63 / 6.32 / 3.30	2.69
NE	0 / 0.00 / 0.00	29 / 2.91 / 1.52	18 / 1.81 / .94	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	47 / 4.71 / 2.46	2.83
ENE	1 / .10 / .05	22 / 2.21 / 1.15	10 / 1.00 / .52	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	33 / 3.31 / 1.73	2.65
E	3 / .30 / .15	21 / 2.11 / 1.10	24 / 2.41 / 1.26	5 / .50 / .26	0 / 0.00 / 0.00	0 / 0.00 / 0.00	53 / 5.32 / 2.77	3.40
ESE	3 / .30 / .16	19 / 1.91 / 1.00	43 / 4.31 / 2.25	12 / 1.20 / .63	0 / 0.00 / 0.00	0 / 0.00 / 0.00	77 / 7.72 / 4.04	3.73
SE	1 / .10 / .05	16 / 1.60 / .84	47 / 4.71 / 2.46	21 / 2.11 / 1.10	6 / .60 / .31	0 / 0.00 / 0.00	91 / 9.13 / 4.77	4.46
SSE	3 / .30 / .16	5 / .50 / .26	14 / 1.40 / .73	4 / .40 / .21	4 / .40 / .21	0 / 0.00 / 0.00	30 / 3.01 / 1.57	4.41
S	1 / .10 / .05	9 / .90 / .47	17 / 1.71 / .89	6 / .60 / .31	1 / .10 / .05	0 / 0.00 / 0.00	34 / 3.41 / 1.78	3.76
SSW	2 / .20 / .10	6 / .60 / .31	13 / 1.30 / .68	15 / 1.50 / .79	4 / .40 / .21	0 / 0.00 / 0.00	40 / 4.01 / 2.10	4.90
SW	0 / 0.00 / 0.00	13 / 1.30 / .68	11 / 1.10 / .58	6 / .60 / .31	0 / 0.00 / 0.00	6 / .60 / .31	36 / 3.61 / 1.89	5.32
WSW	2 / .20 / .10	9 / .90 / .47	12 / 1.20 / .63	12 / 1.20 / .63	7 / .70 / .37	2 / .20 / .10	44 / 4.41 / 2.31	5.11
W	1 / .10 / .05	15 / 1.50 / .79	42 / 4.21 / 2.20	37 / 3.71 / 1.94	5 / .50 / .26	5 / .50 / .26	105 / 10.53 / 5.51	4.49
WNW	0 / 0.00 / 0.00	15 / 1.50 / .79	66 / 6.62 / 3.46	43 / 4.31 / 2.25	7 / .70 / .37	0 / 0.00 / 0.00	131 / 13.14 / 6.87	4.73
NW	1 / .10 / .05	12 / 1.20 / .63	46 / 4.61 / 2.41	28 / 2.81 / 1.47	5 / .50 / .26	0 / 0.00 / 0.00	92 / 9.23 / 4.82	4.62
NNW	3 / .30 / .16	12 / 1.20 / .63	31 / 3.11 / 1.63	27 / 2.71 / 1.42	0 / 0.00 / 0.00	0 / 0.00 / 0.00	73 / 7.32 / 3.83	4.37
N	1 / .10 / .05	11 / 1.10 / .58	29 / 2.91 / 1.52	6 / .60 / .31	2 / .20 / .10	0 / 0.00 / 0.00	49 / 4.91 / 2.57	3.76
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	24 / 2.41 / 1.26	257 / 25.78 / 13.49	441 / 44.23 / 23.17	223 / 22.37 / 11.56	41 / 4.11 / 2.15	13 / 1.30 / .68	997 / 100.00 / [illegible]	[illegible]

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-60 (Continued)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JANUARY

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 14.25.37.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7577-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	7 1.24 .37	2 .36 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 1.60 .47	2.73
NE	2 .36 .10	10 1.78 .52	3 .53 .15	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	15 2.66 .79	2.51
ENE	3 .53 .16	9 1.60 .47	4 .71 .21	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	16 2.84 .84	2.19
E	1 .18 .05	18 3.20 .94	10 1.78 .52	2 .36 .10	0 0.00 0.00	0 0.00 0.00	31 5.51 1.63	2.47
ESE	3 .53 .16	11 1.95 .58	8 1.42 .42	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	22 3.91 1.15	2.52
SE	0 0.00 0.00	13 2.31 .68	36 6.39 1.89	8 1.42 .42	0 0.00 0.00	0 0.00 0.00	57 10.12 2.99	3.47
SSE	0 0.00 0.00	8 1.42 .42	17 3.02 .89	7 1.24 .37	1 .18 .05	0 0.00 0.00	33 5.86 1.73	4.25
S	1 .18 .05	15 2.66 .79	38 6.75 1.99	12 2.13 .63	0 0.00 0.00	0 0.00 0.00	66 11.72 3.46	4.41
SSW	2 .36 .10	11 1.95 .58	32 5.68 1.68	7 1.24 .37	3 .53 .16	0 0.00 0.00	55 9.77 2.88	4.42
SW	3 .53 .16	13 [illegible] [illegible]	20 [illegible] [illegible]	[illegible]	0 0.00 0.00	0 0.00 0.00	[illegible]	4.31
WSW	1 .18 .05	5 .89 .26	7 1.24 .37	7 1.24 .37	0 0.00 0.00	0 0.00 0.00	20 3.55 1.05	4.13
W	6 1.07 .31	20 3.55 1.05	22 3.91 1.15	10 1.78 .52	3 .53 .16	3 .53 .16	65 11.55 3.41	4.14
WNW	4 .71 .21	19 3.37 1.00	12 2.13 .63	7 1.24 .37	3 .53 .16	3 .53 .16	50 8.88 2.62	3.44
NW	3 .53 .16	15 2.66 .79	14 2.49 .73	1 .18 .05	0 0.00 0.00	0 0.00 0.00	33 5.86 1.73	2.77
NNW	3 .53 .16	14 2.49 .73	3 .53 .16	3 .53 .16	0 0.00 0.00	0 0.00 0.00	23 4.09 1.21	2.42
N	1 .18 .05	8 1.42 .42	3 .53 .15	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	12 2.13 .63	2.42
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	37 6.57 1.94	192 34.10 10.07	233 41.39 12.22	82 14.56 4.30	14 2.49 .73	5 .89 .26	563 100.00 29.52	3.57

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 14.25.37.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7577-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NE	0 0.00 0.00	1 1.56 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.56 .05	1.[illegible]
ENE	0 0.00 0.00	1 1.56 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.56 .05	1.40
E	0 0.00 0.00	2 3.13 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.13 .10	1.[illegible]
ESE	1 1.56 .05	1 1.56 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.13 .10	1.[illegible]
SE	0 0.00 0.00	13 20.31 .68	4 6.25 .21	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	17 26.56 .89	2.[illegible]
SSE	2 3.13 .10	11 17.19 .58	8 12.50 .42	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	21 32.81 1.10	2.[illegible]
S	0 0.00 0.00	5 7.81 .26	4 6.25 .21	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 14.06 .47	2.[illegible]
SSW	1 1.56 .05	1 1.56 .05	1 1.56 .05	1 1.56 .05	0 0.00 0.00	0 0.00 0.00	4 6.25 .21	3.[illegible]
SW	1 1.56 .05	0 0.00 0.00	3 4.69 .16	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 6.25 .21	3.[illegible]
WSW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
W	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
WNW	1 1.56 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.56 .05	1.1[illegible]
NW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NNW	1 1.56 .05	1 1.56 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.13 .10	1.[illegible]
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	7 10.94 .37	36 56.25 1.89	20 31.25 1.05	1 1.56 .05	0 0.00 0.00	0 0.00 0.00	64 100.00 3.36	2.74

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JANUARY

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 14.25.37.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7577-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	5 2.69 .26	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 2.69 .26	2.50
NE	1 .54 .05	5 2.69 .26	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 3.23 .31	1.43
ENE	1 .54 .05	3 1.61 .16	1 .54 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 2.69 .26	2.16
E	0 0.00 0.00	2 1.08 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.08 .10	2.75
ESE	0 0.00 0.00	2 1.08 .10	1 .54 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 1.61 .16	2.53
SE	0 0.00 0.00	12 6.45 .63	12 6.45 .63	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	24 12.90 1.26	3.21
SSE	1 .54 .05	[illegible]	10 5.38 .52	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	26 13.98 1.36	2.47
S	0 0.00 0.00	[illegible]	[illegible]	[illegible]	0 0.00 0.00	0 0.00 0.00	30 16.13 1.57	3.55
SSW	[illegible]	[illegible]	[illegible]	[illegible]	0 0.00 0.00	0 0.00 0.00	28 15.05 1.47	3.06
SW	0 0.00 0.00	[illegible]	[illegible]	[illegible]	0 0.00 0.00	0 0.00 0.00	22 11.83 1.15	3.12
WSW	[illegible]	[illegible]	0 0.00 0.00	[illegible]	0 0.00 0.00	0 0.00 0.00	6 3.23 .31	2.35
W	[illegible]	[illegible]	[illegible]	[illegible]	0 0.00 0.00	0 0.00 0.00	11 5.91 .58	2.62
WNW	0 0.00 0.00	[illegible]	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 3.23 .31	2.17
NW	[illegible]	[illegible]	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 4.30 .42	1.79
NNW	[illegible]	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.08 .10	1.40
N	1 .54 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .54 .05	1.10
CALM	1 .54 .05						1 .54 .05	CALM
TOTAL	15 8.06 .79	99 53.23 5.19	62 33.33 3.25	10 5.38 .52	0 0.00 0.00	0 0.00 0.00	186 100.00 9.75	2.97

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 14.25.37.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7577-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	2 .10	56 2.82	22 1.11	0 0.00	0 0.00	0 0.00	80 4.03	2.72
NE	3 .15	46 2.32	21 1.06	0 0.00	0 0.00	0 0.00	70 3.53	2.55
ENE	6 .30	36 1.82	16 .81	0 0.00	0 0.00	0 0.00	58 2.92	2.44
E	4 .20	45 2.27	47 2.37	7 .35	0 0.00	0 0.00	103 5.19	3.22
ESE	7 .35	33 1.66	55 2.77	12 .61	0 0.00	0 0.00	107 5.40	3.42
SE	1 .05	54 2.72	99 4.99	31 1.56	8 .40	0 0.00	193 9.73	4.04
SSE	6 .30	41 2.07	52 2.62	13 .66	5 .25	0 0.00	117 5.90	3.76
S	2 .10	42 2.12	75 3.78	20 1.01	1 .05	0 0.00	140 7.06	3.75
SSW	7 .35	29 1.46	64 3.23	37 1.87	8 .40	0 0.00	145 7.31	4.27
SW	4 .20	39 1.97	51 2.57	30 1.51	0 0.00	6 .30	130 6.56	4.21
WSW	6 .30	23 1.16	25 1.26	22 1.11	10 .50	2 .10	88 4.44	4.60
W	12 .61	47 2.37	90 4.54	57 2.87	15 .76	9 .45	230 11.60	4.49
WNW	9 .45	42 2.12	91 4.59	52 2.62	12 .61	2 .10	208 10.49	4.34
NW	5 .25	37 1.87	64 3.23	30 1.51	5 .25	0 0.00	141 7.11	3.90
NNW	9 .45	27 1.36	39 1.97	31 1.56	1 .05	3 .15	110 5.55	4.00
N	3 .15	19 .96	35 1.77	7 .35	2 .10	0 0.00	66 3.33	3.57
CALM	1 .05						1 .05	CALM
TOTAL	87 4.39	616 31.06	853 43.02	343 17.30	66 3.33	18 .91	1983 100.00	3.89

NUMBER OF VALID OBSERVATIONS 1983 88.84 PCT.
NUMBER OF INVALID OBSERVATIONS 249 11.16 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-60 (Continued) (Sheet 3 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JANUARY

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 14.25.37.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-043-07

WIND SECTOR	WIND SPEED CATEGORIES(METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ESE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SSE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
S	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SSW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 4.00 .06	0 0.00 0.00	0 0.00 0.00	1 4.00 .06	5.19
SW	0 0.00 0.00	0 0.00 0.00	3 12.00 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 12.00 .19	4.40
WSW	0 0.00 0.00	0 0.00 0.00	1 4.00 .06	2 8.00 .12	0 0.00 0.00	0 0.00 0.00	3 12.00 .19	5.17
W	0 0.00 0.00	0 0.00 0.00	3 12.00 .19	2 8.00 .12	1 4.00 .06	6 24.00 .37	12 48.00 .75	8.91
WNW	0 0.00 0.00	1 4.00 .06	1 4.00 .06	2 8.00 .12	0 0.00 0.00	0 0.00 0.00	4 16.00 .25	4.45
NW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 8.00 .12	0 0.00 0.00	2 8.00 .12	8.34
NNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	0 0.00 0.00	1 4.00 .06	8 32.00 .50	7 28.00 .44	3 12.00 .19	6 24.00 .37	25 100.00 1.56	7.12

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JANUARY

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 14.25.37.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-043-07

WIND SECTOR	WIND SPEED CATEGORIES(METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	0 0.00 0.00	3 9.09 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 9.09 .19	3.50
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
E	0 0.00 0.00	0 0.00 0.00	1 3.03 .06	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 3.03 .06	3.40
ESE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SSE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 3.03 .06	0 0.00 0.00	0 0.00 0.00	1 3.03 .06	5.70
S	0 0.00 0.00	0 0.00 0.00	2 6.06 .12	1 3.03 .06	0 0.00 0.00	0 0.00 0.00	3 9.09 .19	5.01
SSW	0 0.00 0.00	0 0.00 0.00	1 3.03 .06	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 3.03 .06	5.00
SW	0 0.00 0.00	1 3.03 .06	3 9.09 .19	1 3.03 .06	2 6.06 .12	0 0.00 0.00	7 21.21 .44	5.59
WSW	0 0.00 0.00	2 6.06 .12	0 0.00 0.00	3 9.09 .19	0 0.00 0.00	0 0.00 0.00	5 15.15 .31	4.14
W	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 9.09 .19	0 0.00 0.00	0 0.00 0.00	3 9.09 .19	6.40
WNW	0 0.00 0.00	1 3.03 .06	1 3.03 .06	3 9.09 .19	0 0.00 0.00	0 0.00 0.00	5 15.15 .31	4.46
NW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 3.03 .06	0 0.00 0.00	0 0.00 0.00	1 3.03 .06	6.10
NNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 3.03 .06	0 0.00 0.00	1 3.03 .06	8.90
N	0 0.00 0.00	0 0.00 0.00	1 3.03 .06	0 0.00 0.00	0 0.00 0.00	1 3.03 .06	2 6.06 .12	9.40
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	0 0.00 0.00	4 12.12 .25	12 36.36 .75	13 39.39 .81	3 9.09 .19	1 3.03 .06	33 100.00 2.06	5.22

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 14.25.37.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-043-07

WIND SECTOR	WIND SPEED CATEGORIES(METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	0 0.00 0.00	2 5.13 .12	1 2.56 .06	0 0.00 0.00	0 0.00 0.00	3 7.69 .19	4.67
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ESE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.56 .06	0 0.00 0.00	0 0.00 0.00	1 2.56 .06	5.90
SE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.56 .06	0 0.00 0.00	1 2.56 .06	2 5.13 .12	8.60
SSE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.56 .06	1 2.56 .06	0 0.00 0.00	2 5.13 .12	8.15
S	0 0.00 0.00	2 5.13 .12	0 0.00 0.00	1 2.56 .06	0 0.00 0.00	0 0.00 0.00	3 7.69 .19	4.13
SSW	0 0.00 0.00	0 0.00 0.00	1 2.56 .06	2 5.13 .12	0 0.00 0.00	0 0.00 0.00	3 7.69 .19	6.33
SW	0 0.00 0.00	0 0.00 0.00	3 7.69 .19	4 10.26 .25	2 5.13 .12	0 0.00 0.00	9 23.08 .56	6.10
WSW	0 0.00 0.00	2 5.13 .12	0 0.00 0.00	1 2.56 .06	1 2.56 .06	0 0.00 0.00	4 10.26 .25	4.40
W	1 2.56 .06	0 0.00 0.00	1 2.56 .06	2 5.13 .12	0 0.00 0.00	1 2.56 .06	5 12.82 .31	5.78
WNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 5.13 .12	0 0.00 0.00	2 5.13 .12	8.40
NW	0 0.00 0.00	0 0.00 0.00	1 2.56 .06	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.56 .06	4.00
NNW	0 0.00 0.00	0 0.00 0.00	1 2.56 .06	0 0.00 0.00	2 5.13 .12	0 0.00 0.00	3 7.69 .19	[illegible]
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.56 .06	0 0.00 0.00	0 0.00 0.00	1 2.56 .06	5.80
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	1 2.56 .06	4 10.26 .25	9 23.08 .56	15 38.46 .94	8 20.51 .50	2 5.13 .12	39 100.00 2.43	[illegible]

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 14.25.37.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-043-07

WIND SECTOR	WIND SPEED CATEGORIES(METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	15 1.90 .94	25 3.16 1.56	4 .51 .25	1 .13 .06	0 0.00 0.00	46 5.82 2.87	3.66
NE	0 0.00 0.00	22 2.78 1.37	27 3.41 1.68	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	49 6.19 3.05	3.14
ENE	1 .13 .06	6 .76 .37	15 1.90 .94	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	22 2.78 1.37	3.16
E	1 .13 .06	7 .88 .44	18 2.28 1.12	5 .63 .31	0 0.00 0.00	0 0.00 0.00	31 3.92 1.93	3.84
ESE	2 .25 .12	14 1.77 .87	37 4.68 2.31	12 1.52 .75	4 .51 .25	0 0.00 0.00	69 8.72 4.30	4.65
SE	1 .13 .06	6 .76 .37	16 2.02 1.00	28 3.54 1.75	7 .88 .44	1 .13 .06	59 7.46 3.68	5.55
SSE	1 .13 .06	6 .76 .37	9 1.14 .56	12 1.52 .75	8 1.01 .50	2 .25 .12	38 4.80 2.37	5.75
S	0 0.00 0.00	7 .88 .44	15 1.90 .94	6 .76 .37	3 .38 .19	2 .25 .12	33 4.17 2.06	4.49
SSW	3 .38 .19	4 .51 .25	10 1.26 .62	8 1.01 .50	0 0.00 0.00	1 .13 .06	26 3.29 1.62	4.62
SW	1 .13 .06	5 .63 .31	9 1.14 .56	21 2.65 1.31	6 .76 .37	7 .88 .44	49 6.19 3.05	6.65
WSW	0 0.00 0.00	3 .38 .19	5 .63 .31	12 1.52 .75	6 .76 .37	12 1.52 .75	38 4.80 2.37	6.16
W	1 .13 .06	6 .76 .37	19 2.40 1.19	26 3.29 1.62	17 2.15 1.06	1 .13 .06	70 8.85 4.36	5.43
WNW	1 .13 .06	3 .38 .19	15 1.90 .94	40 5.06 2.49	14 1.77 .87	11 1.39 .69	84 10.62 5.24	6.40
NW	1 .13 .06	6 .76 .37	21 2.65 1.31	39 4.93 2.43	9 1.14 .56	0 0.00 0.00	76 9.61 4.74	5.44
NNW	1 .13 .06	5 .63 .31	18 2.28 1.12	19 2.40 1.18	5 .63 .31	0 0.00 0.00	48 6.07 2.99	5.27
N	0 0.00 0.00	7 .88 .44	24 3.03 1.50	16 2.02 1.00	5 .63 .31	1 .13 .06	53 6.70 3.30	5. 5
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	14 1.77 .87	122 15.42 7.61	284 35.90 17.71	248 31.35 15.46	93 11.76 5.80	34 4.30 2.12	791 100.00 49.31	5.24

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-60 (Continued) (Sheet 4 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JANUARY

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 14.25.37.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
JAMES AND MOORE JOB NO: 7577-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	1 / .21 / .06	2 / .41 / .12	5 / 1.04 / .31	2 / .41 / .12	0 / 0.00 / 0.00	0 / 0.00 / 0.00	10 / 2.07 / .62	3.55
NE	0 / 0.00 / 0.00	2 / .41 / .12	7 / 1.45 / .44	4 / .83 / .25	0 / 0.00 / 0.00	0 / 0.00 / 0.00	13 / 2.70 / .81	4.24
ENE	0 / 0.00 / 0.00	1 / .21 / .06	8 / 1.66 / .50	4 / .83 / .25	0 / 0.00 / 0.00	0 / 0.00 / 0.00	13 / 2.70 / .81	4.42
E	1 / .21 / .06	3 / .62 / .19	7 / 1.45 / .44	3 / .62 / .19	0 / 0.00 / 0.00	0 / 0.00 / 0.00	14 / 2.90 / .87	3.93
ESE	0 / 0.00 / 0.00	1 / .21 / .06	11 / 2.28 / .69	13 / 2.70 / .81	2 / .41 / .12	0 / 0.00 / 0.00	27 / 5.60 / 1.68	5.19
SE	0 / 0.00 / 0.00	1 / .21 / .06	6 / 1.24 / .37	17 / 3.53 / 1.06	2 / .41 / .12	0 / 0.00 / 0.00	26 / 5.39 / 1.62	5.49
SSE	0 / 0.00 / 0.00	1 / .21 / .06	3 / .62 / .19	18 / 3.73 / 1.12	6 / 1.24 / .37	0 / 0.00 / 0.00	28 / 5.81 / 1.75	6.42
S	0 / 0.00 / 0.00	1 / .21 / .06	3 / .62 / .19	10 / 2.07 / .62	13 / 2.70 / .81	1 / .21 / .06	28 / 5.81 / 1.75	7.24
SSW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	10 / 2.07 / .62	30 / 6.22 / 1.87	9 / 1.87 / .56	2 / .41 / .12	51 / 10.58 / 3.18	6.52
SW	0 / 0.00 / 0.00	2 / .41 / .12	12 / 2.49 / .75	31 / 6.43 / 1.93	31 / 6.43 / 1.93	4 / .83 / .25	80 / 16.60 / 4.99	6.37
WSW	2 / .41 / .12	0 / 0.00 / 0.00	7 / 1.45 / .44	6 / 1.24 / .37	12 / 2.49 / .75	0 / 0.00 / 0.00	27 / 5.60 / 1.68	6.56
W	0 / 0.00 / 0.00	3 / .62 / .19	10 / 2.07 / .62	17 / 3.53 / 1.06	9 / 1.87 / .56	1 / .21 / .06	40 / 8.30 / 2.49	6.32
WNW	3 / .62 / .19	3 / .62 / .19	10 / 2.07 / .62	10 / 2.07 / .62	6 / 1.24 / .37	16 / 3.32 / 1.00	48 / 9.96 / 2.99	7.49
NW	3 / .62 / .19	6 / 1.24 / .37	8 / 1.66 / .50	16 / 3.32 / 1.00	1 / .21 / .06	0 / 0.00 / 0.00	34 / 7.05 / 2.12	4.57
NNW	0 / 0.00 / 0.00	3 / .62 / .19	10 / 2.07 / .62	8 / 1.66 / .50	0 / 0.00 / 0.00	0 / 0.00 / 0.00	21 / 4.36 / 1.31	4.45
N	2 / .41 / .12	3 / .62 / .19	14 / 2.90 / .87	4 / .83 / .25	0 / 0.00 / 0.00	0 / 0.00 / 0.00	23 / 4.77 / 1.43	3.90
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	12 / 2.49 / .75	32 / 6.64 / 2.00	131 / 27.18 / 8.17	192 / 39.83 / 11.97	91 / 18.88 / 5.67	24 / 4.98 / 1.50	482 / 100.00 / 30.05	6.06

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 14.25.37.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
JAMES AND MOORE JOB NO: 7577-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
NE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
ENE	0 / 0.00 / 0.00	1 / 1.69 / .06	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.69 / .06	2.00
E	1 / 1.69 / .06	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.69 / .06	1.20
ESE	1 / 1.69 / .06	1 / 1.69 / .06	1 / 1.69 / .06	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 5.08 / .19	2.51
SE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 8.47 / .31	1 / 1.69 / .06	0 / 0.00 / 0.00	0 / 0.00 / 0.00	6 / 10.17 / .37	4.24
SSE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 3.39 / .12	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 3.39 / .12	4.20
S	0 / 0.00 / 0.00	0 / 0.00 / 0.00	7 / 11.86 / .44	5 / 8.47 / .31	1 / 1.69 / .06	0 / 0.00 / 0.00	13 / 22.03 / .81	5.12
SSW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 3.39 / .12	9 / 15.25 / .56	3 / 5.08 / .19	0 / 0.00 / 0.00	14 / 23.73 / .87	6.17
SW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	8 / 13.56 / .50	6 / 10.17 / .37	2 / 3.39 / .12	3 / 5.08 / .19	19 / 32.20 / 1.18	6.18
WSW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
W	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
WNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
NW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
NNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
N	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	2 / 3.39 / .12	2 / 3.39 / .12	25 / 42.37 / 1.56	21 / 35.59 / 1.31	6 / 10.17 / .37	3 / 5.08 / .19	59 / 100.00 / 3.68	5.46

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JANUARY

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 14.25.37.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
JAMES AND MOORE JOB NO: 7577-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 1.14 / .12	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 1.14 / .12	4.45
NE	0 / 0.00 / 0.00	1 / .57 / .06	3 / 1.71 / .19	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 2.29 / .25	3.40
ENE	0 / 0.00 / 0.00	2 / 1.14 / .12	2 / 1.14 / .12	1 / .57 / .06	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 2.86 / .31	3.49
E	0 / 0.00 / 0.00	1 / .57 / .06	3 / 1.71 / .19	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 2.29 / .25	3.65
ESE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 1.14 / .12	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 1.14 / .12	5.75
SE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 1.71 / .19	3 / 1.71 / .19	0 / 0.00 / 0.00	0 / 0.00 / 0.00	6 / 3.43 / .37	5.60
SSE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / .57 / .06	10 / 5.71 / .62	3 / 1.71 / .19	0 / 0.00 / 0.00	14 / 8.00 / .87	7.01
S	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 2.86 / .31	12 / 6.86 / .75	4 / 2.29 / .25	0 / 0.00 / 0.00	21 / 12.00 / 1.31	6.14
SSW	0 / 0.00 / 0.00	2 / 1.14 / .12	6 / 3.43 / .37	19 / 10.86 / 1.18	11 / 6.29 / .69	0 / 0.00 / 0.00	38 / 21.71 / 2.37	6.34
SW	0 / 0.00 / 0.00	1 / .57 / .06	3 / 1.71 / .19	13 / 7.43 / .81	20 / 11.43 / 1.25	0 / 0.00 / 0.00	37 / 21.14 / 2.31	7.35
WSW	0 / 0.00 / 0.00	4 / 2.29 / .25	4 / 2.29 / .25	7 / 4.00 / .44	1 / .57 / .06	0 / 0.00 / 0.00	16 / 9.14 / 1.00	4.80
W	0 / 0.00 / 0.00	0 / 0.00 / 0.00	6 / 3.43 / .37	3 / 1.71 / .19	2 / 1.14 / .12	0 / 0.00 / 0.00	11 / 6.29 / .69	5.07
WNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 1.71 / .19	2 / 1.14 / .12	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 2.86 / .31	4.49
NW	0 / 0.00 / 0.00	1 / .57 / .06	0 / 0.00 / 0.00	5 / 2.86 / .31	1 / .57 / .06	0 / 0.00 / 0.00	7 / 4.00 / .44	5.41
NNW	1 / .57 / .06	1 / .57 / .06	0 / 0.00 / 0.00	1 / .57 / .06	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 1.71 / .19	2.53
N	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	1 / .57 / .06	13 / 7.43 / .81	41 / 23.43 / 2.56	78 / 44.57 / 4.86	42 / 24.00 / 2.62	0 / 0.00 / 0.00	175 / 100.00 / 10.91	6.00

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 14.25.37.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
JAMES AND MOORE JOB NO: 7577-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	1 / .06	17 / 1.03	38 / 2.31	7 / .43	1 / .06	0 / 0.00	64 / 3.89	3.71
NE	0 / 0.00	25 / 1.52	37 / 2.25	4 / .24	0 / 0.00	0 / 0.00	66 / 4.01	3.40
ENE	1 / .06	10 / .61	25 / 1.52	5 / .30	0 / 0.00	0 / 0.00	41 / 2.49	3.60
E	3 / .18	11 / .67	29 / 1.76	8 / .49	0 / 0.00	0 / 0.00	51 / 3.10	3.79
ESE	3 / .18	16 / .97	51 / 3.10	29 / 1.76	6 / .36	0 / 0.00	105 / 6.38	4.51
SE	1 / .06	7 / .43	30 / 1.82	50 / 3.04	9 / .55	2 / .12	99 / 6.02	5.51
SSE	1 / .06	7 / .43	15 / .91	42 / 2.55	18 / 1.09	2 / .12	85 / 5.17	6.20
S	0 / 0.00	10 / .61	32 / 1.95	35 / 2.13	21 / 1.28	3 / .18	101 / 6.14	5.80
SSW	3 / .18	8 / .49	30 / 1.82	68 / 4.13	23 / 1.40	3 / .18	135 / 8.21	5.99
SW	1 / .06	9 / .55	41 / 2.49	76 / 4.62	63 / 3.83	14 / .85	204 / 12.40	6.77
WSW	2 / .12	11 / .67	17 / 1.03	31 / 1.88	20 / 1.22	12 / .73	93 / 5.65	6.66
W	2 / .12	9 / .55	42 / 2.55	57 / 3.47	29 / 1.76	9 / .55	148 / 9.00	6.20
WNW	4 / .24	8 / .49	32 / 1.95	76 / 4.62	22 / 1.34	27 / 1.64	169 / 10.27	6.94
NW	4 / .24	13 / .79	31 / 1.88	63 / 3.83	13 / .79	0 / 0.00	124 / 7.54	5.24
NNW	2 / .12	9 / .55	33 / 2.01	29 / 1.76	8 / .49	0 / 0.00	81 / 4.92	5.37
N	2 / .12	10 / .61	39 / 2.37	21 / 1.28	5 / .30	2 / .12	79 / 4.80	4.41
CALM	0 / 0.00						0 / 0.00	CALM
TOTAL	30 / 1.82	180 / 10.94	522 / 31.73	601 / 36.53	238 / 14.47	74 / 4.50	1645 / 100.00	5.86

NUMBER OF VALID OBSERVATIONS 1645 73.70 PCT.
NUMBER OF INVALID OBSERVATIONS 587 26.30 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-60 (Continued) (Sheet 5 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - FEBRUARY

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 15.08.15.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7577-043-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0	0	0	0	0	0	0	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
NE	0	0	1	0	0	0	1	4.40
	0.00	0.00	2.50	0.00	0.00	0.00	2.50	
	0.00	0.00	.05	0.00	0.00	0.00	.04	
ENE	0	0	1	0	0	0	1	4.50
	0.00	0.00	2.50	0.00	0.00	0.00	2.50	
	0.00	0.00	.05	0.00	0.00	0.00	.05	
E	0	0	0	4	0	0	4	6.40
	0.00	0.00	0.00	10.00	0.00	0.00	10.00	
	0.00	0.00	0.00	.23	0.00	0.00	.23	
ESE	0	0	0	0	0	0	0	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
SE	0	0	0	0	0	0	0	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
SSE	0	0	0	0	0	0	0	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
S	0	0	0	0	0	0	0	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
SSW	0	0	1	2	0	0	3	5.73
	0.00	0.00	2.50	5.00	0.00	0.00	7.50	
	0.00	0.00	.06	.11	0.00	0.00	.17	
SW	0	0	0	1	0	0	1	6.70
	0.00	0.00	0.00	2.50	0.00	0.00	2.50	
	0.00	0.00	0.00	.06	0.00	0.00	.06	
WSW	0	0	2	0	0	0	2	4.05
	0.00	0.00	5.00	0.00	0.00	0.00	5.00	
	0.00	0.00	.11	0.00	0.00	0.00	.11	
W	1	1	8	2	1	0	13	4.28
	2.50	2.50	20.00	5.00	2.50	0.00	32.50	
	.06	.06	.45	.11	.06	0.00	.73	
WNW	0	1	3	2	0	0	6	4.47
	0.00	2.50	7.50	5.00	0.00	0.00	15.00	
	0.00	.06	.17	.11	0.00	0.00	.34	
NW	0	0	0	8	1	0	9	7.06
	0.00	0.00	0.00	20.00	2.50	0.00	22.50	
	0.00	0.00	0.00	.45	.06	0.00	.51	
NNW	0	0	0	0	0	0	0	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
N	0	0	0	0	0	0	0	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
CALM	0						0	CALM
	0.00						0.00	
	0.00						0.00	
TOTAL	1	2	16	19	2	0	40	5.31
	2.50	5.00	40.00	47.50	5.00	0.00	100.00	
	.06	.11	.90	1.07	.11	0.00	2.26	

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - FEBRUARY

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 15.08.15.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7577-043-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0	0	0	0	0	0	0	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
NE	0	0	1	0	0	0	1	4.40
	0.00	0.00	2.63	0.00	0.00	0.00	2.63	
	0.00	0.00	.05	0.00	0.00	0.00	.05	
ENE	0	0	1	0	0	0	1	4.70
	0.00	0.00	2.63	0.00	0.00	0.00	2.63	
	0.00	0.00	.05	0.00	0.00	0.00	.05	
E	0	0	1	2	0	0	3	5.50
	0.00	0.00	2.63	5.26	0.00	0.00	7.89	
	0.00	0.00	.05	.11	0.00	0.00	.17	
ESE	0	0	1	0	0	0	1	4.40
	0.00	0.00	2.63	0.00	0.00	0.00	2.63	
	0.00	0.00	.05	0.00	0.00	0.00	.05	
SE	0	1	3	0	0	0	4	3.20
	0.00	2.63	7.89	0.00	0.00	0.00	10.53	
	0.00	.05	.17	0.00	0.00	0.00	.23	
SSE	0	0	0	0	0	0	0	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
S	0	0	1	0	0	0	1	4.30
	0.00	0.00	2.63	0.00	0.00	0.00	2.63	
	0.00	0.00	.05	0.00	0.00	0.00	.05	
SSW	0	0	1	1	3	0	5	7.42
	0.00	0.00	2.63	2.63	7.89	0.00	13.16	
	0.00	0.00	.06	.05	.17	0.00	.28	
SW	0	0	0	2	0	0	2	7.15
	0.00	0.00	0.00	5.26	0.00	0.00	5.26	
	0.00	0.00	0.00	.11	0.00	0.00	.11	
WSW	0	1	0	0	0	0	1	2.70
	0.00	2.63	0.00	0.00	0.00	0.00	2.63	
	0.00	.06	0.00	0.00	0.00	0.00	.06	
W	0	4	2	1	0	0	7	3.31
	0.00	10.53	5.26	2.63	0.00	0.00	18.42	
	0.00	.23	.11	.06	0.00	0.00	.39	
WNW	0	1	2	2	1	0	6	5.23
	0.00	2.63	5.26	5.26	2.63	0.00	15.79	
	0.00	.06	.11	.11	.06	0.00	.34	
NW	0	0	1	1	1	1	4	7.32
	0.00	0.00	2.63	2.63	2.63	2.63	10.53	
	0.00	0.00	.06	.06	.06	.06	.23	
NNW	0	0	0	0	2	0	2	8.25
	0.00	0.00	0.00	0.00	5.26	0.00	5.26	
	0.00	0.00	0.00	0.00	.11	0.00	.11	
N	0	0	0	0	0	0	0	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
CALM	0						0	CALM
	0.00						0.00	
	0.00						0.00	
TOTAL	0	7	14	9	7	1	38	5.26
	0.00	18.42	36.84	23.68	18.42	2.63	100.00	
	0.00	.39	.79	.51	.39	.06	2.14	

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 15.08.15.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7577-043-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0	0	0	0	0	0	0	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
NE	0	0	1	0	0	0	1	4.10
	0.00	0.00	1.89	0.00	0.00	0.00	1.89	
	0.00	0.00	.06	0.00	0.00	0.00	.06	
ENE	0	0	2	2	0	0	4	4.45
	0.00	0.00	3.77	3.77	0.00	0.00	7.55	
	0.00	0.00	.11	.11	0.00	0.00	.23	
E	0	0	2	0	0	0	2	4.35
	0.00	0.00	3.77	0.00	0.00	0.00	3.77	
	0.00	0.00	.11	0.00	0.00	0.00	.11	
ESE	0	1	1	0	0	0	2	[illegible]
	0.00	1.89	1.89	0.00	0.00	0.00	3.77	
	0.00	.06	.06	0.00	0.00	0.00	.11	
SE	0	0	1	1	0	0	2	[illegible]
	0.00	0.00	1.89	1.89	0.00	0.00	3.77	
	0.00	0.00	.06	.06	0.00	0.00	.11	
SSE	0	0	1	0	0	0	1	4.00
	0.00	0.00	1.89	0.00	0.00	0.00	1.89	
	0.00	0.00	.06	0.00	0.00	0.00	.06	
S	0	0	1	3	0	0	4	5.75
	0.00	0.00	1.89	5.66	0.00	0.00	7.55	
	0.00	0.00	.06	.17	0.00	0.00	.23	
SSW	0	0	1	7	2	0	10	[illegible]
	0.00	0.00	1.89	13.21	3.77	0.00	18.87	
	0.00	0.00	.06	.39	.11	0.00	.56	
SW	0	0	2	0	0	0	2	3.50
	0.00	0.00	3.77	0.00	0.00	0.00	3.77	
	0.00	0.00	.11	0.00	0.00	0.00	.11	
WSW	0	1	1	0	0	0	2	2.45
	0.00	1.89	1.89	0.00	0.00	0.00	3.77	
	0.00	.06	.06	0.00	0.00	0.00	.11	
W	0	1	4	0	1	0	6	4.17
	0.00	1.89	7.55	0.00	1.89	0.00	11.32	
	0.00	.06	.23	0.00	.06	0.00	.34	
WNW	0	1	3	0	1	0	5	[illegible]
	0.00	1.89	5.66	0.00	1.89	0.00	9.43	
	0.00	.06	.17	0.00	.06	0.00	.28	
NW	0	0	3	3	1	0	7	5.29
	0.00	0.00	5.66	5.66	1.89	0.00	13.21	
	0.00	0.00	.17	.17	.06	0.00	.39	
NNW	0	1	0	1	3	0	5	[illegible]
	0.00	1.89	0.00	1.89	5.66	0.00	9.43	
	0.00	.06	0.00	.06	.17	0.00	.28	
N	0	0	0	0	0	0	0	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
CALM	0						0	CALM
	0.00						0.00	
	0.00						0.00	
TOTAL	0	5	23	17	8	0	53	5.14
	0.00	9.43	43.40	32.08	15.09	0.00	100.00	
	0.00	.28	1.30	.96	.45	0.00	2.99	

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 15.08.15.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7577-043-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	1	13	23	12	1	0	50	4.06
	.12	1.59	2.82	1.47	.12	0.00	6.12	
	.06	.73	1.30	.68	.06	0.00	2.82	
NE	1	18	25	9	0	0	53	3.74
	.12	2.20	3.06	1.10	0.00	0.00	6.49	
	.06	1.02	1.41	.51	0.00	0.00	2.99	
ENE	1	7	22	15	0	0	45	4.47
	.12	.86	2.69	1.84	0.00	0.00	5.51	
	.06	.39	1.24	.85	0.00	0.00	2.54	
E	1	7	26	4	1	0	39	4.02
	.12	.86	3.18	.49	.12	0.00	4.77	
	.06	.39	1.47	.23	.06	0.00	2.20	
ESE	0	4	25	11	0	0	40	4.32
	0.00	.49	3.06	1.35	0.00	0.00	4.90	
	0.00	.23	1.41	.62	0.00	0.00	2.26	
SE	0	10	23	13	6	0	52	4.70
	0.00	1.22	2.82	1.59	.73	0.00	6.36	
	0.00	.56	1.30	.73	.34	0.00	2.93	
SSE	2	7	6	9	0	0	24	4.17
	.24	.86	.73	1.10	0.00	0.00	2.94	
	.11	.39	.34	.51	0.00	0.00	1.35	
S	1	6	5	15	4	0	31	5.42
	.12	.73	.61	1.84	.49	0.00	3.79	
	.06	.34	.28	.85	.23	0.00	1.75	
SSW	1	6	10	10	5	0	32	4.97
	.12	.73	1.22	1.22	.61	0.00	3.92	
	.06	.34	.56	.56	.28	0.00	1.80	
SW	0	4	2	6	0	0	12	4.72
	0.00	.49	.24	.73	0.00	0.00	1.47	
	0.00	.23	.11	.34	0.00	0.00	.68	
WSW	2	4	8	8	0	0	22	4.17
	.24	.49	.98	.98	0.00	0.00	2.69	
	.11	.23	.45	.45	0.00	0.00	1.24	
W	0	9	27	8	9	0	53	4.77
	0.00	1.10	3.30	.98	1.10	0.00	6.49	
	0.00	.51	1.52	.45	.51	0.00	2.99	
WNW	4	14	30	20	14	0	82	4.77
	.49	1.71	3.67	2.45	1.71	0.00	10.04	
	.23	.79	1.69	1.13	.79	0.00	4.62	
NW	4	18	46	35	6	0	109	4.55
	.49	2.20	5.63	4.28	.73	0.00	13.34	
	.23	1.02	2.59	1.97	.34	0.00	6.15	
NNW	3	14	45	24	12	0	98	[illegible]
	.37	1.71	5.51	2.94	1.47	0.00	12.00	
	.17	.79	2.54	1.35	.68	0.00	5.53	
N	1	12	28	25	7	2	75	6.43
	.12	1.47	3.43	3.06	.86	.24	9.18	
	.06	.68	1.58	1.41	.39	.11	4.23	
CALM	0						0	CALM
	0.00						0.00	
	0.00						0.00	
TOTAL	22	153	351	224	65	2	817	4.56
	2.69	18.73	42.96	27.42	7.96	.24	100.00	
	1.24	8.63	19.80	12.63	3.67	.11	46.08	

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-60 (Continued) (Sheet 6 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - FEBRUARY

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 15.08.15.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7577-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	4 .67 .23	9 1.50 .51	4 .67 .23	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	17 2.84 .96	2.44
NE	10 1.67 .56	18 3.01 1.02	2 .33 .11	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	30 5.01 1.69	2.13
ENE	5 .83 .28	10 1.67 .56	14 2.34 .79	3 .50 .17	0 0.00 0.00	0 0.00 0.00	32 5.34 1.80	3.[illegible]
E	4 .67 .23	13 2.17 .73	32 5.34 1.80	3 .50 .17	0 0.00 0.00	0 0.00 0.00	52 8.68 2.93	3.33
ESE	5 .83 .28	19 3.17 1.07	32 5.34 1.80	2 .33 .11	0 0.00 0.00	0 0.00 0.00	58 9.68 3.27	3.14
SE	3 .50 .17	30 5.01 1.69	51 8.51 2.87	19 3.17 1.07	0 0.00 0.00	0 0.00 0.00	103 17.20 5.81	3.74
SSE	1 .17 .06	2 .33 .11	23 3.84 1.30	6 1.00 .34	0 0.00 0.00	0 0.00 0.00	32 5.34 1.80	4.22
S	1 .17 .06	6 1.00 .34	14 2.34 .79	23 3.84 1.30	0 0.00 0.00	0 0.00 0.00	44 7.35 2.48	4.55
SSW	1 .17 .06	6 1.00 .34	6 1.00 .34	12 2.00 .68	4 .67 .23	0 0.00 0.00	29 4.84 1.63	4.75
SW	2 .33 .11	3 .50 .17	9 1.50 .51	6 1.00 .34	0 0.00 0.00	0 0.00 0.00	20 3.34 1.13	4.15
WSW	3 .50 .17	9 1.50 .51	11 1.84 .62	5 .83 .28	0 0.00 0.00	0 0.00 0.00	28 4.67 1.58	3.43
W	0 0.00 0.00	9 1.50 .51	14 2.34 .79	3 .50 .17	0 0.00 0.00	0 0.00 0.00	26 4.34 1.47	3.53
WNW	2 .33 .11	12 2.00 .68	16 2.67 .90	9 1.50 .51	0 0.00 0.00	0 0.00 0.00	39 6.51 2.20	3.41
NW	3 .50 .17	12 2.00 .68	25 4.17 1.41	2 .33 .11	0 0.00 0.00	0 0.00 0.00	42 7.01 2.37	3.44
NNW	3 .50 .17	14 2.34 .79	8 1.34 .45	1 .17 .06	1 .17 .06	0 0.00 0.00	27 4.51 1.52	2.[illegible]
N	5 .83 .28	3 .50 .17	6 1.00 .34	5 .83 .28	0 0.00 0.00	0 0.00 0.00	19 3.17 1.07	3.[illegible]
CALM	1 .17 .06						1 .17 .06	CALM
TOTAL	53 8.85 2.99	175 29.22 9.87	267 44.57 15.06	99 16.53 5.58	5 .83 .28	0 0.00 0.00	599 100.00 33.78	3.57

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 15.08.15.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7577-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ESE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SE	0 0.00 0.00	6 13.91 .34	14 32.71 1.02	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	20 46.66 1.35	3.26
SSE	0 0.00 0.00	3 7.03 .17	13 23.64 .73	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	16 [illegible] .90	3.44
S	0 0.00 0.00	2 3.64 .11	1 1.82 .06	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 5.45 .17	2.43
SSW	0 0.00 0.00	2 3.64 .11	4 7.27 .23	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 10.91 .34	3.43
SW	0 0.00 0.00	2 3.64 .11	2 3.64 .11	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 7.27 .23	3.11
WSW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
W	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
WNW	0 0.00 0.00	0 0.00 0.00	1 1.82 .06	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.82 .06	4.1[illegible]
NW	0 0.00 0.00	1 1.82 .06	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.82 .06	2.[illegible]
NNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	0 0.00 0.00	16 29.09 .90	39 70.91 2.20	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	55 100.00 3.10	3.24

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - FEBRUARY

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 15.08.15.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7577-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	3 1.75 .17	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 1.75 .17	2.[illegible]7
NE	0 0.00 0.00	4 2.34 .23	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 2.34 .23	2.[illegible]2
ENE	1 .58 .06	1 .58 .06	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.17 .11	1.[illegible]
E	3 1.75 .17	3 1.75 .17	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 3.51 .34	1.65
ESE	0 0.00 0.00	3 1.75 .17	4 2.34 .23	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 4.09 .39	2.66
SE	1 .58 .06	9 5.26 .51	22 12.87 1.24	1 .58 .06	0 0.00 0.00	0 0.00 0.00	33 19.30 1.86	3.25
SSE	0 0.00 0.00	2 1.17 .11	10 5.85 .56	1 .58 .06	0 0.00 0.00	0 0.00 0.00	13 7.60 .73	3.46
S	0 0.00 0.00	9 5.26 .51	14 8.19 .79	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	23 13.45 1.30	3.37
SSW	1 .58 .06	5 2.92 .28	7 4.09 .39	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	13 7.60 .73	3.17
SW	0 0.00 0.00	5 2.92 .28	15 8.77 .85	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	20 11.70 1.13	3.55
WSW	1 .58 .06	2 1.17 .11	7 4.09 .39	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	10 5.85 .56	3.44
W	0 0.00 0.00	3 1.75 .17	8 4.68 .45	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	11 6.43 .62	3.35
WNW	1 .58 .06	9 5.26 .51	3 1.75 .17	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	13 7.60 .73	2.44
NW	0 0.00 0.00	4 2.34 .23	2 1.17 .11	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 3.51 .34	2.45
NNW	1 .58 .06	2 1.17 .11	1 .58 .06	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 2.34 .23	2.[illegible]2
N	1 .58 .06	2 1.17 .11	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 1.75 .17	1.[illegible]7
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	10 5.85 .56	[illegible] 34.6[illegible] 3.7[illegible]	93 [illegible] [illegible]	2 1.17 .11	0 0.00 0.00	0 0.00 0.00	171 100.00 9.6[illegible]	3.10

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 15.08.15.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7577-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	5 .28	29 1.64	27 1.51	12 .67	1 .05	0 0.00	70 3.92	3.57
NE	12 .67	40 2.24	30 1.69	9 .50	0 0.00	0 0.00	91 5.09	3.15
ENE	7 .39	18 1.01	40 2.24	20 1.12	0 0.00	0 0.00	85 4.76	3.46
E	8 .45	23 1.29	61 3.41	13 .73	1 .05	0 0.00	106 5.93	3.48
ESE	6 .34	27 1.51	63 3.53	13 .73	0 0.00	0 0.00	109 6.10	3.58
SE	5 .28	56 3.13	118 6.60	26 1.46	6 .34	0 0.00	213 12.25	3.43
SSE	3 .17	14 .78	53 2.97	16 .90	0 0.00	0 0.00	86 4.81	4.00
S	2 .11	24 1.34	36 2.01	41 2.29	4 .22	0 0.00	107 5.99	4.56
SSW	3 .17	20 1.12	30 1.68	32 1.79	14 .78	0 0.00	99 5.54	4.42
SW	2 .11	15 .84	31 1.73	15 .84	0 0.00	0 0.00	63 3.53	4.11
WSW	6 .34	18 1.01	29 1.62	13 .73	0 0.00	0 0.00	66 3.69	3.76
W	1 .06	31 1.73	61 3.43	14 .78	11 .62	0 0.00	120 6.72	4.13
WNW	7 .39	40 2.24	58 3.25	33 1.85	16 .90	0 0.00	154 8.62	4.29
NW	7 .39	35 1.96	77 4.31	49 2.74	9 .50	1 .06	178 9.96	4.62
NNW	7 .39	31 1.73	54 [illegible]	26 1.45	14 [illegible]	0 0.00	136 7.61	4.49
N	7 .39	17 .95	34 1.90	30 1.68	7 .39	2 .11	97 5.43	4.50
CALM	1 .06						1 .06	CALM
TOTAL	89 4.98	474 26.52	796 44.54	370 20.71	83 4.64	3 .17	1787 100.00	4.08

NUMBER OF VALID OBSERVATIONS 1787 88.65 PCT.
NUMBER OF INVALID OBSERVATIONS 229 11.35 PCT.
TOTAL NUMBER OF OBSERVATIONS 2016 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-60 (Continued) (Sheet 7 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - FEBRUARY

STABILITY CLASS: PASQUILL A — CALLAWAY GENERATING STATION
DATA SOURCE: ON SITE — REFORM, MISSOURI
WIND SENSOR HEIGHT: 60.00 METERS — UNION ELECTRIC COMPANY
TABLE GENERATED: 05/22/79. 15.04.15. — DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NE	0 0.00 0.00	0 0.00 0.00	1 2.50 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.50 .05	[illegible]
ENE	0 0.00 0.00	0 0.00 0.00	1 2.50 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.50 .06	4.40
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ESE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 10.00 .23	0 0.00 0.00	0 0.00 0.00	4 10.00 .23	6.45
SE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SSE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
S	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SSW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.50 .05	0 0.00 0.00	0 0.00 0.00	1 2.50 .05	5.13
SW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.50 .05	2 5.00 .12	0 0.00 0.00	3 7.50 .18	7.73
WSW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
W	0 0.00 0.00	1 2.50 .05	6 15.00 .35	1 2.50 .05	0 0.00 0.00	1 2.50 .06	9 22.50 .53	5.12
WNW	0 0.00 0.00	2 5.00 .12	3 7.50 .18	3 7.50 .18	2 5.00 .12	0 0.00 0.00	10 25.00 .59	5.32
NW	0 0.00 0.00	0 0.00 0.00	1 2.50 .06	0 0.00 0.00	7 17.50 .41	0 0.00 0.00	8 20.00 .47	8.29
NNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 7.50 .18	0 0.00 0.00	3 7.50 .18	9.50
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	0 0.00 0.00	3 7.50 .19	12 30.00 .70	10 25.00 .59	14 35.00 .82	1 2.50 .06	40 100.00 2.35	5.47

STABILITY CLASS: PASQUILL C — CALLAWAY GENERATING STATION
DATA SOURCE: ON SITE — REFORM, MISSOURI
WIND SENSOR HEIGHT: 60.00 METERS — UNION ELECTRIC COMPANY
TABLE GENERATED: 05/22/79. 15.04.15. — DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	0 0.00 0.00	2 3.77 .12	3 5.66 .18	0 0.00 0.00	0 0.00 0.00	5 9.43 .29	5.44
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ESE	0 0.00 0.00	0 0.00 0.00	1 1.89 .06	2 3.77 .12	0 0.00 0.00	0 0.00 0.00	3 5.66 .18	5.17
SE	0 0.00 0.00	0 0.00 0.00	2 3.77 .12	1 1.89 .06	0 0.00 0.00	0 0.00 0.00	3 5.66 .18	[illegible]
SSE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
S	0 0.00 0.00	0 0.00 0.00	2 3.77 .12	1 1.89 .06	1 1.89 .06	0 0.00 0.00	4 7.55 .23	[illegible]
SSW	0 0.00 0.00	0 0.00 0.00	1 1.89 .06	5 9.43 .29	2 3.77 .12	1 1.89 .06	9 16.98 .53	7.78
SW	0 0.00 0.00	0 0.00 0.00	2 3.77 .12	1 1.89 .06	0 0.00 0.00	1 1.89 .06	4 7.55 .23	6.17
WSW	0 0.00 0.00	1 1.89 .06	1 1.89 .06	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.77 .12	3.35
W	0 0.00 0.00	1 1.89 .06	0 0.00 0.00	1 1.89 .06	0 0.00 0.00	1 1.89 .06	3 5.66 .18	6.00
WNW	0 0.00 0.00	1 1.89 .06	4 7.55 .23	1 1.89 .06	0 0.00 0.00	1 1.89 .06	7 13.21 .41	5.44
NW	0 0.00 0.00	0 0.00 0.00	4 7.55 .23	1 1.89 .06	1 1.89 .06	1 1.89 .06	7 13.21 .41	5.66
NNW	0 0.00 0.00	1 1.89 .06	0 0.00 0.00	1 1.89 .06	1 1.89 .06	0 0.00 0.00	3 5.66 .18	6.11
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 5.66 .18	3 5.66 .18	10.70
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	0 0.00 0.00	4 7.55 .23	19 35.85 1.12	17 32.08 1.00	5 9.43 .29	8 15.09 .47	53 100.00 3.11	6.14

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - FEBRUARY

STABILITY CLASS: PASQUILL B — CALLAWAY GENERATING STATION
DATA SOURCE: ON SITE — REFORM, MISSOURI
WIND SENSOR HEIGHT: 60.00 METERS — UNION ELECTRIC COMPANY
TABLE GENERATED: 05/22/79. 15.04.15. — DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.63 .06	0 0.00 0.00	0 0.00 0.00	1 2.63 .06	5.20
ENE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.63 .06	0 0.00 0.00	0 0.00 0.00	1 2.63 .06	5.20
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.63 .06	1 2.63 .06	0 0.00 0.00	2 5.26 .12	7.45
ESE	0 0.00 0.00	0 0.00 0.00	1 2.63 .06	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.63 .06	3.90
SE	0 0.00 0.00	0 0.00 0.00	4 10.53 .23	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 10.53 .23	3.95
SSE	0 0.00 0.00	0 0.00 0.00	1 2.63 .06	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.63 .06	[illegible]
S	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.63 .06	0 0.00 0.00	0 0.00 0.00	1 2.63 .06	5.10
SSW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.63 .06	0 0.00 0.00	0 0.00 0.00	1 2.63 .06	[illegible]
SW	0 0.00 0.00	0 0.00 0.00	1 2.63 .06	0 0.00 0.00	3 7.89 .18	2 5.26 .12	6 15.79 .35	8.45
WSW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
W	0 0.00 0.00	2 5.26 .12	3 7.89 .18	0 0.00 0.00	1 2.63 .06	0 0.00 0.00	6 15.79 .35	4.22
WNW	0 0.00 0.00	2 5.26 .12	1 2.63 .06	2 5.26 .12	2 5.26 .12	1 2.63 .06	8 21.05 .47	[illegible]
NW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.63 .06	0 0.00 0.00	2 5.26 .12	3 7.89 .18	10.90
NNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.63 .06	1 2.63 .06	2 5.26 .12	[illegible]
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.63 .06	1 2.63 .06	10.70
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	0 0.00 0.00	4 10.53 .23	11 28.95 .65	8 21.05 .47	8 21.05 .47	7 18.42 .41	38 100.00 2.23	6.43

STABILITY CLASS: PASQUILL D — CALLAWAY GENERATING STATION
DATA SOURCE: ON SITE — REFORM, MISSOURI
WIND SENSOR HEIGHT: 60.00 METERS — UNION ELECTRIC COMPANY
TABLE GENERATED: 05/22/79. 15.04.15. — DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	1 .13 .06	3 .38 .18	21 2.68 1.23	22 2.81 1.29	5 .64 .29	1 .13 .06	53 6.77 3.11	5.39
NE	2 .26 .12	12 1.53 .70	13 1.66 .76	13 1.66 .76	3 .38 .18	0 0.00 0.00	43 5.49 2.52	[illegible]
ENE	0 0.00 0.00	4 .51 .23	14 1.79 .82	29 3.70 1.70	1 .13 .06	0 0.00 0.00	48 6.13 2.82	5.14
E	0 0.00 0.00	2 .26 .12	17 2.17 1.00	10 1.28 .59	2 .26 .12	1 .13 .06	32 4.09 1.88	5.24
ESE	1 .13 .06	4 .51 .23	10 1.28 .59	35 4.47 2.05	0 0.00 0.00	0 0.00 0.00	50 6.39 2.94	5.73
SE	0 0.00 0.00	5 .64 .29	10 1.28 .59	9 1.15 .53	7 .89 .41	5 .64 .29	36 4.60 2.11	6.18
SSE	0 0.00 0.00	4 .51 .23	14 1.79 .82	14 1.79 .82	2 .26 .12	0 0.00 0.00	34 4.34 2.00	[illegible]
S	0 0.00 0.00	3 .38 .18	9 1.15 .53	13 1.66 .76	9 1.15 .53	2 .26 .12	36 4.60 2.11	6.15
SSW	1 .13 .06	6 .77 .35	7 .89 .41	6 .77 .35	7 .89 .41	3 .38 .18	30 3.83 1.76	5.75
SW	0 0.00 0.00	2 .26 .12	6 .77 .35	1 .13 .06	8 1.02 .47	2 .26 .12	19 2.43 1.12	6.44
WSW	0 0.00 0.00	2 .26 .12	4 .51 .23	11 1.40 .65	4 .51 .23	0 0.00 0.00	21 2.68 1.23	6.06
W	0 0.00 0.00	5 .64 .29	12 1.53 .70	17 2.17 1.00	4 .51 .23	5 .64 .29	43 5.49 2.52	[illegible]
WNW	3 .38 .18	6 .77 .35	21 2.68 1.23	14 1.79 .82	13 1.66 .76	15 1.92 .88	72 9.20 4.23	6.59
NW	0 0.00 0.00	8 1.02 .47	26 3.32 1.53	22 2.81 1.29	13 1.66 .76	11 1.40 .65	80 10.22 4.70	6.27
NNW	3 .38 .18	6 .77 .35	36 4.60 2.11	37 4.73 2.17	33 4.21 1.94	2 .26 .12	117 14.94 6.87	[illegible]
N	0 0.00 0.00	8 1.02 .47	18 2.30 1.06	20 2.55 1.17	14 1.79 .82	9 1.15 .53	69 8.81 4.05	6.47
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	11 1.40 .65	80 10.22 4.70	238 30.40 13.98	273 34.87 16.03	125 15.96 7.34	56 7.15 3.29	783 100.00 45.98	[illegible]

KEY: XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-60 (Continued) (Sheet 8 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - FEBRUARY

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79, 15.09.15.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ENE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
E	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ESE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SSE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
S	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
W	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WNW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NNW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CALM	[illegible]						[illegible]	CALM
TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79, 15.09.15.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ENE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
E	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ESE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SSE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
S	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
W	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WNW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NNW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
CALM	[illegible]						[illegible]	CALM
TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	100.00	[illegible]

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - FEBRUARY

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79, 15.09.15.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ENE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
E	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ESE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SSE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
S	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
W	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
WNW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
NNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 1.19 / .12	1 / .59 / .06	1 / .59 / .05	0 / 0.00 / 0.00	4 / 2.35 / .23	[illegible]
N	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / [illegible] / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / .59 / .05	[illegible]
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	0 / 0.00 / 0.00	12 / 7.06 / .70	36 / 21.18 / 2.11	81 / 47.65 / 4.76	41 / 24.12 / 2.41	0 / 0.00 / 0.00	170 / 100.00 / 9.98	6.19

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79, 15.09.15.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	2 / .12	6 / .35	29 / 1.69	28 / 1.63	6 / .35	1 / .06	72 / 4.19	5.17
NE	2 / .12	16 / .93	24 / 1.40	16 / .93	3 / .17	0 / 0.00	61 / 3.55	4.14
ENE	2 / .12	8 / .47	39 / 2.27	35 / 2.04	2 / .12	0 / 0.00	86 / 5.01	4.77
E	0 / 0.00	6 / .35	38 / 2.21	24 / 1.40	3 / .17	1 / .06	77 / 4.48	4.44
ESE	1 / .06	9 / .52	30 / 1.75	66 / 3.84	0 / 0.00	0 / 0.00	106 / 6.17	5.34
SE	3 / .17	16 / .92	44 / 2.55	51 / 2.97	20 / 1.15	4 / .24	137 / 7.98	5.88
SSE	1 / .06	21 / 1.22	38 / 2.21	65 / 3.79	22 / 1.28	1 / .06	148 / 8.62	5.50
S	4 / .23	5 / .29	21 / 1.22	55 / 3.20	31 / 1.81	3 / .17	[illegible]	[illegible]
SSW	2 / .12	9 / .52	16 / .93	42 / 2.42	31 / 1.81	7 / .41	[illegible]	[illegible]
SW	2 / .12	6 / .35	16 / .93	20 / 1.15	39 / 2.27	6 / .35	89 / 5.18	[illegible]
WSW	1 / .06	8 / .47	8 / .47	23 / 1.34	26 / 1.53	1 / .05	69 / 4.02	[illegible]
W	1 / .05	12 / .70	27 / 1.57	39 / 2.27	20 / 1.16	7 / .41	106 / 6.17	[illegible]
WNW	5 / .29	16 / .92	36 / 1.94	[illegible]	22 / 1.28	17 / .99	[illegible]	6.19
NW	1 / .06	8 / .47	39 / 2.27	[illegible] / 3.84	26 / 1.60	15 / .87	[illegible]	6.43
NNW	3 / .17	9 / .52	45 / 2.62	[illegible]	40 / 2.33	3 / .17	156 / 9.09	[illegible]
N	0 / 0.00	11 / .64	26 / 1.51	26 / 1.51	16 / .92	13 / .76	90 / 5.24	6.39
CALM	0 / 0.00						0 / 0.00	CALM
TOTAL	30 / 1.75	[illegible]	476 / 27.71	[illegible] / [illegible].74	305 / 17.76	60 / [illegible]	1717 / 100.00	[illegible]

NUMBER OF VALID OBSERVATIONS 1717 [illegible] PCT.
NUMBER OF INVALID OBSERVATIONS [illegible] [illegible] PCT.
TOTAL NUMBER OF OBSERVATIONS [illegible] 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-60 (Continued) (Sheet 9 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - MARCH

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 11.03.49.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	1 .63 .05	2 1.26 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 1.89 .15	3.40
NE	0 0.00 0.00	3 1.89 .15	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 1.89 .15	2.80
ENE	1 .63 .05	0 0.00 0.00	6 3.77 .31	4 2.52 .20	0 0.00 0.00	0 0.00 0.00	11 6.92 .56	4.37
E	0 0.00 0.00	1 .63 .05	0 0.00 0.00	0 0.00 0.00	2 1.26 .10	0 0.00 0.00	3 1.89 .15	6.60
ESE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .63 .05	5 3.14 .25	0 0.00 0.00	6 3.77 .31	8.27
SE	0 0.00 0.00	1 .63 .05	1 .63 .05	0 0.00 0.00	1 .63 .05	2 1.26 .10	5 3.14 .25	7.72
SSE	0 0.00 0.00	2 1.26 .10	10 6.29 .51	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	12 7.55 .61	3.64
S	0 0.00 0.00	2 1.26 .10	9 5.66 .46	9 5.66 .46	0 0.00 0.00	0 0.00 0.00	20 12.58 1.02	4.87
SSW	0 0.00 0.00	3 1.89 .15	7 4.40 .36	5 3.14 .25	5 3.14 .25	1 .63 .05	21 13.21 1.07	5.73
SW	0 0.00 0.00	1 .63 .05	3 1.89 .15	5 3.14 .25	3 1.89 .15	0 0.00 0.00	12 7.55 .61	6.03
WSW	0 0.00 0.00	3 1.89 .15	2 1.26 .10	0 0.00 0.00	1 .63 .05	4 2.52 .20	10 6.29 .51	6.81
W	0 0.00 0.00	2 1.26 .10	7 4.40 .36	7 4.40 .36	3 1.89 .15	2 1.26 .10	21 13.21 1.07	6.22
WNW	0 0.00 0.00	1 .63 .05	7 4.40 .36	1 .63 .05	10 6.29 .51	0 0.00 0.00	19 11.95 .97	6.62
NW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 2.52 .20	2 1.26 .10	0 0.00 0.00	6 3.77 .31	6.73
NNW	0 0.00 0.00	1 .63 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .63 .05	2.70
N	0 0.00 0.00	0 0.00 0.00	4 2.52 .20	2 1.26 .10	0 0.00 0.00	0 0.00 0.00	6 3.77 .31	4.92
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	1 .63 .05	21 13.21 1.07	58 36.48 2.95	38 23.90 1.93	32 20.13 1.63	9 5.66 .46	159 100.00 8.09	5.70

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - MARCH

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 11.03.49.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	1 1.03 .05	2 2.06 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 3.09 .15	3.10
NE	0 0.00 0.00	1 1.03 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.03 .05	3.00
ENE	0 0.00 0.00	3 3.09 .15	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 3.09 .15	2.17
E	0 0.00 0.00	1 1.03 .05	0 0.00 0.00	0 0.00 0.00	1 1.03 .05	0 0.00 0.00	2 2.06 .10	4.70
ESE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SE	0 0.00 0.00	1 1.03 .05	3 3.09 .15	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 4.12 .20	3.22
SSE	1 1.03 .05	2 2.06 .10	1 1.03 .05	0 0.00 0.00	1 1.03 .05	0 0.00 0.00	5 5.15 .25	3.92
S	1 1.03 .05	4 4.12 .20	3 3.09 .15	6 6.19 .31	0 0.00 0.00	0 0.00 0.00	14 14.43 .71	4.26
SSW	0 0.00 0.00	1 1.03 .05	5 5.15 .25	2 2.06 .10	3 3.09 .15	0 0.00 0.00	11 11.34 .56	5.56
SW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.03 .05	2 2.06 .10	1 1.03 .05	4 4.12 .20	7.07
WSW	0 0.00 0.00	1 1.03 .05	2 2.06 .10	0 0.00 0.00	0 0.00 0.00	1 1.03 .05	4 4.12 .20	5.87
W	0 0.00 0.00	1 1.03 .05	5 5.15 .25	1 1.03 .05	3 3.09 .15	0 0.00 0.00	10 10.31 .51	5.37
WNW	0 0.00 0.00	3 3.09 .15	2 2.06 .10	2 2.06 .10	3 3.09 .15	0 0.00 0.00	10 10.31 .51	5.30
NW	0 0.00 0.00	5 5.15 .25	2 2.06 .10	3 3.09 .15	2 2.06 .10	0 0.00 0.00	12 12.37 .61	4.74
NNW	1 1.03 .05	0 0.00 0.00	1 1.03 .05	3 3.09 .15	0 0.00 0.00	0 0.00 0.00	5 5.15 .25	4.24
N	1 1.03 .05	0 0.00 0.00	6 6.19 .31	2 2.06 .10	0 0.00 0.00	0 0.00 0.00	9 9.28 .46	4.23
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	4 4.12 .20	24 24.74 1.22	32 32.99 1.63	20 20.62 1.02	15 15.46 .76	2 2.06 .10	97 100.00 4.93	4.76

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 11.03.49.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	0 0.00 0.00	5 3.82 .25	4 3.05 .20	0 0.00 0.00	0 0.00 0.00	9 6.87 .46	4.88
NE	0 0.00 0.00	1 .76 .05	1 .76 .05	1 .76 .05	0 0.00 0.00	0 0.00 0.00	3 2.29 .15	3.97
ENE	0 0.00 0.00	0 0.00 0.00	1 .76 .05	3 2.29 .15	0 0.00 0.00	0 0.00 0.00	4 3.05 .20	5.65
E	0 0.00 0.00	0 0.00 0.00	1 .76 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .76 .05	4.90
ESE	0 0.00 0.00	1 .76 .05	0 0.00 0.00	2 1.53 .10	1 .76 .05	0 0.00 0.00	4 3.05 .20	6.52
SE	0 0.00 0.00	1 .76 .05	2 1.53 .10	2 1.53 .10	1 .76 .05	0 0.00 0.00	6 4.58 .31	4.75
SSE	0 0.00 0.00	1 .76 .05	3 2.29 .15	1 .76 .05	1 .76 .05	0 0.00 0.00	6 4.58 .31	5.07
S	0 0.00 0.00	0 0.00 0.00	4 3.05 .20	3 2.29 .15	2 1.53 .10	0 0.00 0.00	9 6.87 .46	5.90
SSW	0 0.00 0.00	0 0.00 0.00	2 1.53 .10	5 3.82 .25	3 2.29 .15	0 0.00 0.00	10 7.63 .51	6.43
SW	0 0.00 0.00	0 0.00 0.00	3 2.29 .15	1 .76 .05	1 .76 .05	1 .76 .05	6 4.58 .31	7.00
WSW	0 0.00 0.00	0 0.00 0.00	2 1.53 .10	0 0.00 0.00	2 1.53 .10	3 2.29 .15	7 5.34 .36	9.61
W	0 0.00 0.00	1 .76 .05	2 1.53 .10	0 0.00 0.00	1 .76 .05	1 .76 .05	5 3.82 .25	6.16
WNW	0 0.00 0.00	1 .76 .05	2 1.53 .10	9 6.87 .46	3 2.29 .15	1 .76 .05	16 12.21 .81	6.52
NW	0 0.00 0.00	1 .76 .05	6 4.58 .31	8 6.11 .41	2 1.53 .10	0 0.00 0.00	17 12.98 .86	5.31
NNW	0 0.00 0.00	1 .76 .05	4 3.05 .20	5 3.82 .25	0 0.00 0.00	0 0.00 0.00	10 7.63 .51	4.78
N	0 0.00 0.00	0 0.00 0.00	8 6.11 .41	9 6.87 .46	1 .76 .05	0 0.00 0.00	18 13.74 .92	5.34
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	0 0.00 0.00	8 6.11 .41	46 35.11 2.34	53 40.46 2.70	18 13.74 .92	6 4.58 .31	131 100.00 6.66	5.83

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 11.03.48.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	1 .12 [illegible]	11 1.31 [illegible]	37 4.41 [illegible]	3 .36 [illegible]	0 0.00 0.00	0 0.00 0.00	52 6.20 [illegible]	3.59
NE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.47
ENE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.46
E	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.17
ESE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5.30
SE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.69
SSE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5.02
S	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5.76
SSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5.99
SW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5.28
WSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5.22
W	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5.61
WNW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	5.48
NW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.95
NNW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.79
N	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.99
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	[illegible]	107 12.75 [illegible]	370 44.10 18.82	261 31.11 13.28	[illegible]	9 1.07 .46	[illegible] 100.00 [illegible]	4.95

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-60 (Continued) (Sheet 10 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - MARCH

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 11.03.45.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	9 1.58 .46	22 3.87 1.12	1 .18 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	32 5.62 1.63	1.43
NE	0 0.00 0.00	14 2.46 .71	5 .88 .25	1 .18 .05	10 1.76 .51	0 0.00 0.00	30 5.27 1.53	4.83
ENE	3 .53 .15	9 1.58 .46	4 .70 .20	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	16 2.81 .81	2.49
E	5 .88 .25	24 4.22 1.22	26 4.57 1.32	3 .53 .15	2 .35 .10	0 0.00 0.00	60 10.54 3.05	3.24
ESE	3 .53 .15	16 2.81 .81	25 4.39 1.27	10 1.76 .51	0 0.00 0.00	0 0.00 0.00	54 9.49 2.75	3.76
SE	4 .70 .20	9 1.58 .46	36 6.33 1.83	8 1.41 .41	0 0.00 0.00	0 0.00 0.00	57 10.02 2.90	3.85
SSE	4 .70 .20	6 1.05 .31	25 4.39 1.27	1 .18 .05	0 0.00 0.00	0 0.00 0.00	36 6.33 1.83	3.58
S	2 .35 .10	4 .70 .20	36 6.33 1.83	15 2.64 .76	3 .53 .15	0 0.00 0.00	60 10.54 3.05	4.54
SSW	1 .18 .05	5 .88 .25	33 5.80 1.68	16 2.81 .81	0 0.00 0.00	0 0.00 0.00	55 9.67 2.80	4.37
SW	0 0.00 0.00	5 .88 .25	6 1.05 .31	9 1.58 .46	1 .18 .05	0 0.00 0.00	21 3.69 1.07	4.82
WSW	1 .18 .05	7 1.23 .36	5 .88 .25	6 1.05 .31	4 .70 .20	3 .53 .15	26 4.57 1.32	5.51
W	4 .70 .20	12 2.11 .61	11 1.93 .56	2 .35 .10	3 .53 .15	0 0.00 0.00	32 5.62 1.63	3.51
WNW	3 .53 .15	9 1.58 .46	13 2.28 .66	2 .35 .10	0 0.00 0.00	0 0.00 0.00	27 4.75 1.37	2.97
NW	4 .70 .20	13 2.28 .66	9 1.58 .46	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	26 4.57 1.32	2.71
NNW	2 .35 .10	5 .88 .25	4 .70 .20	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	11 1.93 .56	2.63
N	7 1.23 .36	15 2.64 .76	4 .70 .20	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	26 4.57 1.32	2.21
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	52 9.14 2.64	175 30.76 8.90	243 42.71 12.36	73 12.83 3.71	23 4.04 1.17	3 .53 .15	569 100.00 28.94	3.69

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 11.03.49.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NE	1 3.23 .05	2 6.45 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 9.68 .15	1.83
ENE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ESE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SE	0 0.00 0.00	5 16.13 .25	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 16.13 .25	2.60
SSE	0 0.00 0.00	1 3.23 .05	10 32.26 .51	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	11 35.48 .56	3.35
S	0 0.00 0.00	0 0.00 0.00	2 6.45 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 6.45 .10	3.70
SSW	0 0.00 0.00	1 3.23 .05	2 6.45 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 9.68 .15	3.57
SW	0 0.00 0.00	2 6.45 .10	2 6.45 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 12.90 .20	2.62
WSW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
W	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
WNW	0 0.00 0.00	1 3.23 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 3.23 .05	2.30
NW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
N	1 3.23 .05	1 3.23 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 6.45 .10	1.70
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	2 6.45 .10	13 41.94 .66	16 51.61 .81	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	31 100.00 1.58	2.49

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - MARCH

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 11.03.48.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	ME SP
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	3 2.14 .15	8 5.71 .41	2 1.43 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	13 9.29 .66	2
NE	2 1.43 .10	3 2.14 .15	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 3.57 .25	1
ENE	0 0.00 0.00	1 .71 .05	1 .71 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.43 .10	2
E	0 0.00 0.00	1 .71 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .71 .05	1
ESE	1 .71 .05	2 1.43 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 2.14 .15	1
SE	0 0.00 0.00	8 5.71 .41	9 6.43 .46	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	17 12.14 .86	2
SSE	0 0.00 0.00	6 4.29 .31	8 5.71 .41	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	14 10.00 .71	3
S	1 .71 .05	6 4.29 .31	15 10.71 .76	2 1.43 .10	0 0.00 0.00	0 0.00 0.00	24 17.14 1.22	3
SSW	1 .71 .05	7 5.00 .36	10 7.14 .51	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	18 12.86 .92	3
SW	0 0.00 0.00	7 5.00 .36	13 9.29 .66	2 1.43 .10	0 0.00 0.00	0 0.00 0.00	22 15.71 1.12	3
WSW	0 0.00 0.00	5 3.57 .25	1 .71 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 4.29 .31	4
W	2 1.43 .10	3 2.14 .15	2 1.43 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 5.00 .36	2
WNW	0 0.00 0.00	0 0.00 0.00	1 .71 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .71 .05	3
NW	0 0.00 0.00	1 .71 .05	1 .71 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.43 .10	2
NNW	0 0.00 0.00	1 .71 .05	1 .71 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.43 .10	2
N	1 .71 .05	2 1.43 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 2.14 .15	1
CALM	0 0.00 0.00						0 0.00 0.00	C
TOTAL	11 7.86 .56	61 43.57 3.10	64 45.71 3.26	4 2.86 .20	0 0.00 0.00	0 0.00 0.00	140 100.00 7.12	3

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 11.03.49.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	ME SP
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	14 .66	43 2.01	49 2.30	7 .33	0 0.00	0 0.00	113 5.29	3
NE	5 .23	38 1.78	36 1.69	8 .37	11 .52	0 0.00	98 4.59	3
ENE	5 .23	17 .80	28 1.31	16 .75	0 0.00	0 0.00	66 3.09	3
E	7 .33	42 1.97	50 2.34	8 .37	6 .28	0 0.00	113 5.29	3
ESE	4 .19	32 1.50	65 3.04	26 1.22	19 .89	1 .05	147 6.89	4
SE	7 .33	32 1.50	113 5.29	38 1.78	2 .09	2 .09	194 9.09	4
SSE	5 .23	27 1.26	73 3.42	8 .37	7 .33	0 0.00	120 5.62	3
S	5 .23	23 1.08	83 3.89	46 2.15	19 .89	1 .05	177 8.29	4
SSW	2 .09	25 1.17	79 3.70	43 2.01	21 .98	2 .09	172 8.06	4
SW	1 .05	19 .89	35 1.64	26 1.22	12 .56	2 .09	95 4.45	4
WSW	3 .14	21 .98	26 1.22	28 1.31	7 .33	13 .61	98 4.59	5
W	6 .28	29 1.36	49 2.30	33 1.55	15 .70	7 .33	139 6.51	4
WNW	7 .33	31 1.45	50 2.34	50 2.34	42 1.97	1 .05	181 8.48	5
NW	6 .28	35 1.64	66 3.09	68 3.19	15 .70	0 0.00	190 8.90	4
NNW	3 .14	20 .94	48 2.25	45 2.11	2 .09	0 0.00	118 5.53	4
N	10 .47	21 .98	50 2.34	31 1.45	2 .09	0 0.00	114 5.34	4
CALM	0 0.00						0 0.00	C
TOTAL	90 4.22	455 21.31	900 42.15	481 22.53	180 8.43	29 1.36	2135 100.00	4

NUMBER OF VALID OBSERVATIONS 2135 95.65 PCT.
NUMBER OF INVALID OBSERVATIONS 97 4.35 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-60 (Continued) (Sheet 11 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - MARCH

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 14.09.30.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 2.52 / .21	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 2.52 / .21	4.47
NE	0 / 0.00 / 0.00	1 / .63 / .05	1 / .63 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 1.26 / .10	3.00
ENE	0 / 0.00 / 0.00	2 / 1.26 / .10	4 / 2.52 / .21	5 / 3.14 / .26	0 / 0.00 / 0.00	0 / 0.00 / 0.00	11 / 6.92 / .56	4.53
E	0 / 0.00 / 0.00	1 / .63 / .05	1 / .63 / .05	1 / .63 / .05	1 / .63 / .05	1 / .63 / .05	5 / 3.14 / .26	6.34
ESE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / .63 / .05	1 / .63 / .05	2 / 1.26 / .10	9.80
SE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / .63 / .05	0 / 0.00 / 0.00	3 / 1.89 / .15	2 / 1.26 / .10	6 / 3.77 / .31	8.80
SSE	0 / 0.00 / 0.00	1 / .63 / .05	7 / 4.40 / .36	1 / .63 / .05	0 / 0.00 / 0.00	2 / 1.26 / .10	11 / 6.92 / .56	5.77
S	0 / 0.00 / 0.00	1 / .63 / .05	8 / 5.03 / .41	6 / 3.77 / .31	0 / 0.00 / 0.00	0 / 0.00 / 0.00	15 / 9.43 / .77	4.76
SSW	0 / 0.00 / 0.00	3 / 1.89 / .15	4 / 2.52 / .21	11 / 6.92 / .56	2 / 1.26 / .10	2 / 1.26 / .10	22 / 13.84 / 1.13	6.18
SW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 1.89 / .15	5 / 3.14 / .26	4 / 2.52 / .21	4 / 2.52 / .21	16 / 10.06 / .82	8.26
WSW	0 / 0.00 / 0.00	2 / 1.26 / .10	2 / 1.26 / .10	2 / 1.26 / .10	2 / 1.26 / .10	4 / 2.52 / .21	12 / 7.55 / .62	8.32
W	0 / 0.00 / 0.00	3 / 1.89 / .15	1 / .63 / .05	9 / 5.66 / .46	4 / 2.52 / .21	4 / 2.52 / .21	21 / 13.21 / 1.08	7.50
WNW	0 / 0.00 / 0.00	1 / .63 / .05	1 / .63 / .05	7 / 4.40 / .36	2 / 1.26 / .10	5 / 3.14 / .26	16 / 10.06 / .82	8.36
NW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 2.52 / .21	1 / .63 / .05	6 / 3.77 / .31	11 / 6.92 / .56	9.31
NNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / .63 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / .63 / .05	3.10
N	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 2.52 / .21	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 2.52 / .21	5.62
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	0 / 0.00 / 0.00	15 / 9.43 / .77	38 / 23.90 / 1.95	55 / 34.59 / 2.82	20 / 12.58 / 1.03	31 / 19.50 / 1.59	159 / 100.00 / 8.16	6.92

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - MARCH

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 14.09.30.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 / 0.00 / 0.00	1 / 1.03 / .05	2 / 2.06 / .10	4 / 4.12 / .21	0 / 0.00 / 0.00	0 / 0.00 / 0.00	7 / 7.22 / .36	6.63
NE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.03 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.03 / .05	3.10
ENE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.03 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.03 / .05	[illegible]
E	1 / 1.03 / .05	2 / 2.06 / .10	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 3.09 / .15	1.73
ESE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.03 / .05	0 / 0.00 / 0.00	1 / 1.03 / .05	8.10
SE	0 / 0.00 / 0.00	1 / 1.03 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.03 / .05	2.30
SSE	0 / 0.00 / 0.00	2 / 2.06 / .10	2 / 2.06 / .10	2 / 2.06 / .10	0 / 0.00 / 0.00	0 / 0.00 / 0.00	6 / 6.19 / .31	3.52
S	0 / 0.00 / 0.00	3 / 3.09 / .15	1 / 1.03 / .05	2 / 2.06 / .10	1 / 1.03 / .05	1 / 1.03 / .05	8 / 8.25 / .41	5.49
SSW	0 / 0.00 / 0.00	3 / 3.09 / .15	2 / 2.06 / .10	5 / 5.15 / .26	1 / 1.03 / .05	1 / 1.03 / .05	12 / 12.37 / .62	5.36
SW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 2.06 / .10	3 / 3.09 / .15	3 / 3.09 / .15	3 / 3.09 / .15	11 / 11.34 / .56	[illegible]
WSW	0 / 0.00 / 0.00	1 / 1.03 / .05	1 / 1.03 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.03 / .05	3 / 3.09 / .15	7.73
W	0 / 0.00 / 0.00	3 / 3.09 / .15	1 / 1.03 / .05	4 / 4.12 / .21	0 / 0.00 / 0.00	3 / 3.09 / .15	11 / 11.34 / .56	6.27
WNW	0 / 0.00 / 0.00	1 / 1.03 / .05	2 / 2.06 / .10	1 / 1.03 / .05	3 / 3.09 / .15	2 / 2.06 / .10	9 / 9.28 / .46	7.11
NW	1 / 1.03 / .05	1 / 1.03 / .05	4 / 4.12 / .21	2 / 2.06 / .10	2 / 2.06 / .10	2 / 2.06 / .10	12 / 12.37 / .62	6.22
NNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 3.09 / .15	3 / 3.09 / .15	0 / 0.00 / 0.00	0 / 0.00 / 0.00	6 / 6.19 / .31	5.13
N	1 / 1.03 / .05	0 / 0.00 / 0.00	3 / 3.09 / .15	1 / 1.03 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 5.15 / .26	4.20
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	3 / 3.09 / .15	18 / 19.56 / .92	25 / 25.77 / 1.28	27 / 27.84 / 1.39	11 / 11.34 / .56	13 / 13.40 / .67	97 / 100.00 / 4.98	5.72

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 14.09.30.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 3.05 / .21	3 / 2.29 / .15	3 / 2.29 / .15	0 / 0.00 / 0.00	10 / 7.63 / .51	6.03
NE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 1.53 / .10	1 / .76 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 2.29 / .15	4.47
ENE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 1.53 / .10	2 / 1.53 / .10	1 / .76 / .05	0 / 0.00 / 0.00	5 / 3.82 / .26	6.02
E	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / .76 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / .76 / .05	5.30
ESE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / .76 / .05	1 / .76 / .05	2 / 1.53 / .10	9.75
SE	0 / 0.00 / 0.00	2 / 1.53 / .10	0 / 0.00 / 0.00	1 / .76 / .05	1 / .76 / .05	0 / 0.00 / 0.00	4 / 3.05 / .21	5.00
SSE	0 / 0.00 / 0.00	1 / .76 / .05	2 / 1.53 / .10	2 / 1.53 / .10	0 / 0.00 / 0.00	1 / .76 / .05	6 / 4.58 / .31	5.45
S	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 1.53 / .10	5 / 3.82 / .26	6 / 4.58 / .31	0 / 0.00 / 0.00	13 / 9.92 / .67	6.98
SSW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 2.29 / .15	4 / 3.05 / .21	1 / .76 / .05	8 / 6.11 / .41	7.91
SW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / .76 / .05	3 / 2.29 / .15	2 / 1.53 / .10	2 / 1.53 / .10	8 / 6.11 / .41	8.27
WSW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / .76 / .05	0 / 0.00 / 0.00	4 / 3.05 / .21	5 / 3.82 / .26	13.96
W	0 / 0.00 / 0.00	1 / .76 / .05	1 / .76 / .05	2 / 1.53 / .10	0 / 0.00 / 0.00	3 / 2.29 / .15	7 / 5.34 / .36	8.24
WNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 1.53 / .10	4 / 3.05 / .21	3 / 2.29 / .15	3 / 2.29 / .15	12 / 9.16 / .62	8.27
NW	0 / 0.00 / 0.00	1 / .76 / .05	5 / 3.82 / .26	7 / 5.34 / .36	5 / 3.82 / .26	4 / 3.05 / .21	22 / 16.79 / 1.13	7.29
NNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 2.29 / .15	2 / 1.53 / .10	1 / .76 / .05	0 / 0.00 / 0.00	6 / 4.58 / .31	5.90
N	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 3.05 / .21	11 / 8.40 / .56	4 / 3.05 / .21	0 / 0.00 / 0.00	19 / 14.50 / .97	6.23
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	0 / 0.00 / 0.00	5 / 3.82 / .26	28 / 21.37 / 1.44	48 / 36.64 / 2.46	31 / 23.66 / 1.59	19 / 14.50 / .97	131 / 100.00 / 6.72	7.19

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 14.09.30.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 / 0.00 / 0.00	4 / .48 / .21	28 / 3.36 / 1.44	18 / 2.16 / .92	3 / .36 / .15	0 / 0.00 / 0.00	53 / 6.36 / 2.72	4.79
NE	0 / 0.00 / 0.00	8 / .96 / .41	24 / 2.88 / 1.23	18 / 2.16 / .92	2 / .24 / .10	0 / 0.00 / 0.00	52 / 6.24 / 2.67	4.71
ENE	0 / 0.00 / 0.00	1 / .12 / .05	13 / 1.56 / .67	6 / .72 / .31	5 / .60 / .26	2 / .24 / .10	27 / 3.24 / 1.39	5.89
E	0 / 0.00 / 0.00	4 / .48 / .21	10 / 1.20 / .51	19 / 2.28 / .97	1 / .12 / .05	0 / 0.00 / 0.00	34 / 4.08 / 1.74	5.14
ESE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	12 / 1.44 / .62	16 / 1.92 / .82	6 / .72 / .31	10 / 1.20 / .51	44 / 5.28 / 2.26	7.10
SE	0 / 0.00 / 0.00	4 / .48 / .21	20 / 2.40 / 1.03	51 / 6.12 / 2.62	11 / 1.32 / .56	1 / .12 / .05	87 / 10.44 / 4.46	5.87
SSE	0 / 0.00 / 0.00	1 / .12 / .05	9 / 1.08 / .46	12 / 1.44 / .62	5 / .60 / .26	0 / 0.00 / 0.00	27 / 3.24 / 1.39	5.71
S	1 / .12 / .05	4 / .48 / .21	4 / .48 / .21	13 / 1.56 / .67	12 / 1.44 / .62	8 / .96 / .41	42 / 5.04 / 2.15	7.33
SSW	0 / 0.00 / 0.00	2 / .24 / .10	6 / .72 / .31	18 / 2.16 / .92	14 / 1.68 / .72	7 / .84 / .36	47 / 5.64 / 2.41	7.45
SW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	6 / .72 / .31	4 / .48 / .21	6 / .72 / .31	5 / .60 / .26	21 / 2.52 / 1.08	7.55
WSW	1 / .12 / .05	3 / .36 / .15	3 / .36 / .15	13 / 1.56 / .67	15 / 1.80 / .77	2 / .24 / .10	37 / 4.44 / 1.90	6.96
W	1 / .12 / .05	1 / .12 / .05	4 / .48 / .21	26 / 3.12 / 1.33	13 / 1.56 / .67	5 / .60 / .26	50 / 6.00 / 2.57	7.48
WNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	9 / 1.08 / .46	16 / 1.92 / .82	15 / 1.80 / .77	19 / 2.28 / .97	59 / 7.08 / 3.03	8.44
NW	1 / .12 / .05	4 / .48 / .21	14 / 1.68 / .72	32 / 3.84 / 1.64	39 / 4.68 / 2.00	15 / 1.80 / .77	105 / 12.61 / 5.39	7.37
NNW	0 / 0.00 / 0.00	8 / .96 / .41	17 / 2.04 / .87	54 / 6.48 / 2.77	25 / 3.00 / 1.28	1 / .12 / .05	105 / 12.61 / 5.39	6.25
N	0 / 0.00 / 0.00	1 / .12 / .05	12 / 1.44 / .62	20 / 2.40 / 1.03	10 / 1.20 / .51	0 / 0.00 / 0.00	43 / 5.16 / 2.21	6.18
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	4 / .48 / .21	45 / 5.40 / 2.31	191 / 22.93 / 9.80	336 / 40.34 / 17.24	182 / 21.85 / 9.34	75 / 9.00 / 3.85	833 / 100.00 / 42.74	6.55

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - MARCH

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 14.09.30.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	1 .18 .05	9 1.61 .46	18 3.21 .92	5 .89 .26	0 0.00 0.00	0 0.00 0.00	33 5.89 1.69	3.79
NE	1 .18 .05	5 .89 .26	16 2.86 .82	9 1.61 .46	0 0.00 0.00	1 .18 .05	32 5.71 1.64	4.36
ENE	0 0.00 0.00	1 .18 .05	6 1.07 .31	3 .54 .15	1 .18 .05	3 .54 .15	14 2.50 .72	6.49
E	3 .54 .15	6 1.07 .31	15 2.68 .77	13 2.32 .67	0 0.00 0.00	1 .18 .05	38 6.79 1.95	4.44
ESE	0 0.00 0.00	1 .18 .05	21 3.75 1.08	32 5.71 1.64	8 1.43 .41	1 .18 .05	63 11.25 3.23	5.92
SE	1 .18 .05	3 .54 .15	11 1.96 .56	40 7.14 2.05	11 1.96 .56	0 0.00 0.00	66 11.79 3.39	5.92
SSE	0 0.00 0.00	2 .36 .10	4 .71 .21	19 3.39 .97	3 .54 .15	0 0.00 0.00	28 5.00 1.44	6.11
S	0 0.00 0.00	5 .89 .26	2 .36 .10	27 4.82 1.39	9 1.61 .46	3 .54 .15	46 8.21 2.36	6.52
SSW	0 0.00 0.00	1 .18 .05	3 .54 .15	34 6.07 1.74	22 3.93 1.13	3 .54 .15	63 11.25 3.23	7.24
SW	0 0.00 0.00	0 0.00 0.00	4 .71 .21	18 3.21 .92	17 3.04 .87	0 0.00 0.00	39 6.96 2.00	7.26
WSW	0 0.00 0.00	2 .36 .10	8 1.43 .41	2 .36 .10	10 1.79 .51	8 1.43 .41	30 5.36 1.54	8.17
W	1 .18 .05	1 .18 .05	6 1.07 .31	7 1.25 .36	4 .71 .21	2 .36 .10	21 3.75 1.08	6.18
WNW	1 .18 .05	0 0.00 0.00	6 1.07 .31	14 2.50 .72	4 .71 .21	1 .18 .05	26 4.64 1.33	5.84
NW	1 .18 .05	1 .18 .05	6 1.07 .31	18 3.21 .92	0 0.00 0.00	0 0.00 0.00	26 4.64 1.33	5.24
NNW	0 0.00 0.00	5 .89 .26	4 .71 .21	9 1.61 .46	0 0.00 0.00	0 0.00 0.00	18 3.21 .92	4.57
N	1 .18 .05	3 .54 .15	9 1.61 .46	4 .71 .21	0 0.00 0.00	0 0.00 0.00	17 3.04 .87	4.03
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	10 1.79 .51	45 8.04 2.31	139 24.82 7.13	254 45.36 13.03	89 15.89 4.57	23 4.11 1.18	560 100.00 28.73	5.92

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 14.09.30.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
E	0 0.00 0.00	0 0.00 0.00	3 9.68 .15	1 3.23 .05	0 0.00 0.00	0 0.00 0.00	4 12.90 .21	4.40
ESE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 3.23 .05	0 0.00 0.00	0 0.00 0.00	1 3.23 .05	6.10
SSE	0 0.00 0.00	0 0.00 0.00	2 6.45 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 6.45 .10	4.35
S	0 0.00 0.00	0 0.00 0.00	1 3.23 .05	8 25.81 .41	2 6.45 .10	0 0.00 0.00	11 35.48 .56	6.36
SSW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 9.68 .15	1 3.23 .05	0 0.00 0.00	4 12.90 .21	6.40
SW	0 0.00 0.00	1 3.23 .05	1 3.23 .05	1 3.23 .05	4 12.90 .21	0 0.00 0.00	7 22.58 .36	6.69
WSW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 3.23 .05	0 0.00 0.00	0 0.00 0.00	1 3.23 .05	5.70
W	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
WNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 3.23 .05	0 0.00 0.00	1 3.23 .05	8.10
NW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	0 0.00 0.00	1 3.23 .05	7 22.58 .36	15 48.39 .77	8 25.81 .41	0 0.00 0.00	31 100.00 1.59	6.07

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - MARCH

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 14.09.30.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	0 0.00 0.00	3 2.17 .15	1 .72 .05	0 0.00 0.00	0 0.00 0.00	4 2.90 .21	4.60
NE	0 0.00 0.00	1 .72 .05	0 0.00 0.00	6 4.35 .31	0 0.00 0.00	0 0.00 0.00	7 5.07 .36	5.33
ENE	0 0.00 0.00	1 .72 .05	3 2.17 .15	5 3.62 .26	0 0.00 0.00	0 0.00 0.00	9 6.52 .46	4.70
E	0 0.00 0.00	0 0.00 0.00	1 .72 .05	2 1.45 .10	0 0.00 0.00	0 0.00 0.00	3 2.17 .15	4.90
ESE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.45 .10	0 0.00 0.00	0 0.00 0.00	2 1.45 .10	5.05
SE	0 0.00 0.00	0 0.00 0.00	3 2.17 .15	5 3.62 .26	0 0.00 0.00	0 0.00 0.00	8 5.80 .41	5.11
SSE	0 0.00 0.00	0 0.00 0.00	6 4.35 .31	6 4.35 .31	3 2.17 .15	0 0.00 0.00	15 10.87 .77	5.60
S	0 0.00 0.00	0 0.00 0.00	2 1.45 .10	8 5.80 .41	2 1.45 .10	0 0.00 0.00	12 8.70 .62	6.12
SSW	1 .72 .05	2 1.45 .10	1 .72 .05	13 9.42 .67	10 7.25 .51	0 0.00 0.00	27 19.57 1.39	6.60
SW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 6.52 .46	14 10.14 .72	1 .72 .05	24 17.39 1.23	7.88
WSW	0 0.00 0.00	0 0.00 0.00	1 .72 .05	9 6.52 .46	1 .72 .05	0 0.00 0.00	11 7.97 .56	5.41
W	0 0.00 0.00	0 0.00 0.00	1 .72 .05	4 2.90 .21	1 .72 .05	0 0.00 0.00	6 4.35 .31	6.33
WNW	0 0.00 0.00	0 0.00 0.00	2 1.45 .10	1 .72 .05	1 .72 .05	0 0.00 0.00	4 2.90 .21	5.85
NW	0 0.00 0.00	0 0.00 0.00	1 .72 .05	0 0.00 0.00	1 .72 .05	0 0.00 0.00	2 1.45 .10	6.25
NNW	1 .72 .05	0 0.00 0.00	1 .72 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.45 .10	2.60
N	0 0.00 0.00	1 .72 .05	0 0.00 0.00	0 0.00 0.00	1 .72 .05	0 0.00 0.00	2 1.45 .10	5.30
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	2 1.45 .10	5 3.62 .26	25 18.12 1.28	71 51.45 3.64	34 24.64 1.74	1 .72 .05	138 100.00 7.08	6.12

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 14.09.30.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	1 .05	16 .75	61 2.86	31 1.45	6 .28	0 0.00	115 5.39	4.52
NE	1 .05	16 .75	45 2.11	34 1.59	2 .09	1 .05	99 4.64	4.55
ENE	0 0.00	5 .23	31 1.45	21 .98	7 .33	5 .23	69 3.23	5.55
E	5 .23	15 .70	32 1.50	39 1.83	2 .09	2 .09	95 4.45	4.65
ESE	1 .05	2 .09	44 2.06	54 2.53	17 .80	13 .61	131 6.14	6.22
SE	1 .05	10 .47	44 2.06	108 5.06	26 1.22	3 .14	192 9.00	5.83
SSE	0 0.00	10 .47	36 1.69	52 2.44	11 .52	3 .14	112 5.25	5.52
S	1 .05	15 .70	21 .98	76 3.56	35 1.64	12 .56	160 7.50	6.48
SSW	1 .05	15 .70	19 .89	89 4.17	54 2.53	14 .66	192 9.00	6.82
SW	0 0.00	2 .09	18 .84	43 2.02	52 2.44	15 .70	130 6.09	7.63
WSW	1 .05	9 .42	16 .75	30 1.41	29 1.36	20 .94	105 4.92	7.66
W	2 .09	9 .42	18 .84	56 2.63	24 1.13	18 .84	127 5.95	7.15
WNW	1 .05	3 .14	25 1.17	51 2.39	40 1.88	35 1.64	155 7.27	7.72
NW	3 .14	7 .33	34 1.59	67 3.14	56 2.63	33 1.55	200 9.38	7.17
NNW	2 .09	15 .70	32 1.50	79 3.70	28 1.31	1 .05	157 7.36	5.84
N	2 .09	5 .23	28 1.31	42 1.97	17 .80	0 0.00	94 4.41	5.72
CALM	0 0.00						0 0.00	CALM
TOTAL	22 1.03	154 7.22	504 23.63	872 40.88	406 19.03	175 8.20	2133 100.00	6.32

NUMBER OF VALID OBSERVATIONS 2133 95.56 PCT.
NUMBER OF INVALID OBSERVATIONS 99 4.44 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-60 (Continued) (Sheet 13 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - APRIL

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 16.46.47.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	0 0.00 0.00	2 3.17 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.17 .10	3.50
E	0 0.00 0.00	0 0.00 0.00	1 1.59 .05	4 6.35 .19	0 0.00 0.00	0 0.00 0.00	5 7.94 .24	5.66
ESE	0 0.00 0.00	0 0.00 0.00	1 1.59 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.59 .05	3.70
SE	0 0.00 0.00	0 0.00 0.00	1 1.59 .05	2 3.17 .10	0 0.00 0.00	0 0.00 0.00	3 4.76 .15	5.70
SSE	0 0.00 0.00	0 0.00 0.00	1 1.59 .05	1 1.59 .05	0 0.00 0.00	0 0.00 0.00	2 3.17 .10	4.50
S	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SSW	0 0.00 0.00	0 0.00 0.00	2 3.17 .10	4 6.35 .19	0 0.00 0.00	0 0.00 0.00	6 9.52 .29	5.28
SW	0 0.00 0.00	1 1.59 .05	2 3.17 .10	2 3.17 .10	0 0.00 0.00	0 0.00 0.00	5 7.94 .24	4.42
WSW	0 0.00 0.00	0 0.00 0.00	1 1.59 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.59 .05	4.00
W	0 0.00 0.00	0 0.00 0.00	1 1.59 .05	7 11.11 .34	9 14.29 .44	0 0.00 0.00	17 26.98 .83	7.61
WNW	0 0.00 0.00	0 0.00 0.00	3 4.76 .15	5 7.94 .24	3 4.76 .15	0 0.00 0.00	11 17.46 .53	6.26
NW	0 0.00 0.00	0 0.00 0.00	3 4.76 .15	6 9.52 .29	0 0.00 0.00	0 0.00 0.00	9 14.29 .44	5.93
NNW	0 0.00 0.00	0 0.00 0.00	1 1.59 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.59 .05	4.70
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	0 0.00 0.00	1 1.59 .05	19 30.16 .92	31 49.21 1.51	12 19.05 .58	0 0.00 0.00	63 100.00 3.06	6.02

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 16.46.47.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	0 0.00 0.00	1 1.16 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.16 .05	3.10
NE	0 0.00 0.00	0 0.00 0.00	1 1.16 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.16 .05	4.00
ENE	0 0.00 0.00	0 0.00 0.00	3 3.49 .15	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 3.49 .15	4.00
E	0 0.00 0.00	0 0.00 0.00	1 1.16 .05	4 4.65 .19	0 0.00 0.00	0 0.00 0.00	5 5.81 .24	6.06
ESE	0 0.00 0.00	0 0.00 0.00	4 4.65 .19	6 6.98 .29	0 0.00 0.00	0 0.00 0.00	10 11.63 .49	5.27
SE	0 0.00 0.00	0 0.00 0.00	2 2.33 .10	1 1.16 .05	0 0.00 0.00	0 0.00 0.00	3 3.49 .15	4.73
SSE	0 0.00 0.00	0 0.00 0.00	4 4.65 .19	0 0.00 0.00	1 1.16 .05	2 2.33 .10	7 8.14 .34	6.59
S	0 0.00 0.00	1 1.16 .05	0 0.00 0.00	4 4.65 .19	1 1.16 .05	0 0.00 0.00	6 6.98 .29	5.97
SSW	0 0.00 0.00	1 1.16 .05	3 3.49 .15	0 0.00 0.00	1 1.16 .05	0 0.00 0.00	5 5.81 .24	4.08
SW	0 0.00 0.00	1 1.16 .05	2 2.33 .10	1 1.16 .05	1 1.16 .05	0 0.00 0.00	5 5.81 .24	4.78
WSW	0 0.00 0.00	0 0.00 0.00	1 1.16 .05	1 1.16 .05	1 1.16 .05	0 0.00 0.00	3 3.49 .15	6.33
W	0 0.00 0.00	0 0.00 0.00	3 3.49 .15	1 1.16 .05	1 1.16 .05	0 0.00 0.00	5 5.81 .24	5.5[illegible]
WNW	0 0.00 0.00	0 0.00 0.00	4 4.65 .19	6 6.98 .29	0 0.00 0.00	0 0.00 0.00	10 11.63 .49	5.31
NW	0 0.00 0.00	1 1.16 .05	5 5.81 .24	3 3.49 .15	1 1.16 .05	0 0.00 0.00	10 11.63 .49	5.09
NNW	0 0.00 0.00	0 0.00 0.00	7 8.14 .34	3 3.49 .15	0 0.00 0.00	0 0.00 0.00	10 11.63 .49	4.70
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 2.33 .10	0 0.00 0.00	0 0.00 0.00	2 2.33 .10	6.45
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	0 0.00 0.00	4 4.65 .19	41 47.67 1.99	32 37.21 1.56	7 8.14 .34	2 2.33 .10	86 100.00 4.18	5.27

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - APRIL

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 16.46.47.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NE	0 0.00 0.00	0 0.00 0.00	1 1.67 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.67 .05	3.50
ENE	0 0.00 0.00	1 1.67 .05	2 3.33 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 5.00 .15	3.33
E	0 0.00 0.00	0 0.00 0.00	1 1.67 .05	3 5.00 .15	0 0.00 0.00	0 0.00 0.00	4 6.67 .19	5.80
ESE	0 0.00 0.00	0 0.00 0.00	1 1.67 .05	3 5.00 .15	0 0.00 0.00	0 0.00 0.00	4 6.67 .19	5.77
SE	0 0.00 0.00	0 0.00 0.00	1 1.67 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.67 .05	3.80
SSE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
S	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.33 .10	0 0.00 0.00	0 0.00 0.00	2 3.33 .10	6.60
SSW	0 0.00 0.00	1 1.67 .05	3 5.00 .15	1 1.67 .05	0 0.00 0.00	0 0.00 0.00	5 8.33 .24	4.40
SW	1 1.67 .05	0 0.00 0.00	3 5.00 .15	2 3.33 .10	1 1.67 .05	0 0.00 0.00	7 11.67 .34	5.19
WSW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
W	0 0.00 0.00	1 1.67 .05	0 0.00 0.00	5 8.33 .24	4 6.67 .19	0 0.00 0.00	10 16.67 .49	6.71
WNW	0 0.00 0.00	0 0.00 0.00	4 6.67 .19	3 5.00 .15	0 0.00 0.00	0 0.00 0.00	7 11.67 .34	4.43
NW	0 0.00 0.00	1 1.67 .05	4 6.67 .19	3 5.00 .15	1 1.67 .05	0 0.00 0.00	9 15.00 .44	5.31
NNW	0 0.00 0.00	0 0.00 0.00	1 1.67 .05	3 5.00 .15	0 0.00 0.00	0 0.00 0.00	4 6.67 .19	5.22
N	0 0.00 0.00	0 0.00 0.00	1 1.67 .05	2 3.33 .10	0 0.00 0.00	0 0.00 0.00	3 5.00 .15	5.67
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	1 1.67 .05	4 6.67 .19	22 36.67 1.07	27 45.00 1.31	6 10.00 .29	0 0.00 0.00	60 100.00 2.92	5.30

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 16.46.47.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	3 .35 .15	15 1.76 .73	14 1.65 .68	4 .47 .19	3 .35 .15	0 0.00 0.00	39 4.59 1.90	3.66
NE	1 .12 .05	6 .71 .29	7 .82 .34	1 .12 .05	0 0.00 0.00	0 0.00 0.00	15 1.76 .73	3.43
ENE	1 .12 .05	8 .94 .39	20 2.35 .97	16 1.88 .78	0 0.00 0.00	0 0.00 0.00	45 5.29 2.19	4.37
E	1 .12 .05	3 .35 .15	16 1.88 .78	41 4.82 1.99	2 .24 .10	0 0.00 0.00	63 7.41 3.06	5.50
ESE	0 0.00 0.00	4 .47 .19	29 3.41 1.41	43 5.06 2.09	1 .12 .05	0 0.00 0.00	77 9.06 3.74	5.21
SE	0 0.00 0.00	4 .47 .19	29 3.41 1.41	19 2.24 .92	2 .24 .10	0 0.00 0.00	54 6.35 2.63	4.81
SSE	0 0.00 0.00	4 .47 .19	8 .94 .39	29 3.41 1.41	12 1.41 .58	4 .47 .19	57 6.71 2.77	6.49
S	0 0.00 0.00	6 .71 .29	18 2.12 .88	42 4.94 2.04	18 2.12 .88	1 .12 .05	85 10.00 4.13	6.10
SSW	0 0.00 0.00	8 .94 .39	12 1.41 .58	20 2.35 .97	12 1.41 .58	1 .12 .05	53 6.24 2.58	5.77
SW	1 .12 .05	3 .35 .15	8 .94 .39	18 2.12 .88	7 .82 .34	5 .59 .24	42 4.94 2.04	6.67
WSW	1 .12 .05	4 .47 .19	7 .82 .34	12 1.41 .58	7 .82 .34	5 .59 .24	36 4.24 1.75	6.36
W	0 0.00 0.00	1 .12 .05	10 1.18 .49	10 1.18 .49	7 .82 .34	8 .94 .39	36 4.24 1.75	6.97
WNW	1 .12 .05	8 .94 .39	21 2.47 1.02	41 4.82 1.99	13 1.53 .63	2 .24 .10	86 10.12 4.18	5.58
NW	2 .24 .10	4 .47 .19	24 2.82 1.17	27 3.18 1.31	4 .47 .19	0 0.00 0.00	61 7.18 2.97	5.10
NNW	1 .12 .05	9 1.06 .44	34 4.00 1.65	9 1.06 .44	0 0.00 0.00	0 0.00 0.00	53 6.24 2.58	4.13
N	2 .24 .10	8 .94 .39	17 2.00 .83	12 1.41 .58	9 1.06 .44	0 0.00 0.00	48 5.65 2.33	5.00
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	14 1.65 .68	95 11.18 4.62	274 32.24 13.32	344 40.47 16.72	97 11.41 4.72	26 3.06 1.26	850 100.00 41.32	5.41

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-60 (Continued) (Sheet 14 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - APRIL

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 16.46.47.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	5 .68 .24	9 1.22 .44	2 .27 .10	1 .14 .05	0 0.00 0.00	0 0.00 0.00	17 2.30 .83	2.21
NE	1 .14 .05	12 1.62 .58	4 .54 .19	2 .27 .10	0 0.00 0.00	0 0.00 0.00	19 2.57 .92	2.95
ENE	1 .14 .05	5 .68 .24	22 2.98 1.07	8 1.08 .39	0 0.00 0.00	0 0.00 0.00	36 4.87 1.75	4.31
E	2 .27 .10	21 2.84 1.02	39 5.28 1.90	16 2.17 .78	1 .14 .05	0 0.00 0.00	79 10.69 3.84	3.99
ESE	0 0.00 0.00	25 3.38 1.22	37 5.01 1.80	10 1.35 .49	0 0.00 0.00	0 0.00 0.00	72 9.74 3.50	3.73
SE	1 .14 .05	18 2.44 .88	30 4.06 1.46	12 1.62 .58	2 .27 .10	0 0.00 0.00	63 8.53 3.06	4.03
SSE	1 .14 .05	11 1.49 .53	47 6.36 2.28	18 2.44 .88	7 .95 .34	0 0.00 0.00	84 11.37 4.08	4.62
S	2 .27 .10	12 1.62 .58	47 6.36 2.28	31 4.19 1.51	11 1.49 .53	2 .27 .10	105 14.21 5.10	5.04
SSW	0 0.00 0.00	8 1.08 .39	30 4.06 1.46	18 2.44 .88	4 .54 .19	1 .14 .05	61 8.25 2.97	4.74
SW	3 .41 .15	4 .54 .19	15 2.03 .73	3 .41 .15	1 .14 .05	0 0.00 0.00	26 3.52 1.26	3.05
WSW	3 .41 .15	4 .54 .19	9 1.22 .44	6 .81 .29	2 .27 .10	1 .14 .05	25 3.38 1.22	4.61
W	3 .41 .15	11 1.49 .53	22 2.98 1.07	5 .68 .24	3 .41 .15	0 0.00 0.00	44 5.95 2.14	3.84
WNW	4 .54 .19	14 1.89 .68	13 1.76 .63	4 .54 .19	0 0.00 0.00	0 0.00 0.00	35 4.74 1.70	3.17
NW	6 .81 .29	17 2.30 .83	12 1.62 .58	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	35 4.74 1.70	2.62
NNW	2 .27 .10	8 1.08 .39	14 1.89 .68	1 .14 .05	0 0.00 0.00	0 0.00 0.00	25 3.38 1.22	3.06
N	3 .41 .15	5 .68 .24	4 .54 .19	1 .14 .05	0 0.00 0.00	0 0.00 0.00	13 1.75 .63	2.63
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	37 5.01 1.80	184 24.90 8.95	347 46.96 16.87	136 18.40 6.61	31 4.19 1.51	4 .54 .19	739 100.00 35.93	4.[illegible]

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - APRIL

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 16.46.47.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	1 .53 .05	3 1.60 .15	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 2.13 .19	1.65
NE	1 .53 .05	1 .53 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.06 .10	1.55
ENE	1 .53 .05	6 3.19 .29	0 0.00 0.00	1 .53 .05	0 0.00 0.00	0 0.00 0.00	8 4.26 .39	2.61
E	1 .53 .05	3 1.60 .15	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 2.13 .19	2.20
ESE	0 0.00 0.00	4 2.13 .19	1 .53 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 2.66 .24	2.60
SE	0 0.00 0.00	13 6.91 .63	10 5.32 .49	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	23 12.23 1.12	3.10
SSE	2 1.06 .10	14 7.45 .68	14 7.45 .68	1 .53 .05	0 0.00 0.00	0 0.00 0.00	31 16.49 1.51	3.01
S	1 .53 .05	11 5.85 .53	11 5.85 .53	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	23 12.23 1.12	2.99
SSW	0 0.00 0.00	6 3.19 .29	5 2.66 .24	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	11 5.85 .53	2.98
SW	1 .53 .05	4 2.13 .19	2 1.06 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 3.72 .34	2.69
WSW	4 2.13 .19	4 2.13 .19	3 1.60 .15	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	11 5.85 .53	2.37
W	1 .53 .05	7 3.72 .34	4 2.13 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	12 6.38 .58	2.63
WNW	2 1.06 .10	14 7.45 .68	4 2.13 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	20 10.64 .97	2.35
NW	0 0.00 0.00	7 3.72 .34	4 2.13 .19	1 .53 .05	0 0.00 0.00	0 0.00 0.00	12 6.38 .58	2.97
NNW	1 .53 .05	7 3.72 .34	2 1.06 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	10 5.32 .49	2.33
N	0 0.00 0.00	1 .53 .05	4 2.13 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 2.66 .24	3.32
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	16 8.51 .78	105 55.85 5.10	64 34.04 3.11	3 1.60 .15	0 0.00 0.00	0 0.00 0.00	188 100.00 9.14	2.75

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 16.46.47.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	1 1.41 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.41 .05	.90
NE	1 1.41 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.41 .05	1.30
ENE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
E	2 2.82 .10	1 1.41 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 4.23 .15	1.43
ESE	0 0.00 0.00	1 1.41 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.41 .05	2.20
SE	0 0.00 0.00	5 7.04 .24	8 11.27 .39	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	13 18.31 .63	3.17
SSE	0 0.00 0.00	5 7.04 .24	5 7.04 .24	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	10 14.08 .49	3.06
S	0 0.00 0.00	6 8.45 .29	1 1.41 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 9.86 .34	2.80
SSW	0 0.00 0.00	5 7.04 .24	2 2.82 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 9.86 .34	2.57
SW	1 1.41 .05	7 9.86 .34	1 1.41 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 12.68 .44	2.27
WSW	2 2.82 .10	1 1.41 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 4.23 .15	1.67
W	0 0.00 0.00	6 8.45 .29	1 1.41 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 9.86 .34	2.50
WNW	0 0.00 0.00	1 1.41 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.41 .05	2.60
NW	0 0.00 0.00	0 0.00 0.00	2 2.82 .10	2 2.82 .10	0 0.00 0.00	0 0.00 0.00	4 5.63 .19	4.95
NNW	1 1.41 .05	0 0.00 0.00	0 0.00 0.00	1 1.41 .05	0 0.00 0.00	0 0.00 0.00	2 2.82 .10	3.05
N	1 1.41 .05	1 1.41 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 2.82 .10	1.45
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	9 12.68 .44	39 54.93 1.90	20 28.17 .97	3 4.23 .15	0 0.00 0.00	0 0.00 0.00	71 100.00 3.45	2.59

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/22/79. 16.46.47.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	10 .47	28 1.32	17 .80	5 .24	3 .14	0 0.00	63 2.97	3.06
NE	7 .33	27 1.27	21 .99	4 .19	0 0.00	0 0.00	59 2.78	2.99
ENE	3 .14	25 1.18	56 2.64	27 1.27	0 0.00	0 0.00	111 5.23	4.08
E	7 .33	31 1.44	63 2.97	68 3.21	3 .14	0 0.00	172 8.11	4.55
ESE	0 0.00	36 1.70	77 3.63	62 2.92	1 .05	0 0.00	176 8.30	4.46
SE	1 .05	42 1.98	81 3.82	34 1.60	4 .19	0 0.00	162 7.64	4.10
SSE	3 .14	37 1.74	80 3.77	49 2.31	20 .94	6 .28	195 9.19	4.86
S	3 .14	36 1.70	77 3.63	79 3.72	30 1.41	3 .14	228 10.75	5.20
SSW	0 0.00	29 1.37	57 2.69	43 2.03	17 .80	2 .09	148 6.98	4.86
SW	7 .33	20 .94	33 1.56	26 1.23	10 .47	5 .24	101 4.76	4.97
WSW	10 .47	13 .61	21 .99	19 .90	10 .47	6 .28	79 3.72	5.04
W	4 .19	26 1.23	41 1.93	28 1.32	24 1.13	8 .38	131 6.18	5.29
WNW	7 .33	37 1.74	49 2.31	59 2.78	16 .75	2 .09	170 8.02	4.67
NW	8 .38	30 1.41	54 2.55	42 1.98	6 .28	0 0.00	140 6.60	4.36
NNW	5 .24	24 1.13	59 2.78	17 .80	0 0.00	0 0.00	105 4.95	3.78
N	6 .28	22 1.04	27 1.27	17 .80	9 .42	0 0.00	81 3.82	4.20
CALM	0 0.00						0 0.00	CALM
TOTAL	81 3.82	463 21.83	813 38.33	579 27.30	153 7.21	32 1.51	2121 100.00	4.55

NUMBER OF VALID OBSERVATIONS 2121 98.19 PCT.
NUMBER OF INVALID OBSERVATIONS 39 1.81 PCT.
TOTAL NUMBER OF OBSERVATIONS 2160 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-60 (Continued) (Sheet 15 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - APRIL

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 16.46.47.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	0 0.00 0.00	1 1.59 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.59 .05	3.40
E	0 0.00 0.00	0 0.00 0.00	2 3.17 .10	3 4.76 .15	0 0.00 0.00	0 0.00 0.00	5 7.94 .25	5.58
ESE	0 0.00 0.00	0 0.00 0.00	1 1.59 .05	1 1.59 .05	0 0.00 0.00	0 0.00 0.00	2 3.17 .10	5.60
SE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.59 .05	0 0.00 0.00	0 0.00 0.00	1 1.59 .05	6.70
SSE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
S	0 0.00 0.00	0 0.00 0.00	1 1.59 .05	3 4.76 .15	2 3.17 .10	0 0.00 0.00	6 9.52 .30	6.45
SSW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.17 .10	0 0.00 0.00	0 0.00 0.00	2 3.17 .10	6.25
SW	0 0.00 0.00	1 1.59 .05	2 3.17 .10	3 4.76 .15	1 1.59 .05	0 0.00 0.00	7 11.11 .35	5.31
WSW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.59 .05	0 0.00 0.00	0 0.00 0.00	1 1.59 .05	5.40
W	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.59 .05	6 9.52 .30	7 11.11 .35	14 22.22 .69	9.80
WNW	0 0.00 0.00	0 0.00 0.00	1 1.59 .05	5 7.94 .25	2 3.17 .10	5 7.94 .25	13 20.63 .64	8.75
NW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 6.35 .20	3 4.76 .15	0 0.00 0.00	7 11.11 .35	6.89
NNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.17 .10	2 3.17 .10	0 0.00 0.00	4 6.35 .20	6.92
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	0 0.00 0.00	1 1.59 .05	8 12.70 .39	26 41.27 1.28	16 25.40 .79	12 19.05 .59	63 100.00 3.11	7.47

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 16.46.47.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	0 0.00 0.00	1 1.16 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.16 .05	3.80
NE	0 0.00 0.00	0 0.00 0.00	1 1.16 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.16 .05	4.10
ENE	0 0.00 0.00	0 0.00 0.00	1 1.16 .05	1 1.16 .05	0 0.00 0.00	0 0.00 0.00	2 2.33 .10	4.85
E	0 0.00 0.00	0 0.00 0.00	1 1.16 .05	1 1.16 .05	1 1.16 .05	0 0.00 0.00	3 3.49 .15	6.17
ESE	0 0.00 0.00	0 0.00 0.00	3 3.49 .15	7 8.14 .35	2 2.33 .10	0 0.00 0.00	12 13.95 .59	6.19
SE	0 0.00 0.00	0 0.00 0.00	2 2.33 .10	2 2.33 .10	0 0.00 0.00	0 0.00 0.00	4 4.65 .20	4.88
SSE	0 0.00 0.00	0 0.00 0.00	1 1.16 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.16 .05	4.80
S	0 0.00 0.00	0 0.00 0.00	3 3.49 .15	2 2.33 .10	2 2.33 .10	3 3.49 .15	10 11.63 .49	8.00
SSW	0 0.00 0.00	2 2.33 .10	1 1.16 .05	2 2.33 .10	2 2.33 .10	0 0.00 0.00	7 8.14 .35	5.69
SW	0 0.00 0.00	1 1.16 .05	3 3.49 .15	1 1.16 .05	1 1.16 .05	0 0.00 0.00	6 6.98 .30	5.32
WSW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.16 .05	0 0.00 0.00	1 1.16 .05	8.90
W	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 3.49 .15	1 1.16 .05	2 2.33 .10	6 6.98 .30	8.40
WNW	0 0.00 0.00	0 0.00 0.00	1 1.16 .05	6 6.98 .30	2 2.33 .10	0 0.00 0.00	9 10.47 .44	6.92
NW	0 0.00 0.00	1 1.16 .05	1 1.16 .05	2 2.33 .10	3 3.49 .15	0 0.00 0.00	7 8.14 .35	6.41
NNW	0 0.00 0.00	0 0.00 0.00	5 5.81 .25	6 6.98 .30	2 2.33 .10	0 0.00 0.00	13 15.12 .64	5.62
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 2.33 .10	1 1.16 .05	0 0.00 0.00	3 3.49 .15	6.87
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	0 0.00 0.00	4 4.65 .20	24 27.91 1.18	35 40.70 1.73	18 20.93 .89	5 5.81 .25	86 100.00 4.24	6.15

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - APRIL

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 16.46.47.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NE	0 0.00 0.00	0 0.00 0.00	1 1.69 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.69 .05	3.80
ENE	0 0.00 0.00	0 0.00 0.00	2 3.39 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.39 .10	4.35
E	0 0.00 0.00	0 0.00 0.00	1 1.69 .05	2 3.39 .10	0 0.00 0.00	0 0.00 0.00	3 5.08 .15	5.43
ESE	0 0.00 0.00	0 0.00 0.00	1 1.69 .05	3 5.08 .15	2 3.39 .10	0 0.00 0.00	6 10.17 .30	6.60
SE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SSE	0 0.00 0.00	0 0.00 0.00	1 1.69 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.69 .05	4.13
S	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.39 .10	1 1.69 .05	0 0.00 0.00	3 5.08 .15	6.80
SSW	1 1.69 .05	0 0.00 0.00	0 0.00 0.00	2 3.39 .10	0 0.00 0.00	0 0.00 0.00	3 5.08 .15	4.66
SW	0 0.00 0.00	1 1.69 .05	2 3.39 .10	3 5.08 .15	2 3.39 .10	0 0.00 0.00	8 13.56 .39	5.94
WSW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
W	0 0.00 0.00	1 1.69 .05	0 0.00 0.00	0 0.00 0.00	6 10.17 .30	2 3.39 .10	9 15.25 .44	8.54
WNW	0 0.00 0.00	0 0.00 0.00	2 3.39 .10	1 1.69 .05	2 3.39 .10	1 1.69 .05	6 10.17 .30	7.33
NW	0 0.00 0.00	0 0.00 0.00	2 3.39 .10	4 6.78 .20	2 3.39 .10	0 0.00 0.00	8 13.56 .39	5.95
NNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 6.78 .20	2 3.39 .10	0 0.00 0.00	6 10.17 .30	6.83
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.39 .10	1 1.69 .05	0 0.00 0.00	3 5.08 .15	6.20
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	1 1.69 .05	2 3.39 .10	12 20.34 .59	23 38.98 1.13	18 30.51 .89	3 5.08 .15	59 100.00 2.91	6.46

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 16.46.47.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	10 1.21 .49	12 1.45 .59	6 .73 .30	4 .48 .20	1 .12 .05	33 3.99 1.63	4.65
NE	3 .36 .15	6 .73 .30	7 .85 .35	4 .48 .20	1 .12 .05	0 0.00 0.00	21 2.54 1.04	3.59
ENE	1 .12 .05	4 .48 .20	13 1.57 .64	19 2.30 .94	2 .24 .10	0 0.00 0.00	39 4.72 1.92	5.14
E	1 .12 .05	4 .48 .20	4 .48 .20	29 3.51 1.43	10 1.21 .49	0 0.00 0.00	48 5.81 2.37	6.17
ESE	0 0.00 0.00	3 .36 .15	14 1.69 .69	38 4.59 1.87	29 3.51 1.43	0 0.00 0.00	84 10.16 4.14	6.59
SE	0 0.00 0.00	0 0.00 0.00	18 2.18 .89	25 3.02 1.23	7 .85 .35	2 .24 .10	52 6.29 2.57	[illegible]
SSE	0 0.00 0.00	2 .24 .10	10 1.21 .49	17 2.06 .84	14 1.69 .69	4 .48 .20	47 5.68 2.32	6.72
S	0 0.00 0.00	2 .24 .10	13 1.57 .64	28 3.39 1.38	36 4.35 1.78	15 1.81 .74	94 11.37 4.64	7.71
SSW	0 0.00 0.00	2 .24 .10	6 .73 .30	16 1.93 .79	22 2.66 1.09	13 1.57 .64	59 7.13 2.91	[illegible]
SW	1 .12 .05	2 .24 .10	11 1.33 .54	12 1.45 .59	18 2.18 .89	10 1.21 .49	54 6.53 2.66	[illegible]
WSW	0 0.00 0.00	1 .12 .05	4 .48 .20	5 .60 .25	12 1.45 .59	13 1.57 .64	35 4.23 1.73	[illegible]
W	0 0.00 0.00	1 .12 .05	3 .36 .15	8 .97 .39	9 1.09 .44	14 1.69 .69	35 4.23 1.73	[illegible]
WNW	0 0.00 0.00	2 .24 .10	7 .85 .35	15 1.81 .74	21 2.54 1.04	14 1.69 .69	59 7.13 2.91	[illegible]
NW	0 0.00 0.00	3 .36 .15	16 1.93 .79	21 2.54 1.04	21 2.54 1.04	4 .48 .20	65 7.86 3.21	6.71
NNW	0 0.00 0.00	3 .36 .15	8 .97 .39	33 3.99 1.63	5 .60 .25	0 0.00 0.00	49 5.93 2.42	[illegible]
N	0 0.00 0.00	4 .48 .20	14 1.69 .69	18 2.18 .89	13 1.57 .64	4 .48 .20	53 6.41 2.61	6.15
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	6 .73 .30	49 5.93 2.42	160 19.35 7.89	294 35.55 14.50	224 27.09 11.05	94 11.37 4.64	827 100.00 40.80	[illegible]

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-60 (Continued) (Sheet 16 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - APRIL

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 16.46.47.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 0.00 0.00	4 .54 .20	3 .41 .15	3 .41 .15	0 0.00 0.00	0 0.00 0.00	10 1.36 .49	3.93
NE	0 0.00 0.00	1 .14 .05	17 2.31 .84	2 .27 .10	1 .14 .05	0 0.00 0.00	21 2.85 1.04	4.14
ENE	0 0.00 0.00	4 .54 .20	7 .95 .35	16 2.17 .79	7 .95 .35	0 0.00 0.00	34 4.61 1.68	5.67
E	0 0.00 0.00	2 .27 .10	13 1.76 .64	35 4.75 1.73	9 1.22 .44	1 .14 .05	60 8.14 2.96	6.13
ESE	0 0.00 0.00	0 0.00 0.00	27 3.66 1.33	56 7.60 2.76	5 .68 .25	0 0.00 0.00	88 11.94 4.34	5.80
SE	0 0.00 0.00	1 .14 .05	14 1.90 .69	36 4.88 1.78	8 1.09 .39	1 .14 .05	60 8.14 2.96	5.99
SSE	1 .14 .05	1 .14 .05	11 1.49 .54	28 3.80 1.38	14 1.90 .69	5 .68 .25	60 8.14 2.96	6.62
S	0 0.00 0.00	3 .41 .15	8 1.09 .39	59 8.01 2.91	35 4.75 1.73	8 1.09 .39	113 15.33 5.57	7.17
SSW	0 0.00 0.00	0 0.00 0.00	11 1.49 .54	35 4.75 1.73	22 2.99 1.09	8 1.09 .39	76 10.31 3.75	7.09
SW	0 0.00 0.00	1 .14 .05	3 .41 .15	20 2.71 .99	11 1.49 .54	3 .41 .15	38 5.16 1.87	6.91
WSW	1 .14 .05	2 .27 .10	1 .14 .05	12 1.63 .59	9 1.22 .44	4 .54 .20	29 3.93 1.43	7.47
W	0 0.00 0.00	0 0.00 0.00	2 .27 .10	15 2.04 .74	13 1.76 .64	2 .27 .10	32 4.34 1.58	7.35
WNW	1 .14 .05	6 .81 .30	7 .95 .35	12 1.63 .59	5 .68 .25	3 .41 .15	34 4.61 1.68	5.58
NW	0 0.00 0.00	5 .68 .25	8 1.09 .39	24 3.26 1.18	2 .27 .10	0 0.00 0.00	39 5.29 1.92	5.36
NNW	0 0.00 0.00	2 .27 .10	9 1.22 .44	11 1.49 .54	2 .27 .10	0 0.00 0.00	24 3.26 1.18	5.01
N	0 0.00 0.00	5 .68 .25	6 .81 .30	7 .95 .35	1 .14 .05	0 0.00 0.00	19 2.58 .94	4.58
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	3 .41 .15	37 5.02 1.83	147 19.95 7.25	371 50.34 18.30	144 19.54 7.10	35 4.75 1.73	737 100.00 36.36	6.27

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 16.46.47.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 0.00 0.00	2 2.86 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 2.86 .10	2.30
NE	0 0.00 0.00	1 1.43 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.43 .05	2.40
ENE	0 0.00 0.00	0 0.00 0.00	1 1.43 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.43 .05	3.60
E	0 0.00 0.00	0 0.00 0.00	1 1.43 .05	1 1.43 .05	0 0.00 0.00	0 0.00 0.00	2 2.86 .10	5.15
ESE	0 0.00 0.00	0 0.00 0.00	1 1.43 .05	1 1.43 .05	0 0.00 0.00	0 0.00 0.00	2 2.86 .10	5.30
SE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SSE	0 0.00 0.00	0 0.00 0.00	1 1.43 .05	6 8.57 .30	0 0.00 0.00	0 0.00 0.00	7 10.00 .35	6.00
S	0 0.00 0.00	1 1.43 .05	2 2.86 .10	11 15.71 .54	0 0.00 0.00	0 0.00 0.00	14 20.00 .69	5.69
SSW	0 0.00 0.00	1 1.43 .05	1 1.43 .05	4 5.71 .20	1 1.43 .05	0 0.00 0.00	7 10.00 .35	6.24
SW	0 0.00 0.00	0 0.00 0.00	3 4.29 .15	6 8.57 .30	0 0.00 0.00	0 0.00 0.00	9 12.86 .44	5.72
WSW	0 0.00 0.00	1 1.43 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.43 .05	1.70
W	0 0.00 0.00	1 1.43 .05	5 7.14 .25	3 4.29 .15	0 0.00 0.00	0 0.00 0.00	9 12.86 .44	4.50
WNW	0 0.00 0.00	0 0.00 0.00	4 5.71 .20	0 0.00 0.00	2 2.86 .10	0 0.00 0.00	6 8.57 .30	5.58
NW	0 0.00 0.00	1 1.43 .05	2 2.86 .10	5 7.14 .25	0 0.00 0.00	0 0.00 0.00	8 11.43 .39	5.21
NNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.43 .05	0 0.00 0.00	0 0.00 0.00	1 1.43 .05	5.80
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	0 0.00 0.00	8 11.43 .39	21 30.00 1.04	38 54.29 1.87	3 4.29 .15	0 0.00 0.00	70 100.00 3.45	5.27

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - APRIL

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 16.46.47.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 0.00 0.00	2 1.08 .10	3 1.62 .15	1 .54 .05	0 0.00 0.00	0 0.00 0.00	6 3.24 .30	3.75
NE	0 0.00 0.00	1 .54 .05	1 .54 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.08 .10	3.15
ENE	0 0.00 0.00	1 .54 .05	2 1.08 .10	2 1.08 .10	1 .54 .05	0 0.00 0.00	6 3.24 .30	5.28
E	0 0.00 0.00	0 0.00 0.00	6 3.24 .30	3 1.62 .15	0 0.00 0.00	0 0.00 0.00	9 4.86 .44	4.41
ESE	1 .54 .05	1 .54 .05	0 0.00 0.00	4 2.16 .20	0 0.00 0.00	0 0.00 0.00	6 3.24 .30	4.58
SE	0 0.00 0.00	0 0.00 0.00	3 1.62 .15	4 2.16 .20	0 0.00 0.00	0 0.00 0.00	7 3.78 .35	5.44
SSE	0 0.00 0.00	0 0.00 0.00	2 1.08 .10	14 7.57 .69	2 1.08 .10	0 0.00 0.00	18 9.73 .89	6.34
S	0 0.00 0.00	0 0.00 0.00	5 2.70 .25	20 10.81 .99	3 1.62 .15	0 0.00 0.00	28 15.14 1.38	5.81
SSW	0 0.00 0.00	2 1.08 .10	10 5.41 .49	11 5.95 .54	1 .54 .05	0 0.00 0.00	24 12.97 1.18	5.26
SW	1 .54 .05	0 0.00 0.00	4 2.16 .20	8 4.32 .39	2 1.08 .10	0 0.00 0.00	15 8.11 .74	5.62
WSW	0 0.00 0.00	1 .54 .05	5 2.70 .25	4 2.16 .20	1 .54 .05	0 0.00 0.00	11 5.95 .54	4.90
W	0 0.00 0.00	1 .54 .05	3 1.62 .15	9 4.86 .44	3 1.62 .15	0 0.00 0.00	16 8.65 .79	6.19
WNW	0 0.00 0.00	2 1.08 .10	0 0.00 0.00	4 2.16 .20	3 1.62 .15	0 0.00 0.00	9 4.86 .44	6.04
NW	0 0.00 0.00	0 0.00 0.00	1 .54 .05	16 8.65 .79	1 .54 .05	0 0.00 0.00	18 9.73 .89	6.47
NNW	0 0.00 0.00	0 0.00 0.00	2 1.08 .10	4 2.16 .20	0 0.00 0.00	0 0.00 0.00	6 3.24 .30	5.53
N	0 0.00 0.00	0 0.00 0.00	1 .54 .05	3 1.62 .15	0 0.00 0.00	0 0.00 0.00	4 2.16 .20	4.87
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	2 1.08 .10	11 5.95 .54	48 25.95 2.37	107 57.84 5.28	17 9.19 .84	0 0.00 0.00	185 100.00 9.13	5.58

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/22/79. 16.46.47.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 0.00	18 .86	24 1.15	10 .48	4 .19	1 .05	57 2.73	4.32
NE	3 .14	10 .48	30 1.43	12 .57	3 .14	0 0.00	58 2.77	4.11
ENE	1 .05	10 .48	34 1.63	48 2.30	10 .48	0 0.00	103 4.93	5.26
E	1 .05	7 .33	36 1.72	76 3.63	20 .96	1 .05	141 6.74	5.85
ESE	1 .05	5 .24	52 2.49	112 5.36	38 1.82	0 0.00	208 9.95	6.06
SE	0 0.00	4 .19	37 1.77	68 3.25	15 .72	3 .14	127 6.07	5.89
SSE	1 .05	4 .19	29 1.39	65 3.11	30 1.43	9 .43	138 6.60	6.46
S	0 0.00	6 .29	32 1.53	126 6.03	79 3.78	26 1.24	269 12.86	7.14
SSW	1 .05	7 .33	29 1.39	72 3.44	48 2.30	21 1.00	178 8.51	6.97
SW	2 .10	6 .29	28 1.34	53 2.53	35 1.67	13 .62	137 6.55	6.68
WSW	1 .05	5 .24	10 .48	22 1.05	23 1.10	17 .81	78 3.73	7.95
W	0 0.00	4 .19	13 .62	39 1.87	38 1.82	27 1.29	121 5.79	7.98
WNW	1 .05	10 .48	22 1.05	43 2.06	37 1.77	23 1.10	136 6.50	7.13
NW	0 0.00	10 .48	30 1.43	76 3.63	32 1.53	4 .19	152 7.27	6.21
NNW	0 0.00	5 .24	24 1.15	61 2.92	13 .62	0 0.00	103 4.93	5.69
N	0 0.00	9 .43	24 1.15	32 1.53	16 .77	4 .19	85 4.07	5.71
CALM	0 0.00						0 0.00	CALM
TOTAL	12 .57	120 5.74	454 21.71	915 43.76	441 21.09	149 7.13	2091 100.00	6.41

NUMBER OF VALID OBSERVATIONS 2091 96.81 PCT.
NUMBER OF INVALID OBSERVATIONS 69 3.19 PCT.
TOTAL NUMBER OF OBSERVATIONS 2160 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-60 (Continued) (Sheet 17 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - MAY

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 09.32.25.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
NE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
ENE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
E	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 3.28 / .10	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 3.28 / .10	6.15
ESE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 3.28 / .10	3 / 4.92 / .15	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 8.20 / .26	5.06
SE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 3.28 / .10	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 3.28 / .10	3.65
SSE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
S	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.64 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.64 / .05	3.60
SSW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.64 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.64 / .05	4.70
SW	0 / 0.00 / 0.00	1 / 1.64 / .05	2 / 3.28 / .10	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 4.92 / .15	2.97
WSW	0 / 0.00 / 0.00	1 / 1.64 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.64 / .05	2.60
W	0 / 0.00 / 0.00	1 / 1.64 / .05	9 / 14.75 / .46	1 / 1.64 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	11 / 18.03 / .57	4.04
WNW	0 / 0.00 / 0.00	2 / 3.28 / .10	3 / 4.92 / .15	4 / 6.56 / .21	1 / 1.64 / .05	0 / 0.00 / 0.00	10 / 16.39 / .52	5.19
NW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	7 / 11.48 / .36	8 / 13.11 / .41	2 / 3.28 / .10	0 / 0.00 / 0.00	17 / 27.87 / .88	5.79
NNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 8.20 / .26	2 / 3.28 / .10	0 / 0.00 / 0.00	0 / 0.00 / 0.00	7 / 11.48 / .36	4.83
N	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.64 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.64 / .05	3.80
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	0 / 0.00 / 0.00	5 / 8.20 / .25	33 / 54.10 / 1.70	20 / 32.79 / 1.03	3 / 4.92 / .15	0 / 0.00 / 0.00	61 / 100.00 / 3.15	4.08

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - MAY

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 09.32.25.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
NE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
ENE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
E	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
ESE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
SE	0 / 0.00 / 0.00	1 / 2.27 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 2.27 / .05	2.10
SSE	0 / 0.00 / 0.00	1 / 2.27 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 2.27 / .05	2.30
S	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 2.27 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 2.27 / .05	3.80
SSW	0 / 0.00 / 0.00	1 / 2.27 / .05	2 / 4.55 / .10	2 / 4.55 / .10	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 11.36 / .26	3.96
SW	3 / 6.82 / .15	1 / 2.27 / .05	0 / 0.00 / 0.00	2 / 4.55 / .10	0 / 0.00 / 0.00	0 / 0.00 / 0.00	6 / 13.64 / .31	3.10
WSW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 4.55 / .10	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 4.55 / .10	3.75
W	0 / 0.00 / 0.00	1 / 2.27 / .05	3 / 6.82 / .15	1 / 2.27 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 11.36 / .26	3.64
WNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 11.36 / .26	1 / 2.27 / .05	5 / 11.36 / .26	0 / 0.00 / 0.00	11 / 25.00 / .57	6.08
NW	0 / 0.00 / 0.00	1 / 2.27 / .05	4 / 9.09 / .21	2 / 4.55 / .10	1 / 2.27 / .05	0 / 0.00 / 0.00	8 / 18.18 / .41	5.37
NNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 4.55 / .10	1 / 2.27 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 6.82 / .15	5.20
N	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 2.27 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 2.27 / .05	4.40
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	3 / 6.82 / .15	6 / 13.64 / .31	20 / 45.45 / 1.03	9 / 20.45 / .46	6 / 13.64 / .31	0 / 0.00 / 0.00	44 / 100.00 / 2.27	4.60

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 09.32.25.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	1 / 1.27 / .05	0 / 0.00 / 0.00	1 / 1.27 / .05	1 / 1.27 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 3.80 / .15	3.30
NE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.27 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.27 / .05	5.60
ENE	0 / 0.00 / 0.00	2 / 2.53 / .10	1 / 1.27 / .05	1 / 1.27 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 5.06 / .21	3.75
E	0 / 0.00 / 0.00	1 / 1.27 / .05	0 / 0.00 / 0.00	1 / 1.27 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 2.53 / .10	4.50
ESE	0 / 0.00 / 0.00	2 / 2.53 / .10	1 / 1.27 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 3.80 / .15	2.77
SE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.27 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.27 / .05	4.60
SSE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.27 / .05	1 / 1.27 / .05	0 / 0.00 / 0.00	2 / 2.53 / .10	7.40
S	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 3.80 / .15	1 / 1.27 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 5.06 / .21	4.77
SSW	1 / 1.27 / .05	1 / 1.27 / .05	1 / 1.27 / .05	2 / 2.53 / .10	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 6.33 / .26	3.74
SW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 5.06 / .21	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 5.06 / .21	6.15
WSW	0 / 0.00 / 0.00	2 / 2.53 / .10	2 / 2.53 / .10	1 / 1.27 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 6.33 / .26	3.64
W	0 / 0.00 / 0.00	5 / 6.33 / .26	0 / 0.00 / 0.00	2 / 2.53 / .10	1 / 1.27 / .05	0 / 0.00 / 0.00	8 / 10.13 / .41	3.94
WNW	1 / 1.27 / .05	1 / 1.27 / .05	9 / 11.39 / .46	4 / 5.06 / .21	2 / 2.53 / .10	0 / 0.00 / 0.00	17 / 21.52 / .88	4.81
NW	0 / 0.00 / 0.00	1 / 1.27 / .05	6 / 7.59 / .31	8 / 10.13 / .41	1 / 1.27 / .05	0 / 0.00 / 0.00	16 / 20.25 / .83	5.11
NNW	0 / 0.00 / 0.00	1 / 1.27 / .05	0 / 0.00 / 0.00	2 / 2.53 / .10	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 3.80 / .15	4.67
N	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.27 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.27 / .05	4.90
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	3 / 3.80 / .15	16 / 20.25 / .83	26 / 32.91 / 1.34	29 / 36.71 / 1.50	5 / 6.33 / .26	0 / 0.00 / 0.00	79 / 100.00 / 4.07	4.58

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 09.32.25.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	1 / .15 / .05	9 / 1.36 / .46	2 / .30 / .10	2 / .30 / .10	0 / 0.00 / 0.00	0 / 0.00 / 0.00	14 / 2.12 / .72	3.12
NE	1 / .15 / .05	17 / 2.57 / .88	11 / 1.66 / .57	7 / 1.06 / .36	0 / 0.00 / 0.00	0 / 0.00 / 0.00	36 / 5.45 / 1.86	3.69
ENE	2 / .30 / .10	10 / 1.51 / .52	15 / 2.27 / .77	3 / .45 / .15	0 / 0.00 / 0.00	0 / 0.00 / 0.00	30 / 4.54 / 1.55	3.39
E	2 / .30 / .10	17 / 2.57 / .88	18 / 2.72 / .93	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	37 / 5.60 / 1.91	2.96
ESE	1 / .15 / .05	12 / 1.82 / .62	25 / 3.78 / 1.29	4 / .61 / .21	0 / 0.00 / 0.00	0 / 0.00 / 0.00	42 / 6.35 / 2.17	3.65
SE	2 / .30 / .10	6 / .91 / .31	33 / 4.99 / 1.70	19 / 2.87 / .98	0 / 0.00 / 0.00	0 / 0.00 / 0.00	60 / 9.08 / 3.09	4.36
SSE	3 / .45 / .15	12 / 1.82 / .62	32 / 4.84 / 1.65	19 / 2.87 / .98	1 / .15 / .05	0 / 0.00 / 0.00	67 / 10.14 / 3.46	4.00
S	5 / .76 / .26	17 / 2.57 / .88	22 / 3.33 / 1.13	23 / 3.48 / 1.19	6 / .91 / .31	1 / .15 / .05	74 / 11.20 / 3.82	4.56
SSW	2 / .30 / .10	17 / 2.57 / .88	12 / 1.82 / .62	15 / 2.27 / .77	2 / .30 / .10	1 / .15 / .05	49 / 7.41 / 2.53	4.26
SW	4 / .61 / .21	9 / 1.36 / .46	20 / 3.03 / 1.03	10 / 1.51 / .52	2 / .30 / .10	0 / 0.00 / 0.00	45 / 6.81 / 2.32	4.01
WSW	6 / .91 / .31	17 / 2.57 / .88	10 / 1.51 / .52	3 / .45 / .15	2 / .30 / .10	0 / 0.00 / 0.00	38 / 5.75 / 1.96	3.29
W	2 / .30 / .10	5 / .76 / .26	16 / 2.42 / .83	9 / 1.36 / .46	5 / .76 / .26	1 / .15 / .05	38 / 5.75 / 1.96	4.94
WNW	3 / .45 / .15	8 / 1.21 / .41	19 / 2.87 / .98	4 / .61 / .21	3 / .45 / .15	6 / .91 / .31	43 / 6.51 / 2.22	4.99
NW	0 / 0.00 / 0.00	8 / 1.21 / .41	18 / 2.72 / .93	10 / 1.51 / .52	0 / 0.00 / 0.00	3 / .45 / .15	39 / 5.90 / 2.01	4.65
NNW	3 / .45 / .15	9 / 1.36 / .46	8 / 1.21 / .41	6 / .91 / .31	0 / 0.00 / 0.00	0 / 0.00 / 0.00	26 / 3.93 / 1.34	3.45
N	0 / 0.00 / 0.00	10 / 1.51 / .52	3 / .45 / .15	8 / 1.21 / .41	0 / 0.00 / 0.00	0 / 0.00 / 0.00	21 / 3.18 / 1.08	3.82
CALM	2 / .30 / .10						2 / .30 / .10	CALM
TOTAL	39 / 5.90 / 2.01	183 / 27.69 / 9.44	264 / 39.94 / 13.62	142 / 21.48 / 7.32	21 / 3.18 / 1.08	12 / 1.82 / .62	661 / 100.00 / 34.09	4.15

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - MAY

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79, 09.32.25.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	9 1.35 .46	20 2.99 1.03	2 .30 .10	1 .15 .05	0 0.00 0.00	0 0.00 0.00	32 4.79 1.65	2.13
NE	7 1.05 .36	19 2.84 .98	5 .75 .26	1 .15 .05	0 0.00 0.00	0 0.00 0.00	32 4.79 1.65	2.32
ENE	4 .60 .21	15 2.25 .77	17 2.54 .88	4 .60 .21	0 0.00 0.00	0 0.00 0.00	40 5.99 2.06	3.02
E	6 .90 .31	20 2.99 1.03	14 2.10 .72	10 1.50 .52	1 .15 .05	0 0.00 0.00	51 7.63 2.63	3.44
ESE	6 .90 .31	18 2.69 .93	9 1.35 .46	2 .30 .10	0 0.00 0.00	0 0.00 0.00	35 5.24 1.81	2.69
SE	9 1.35 .46	42 6.29 2.17	33 4.94 1.70	2 .30 .10	0 0.00 0.00	0 0.00 0.00	86 12.87 4.44	2.86
SSE	4 .60 .21	30 4.49 1.55	27 4.04 1.39	3 .45 .15	0 0.00 0.00	0 0.00 0.00	64 9.58 3.30	3.07
S	5 .75 .26	24 3.59 1.24	36 5.39 1.86	8 1.20 .41	1 .15 .05	0 0.00 0.00	74 11.08 3.82	3.44
SSW	3 .45 .15	10 1.50 .52	19 2.84 .98	4 .60 .21	0 0.00 0.00	0 0.00 0.00	36 5.39 1.86	3.46
SW	3 .45 .15	16 2.40 .83	13 1.95 .67	4 .60 .21	0 0.00 0.00	0 0.00 0.00	36 5.39 1.86	3.24
WSW	3 .45 .15	8 1.20 .41	10 1.50 .52	0 0.00 0.00	1 .15 .05	0 0.00 0.00	22 3.29 1.13	3.13
W	7 1.05 .36	16 2.40 .83	17 2.54 .88	2 .30 .10	3 .45 .15	0 0.00 0.00	45 6.74 2.32	3.12
WNW	1 .15 .05	9 1.35 .46	19 2.84 .98	3 .45 .15	0 0.00 0.00	0 0.00 0.00	32 4.79 1.65	3.40
NW	5 .75 .26	14 2.10 .72	5 .75 .26	0 0.00 0.00	2 .30 .10	0 0.00 0.00	26 3.89 1.34	2.97
NNW	4 .60 .21	10 1.50 .52	5 .75 .26	2 .30 .10	0 0.00 0.00	0 0.00 0.00	21 3.14 1.08	2.77
N	10 1.50 .52	18 2.69 .93	4 .60 .21	1 .15 .05	0 0.00 0.00	0 0.00 0.00	33 4.94 1.70	2.20
CALM	3 .45 .15						3 .45 .15	CALM
TOTAL	89 13.32 4.59	289 43.26 14.90	235 35.18 12.12	47 7.04 2.42	8 1.20 .41	0 0.00 0.00	668 100.00 34.45	2.99

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79, 09.32.25.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	1 .81 .05	2 1.61 .10	1 .81 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 3.23 .21	2.17
NE	2 1.61 .10	3 2.42 .15	1 .81 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 4.84 .31	1.97
ENE	0 0.00 0.00	2 1.61 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.61 .10	1.85
E	2 1.61 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.61 .10	1.00
ESE	1 .81 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .81 .05	1.30
SE	3 2.42 .15	11 8.87 .57	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	14 11.29 .72	2.15
SSE	1 .81 .05	11 8.87 .57	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	12 9.68 .62	2.20
S	3 2.42 .15	2 1.61 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 4.03 .26	1.42
SSW	2 1.61 .10	4 3.23 .21	5 4.03 .26	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	11 8.87 .57	2.58
SW	5 4.03 .26	11 8.87 .57	3 2.42 .15	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	19 15.32 .98	2.17
WSW	4 3.23 .21	3 2.42 .15	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 5.65 .36	1.66
W	2 1.61 .10	10 8.06 .52	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	12 9.68 .62	2.17
WNW	1 .81 .05	8 6.45 .41	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 7.26 .46	1.93
NW	1 .81 .05	8 6.45 .41	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 7.26 .46	1.99
NNW	1 .81 .05	5 4.03 .26	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 4.84 .31	1.75
N	1 .81 .05	4 3.23 .21	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 4.03 .26	1.74
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	30 24.19 1.55	84 67.74 4.33	10 8.06 .52	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	124 100.00 6.40	2.04

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - MAY

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79, 09.32.25.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	6 1.99 .31	7 2.32 .36	2 .66 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	15 4.97 .77	1.95
NE	9 2.98 .46	8 2.65 .41	1 .33 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	18 5.96 .93	1.50
ENE	3 .99 .15	3 .99 .15	1 .33 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 2.32 .36	1.73
E	4 1.32 .21	10 3.31 .52	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	14 4.64 .72	1.76
ESE	5 1.66 .26	10 3.31 .52	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	15 4.97 .77	1.66
SE	8 2.65 .41	33 10.93 1.70	6 1.99 .31	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	47 15.56 2.42	2.21
SSE	9 2.98 .46	19 6.29 .98	9 2.98 .46	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	37 12.25 1.91	2.25
S	3 .99 .15	17 5.63 .88	5 1.66 .26	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	25 8.28 1.29	2.36
SSW	1 .33 .05	3 .99 .15	14 4.64 .72	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	18 5.96 .93	3.27
SW	7 2.32 .36	11 3.64 .57	3 .99 .15	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	21 6.95 1.08	2.21
WSW	4 1.32 .21	6 1.99 .31	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	10 3.31 .52	1.85
W	4 1.32 .21	13 4.30 .67	1 .33 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	18 5.96 .93	2.08
WNW	2 .66 .10	12 3.97 .62	1 .33 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	15 4.97 .77	2.23
NW	4 1.32 .21	10 3.31 .52	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	14 4.64 .72	1.90
NNW	6 1.99 .31	6 1.99 .31	2 .66 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	14 4.64 .72	1.91
N	10 3.31 .52	4 1.32 .21	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	14 4.64 .72	1.21
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	85 28.15 4.38	172 56.95 8.87	45 14.90 2.32	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	302 100.00 15.58	2.08

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79, 09.32.25.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	18 .89	38 1.88	8 .40	4 .20	0 0.00	0 0.00	68 3.37	2.35
NE	19 .94	45 2.23	20 .99	16 .79	0 0.00	0 0.00	100 4.96	2.95
ENE	10 .50	33 1.64	34 1.69	10 .50	0 0.00	0 0.00	87 4.31	3.09
E	14 .69	50 2.48	32 1.59	13 .64	1 .05	0 0.00	110 5.45	3.07
ESE	13 .64	42 2.08	37 1.83	9 .45	0 0.00	0 0.00	101 5.01	3.04
SE	22 1.09	101 5.01	80 3.97	23 1.14	0 0.00	0 0.00	226 11.20	3.12
SSE	17 .84	80 3.97	67 3.32	24 1.19	3 .15	0 0.00	191 9.47	3.26
S	16 .79	62 3.07	68 3.37	32 1.59	7 .35	1 .05	186 9.22	3.71
SSW	9 .45	38 1.88	54 2.68	23 1.14	2 .10	1 .05	127 6.30	3.48
SW	22 1.09	49 2.43	41 2.03	20 .99	2 .10	0 0.00	134 6.64	3.26
WSW	17 .84	35 1.74	24 1.19	4 .20	3 .15	0 0.00	83 4.12	2.96
W	15 .74	52 2.58	52 2.58	15 .74	9 .45	1 .05	144 7.14	3.55
WNW	8 .40	44 2.18	74 3.67	16 .79	11 .55	6 .30	159 7.88	4.12
NW	10 .50	44 2.18	46 2.28	30 1.49	6 .30	3 .15	139 6.89	4.07
NNW	14 .69	31 1.54	23 1.14	13 .64	0 0.00	0 0.00	81 4.02	3.12
N	21 1.04	36 1.78	10 .50	9 .45	0 0.00	0 0.00	76 3.77	2.52
CALM	5 .25						5 .25	CALM
TOTAL	250 12.39	780 38.67	670 33.22	261 12.94	44 2.18	12 .59	2017 100.00	3.33

NUMBER OF VALID OBSERVATIONS 2017 90.37 PCT.
NUMBER OF INVALID OBSERVATIONS 215 9.63 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-60 (Continued) (Sheet 19 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - MAY

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 09.32.25.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.64 .05	0 0.00 0.00	1 1.64 .05	7.60
ESE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 9.84 .31	0 0.00 0.00	0 0.00 0.00	6 9.84 .31	6.03
SE	0 0.00 0.00	0 0.00 0.00	1 1.64 .05	1 1.64 .05	0 0.00 0.00	0 0.00 0.00	2 3.28 .10	4.40
SSE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
S	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SSW	0 0.00 0.00	0 0.00 0.00	2 3.28 .10	1 1.64 .05	0 0.00 0.00	0 0.00 0.00	3 4.92 .16	4.80
SW	0 0.00 0.00	0 0.00 0.00	1 1.64 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.64 .05	3.80
WSW	0 0.00 0.00	0 0.00 0.00	2 3.28 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.28 .10	3.35
W	0 0.00 0.00	1 1.64 .05	1 1.64 .05	7 11.48 .36	0 0.00 0.00	1 1.64 .05	10 16.39 .52	5.72
WNW	0 0.00 0.00	1 1.64 .05	2 3.28 .10	6 9.84 .31	7 11.48 .36	1 1.64 .05	17 27.87 .88	6.96
NW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 11.48 .36	4 6.56 .21	2 3.28 .10	13 21.31 .67	7.72
NNW	0 0.00 0.00	0 0.00 0.00	2 3.28 .10	4 6.56 .21	0 0.00 0.00	0 0.00 0.00	6 9.84 .31	5.58
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	0 0.00 0.00	2 3.28 .10	11 18.03 .57	32 52.46 1.65	12 19.67 .62	4 6.56 .21	61 100.00 3.15	6.34

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 09.32.25.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.28 .05	0 0.00 0.00	0 0.00 0.00	1 1.28 .05	7.20
NE	1 1.28 .05	1 1.28 .05	2 2.56 .10	1 1.28 .05	0 0.00 0.00	0 0.00 0.00	5 6.41 .26	3.68
ENE	0 0.00 0.00	0 0.00 0.00	1 1.28 .05	1 1.28 .05	0 0.00 0.00	0 0.00 0.00	2 2.56 .10	4.90
E	0 0.00 0.00	0 0.00 0.00	1 1.28 .05	0 0.00 0.00	1 1.28 .05	0 0.00 0.00	2 2.56 .10	5.55
ESE	0 0.00 0.00	1 1.28 .05	1 1.28 .05	1 1.28 .05	0 0.00 0.00	0 0.00 0.00	3 3.85 .16	3.53
SE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.28 .05	0 0.00 0.00	0 0.00 0.00	1 1.28 .05	5.80
SSE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 3.85 .16	0 0.00 0.00	3 3.85 .16	8.87
S	0 0.00 0.00	1 1.28 .05	2 2.56 .10	1 1.28 .05	0 0.00 0.00	0 0.00 0.00	4 5.13 .21	4.20
SSW	1 1.28 .05	0 0.00 0.00	2 2.56 .10	3 3.85 .16	0 0.00 0.00	0 0.00 0.00	6 7.69 .31	4.97
SW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 2.56 .10	1 1.28 .05	0 0.00 0.00	3 3.85 .16	7.73
WSW	0 0.00 0.00	2 2.56 .10	1 1.28 .05	0 0.00 0.00	1 1.28 .05	0 0.00 0.00	4 5.13 .21	4.40
W	0 0.00 0.00	2 2.56 .10	0 0.00 0.00	3 3.85 .16	1 1.28 .05	0 0.00 0.00	6 7.69 .31	5.52
WNW	0 0.00 0.00	1 1.28 .05	5 6.41 .26	6 7.69 .31	2 2.56 .10	5 6.41 .26	19 24.36 .98	6.97
NW	1 1.28 .05	0 0.00 0.00	3 3.85 .16	5 6.41 .26	6 7.69 .31	1 1.28 .05	16 20.51 .83	6.57
NNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 2.56 .10	0 0.00 0.00	0 0.00 0.00	2 2.56 .10	6.85
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.28 .05	0 0.00 0.00	0 0.00 0.00	1 1.28 .05	6.20
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	3 3.85 .16	8 10.26 .41	18 23.08 .93	28 35.90 1.45	15 19.23 .78	6 7.69 .31	78 100.00 4.03	5.99

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - MAY

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 09.32.25.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ESE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SE	0 0.00 0.00	2 4.55 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 4.55 .10	2.50
SSE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
S	0 0.00 0.00	0 0.00 0.00	1 2.27 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.27 .05	4.40
SSW	1 2.27 .05	1 2.27 .05	2 4.55 .10	1 2.27 .05	1 2.27 .05	0 0.00 0.00	6 13.64 .31	4.22
SW	2 4.55 .10	1 2.27 .05	0 0.00 0.00	1 2.27 .05	1 2.27 .05	0 0.00 0.00	5 11.36 .26	4.00
WSW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
W	0 0.00 0.00	1 2.27 .05	3 6.82 .16	3 6.82 .16	0 0.00 0.00	0 0.00 0.00	7 15.91 .36	4.97
WNW	0 0.00 0.00	0 0.00 0.00	4 9.09 .21	3 6.82 .16	0 0.00 0.00	5 11.36 .26	12 27.27 .62	7.68
NW	0 0.00 0.00	0 0.00 0.00	1 2.27 .05	4 9.09 .21	2 4.55 .10	2 4.55 .10	9 20.45 .47	7.93
NNW	0 0.00 0.00	0 0.00 0.00	1 2.27 .05	1 2.27 .05	0 0.00 0.00	0 0.00 0.00	2 4.55 .10	5.35
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	3 6.82 .16	5 11.36 .26	12 27.27 .62	13 29.55 .67	4 9.09 .21	7 15.91 .36	44 100.00 2.27	6.00

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 09.32.25.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	1 .15 .05	5 .76 .26	5 .76 .26	6 .91 .31	0 0.00 0.00	0 0.00 0.00	17 2.58 .88	3.92
NE	1 .15 .05	7 1.06 .36	11 1.67 .57	7 1.06 .36	1 .15 .05	1 .15 .05	28 4.26 1.45	4.32
ENE	3 .46 .16	6 .91 .31	15 2.28 .78	11 1.67 .57	0 0.00 0.00	0 0.00 0.00	35 5.32 1.81	4.17
E	0 0.00 0.00	11 1.67 .57	19 2.89 .98	6 .91 .31	0 0.00 0.00	0 0.00 0.00	36 5.47 1.86	3.84
ESE	0 0.00 0.00	7 1.06 .36	21 3.19 1.09	10 1.52 .52	3 .46 .16	0 0.00 0.00	41 6.23 2.12	4.61
SE	3 .46 .16	8 1.22 .41	17 2.58 .88	26 3.95 1.34	9 1.37 .47	0 0.00 0.00	63 9.57 3.26	5.26
SSE	2 .30 .10	9 1.37 .47	18 2.74 .93	32 4.86 1.65	11 1.67 .57	0 0.00 0.00	72 10.94 3.72	5.22
S	2 .30 .10	10 1.52 .52	23 3.50 1.19	20 3.04 1.03	9 1.37 .47	5 .76 .26	69 10.49 3.57	5.53
SSW	2 .30 .10	11 1.67 .57	13 1.98 .67	20 3.04 1.03	8 1.22 .41	6 .91 .31	60 9.12 3.10	5.79
SW	1 .15 .05	6 .91 .31	15 2.28 .78	11 1.67 .57	5 .76 .26	0 0.00 0.00	38 5.78 1.96	4.81
WSW	1 .15 .05	13 1.98 .67	12 1.82 .62	7 1.06 .36	2 .30 .10	1 .15 .05	36 5.47 1.86	4.13
W	0 0.00 0.00	6 .91 .31	7 1.06 .36	10 1.52 .52	12 1.82 .62	6 .91 .31	41 6.23 2.12	7.09
WNW	2 .30 .10	3 .46 .16	9 1.37 .47	15 2.28 .78	3 .46 .16	7 1.06 .36	39 5.93 2.02	6.62
NW	1 .15 .05	4 .61 .21	9 1.37 .47	16 2.43 .83	5 .76 .26	6 .91 .31	41 6.23 2.12	6.86
NNW	0 0.00 0.00	2 .30 .10	7 1.06 .36	7 1.06 .36	3 .46 .16	0 0.00 0.00	19 2.89 .98	5.24
N	2 .30 .10	6 .91 .31	5 .76 .26	7 1.06 .36	1 .15 .05	0 0.00 0.00	21 3.19 1.09	4.12
CALM	2 .30 .10						2 .30 .10	CALM
TOTAL	23 3.50 1.19	114 17.33 5.89	206 31.31 10.65	211 32.07 10.90	72 10.94 3.72	32 4.86 1.65	658 100.00 34.01	5.23

KEY
XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-60 (Continued) (Sheet 20 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - MAY

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79, 09.32.25.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 0.00 0.00	10 1.50 .52	10 1.50 .52	5 .75 .26	0 0.00 0.00	0 0.00 0.00	25 3.74 1.29	3.75
NE	0 0.00 0.00	8 1.20 .41	17 2.54 .88	7 1.05 .36	1 .15 .05	0 0.00 0.00	33 4.94 1.71	4.11
ENE	3 .45 .16	6 .90 .31	21 3.14 1.09	22 3.29 1.14	0 0.00 0.00	0 0.00 0.00	52 7.78 2.69	4.59
E	0 0.00 0.00	2 .30 .10	26 3.89 1.34	13 1.95 .67	5 .75 .26	0 0.00 0.00	46 6.89 2.38	5.13
ESE	2 .30 .10	4 .60 .21	14 2.10 .72	12 1.80 .62	0 0.00 0.00	0 0.00 0.00	32 4.79 1.65	4.25
SE	3 .45 .16	12 1.80 .62	26 3.89 1.34	35 5.24 1.81	2 .30 .10	0 0.00 0.00	78 11.68 4.03	4.74
SSE	1 .15 .05	8 1.20 .41	24 3.59 1.24	25 3.74 1.29	3 .45 .16	0 0.00 0.00	61 9.13 3.15	4.41
S	4 .60 .21	5 .75 .26	29 4.34 1.50	40 5.99 2.07	5 .75 .26	2 .30 .10	85 12.72 4.39	5.32
SSW	1 .15 .05	3 .45 .16	9 1.35 .47	30 4.49 1.55	8 1.20 .41	0 0.00 0.00	51 7.63 2.64	5.87
SW	2 .30 .10	1 .15 .05	10 1.50 .52	16 2.40 .83	3 .45 .16	0 0.00 0.00	32 4.79 1.65	5.34
WSW	0 0.00 0.00	5 .75 .26	5 .75 .25	11 1.65 .57	2 .30 .10	1 .15 .05	24 3.59 1.24	5.53
W	1 .15 .05	1 .15 .05	8 1.20 .41	21 3.14 1.09	3 .45 .16	3 .45 .16	37 5.54 1.91	6.15
WNW	1 .15 .05	3 .45 .16	11 1.65 .57	13 1.95 .67	4 .60 .21	0 0.00 0.00	32 4.79 1.65	5.20
NW	2 .30 .10	7 1.05 .36	6 .90 .31	10 1.50 .52	9 1.35 .47	2 .30 .10	36 5.39 1.86	5.60
NNW	0 0.00 0.00	1 .15 .05	3 .45 .16	7 1.05 .36	1 .15 .05	0 0.00 0.00	12 1.80 .62	5.58
N	0 0.00 0.00	4 .60 .21	19 2.84 .98	6 .90 .31	1 .15 .05	0 0.00 0.00	30 4.49 1.55	4.40
CALM	2 .30 .10						2 .30 .10	CALM
TOTAL	22 3.29 1.14	80 11.98 4.13	238 35.63 12.30	273 40.87 14.11	47 7.04 2.43	8 1.20 .41	668 100.00 34.52	5.02

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79, 09.32.25.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 0.00 0.00	4 3.23 .21	2 1.61 .10	1 .81 .05	0 0.00 0.00	0 0.00 0.00	7 5.65 .36	3.09
NE	0 0.00 0.00	0 0.00 0.00	4 3.23 .21	0 0.00 0.00	5 4.03 .26	0 0.00 0.00	9 7.26 .47	6.36
ENE	0 0.00 0.00	0 0.00 0.00	2 1.61 .10	1 .81 .05	1 .81 .05	0 0.00 0.00	4 3.23 .21	6.00
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .81 .05	0 0.00 0.00	0 0.00 0.00	1 .81 .05	5.50
ESE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .81 .05	0 0.00 0.00	0 0.00 0.00	1 .81 .05	7.00
SSE	0 0.00 0.00	4 3.23 .21	3 2.42 .16	1 .81 .05	0 0.00 0.00	0 0.00 0.00	8 6.45 .41	3.37
S	0 0.00 0.00	2 1.61 .10	9 7.26 .47	2 1.61 .10	0 0.00 0.00	0 0.00 0.00	13 10.48 .67	3.90
SSW	0 0.00 0.00	0 0.00 0.00	4 3.23 .21	5 4.03 .26	0 0.00 0.00	0 0.00 0.00	9 7.26 .47	4.94
SW	1 .81 .05	1 .81 .05	1 .81 .05	2 1.61 .10	10 8.06 .52	0 0.00 0.00	15 12.10 .78	6.83
WSW	0 0.00 0.00	3 2.42 .16	1 .81 .05	5 4.03 .26	2 1.61 .10	0 0.00 0.00	11 8.87 .57	5.68
W	0 0.00 0.00	1 .81 .05	5 4.03 .26	7 5.65 .36	1 .81 .05	0 0.00 0.00	14 11.29 .72	5.16
WNW	0 0.00 0.00	0 0.00 0.00	3 2.42 .16	3 2.42 .16	5 4.03 .26	0 0.00 0.00	11 8.87 .57	6.64
NW	0 0.00 0.00	1 .81 .05	2 1.61 .10	2 1.61 .10	1 .81 .05	0 0.00 0.00	6 4.84 .31	5.20
NNW	0 0.00 0.00	0 0.00 0.00	2 1.61 .10	8 6.45 .41	0 0.00 0.00	0 0.00 0.00	10 8.06 .52	5.95
N	0 0.00 0.00	0 0.00 0.00	1 .81 .05	4 3.23 .21	0 0.00 0.00	0 0.00 0.00	5 4.03 .26	5.48
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	1 .81 .05	16 12.90 .83	39 31.45 2.02	43 34.68 2.22	25 20.16 1.29	0 0.00 0.00	124 100.00 6.41	5.37

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - MAY

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79, 09.32.25.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	1 .33 .05	4 1.32 .21	3 .99 .16	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 2.65 .41	2.86
NE	0 0.00 0.00	6 1.99 .31	6 1.99 .31	6 1.99 .31	0 0.00 0.00	0 0.00 0.00	18 5.96 .93	4.24
ENE	1 .33 .05	0 0.00 0.00	10 3.31 .52	5 1.66 .26	1 .33 .05	0 0.00 0.00	17 5.63 .88	4.72
E	1 .33 .05	3 .99 .16	6 1.99 .31	7 2.32 .36	0 0.00 0.00	0 0.00 0.00	17 5.63 .88	4.21
ESE	1 .33 .05	3 .99 .16	11 3.64 .57	6 1.99 .31	1 .33 .05	0 0.00 0.00	22 7.28 1.14	4.56
SE	0 0.00 0.00	5 1.66 .26	10 3.31 .52	14 4.64 .72	0 0.00 0.00	0 0.00 0.00	29 9.60 1.50	4.72
SSE	2 .66 .10	4 1.32 .21	15 4.97 .78	11 3.64 .57	0 0.00 0.00	0 0.00 0.00	32 10.60 1.65	4.25
S	1 .33 .05	2 .66 .10	14 4.64 .72	16 5.30 .83	0 0.00 0.00	0 0.00 0.00	33 10.93 1.71	4.71
SSW	1 .33 .05	4 1.32 .21	10 3.31 .52	8 2.65 .41	7 2.32 .36	0 0.00 0.00	30 9.93 1.55	5.32
SW	0 0.00 0.00	0 0.00 0.00	5 1.66 .26	6 1.99 .31	6 1.99 .31	0 0.00 0.00	17 5.63 .88	6.51
WSW	0 0.00 0.00	1 .33 .05	2 .66 .10	4 1.32 .21	0 0.00 0.00	0 0.00 0.00	7 2.32 .36	5.10
W	0 0.00 0.00	3 .99 .16	3 .99 .16	11 3.64 .57	1 .33 .05	0 0.00 0.00	18 5.96 .93	5.20
WNW	0 0.00 0.00	0 0.00 0.00	2 .66 .10	8 2.65 .41	2 .66 .10	0 0.00 0.00	12 3.97 .62	6.54
NW	0 0.00 0.00	1 .33 .05	2 .66 .10	8 2.65 .41	0 0.00 0.00	0 0.00 0.00	11 3.64 .57	5.65
NNW	0 0.00 0.00	2 .66 .10	1 .33 .05	7 2.32 .36	0 0.00 0.00	0 0.00 0.00	10 3.31 .52	5.17
N	0 0.00 0.00	2 .66 .10	9 2.98 .47	9 2.98 .47	1 .33 .05	0 0.00 0.00	21 6.95 1.09	4.62
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	8 2.65 .41	40 13.25 2.07	109 36.09 5.63	126 41.72 6.51	19 6.29 .98	0 0.00 0.00	302 100.00 15.61	4.86

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79, 09.32.25.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	2 .10	23 1.17	20 1.01	13 .66	0 0.00	0 0.00	58 2.94	3.66
NE	2 .10	22 1.11	41 2.08	22 1.11	10 .51	1 .05	98 4.96	4.51
ENE	7 .35	12 .61	49 2.48	41 2.08	6 .30	0 0.00	115 5.83	4.70
E	1 .05	16 .81	55 2.79	27 1.37	7 .35	0 0.00	106 5.37	4.53
ESE	3 .15	15 .76	47 2.38	35 1.77	4 .20	0 0.00	104 5.27	4.54
SE	6 .30	27 1.37	56 2.84	80 4.05	11 .56	0 0.00	180 9.12	4.92
SSE	5 .25	25 1.27	68 3.44	73 3.70	18 .91	1 .05	190 9.63	4.92
S	7 .35	21 1.06	81 4.10	79 4.00	14 .71	7 .35	209 10.59	5.15
SSW	6 .30	21 1.06	42 2.13	69 3.50	24 1.22	6 .30	168 8.51	5.53
SW	6 .30	9 .46	32 1.62	38 1.93	26 1.32	0 0.00	111 5.62	5.53
WSW	1 .05	24 1.22	23 1.17	27 1.37	7 .35	2 .10	84 4.26	4.81
W	1 .05	15 .76	27 1.37	62 3.14	18 .91	10 .51	133 6.74	6.08
WNW	3 .15	8 .41	36 1.82	55 2.79	23 1.17	18 .91	143 7.24	6.47
NW	4 .20	13 .66	23 1.17	52 2.63	27 1.37	13 .66	132 6.69	6.46
NNW	0 0.00	5 .25	16 .81	36 1.82	4 .20	0 0.00	61 3.09	5.50
N	2 .10	12 .61	34 1.72	27 1.37	3 .15	0 0.00	78 3.95	4.48
CALM	4 .20						4 .20	CALM
TOTAL	60 3.04	268 13.58	650 32.93	736 37.28	202 10.23	58 2.94	1974 100.00	5.20

NUMBER OF VALID OBSERVATIONS 1974 88.44 PCT.
NUMBER OF INVALID OBSERVATIONS 258 11.56 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-60 (Continued) (Sheet 21 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JUNE

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 10.29.27.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	1 2.86 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.86 .05	2.20
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ESE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SE	0 0.00 0.00	0 0.00 0.00	2 5.71 .10	1 2.86 .05	0 0.00 0.00	0 0.00 0.00	3 8.57 .14	4.63
SSE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
S	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SSW	1 2.86 .05	0 0.00 0.00	0 0.00 0.00	3 8.57 .14	2 5.71 .10	0 0.00 0.00	6 17.14 .29	6.33
SW	0 0.00 0.00	1 2.86 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.86 .05	1.60
WSW	0 0.00 0.00	1 2.86 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.86 .05	2.70
W	4 11.43 .19	2 5.71 .10	6 17.14 .29	3 8.57 .14	0 0.00 0.00	0 0.00 0.00	15 42.86 .72	3.43
WNW	1 2.86 .05	2 5.71 .10	3 8.57 .14	2 5.71 .10	0 0.00 0.00	0 0.00 0.00	8 22.86 .38	3.96
NW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	6 17.14 .29	7 20.00 .34	11 31.43 .53	9 25.71 .43	2 5.71 .10	0 0.00 0.00	35 100.00 1.68	4.05

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JUNE

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 10.29.27.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	0 0.00 0.00	1 1.41 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.41 .05	3.90
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	1 1.41 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.41 .05	2.20
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ESE	0 0.00 0.00	0 0.00 0.00	1 1.41 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.41 .05	3.60
SE	0 0.00 0.00	1 1.41 .05	3 4.23 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 5.63 .19	4.07
SSE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
S	0 0.00 0.00	1 1.41 .05	3 4.23 .14	3 4.23 .14	0 0.00 0.00	0 0.00 0.00	7 9.86 .34	4.66
SSW	1 1.41 .05	2 2.82 .10	0 0.00 0.00	6 8.45 .29	0 0.00 0.00	0 0.00 0.00	9 12.68 .43	4.72
SW	2 2.82 .10	0 0.00 0.00	1 1.41 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 4.23 .14	2.23
WSW	0 0.00 0.00	1 1.41 .05	4 5.63 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 7.04 .24	3.56
W	1 1.41 .05	5 7.04 .24	6 8.45 .29	2 2.82 .10	0 0.00 0.00	0 0.00 0.00	14 19.72 .67	3.51
WNW	2 2.82 .10	3 4.23 .14	3 4.23 .14	4 5.63 .19	0 0.00 0.00	0 0.00 0.00	12 16.90 .58	3.87
NW	0 0.00 0.00	1 1.41 .05	2 2.82 .10	5 7.04 .24	0 0.00 0.00	0 0.00 0.00	8 11.27 .38	4.46
NNW	1 1.41 .05	1 1.41 .05	0 0.00 0.00	3 4.23 .14	0 0.00 0.00	0 0.00 0.00	5 7.04 .24	4.18
N	0 0.00 0.00	1 1.41 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.41 .05	1.80
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	7 9.86 .34	17 23.94 .82	24 33.80 1.15	23 32.39 1.10	0 0.00 0.00	0 0.00 0.00	71 100.00 3.41	3.98

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 10.29.27.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	3 2.24 .14	4 2.99 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 5.22 .34	3.04
NE	0 0.00 0.00	5 3.73 .24	1 .75 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 4.48 .29	2.57
ENE	0 0.00 0.00	3 2.24 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 2.24 .14	2.30
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ESE	0 0.00 0.00	2 1.49 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.49 .10	2.45
SE	0 0.00 0.00	1 .75 .05	1 .75 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.49 .10	3.80
SSE	0 0.00 0.00	1 .75 .05	1 .75 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.49 .10	3.55
S	2 1.49 .10	2 1.49 .10	3 2.24 .14	9 6.72 .43	1 .75 .05	0 0.00 0.00	17 12.69 .82	5.16
SSW	1 .75 .05	2 1.49 .10	4 2.99 .19	5 3.73 .24	0 0.00 0.00	0 0.00 0.00	12 8.96 .58	4.26
SW	1 .75 .05	5 3.73 .24	13 9.70 .62	3 2.24 .14	0 0.00 0.00	0 0.00 0.00	22 16.42 1.06	3.72
WSW	2 1.49 .10	1 .75 .05	2 1.49 .10	1 .75 .05	0 0.00 0.00	0 0.00 0.00	6 4.48 .29	2.57
W	3 2.24 .14	9 6.72 .43	3 2.24 .14	3 2.24 .14	0 0.00 0.00	0 0.00 0.00	18 13.43 .86	3.06
WNW	1 .75 .05	5 3.73 .24	4 2.99 .19	2 1.49 .10	0 0.00 0.00	0 0.00 0.00	12 8.96 .58	3.29
NW	0 0.00 0.00	1 .75 .05	4 2.99 .19	5 3.73 .24	0 0.00 0.00	0 0.00 0.00	10 7.46 .48	4.77
NNW	0 0.00 0.00	2 1.49 .10	2 1.49 .10	5 3.73 .24	1 .75 .05	0 0.00 0.00	10 7.46 .48	4.99
N	1 .75 .05	3 2.24 .14	1 .75 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 3.73 .24	2.48
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	11 8.21 .53	45 33.58 2.16	43 32.09 2.06	33 24.63 1.58	2 1.49 .10	0 0.00 0.00	134 100.00 6.43	3.76

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 10.29.27.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	8 1.16 .38	8 1.16 .38	5 .73 .24	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	21 3.05 1.01	1.90
NE	6 .87 .29	7 1.02 .34	4 .58 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	17 2.47 .82	2.06
ENE	1 .15 .05	3 .44 .14	3 .44 .14	2 .29 .10	0 0.00 0.00	0 0.00 0.00	9 1.31 .43	3.58
E	4 .58 .19	12 1.74 .58	3 .44 .14	1 .15 .05	0 0.00 0.00	0 0.00 0.00	20 2.90 .96	2.43
ESE	1 .15 .05	5 .73 .24	7 1.02 .34	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	13 1.89 .62	2.96
SE	3 .44 .14	12 1.74 .58	26 3.77 1.25	7 1.02 .34	0 0.00 0.00	0 0.00 0.00	48 6.97 2.30	3.66
SSE	6 .87 .29	17 2.47 .82	35 5.08 1.68	12 1.74 .58	0 0.00 0.00	0 0.00 0.00	70 10.16 3.36	3.61
S	10 1.45 .48	29 4.21 1.39	42 6.10 2.01	32 4.64 1.53	2 .29 .10	0 0.00 0.00	115 16.69 5.52	4.10
SSW	10 1.45 .48	23 3.34 1.10	35 5.08 1.68	22 3.19 1.06	3 .44 .14	1 .15 .05	94 13.64 4.51	3.94
SW	6 .87 .29	19 2.76 .91	39 5.66 1.87	12 1.74 .58	2 .29 .10	1 .15 .05	79 11.47 3.79	3.79
WSW	5 .73 .24	16 2.32 .77	5 .73 .24	9 1.31 .43	1 .15 .05	0 0.00 0.00	36 5.22 1.73	3.58
W	9 1.31 .43	10 1.45 .48	5 .73 .24	3 .44 .14	0 0.00 0.00	0 0.00 0.00	27 3.92 1.29	2.46
WNW	5 .73 .24	11 1.60 .53	12 1.74 .58	2 .29 .10	0 0.00 0.00	0 0.00 0.00	30 4.35 1.44	2.89
NW	2 .29 .10	12 1.74 .58	14 2.03 .67	4 .58 .19	0 0.00 0.00	0 0.00 0.00	32 4.64 1.53	3.33
NNW	7 1.02 .34	7 1.02 .34	17 2.47 .82	2 .29 .10	0 0.00 0.00	0 0.00 0.00	33 4.79 1.58	2.92
N	8 1.16 .38	20 2.90 .96	13 1.89 .62	3 .44 .14	1 .15 .05	0 0.00 0.00	45 6.53 2.16	2.82
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	91 13.21 4.36	211 30.62 10.12	265 38.46 12.71	111 16.11 5.32	9 1.31 .43	2 .29 .10	689 100.00 33.05	3.45

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-60 (Continued) (Sheet 22 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JUNE

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 10.29.27.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	5 .82 .24	4 .65 .19	1 .16 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	10 1.63 .48	1.85
NE	12 1.96 .58	2 .33 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	14 2.29 .67	1.11
ENE	3 .49 .14	4 .65 .19	2 .33 .10	1 .16 .05	0 0.00 0.00	0 0.00 0.00	10 1.63 .48	2.56
E	9 1.47 .43	3 .49 .14	2 .33 .10	1 .16 .05	0 0.00 0.00	0 0.00 0.00	15 2.45 .72	1.72
ESE	10 1.63 .48	8 1.31 .38	2 .33 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	20 3.27 .96	1.70
SE	15 2.45 .72	35 5.72 1.68	20 3.27 .96	1 .16 .05	0 0.00 0.00	0 0.00 0.00	71 11.60 3.41	2.38
SSE	12 1.96 .58	40 6.54 1.92	40 6.54 1.92	5 .82 .24	0 0.00 0.00	0 0.00 0.00	97 15.85 4.65	2.86
S	8 1.31 .38	35 5.72 1.68	64 10.46 3.07	17 2.78 .82	0 0.00 0.00	0 0.00 0.00	124 20.26 5.95	3.53
SSW	1 .16 .05	20 3.27 .96	47 7.68 2.25	2 .33 .10	0 0.00 0.00	0 0.00 0.00	70 11.44 3.36	3.92
SW	3 .49 .14	20 3.27 .96	31 5.07 1.49	5 .82 .24	0 0.00 0.00	0 0.00 0.00	59 9.64 2.83	3.48
WSW	9 1.47 .43	7 1.14 .34	5 .82 .24	1 .16 .05	1 .16 .05	0 0.00 0.00	23 3.76 1.10	2.60
W	4 .65 .19	5 .82 .24	1 .16 .05	3 .49 .14	0 0.00 0.00	0 0.00 0.00	13 2.12 .62	2.85
WNW	4 .65 .19	4 .65 .19	1 .16 .05	1 .16 .05	0 0.00 0.00	0 0.00 0.00	10 1.63 .48	2.26
NW	4 .65 .19	10 1.63 .48	5 .82 .24	2 .33 .10	0 0.00 0.00	0 0.00 0.00	21 3.43 1.01	2.74
NNW	2 .33 .10	14 2.29 .67	4 .65 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	20 3.27 .96	2.54
N	5 .82 .24	20 3.27 .96	6 .98 .29	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	31 5.07 1.49	2.39
CALM	4 .65 .19						4 .65 .19	CALM
TOTAL	110 17.97 5.28	231 37.75 11.08	231 37.75 11.08	39 6.37 1.87	1 .16 .05	0 0.00 0.00	612 100.00 29.35	2.87

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 10.29.27.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	8 4.44 .38	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 4.44 .38	1.00
NE	6 3.33 .29	2 1.11 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 4.44 .38	1.02
ENE	3 1.67 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 1.67 .14	1.30
E	1 .56 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .56 .05	.70
ESE	2 1.11 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.11 .10	.40
SE	0 0.00 0.00	15 8.33 .72	1 .56 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	16 8.89 .77	2.37
SSE	1 .56 .05	10 5.56 .48	1 .56 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	12 6.67 .58	2.31
S	5 2.78 .24	11 6.11 .53	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	16 8.89 .77	1.93
SSW	2 1.11 .10	10 5.56 .48	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	12 6.67 .58	2.10
SW	11 6.11 .53	16 8.89 .77	1 .56 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	28 15.56 1.34	1.86
WSW	4 2.22 .19	4 2.22 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 4.44 .38	1.60
W	15 8.33 .72	1 .56 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	16 8.89 .77	1.06
WNW	7 3.89 .34	4 2.22 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	11 6.11 .53	1.38
NW	5 2.78 .24	8 4.44 .38	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	13 7.22 .62	1.68
NNW	5 2.78 .24	6 3.33 .29	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	11 6.11 .53	1.58
N	7 3.89 .34	6 3.33 .29	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	13 7.22 .62	1.40
CALM	2 1.11 .10						2 1.11 .10	CALM
TOTAL	84 46.67 4.03	93 51.67 4.46	3 1.67 .14	0 0.00 0.00	0 0.00 .00	0 0.00 0.00	180 100.00 8.63	1.65

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JUNE

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 10.29.27.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	9 2.47 .43	3 .82 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	12 3.30 .58	1.04
NE	13 3.57 .62	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	13 3.57 .62	.95
ENE	3 .82 .14	3 .82 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 1.65 .29	1.50
E	12 3.30 .58	1 .27 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	13 3.57 .62	1.09
ESE	6 1.65 .29	2 .55 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 2.20 .38	1.35
SE	13 3.57 .62	39 10.71 1.87	6 1.65 .29	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	58 15.93 2.78	2.12
SSE	5 1.37 .24	35 9.62 1.68	8 2.20 .38	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	48 13.19 2.30	2.37
S	5 1.37 .24	19 5.22 .91	4 1.10 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	28 7.69 1.34	2.34
SSW	4 1.10 .19	26 7.14 1.25	9 2.47 .43	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	39 10.71 1.87	2.50
SW	8 2.20 .38	25 6.87 1.20	10 2.75 .48	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	43 11.81 2.06	2.49
WSW	9 2.47 .43	11 3.02 .53	1 .27 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	21 5.77 1.01	1.67
W	14 3.85 .67	7 1.92 .34	1 .27 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	22 6.04 1.06	1.64
WNW	2 .55 .10	3 .82 .14	1 .27 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 1.65 .29	1.88
NW	6 1.65 .29	17 4.67 .82	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	23 6.32 1.10	1.90
NNW	7 1.92 .34	6 1.65 .29	0 0.00 0.00	1 .27 .05	0 0.00 0.00	0 0.00 0.00	14 3.85 .67	1.84
N	2 .55 .10	3 .82 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 1.37 .24	1.70
CALM	5 1.37 .24						5 1.37 .24	CALM
TOTAL	123 33.79 5.90	200 54.95 9.59	40 10.99 1.92	1 .27 .05	0 0.00 0.00	0 0.00 0.00	364 100.00 17.46	1.99

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 10.29.27.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	30 1.43	22 1.05	14 .67	1 .05	0 0.00	0 0.00	67 3.20	1.94
NE	37 1.76	16 .76	5 .24	0 0.00	0 0.00	0 0.00	58 2.77	1.49
ENE	10 .48	14 .67	5 .24	3 .14	0 0.00	0 0.00	32 1.53	2.49
E	26 1.24	16 .76	5 .24	2 .10	0 0.00	0 0.00	49 2.34	1.82
ESE	19 .91	17 .81	10 .48	0 0.00	0 0.00	0 0.00	46 2.19	2.02
SE	31 1.48	103 4.91	59 2.81	9 .43	0 0.00	0 0.00	202 9.63	2.69
SSE	24 1.14	103 4.91	85 4.05	17 .81	0 0.00	0 0.00	229 10.92	2.96
S	30 1.43	97 4.63	116 5.53	61 2.91	3 .14	0 0.00	307 14.64	3.67
SSW	20 .95	83 3.96	95 4.53	38 1.81	5 .24	1 .05	242 11.54	3.60
SW	31 1.48	86 4.10	95 4.53	20 .95	2 .10	1 .05	235 11.21	3.21
WSW	29 1.38	41 1.96	17 .81	11 .52	2 .10	0 0.00	100 4.77	2.72
W	50 2.38	39 1.86	22 1.05	14 .67	0 0.00	0 0.00	125 5.96	2.50
WNW	22 1.05	32 1.53	24 1.14	11 .52	0 0.00	0 0.00	89 4.24	2.85
NW	17 .81	49 2.34	25 1.19	16 .76	0 0.00	0 0.00	107 5.10	2.95
NNW	22 1.05	36 1.72	23 1.10	11 .52	1 .05	0 0.00	93 4.43	2.81
N	23 1.10	55 2.62	20 .95	6 .29	1 .05	0 0.00	105 5.01	2.52
CALM	11 .52						11 .52	CALM
TOTAL	432 20.60	809 38.58	620 29.57	220 10.49	14 .67	2 .10	2097 100.00	2.92

NUMBER OF VALID OBSERVATIONS 2097 97.08 PCT.
NUMBER OF INVALID OBSERVATIONS 63 2.92 PCT.
TOTAL NUMBER OF OBSERVATIONS 2160 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-60 (Continued) (Sheet 23 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JUNE

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 10.29.27.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ESE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SE	0 0.00 0.00	0 0.00 0.00	1 2.86 .05	2 5.71 .10	0 0.00 0.00	0 0.00 0.00	3 8.57 .15	5.53
SSE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
S	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.86 .05	0 0.00 0.00	1 2.86 .05	8.90
SSW	1 2.86 .05	1 2.86 .05	0 0.00 0.00	0 0.00 0.00	3 8.57 .15	1 2.86 .05	6 17.14 .29	6.62
SW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
WSW	0 0.00 0.00	1 2.86 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.86 .05	3.00
W	3 8.57 .15	1 2.86 .05	6 17.14 .29	4 11.43 .20	2 5.71 .10	2 5.71 .10	18 51.43 .88	5.23
WNW	0 0.00 0.00	0 0.00 0.00	1 2.86 .05	2 5.71 .10	0 0.00 0.00	1 2.86 .05	4 11.43 .20	6.40
NW	0 0.00 0.00	1 2.86 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.86 .05	2.20
NNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
N	0 0.00 0.00	1 2.86 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.86 .05	2.70
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	4 11.43 .20	5 14.29 .24	8 22.86 .39	8 22.86 .39	6 17.14 .29	4 11.43 .20	35 100.00 1.71	5.51

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 10.29.27.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	1 .75 .05	5 3.73 .24	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 4.48 .29	3.55
NE	0 0.00 0.00	4 2.99 .20	2 1.49 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 4.48 .29	3.18
ENE	0 0.00 0.00	1 .75 .05	1 .75 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.49 .10	2.85
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ESE	0 0.00 0.00	1 .75 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .75 .05	3.00
SE	0 0.00 0.00	1 .75 .05	1 .75 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.49 .10	3.15
SSE	0 0.00 0.00	1 .75 .05	0 0.00 0.00	2 1.49 .10	0 0.00 0.00	0 0.00 0.00	3 2.24 .15	4.60
S	0 0.00 0.00	2 1.49 .10	1 .75 .05	7 5.22 .34	5 3.73 .24	0 0.00 0.00	15 11.19 .73	6.47
SSW	2 1.49 .10	1 .75 .05	2 1.49 .10	3 2.24 .15	4 2.99 .20	0 0.00 0.00	12 8.96 .59	5.49
SW	0 0.00 0.00	6 4.48 .29	9 6.72 .44	8 5.97 .39	0 0.00 0.00	0 0.00 0.00	23 17.16 1.12	4.45
WSW	1 .75 .05	4 2.99 .20	4 2.99 .20	1 .75 .05	0 0.00 0.00	0 0.00 0.00	10 7.46 .49	3.09
W	2 1.49 .10	4 2.99 .20	7 5.22 .34	0 0.00 0.00	2 1.49 .10	1 .75 .05	16 11.94 .78	4.27
WNW	0 0.00 0.00	2 1.49 .10	5 3.73 .24	2 1.49 .10	3 2.24 .15	0 0.00 0.00	12 8.96 .59	5.21
NW	0 0.00 0.00	1 .75 .05	3 2.24 .15	5 3.73 .24	2 1.49 .10	1 .75 .05	12 8.96 .59	6.08
NNW	1 .75 .05	0 0.00 0.00	3 2.24 .15	4 2.99 .20	1 .75 .05	0 0.00 0.00	9 6.72 .44	5.56
N	0 0.00 0.00	3 2.24 .15	1 .75 .05	1 .75 .05	0 0.00 0.00	0 0.00 0.00	5 3.73 .24	3.44
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	6 4.48 .29	32 23.88 1.56	44 32.84 2.15	33 24.63 1.61	17 12.69 .83	2 1.49 .10	134 100.00 6.53	4.75

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JUNE

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 10.29.27.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	0 0.00 0.00	1 1.41 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.41 .05	4.60
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	1 1.41 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.41 .05	2.70
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ESE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SE	0 0.00 0.00	0 0.00 0.00	3 4.23 .15	2 2.82 .10	0 0.00 0.00	0 0.00 0.00	5 7.04 .24	4.86
SSE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
S	0 0.00 0.00	0 0.00 0.00	3 4.23 .15	3 4.23 .15	3 4.23 .15	0 0.00 0.00	9 12.68 .44	6.22
SSW	2 2.82 .10	2 2.82 .10	0 0.00 0.00	2 2.82 .10	2 2.82 .10	0 0.00 0.00	8 11.27 .39	4.50
SW	1 1.41 .05	0 0.00 0.00	0 0.00 0.00	1 1.41 .05	0 0.00 0.00	0 0.00 0.00	2 2.82 .10	3.40
WSW	0 0.00 0.00	0 0.00 0.00	4 5.63 .20	1 1.41 .05	0 0.00 0.00	0 0.00 0.00	5 7.04 .24	4.34
W	1 1.41 .05	1 1.41 .05	10 14.08 .49	1 1.41 .05	1 1.41 .05	1 1.41 .05	15 21.13 .73	4.60
WNW	1 1.41 .05	0 0.00 0.00	3 4.23 .15	2 2.82 .10	3 4.23 .15	1 1.41 .05	10 14.08 .49	6.53
NW	0 0.00 0.00	1 1.41 .05	1 1.41 .05	7 9.86 .34	2 2.82 .10	0 0.00 0.00	11 15.49 .54	6.17
NNW	1 1.41 .05	1 1.41 .05	0 0.00 0.00	1 1.41 .05	0 0.00 0.00	0 0.00 0.00	3 4.23 .15	3.50
N	0 0.00 0.00	1 1.41 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.41 .05	2.20
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	6 8.45 .29	7 9.86 .34	25 35.21 1.22	20 28.17 .98	11 15.49 .54	2 2.82 .10	71 100.00 3.46	5.17

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 10.29.27.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	6 .88 .29	10 1.47 .49	9 1.32 .44	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	25 3.68 1.22	2.41
NE	2 .29 .10	5 .74 .24	9 1.32 .44	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	16 2.35 .78	3.12
ENE	5 .74 .24	5 .74 .24	2 .29 .10	1 .15 .05	2 .29 .10	0 0.00 0.00	15 2.21 .73	3.03
E	1 .15 .05	8 1.18 .39	3 .44 .15	2 .29 .10	0 0.00 0.00	0 0.00 0.00	14 2.06 .68	3.24
ESE	1 .15 .05	3 .44 .15	7 1.03 .34	4 .59 .20	0 0.00 0.00	0 0.00 0.00	15 2.21 .73	3.94
SE	2 .29 .10	5 .74 .24	15 2.21 .73	12 1.76 .59	5 .74 .24	0 0.00 0.00	39 5.74 1.90	4.84
SSE	4 .59 .20	9 1.32 .44	21 3.09 1.02	25 3.68 1.22	5 .74 .24	0 0.00 0.00	64 9.41 3.12	4.69
S	7 1.03 .34	16 2.35 .78	31 4.56 1.51	33 4.85 1.61	18 2.65 .88	2 .29 .10	107 15.74 5.22	5.11
SSW	5 .74 .24	21 3.09 1.02	27 3.97 1.32	40 5.88 1.95	4 .59 .20	3 .44 .15	100 14.71 4.88	4.85
SW	2 .29 .10	13 1.91 .63	39 5.74 1.90	25 3.68 1.22	2 .29 .10	5 .74 .24	86 12.65 4.19	5.03
WSW	3 .44 .15	7 1.03 .34	9 1.32 .44	3 .44 .15	6 .88 .29	4 .59 .20	32 4.71 1.56	5.10
W	5 .74 .24	10 1.47 .49	14 2.06 .68	1 .15 .05	2 .29 .10	1 .15 .05	33 4.85 1.61	3.66
WNW	3 .44 .15	6 .88 .29	9 1.32 .44	12 1.76 .59	4 .59 .20	0 0.00 0.00	34 5.00 1.66	4.76
NW	3 .44 .15	5 .74 .24	9 1.32 .44	6 .88 .29	3 .44 .15	0 0.00 0.00	26 3.82 1.27	4.40
NNW	1 .15 .05	9 1.32 .44	13 1.91 .63	8 1.18 .39	2 .29 .10	1 .15 .05	34 5.00 1.66	4.35
N	7 1.03 .34	11 1.62 .54	14 2.06 .68	7 1.03 .34	0 0.00 0.00	0 0.00 0.00	39 5.74 1.90	3.29
CALM	1 .15 .05						1 .15 .05	CALM
TOTAL	58 8.53 2.83	143 21.03 6.97	231 33.97 11.26	179 26.32 8.73	53 7.79 2.58	16 2.35 .78	680 100.00 33.15	4.50

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-60 (Continued) (Sheet 24 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JUNE

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 10.29.27.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	1 .17 .05	4 .68 .20	9 1.53 .44	3 .51 .15	0 0.00 0.00	0 0.00 0.00	17 2.89 .83	3.75
NE	2 .34 .10	3 .51 .15	7 1.19 .34	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	12 2.04 .59	2.81
ENE	0 0.00 0.00	3 .51 .15	8 1.36 .39	0 0.00 0.00	1 .17 .05	0 0.00 0.00	12 2.04 .59	3.74
E	0 0.00 0.00	0 0.00 0.00	4 .68 .20	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 .68 .20	4.12
ESE	4 .68 .20	5 .85 .24	8 1.36 .39	2 .34 .10	0 0.00 0.00	0 0.00 0.00	19 3.23 .93	2.93
SE	1 .17 .05	12 2.04 .59	19 3.23 .93	15 2.55 .73	1 .17 .05	0 0.00 0.00	48 8.16 2.34	4.28
SSE	4 .68 .20	13 2.21 .63	25 4.25 1.22	38 6.46 1.85	3 .51 .15	0 0.00 0.00	83 14.12 4.05	4.78
S	5 .85 .24	16 2.72 .78	29 4.93 1.41	71 12.07 3.46	8 1.36 .39	0 0.00 0.00	129 21.94 6.29	5.25
SSW	2 .34 .10	4 .68 .20	20 3.40 .98	56 9.52 2.73	8 1.36 .39	0 0.00 0.00	90 15.31 4.39	5.68
SW	0 0.00 0.00	0 0.00 0.00	18 3.06 .88	32 5.44 1.56	5 .85 .24	1 .17 .05	56 9.52 2.73	5.93
WSW	2 .34 .10	3 .51 .15	7 1.19 .34	3 .51 .15	2 .34 .10	2 .34 .10	19 3.23 .93	4.55
W	1 .17 .05	8 1.36 .39	9 1.53 .44	3 .51 .15	2 .34 .10	0 0.00 0.00	23 3.91 1.12	3.90
WNW	2 .34 .10	5 .85 .24	2 .34 .10	6 1.02 .29	0 0.00 0.00	0 0.00 0.00	15 2.55 .73	3.90
NW	1 .17 .05	1 .17 .05	3 .51 .15	7 1.19 .34	0 0.00 0.00	0 0.00 0.00	12 2.04 .59	4.98
NNW	0 0.00 0.00	2 .34 .10	4 .68 .20	6 1.02 .29	2 .34 .10	0 0.00 0.00	14 2.38 .68	5.06
N	1 .17 .05	3 .51 .15	19 3.23 .93	9 1.53 .44	0 0.00 0.00	0 0.00 0.00	32 5.44 1.56	4.34
CALM	3 .51 .15						3 .51 .15	CALM
TOTAL	29 4.93 1.41	82 13.95 4.00	191 32.48 9.31	251 42.69 12.24	32 5.44 1.56	3 .51 .15	588 100.00 28.67	4.84

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 10.29.27.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	1 .56 .05	1 .56 .05	4 2.22 .20	1 .56 .05	0 0.00 0.00	0 0.00 0.00	7 3.89 .34	3.53
NE	1 .56 .05	2 1.11 .10	8 4.44 .39	2 1.11 .10	0 0.00 0.00	0 0.00 0.00	13 7.22 .63	3.72
ENE	0 0.00 0.00	0 0.00 0.00	6 3.33 .29	3 1.67 .15	0 0.00 0.00	0 0.00 0.00	9 5.00 .44	4.48
E	2 1.11 .10	0 0.00 0.00	2 1.11 .10	2 1.11 .10	0 0.00 0.00	0 0.00 0.00	6 3.33 .29	3.68
ESE	3 1.67 .15	3 1.67 .15	0 0.00 0.00	1 .56 .05	0 0.00 0.00	0 0.00 0.00	7 3.89 .34	2.04
SE	1 .56 .05	0 0.00 0.00	1 .56 .05	3 1.67 .15	0 0.00 0.00	0 0.00 0.00	5 2.78 .24	4.82
SSE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 2.22 .20	0 0.00 0.00	0 0.00 0.00	4 2.22 .20	5.25
S	0 0.00 0.00	1 .56 .05	13 7.22 .63	4 2.22 .20	0 0.00 0.00	0 0.00 0.00	18 10.00 .88	4.46
SSW	0 0.00 0.00	2 1.11 .10	6 3.33 .29	6 3.33 .29	0 0.00 0.00	0 0.00 0.00	14 7.78 .68	4.65
SW	2 1.11 .10	2 1.11 .10	10 5.56 .49	19 10.56 .93	0 0.00 0.00	0 0.00 0.00	33 18.33 1.61	4.92
WSW	0 0.00 0.00	0 0.00 0.00	2 1.11 .10	5 2.78 .24	2 1.11 .10	0 0.00 0.00	9 5.00 .44	6.21
W	2 1.11 .10	2 1.11 .10	8 4.44 .39	7 3.89 .34	0 0.00 0.00	0 0.00 0.00	19 10.56 .93	4.29
WNW	1 .56 .05	0 0.00 0.00	9 5.00 .44	3 1.67 .15	0 0.00 0.00	0 0.00 0.00	13 7.22 .63	4.57
NW	0 0.00 0.00	0 0.00 0.00	1 .56 .05	2 1.11 .10	0 0.00 0.00	0 0.00 0.00	3 1.67 .15	5.00
NNW	0 0.00 0.00	0 0.00 0.00	4 2.22 .20	4 2.22 .20	0 0.00 0.00	0 0.00 0.00	8 4.44 .39	5.25
N	1 .56 .05	0 0.00 0.00	5 2.78 .24	3 1.67 .15	0 0.00 0.00	0 0.00 0.00	9 5.00 .44	4.62
CALM	3 1.67 .15						3 1.67 .15	CALM
TOTAL	17 9.44 .83	13 7.22 .63	79 43.89 3.85	69 38.33 3.36	2 1.11 .10	0 0.00 0.00	180 100.00 8.78	4.43

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JUNE

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 10.29.27.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	2 .55 .10	1 .28 .05	2 .55 .10	3 .83 .15	0 0.00 0.00	0 0.00 0.00	8 2.20 .39	3.90
NE	0 0.00 0.00	1 .28 .05	4 1.10 .20	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 1.38 .24	3.58
ENE	2 .55 .10	2 .55 .10	8 2.20 .39	2 .55 .10	0 0.00 0.00	0 0.00 0.00	14 3.86 .68	3.60
E	1 .28 .05	2 .55 .10	3 .83 .15	3 .83 .15	0 0.00 0.00	0 0.00 0.00	9 2.48 .44	3.70
ESE	1 .28 .05	3 .83 .15	8 2.20 .39	3 .83 .15	0 0.00 0.00	0 0.00 0.00	15 4.13 .73	4.02
SE	2 .55 .10	4 1.10 .20	9 2.48 .44	12 3.31 .59	0 0.00 0.00	0 0.00 0.00	27 7.44 1.32	4.44
SSE	0 0.00 0.00	0 0.00 0.00	12 3.31 .59	31 8.54 1.51	0 0.00 0.00	0 0.00 0.00	43 11.85 2.10	5.32
S	2 .55 .10	6 1.65 .29	26 7.16 1.27	19 5.23 .93	0 0.00 0.00	0 0.00 0.00	53 14.60 2.58	4.43
SSW	3 .83 .15	7 1.93 .34	12 3.31 .59	30 8.26 1.46	0 0.00 0.00	0 0.00 0.00	52 14.33 2.54	4.78
SW	2 .55 .10	3 .83 .15	8 2.20 .39	26 7.16 1.27	3 .83 .15	0 0.00 0.00	42 11.57 2.05	5.61
WSW	0 0.00 0.00	3 .83 .15	8 2.20 .39	4 1.10 .20	2 .55 .10	0 0.00 0.00	17 4.68 .83	4.70
W	1 .28 .05	4 1.10 .20	12 3.31 .59	9 2.48 .44	0 0.00 0.00	0 0.00 0.00	26 7.16 1.27	4.25
WNW	0 0.00 0.00	2 .55 .10	2 .55 .10	5 1.38 .24	0 0.00 0.00	0 0.00 0.00	9 2.48 .44	4.97
NW	2 .55 .10	1 .28 .05	4 1.10 .20	11 3.03 .54	0 0.00 0.00	0 0.00 0.00	18 4.96 .88	4.89
NNW	1 .28 .05	1 .28 .05	3 .83 .15	8 2.20 .39	1 .28 .05	0 0.00 0.00	14 3.86 .68	5.38
N	0 0.00 0.00	1 .28 .05	5 1.38 .24	2 .55 .10	0 0.00 0.00	0 0.00 0.00	8 2.20 .39	4.17
CALM	3 .83 .15						3 .83 .15	CALM
TOTAL	22 6.06 1.07	41 11.29 2.00	126 34.71 6.14	168 46.28 8.19	6 1.65 .29	0 0.00 0.00	363 100.00 17.70	4.66

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 10.29.27.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	10 .48	17 .82	38 1.83	12 .58	0 0.00	0 0.00	77 3.72	3.47
NE	5 .24	16 .77	30 1.45	4 .19	0 0.00	0 0.00	55 2.66	3.32
ENE	7 .34	12 .58	25 1.21	6 .29	3 .14	0 0.00	53 2.56	3.57
E	4 .19	10 .48	12 .58	7 .34	0 0.00	0 0.00	33 1.59	3.55
ESE	9 .43	15 .72	23 1.11	10 .48	0 0.00	0 0.00	57 2.75	3.37
SE	6 .29	22 1.06	49 2.37	46 2.22	6 .29	0 0.00	129 6.23	4.54
SSE	8 .39	23 1.11	58 2.80	100 4.83	8 .39	0 0.00	197 9.51	4.88
S	14 .68	41 1.98	103 4.97	137 6.62	35 1.69	2 .10	332 16.03	5.12
SSW	15 .72	38 1.83	67 3.24	137 6.62	21 1.01	4 .19	282 13.62	5.15
SW	7 .34	24 1.16	84 4.06	111 5.36	10 .48	6 .29	242 11.69	5.25
WSW	6 .29	18 .87	34 1.64	17 .82	12 .58	6 .29	93 4.49	4.87
W	15 .72	30 1.45	66 3.19	25 1.21	9 .43	5 .24	150 7.24	4.23
WNW	7 .34	15 .72	31 1.50	32 1.55	10 .48	2 .10	97 4.68	4.93
NW	6 .29	10 .48	21 1.01	38 1.83	7 .34	1 .05	83 4.01	5.06
NNW	4 .19	13 .63	27 1.30	31 1.50	6 .29	1 .05	82 3.96	4.84
N	9 .43	20 .97	44 2.12	26 1.26	0 0.00	0 0.00	99 4.78	3.95
CALM	10 .48						10 .48	CALM
TOTAL	142 6.86	324 15.64	712 34.38	739 35.68	127 6.13	27 1.30	2071 100.00	4.68

NUMBER OF VALID OBSERVATIONS 2071 95.88 PCT.
NUMBER OF INVALID OBSERVATIONS 89 4.12 PCT.
TOTAL NUMBER OF OBSERVATIONS 2160 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-60 (Continued) (Sheet 25 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JULY

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 09.45.20.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 0.00 0.00	2 2.38 .09	3 3.57 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 5.95 .24	3.70
NE	0 0.00 0.00	1 1.19 .05	2 2.38 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 3.57 .14	3.17
ENE	0 0.00 0.00	0 0.00 0.00	1 1.19 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.19 .05	4.50
E	0 0.00 0.00	1 1.19 .05	2 2.38 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 3.57 .14	3.80
ESE	0 0.00 0.00	0 0.00 0.00	2 2.38 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 2.38 .09	3.40
SE	0 0.00 0.00	1 1.19 .05	2 2.38 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 3.57 .14	3.17
SSE	0 0.00 0.00	1 1.19 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.19 .05	2.70
S	0 0.00 0.00	1 1.19 .05	5 5.95 .24	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 7.14 .28	3.87
SSW	0 0.00 0.00	2 2.38 .09	1 1.19 .05	1 1.19 .05	0 0.00 0.00	0 0.00 0.00	4 4.76 .19	3.35
SW	0 0.00 0.00	4 4.76 .19	5 5.95 .24	1 1.19 .05	0 0.00 0.00	0 0.00 0.00	10 11.90 .47	3.46
WSW	0 0.00 0.00	1 1.19 .05	3 3.57 .14	2 2.38 .09	1 1.19 .05	0 0.00 0.00	7 8.33 .33	5.03
W	0 0.00 0.00	3 3.57 .14	8 9.52 .38	2 2.38 .09	0 0.00 0.00	0 0.00 0.00	13 15.48 .61	4.11
WNW	0 0.00 0.00	3 3.57 .14	5 5.95 .24	1 1.19 .05	0 0.00 0.00	0 0.00 0.00	9 10.71 .42	3.81
NW	0 0.00 0.00	0 0.00 0.00	7 8.33 .33	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 8.33 .33	4.01
NNW	0 0.00 0.00	0 0.00 0.00	8 9.52 .38	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 9.52 .38	4.15
N	0 0.00 0.00	0 0.00 0.00	2 2.38 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 2.38 .09	4.25
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	0 0.00 0.00	20 23.81 .94	56 66.67 2.64	7 8.33 .33	1 1.19 .05	0 0.00 0.00	84 100.00 3.95	3.90

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JULY

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 09.45.20.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 0.00 0.00	4 3.51 .19	1 .88 .05	1 .88 .05	0 0.00 0.00	0 0.00 0.00	6 5.26 .28	3.07
NE	0 0.00 0.00	1 .88 .05	1 .88 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.75 .09	3.15
ENE	0 0.00 0.00	1 .88 .05	0 0.00 0.00	1 .88 .05	0 0.00 0.00	0 0.00 0.00	2 1.75 .09	4.25
E	0 0.00 0.00	0 0.00 0.00	1 .88 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .88 .05	4.20
ESE	0 0.00 0.00	3 2.63 .14	1 .88 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 3.51 .19	2.75
SE	0 0.00 0.00	2 1.75 .09	2 1.75 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 3.51 .19	3.15
SSE	0 0.00 0.00	4 3.51 .19	5 4.39 .24	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 7.89 .42	3.39
S	0 0.00 0.00	2 1.75 .09	7 6.14 .33	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 7.89 .42	3.43
SSW	1 .88 .05	7 6.14 .33	11 9.65 .52	4 3.51 .19	0 0.00 0.00	0 0.00 0.00	23 20.18 1.08	3.54
SW	1 .88 .05	4 3.51 .19	8 7.02 .38	1 .88 .05	0 0.00 0.00	0 0.00 0.00	14 12.28 .66	3.35
WSW	0 0.00 0.00	4 3.51 .19	4 3.51 .19	1 .88 .05	0 0.00 0.00	0 0.00 0.00	9 7.89 .42	3.48
W	0 0.00 0.00	3 2.63 .14	6 5.26 .28	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 7.89 .42	3.51
WNW	0 0.00 0.00	1 .88 .05	5 4.39 .24	1 .88 .05	0 0.00 0.00	0 0.00 0.00	7 6.14 .33	4.27
NW	0 0.00 0.00	1 .88 .05	3 2.63 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 3.51 .19	3.67
NNW	0 0.00 0.00	1 .88 .05	4 3.51 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 4.39 .24	3.68
N	0 0.00 0.00	4 3.51 .19	2 1.75 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 5.26 .28	2.58
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	2 1.75 .09	42 36.84 1.98	61 53.51 2.87	9 7.89 .42	0 0.00 0.00	0 0.00 0.00	114 100.00 5.36	3.50

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 09.45.20.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	1 .65 .05	1 .65 .05	5 3.25 .24	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 4.55 .33	3.23
NE	0 0.00 0.00	2 1.30 .09	1 .65 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 1.95 .14	2.43
ENE	0 0.00 0.00	3 1.95 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 1.95 .14	2.77
E	0 0.00 0.00	0 0.00 0.00	4 2.60 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 2.60 .19	3.55
ESE	0 0.00 0.00	6 3.90 .28	3 1.95 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 5.84 .42	3.16
SE	0 0.00 0.00	2 1.30 .09	8 5.19 .38	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	10 6.49 .47	3.29
SSE	0 0.00 0.00	3 1.95 .14	5 3.25 .24	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 5.19 .38	3.10
S	0 0.00 0.00	10 6.49 .47	11 7.14 .52	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	21 13.64 .99	3.13
SSW	0 0.00 0.00	6 3.90 .28	11 7.14 .52	5 3.25 .24	2 1.30 .09	0 0.00 0.00	24 15.58 1.13	4.31
SW	0 0.00 0.00	1 .65 .05	12 7.79 .56	0 0.00 0.00	1 .65 .05	0 0.00 0.00	14 9.09 .66	3.85
WSW	0 0.00 0.00	3 1.95 .14	6 3.90 .28	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 5.84 .42	3.37
W	1 .65 .05	2 1.30 .09	6 3.90 .28	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 5.84 .42	3.16
WNW	1 .65 .05	3 1.95 .14	3 1.95 .14	1 .65 .05	0 0.00 0.00	0 0.00 0.00	8 5.19 .38	3.26
NW	0 0.00 0.00	4 2.60 .19	4 2.60 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 5.19 .38	3.09
NNW	2 1.30 .09	4 2.60 .19	5 3.25 .24	1 .65 .05	0 0.00 0.00	0 0.00 0.00	12 7.79 .56	3.24
N	1 .65 .05	3 1.95 .14	1 .65 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 3.25 .24	2.44
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	6 3.90 .28	53 34.42 2.49	85 55.19 4.00	7 4.55 .33	3 1.95 .14	0 0.00 0.00	154 100.00 7.25	3.40

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 09.45.20.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	9 1.69 .42	30 5.62 1.41	4 .75 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	43 8.05 2.02	2.10
NE	7 1.31 .33	22 4.12 1.04	3 .56 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	32 5.99 1.51	2.13
ENE	4 .75 .19	15 2.81 .71	4 .75 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	23 4.31 1.08	2.10
E	3 .56 .14	17 3.18 .80	6 1.12 .28	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	26 4.87 1.22	2.44
ESE	2 .37 .09	8 1.50 .38	17 3.18 .80	1 .19 .05	0 0.00 0.00	0 0.00 0.00	28 5.24 1.32	3.24
SE	4 .75 .19	17 3.18 .80	23 4.31 1.08	1 .19 .05	0 0.00 0.00	0 0.00 0.00	45 8.43 2.12	3.05
SSE	5 .94 .24	28 5.24 1.32	20 3.75 .94	2 .37 .09	0 0.00 0.00	0 0.00 0.00	55 10.30 2.59	2.81
S	3 .56 .14	29 5.43 1.36	25 4.68 1.18	4 .75 .19	0 0.00 0.00	0 0.00 0.00	61 11.42 2.87	3.10
SSW	1 .19 .05	17 3.18 .80	25 4.68 1.18	14 2.62 .66	2 .37 .09	0 0.00 0.00	59 11.05 2.78	4.11
SW	2 .37 .09	17 3.18 .80	15 2.81 .71	4 .75 .19	0 0.00 0.00	0 0.00 0.00	38 7.12 1.79	3.14
WSW	0 0.00 0.00	4 .75 .19	9 1.69 .42	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	13 2.43 .61	3.43
W	5 .94 .24	9 1.69 .42	5 .94 .24	1 .19 .05	0 0.00 0.00	0 0.00 0.00	20 3.75 .94	2.59
WNW	5 .94 .24	6 1.12 .28	8 1.50 .38	2 .37 .09	0 0.00 0.00	0 0.00 0.00	21 3.93 .99	2.44
NW	2 .37 .09	3 .56 .14	7 1.31 .33	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	12 2.25 .56	2.77
NNW	4 .75 .19	4 .75 .19	11 2.06 .52	2 .37 .09	0 0.00 0.00	0 0.00 0.00	21 3.93 .99	3.19
N	12 2.25 .56	15 2.81 .71	9 1.69 .42	1 .19 .05	0 0.00 0.00	0 0.00 0.00	37 6.93 1.74	2.39
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	68 12.73 3.20	241 45.13 11.34	191 35.77 8.99	32 5.99 1.51	2 .37 .09	0 0.00 0.00	534 100.00 25.13	2.91

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-60 (Continued) (Sheet 26 of 48)

DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JULY

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 09.45.20.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	4 .69 .19	11 1.90 .52	4 .69 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	19 3.28 .89	2.26
NE	7 1.21 .33	8 1.38 .38	3 .52 .14	1 .17 .05	0 0.00 0.00	0 0.00 0.00	19 3.28 .89	2.12
ENE	11 1.90 .52	11 1.90 .52	1 .17 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	23 3.97 1.08	1.91
E	6 1.04 .28	22 3.80 1.04	5 .86 .24	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	33 5.70 1.55	2.22
ESE	7 1.21 .33	23 3.97 1.08	5 .86 .24	1 .17 .05	0 0.00 0.00	0 0.00 0.00	36 6.22 1.69	2.24
SE	9 1.55 .42	51 8.81 2.40	27 4.66 1.27	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	87 15.03 4.09	2.58
SSE	9 1.55 .42	39 6.74 1.84	25 4.32 1.18	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	73 12.61 3.44	2.65
S	5 .86 .24	32 5.53 1.51	39 6.74 1.84	3 .52 .14	0 0.00 0.00	0 0.00 0.00	79 13.64 3.72	3.14
SSW	7 1.21 .33	18 3.11 .85	16 2.76 .75	5 .86 .24	0 0.00 0.00	0 0.00 0.00	46 7.94 2.16	2.96
SW	4 .69 .19	7 1.21 .33	7 1.21 .33	3 .52 .14	0 0.00 0.00	0 0.00 0.00	21 3.63 .99	3.11
WSW	7 1.21 .33	13 2.25 .61	3 .52 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	23 3.97 1.08	2.03
W	10 1.73 .47	11 1.90 .52	5 .86 .24	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	26 4.49 1.22	2.12
WNW	7 1.21 .33	10 1.73 .47	1 .17 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	18 3.11 .85	1.96
NW	5 .86 .24	3 .52 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 1.38 .38	1.56
NNW	5 .86 .24	12 2.07 .56	7 1.21 .33	1 .17 .05	0 0.00 0.00	0 0.00 0.00	25 4.32 1.18	2.63
N	5 .86 .24	25 4.32 1.18	9 1.55 .42	1 .17 .05	0 0.00 0.00	0 0.00 0.00	40 6.91 1.88	2.54
CALM	3 .52 .14						3 .52 .14	CALM
TOTAL	111 19.17 5.22	296 51.12 13.93	157 27.12 7.39	15 2.59 .71	0 0.00 0.00	0 0.00 0.00	579 100.00 27.25	2.53

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 09.45.20.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	6 3.92 .28	12 7.84 .56	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	18 11.76 .85	1.90
NE	4 2.61 .19	5 3.27 .24	1 .65 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	10 6.54 .47	1.77
ENE	3 1.96 .14	8 5.23 .38	1 .65 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	12 7.84 .56	2.08
E	3 1.96 .14	1 .65 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 2.61 .19	1.55
ESE	3 1.96 .14	5 3.27 .24	1 .65 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 5.88 .42	1.93
SE	2 1.31 .09	5 3.27 .24	4 2.61 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	11 7.19 .52	2.59
SSE	1 .65 .05	9 5.88 .42	1 .65 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	11 7.19 .52	2.44
S	4 2.61 .19	5 3.27 .24	2 1.31 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	11 7.19 .52	2.06
SSW	2 1.31 .09	4 2.61 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 3.92 .28	1.62
SW	3 1.96 .14	12 7.84 .56	3 1.96 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	18 11.76 .85	2.32
WSW	1 .65 .05	5 3.27 .24	3 1.96 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 5.88 .42	2.61
W	2 1.31 .09	4 2.61 .19	1 .65 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 4.58 .33	1.80
WNW	5 3.27 .24	1 .65 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 3.92 .28	1.32
NW	0 0.00 0.00	5 3.27 .24	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 3.27 .24	2.62
NNW	2 1.31 .09	5 3.27 .24	1 .65 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 5.23 .38	2.22
N	0 0.00 0.00	3 1.96 .14	1 .65 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 2.61 .19	2.27
CALM	4 2.61 .19						4 2.61 .19	CALM
TOTAL	45 29.41 2.12	89 58.17 4.19	19 12.42 .89	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	153 100.00 7.20	2.05

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JULY

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 09.45.20.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	6 1.18 .28	6 1.18 .28	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	12 2.37 .56	1.48
NE	5 .99 .24	4 .79 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 1.78 .42	1.62
ENE	5 .99 .24	8 1.58 .38	1 .20 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	14 2.76 .66	1.91
E	10 1.97 .47	11 2.17 .52	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	21 4.14 .99	1.63
ESE	6 1.18 .28	22 4.34 1.04	0 0.00 0.00	1 .20 .05	0 0.00 0.00	0 0.00 0.00	29 5.72 1.36	2.16
SE	9 1.78 .42	59 11.64 2.78	21 4.14 .99	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	89 17.55 4.19	2.50
SSE	9 1.78 .42	68 13.41 3.20	29 5.72 1.36	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	106 20.91 4.99	2.59
S	6 1.18 .28	40 7.89 1.88	21 4.14 .99	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	67 13.21 3.15	2.58
SSW	5 .99 .24	16 3.16 .75	14 2.76 .66	1 .20 .05	0 0.00 0.00	0 0.00 0.00	36 7.10 1.69	2.72
SW	9 1.78 .42	17 3.35 .80	5 .99 .24	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	31 6.11 1.46	2.21
WSW	12 2.37 .56	8 1.58 .38	1 .20 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	21 4.14 .99	1.54
W	9 1.78 .42	7 1.38 .33	1 .20 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	17 3.35 .80	1.46
WNW	9 1.78 .42	4 .79 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	13 2.56 .61	1.34
NW	4 .79 .19	4 .79 .19	1 .20 .05	1 .20 .05	0 0.00 0.00	0 0.00 0.00	10 1.97 .47	2.09
NNW	3 .59 .14	4 .79 .19	1 .20 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 1.58 .38	1.75
N	6 1.18 .28	9 1.78 .42	3 .59 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	18 3.55 .85	2.10
CALM	6 1.18 .28						6 1.18 .28	CALM
TOTAL	119 23.47 5.60	287 56.61 13.51	98 19.33 4.61	3 .59 .14	0 0.00 0.00	0 0.00 0.00	507 100.00 23.86	2.25

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 09.45.20.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	26 1.19	66 3.02	17 .78	1 .05	0 0.00	0 0.00	110 5.03	2.26
NE	23 1.05	44 2.01	11 .50	1 .05	0 0.00	0 0.00	79 3.61	2.19
ENE	24 1.10	46 2.10	8 .37	1 .05	0 0.00	0 0.00	79 3.61	2.10
E	23 1.05	53 2.42	18 .82	0 0.00	0 0.00	0 0.00	94 4.30	2.24
ESE	19 .87	71 3.25	29 1.33	3 .14	0 0.00	0 0.00	122 5.58	2.54
SE	26 1.19	143 6.54	89 4.07	1 .05	0 0.00	0 0.00	259 11.84	2.67
SSE	28 1.28	155 7.09	86 3.93	2 .09	0 0.00	0 0.00	271 12.39	2.47
S	20 .91	122 5.58	110 5.03	8 .37	0 0.00	0 0.00	260 11.89	2.96
SSW	18 .82	72 3.29	78 3.57	30 1.37	5 .23	0 0.00	203 9.28	3.49
SW	20 .91	69 3.16	57 2.61	10 .46	1 .05	0 0.00	157 7.18	2.94
WSW	20 .91	40 1.83	30 1.37	3 .14	1 .05	0 0.00	94 4.30	2.69
W	28 1.28	40 1.83	33 1.51	3 .14	0 0.00	0 0.00	104 4.76	2.55
WNW	27 1.23	28 1.28	22 1.01	5 .23	0 0.00	0 0.00	82 3.75	2.57
NW	11 .50	22 1.01	23 1.05	1 .05	0 0.00	0 0.00	57 2.61	2.72
NNW	16 .73	32 1.46	37 1.69	4 .18	0 0.00	0 0.00	89 4.07	2.91
N	25 1.14	59 2.70	27 1.23	2 .09	0 0.00	0 0.00	113 5.17	2.43
CALM	14 .64						14 .64	CALM
TOTAL	368 16.83	1062 48.56	675 30.86	75 3.43	7 .32	0 0.00	2187 100.00	2.48

NUMBER OF VALID OBSERVATIONS 2187 97.98 PCT.
NUMBER OF INVALID OBSERVATIONS 45 2.02 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-60 (Continued) (Sheet 27 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JULY

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 09.45.20.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	1 1.19 .05	3 3.57 .14	3 3.57 .14	0 0.00 0.00	0 0.00 0.00	7 8.33 .33	4.24
NE	0 0.00 0.00	1 1.19 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.19 .05	2.80
ENE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
E	0 0.00 0.00	1 1.19 .05	1 1.19 .05	2 2.38 .09	0 0.00 0.00	0 0.00 0.00	4 4.76 .19	4.52
ESE	0 0.00 0.00	0 0.00 0.00	2 2.38 .09	1 1.19 .05	0 0.00 0.00	0 0.00 0.00	3 3.57 .14	4.43
SE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SSE	0 0.00 0.00	0 0.00 0.00	1 1.19 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.19 .05	4.10
S	0 0.00 0.00	0 0.00 0.00	3 3.57 .14	2 2.38 .09	0 0.00 0.00	0 0.00 0.00	5 5.95 .24	4.36
SSW	0 0.00 0.00	2 2.38 .09	4 4.76 .19	2 2.38 .09	0 0.00 0.00	0 0.00 0.00	8 9.52 .38	4.05
SW	0 0.00 0.00	5 5.95 .24	3 3.57 .14	2 2.38 .09	0 0.00 0.00	0 0.00 0.00	10 11.90 .47	3.79
WSW	0 0.00 0.00	2 2.38 .09	1 1.19 .05	2 2.38 .09	2 2.38 .09	0 0.00 0.00	7 8.33 .33	5.50
W	0 0.00 0.00	0 0.00 0.00	10 11.90 .47	4 4.76 .19	0 0.00 0.00	0 0.00 0.00	14 16.67 .66	4.86
WNW	0 0.00 0.00	1 1.19 .05	4 4.76 .19	3 3.57 .14	0 0.00 0.00	0 0.00 0.00	8 9.52 .38	4.81
NW	0 0.00 0.00	0 0.00 0.00	3 3.57 .14	3 3.57 .14	0 0.00 0.00	0 0.00 0.00	6 7.14 .28	4.90
NNW	0 0.00 0.00	0 0.00 0.00	6 7.14 .28	2 2.38 .09	0 0.00 0.00	0 0.00 0.00	8 9.52 .38	4.31
N	0 0.00 0.00	0 0.00 0.00	1 1.19 .05	1 1.19 .05	0 0.00 0.00	0 0.00 0.00	2 2.38 .09	4.95
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	0 0.00 0.00	13 15.48 .61	42 50.00 1.98	27 32.14 1.27	2 2.38 .09	0 0.00 0.00	84 100.00 3.97	4.57

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JULY

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 09.45.20.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	4 3.51 .19	1 .88 .05	1 .88 .05	0 0.00 0.00	0 0.00 0.00	6 5.26 .28	3.43
NE	0 0.00 0.00	2 1.75 .09	1 .88 .05	1 .88 .05	0 0.00 0.00	0 0.00 0.00	4 3.51 .19	4.13
ENE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
E	0 0.00 0.00	1 .88 .05	1 .88 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.75 .09	2.85
ESE	0 0.00 0.00	1 .88 .05	2 1.75 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 2.63 .14	3.67
SE	0 0.00 0.00	1 .88 .05	3 2.63 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 3.51 .19	3.32
SSE	0 0.00 0.00	1 .88 .05	4 3.51 .19	2 1.75 .09	0 0.00 0.00	0 0.00 0.00	7 6.14 .33	4.11
S	0 0.00 0.00	2 1.75 .09	7 6.14 .33	4 3.51 .19	0 0.00 0.00	0 0.00 0.00	13 11.40 .61	4.37
SSW	0 0.00 0.00	5 4.39 .24	10 8.77 .47	6 5.26 .28	1 .88 .05	0 0.00 0.00	22 19.30 1.04	4.31
SW	0 0.00 0.00	3 2.63 .14	8 7.02 .38	2 1.75 .09	0 0.00 0.00	0 0.00 0.00	13 11.40 .61	3.80
WSW	0 0.00 0.00	5 4.39 .24	2 1.75 .09	2 1.75 .09	0 0.00 0.00	0 0.00 0.00	9 7.89 .42	3.58
W	0 0.00 0.00	3 2.63 .14	4 3.51 .19	3 2.63 .14	0 0.00 0.00	0 0.00 0.00	10 8.77 .47	4.00
WNW	0 0.00 0.00	3 2.63 .14	2 1.75 .09	2 1.75 .09	0 0.00 0.00	0 0.00 0.00	7 6.14 .33	4.13
NW	0 0.00 0.00	0 0.00 0.00	2 1.75 .09	2 1.75 .09	0 0.00 0.00	0 0.00 0.00	4 3.51 .19	4.40
NNW	0 0.00 0.00	1 .88 .05	4 3.51 .19	1 .88 .05	0 0.00 0.00	0 0.00 0.00	6 5.26 .28	4.23
N	0 0.00 0.00	2 1.75 .09	2 1.75 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 3.51 .19	3.25
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	0 0.00 0.00	34 29.82 1.61	53 46.49 2.50	26 22.81 1.23	1 .88 .05	0 0.00 0.00	114 100.00 5.38	4.11

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 09.45.20.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	1 .65 .05	4 2.60 .19	1 .65 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 3.90 .28	2.75
NE	0 0.00 0.00	2 1.30 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.30 .09	2.10
ENE	0 0.00 0.00	2 1.30 .09	1 .65 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 1.95 .14	2.73
E	0 0.00 0.00	1 .65 .05	1 .65 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.30 .09	3.50
ESE	0 0.00 0.00	2 1.30 .09	9 5.84 .42	1 .65 .05	0 0.00 0.00	0 0.00 0.00	12 7.79 .57	3.70
SE	0 0.00 0.00	2 1.30 .09	4 2.60 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 3.90 .28	3.33
SSE	0 0.00 0.00	6 3.90 .28	4 2.60 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	10 6.49 .47	3.09
S	0 0.00 0.00	7 4.55 .33	13 8.44 .61	2 1.30 .09	0 0.00 0.00	0 0.00 0.00	22 14.29 1.04	3.63
SSW	0 0.00 0.00	4 2.60 .19	7 4.55 .33	8 5.19 .38	3 1.95 .14	0 0.00 0.00	22 14.29 1.04	5.08
SW	0 0.00 0.00	4 2.60 .19	9 5.84 .42	0 0.00 0.00	1 .65 .05	0 0.00 0.00	14 9.09 .66	4.25
WSW	0 0.00 0.00	4 2.60 .19	6 3.90 .28	2 1.30 .09	0 0.00 0.00	0 0.00 0.00	12 7.79 .57	3.71
W	0 0.00 0.00	5 3.25 .24	5 3.25 .24	1 .65 .05	0 0.00 0.00	0 0.00 0.00	11 7.14 .52	3.55
WNW	1 .65 .05	3 1.95 .14	1 .65 .05	2 1.30 .09	0 0.00 0.00	0 0.00 0.00	7 4.55 .33	3.69
NW	0 0.00 0.00	1 .65 .05	5 3.25 .24	3 1.95 .14	0 0.00 0.00	0 0.00 0.00	9 5.84 .42	4.23
NNW	0 0.00 0.00	3 1.95 .14	5 3.25 .24	1 .65 .05	0 0.00 0.00	0 0.00 0.00	9 5.84 .42	3.74
N	1 .65 .05	4 2.60 .19	1 .65 .05	1 .65 .05	0 0.00 0.00	0 0.00 0.00	7 4.55 .33	3.20
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	3 1.95 .14	54 35.06 2.55	72 46.75 3.40	21 13.64 .99	4 2.60 .19	0 0.00 0.00	154 100.00 7.27	3.80

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 09.45.20.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	3 .56 .14	18 3.38 .85	17 3.19 .80	3 .56 .14	0 0.00 0.00	0 0.00 0.00	41 7.69 1.94	3.10
NE	3 .56 .14	18 3.38 .85	11 2.06 .52	2 .38 .09	0 0.00 0.00	0 0.00 0.00	34 6.38 1.61	2.95
ENE	1 .19 .05	15 2.81 .71	5 .94 .24	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	21 3.94 .99	2.60
E	1 .19 .05	15 2.81 .71	10 1.88 .47	1 .19 .05	0 0.00 0.00	0 0.00 0.00	27 5.07 1.27	3.04
ESE	1 .19 .05	4 .75 .19	14 2.63 .66	8 1.50 .38	0 0.00 0.00	0 0.00 0.00	27 5.07 1.27	4.40
SE	1 .19 .05	11 2.06 .52	25 4.69 1.18	6 1.13 .28	0 0.00 0.00	0 0.00 0.00	43 8.07 2.03	3.70
SSE	1 .19 .05	20 3.75 .94	26 4.88 1.23	6 1.13 .28	0 0.00 0.00	0 0.00 0.00	53 9.94 2.50	3.63
S	4 .75 .19	15 2.81 .71	30 5.63 1.42	11 2.06 .52	0 0.00 0.00	0 0.00 0.00	60 11.26 2.83	3.73
SSW	0 0.00 0.00	13 2.44 .61	20 3.75 .94	23 4.32 1.09	7 1.31 .33	0 0.00 0.00	63 11.82 2.97	4.92
SW	0 0.00 0.00	9 1.69 .42	18 3.38 .85	5 .94 .24	1 .19 .05	0 0.00 0.00	33 6.19 1.56	4.02
WSW	1 .19 .05	7 1.31 .33	2 .38 .09	7 1.31 .33	0 0.00 0.00	0 0.00 0.00	17 3.19 .80	4.06
W	3 .56 .14	6 1.13 .28	5 .94 .24	9 1.69 .42	2 .38 .09	0 0.00 0.00	25 4.69 1.18	4.36
WNW	1 .19 .05	7 1.31 .33	5 .94 .24	3 .56 .14	2 .38 .09	0 0.00 0.00	18 3.38 .85	4.12
NW	3 .56 .14	4 .75 .19	9 1.69 .42	3 .56 .14	0 0.00 0.00	0 0.00 0.00	19 3.56 .90	3.53
NNW	1 .19 .05	5 .94 .24	4 .75 .19	5 .94 .24	1 .19 .05	0 0.00 0.00	16 3.00 .76	4.11
N	4 .75 .19	11 2.06 .52	15 2.81 .71	5 .94 .24	0 0.00 0.00	0 0.00 0.00	35 6.57 1.65	3.25
CALM	1 .19 .05						1 .19 .05	CALM
TOTAL	29 5.44 1.37	178 33.40 8.40	216 40.53 10.20	97 18.20 4.58	13 2.44 .61	0 0.00 0.00	533 100.00 25.17	3.75

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-60 (Continued) (Sheet 28 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JULY

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 09.45.20.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	1 / .17 / .05	5 / .87 / .24	15 / 2.60 / .71	6 / 1.04 / .28	0 / 0.00 / 0.00	0 / 0.00 / 0.00	27 / 4.68 / 1.27	4.22
NE	3 / .52 / .14	10 / 1.73 / .47	8 / 1.39 / .38	2 / .35 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	23 / 3.99 / 1.09	3.05
ENE	0 / 0.00 / 0.00	6 / 1.04 / .28	10 / 1.73 / .47	4 / .69 / .19	0 / 0.00 / 0.00	0 / 0.00 / 0.00	20 / 3.47 / .94	3.88
E	0 / 0.00 / 0.00	10 / 1.73 / .47	23 / 3.99 / 1.09	5 / .87 / .24	0 / 0.00 / 0.00	0 / 0.00 / 0.00	38 / 6.59 / 1.79	4.01
ESE	4 / .69 / .19	6 / 1.04 / .28	17 / 2.95 / .80	6 / 1.04 / .28	0 / 0.00 / 0.00	0 / 0.00 / 0.00	33 / 5.72 / 1.56	3.71
SE	0 / 0.00 / 0.00	11 / 1.91 / .52	46 / 7.97 / 2.17	24 / 4.16 / 1.13	0 / 0.00 / 0.00	0 / 0.00 / 0.00	81 / 14.04 / 3.82	4.41
SSE	0 / 0.00 / 0.00	5 / .87 / .24	38 / 6.59 / 1.79	21 / 3.64 / .99	0 / 0.00 / 0.00	0 / 0.00 / 0.00	64 / 11.09 / 3.02	4.50
S	1 / .17 / .05	15 / 2.60 / .71	21 / 3.64 / .99	36 / 6.24 / 1.70	0 / 0.00 / 0.00	0 / 0.00 / 0.00	73 / 12.65 / 3.45	4.72
SSW	1 / .17 / .05	11 / 1.91 / .52	17 / 2.95 / .80	27 / 4.68 / 1.27	4 / .69 / .19	0 / 0.00 / 0.00	60 / 10.40 / 2.83	4.97
SW	0 / 0.00 / 0.00	7 / 1.21 / .33	11 / 1.91 / .52	5 / .87 / .24	2 / .35 / .09	0 / 0.00 / 0.00	25 / 4.33 / 1.18	4.35
WSW	0 / 0.00 / 0.00	6 / 1.04 / .28	15 / 2.60 / .71	3 / .52 / .14	0 / 0.00 / 0.00	0 / 0.00 / 0.00	24 / 4.16 / 1.13	3.79
W	0 / 0.00 / 0.00	3 / .52 / .14	17 / 2.95 / .80	6 / 1.04 / .28	1 / .17 / .05	0 / 0.00 / 0.00	27 / 4.68 / 1.27	4.62
WNW	1 / .17 / .05	3 / .52 / .14	11 / 1.91 / .52	6 / 1.04 / .28	0 / 0.00 / 0.00	0 / 0.00 / 0.00	21 / 3.64 / .99	4.35
NW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / .87 / .24	2 / .35 / .09	1 / .17 / .05	0 / 0.00 / 0.00	8 / 1.39 / .38	4.71
NNW	1 / .17 / .05	2 / .35 / .09	7 / 1.21 / .33	10 / 1.73 / .47	0 / 0.00 / 0.00	1 / .17 / .05	21 / 3.64 / .99	5.23
N	2 / .35 / .09	3 / .52 / .14	18 / 3.12 / .85	6 / 1.04 / .28	3 / .52 / .14	0 / 0.00 / 0.00	32 / 5.55 / 1.51	4.53
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	14 / 2.43 / .66	103 / 17.85 / 4.86	279 / 48.35 / 13.17	169 / 29.29 / 7.98	11 / 1.91 / .52	1 / .17 / .05	577 / 100.00 / 27.24	4.38

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 09.45.20.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	8 / 5.30 / .38	1 / .66 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	9 / 5.96 / .42	4.31
NE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 3.31 / .24	4 / 2.65 / .19	0 / 0.00 / 0.00	0 / 0.00 / 0.00	9 / 5.96 / .42	4.89
ENE	1 / .66 / .05	0 / 0.00 / 0.00	3 / 1.99 / .14	3 / 1.99 / .14	1 / .66 / .05	0 / 0.00 / 0.00	8 / 5.30 / .38	4.40
E	0 / 0.00 / 0.00	6 / 3.97 / .28	5 / 3.31 / .24	1 / .66 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	12 / 7.95 / .57	3.29
ESE	0 / 0.00 / 0.00	1 / .66 / .05	7 / 4.64 / .33	4 / 2.65 / .19	0 / 0.00 / 0.00	0 / 0.00 / 0.00	12 / 7.95 / .57	4.70
SE	0 / 0.00 / 0.00	1 / .66 / .05	4 / 2.65 / .19	3 / 1.99 / .14	0 / 0.00 / 0.00	0 / 0.00 / 0.00	8 / 5.30 / .38	4.31
SSE	0 / 0.00 / 0.00	1 / .66 / .05	5 / 3.31 / .24	7 / 4.64 / .33	0 / 0.00 / 0.00	0 / 0.00 / 0.00	13 / 8.61 / .61	4.75
S	0 / 0.00 / 0.00	4 / 2.65 / .19	8 / 5.30 / .38	1 / .66 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	13 / 8.61 / .61	3.62
SSW	0 / 0.00 / 0.00	4 / 2.65 / .19	5 / 3.31 / .24	4 / 2.65 / .19	0 / 0.00 / 0.00	0 / 0.00 / 0.00	13 / 8.61 / .61	4.27
SW	0 / 0.00 / 0.00	1 / .66 / .05	5 / 3.31 / .24	5 / 3.31 / .24	0 / 0.00 / 0.00	0 / 0.00 / 0.00	11 / 7.28 / .52	5.13
WSW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 1.32 / .09	7 / 4.64 / .33	0 / 0.00 / 0.00	0 / 0.00 / 0.00	9 / 5.96 / .42	5.94
W	2 / 1.32 / .09	1 / .66 / .05	3 / 1.99 / .14	7 / 4.64 / .33	0 / 0.00 / 0.00	0 / 0.00 / 0.00	13 / 8.61 / .61	4.91
WNW	0 / 0.00 / 0.00	1 / .66 / .05	0 / 0.00 / 0.00	2 / 1.32 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 1.99 / .14	4.33
NW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 1.99 / .14	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 1.99 / .14	5.77
NNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / .66 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / .66 / .05	6.40
N	0 / 0.00 / 0.00	0 / 0.00 / 0.00	7 / 4.64 / .33	6 / 3.97 / .28	1 / .66 / .05	0 / 0.00 / 0.00	14 / 9.27 / .66	5.01
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	3 / 1.99 / .14	20 / 13.25 / .94	67 / 44.37 / 3.16	59 / 39.07 / 2.79	2 / 1.32 / .09	0 / 0.00 / 0.00	151 / 100.00 / 7.13	4.61

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - JULY

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 09.45.20.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	1 / .20 / .05	2 / .40 / .09	3 / .59 / .14	2 / .40 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	8 / 1.58 / .38	3.40
NE	1 / .20 / .05	1 / .20 / .05	3 / .59 / .14	2 / .40 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	7 / 1.39 / .33	3.77
ENE	0 / 0.00 / 0.00	2 / .40 / .09	6 / 1.19 / .29	2 / .40 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	10 / 1.98 / .47	3.90
E	0 / 0.00 / 0.00	4 / .79 / .19	10 / 1.98 / .47	12 / 2.38 / .57	0 / 0.00 / 0.00	0 / 0.00 / 0.00	26 / 5.15 / 1.23	4.47
ESE	0 / 0.00 / 0.00	3 / .59 / .14	16 / 3.17 / .76	9 / 1.78 / .42	0 / 0.00 / 0.00	0 / 0.00 / 0.00	28 / 5.54 / 1.32	4.42
SE	0 / 0.00 / 0.00	4 / .79 / .19	32 / 6.34 / 1.51	22 / 4.36 / 1.04	0 / 0.00 / 0.00	0 / 0.00 / 0.00	58 / 11.49 / 2.74	4.78
SSE	2 / .40 / .09	3 / .59 / .14	38 / 7.52 / 1.79	30 / 5.94 / 1.42	0 / 0.00 / 0.00	0 / 0.00 / 0.00	73 / 14.46 / 3.45	4.60
S	0 / 0.00 / 0.00	3 / .59 / .14	47 / 9.31 / 2.22	42 / 8.32 / 1.98	1 / .20 / .05	0 / 0.00 / 0.00	93 / 18.42 / 4.39	4.93
SSW	1 / .20 / .05	7 / 1.39 / .33	30 / 5.94 / 1.42	36 / 7.13 / 1.70	2 / .40 / .09	0 / 0.00 / 0.00	76 / 15.05 / 3.59	4.93
SW	0 / 0.00 / 0.00	6 / 1.19 / .28	14 / 2.77 / .66	7 / 1.39 / .33	3 / .59 / .14	0 / 0.00 / 0.00	30 / 5.94 / 1.42	4.67
WSW	0 / 0.00 / 0.00	4 / .79 / .19	11 / 2.18 / .52	6 / 1.19 / .28	0 / 0.00 / 0.00	0 / 0.00 / 0.00	21 / 4.16 / .99	4.21
W	0 / 0.00 / 0.00	2 / .40 / .09	14 / 2.77 / .66	6 / 1.19 / .28	0 / 0.00 / 0.00	0 / 0.00 / 0.00	22 / 4.36 / 1.04	4.52
WNW	0 / 0.00 / 0.00	3 / .59 / .14	5 / .99 / .24	2 / .40 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	10 / 1.98 / .47	3.77
NW	0 / 0.00 / 0.00	6 / 1.19 / .28	2 / .40 / .09	1 / .20 / .05	1 / .20 / .05	0 / 0.00 / 0.00	10 / 1.98 / .47	3.73
NNW	1 / .20 / .05	3 / .59 / .14	5 / .99 / .24	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	9 / 1.78 / .42	3.20
N	2 / .40 / .09	5 / .99 / .24	7 / 1.39 / .33	8 / 1.58 / .38	1 / .20 / .05	0 / 0.00 / 0.00	23 / 4.55 / 1.09	4.31
CALM	1 / .20 / .05						1 / .20 / .05	CALM
TOTAL	9 / 1.78 / .42	58 / 11.49 / 2.74	243 / 48.12 / 11.47	187 / 37.03 / 8.83	8 / 1.58 / .38	0 / 0.00 / 0.00	505 / 100.00 / 23.84	4.57

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 09.45.20.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	6 / .28	34 / 1.56	48 / 2.20	16 / .73	0 / 0.00	0 / 0.00	104 / 4.77	3.60
NE	7 / .32	34 / 1.56	28 / 1.28	11 / .50	0 / 0.00	0 / 0.00	80 / 3.67	3.30
ENE	2 / .09	26 / 1.19	27 / 1.24	9 / .41	1 / .05	0 / 0.00	65 / 2.98	3.52
E	3 / .14	38 / 1.74	52 / 2.39	22 / 1.01	0 / 0.00	0 / 0.00	115 / 5.28	3.78
ESE	5 / .23	18 / .83	69 / 3.17	29 / 1.33	0 / 0.00	0 / 0.00	121 / 5.55	4.14
SE	1 / .05	35 / 1.61	120 / 5.50	57 / 2.61	0 / 0.00	0 / 0.00	213 / 9.77	4.27
SSE	3 / .14	41 / 1.88	117 / 5.37	66 / 3.03	0 / 0.00	0 / 0.00	227 / 10.41	4.21
S	5 / .23	48 / 2.20	132 / 6.06	98 / 4.50	1 / .05	0 / 0.00	284 / 13.03	4.40
SSW	2 / .09	50 / 2.29	96 / 4.40	107 / 4.91	17 / .78	3 / .14	275 / 12.61	4.88
SW	0 / 0.00	39 / 1.79	69 / 3.17	27 / 1.24	7 / .32	0 / 0.00	142 / 6.51	4.24
WSW	1 / .05	29 / 1.33	39 / 1.79	29 / 1.33	2 / .09	0 / 0.00	100 / 4.59	4.21
W	5 / .23	21 / .96	59 / 2.71	38 / 1.74	3 / .14	0 / 0.00	126 / 5.78	4.44
WNW	3 / .14	21 / .96	30 / 1.38	20 / .92	2 / .09	0 / 0.00	76 / 3.49	4.19
NW	3 / .14	11 / .50	26 / 1.19	17 / .78	2 / .09	0 / 0.00	59 / 2.71	4.18
NNW	3 / .14	14 / .64	32 / 1.47	22 / 1.01	1 / .05	1 / .05	73 / 3.35	4.43
N	9 / .41	25 / 1.15	51 / 2.34	28 / 1.28	5 / .23	0 / 0.00	118 / 5.41	4.06
CALM	2 / .09						2 / .09	CALM
TOTAL	60 / 2.75	484 / 22.20	995 / 45.64	596 / 27.34	41 / 1.88	4 / .18	2180 / 100.00	4.22

NUMBER OF VALID OBSERVATIONS 2180 97.67 PCT.
NUMBER OF INVALID OBSERVATIONS 52 2.33 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-60 (Continued) (Sheet 29 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - AUGUST

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 10.45.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	2 2.17 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 2.17 .09	2.35
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ESE	0 0.00 0.00	1 1.09 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.09 .05	2.40
SE	0 0.00 0.00	1 1.09 .05	7 7.61 .33	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 8.70 .38	3.52
SSE	0 0.00 0.00	2 2.17 .09	1 1.09 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 3.26 .14	2.77
S	0 0.00 0.00	1 1.09 .05	3 3.26 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 4.35 .19	3.17
SSW	0 0.00 0.00	5 5.43 .24	2 2.17 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 7.61 .33	2.41
SW	2 2.17 .09	5 5.43 .24	3 3.26 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	10 10.87 .47	2.43
WSW	0 0.00 0.00	5 5.43 .24	1 1.09 .05	0 0.00 0.00	0 0.00 0.00	1 1.09 .05	7 7.61 .33	3.49
W	0 0.00 0.00	5 5.43 .24	2 2.17 .09	2 2.17 .09	3 3.26 .14	1 1.09 .05	13 14.13 .61	5.35
WNW	1 1.09 .05	2 2.17 .09	7 7.61 .33	6 6.52 .28	1 1.09 .05	1 1.09 .05	18 19.57 .85	4.92
NW	0 0.00 0.00	2 2.17 .09	3 3.26 .14	1 1.09 .05	0 0.00 0.00	0 0.00 0.00	6 6.52 .28	3.62
NNW	0 0.00 0.00	0 0.00 0.00	10 10.87 .47	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	10 10.87 .47	3.95
N	0 0.00 0.00	1 1.09 .05	2 2.17 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 3.26 .14	3.00
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	3 3.26 .14	32 34.78 1.51	41 44.57 1.93	9 9.78 .42	4 4.35 .19	3 3.26 .14	92 100.00 4.34	3.81

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - AUGUST

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 10.45.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	0 0.00 0.00	3 2.97 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 2.97 .14	3.50
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	1 .99 .05	1 .99 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.98 .09	2.35
E	0 0.00 0.00	0 0.00 0.00	1 .99 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .99 .05	3.40
ESE	0 0.00 0.00	1 .99 .05	2 1.98 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 2.97 .14	3.20
SE	1 .99 .05	4 3.96 .19	9 8.91 .42	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	14 13.86 .66	3.18
SSE	0 0.00 0.00	4 3.96 .19	4 3.96 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 7.92 .38	3.12
S	0 0.00 0.00	6 5.94 .28	8 7.92 .38	0 0.00 0.00	0 0.00 0.00	1 .99 .05	15 14.85 .71	3.61
SSW	0 0.00 0.00	5 4.95 .24	7 6.93 .33	0 0.00 0.00	1 .99 .05	1 .99 .05	14 13.86 .66	4.08
SW	0 0.00 0.00	4 3.96 .19	4 3.96 .19	1 .99 .05	0 0.00 0.00	0 0.00 0.00	9 8.91 .42	3.47
WSW	0 0.00 0.00	2 1.98 .09	2 1.98 .09	0 0.00 0.00	1 .99 .05	0 0.00 0.00	5 4.95 .24	4.16
W	1 .99 .05	6 5.94 .28	0 0.00 0.00	2 1.98 .09	0 0.00 0.00	0 0.00 0.00	9 8.91 .42	2.94
WNW	1 .99 .05	1 .99 .05	1 .99 .05	0 0.00 0.00	2 1.98 .09	0 0.00 0.00	5 4.95 .24	5.62
NW	1 .99 .05	1 .99 .05	1 .99 .05	1 .99 .05	0 0.00 0.00	0 0.00 0.00	4 3.96 .19	3.10
NNW	0 0.00 0.00	1 .99 .05	2 1.98 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 2.97 .14	3.40
N	0 0.00 0.00	1 .99 .05	5 4.95 .24	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 5.94 .28	3.40
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	4 3.96 .19	37 36.63 1.75	50 49.50 2.36	4 3.96 .19	4 3.96 .19	2 1.98 .09	101 100.00 4.77	3.54

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 10.45.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	1 .54 .05	2 1.09 .09	2 1.09 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 2.72 .24	2.38
NE	1 .54 .05	0 0.00 0.00	0 0.00 0.00	2 1.09 .09	0 0.00 0.00	0 0.00 0.00	3 1.63 .14	4.30
ENE	1 .54 .05	1 .54 .05	2 1.09 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 2.17 .19	2.72
E	2 1.09 .09	8 4.35 .38	3 1.63 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	13 7.07 .61	2.35
ESE	2 1.09 .09	1 .54 .05	5 2.72 .24	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 4.35 .38	2.77
SE	0 0.00 0.00	7 3.80 .33	18 9.78 .85	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	25 13.59 1.18	3.46
SSE	1 .54 .05	15 8.15 .71	6 3.26 .28	1 .54 .05	0 0.00 0.00	0 0.00 0.00	23 12.50 1.09	2.82
S	2 1.09 .09	10 5.43 .47	10 5.43 .47	1 .54 .05	0 0.00 0.00	0 0.00 0.00	23 12.50 1.09	2.99
SSW	2 1.09 .09	7 3.80 .33	16 8.70 .76	3 1.63 .14	2 1.09 .09	3 1.63 .14	33 17.93 1.56	4.61
SW	0 0.00 0.00	1 .54 .05	5 2.72 .24	0 0.00 0.00	2 1.09 .09	2 1.09 .09	10 5.43 .47	5.93
WSW	0 0.00 0.00	2 1.09 .09	0 0.00 0.00	0 0.00 0.00	1 .54 .05	0 0.00 0.00	3 1.63 .14	4.40
W	0 0.00 0.00	4 2.17 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 2.17 .19	2.22
WNW	3 1.63 .14	2 1.09 .09	3 1.63 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 4.35 .38	2.32
NW	1 .54 .05	3 1.63 .14	2 1.09 .09	0 0.00 0.00	1 .54 .05	0 0.00 0.00	7 3.80 .33	3.70
NNW	1 .54 .05	2 1.09 .09	3 1.63 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 3.26 .28	3.12
N	0 0.00 0.00	3 1.63 .14	4 2.17 .19	2 1.09 .09	0 0.00 0.00	0 0.00 0.00	9 4.89 .42	3.68
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	17 9.24 .80	68 36.96 3.21	79 42.93 3.73	9 4.89 .42	6 3.26 .28	5 2.72 .24	184 100.00 8.68	3.47

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 10.45.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	7 1.29 .33	23 4.25 1.09	19 3.51 .90	1 .18 .05	0 0.00 0.00	0 0.00 0.00	49 9.06 2.31	2.62
NE	4 .74 .19	25 4.62 1.18	16 2.96 .76	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	45 8.32 2.12	2.69
ENE	4 .74 .19	13 2.40 .61	3 .55 .14	1 .18 .05	0 0.00 0.00	0 0.00 0.00	21 3.88 .99	2.30
E	7 1.29 .33	9 1.66 .42	6 1.11 .28	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	22 4.07 1.04	2.25
ESE	3 .55 .14	18 3.33 .85	20 3.70 .94	0 0.00 0.00	1 .18 .05	0 0.00 0.00	42 7.76 1.98	3.10
SE	5 .92 .24	27 4.99 1.27	34 6.28 1.60	0 0.00 0.00	2 .37 .09	0 0.00 0.00	68 12.57 3.21	3.11
SSE	7 1.29 .33	24 4.44 1.13	21 3.88 .99	2 .37 .09	2 .37 .09	0 0.00 0.00	56 10.35 2.64	2.97
S	7 1.29 .33	22 4.07 1.04	18 3.33 .85	7 1.29 .33	1 .18 .05	0 0.00 0.00	55 10.17 2.60	3.31
SSW	4 .74 .19	14 2.59 .66	18 3.33 .85	5 .92 .24	4 .74 .19	1 .18 .05	46 8.50 2.17	4.13
SW	6 1.11 .28	8 1.48 .38	12 2.22 .57	1 .18 .05	0 0.00 0.00	0 0.00 0.00	27 4.99 1.27	2.71
WSW	1 .18 .05	7 1.29 .33	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .18 .05	9 1.66 .42	3.12
W	0 0.00 0.00	9 1.66 .42	0 0.00 0.00	0 0.00 0.00	1 .18 .05	0 0.00 0.00	10 1.85 .47	2.30
WNW	2 .37 .09	9 1.66 .42	2 .37 .09	1 .18 .05	0 0.00 0.00	0 0.00 0.00	14 2.59 .66	2.64
NW	1 .18 .05	3 .55 .14	11 2.03 .52	1 .18 .05	1 .18 .05	0 0.00 0.00	17 3.14 .80	4.02
NNW	2 .37 .09	15 2.77 .71	4 .74 .19	1 .18 .05	0 0.00 0.00	0 0.00 0.00	22 4.07 1.04	2.66
N	4 .74 .19	25 4.62 1.18	8 1.48 .38	0 0.00 0.00	1 .18 .05	0 0.00 0.00	38 7.02 1.79	2.59
CALM	1 .18 .05						1 .18 .05	CALM
TOTAL	65 12.01 3.07	251 46.40 11.85	190 35.12 8.97	20 3.70 .94	13 2.40 .61	2 .37 .09	541 100.00 25.53	2.99

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-60 (Continued) (Sheet 30 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED AUGUST

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 10.45.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	12 1.99 .57	13 2.16 .61	2 .33 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	27 4.49 1.27	1.79
NE	5 .83 .24	15 2.49 .71	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	20 3.32 .94	1.96
ENE	4 .66 .19	11 1.83 .52	1 .17 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	16 2.66 .75	2.09
E	7 1.16 .33	23 3.82 1.09	5 .83 .24	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	35 5.81 1.65	2.17
ESE	13 2.16 .61	39 6.48 1.84	4 .66 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	56 9.30 2.64	2.12
SE	8 1.33 .38	69 11.46 3.26	32 5.32 1.51	1 .17 .05	3 .50 .14	0 0.00 0.00	113 18.77 5.33	2.81
SSE	3 .50 .14	55 9.14 2.60	32 5.32 1.51	1 .17 .05	3 .50 .14	0 0.00 0.00	94 15.61 4.44	3.11
S	3 .50 .14	34 5.65 1.60	31 5.15 1.46	5 .83 .24	3 .50 .14	0 0.00 0.00	76 12.62 3.59	3.40
SSW	7 1.16 .33	19 3.16 .90	15 2.49 .71	1 .17 .05	8 1.33 .38	0 0.00 0.00	50 8.31 2.36	3.67
SW	2 .33 .09	8 1.33 .38	1 .17 .05	1 .17 .05	4 .66 .19	1 .17 .05	17 2.82 .80	4.54
WSW	4 .66 .19	8 1.33 .38	0 0.00 0.00	1 .17 .05	2 .33 .09	0 0.00 0.00	15 2.49 .71	3.13
W	3 .50 .14	5 .83 .24	0 0.00 0.00	1 .17 .05	1 .17 .05	0 0.00 0.00	10 1.66 .47	2.75
WNW	3 .50 .14	9 1.50 .42	2 .33 .09	1 .17 .05	0 0.00 0.00	0 0.00 0.00	15 2.49 .71	2.45
NW	4 .66 .19	6 1.00 .28	2 .33 .09	0 0.00 0.00	1 .17 .05	0 0.00 0.00	13 2.16 .61	2.64
NNW	0 0.00 0.00	10 1.66 .47	1 .17 .05	1 .17 .05	0 0.00 0.00	0 0.00 0.00	12 1.99 .57	2.47
N	6 1.00 .28	21 3.49 .99	2 .33 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	29 4.82 1.37	2.32
CALM	4 .66 .19						4 .66 .19	CALM
TOTAL	88 14.62 4.15	345 57.31 16.28	130 21.59 6.13	13 2.16 .61	25 4.15 1.18	1 .17 .05	602 100.00 28.41	2.81

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 10.45.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	8 7.02 .38	3 2.63 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	11 9.65 .52	1.21
NE	7 6.14 .33	2 1.75 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 7.89 .42	1.31
ENE	3 2.63 .14	0 0.00 0.00	1 .88 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 3.51 .19	1.62
E	3 2.63 .14	1 .88 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 3.51 .19	1.05
ESE	2 1.75 .09	1 .88 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 2.63 .14	1.47
SE	4 3.51 .19	2 1.75 .09	3 2.63 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 7.89 .42	2.14
SSE	4 3.51 .19	7 6.14 .33	0 0.00 0.00	0 0.00 0.00	5 4.39 .24	0 0.00 0.00	16 14.04 .76	3.95
S	2 1.75 .09	3 2.63 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 4.39 .24	1.76
SSW	1 .88 .05	2 1.75 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 2.63 .14	1.43
SW	6 5.26 .28	1 .88 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 6.14 .33	.80
WSW	0 0.00 0.00	3 2.63 .14	2 1.75 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 4.39 .24	2.52
W	2 1.75 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.75 .09	1.20
WNW	2 1.75 .09	2 1.75 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 3.51 .19	1.50
NW	4 3.51 .19	3 2.63 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 6.14 .33	1.49
NNW	7 6.14 .33	4 3.51 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	11 9.65 .52	1.35
N	6 5.26 .28	7 6.14 .33	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	13 11.40 .61	1.58
CALM	1 .88 .05						1 .88 .05	CALM
TOTAL	62 54.39 2.93	41 35.96 1.93	6 5.26 .28	0 0.00 0.00	5 4.39 .24	0 0.00 0.00	114 100.00 5.38	1.91

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED AUGUST

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 10.45.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.68
NE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.36
ENE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.05
E	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.68
ESE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.79
SE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.40
SSE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.55
S	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.48
SSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.34
SW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3.65
WSW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.12
W	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.30
WNW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2.04
NW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.97
NNW	[illegible] .24	[illegible] .28	[illegible] .05	[illegible] 0.00	[illegible] 0.00	[illegible] 0.00	[illegible] .57	1.85
N	9 1.86 .42	5 1.03 .24	1 .21 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	15 3.09 .71	1.45
CALM	2 .41 .09						2 .41 .09	CALM
TOTAL	110 22.68 5.19	290 59.79 13.69	67 13.81 3.16	7 1.44 .33	11 2.27 .52	0 0.00 0.00	485 100.00 22.89	2.36

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 10.45.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	33 1.52	54 2.49	27 1.24	1 .05	0 0.00	0 0.00	115 5.29	2.20
NE	30 1.38	50 2.30	17 .78	2 .09	0 0.00	0 0.00	99 4.56	2.18
ENE	21 .97	33 1.52	7 .32	3 .14	0 0.00	0 0.00	64 2.95	2.16
E	30 1.38	55 2.53	15 .69	0 0.00	0 0.00	0 0.00	100 4.60	2.05
ESE	29 1.33	84 3.87	31 1.43	0 0.00	1 .05	0 0.00	145 6.67	2.37
SE	32 1.47	152 6.99	120 5.52	2 .09	5 .23	0 0.00	311 14.31	2.44
SSE	26 1.20	194 8.93	92 4.23	5 .23	10 .46	0 0.00	327 15.05	2.88
S	17 .78	130 5.98	79 3.64	13 .60	8 .37	1 .05	248 11.41	3.14
SSW	16 .74	72 3.31	62 2.85	9 .41	19 .87	5 .23	183 8.42	3.83
SW	19 .87	37 1.70	25 1.15	4 .18	9 .41	3 .14	97 4.46	3.40
WSW	10 .46	34 1.56	6 .28	2 .09	4 .18	2 .09	58 2.67	3.34
W	9 .41	37 1.70	2 .09	6 .28	5 .23	1 .05	60 2.76	3.16
WNW	17 .78	34 1.56	16 .74	8 .37	3 .14	1 .05	79 3.64	3. 8
NW	20 .92	27 1.24	24 1.10	3 .14	3 .14	0 0.00	77 3.54	2.81
NNW	15 .69	45 2.07	21 .97	2 .09	0 0.00	0 0.00	83 3.82	2.56
N	25 1.15	67 3.08	24 1.10	2 .09	1 .05	0 0.00	119 5.48	2.41
CALM	8 .37						8 .37	CALM
TOTAL	357 16.43	1105 50.85	568 26.14	62 2.85	68 3.13	13 .60	2173 100.00	2.82

NUMBER OF VALID OBSERVATIONS 2173 97.36 PCT.
NUMBER OF INVALID OBSERVATIONS 59 2.64 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-60 (Continued) (Sheet 31 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - AUGUST

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 10.45.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	1 1.08 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.08 .05	1.60
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
E	1 1.08 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.08 .05	1.10
ESE	0 0.00 0.00	1 1.08 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.08 .05	2.90
SE	0 0.00 0.00	1 1.08 .05	5 5.38 .24	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 6.45 .28	4.18
SSE	0 0.00 0.00	1 1.08 .05	2 2.15 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 3.23 .14	3.10
S	0 0.00 0.00	3 3.23 .14	5 5.38 .24	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 8.60 .38	3.24
SSW	0 0.00 0.00	5 5.38 .24	4 4.30 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 9.68 .43	2.80
SW	1 1.08 .05	3 3.23 .14	1 1.08 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 5.38 .24	2.34
WSW	0 0.00 0.00	4 4.30 .19	3 3.23 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 7.53 .33	3.11
W	0 0.00 0.00	4 4.30 .19	4 4.30 .19	2 2.15 .09	3 3.23 .14	0 0.00 0.00	13 13.98 .61	5.11
WNW	0 0.00 0.00	3 3.23 .14	6 6.45 .28	11 11.83 .52	2 2.15 .09	0 0.00 0.00	22 23.66 1.04	5.29
NW	0 0.00 0.00	1 1.08 .05	3 3.23 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 4.30 .19	4.13
NNW	0 0.00 0.00	0 0.00 0.00	7 7.53 .33	3 3.23 .14	0 0.00 0.00	0 0.00 0.00	10 10.75 .47	4.75
N	0 0.00 0.00	1 1.08 .05	2 2.15 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 3.23 .14	3.70
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	2 2.15 .09	28 30.11 1.32	42 45.16 1.99	16 17.20 .76	5 5.38 .24	0 0.00 0.00	93 100.00 4.40	4.11

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 10.45.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	2 1.08 .09	3 1.62 .14	1 .54 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 3.24 .28	2.28
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.08 .09	0 0.00 0.00	0 0.00 0.00	2 1.08 .09	5.65
ENE	0 0.00 0.00	1 .54 .05	3 1.62 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 2.16 .19	3.17
E	1 .54 .05	6 3.24 .28	2 1.08 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 4.86 .43	2.48
ESE	1 .54 .05	3 1.62 .14	8 4.32 .38	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	12 6.49 .57	3.27
SE	0 0.00 0.00	4 2.16 .19	17 9.19 .80	1 .54 .05	0 0.00 0.00	0 0.00 0.00	22 11.89 1.04	3.66
SSE	0 0.00 0.00	9 4.86 .43	12 6.49 .57	1 .54 .05	0 0.00 0.00	0 0.00 0.00	22 11.89 1.04	3.14
S	1 .54 .05	12 6.49 .57	11 5.95 .52	6 3.24 .28	0 0.00 0.00	0 0.00 0.00	30 16.22 1.42	3.57
SSW	1 .54 .05	5 2.70 .24	14 7.57 .66	9 4.86 .43	0 0.00 0.00	0 0.00 0.00	29 15.68 1.37	4.20
SW	0 0.00 0.00	4 2.16 .19	4 2.16 .19	2 1.08 .09	0 0.00 0.00	0 0.00 0.00	10 5.41 .47	3.57
WSW	0 0.00 0.00	2 1.08 .09	2 1.08 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 2.16 .19	2.92
W	2 1.08 .09	2 1.08 .09	3 1.62 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 3.78 .33	2.61
WNW	1 .54 .05	1 .54 .05	4 2.16 .19	1 .54 .05	0 0.00 0.00	0 0.00 0.00	7 3.78 .33	3.60
NW	0 0.00 0.00	2 1.08 .09	2 1.08 .09	1 .54 .05	0 0.00 0.00	0 0.00 0.00	5 2.70 .24	3.48
NNW	1 .54 .05	1 .54 .05	4 2.16 .19	1 .54 .05	0 0.00 0.00	0 0.00 0.00	7 3.78 .33	3.87
N	0 0.00 0.00	3 1.62 .14	4 2.16 .19	2 1.08 .09	0 0.00 0.00	0 0.00 0.00	9 4.86 .43	3.74
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	10 5.41 .47	58 31.35 2.74	91 49.19 4.30	26 14.05 1.23	0 0.00 0.00	0 0.00 0.00	185 100.00 8.75	3.49

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - AUGUST

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 10.45.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	0 0.00 0.00	2 1.94 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.94 .09	4.00
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	0 0.00 0.00	1 .97 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .97 .05	3.40
E	0 0.00 0.00	0 0.00 0.00	2 1.94 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.94 .09	3.45
ESE	0 0.00 0.00	0 0.00 0.00	2 1.94 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.94 .09	4.00
SE	0 0.00 0.00	2 1.94 .09	6 5.83 .28	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 7.77 .38	3.36
SSE	0 0.00 0.00	7 6.80 .33	8 7.77 .38	1 .97 .05	0 0.00 0.00	0 0.00 0.00	16 15.53 .76	3.39
S	0 0.00 0.00	2 1.94 .09	6 5.83 .28	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 7.77 .38	3.61
SSW	0 0.00 0.00	7 6.80 .33	10 9.71 .47	3 2.91 .14	0 0.00 0.00	0 0.00 0.00	20 19.42 .95	3.61
SW	2 1.94 .09	3 2.91 .14	3 2.91 .14	2 1.94 .09	0 0.00 0.00	0 0.00 0.00	10 9.71 .47	3.21
WSW	0 0.00 0.00	0 0.00 0.00	3 2.91 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 2.91 .14	4.50
W	1 .97 .05	2 1.94 .09	4 3.88 .19	2 1.94 .09	0 0.00 0.00	0 0.00 0.00	9 8.74 .43	3.74
WNW	0 0.00 0.00	4 3.88 .19	5 4.85 .24	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 8.74 .43	3.46
NW	0 0.00 0.00	2 1.94 .09	0 0.00 0.00	2 1.94 .09	0 0.00 0.00	0 0.00 0.00	4 3.88 .19	3.75
NNW	0 0.00 0.00	1 .97 .05	4 3.88 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 4.85 .24	4.36
N	0 0.00 0.00	0 0.00 0.00	4 3.88 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 3.88 .19	4.07
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	3 2.91 .14	30 29.13 1.42	60 58.25 2.84	10 9.71 .47	0 0.00 0.00	0 0.00 0.00	103 100.00 4.87	3.61

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 10.45.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	2 .37 .09	23 4.31 1.09	24 4.49 1.14	4 .75 .19	0 0.00 0.00	0 0.00 0.00	53 9.93 2.51	3.27
NE	5 .94 .24	14 2.62 .66	20 3.75 .95	3 .56 .14	0 0.00 0.00	0 0.00 0.00	42 7.87 1.99	3.21
ENE	2 .37 .09	12 2.25 .57	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	14 2.62 .66	2.15
E	3 .56 .14	10 1.87 .47	7 1.31 .33	1 .19 .05	0 0.00 0.00	0 0.00 0.00	21 3.93 .99	2.84
ESE	2 .37 .09	13 2.43 .61	17 3.18 .80	3 .56 .14	0 0.00 0.00	0 0.00 0.00	35 6.55 1.66	3.40
SE	1 .19 .05	25 4.68 1.18	28 5.24 1.32	5 .94 .24	0 0.00 0.00	0 0.00 0.00	59 11.05 2.79	3.34
SSE	1 .19 .05	27 5.06 1.28	28 5.24 1.32	6 1.12 .28	0 0.00 0.00	0 0.00 0.00	62 11.61 2.93	3.42
S	7 1.31 .33	15 2.81 .71	21 3.93 .99	12 2.25 .57	2 .37 .09	0 0.00 0.00	57 10.67 2.70	3.77
SSW	2 .37 .09	14 2.62 .66	21 3.93 .99	11 2.06 .52	3 .56 .14	0 0.00 0.00	51 9.55 2.41	4.19
SW	3 .56 .14	6 1.12 .28	15 2.81 .71	1 .19 .05	0 0.00 0.00	0 0.00 0.00	25 4.68 1.18	3.18
WSW	0 0.00 0.00	4 .75 .19	5 .94 .24	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 1.69 .43	3.34
W	1 .19 .05	8 1.50 .38	3 .56 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	12 2.25 .57	2.54
WNW	4 .75 .19	3 .56 .14	6 1.12 .28	3 .56 .14	1 .19 .05	0 0.00 0.00	17 3.18 .80	3.66
NW	3 .56 .14	3 .56 .14	3 .56 .14	8 1.50 .38	1 .19 .05	0 0.00 0.00	18 3.37 .85	4.37
NNW	3 .56 .14	8 1.50 .38	12 2.25 .57	3 .56 .14	1 .19 .05	0 0.00 0.00	27 5.06 1.28	3.45
N	0 0.00 0.00	14 2.62 .66	16 3.00 .76	1 .19 .05	0 0.00 0.00	1 .19 .05	32 5.99 1.51	3.47
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	39 7.30 1.84	199 37.27 9.41	226 42.32 10.69	61 11.42 2.89	8 1.50 .38	1 .19 .05	534 100.00 25.26	3.45

KEY
XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-60 (Continued) (Sheet 32 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - AUGUST

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 10.45.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	1 .17 .05	8 1.35 .38	16 2.69 .76	1 .17 .05	0 0.00 0.00	0 0.00 0.00	26 4.38 1.23	3.54
NE	3 .51 .14	6 1.01 .28	20 3.37 .95	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	29 4.88 1.37	3.36
ENE	0 0.00 0.00	2 .34 .09	8 1.35 .38	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	10 1.68 .47	3.95
E	2 .34 .09	6 1.01 .28	14 2.36 .66	4 .67 .19	0 0.00 0.00	0 0.00 0.00	26 4.38 1.23	3.77
ESE	3 .51 .14	5 .84 .24	41 6.90 1.94	9 1.52 .43	0 0.00 0.00	0 0.00 0.00	58 9.76 2.74	4.12
SE	1 .17 .05	16 2.69 .76	45 7.58 2.13	36 6.06 1.70	0 0.00 0.00	0 0.00 0.00	98 16.50 4.64	4.60
SSE	0 0.00 0.00	3 .51 .14	45 7.58 2.13	45 7.58 2.13	0 0.00 0.00	0 0.00 0.00	93 15.66 4.40	4.96
S	1 .17 .05	7 1.18 .33	30 5.05 1.42	35 5.89 1.66	3 .51 .14	0 0.00 0.00	76 12.79 3.60	5.13
SSW	2 .34 .09	5 .84 .24	29 4.88 1.37	26 4.38 1.23	0 0.00 0.00	0 0.00 0.00	62 10.44 2.93	4.67
SW	1 .17 .05	2 .34 .09	22 3.70 1.04	8 1.35 .38	0 0.00 0.00	0 0.00 0.00	33 5.56 1.56	4.24
WSW	1 .17 .05	1 .17 .05	6 1.01 .28	4 .67 .19	0 0.00 0.00	0 0.00 0.00	12 2.02 .57	4.45
W	1 .17 .05	2 .34 .09	7 1.18 .33	2 .34 .09	0 0.00 0.00	0 0.00 0.00	12 2.02 .57	3.74
WNW	0 0.00 0.00	2 .34 .09	8 1.35 .38	5 .84 .24	0 0.00 0.00	0 0.00 0.00	15 2.53 .71	4.79
NW	0 0.00 0.00	3 .51 .14	5 .84 .24	3 .51 .14	0 0.00 0.00	0 0.00 0.00	11 1.85 .52	4.31
NNW	0 0.00 0.00	2 .34 .09	6 1.01 .28	4 .67 .19	0 0.00 0.00	0 0.00 0.00	12 2.02 .57	4.52
N	0 0.00 0.00	4 .67 .19	10 1.68 .47	7 1.18 .33	0 0.00 0.00	0 0.00 0.00	21 3.54 .99	4.42
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	16 2.69 .76	74 12.46 3.50	312 52.53 14.76	189 31.82 8.94	3 .51 .14	0 0.00 0.00	594 100.00 28.10	4.48

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 10.45.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	1 .86 .05	0 0.00 0.00	4 3.45 .19	1 .86 .05	0 0.00 0.00	0 0.00 0.00	6 5.17 .28	3.63
NE	1 .86 .05	5 4.31 .24	5 4.31 .24	5 4.31 .24	0 0.00 0.00	0 0.00 0.00	16 13.79 .76	3.65
ENE	2 1.72 .09	2 1.72 .09	1 .86 .05	3 2.59 .14	0 0.00 0.00	0 0.00 0.00	8 6.90 .38	3.82
E	3 2.59 .14	5 4.31 .24	3 2.59 .14	2 1.72 .09	0 0.00 0.00	0 0.00 0.00	13 11.21 .61	2.82
ESE	1 .86 .05	0 0.00 0.00	1 .86 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.72 .09	2.35
SE	0 0.00 0.00	1 .86 .05	3 2.59 .14	2 1.72 .09	0 0.00 0.00	0 0.00 0.00	6 5.17 .28	4.02
SSE	0 0.00 0.00	1 .86 .05	2 1.72 .09	2 1.72 .09	0 0.00 0.00	0 0.00 0.00	5 4.31 .24	4.62
S	0 0.00 0.00	3 2.59 .14	3 2.59 .14	1 .86 .05	0 0.00 0.00	0 0.00 0.00	7 6.03 .33	3.54
SSW	0 0.00 0.00	4 3.45 .19	10 8.62 .47	2 1.72 .09	0 0.00 0.00	0 0.00 0.00	16 13.79 .76	3.85
SW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
WSW	0 0.00 0.00	1 .86 .05	0 0.00 0.00	4 3.45 .19	0 0.00 0.00	0 0.00 0.00	5 4.31 .24	5.22
W	0 0.00 0.00	3 2.59 .14	0 0.00 0.00	2 1.72 .09	0 0.00 0.00	0 0.00 0.00	5 4.31 .24	3.76
WNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NW	1 .86 .05	4 3.45 .19	2 1.72 .09	1 .86 .05	0 0.00 0.00	0 0.00 0.00	8 6.90 .38	3.02
NNW	0 0.00 0.00	2 1.72 .09	2 1.72 .09	1 .86 .05	0 0.00 0.00	0 0.00 0.00	5 4.31 .24	3.44
N	3 2.59 .14	5 4.31 .24	2 1.72 .09	3 2.59 .14	0 0.00 0.00	0 0.00 0.00	13 11.21 .61	3.28
CALM	1 .86 .05						1 .86 .05	CALM
TOTAL	13 11.21 .61	36 31.03 1.70	38 32.76 1.80	29 25.00 1.37	0 0.00 0.00	0 0.00 0.00	116 100.00 5.49	3.58

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - AUGUST

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 10.45.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	1 .20 .05	5 1.02 .24	10 2.04 .47	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	16 3.27 .76	3.16
NE	2 .41 .09	3 .61 .14	4 .82 .19	3 .61 .14	0 0.00 0.00	0 0.00 0.00	12 2.45 .57	3.57
ENE	2 .41 .09	2 .41 .09	8 1.64 .38	2 .41 .09	0 0.00 0.00	0 0.00 0.00	14 2.86 .66	3.56
E	2 .41 .09	7 1.43 .33	10 2.04 .47	7 1.43 .33	0 0.00 0.00	0 0.00 0.00	26 5.32 1.23	3.86
ESE	1 .20 .05	3 .61 .14	20 4.09 .95	7 1.43 .33	1 .20 .05	0 0.00 0.00	32 6.54 1.51	4.29
SE	1 .20 .05	5 1.02 .24	32 6.54 1.51	22 4.50 1.04	0 0.00 0.00	0 0.00 0.00	60 12.27 2.84	4.49
SSE	2 .41 .09	5 1.02 .24	26 5.32 1.23	30 6.13 1.42	0 0.00 0.00	0 0.00 0.00	63 12.88 2.98	4.71
S	1 .20 .05	14 2.86 .66	59 12.07 2.79	25 5.11 1.18	0 0.00 0.00	0 0.00 0.00	99 20.25 4.68	4.34
SSW	2 .41 .09	5 1.02 .24	33 6.75 1.56	27 5.52 1.28	0 0.00 0.00	0 0.00 0.00	67 13.70 3.17	4.57
SW	0 0.00 0.00	3 .61 .14	8 1.64 .38	12 2.45 .57	1 .20 .05	0 0.00 0.00	25 5.11 1.18	4.95
WSW	1 .20 .05	3 .61 .14	5 1.02 .24	8 1.64 .38	0 0.00 0.00	0 0.00 0.00	17 3.48 .80	4.58
W	1 .20 .05	5 1.02 .24	0 0.00 0.00	6 1.23 .28	0 0.00 0.00	0 0.00 0.00	12 2.45 .57	4.12
WNW	0 0.00 0.00	0 0.00 0.00	2 .41 .09	6 1.23 .28	0 0.00 0.00	0 0.00 0.00	8 1.64 .38	5.44
NW	0 0.00 0.00	5 1.02 .24	0 0.00 0.00	10 2.04 .47	0 0.00 0.00	0 0.00 0.00	15 3.07 .71	5.06
NNW	1 .20 .05	1 .20 .05	2 .41 .09	5 1.02 .24	0 0.00 0.00	0 0.00 0.00	9 1.84 .43	4.41
N	3 .61 .14	1 .20 .05	6 1.23 .28	4 .82 .19	0 0.00 0.00	0 0.00 0.00	14 2.86 .66	3.88
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	20 4.09 .95	67 13.70 3.17	225 46.01 10.64	175 35.79 8.28	2 .41 .09	0 0.00 0.00	489 100.00 23.13	4.39

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 10.45.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	8 .37	41 1.89	61 2.82	6 .28	0 0.00	0 0.00	116 5.36	3.27
NE	11 .51	28 1.29	49 2.26	13 .60	0 0.00	0 0.00	101 4.67	3.42
ENE	6 .28	19 .88	21 .97	5 .23	0 0.00	0 0.00	51 2.36	3.26
E	12 .55	35 1.62	39 1.80	14 .65	0 0.00	0 0.00	100 4.62	3.30
ESE	9 .42	25 1.15	90 4.16	19 .88	1 .05	0 0.00	144 6.65	3.85
SE	3 .14	55 2.54	138 6.37	68 3.14	0 0.00	0 0.00	264 12.19	4.16
SSE	3 .14	56 2.59	123 5.68	86 3.97	0 0.00	0 0.00	268 12.38	4.25
S	10 .46	59 2.73	136 6.28	80 3.70	5 .23	0 0.00	290 13.39	4.27
SSW	7 .32	46 2.12	121 5.59	78 3.60	3 .14	0 0.00	255 11.78	4.28
SW	8 .37	22 1.02	54 2.49	26 1.20	1 .05	0 0.00	111 5.13	3.87
WSW	4 .18	15 .69	25 1.15	16 .74	0 0.00	0 0.00	60 2.77	4.03
W	6 .28	27 1.25	21 .97	14 .65	3 .14	0 0.00	71 3.28	3.73
WNW	5 .23	13 .60	31 1.43	26 1.20	3 .14	0 0.00	78 3.60	4.47
NW	4 .18	20 .92	18 .83	25 1.15	1 .05	0 0.00	68 3.14	4.19
NNW	5 .23	16 .74	41 1.89	17 .79	1 .05	0 0.00	80 3.70	4.00
N	6 .28	29 1.34	52 2.40	19 .88	0 0.00	1 .05	107 4.94	3.83
CALM	1 .05						1 .05	CALM
TOTAL	108 4.99	506 23.37	1020 47.11	512 23.65	18 .83	1 .05	2165 100.00	3.99

NUMBER OF VALID OBSERVATIONS 2165 97.00 PCT.
NUMBER OF INVALID OBSERVATIONS 67 3.00 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-60 (Continued) (Sheet 33 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - SEPTEMBER

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79, 11.18.40.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	WIND SPEED CATEGORIES (METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.14 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.14 / .05	4.40
NE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
ENE	0 / 0.00 / 0.00	1 / 1.14 / .05	0 / 0.00 / 0.00	2 / 2.27 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 3.41 / .14	4.47
E	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 2.27 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 2.27 / .09	3.45
ESE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.14 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.14 / .05	4.00
SE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 4.55 / .19	3 / 3.41 / .14	0 / 0.00 / 0.00	0 / 0.00 / 0.00	7 / 7.95 / .32	4.91
SSE	0 / 0.00 / 0.00	3 / 3.41 / .14	1 / 1.14 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 4.55 / .19	2.80
S	0 / 0.00 / 0.00	3 / 3.41 / .14	3 / 3.41 / .14	2 / 2.27 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	8 / 9.09 / .37	3.61
SSW	0 / 0.00 / 0.00	4 / 4.55 / .19	8 / 9.09 / .37	6 / 6.82 / .28	0 / 0.00 / 0.00	0 / 0.00 / 0.00	18 / 20.45 / .84	4.54
SW	2 / 2.27 / .09	1 / 1.14 / .05	11 / 12.50 / .51	5 / 5.68 / .23	0 / 0.00 / 0.00	0 / 0.00 / 0.00	19 / 21.59 / .88	3.99
WSW	3 / 3.41 / .14	3 / 3.41 / .14	1 / 1.14 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	7 / 7.95 / .32	2.57
W	1 / 1.14 / .05	1 / 1.14 / .05	7 / 7.95 / .32	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	9 / 10.23 / .42	3.08
WNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 2.27 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 2.27 / .09	3.60
NW	0 / 0.00 / 0.00	1 / 1.14 / .05	2 / 2.27 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 3.41 / .14	3.13
NNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 2.27 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 2.27 / .09	3.85
N	0 / 0.00 / 0.00	1 / 1.14 / .05	1 / 1.14 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 2.27 / .09	3.05
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	6 / 6.82 / .28	18 / 20.45 / .84	46 / 52.27 / 2.14	18 / 20.45 / .84	0 / 0.00 / 0.00	0 / 0.00 / 0.00	88 / 100.00 / 4.09	3.79

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79, 11.18.40.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	WIND SPEED CATEGORIES (METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	1 / .79 / .05	4 / 3.17 / .19	4 / 3.17 / .19	2 / 1.59 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	11 / 8.73 / .51	3.55
NE	0 / 0.00 / 0.00	3 / 2.38 / .14	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 2.38 / .14	2.23
ENE	1 / .79 / .05	3 / 2.38 / .14	2 / 1.59 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	6 / 4.76 / .28	2.85
E	0 / 0.00 / 0.00	1 / .79 / .05	4 / 3.17 / .19	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 3.97 / .23	3.42
ESE	0 / 0.00 / 0.00	1 / .79 / .05	2 / 1.59 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 2.38 / .14	3.87
SE	1 / .79 / .05	1 / .79 / .05	6 / 4.76 / .28	1 / .79 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	9 / 7.14 / .42	3.60
SSE	0 / 0.00 / 0.00	1 / .79 / .05	10 / 7.94 / .46	1 / .79 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	12 / 9.52 / .56	3.96
S	0 / 0.00 / 0.00	6 / 4.76 / .28	13 / 10.32 / .60	3 / 2.38 / .14	0 / 0.00 / 0.00	0 / 0.00 / 0.00	22 / 17.46 / 1.02	3.65
SSW	1 / .79 / .05	2 / 1.59 / .09	4 / 3.17 / .19	1 / .79 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	8 / 6.35 / .37	3.17
SW	0 / 0.00 / 0.00	4 / 3.17 / .19	4 / 3.17 / .19	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	8 / 6.35 / .37	3.26
WSW	3 / 2.38 / .14	1 / .79 / .05	1 / .79 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 3.97 / .23	1.64
W	0 / 0.00 / 0.00	3 / 2.38 / .14	2 / 1.59 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 3.97 / .23	2.86
WNW	0 / 0.00 / 0.00	1 / .79 / .05	1 / .79 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 1.59 / .09	2.55
NW	0 / 0.00 / 0.00	3 / 2.38 / .14	6 / 4.76 / .28	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	9 / 7.14 / .42	3.38
NNW	0 / 0.00 / 0.00	1 / .79 / .05	7 / 5.56 / .32	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	8 / 6.35 / .37	3.62
N	0 / 0.00 / 0.00	3 / 2.38 / .14	7 / 5.56 / .32	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	10 / 7.94 / .46	3.20
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	7 / 5.56 / .32	38 / 30.16 / 1.76	73 / 57.94 / 3.39	8 / 6.35 / .37	0 / 0.00 / 0.00	0 / 0.00 / 0.00	126 / 100.00 / 5.85	3.35

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - SEPTEMBER

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79, 11.18.40.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	WIND SPEED CATEGORIES (METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 / 0.00 / 0.00	1 / 1.32 / .05	1 / 1.32 / .05	1 / 1.32 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 3.95 / .14	3.87
NE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
ENE	0 / 0.00 / 0.00	3 / 3.95 / .14	2 / 2.63 / .09	1 / 1.32 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	6 / 7.89 / .28	3.38
E	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 3.95 / .14	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 3.95 / .14	3.87
ESE	0 / 0.00 / 0.00	3 / 3.95 / .14	1 / 1.32 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 5.26 / .19	2.95
SE	0 / 0.00 / 0.00	3 / 3.95 / .14	4 / 5.26 / .19	1 / 1.32 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	8 / 10.53 / .37	3.60
SSE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 3.95 / .14	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 3.95 / .14	3.47
S	0 / 0.00 / 0.00	3 / 3.95 / .14	2 / 2.63 / .09	3 / 3.95 / .14	0 / 0.00 / 0.00	0 / 0.00 / 0.00	8 / 10.53 / .37	4.17
SSW	2 / 2.63 / .09	3 / 3.95 / .14	3 / 3.95 / .14	2 / 2.63 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	10 / 13.16 / .46	3.23
SW	1 / 1.32 / .05	2 / 2.63 / .09	2 / 2.63 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 6.58 / .23	2.52
WSW	1 / 1.32 / .05	2 / 2.63 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 3.95 / .14	1.67
W	0 / 0.00 / 0.00	1 / 1.32 / .05	2 / 2.63 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 3.95 / .14	3.10
WNW	0 / 0.00 / 0.00	3 / 3.95 / .14	2 / 2.63 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 6.58 / .23	2.94
NW	0 / 0.00 / 0.00	2 / 2.63 / .09	5 / 6.58 / .23	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	7 / 9.21 / .32	3.27
NNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 3.95 / .14	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 3.95 / .14	4.07
N	0 / 0.00 / 0.00	1 / 1.32 / .05	4 / 5.26 / .19	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 6.58 / .23	3.94
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	4 / 5.26 / .19	27 / 35.53 / 1.25	37 / 48.68 / 1.72	8 / 10.53 / .37	0 / 0.00 / 0.00	0 / 0.00 / 0.00	76 / 100.00 / 3.53	3.38

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79, 11.18.40.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	WIND SPEED CATEGORIES (METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	5 / .70 / .23	13 / 1.82 / .60	16 / 2.23 / .74	3 / .42 / .14	0 / 0.00 / 0.00	0 / 0.00 / 0.00	37 / 5.17 / 1.72	3.26
NE	6 / .84 / .28	22 / 3.07 / 1.02	10 / 1.40 / .46	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	38 / 5.31 / 1.76	2.50
ENE	5 / .70 / .23	15 / 2.09 / .70	11 / 1.54 / .51	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	31 / 4.33 / 1.44	2.65
E	5 / .70 / .23	16 / 2.23 / .74	10 / 1.40 / .46	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	31 / 4.33 / 1.44	2.54
ESE	4 / .56 / .19	36 / 5.03 / 1.67	11 / 1.54 / .51	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	51 / 7.12 / 2.37	2.48
SE	5 / .70 / .23	23 / 3.21 / 1.07	23 / 3.21 / 1.07	2 / .28 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	53 / 7.40 / 2.46	2.84
SSE	5 / .70 / .23	33 / 4.61 / 1.53	40 / 5.59 / 1.86	7 / .98 / .32	0 / 0.00 / 0.00	0 / 0.00 / 0.00	85 / 11.87 / 3.95	3.25
S	7 / .98 / .32	26 / 3.63 / 1.21	48 / 6.70 / 2.23	23 / 3.21 / 1.07	0 / 0.00 / 0.00	0 / 0.00 / 0.00	104 / 14.53 / 4.83	3.79
SSW	4 / .56 / .19	16 / 2.23 / .74	29 / 4.05 / 1.35	6 / .84 / .28	0 / 0.00 / 0.00	0 / 0.00 / 0.00	55 / 7.68 / 2.55	3.40
SW	3 / .42 / .14	15 / 2.09 / .70	8 / 1.12 / .37	2 / .28 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	28 / 3.91 / 1.30	2.86
WSW	1 / .14 / .05	4 / .56 / .19	12 / 1.68 / .56	2 / .28 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	19 / 2.65 / .88	3.49
W	6 / .84 / .28	10 / 1.40 / .46	8 / 1.12 / .37	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	24 / 3.35 / 1.11	2.60
WNW	2 / .28 / .09	6 / .84 / .28	2 / .28 / .09	3 / .42 / .14	0 / 0.00 / 0.00	0 / 0.00 / 0.00	13 / 1.82 / .60	3.15
NW	5 / .70 / .23	6 / .84 / .28	13 / 1.82 / .60	5 / .70 / .23	0 / 0.00 / 0.00	0 / 0.00 / 0.00	29 / 4.05 / 1.35	3.36
NNW	2 / .28 / .09	12 / 1.68 / .56	28 / 3.91 / 1.30	8 / 1.12 / .37	0 / 0.00 / 0.00	0 / 0.00 / 0.00	50 / 6.98 / 2.32	3.85
N	5 / .70 / .23	11 / 1.54 / .51	46 / 6.42 / 2.14	4 / .56 / .19	0 / 0.00 / 0.00	0 / 0.00 / 0.00	66 / 9.22 / 3.06	3.65
CALM	2 / .28 / .09						2 / .28 / .09	CALM
TOTAL	72 / 10.06 / 3.34	264 / 36.87 / 12.26	315 / 43.99 / 14.62	65 / 9.08 / 3.02	0 / 0.00 / 0.00	0 / 0.00 / 0.00	716 / 100.00 / 33.24	3.21

KEY
XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-60 (Continued) (Sheet 34 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - SEPTEMBER

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 11.18.40.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	3 .48 .14	7 1.13 .32	1 .16 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	11 1.78 .51	2.01
NE	3 .48 .14	9 1.45 .42	1 .16 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	13 2.10 .60	2.08
ENE	7 1.13 .32	15 2.42 .70	4 .65 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	26 4.20 1.21	2.03
E	9 1.45 .42	11 1.78 .51	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	20 3.23 .93	1.69
ESE	11 1.78 .51	18 2.91 .84	2 .32 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	31 5.01 1.44	1.84
SE	10 1.62 .46	65 10.50 3.02	23 3.72 1.07	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	98 15.83 4.55	2.54
SSE	6 .97 .28	62 10.02 2.88	58 9.37 2.69	3 .48 .14	0 0.00 0.00	0 0.00 0.00	129 20.84 5.99	3.01
S	11 1.78 .51	49 7.92 2.27	59 9.53 2.74	8 1.29 .37	0 0.00 0.00	0 0.00 0.00	127 20.52 5.90	3.13
SSW	2 .32 .09	21 3.39 .97	10 1.62 .46	6 .97 .28	1 .16 .05	0 0.00 0.00	40 6.46 1.86	3.14
SW	3 .48 .14	17 2.75 .79	6 .97 .28	2 .32 .09	0 0.00 0.00	0 0.00 0.00	28 4.52 1.30	2.80
WSW	5 .81 .23	8 1.29 .37	5 .81 .23	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	18 2.91 .84	2.23
W	6 .97 .28	4 .65 .19	2 .32 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	12 1.94 .56	1.72
WNW	2 .32 .09	5 .81 .23	1 .16 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 1.29 .37	2.15
NW	5 .81 .23	8 1.29 .37	1 .16 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	14 2.26 .65	1.84
NNW	5 .81 .23	10 1.62 .46	1 .16 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	16 2.58 .74	2.02
N	5 .81 .23	17 2.75 .79	3 .48 .14	2 .32 .09	0 0.00 0.00	0 0.00 0.00	27 4.36 1.25	2.52
CALM	1 .16 .05						1 .16 .05	CALM
TOTAL	94 15.19 4.36	326 52.67 15.13	177 28.59 8.22	21 3.39 .97	1 .16 .05	0 0.00 0.00	619 100.00 28.74	2.64

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 11.18.40.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	12 6.70 .56	6 3.35 .28	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	18 10.06 .84	1.36
NE	24 13.41 1.11	3 1.68 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	27 15.08 1.25	1.11
ENE	8 4.47 .37	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 4.47 .37	1.12
E	3 1.68 .14	1 .56 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 2.23 .19	1.12
ESE	5 2.79 .23	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 2.79 .23	1.16
SE	5 2.79 .23	9 5.03 .42	2 1.12 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	16 8.94 .74	1.46
SSE	5 2.79 .23	13 7.26 .60	5 2.79 .23	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	23 12.85 1.07	2.19
S	4 2.23 .19	11 6.15 .51	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	15 8.38 .70	1.88
SSW	2 1.12 .09	7 3.91 .32	1 .56 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	10 5.59 .46	2.36
SW	0 0.00 0.00	2 1.12 .09	1 .56 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 1.68 .14	2.97
WSW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
W	0 0.00 0.00	1 .56 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .56 .05	1.40
WNW	2 1.12 .09	3 1.68 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 2.79 .23	1.50
NW	3 1.68 .14	3 1.68 .14	1 .56 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 3.91 .32	1.63
NNW	5 2.79 .23	6 3.35 .28	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	11 6.15 .51	1.59
N	13 7.26 .60	11 6.15 .51	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	24 13.41 1.11	1.53
CALM	2 1.12 .09						2 1.12 .09	CALM
TOTAL	93 51.96 4.32	76 42.46 3.53	10 5.59 .46	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	179 100.00 8.31	1.62

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - SEPTEMBER

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 11.18.40.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	9 2.57 .42	9 2.57 .42	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	18 5.14 .84	1.49
NE	15 4.29 .70	8 2.29 .37	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	23 6.57 1.07	1.38
ENE	15 4.29 .70	8 2.29 .37	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	23 6.57 1.07	1.41
E	10 2.86 .46	8 2.29 .37	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	18 5.14 .84	1.34
ESE	8 2.29 .37	12 3.43 .56	2 .57 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	22 6.29 1.02	1.85
SE	3 .86 .14	32 9.14 1.49	2 .57 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	37 10.57 1.72	2.14
SSE	12 3.43 .56	45 12.86 2.09	12 3.43 .56	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	69 19.71 3.20	2.35
S	7 2.00 .32	25 7.14 1.16	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	32 9.14 1.49	1.97
SSW	4 1.14 .19	16 4.57 .74	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	20 5.71 .93	2.04
SW	4 1.14 .19	4 1.14 .19	1 .29 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 2.57 .42	1.96
WSW	2 .57 .09	1 .29 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 .86 .14	1.37
W	3 .86 .14	1 .29 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 1.14 .19	1.42
WNW	4 1.14 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 1.14 .19	1.00
NW	8 2.29 .37	10 2.86 .46	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	18 5.14 .84	1.66
NNW	5 1.43 .23	15 4.29 .70	2 .57 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	22 6.29 1.02	2.04
N	4 1.14 .19	20 5.71 .93	1 .29 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	25 7.14 1.16	2.10
CALM	3 .86 .14						3 .86 .14	CALM
TOTAL	116 33.14 5.39	214 61.14 9.94	20 5.71 .93	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	350 100.00 16.25	1.88

JOINT WIND FREQUENCY DISTRIBUTION
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - SEPTEMBER

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 11.18.40.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-0

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	30 1.39	40 1.85	23 1.07	6 .28	0 0.00	0 0.00	99 4.59	2.52
NE	48 2.22	45 2.09	11 .51	0 0.00	0 0.00	0 0.00	104 4.82	1.83
ENE	36 1.67	46 2.13	19 .88	3 .14	0 0.00	0 0.00	104 4.82	2.21
E	27 1.25	37 1.71	19 .88	0 0.00	0 0.00	0 0.00	83 3.85	2.13
ESE	28 1.30	70 3.24	21 .97	0 0.00	0 0.00	0 0.00	119 5.51	2.22
SE	24 1.11	133 6.15	65 3.01	7 .32	0 0.00	0 0.00	229 10.61	2.65
SSE	28 1.30	157 7.28	129 5.98	11 .51	0 0.00	0 0.00	325 15.06	2.91
S	29 1.34	123 5.70	125 5.79	39 1.81	0 0.00	0 0.00	316 14.64	3.24
SSW	15 .70	69 3.20	55 2.55	21 .97	1 .05	0 0.00	161 7.46	3.21
SW	13 .60	45 2.09	33 1.53	9 .42	0 0.00	0 0.00	100 4.63	3.00
WSW	15 .70	19 .88	19 .88	2 .09	0 0.00	0 0.00	55 2.55	2.58
W	16 .74	21 .97	21 .97	0 0.00	0 0.00	0 0.00	58 2.69	2.44
WNW	10 .46	18 .83	8 .37	3 .14	0 0.00	0 0.00	39 1.81	2.48
NW	21 .97	33 1.53	28 1.30	5 .23	0 0.00	0 0.00	87 4.03	2.60
NNW	17 .79	44 2.04	43 1.99	8 .37	0 0.00	0 0.00	112 5.19	3.00
N	27 1.25	64 2.97	62 2.87	6 .28	0 0.00	0 0.00	159 7.37	2.87
CALM	8 .37						8 .37	CALM
TOTAL	392 18.16	964 44.67	681 31.56	120 5.56	1 .05	0 0.00	2158 100.00	2.74

NUMBER OF VALID OBSERVATIONS 2158 99.91 PCT.
NUMBER OF INVALID OBSERVATIONS 2 .09 PCT.
TOTAL NUMBER OF OBSERVATIONS 2160 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-60 (Continued) (Sheet 35 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - SEPTEMBER

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79, 11.18.40.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NE	0 0.00 0.00	1 1.16 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.16 .05	2.70
ENE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 2.33 .11	0 0.00 0.00	0 0.00 0.00	2 2.33 .11	6.35
E	0 0.00 0.00	0 0.00 0.00	2 2.33 .11	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 2.33 .11	3.80
ESE	0 0.00 0.00	0 0.00 0.00	2 2.33 .11	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 2.33 .11	4.05
SE	0 0.00 0.00	0 0.00 0.00	3 3.49 .16	3 3.49 .16	0 0.00 0.00	0 0.00 0.00	6 6.98 .32	5.68
SSE	0 0.00 0.00	4 4.65 .22	1 1.16 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 5.81 .27	2.92
S	0 0.00 0.00	3 3.49 .16	5 5.81 .27	4 4.65 .22	4 4.65 .22	0 0.00 0.00	16 18.60 .86	4.99
SSW	0 0.00 0.00	2 2.33 .11	4 4.65 .22	10 11.63 .54	2 2.33 .11	0 0.00 0.00	18 20.93 .97	5.39
SW	1 1.16 .05	4 4.65 .22	3 3.49 .16	2 2.33 .11	0 0.00 0.00	0 0.00 0.00	10 11.63 .54	3.63
WSW	0 0.00 0.00	5 5.81 .27	2 2.33 .11	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 8.14 .38	2.74
W	0 0.00 0.00	2 2.33 .11	6 6.98 .32	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 9.30 .43	4.14
WNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.16 .05	0 0.00 0.00	0 0.00 0.00	1 1.16 .05	5.40
NW	0 0.00 0.00	1 1.16 .05	1 1.16 .05	1 1.16 .05	0 0.00 0.00	0 0.00 0.00	3 3.49 .16	3.83
NNW	0 0.00 0.00	0 0.00 0.00	2 2.33 .11	1 1.16 .05	0 0.00 0.00	0 0.00 0.00	3 3.49 .16	4.87
N	0 0.00 0.00	1 1.16 .05	1 1.16 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 2.33 .11	3.65
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	1 1.16 .05	23 26.74 1.24	32 37.21 1.72	24 27.91 1.29	6 6.98 .32	0 0.00 0.00	86 100.00 4.63	4.67

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79, 11.18.40.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 0.00 0.00	0 0.00 0.00	1 1.64 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.64 .05	4.70
NE	0 0.00 0.00	1 1.64 .05	1 1.64 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.28 .11	3.30
ENE	0 0.00 0.00	4 6.56 .22	3 4.92 .16	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 11.48 .38	3.23
E	0 0.00 0.00	0 0.00 0.00	2 3.28 .11	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.28 .11	3.80
ESE	0 0.00 0.00	1 1.64 .05	1 1.64 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.28 .11	2.90
SE	0 0.00 0.00	1 1.64 .05	3 4.92 .16	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 6.56 .22	3.15
SSE	0 0.00 0.00	1 1.64 .05	2 3.28 .11	3 4.92 .16	0 0.00 0.00	0 0.00 0.00	6 9.84 .32	4.93
S	0 0.00 0.00	2 3.28 .11	5 8.20 .27	3 4.92 .16	1 1.64 .05	0 0.00 0.00	11 18.03 .59	4.37
SSW	1 1.64 .05	0 0.00 0.00	0 0.00 0.00	1 1.64 .05	0 0.00 0.00	0 0.00 0.00	2 3.28 .11	3.45
SW	0 0.00 0.00	2 3.28 .11	3 4.92 .16	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 8.20 .27	3.38
WSW	2 3.28 .11	2 3.28 .11	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 6.56 .22	1.80
W	0 0.00 0.00	3 4.92 .16	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 4.92 .16	2.53
WNW	0 0.00 0.00	0 0.00 0.00	1 1.64 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.64 .05	3.10
NW	0 0.00 0.00	1 1.64 .05	1 1.64 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.28 .11	2.95
NNW	0 0.00 0.00	1 1.64 .05	3 4.92 .16	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 6.56 .22	3.30
N	0 0.00 0.00	0 0.00 0.00	3 4.92 .16	2 3.28 .11	0 0.00 0.00	0 0.00 0.00	5 8.20 .27	4.66
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	3 4.92 .16	19 31.15 1.02	29 47.54 1.56	9 14.75 .48	1 1.64 .05	0 0.00 0.00	61 100.00 3.29	3.63

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79, 11.18.40.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 0.00 0.00	4 3.96 .22	2 1.98 .11	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 5.94 .32	2.80
NE	0 0.00 0.00	3 2.97 .16	2 1.98 .11	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 4.95 .27	3.28
ENE	0 0.00 0.00	2 1.98 .11	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.98 .11	2.55
E	0 0.00 0.00	1 .99 .05	3 2.97 .16	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 3.96 .22	4.07
ESE	0 0.00 0.00	0 0.00 0.00	4 3.96 .22	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 3.96 .22	4.05
SE	0 0.00 0.00	0 0.00 0.00	6 5.94 .32	2 1.98 .11	0 0.00 0.00	0 0.00 0.00	8 7.92 .43	4.67
SSE	2 1.98 .11	0 0.00 0.00	5 4.95 .27	1 .99 .05	0 0.00 0.00	0 0.00 0.00	8 7.92 .43	3.44
S	1 .99 .05	6 5.94 .32	7 6.93 .38	3 2.97 .16	0 0.00 0.00	0 0.00 0.00	17 16.83 .92	3.78
SSW	0 0.00 0.00	3 2.97 .16	1 .99 .05	2 1.98 .11	0 0.00 0.00	0 0.00 0.00	6 5.94 .32	3.97
SW	1 .99 .05	1 .99 .05	2 1.98 .11	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 3.96 .22	2.70
WSW	0 0.00 0.00	1 .99 .05	2 1.98 .11	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 2.97 .16	3.83
W	0 0.00 0.00	0 0.00 0.00	4 3.96 .22	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 3.96 .22	3.77
WNW	0 0.00 0.00	3 2.97 .16	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 2.97 .16	2.40
NW	0 0.00 0.00	1 .99 .05	4 3.96 .22	2 1.98 .11	0 0.00 0.00	0 0.00 0.00	7 6.93 .38	4.11
NNW	0 0.00 0.00	2 1.98 .11	1 .99 .05	3 2.97 .16	0 0.00 0.00	0 0.00 0.00	6 5.94 .32	4.23
N	0 0.00 0.00	7 6.93 .38	4 3.96 .22	2 1.98 .11	0 0.00 0.00	0 0.00 0.00	13 12.87 .70	3.33
CALM	1 .99 .05						1 .99 .05	CALM
TOTAL	5 4.95 .27	34 33.66 1.83	47 46.53 2.53	15 14.85 .81	0 0.00 0.00	0 0.00 0.00	101 100.00 5.44	3.62

KEY
XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79, 11.18.40.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	4 .65 .22	12 1.95 .65	10 1.62 .54	9 1.46 .48	0 0.00 0.00	0 0.00 0.00	35 5.68 1.89	3.65
NE	5 .81 .27	13 2.11 .70	13 2.11 .70	2 .32 .11	0 0.00 0.00	0 0.00 0.00	33 5.36 1.78	2.88
ENE	7 1.14 .38	19 3.08 1.02	10 1.62 .54	1 .16 .05	0 0.00 0.00	0 0.00 0.00	37 6.01 1.99	2.57
E	4 .65 .22	22 3.57 1.19	9 1.46 .48	1 .16 .05	0 0.00 0.00	0 0.00 0.00	36 5.84 1.94	2.54
ESE	1 .16 .05	21 3.41 1.13	12 1.95 .65	2 .32 .11	0 0.00 0.00	0 0.00 0.00	36 5.84 1.94	2.99
SE	3 .49 .16	25 4.06 1.35	35 5.68 1.89	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	63 10.23 3.39	3.08
SSE	4 .65 .22	28 4.55 1.51	30 4.87 1.62	11 1.79 .59	0 0.00 0.00	0 0.00 0.00	73 11.85 3.93	3.37
S	5 .81 .27	28 4.55 1.51	20 3.25 1.08	19 3.08 1.02	6 .97 .32	0 0.00 0.00	78 12.66 4.20	4.06
SSW	1 .16 .05	8 1.30 .43	8 1.30 .43	6 .97 .32	1 .16 .05	0 0.00 0.00	24 3.90 1.29	4.23
SW	2 .32 .11	11 1.79 .59	9 1.46 .48	7 1.14 .38	0 0.00 0.00	0 0.00 0.00	29 4.71 1.56	3.70
WSW	2 .32 .11	3 .49 .16	8 1.30 .43	1 .16 .05	1 .16 .05	0 0.00 0.00	15 2.44 .81	3.65
W	2 .32 .11	2 .32 .11	11 1.79 .59	4 .65 .22	0 0.00 0.00	0 0.00 0.00	19 3.08 1.02	4.02
WNW	3 .49 .16	3 .49 .16	7 1.14 .38	2 .32 .11	0 0.00 0.00	0 0.00 0.00	15 2.44 .81	3.12
NW	2 .32 .11	5 .81 .27	18 2.92 .97	2 .32 .11	2 .32 .11	1 .16 .05	30 4.87 1.62	4.25
NNW	3 .49 .16	8 1.30 .43	20 3.25 1.08	11 1.79 .59	1 .16 .05	0 0.00 0.00	43 6.98 2.32	4.08
N	8 1.30 .43	7 1.14 .38	14 2.27 .75	21 3.41 1.13	0 0.00 0.00	0 0.00 0.00	50 8.12 2.69	4.23
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	56 9.09 3.02	215 34.90 11.58	234 37.99 12.61	99 16.07 5.33	11 1.79 .59	1 .16 .05	616 100.00 33.19	3.52

KEY
XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-60 (Continued) (Sheet 36 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - SEPTEMBER

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 11.18.40.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	5 .95 .27	5 .95 .27	3 .57 .16	0 0.00 0.00	0 0.00 0.00	13 2.47 .70	3.56
NE	1 .19 .05	3 .57 .16	8 1.52 .43	1 .19 .05	0 0.00 0.00	0 0.00 0.00	13 2.47 .70	3.27
ENE	0 0.00 0.00	6 1.14 .32	5 .95 .27	3 .57 .16	0 0.00 0.00	0 0.00 0.00	14 2.66 .75	3.44
E	2 .38 .11	6 1.14 .32	15 2.85 .81	3 .57 .16	0 0.00 0.00	0 0.00 0.00	26 4.93 1.40	3.57
ESE	2 .38 .11	11 2.09 .59	17 3.23 .92	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	30 5.69 1.62	3.89
SE	3 .57 .16	32 6.07 1.72	52 9.87 2.80	8 1.52 .43	0 0.00 0.00	0 0.00 0.00	95 18.03 5.12	3.68
SSE	3 .57 .16	14 2.66 .75	50 9.49 2.69	24 4.55 1.29	0 0.00 0.00	0 0.00 0.00	91 17.27 4.90	4.17
S	0 0.00 0.00	19 3.61 1.02	31 5.88 1.67	57 10.82 3.07	0 0.00 0.00	0 0.00 0.00	107 20.30 5.77	4.76
SSW	1 .19 .05	9 1.71 .48	18 3.42 .97	7 1.33 .38	1 .19 .05	0 0.00 0.00	36 6.83 1.94	4.14
SW	2 .38 .11	10 1.90 .54	16 3.04 .86	6 1.14 .32	2 .38 .11	0 0.00 0.00	36 6.83 1.94	4.08
WSW	0 0.00 0.00	2 .38 .11	9 1.71 .48	6 1.14 .32	0 0.00 0.00	0 0.00 0.00	17 3.23 .92	4.54
W	2 .38 .11	2 .38 .11	5 .95 .27	1 .19 .05	0 0.00 0.00	0 0.00 0.00	10 1.90 .54	3.39
WNW	0 0.00 0.00	1 .19 .05	3 .57 .16	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 .76 .22	4.25
NW	2 .38 .11	4 .76 .22	3 .57 .16	1 .19 .05	0 0.00 0.00	0 0.00 0.00	10 1.90 .54	3.13
NNW	1 .19 .05	4 .76 .22	7 1.33 .38	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	12 2.28 .65	3.02
N	1 .19 .05	2 .38 .11	4 .76 .22	6 1.14 .32	0 0.00 0.00	0 0.00 0.00	13 2.47 .70	4.25
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	20 3.80 1.08	130 24.67 7.00	248 47.06 13.35	126 23.91 6.79	3 .57 .16	0 0.00 0.00	527 100.00 28.39	4.00

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 11.18.40.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	1 .64 .05	10 6.41 .54	7 4.49 .38	1 .64 .05	0 0.00 0.00	0 0.00 0.00	19 12.18 1.02	3.03
NE	0 0.00 0.00	7 4.49 .38	8 5.13 .43	5 3.21 .27	0 0.00 0.00	0 0.00 0.00	20 12.82 1.08	3.84
ENE	1 .64 .05	1 .64 .05	2 1.28 .11	3 1.92 .16	0 0.00 0.00	0 0.00 0.00	7 4.49 .38	4.30
E	0 0.00 0.00	5 3.21 .27	8 5.13 .43	7 4.49 .38	0 0.00 0.00	0 0.00 0.00	20 12.82 1.08	4.12
ESE	3 1.92 .16	6 3.85 .32	12 7.69 .65	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	21 13.46 1.13	2.95
SE	0 0.00 0.00	2 1.28 .11	3 1.92 .15	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 3.21 .27	3.50
SSE	1 .64 .05	1 .64 .05	4 2.56 .22	9 5.77 .48	0 0.00 0.00	0 0.00 0.00	15 9.62 .81	4.77
S	0 0.00 0.00	3 1.92 .16	10 6.41 .54	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	13 8.33 .70	3.67
SSW	0 0.00 0.00	1 .64 .05	5 3.21 .27	3 1.92 .16	0 0.00 0.00	0 0.00 0.00	9 5.77 .48	4.24
SW	0 0.00 0.00	1 .64 .05	3 1.92 .16	9 5.77 .48	0 0.00 0.00	0 0.00 0.00	13 8.33 .70	5.39
WSW	1 .64 .05	1 .64 .05	0 0.00 0.00	1 .64 .05	0 0.00 0.00	0 0.00 0.00	3 1.92 .16	3.33
W	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
WNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.28 .11	0 0.00 0.00	0 0.00 0.00	2 1.28 .11	6.40
NW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.28 .11	0 0.00 0.00	0 0.00 0.00	2 1.28 .11	6.00
NNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
N	0 0.00 0.00	1 .64 .05	4 2.56 .22	2 1.28 .11	0 0.00 0.00	0 0.00 0.00	7 4.49 .38	4.70
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	7 4.49 .38	39 25.00 2.10	66 42.31 3.56	44 28.21 2.37	0 0.00 0.00	0 0.00 0.00	156 100.00 8.41	3.99

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - SEPTEMBER

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 11.18.40.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	7 2.27 .38	5 1.62 .27	8 2.59 .43	0 0.00 0.00	0 0.00 0.00	20 6.47 1.08	4.04
NE	2 .65 .11	2 .65 .11	7 2.27 .38	8 2.59 .43	0 0.00 0.00	0 0.00 0.00	19 6.15 1.02	4.22
ENE	0 0.00 0.00	0 0.00 0.00	5 1.62 .27	4 1.29 .22	0 0.00 0.00	0 0.00 0.00	9 2.91 .48	4.76
E	2 .65 .11	2 .65 .11	10 3.24 .54	5 1.62 .27	0 0.00 0.00	0 0.00 0.00	19 6.15 1.02	4.13
ESE	0 0.00 0.00	6 1.94 .32	19 6.15 1.02	8 2.59 .43	0 0.00 0.00	0 0.00 0.00	33 10.68 1.78	4.14
SE	1 .32 .05	12 3.88 .65	10 3.24 .54	16 5.18 .86	0 0.00 0.00	0 0.00 0.00	39 12.62 2.10	4.05
SSE	1 .32 .05	5 1.62 .27	18 5.83 .97	10 3.24 .54	0 0.00 0.00	0 0.00 0.00	34 11.00 1.83	4.03
S	1 .32 .05	9 2.91 .48	14 4.53 .75	16 5.18 .86	0 0.00 0.00	0 0.00 0.00	40 12.94 2.16	4.26
SSW	0 0.00 0.00	3 .97 .16	13 4.21 .70	1 .32 .05	0 0.00 0.00	0 0.00 0.00	17 5.50 .92	4.07
SW	1 .32 .05	4 1.29 .22	10 3.24 .54	8 2.59 .43	0 0.00 0.00	0 0.00 0.00	23 7.44 1.24	4.30
WSW	1 .32 .05	1 .32 .05	3 .97 .16	3 .97 .16	0 0.00 0.00	0 0.00 0.00	8 2.59 .43	4.22
W	0 0.00 0.00	2 .65 .11	1 .32 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 .97 .16	2.43
WNW	1 .32 .05	0 0.00 0.00	2 .65 .11	1 .32 .05	0 0.00 0.00	0 0.00 0.00	4 1.29 .22	3.67
NW	0 0.00 0.00	3 .97 .16	6 1.94 .32	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 2.91 .48	3.91
NNW	0 0.00 0.00	3 .97 .16	9 2.91 .48	1 .32 .05	0 0.00 0.00	0 0.00 0.00	13 4.21 .70	3.63
N	0 0.00 0.00	3 .97 .16	3 .97 .16	13 4.21 .70	0 0.00 0.00	0 0.00 0.00	19 6.15 1.02	5.38
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	10 3.24 .54	62 20.06 3.34	135 43.69 7.27	102 33.01 5.50	0 0.00 0.00	0 0.00 0.00	309 100.00 16.65	4.19

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 11.18.40.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	5 .27	38 2.05	30 1.61	21 1.13	0 0.00	0 0.00	94 5.06	3.55
NE	8 .43	30 1.61	39 2.10	16 .86	0 0.00	0 0.00	93 5.01	3.44
ENE	8 .43	32 1.72	25 1.35	13 .70	0 0.00	0 0.00	78 4.20	3.29
E	8 .43	36 1.94	49 2.64	16 .86	0 0.00	0 0.00	109 5.87	3.45
ESE	6 .32	46 2.48	68 3.66	10 .54	0 0.00	0 0.00	130 7.00	3.34
SE	7 .38	72 3.88	112 6.03	29 1.56	0 0.00	0 0.00	220 11.84	3.65
SSE	11 .59	53 2.85	110 5.92	58 3.12	0 0.00	0 0.00	232 12.49	3.91
S	7 .38	70 3.77	92 4.95	102 5.49	11 .59	0 0.00	282 15.18	4.38
SSW	3 .16	26 1.40	49 2.64	30 1.61	4 .22	0 0.00	112 6.03	4.29
SW	7 .38	33 1.78	46 2.48	32 1.72	2 .11	0 0.00	120 6.46	4.06
WSW	6 .32	15 .81	24 1.29	11 .59	1 .05	0 0.00	57 3.07	3.75
W	4 .22	11 .59	27 1.45	5 .27	0 0.00	0 0.00	47 2.53	3.71
WNW	4 .22	7 .38	13 .70	6 .32	0 0.00	0 0.00	30 1.61	3.57
NW	4 .22	15 .81	33 1.78	8 .43	2 .11	1 .05	63 3.39	4.00
NNW	4 .22	18 .97	42 2.26	16 .86	1 .05	0.00	81 4.36	3.85
N	9 .48	21 1.13	33 1.78	46 2.48	0 0.00	0 0.00	109 5.87	4.37
CALM	1 .05						1 .05	CALM
TOTAL	102 5.49	523 28.15	792 42.63	419 22.55	21 1.13	1 .05	1858 100.00	3.46

NUMBER OF VALID OBSERVATIONS 1858 86.02 PCT.
NUMBER OF INVALID OBSERVATIONS 302 13.98 PCT.
TOTAL NUMBER OF OBSERVATIONS 2160 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-60 (Continued) (Sheet 37 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - OCTOBER

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 11.50.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 5.88 .14	0 0.00 0.00	0 0.00 0.00	3 5.88 .14	5.33
E	0 0.00 0.00	0 0.00 0.00	1 1.96 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.96 .05	3.80
ESE	0 0.00 0.00	0 0.00 0.00	1 1.96 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.96 .05	3.60
SE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.96 .05	0 0.00 0.00	0 0.00 0.00	1 1.96 .05	5.20
SSE	0 0.00 0.00	0 0.00 0.00	1 1.96 .05	3 5.88 .14	0 0.00 0.00	0 0.00 0.00	4 7.84 .19	5.67
S	0 0.00 0.00	1 1.96 .05	2 3.92 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 5.88 .14	3.43
SSW	0 0.00 0.00	1 1.96 .05	0 0.00 0.00	2 3.92 .09	0 0.00 0.00	0 0.00 0.00	3 5.88 .14	5.07
SW	0 0.00 0.00	1 1.96 .05	2 3.92 .09	2 3.92 .09	0 0.00 0.00	0 0.00 0.00	5 9.80 .23	4.16
WSW	0 0.00 0.00	0 0.00 0.00	2 3.92 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.92 .09	3.95
W	0 0.00 0.00	0 0.00 0.00	6 11.76 .28	1 1.96 .05	0 0.00 0.00	0 0.00 0.00	7 13.73 .33	4.34
WNW	0 0.00 0.00	0 0.00 0.00	8 15.69 .37	6 11.76 .28	0 0.00 0.00	0 0.00 0.00	14 27.45 .66	5.20
NW	0 0.00 0.00	0 0.00 0.00	6 11.76 .28	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 11.76 .28	4.48
NNW	0 0.00 0.00	0 0.00 0.00	1 1.96 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.96 .05	4.50
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	0 0.00 0.00	3 5.88 .14	30 58.82 1.40	18 35.29 .84	0 0.00 0.00	0 0.00 0.00	51 100.00 2.39	4.71

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 11.50.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.77 .09	0 0.00 0.00	0 0.00 0.00	2 3.77 .09	5.30
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ESE	0 0.00 0.00	0 0.00 0.00	3 5.66 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 5.66 .14	3.67
SE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.89 .05	0 0.00 0.00	0 0.00 0.00	1 1.89 .05	6.20
SSE	0 0.00 0.00	1 1.89 .05	1 1.89 .05	1 1.89 .05	0 0.00 0.00	0 0.00 0.00	3 5.66 .14	4.10
S	0 0.00 0.00	1 1.89 .05	1 1.89 .05	2 3.77 .09	0 0.00 0.00	0 0.00 0.00	4 7.55 .19	4.40
SSW	0 0.00 0.00	3 5.66 .14	5 9.43 .23	1 1.89 .05	0 0.00 0.00	0 0.00 0.00	9 16.98 .42	3.74
SW	0 0.00 0.00	1 1.89 .05	3 5.66 .14	1 1.89 .05	0 0.00 0.00	0 0.00 0.00	5 9.43 .23	4.04
WSW	0 0.00 0.00	1 1.89 .05	2 3.77 .09	1 1.89 .05	0 0.00 0.00	0 0.00 0.00	4 7.55 .19	3.85
W	0 0.00 0.00	1 1.89 .05	1 1.89 .05	1 1.89 .05	0 0.00 0.00	0 0.00 0.00	3 5.66 .14	4.10
WNW	0 0.00 0.00	3 5.66 .14	7 13.21 .33	1 1.89 .05	0 0.00 0.00	0 0.00 0.00	11 20.75 .51	3.45
NW	0 0.00 0.00	0 0.00 0.00	2 3.77 .09	1 1.89 .05	0 0.00 0.00	0 0.00 0.00	3 5.66 .14	4.57
NNW	0 0.00 0.00	1 1.89 .05	4 7.55 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 9.43 .23	3.52
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	0 0.00 0.00	12 22.64 .56	29 54.72 1.36	12 22.64 .56	0 0.00 0.00	0 0.00 0.00	53 100.00 2.48	3.94

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 11.50.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 0.00 0.00	1 .99 .05	1 .99 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.98 .09	2.60
NE	0 0.00 0.00	1 .99 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .99 .05	2.20
ENE	0 0.00 0.00	0 0.00 0.00	1 .99 .05	1 .99 .05	0 0.00 0.00	0 0.00 0.00	2 1.98 .09	5.50
E	0 0.00 0.00	0 0.00 0.00	1 .99 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .99 .05	4.50
ESE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SE	0 0.00 0.00	0 0.00 0.00	1 .99 .05	3 2.97 .14	0 0.00 0.00	0 0.00 0.00	4 3.96 .19	5.87
SSE	0 0.00 0.00	4 3.96 .19	5 4.95 .23	2 1.98 .09	0 0.00 0.00	0 0.00 0.00	11 10.89 .51	3.82
S	0 0.00 0.00	1 .99 .05	3 2.97 .14	6 5.94 .28	1 .99 .05	0 0.00 0.00	11 10.89 .51	5.55
SSW	0 0.00 0.00	6 5.94 .28	7 6.93 .33	1 .99 .05	0 0.00 0.00	0 0.00 0.00	14 13.86 .66	3.48
SW	1 .99 .05	3 2.97 .14	7 6.93 .33	6 5.94 .28	0 0.00 0.00	0 0.00 0.00	17 16.83 .80	3.98
WSW	0 0.00 0.00	2 1.98 .09	2 1.98 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 3.96 .19	3.32
W	0 0.00 0.00	1 .99 .05	4 3.96 .19	1 .99 .05	0 0.00 0.00	0 0.00 0.00	6 5.94 .28	3.58
WNW	0 0.00 0.00	1 .99 .05	3 2.97 .14	2 1.98 .09	0 0.00 0.00	0 0.00 0.00	6 5.94 .28	4.18
NW	0 0.00 0.00	3 2.97 .14	4 3.96 .19	4 3.96 .19	0 0.00 0.00	0 0.00 0.00	11 10.89 .51	3.96
NNW	0 0.00 0.00	2 1.98 .09	3 2.97 .14	2 1.98 .09	0 0.00 0.00	0 0.00 0.00	7 6.93 .33	4.06
N	0 0.00 0.00	3 2.97 .14	1 .99 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 3.96 .19	2.90
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	1 .99 .05	28 27.72 1.31	43 42.57 2.01	28 27.72 1.31	1 .99 .05	0 0.00 0.00	101 100.00 4.73	4.05

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 11.50.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	4 .64 .19	14 2.25 .66	14 2.25 .66	7 1.13 .33	0 0.00 0.00	0 0.00 0.00	39 6.27 1.82	3.44
NE	3 .48 .14	2 .32 .09	6 .96 .28	4 .64 .19	0 0.00 0.00	0 0.00 0.00	15 2.41 .70	3.63
ENE	1 .16 .05	4 .64 .19	7 1.13 .33	1 .16 .05	0 0.00 0.00	0 0.00 0.00	13 2.09 .61	3.07
E	2 .32 .09	5 .80 .23	3 .48 .14	1 .16 .05	0 0.00 0.00	0 0.00 0.00	11 1.77 .51	2.71
ESE	3 .48 .14	6 .96 .28	7 1.13 .33	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	16 2.57 .75	2.77
SE	3 .48 .14	11 1.77 .51	20 3.22 .94	4 .64 .19	0 0.00 0.00	0 0.00 0.00	38 6.11 1.78	3.49
SSE	1 .16 .05	13 2.09 .61	30 4.82 1.40	21 3.38 .98	0 0.00 0.00	0 0.00 0.00	65 10.45 3.04	4.28
S	2 .32 .09	9 1.45 .42	41 6.59 1.92	17 2.73 .80	6 .96 .28	0 0.00 0.00	75 12.06 3.51	4.37
SSW	4 .64 .19	14 2.25 .66	41 6.59 1.92	11 1.77 .51	0 0.00 0.00	0 0.00 0.00	70 11.25 3.28	3.80
SW	1 .16 .05	14 2.25 .66	17 2.73 .80	10 1.61 .47	0 0.00 0.00	0 0.00 0.00	42 6.75 1.97	3.89
WSW	5 .80 .23	10 1.61 .47	11 1.77 .51	1 .16 .05	0 0.00 0.00	0 0.00 0.00	27 4.34 1.26	2.67
W	2 .32 .09	18 2.89 .84	7 1.13 .33	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	27 4.34 1.26	2.60
WNW	0 0.00 0.00	16 2.57 .75	13 2.09 .61	4 .64 .19	0 0.00 0.00	0 0.00 0.00	33 5.31 1.54	3.35
NW	3 .48 .14	4 .64 .19	29 4.66 1.36	8 1.29 .37	0 0.00 0.00	0 0.00 0.00	44 7.07 2.06	3.85
NNW	3 .48 .14	9 1.45 .42	33 5.31 1.54	10 1.61 .47	0 0.00 0.00	0 0.00 0.00	55 8.84 2.57	3.84
N	3 .48 .14	9 1.45 .42	28 4.50 1.31	12 1.93 .56	0 0.00 0.00	0 0.00 0.00	52 8.36 2.43	4.01
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	40 6.43 1.87	158 25.40 7.39	307 49.36 14.37	111 17.85 5.19	6 .96 .28	0 0.00 0.00	622 100.00 29.11	3.72

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-60 (Continued) (Sheet 38 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - OCTOBER

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 11.50.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	9 1.36 .42	9 1.36 .42	16 2.41 .75	1 .15 .05	0 0.00 0.00	0 0.00 0.00	35 5.28 1.64	2.76
NE	4 .60 .19	8 1.21 .37	2 .30 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	14 2.11 .66	2.19
ENE	1 .15 .05	3 .45 .14	1 .15 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 .75 .23	2.34
E	4 .60 .19	5 .75 .23	4 .60 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	13 1.96 .61	2.42
ESE	4 .60 .19	9 1.36 .42	5 .75 .23	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	18 2.71 .84	2.47
SE	2 .30 .09	29 4.37 1.36	33 4.98 1.54	2 .30 .09	0 0.00 0.00	0 0.00 0.00	66 9.95 3.09	3.12
SSE	5 .75 .23	28 4.22 1.31	85 12.82 3.98	12 1.81 .56	0 0.00 0.00	0 0.00 0.00	130 19.61 6.08	3.70
S	7 1.06 .33	34 5.13 1.59	67 10.11 3.14	20 3.02 .94	1 .15 .05	0 0.00 0.00	129 19.46 6.04	3.72
SSW	6 .90 .28	17 2.56 .80	28 4.22 1.31	6 .90 .28	1 .15 .05	0 0.00 0.00	58 8.75 2.71	3.46
SW	5 .75 .23	17 2.56 .80	7 1.06 .33	3 .45 .14	0 0.00 0.00	0 0.00 0.00	32 4.83 1.50	2.83
WSW	5 .75 .23	8 1.21 .37	6 .90 .28	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	19 2.87 .89	2.49
W	3 .45 .14	10 1.51 .47	6 .90 .28	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	19 2.87 .89	2.30
WNW	5 .75 .23	14 2.11 .66	10 1.51 .47	2 .30 .09	0 0.00 0.00	0 0.00 0.00	31 4.68 1.45	2.70
NW	7 1.06 .33	22 3.32 1.03	7 1.06 .33	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	36 5.43 1.68	2.28
NNW	2 .30 .09	14 2.11 .66	13 1.96 .61	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	29 4.37 1.36	2.81
N	2 .30 .09	13 1.96 .61	10 1.51 .47	2 .30 .09	0 0.00 0.00	0 0.00 0.00	27 4.07 1.26	3.12
CALM	2 .30 .09						2 .30 .09	CALM
TOTAL	73 11.01 3.42	240 36.20 11.23	300 45.25 14.04	48 7.24 2.25	2 .30 .09	0 0.00 0.00	663 100.00 31.02	3.16

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 11.50.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	2 .89 .09	1 .44 .05	1 .44 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 1.78 .19	2.15
NE	2 .89 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 .89 .09	.90
ENE	2 .89 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 .89 .09	.70
E	1 .44 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .44 .05	.40
ESE	2 .89 .09	2 .89 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 1.78 .19	1.15
SE	4 1.78 .19	12 5.33 .56	3 1.33 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	19 8.44 .89	2.17
SSE	8 3.56 .37	22 9.78 1.03	7 3.11 .33	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	37 16.44 1.73	2.24
S	7 3.11 .33	19 8.44 .89	6 2.67 .28	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	32 14.22 1.50	2.46
SSW	11 4.89 .51	14 6.22 .66	4 1.78 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	29 12.89 1.36	1.96
SW	7 3.11 .33	16 7.11 .75	2 .89 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	25 11.11 1.17	2.05
WSW	5 2.22 .23	19 8.44 .89	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	24 10.67 1.12	1.97
W	9 4.00 .42	2 .89 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	11 4.89 .51	1.12
WNW	3 1.33 .14	6 2.67 .28	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 4.00 .42	1.64
NW	1 .44 .05	2 .89 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 1.33 .14	1.63
NNW	3 1.33 .14	7 3.11 .33	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	10 4.44 .47	1.78
N	7 3.11 .33	4 1.78 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	11 4.89 .51	1.39
CALM	2 .89 .09						2 .89 .09	CALM
TOTAL	76 33.78 3.56	126 56.00 5.90	23 10.22 1.08	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	225 100.00 10.53	1.96

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - OCTOBER

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 11.50.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	6 1.42 .28	6 1.42 .28	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	12 2.84 .56	1.43
NE	8 1.90 .37	7 1.66 .33	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	15 3.55 .70	1.59
ENE	5 1.18 .23	2 .47 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 1.66 .33	1.39
E	1 .24 .05	10 2.37 .47	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	11 2.61 .51	2.20
ESE	2 .47 .09	5 1.18 .23	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 1.66 .33	1.93
SE	3 .71 .14	36 8.53 1.68	11 2.61 .51	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	50 11.85 2.34	2.50
SSE	2 .47 .09	38 9.00 1.78	34 8.06 1.59	2 .47 .09	0 0.00 0.00	0 0.00 0.00	76 18.01 3.56	2.92
S	2 .47 .09	21 4.98 .98	22 5.21 1.03	1 .24 .05	0 0.00 0.00	0 0.00 0.00	46 10.90 2.15	2.90
SSW	4 .95 .19	11 2.61 .51	14 3.32 .66	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	29 6.87 1.36	2.79
SW	5 1.18 .23	17 4.03 .80	2 .47 .09	1 .24 .05	0 0.00 0.00	0 0.00 0.00	25 5.92 1.17	2.23
WSW	3 .71 .14	13 3.08 .61	3 .71 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	19 4.50 .89	2.20
W	8 1.90 .37	20 4.74 .94	3 .71 .14	1 .24 .05	2 .47 .09	0 0.00 0.00	34 8.06 1.59	2.41
WNW	4 .95 .19	15 3.55 .70	3 .71 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	22 5.21 1.03	2.10
NW	8 1.90 .37	25 5.92 1.17	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	33 7.82 1.54	2.08
NNW	4 .95 .19	5 1.18 .23	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 2.13 .42	2.00
N	7 1.66 .33	13 3.08 .61	4 .95 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	24 5.69 1.12	2.17
CALM	3 .71 .14						3 .71 .14	CALM
TOTAL	75 17.77 3.51	244 57.82 11.42	96 22.75 4.49	5 1.18 .23	2 .47 .09	0 0.00 0.00	422 100.00 19.75	2.40

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 11.50.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	24 1.08	32 1.43	32 1.43	8 .36	0 0.00	0 0.00	96 4.30	2.78
NE	17 .76	18 .81	8 .36	4 .18	0 0.00	0 0.00	47 2.11	2.40
ENE	10 .45	9 .40	9 .40	7 .31	0 0.00	0 0.00	35 1.57	2.88
E	8 .36	22 .99	10 .45	1 .04	0 0.00	0 0.00	41 1.84	2.51
ESE	11 .49	25 1.12	20 .90	0 0.00	0 0.00	0 0.00	56 2.51	2.53
SE	12 .54	94 4.22	68 3.05	11 .49	0 0.00	0 0.00	185 8.30	2.98
SSE	16 .72	110 4.93	166 7.44	42 1.88	0 0.00	0 0.00	334 14.98	3.49
S	18 .81	89 3.99	143 6.41	48 2.15	8 .36	0 0.00	306 13.72	3.70
SSW	25 1.12	70 3.14	101 4.53	22 .99	1 .04	0 0.00	219 9.82	3.30
SW	19 .85	70 3.14	43 1.93	23 1.03	0 0.00	0 0.00	155 6.95	3.11
WSW	18 .81	53 2.38	27 1.21	2 .09	0 0.00	0 0.00	100 4.48	2.49
W	22 .99	53 2.38	29 1.30	4 .18	2 .09	0 0.00	110 4.93	2.59
WNW	12 .54	55 2.47	47 2.11	15 .67	0 0.00	0 0.00	129 5.78	3.11
NW	19 .85	60 2.69	53 2.38	13 .58	0 0.00	0 0.00	145 6.50	3.02
NNW	12 .54	41 1.84	60 2.69	16 .72	0 0.00	0 0.00	129 5.78	3.37
N	20 .90	51 2.29	48 2.15	17 .76	0 0.00	0 0.00	136 6.10	3.17
CALM	7 .31						7 .31	CALM
TOTAL	270 12.11	852 38.21	864 38.74	233 10.45	11 .49	0 0.00	2230 100.00	3.15

NUMBER OF VALID OBSERVATIONS 2230 99.91 PCT.
NUMBER OF INVALID OBSERVATIONS 2 .09 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-60 (Continued) (Sheet 39 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - OCTOBER

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 11.50.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
NE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
ENE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 6.67 / .16	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 6.67 / .16	5.00
E	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
ESE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
SE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
SSE	0 / 0.00 / 0.00	1 / 2.22 / .05	1 / 2.22 / .05	3 / 6.67 / .16	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 11.11 / .27	5.44
S	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 2.22 / .05	2 / 4.44 / .11	1 / 2.22 / .05	0 / 0.00 / 0.00	4 / 8.89 / .22	5.82
SSW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 4.44 / .11	1 / 2.22 / .05	1 / 2.22 / .05	0 / 0.00 / 0.00	4 / 8.89 / .22	4.97
SW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 4.44 / .11	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 4.44 / .11	5.95
WSW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 4.44 / .11	2 / 4.44 / .11	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 8.89 / .22	5.37
W	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 2.22 / .05	8 / 17.78 / .44	1 / 2.22 / .05	0 / 0.00 / 0.00	10 / 22.22 / .55	5.60
WNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	6 / 13.33 / .33	0 / 0.00 / 0.00	6 / 13.33 / .33	9.00
NW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 2.22 / .05	5 / 11.11 / .27	0 / 0.00 / 0.00	0 / 0.00 / 0.00	6 / 13.33 / .33	5.53
NNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 2.22 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 2.22 / .05	5.40
N	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	0 / 0.00 / 0.00	1 / 2.22 / .05	8 / 17.78 / .44	27 / 60.00 / 1.48	9 / 20.00 / .49	0 / 0.00 / 0.00	45 / 100.00 / 2.47	6.04

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - OCTOBER

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 11.50.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
NE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
ENE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 5.26 / .11	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 5.26 / .11	6.00
E	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
ESE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
SE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
SSE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 2.63 / .05	1 / 2.63 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 5.26 / .11	4.40
S	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 2.63 / .05	3 / 7.89 / .16	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 10.53 / .22	6.20
SSW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 2.63 / .05	1 / 2.63 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 5.26 / .11	5.20
SW	0 / 0.00 / 0.00	1 / 2.63 / .05	6 / 15.79 / .33	3 / 7.89 / .16	0 / 0.00 / 0.00	0 / 0.00 / 0.00	10 / 26.32 / .55	4.93
WSW	0 / 0.00 / 0.00	2 / 5.26 / .11	1 / 2.63 / .05	1 / 2.63 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 10.53 / .22	4.00
W	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 13.16 / .27	2 / 5.26 / .11	1 / 2.63 / .05	0 / 0.00 / 0.00	8 / 21.05 / .44	5.06
WNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 2.63 / .05	1 / 2.63 / .05	0 / 0.00 / 0.00	2 / 5.26 / .11	7.65
NW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 5.26 / .11	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 5.26 / .11	4.65
NNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 5.26 / .11	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 5.26 / .11	4.20
N	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	0 / 0.00 / 0.00	3 / 7.89 / .16	19 / 50.00 / 1.04	14 / 36.84 / .77	2 / 5.26 / .11	0 / 0.00 / 0.00	38 / 100.00 / 2.08	5.12

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 11.50.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.30 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.30 / .05	4.10
NE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
ENE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 2.60 / .11	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 2.60 / .11	6.25
E	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
ESE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
SE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 2.60 / .11	2 / 2.60 / .11	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 5.19 / .22	4.52
SSE	0 / 0.00 / 0.00	1 / 1.30 / .05	1 / 1.30 / .05	3 / 3.90 / .16	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 6.49 / .27	5.40
S	1 / 1.30 / .05	3 / 3.90 / .16	3 / 3.90 / .16	4 / 5.19 / .22	3 / 3.90 / .16	0 / 0.00 / 0.00	14 / 18.18 / .77	5.11
SSW	0 / 0.00 / 0.00	4 / 5.19 / .22	5 / 6.49 / .27	3 / 3.90 / .16	0 / 0.00 / 0.00	0 / 0.00 / 0.00	12 / 15.58 / .66	4.97
SW	0 / 0.00 / 0.00	3 / 3.90 / .16	7 / 9.09 / .38	6 / 7.79 / .33	0 / 0.00 / 0.00	0 / 0.00 / 0.00	16 / 20.78 / .88	4.32
WSW	0 / 0.00 / 0.00	1 / 1.30 / .05	1 / 1.30 / .05	1 / 1.30 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 3.90 / .16	4.00
W	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 3.90 / .16	2 / 2.60 / .11	1 / 1.30 / .05	0 / 0.00 / 0.00	6 / 7.79 / .33	5.28
WNW	0 / 0.00 / 0.00	1 / 1.30 / .05	0 / 0.00 / 0.00	2 / 2.60 / .11	3 / 3.90 / .16	0 / 0.00 / 0.00	6 / 7.79 / .33	6.92
NW	0 / 0.00 / 0.00	1 / 1.30 / .05	2 / 2.60 / .11	1 / 1.30 / .05	1 / 1.30 / .05	0 / 0.00 / 0.00	5 / 6.49 / .27	4.82
NNW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 2.60 / .11	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 2.60 / .11	4.50
N	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.30 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.30 / .05	3.60
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	1 / 1.30 / .05	14 / 18.18 / .77	28 / 36.36 / 1.53	26 / 33.77 / 1.42	8 / 10.39 / .44	0 / 0.00 / 0.00	77 / 100.00 / 4.22	4.85

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 11.50.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES (METERS PER SECOND)							
NNE	2 / .37 / .11	4 / .74 / .22	19 / 3.51 / 1.04	6 / 1.11 / .33	1 / .18 / .05	0 / 0.00 / 0.00	32 / 5.90 / 1.75	4.08
NE	0 / 0.00 / 0.00	5 / .92 / .27	4 / .74 / .22	5 / .92 / .27	1 / .18 / .05	0 / 0.00 / 0.00	15 / 2.77 / .82	4.65
ENE	0 / 0.00 / 0.00	5 / .92 / .27	8 / 1.48 / .44	2 / .37 / .11	0 / 0.00 / 0.00	0 / 0.00 / 0.00	15 / 2.77 / .82	3.54
E	2 / .37 / .11	3 / .55 / .16	1 / .18 / .05	1 / .18 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	7 / 1.29 / .38	2.60
ESE	1 / .18 / .05	4 / .74 / .22	5 / .92 / .27	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	10 / 1.85 / .55	2.82
SE	0 / 0.00 / 0.00	6 / 1.11 / .33	18 / 3.32 / .99	3 / .55 / .16	0 / 0.00 / 0.00	0 / 0.00 / 0.00	27 / 4.98 / 1.48	4.12
SSE	3 / .55 / .16	9 / 1.66 / .49	9 / 1.66 / .49	24 / 4.43 / 1.32	2 / .37 / .11	0 / 0.00 / 0.00	47 / 8.67 / 2.58	4.77
S	1 / .18 / .05	11 / 2.03 / .60	31 / 5.72 / 1.70	25 / 4.61 / 1.37	6 / 1.11 / .33	0 / 0.00 / 0.00	74 / 13.65 / 4.05	4.80
SSW	2 / .37 / .11	13 / 2.40 / .71	26 / 4.80 / 1.42	27 / 4.98 / 1.48	1 / .18 / .05	0 / 0.00 / 0.00	69 / 12.73 / 3.78	4.57
SW	2 / .37 / .11	10 / 1.85 / .55	10 / 1.85 / .55	20 / 3.69 / 1.10	2 / .37 / .11	0 / 0.00 / 0.00	44 / 8.12 / 2.41	4.58
WSW	2 / .37 / .11	3 / .55 / .16	5 / .92 / .27	3 / .55 / .16	0 / 0.00 / 0.00	0 / 0.00 / 0.00	13 / 2.40 / .71	3.58
W	1 / .18 / .05	9 / 1.66 / .49	15 / 2.77 / .82	3 / .55 / .16	3 / .55 / .16	0 / 0.00 / 0.00	31 / 5.72 / 1.70	4.24
WNW	0 / 0.00 / 0.00	2 / .37 / .11	14 / 2.58 / .77	19 / 3.51 / 1.04	10 / 1.85 / .55	0 / 0.00 / 0.00	45 / 8.30 / 2.47	5.40
NW	2 / .37 / .11	5 / .92 / .27	15 / 2.77 / .82	24 / 4.43 / 1.32	4 / .74 / .22	0 / 0.00 / 0.00	50 / 9.23 / 2.74	5.07
NNW	1 / .18 / .05	2 / .37 / .11	6 / 1.11 / .33	5 / .92 / .27	4 / .74 / .22	0 / 0.00 / 0.00	18 / 3.32 / .99	4.91
N	2 / .37 / .11	1 / .18 / .05	18 / 3.32 / .99	19 / 3.51 / 1.04	5 / .92 / .27	0 / 0.00 / 0.00	45 / 8.30 / 2.47	5.42
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	21 / 3.87 / 1.15	92 / 16.97 / 5.04	204 / 37.64 / 11.18	186 / 34.32 / 10.19	39 / 7.20 / 2.14	0 / 0.00 / 0.00	542 / 100.00 / 29.70	4.67

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-60 (Continued) (Sheet 40 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - OCTOBER

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 11.50.13.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	4 .70 .22	10 1.75 .55	1 .17 .05	0 0.00 0.00	0 0.00 0.00	15 2.62 .82	3.86
NE	0 0.00 0.00	2 .35 .11	10 1.75 .55	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	12 2.10 .66	3.72
ENE	0 0.00 0.00	3 .52 .16	2 .35 .11	1 .17 .05	0 0.00 0.00	0 0.00 0.00	6 1.05 .33	3.60
E	0 0.00 0.00	1 .17 .05	2 .35 .11	6 1.05 .33	0 0.00 0.00	0 0.00 0.00	9 1.57 .49	5.41
ESE	3 .52 .16	1 .17 .05	6 1.05 .33	4 .70 .22	0 0.00 0.00	0 0.00 0.00	14 2.45 .77	3.85
SE	0 0.00 0.00	3 .52 .16	12 2.10 .66	32 5.59 1.75	0 0.00 0.00	0 0.00 0.00	47 8.22 2.58	5.42
SSE	0 0.00 0.00	4 .70 .22	28 4.90 1.53	61 10.66 3.34	2 .35 .11	0 0.00 0.00	95 16.61 5.21	5.55
S	4 .70 .22	9 1.57 .49	31 5.42 1.70	72 12.59 3.95	12 2.10 .66	0 0.00 0.00	128 22.38 7.01	5.50
SSW	2 .35 .11	6 1.05 .33	15 2.62 .82	33 5.77 1.81	4 .70 .22	0 0.00 0.00	60 10.49 3.29	5.21
SW	2 .35 .11	3 .52 .16	11 1.92 .60	14 2.45 .77	3 .52 .16	0 0.00 0.00	33 5.77 1.81	5.06
WSW	1 .17 .05	4 .70 .22	7 1.22 .38	9 1.57 .49	0 0.00 0.00	0 0.00 0.00	21 3.67 1.15	4.48
W	0 0.00 0.00	3 .52 .16	13 2.27 .71	6 1.05 .33	2 .35 .11	1 .17 .05	25 4.37 1.37	4.89
WNW	0 0.00 0.00	9 1.57 .49	7 1.22 .38	17 2.97 .93	4 .70 .22	0 0.00 0.00	37 6.47 2.03	5.21
NW	1 .17 .05	0 0.00 0.00	7 1.22 .38	14 2.45 .77	0 0.00 0.00	0 0.00 0.00	22 3.85 1.21	5.30
NNW	0 0.00 0.00	2 .35 .11	5 .87 .27	12 2.10 .66	2 .35 .11	0 0.00 0.00	21 3.67 1.15	5.74
N	0 0.00 0.00	1 .17 .05	6 1.05 .33	14 2.45 .77	0 0.00 0.00	0 0.00 0.00	21 3.67 1.15	5.77
CALM	6 1.05 .33						6 1.05 .33	CALM
TOTAL	19 3.32 1.04	55 9.62 3.01	172 30.07 9.42	296 51.75 16.22	29 5.07 1.59	1 .17 .05	572 100.00 31.34	5.17

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 11.50.13.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	1 .52 .05	0 0.00 0.00	3 1.56 .16	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 2.08 .22	3.40
NE	0 0.00 0.00	1 .52 .05	0 0.00 0.00	2 1.04 .11	0 0.00 0.00	0 0.00 0.00	3 1.56 .16	4.17
ENE	1 .52 .05	0 0.00 0.00	5 2.60 .27	1 .52 .05	0 0.00 0.00	0 0.00 0.00	7 3.65 .38	4.10
E	0 0.00 0.00	1 .52 .05	3 1.56 .16	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 2.08 .22	3.50
ESE	0 0.00 0.00	1 .52 .05	1 .52 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.04 .11	3.20
SE	0 0.00 0.00	2 1.04 .11	0 0.00 0.00	1 .52 .05	0 0.00 0.00	0 0.00 0.00	3 1.56 .16	4.07
SSE	0 0.00 0.00	1 .52 .05	5 2.60 .27	2 1.04 .11	0 0.00 0.00	0 0.00 0.00	8 4.17 .44	4.55
S	1 .52 .05	4 2.08 .22	9 4.69 .49	26 13.54 1.42	0 0.00 0.00	0 0.00 0.00	40 20.83 2.19	4.84
SSW	2 1.04 .11	0 0.00 0.00	4 2.08 .22	16 8.33 .88	0 0.00 0.00	0 0.00 0.00	22 11.46 1.21	5.53
SW	0 0.00 0.00	0 0.00 0.00	5 2.60 .27	14 7.29 .77	1 .52 .05	0 0.00 0.00	20 10.42 1.10	5.69
WSW	0 0.00 0.00	2 1.04 .11	7 3.65 .38	17 8.85 .93	6 3.12 .33	0 0.00 0.00	32 16.67 1.75	6.14
W	0 0.00 0.00	0 0.00 0.00	6 3.12 .33	4 2.08 .22	0 0.00 0.00	0 0.00 0.00	10 5.21 .55	4.92
WNW	1 .52 .05	1 .52 .05	4 2.08 .22	2 1.04 .11	0 0.00 0.00	0 0.00 0.00	8 4.17 .44	4.01
NW	0 0.00 0.00	1 .52 .05	8 4.17 .44	6 3.12 .33	0 0.00 0.00	0 0.00 0.00	15 7.81 .82	4.71
NNW	0 0.00 0.00	1 .52 .05	5 2.60 .27	3 1.56 .16	0 0.00 0.00	0 0.00 0.00	9 4.69 .49	4.57
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 1.56 .16	1 .52 .05	0 0.00 0.00	4 2.08 .22	4.70
CALM	1 .52 .05						1 .52 .05	CALM
TOTAL	7 3.65 .38	15 7.81 .82	65 33.85 3.56	97 50.52 5.32	8 4.17 .44	0 0.00 0.00	192 100.00 10.52	5.05

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - OCTOBER

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 11.50.13.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	0 0.00 0.00	9 2.51 .49	3 .84 .16	1 .28 .05	0 0.00 0.00	13 3.62 .71	4.82
NE	0 0.00 0.00	0 0.00 0.00	14 3.90 .77	2 .56 .11	0 0.00 0.00	0 0.00 0.00	16 4.46 .88	4.16
ENE	1 .28 .05	0 0.00 0.00	1 .28 .05	2 .56 .11	0 0.00 0.00	0 0.00 0.00	4 1.11 .22	4.12
E	0 0.00 0.00	2 .56 .11	6 1.67 .33	3 .84 .16	0 0.00 0.00	0 0.00 0.00	11 3.06 .60	4.32
ESE	0 0.00 0.00	0 0.00 0.00	4 1.11 .22	8 2.23 .44	0 0.00 0.00	0 0.00 0.00	12 3.34 .66	5.27
SE	1 .28 .05	0 0.00 0.00	5 1.39 .27	15 4.18 .82	0 0.00 0.00	0 0.00 0.00	21 5.85 1.15	5.33
SSE	0 0.00 0.00	2 .56 .11	8 2.23 .44	21 5.85 1.15	4 1.11 .22	0 0.00 0.00	35 9.75 1.92	5.58
S	0 0.00 0.00	0 0.00 0.00	20 5.57 1.10	40 11.14 2.19	3 .84 .16	0 0.00 0.00	63 17.55 3.45	5.63
SSW	1 .28 .05	3 .84 .16	8 2.23 .44	19 5.29 1.04	4 1.11 .22	0 0.00 0.00	35 9.75 1.92	5.44
SW	0 0.00 0.00	1 .28 .05	9 2.51 .49	12 3.34 .66	5 1.39 .27	0 0.00 0.00	27 7.52 1.48	5.83
WSW	1 .28 .05	2 .56 .11	8 2.23 .44	16 4.46 .88	2 .56 .11	1 .28 .05	30 8.36 1.64	5.66
W	2 .56 .11	1 .28 .05	8 2.23 .44	15 4.18 .82	4 1.11 .22	1 .28 .05	31 8.64 1.70	5.51
WNW	0 0.00 0.00	0 0.00 0.00	9 2.51 .49	9 2.51 .49	0 0.00 0.00	0 0.00 0.00	18 5.01 .99	5.40
NW	0 0.00 0.00	0 0.00 0.00	1 .28 .05	9 2.51 .49	1 .28 .05	0 0.00 0.00	11 3.06 .60	6.16
NNW	0 0.00 0.00	1 .28 .05	1 .28 .05	18 5.01 .99	0 0.00 0.00	0 0.00 0.00	20 5.57 1.10	5.95
N	1 .28 .05	3 .84 .16	4 1.11 .22	3 .84 .16	1 .28 .05	0 0.00 0.00	12 3.34 .66	4.33
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	7 1.95 .38	15 4.18 .82	115 32.03 6.30	195 54.32 10.68	25 6.96 1.37	2 .56 .11	359 100.00 19.67	5.41

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 11.50.13.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	3 .16	9 .47	43 2.24	10 .52	2 .10	0 0.00	67 3.50	4.13
NE	0 0.00	9 .47	30 1.56	9 .47	1 .05	0 0.00	49 2.56	4.16
ENE	2 .10	10 .52	19 .99	13 .68	0 0.00	0 0.00	44 2.30	4.04
E	2 .10	9 .47	15 .78	11 .57	0 0.00	0 0.00	37 1.93	4.05
ESE	4 .21	7 .37	19 .99	13 .68	0 0.00	0 0.00	43 2.24	4.03
SE	1 .05	11 .57	44 2.30	55 2.87	0 0.00	0 0.00	111 5.79	4.95
SSE	3 .16	18 .94	55 2.87	118 6.16	8 .42	0 0.00	202 10.54	5.33
S	7 .37	27 1.41	98 5.11	173 9.02	25 1.30	0 0.00	330 17.21	5.28
SSW	7 .37	27 1.41	63 3.29	102 5.32	10 .52	0 0.00	209 10.90	4.98
SW	4 .21	18 .94	52 2.71	73 3.81	12 .63	0 0.00	159 8.29	5.07
WSW	4 .21	14 .73	32 1.67	49 2.56	8 .42	1 .05	108 5.63	5.20
W	3 .16	13 .68	52 2.71	40 2.09	12 .63	2 .10	122 6.36	4.99
WNW	1 .05	13 .68	38 1.98	52 2.71	24 1.25	0 0.00	128 6.68	5.63
NW	3 .16	7 .37	42 2.19	64 3.34	7 .37	0 0.00	123 6.42	5.19
NNW	1 .05	6 .31	26 1.36	52 2.71	8 .42	0 0.00	93 4.85	5.40
N	3 .16	5 .26	29 1.51	40 2.09	8 .42	0 0.00	85 4.43	5.43
CALM	7 .37						7 .37	CALM
TOTAL	55 2.87	203 10.59	657 34.27	874 45.59	125 6.52	3 .16	1917 100.00	5.05

NUMBER OF VALID OBSERVATIONS 1917 85.89 PCT.
NUMBER OF INVALID OBSERVATIONS 315 14.11 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-60 (Continued) (Sheet 41 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - NOVEMBER

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 13.23.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	1 1.96 .05	1 1.96 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.92 .09	3.40
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	0 0.00 0.00	2 3.92 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.92 .09	4.65
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ESE	0 0.00 0.00	1 1.96 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.96 .05	3.00
SE	0 0.00 0.00	1 1.96 .05	1 1.96 .05	1 1.96 .05	0 0.00 0.00	0 0.00 0.00	3 5.88 .14	3.67
SSE	0 0.00 0.00	0 0.00 0.00	1 1.96 .05	1 1.96 .05	2 3.92 .09	0 0.00 0.00	4 7.84 .19	6.72
S	0 0.00 0.00	0 0.00 0.00	1 1.96 .05	0 0.00 0.00	1 1.96 .05	0 0.00 0.00	2 3.92 .09	6.05
SSW	1 1.96 .05	0 0.00 0.00	3 5.88 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 7.84 .19	3.38
SW	0 0.00 0.00	1 1.96 .05	1 1.96 .05	3 5.88 .14	2 3.92 .09	0 0.00 0.00	7 13.73 .33	6.01
WSW	1 1.96 .05	1 1.96 .05	0 0.00 0.00	1 1.96 .05	0 0.00 0.00	0 0.00 0.00	3 5.88 .14	2.83
W	0 0.00 0.00	3 5.88 .14	1 1.96 .05	5 9.80 .23	2 3.92 .09	0 0.00 0.00	11 21.57 .51	5.39
WNW	0 0.00 0.00	3 5.88 .14	0 0.00 0.00	2 3.92 .09	1 1.96 .05	0 0.00 0.00	6 11.76 .28	4.48
NW	0 0.00 0.00	0 0.00 0.00	2 3.92 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.92 .09	4.75
NNW	0 0.00 0.00	0 0.00 0.00	3 5.88 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 5.88 .14	3.97
N	0 0.00 0.00	0 0.00 0.00	1 1.96 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.96 .05	4.90
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	2 3.92 .09	11 21.57 .51	17 33.33 .79	13 25.49 .61	8 15.69 .37	0 0.00 0.00	51 100.00 2.38	4.63

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 13.23.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	0 0.00 0.00	1 1.72 .05	1 1.72 .05	0 0.00 0.00	0 0.00 0.00	2 3.45 .09	4.30
NE	0 0.00 0.00	0 0.00 0.00	1 1.72 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.72 .05	4.20
ENE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
E	0 0.00 0.00	0 0.00 0.00	1 1.72 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.72 .05	3.20
ESE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SE	1 1.72 .05	0 0.00 0.00	3 5.17 .14	1 1.72 .05	0 0.00 0.00	0 0.00 0.00	5 8.62 .23	3.80
SSE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.72 .05	0 0.00 0.00	1 1.72 .05	7.70
S	0 0.00 0.00	0 0.00 0.00	4 6.90 .19	1 1.72 .05	0 0.00 0.00	0 0.00 0.00	5 8.62 .23	4.66
SSW	0 0.00 0.00	2 3.45 .09	5 8.62 .23	0 0.00 0.00	1 1.72 .05	0 0.00 0.00	8 13.79 .37	4.11
SW	0 0.00 0.00	0 0.00 0.00	2 3.45 .09	3 5.17 .14	0 0.00 0.00	0 0.00 0.00	5 8.62 .23	5.14
WSW	1 1.72 .05	1 1.72 .05	2 3.45 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 6.90 .19	2.57
W	1 1.72 .05	4 6.90 .19	2 3.45 .09	2 3.45 .09	0 0.00 0.00	0 0.00 0.00	9 15.52 .42	3.58
WNW	0 0.00 0.00	1 1.72 .05	1 1.72 .05	7 12.07 .33	0 0.00 0.00	0 0.00 0.00	9 15.52 .42	5.38
NW	0 0.00 0.00	1 1.72 .05	2 3.45 .09	1 1.72 .05	0 0.00 0.00	0 0.00 0.00	4 6.90 .19	4.17
NNW	0 0.00 0.00	1 1.72 .05	1 1.72 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.45 .09	3.70
N	0 0.00 0.00	0 0.00 0.00	1 1.72 .05	1 1.72 .05	0 0.00 0.00	0 0.00 0.00	2 3.45 .09	5.10
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	3 5.17 .14	10 17.24 .47	26 44.83 1.21	17 29.31 .79	2 3.45 .09	0 0.00 0.00	58 100.00 2.70	4.31

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - NOVEMBER

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 13.23.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	2 3.39 .09	3 5.08 .14	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 8.47 .23	3.56
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	1 1.69 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.69 .05	2.90
E	1 1.69 .05	2 3.39 .09	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 5.08 .14	2.10
ESE	0 0.00 0.00	0 0.00 0.00	1 1.69 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.69 .05	3.60
SE	0 0.00 0.00	0 0.00 0.00	2 3.39 .09	2 3.39 .09	0 0.00 0.00	0 0.00 0.00	4 6.78 .19	4.95
SSE	1 1.69 .05	0 0.00 0.00	1 1.69 .05	0 0.00 0.00	2 3.39 .09	0 0.00 0.00	4 6.78 .19	5.52
S	0 0.00 0.00	1 1.69 .05	0 0.00 0.00	1 1.69 .05	1 1.69 .05	0 0.00 0.00	3 5.08 .14	5.37
SSW	1 1.69 .05	1 1.69 .05	3 5.08 .14	1 1.69 .05	1 1.69 .05	0 0.00 0.00	7 11.86 .33	3.83
SW	0 0.00 0.00	1 1.69 .05	0 0.00 0.00	2 3.39 .09	0 0.00 0.00	0 0.00 0.00	3 5.08 .14	5.90
WSW	1 1.69 .05	0 0.00 0.00	1 1.69 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.39 .09	2.10
W	0 0.00 0.00	1 1.69 .05	2 3.39 .09	4 6.78 .19	0 0.00 0.00	0 0.00 0.00	7 11.86 .33	5.34
WNW	0 0.00 0.00	3 5.08 .14	1 1.69 .05	5 8.47 .23	0 0.00 0.00	0 0.00 0.00	9 15.25 .42	4.56
NW	0 0.00 0.00	1 1.69 .05	1 1.69 .05	2 3.39 .09	0 0.00 0.00	0 0.00 0.00	4 6.78 .19	4.45
NNW	0 0.00 0.00	0 0.00 0.00	1 1.69 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.69 .05	3.70
N	0 0.00 0.00	0 0.00 0.00	4 6.78 .19	1 1.69 .05	0 0.00 0.00	0 0.00 0.00	5 8.47 .23	4.86
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	4 6.78 .19	13 22.03 .61	20 33.90 .93	18 30.51 .84	4 6.78 .19	0 0.00 0.00	59 100.00 2.75	4.43

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 13.23.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	47 5.22 2.19	36 4.00 1.68	8 .89 .37	0 0.00 0.00	0 0.00 0.00	91 10.11 4.24	3.41
NE	4 .44 .19	40 4.44 1.86	51 5.67 2.38	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	95 10.56 4.43	2.98
ENE	3 .33 .14	23 2.56 1.07	18 2.00 .84	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	44 4.89 2.05	2.80
E	0 0.00 0.00	16 1.78 .75	25 2.78 1.17	6 .67 .28	0 0.00 0.00	0 0.00 0.00	47 5.22 2.19	3.84
ESE	1 .11 .05	12 1.33 .56	15 1.67 .70	13 1.44 .61	1 .11 .05	0 0.00 0.00	42 4.67 1.96	4.13
SE	1 .11 .05	21 2.33 .98	24 2.67 1.12	10 1.11 .47	0 0.00 0.00	0 0.00 0.00	56 6.22 2.61	3.71
SSE	1 .11 .05	7 .78 .33	22 2.44 1.03	18 2.00 .84	0 0.00 0.00	0 0.00 0.00	48 5.33 2.24	4.38
S	1 .11 .05	13 1.44 .61	23 2.56 1.07	14 1.56 .65	3 .33 .14	0 0.00 0.00	54 6.00 2.52	4.23
SSW	0 0.00 0.00	18 2.00 .84	16 1.78 .75	13 1.44 .61	1 .11 .05	0 0.00 0.00	48 5.33 2.24	3.96
SW	2 .22 .09	9 1.00 .42	21 2.33 .98	9 1.00 .42	2 .22 .09	0 0.00 0.00	43 4.78 2.00	4.11
WSW	1 .11 .05	13 1.44 .61	13 1.44 .61	1 .11 .05	4 .44 .19	0 0.00 0.00	32 3.56 1.49	3.82
W	2 .22 .09	16 1.78 .75	32 3.56 1.49	15 1.67 .70	6 .67 .28	0 0.00 0.00	71 7.89 3.31	4.24
WNW	4 .44 .19	11 1.22 .51	20 2.22 .93	36 4.00 1.68	2 .22 .09	0 0.00 0.00	73 8.11 3.40	4.41
NW	3 .33 .14	11 1.22 .51	31 3.44 1.45	10 1.11 .47	2 .22 .09	0 0.00 0.00	57 6.33 2.66	4.11
NNW	1 .11 .05	13 1.44 .61	18 2.00 .84	6 .67 .28	0 0.00 0.00	0 0.00 0.00	38 4.22 1.77	3.73
N	3 .33 .14	16 1.78 .75	29 3.22 1.35	13 1.44 .61	0 0.00 0.00	0 0.00 0.00	61 6.78 2.84	3.76
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	27 3.00 1.26	286 31.78 13.33	394 43.78 18.37	172 19.11 8.02	21 2.33 .98	0 0.00 0.00	900 100.00 41.96	3.85

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-60 (Continued) (Sheet 42 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - NOVEMBER

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79, 13.23.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	3 / .43 / .14	20 / 2.87 / .93	6 / .86 / .28	2 / .29 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	31 / 4.45 / 1.45	2.82
NE	1 / .14 / .05	11 / 1.58 / .51	4 / .57 / .19	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	16 / 2.30 / .75	2.53
ENE	3 / .43 / .14	13 / 1.87 / .61	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	16 / 2.30 / .75	2.05
E	1 / .14 / .05	9 / 1.29 / .42	5 / .72 / .23	2 / .29 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	17 / 2.44 / .79	2.91
ESE	4 / .57 / .19	14 / 2.01 / .65	17 / 2.44 / .79	4 / .57 / .19	0 / 0.00 / 0.00	0 / 0.00 / 0.00	39 / 5.60 / 1.82	3.23
SE	2 / .29 / .09	30 / 4.31 / 1.40	29 / 4.17 / 1.35	2 / .29 / .09	3 / .43 / .14	0 / 0.00 / 0.00	66 / 9.48 / 3.08	3.51
SSE	1 / .14 / .05	22 / 3.16 / 1.03	49 / 7.04 / 2.28	14 / 2.01 / .65	0 / 0.00 / 0.00	0 / 0.00 / 0.00	86 / 12.36 / 4.01	3.84
S	2 / .29 / .09	31 / 4.45 / 1.45	66 / 9.48 / 3.08	10 / 1.44 / .47	0 / 0.00 / 0.00	0 / 0.00 / 0.00	109 / 15.66 / 5.08	3.63
SSW	2 / .29 / .09	13 / 1.87 / .61	40 / 5.75 / 1.86	13 / 1.87 / .61	1 / .14 / .05	0 / 0.00 / 0.00	69 / 9.91 / 3.22	3.97
SW	1 / .14 / .05	23 / 3.30 / 1.07	19 / 2.73 / .89	13 / 1.87 / .61	2 / .29 / .09	0 / 0.00 / 0.00	58 / 8.33 / 2.70	3.77
WSW	0 / 0.00 / 0.00	10 / 1.44 / .47	11 / 1.58 / .51	2 / .29 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	23 / 3.30 / 1.07	3.27
W	5 / .72 / .23	8 / 1.15 / .37	25 / 3.59 / 1.17	4 / .57 / .19	0 / 0.00 / 0.00	0 / 0.00 / 0.00	42 / 6.03 / 1.96	3.53
WNW	3 / .43 / .14	18 / 2.59 / .84	18 / 2.59 / .84	6 / .86 / .28	0 / 0.00 / 0.00	0 / 0.00 / 0.00	45 / 6.47 / 2.10	3.32
NW	3 / .43 / .14	16 / 2.30 / .75	11 / 1.58 / .51	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	30 / 4.31 / 1.40	2.63
NNW	4 / .57 / .19	12 / 1.72 / .56	8 / 1.15 / .37	3 / .43 / .14	0 / 0.00 / 0.00	0 / 0.00 / 0.00	27 / 3.88 / 1.26	3.21
N	1 / .14 / .05	9 / 1.29 / .42	10 / 1.44 / .47	1 / .14 / .05	1 / .14 / .05	0 / 0.00 / 0.00	22 / 3.16 / 1.03	3.34
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	36 / 5.17 / 1.68	259 / 37.21 / 12.07	318 / 45.69 / 14.83	76 / 10.92 / 3.54	7 / 1.01 / .33	0 / 0.00 / 0.00	696 / 100.00 / 32.45	3.45

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79, 13.23.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 / 0.00 / 0.00	6 / 7.23 / .28	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	6 / 7.23 / .28	1.95
NE	2 / 2.41 / .09	1 / 1.20 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 3.61 / .14	1.57
ENE	1 / 1.20 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.20 / .05	.70
E	1 / 1.20 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.20 / .05	.90
ESE	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
SE	1 / 1.20 / .05	14 / 16.87 / .65	1 / 1.20 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	16 / 19.28 / .75	2.08
SSE	2 / 2.41 / .09	19 / 22.89 / .89	3 / 3.61 / .14	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	24 / 28.92 / 1.12	2.38
S	2 / 2.41 / .09	9 / 10.84 / .42	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	11 / 13.25 / .51	1.75
SSW	3 / 3.61 / .14	2 / 2.41 / .09	4 / 4.82 / .19	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	9 / 10.84 / .42	2.49
SW	0 / 0.00 / 0.00	2 / 2.41 / .09	3 / 3.61 / .14	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 6.02 / .23	3.20
WSW	2 / 2.41 / .09	1 / 1.20 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	3 / 3.61 / .14	1.50
W	0 / 0.00 / 0.00	1 / 1.20 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.20 / .05	1.80
WNW	1 / 1.20 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	1 / 1.20 / .05	.90
NW	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
NNW	0 / 0.00 / 0.00	2 / 2.41 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	2 / 2.41 / .09	2.10
N	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0.00
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	15 / 18.07 / .70	57 / 68.67 / 2.66	11 / 13.25 / .51	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	83 / 100.00 / 3.87	2.15

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - NOVEMBER

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79, 13.23.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	6 / 2.01 / .28	7 / 2.35 / .33	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	13 / 4.36 / .61	1.71
NE	5 / 1.68 / .23	4 / 1.34 / .19	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	9 / 3.02 / .42	1.49
ENE	3 / 1.01 / .14	1 / .34 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	4 / 1.34 / .19	1.55
E	6 / 2.01 / .28	2 / .67 / .09	1 / .34 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	9 / 3.02 / .42	1.64
ESE	8 / 2.68 / .37	5 / 1.68 / .23	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	13 / 4.36 / .61	1.44
SE	8 / 2.68 / .37	11 / 3.69 / .51	19 / 6.38 / .89	3 / 1.01 / .14	0 / 0.00 / 0.00	0 / 0.00 / 0.00	41 / 13.76 / 1.91	2.99
SSE	4 / 1.34 / .19	25 / 8.39 / 1.17	27 / 9.06 / 1.26	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	56 / 18.79 / 2.61	2.93
S	0 / 0.00 / 0.00	13 / 4.36 / .61	31 / 10.40 / 1.45	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	44 / 14.77 / 2.05	3.42
SSW	2 / .67 / .09	9 / 3.02 / .42	19 / 6.38 / .89	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	30 / 10.07 / 1.40	3.21
SW	2 / .67 / .09	11 / 3.69 / .51	5 / 1.68 / .23	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	18 / 6.04 / .84	2.74
WSW	0 / 0.00 / 0.00	4 / 1.34 / .19	1 / .34 / .05	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 1.68 / .23	2.74
W	2 / .67 / .09	7 / 2.35 / .33	9 / 3.02 / .42	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	18 / 6.04 / .84	2.73
WNW	0 / 0.00 / 0.00	12 / 4.03 / .56	4 / 1.34 / .19	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	16 / 5.37 / .75	2.56
NW	1 / .34 / .05	5 / 1.68 / .23	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	6 / 2.01 / .28	2.00
NNW	1 / .34 / .05	10 / 3.36 / .47	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	11 / 3.69 / .51	2.08
N	1 / .34 / .05	2 / .67 / .09	2 / .67 / .09	0 / 0.00 / 0.00	0 / 0.00 / 0.00	0 / 0.00 / 0.00	5 / 1.68 / .23	2.46
CALM	0 / 0.00 / 0.00						0 / 0.00 / 0.00	CALM
TOTAL	49 / 16.44 / 2.28	128 / 42.95 / 5.97	118 / 39.60 / 5.50	3 / 1.01 / .14	0 / 0.00 / 0.00	0 / 0.00 / 0.00	298 / 100.00 / 13.89	2.71

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79, 13.23.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	9 / .42	83 / 3.87	48 / 2.24	11 / .51	0 / 0.00	0 / 0.00	151 / 7.03	3.11
NE	12 / .56	56 / 2.61	56 / 2.61	0 / 0.00	0 / 0.00	0 / 0.00	124 / 5.78	2.79
ENE	10 / .47	38 / 1.77	20 / .93	0 / 0.00	0 / 0.00	0 / 0.00	68 / 3.17	2.58
E	9 / .42	29 / 1.35	32 / 1.49	8 / .37	0 / 0.00	0 / 0.00	78 / 3.63	3.27
ESE	13 / .61	32 / 1.49	33 / 1.54	17 / .79	1 / .05	0 / 0.00	96 / 4.47	3.38
SE	13 / .61	77 / 3.59	79 / 3.68	19 / .89	3 / .14	0 / 0.00	191 / 6.90	3.38
SSE	9 / .42	73 / 3.40	103 / 4.80	33 / 1.54	5 / .23	0 / 0.00	223 / 10.39	3.67
S	5 / .23	67 / 3.12	125 / 5.82	26 / 1.21	5 / .23	0 / 0.00	228 / 10.62	3.71
SSW	9 / .42	45 / 2.10	90 / 4.19	27 / 1.26	4 / .19	0 / 0.00	175 / 8.15	3.75
SW	5 / .23	47 / 2.19	51 / 2.38	30 / 1.40	6 / .28	0 / 0.00	139 / 6.47	3.93
WSW	6 / .28	30 / 1.40	28 / 1.30	4 / .19	4 / .19	0 / 0.00	72 / 3.35	3.32
W	10 / .47	40 / 1.86	71 / 3.31	30 / 1.40	8 / .37	0 / 0.00	159 / 7.41	3.96
WNW	8 / .37	48 / 2.24	44 / 2.05	57 / 2.65	3 / .14	0 / 0.00	160 / 7.45	4.15
NW	7 / .33	34 / 1.58	47 / 2.19	13 / .61	2 / .09	0 / 0.00	103 / 4.80	3.58
NNW	6 / .28	38 / 1.77	31 / 1.44	9 / .42	0 / 0.00	0 / 0.00	84 / 3.91	3.31
N	5 / .23	27 / 1.26	47 / 2.19	16 / .75	1 / .05	0 / 0.00	96 / 4.47	3.69
CALM	0 / 0.00						0 / 0.00	CALM
TOTAL	136 / 6.33	764 / 35.58	905 / 42.15	300 / 13.97	42 / 1.96	0 / 0.00	2147 / 100.00	3.55

NUMBER OF VALID OBSERVATIONS 2147 99.40 PCT.
NUMBER OF INVALID OBSERVATIONS 13 .60 PCT.
TOTAL NUMBER OF OBSERVATIONS 2160 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-60 (Continued) (Sheet 43 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - NOVEMBER

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 13.23.13.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	0 0.00 0.00	1 2.13 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.13 .05	3.20
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	0 0.00 0.00	1 2.13 .05	1 2.13 .05	0 0.00 0.00	0 0.00 0.00	2 4.26 .10	4.50
E	0 0.00 0.00	0 0.00 0.00	1 2.13 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.13 .05	5.00
ESE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SE	0 0.00 0.00	0 0.00 0.00	1 2.13 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.13 .05	4.30
SSE	0 0.00 0.00	1 2.13 .05	1 2.13 .05	1 2.13 .05	2 4.26 .10	1 2.13 .05	6 12.77 .29	6.67
S	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.13 .05	0 0.00 0.00	1 2.13 .05	9.50
SSW	0 0.00 0.00	1 2.13 .05	2 4.26 .10	1 2.13 .05	0 0.00 0.00	0 0.00 0.00	4 8.51 .19	3.47
SW	0 0.00 0.00	1 2.13 .05	1 2.13 .05	0 0.00 0.00	3 6.38 .15	1 2.13 .05	6 12.77 .29	7.55
WSW	1 2.13 .05	2 4.26 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 6.38 .15	1.70
W	0 0.00 0.00	1 2.13 .05	1 2.13 .05	1 2.13 .05	2 4.26 .10	1 2.13 .05	6 12.77 .29	6.55
WNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.13 .05	3 6.38 .15	2 4.26 .10	6 12.77 .29	9.27
NW	0 0.00 0.00	2 4.26 .10	1 2.13 .05	2 4.26 .10	0 0.00 0.00	0 0.00 0.00	5 10.64 .24	4.22
NNW	0 0.00 0.00	0 0.00 0.00	2 4.26 .10	2 4.26 .10	0 0.00 0.00	0 0.00 0.00	4 8.51 .19	5.00
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.13 .05	0 0.00 0.00	0 0.00 0.00	1 2.13 .05	5.10
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	1 2.13 .05	8 17.02 .39	12 25.53 .58	10 21.28 .48	11 23.40 .53	5 10.64 .24	47 100.00 2.27	5.41

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 13.23.13.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	0 0.00 0.00	2 3.39 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.39 .10	4.25
NE	0 0.00 0.00	0 0.00 0.00	2 3.39 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.39 .10	3.60
ENE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ESE	0 0.00 0.00	0 0.00 0.00	1 1.69 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.69 .05	4.70
SE	0 0.00 0.00	0 0.00 0.00	1 1.69 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.69 .05	3.60
SSE	0 0.00 0.00	1 1.69 .05	1 1.69 .05	0 0.00 0.00	1 1.69 .05	0 0.00 0.00	3 5.08 .15	4.80
S	0 0.00 0.00	0 0.00 0.00	1 1.69 .05	0 0.00 0.00	2 3.39 .10	0 0.00 0.00	3 5.08 .15	7.53
SSW	0 0.00 0.00	1 1.69 .05	6 10.17 .29	2 3.39 .10	1 1.69 .05	0 0.00 0.00	10 16.95 .48	4.77
SW	0 0.00 0.00	0 0.00 0.00	2 3.39 .10	2 3.39 .10	2 3.39 .10	0 0.00 0.00	6 10.17 .29	6.28
WSW	0 0.00 0.00	1 1.69 .05	0 0.00 0.00	2 3.39 .10	0 0.00 0.00	0 0.00 0.00	3 5.08 .15	4.27
W	1 1.69 .05	1 1.69 .05	6 10.17 .29	0 0.00 0.00	1 1.69 .05	0 0.00 0.00	9 15.25 .44	4.16
WNW	1 1.69 .05	1 1.69 .05	1 1.69 .05	2 3.39 .10	5 8.47 .24	0 0.00 0.00	10 16.95 .48	6.53
NW	0 0.00 0.00	0 0.00 0.00	1 1.69 .05	3 5.08 .15	0 0.00 0.00	0 0.00 0.00	4 6.78 .19	6.50
NNW	0 0.00 0.00	2 3.39 .10	0 0.00 0.00	1 1.69 .05	1 1.69 .05	0 0.00 0.00	4 6.78 .19	4.80
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.69 .05	0 0.00 0.00	0 0.00 0.00	1 1.69 .05	6.00
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	2 3.39 .10	7 11.86 .34	24 40.68 1.16	13 22.03 .63	13 22.03 .63	0 0.00 0.00	59 100.00 2.85	5.31

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - NOVEMBER

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 13.23.13.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	2 3.51 .10	1 1.75 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 5.26 .15	3.20
NE	0 0.00 0.00	1 1.75 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.75 .05	1.70
ENE	0 0.00 0.00	1 1.75 .05	1 1.75 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.51 .10	3.25
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ESE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SE	1 1.75 .05	0 0.00 0.00	3 5.26 .15	1 1.75 .05	0 0.00 0.00	0 0.00 0.00	5 8.77 .24	4.30
SSE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.75 .05	1 1.75 .05	0 0.00 0.00	2 3.51 .10	7.50
S	1 1.75 .05	0 0.00 0.00	1 1.75 .05	0 0.00 0.00	1 1.75 .05	1 1.75 .05	4 7.02 .19	6.27
SSW	0 0.00 0.00	2 3.51 .10	2 3.51 .10	2 3.51 .10	0 0.00 0.00	0 0.00 0.00	6 10.53 .29	4.15
SW	0 0.00 0.00	0 0.00 0.00	1 1.75 .05	0 0.00 0.00	3 5.26 .15	0 0.00 0.00	4 7.02 .19	8.27
WSW	1 1.75 .05	0 0.00 0.00	1 1.75 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 3.51 .10	2.50
W	0 0.00 0.00	0 0.00 0.00	2 3.51 .10	2 3.51 .10	3 5.26 .15	0 0.00 0.00	7 12.28 .34	6.64
WNW	0 0.00 0.00	2 3.51 .10	1 1.75 .05	3 5.26 .15	2 3.51 .10	1 1.75 .05	9 15.79 .44	6.40
NW	0 0.00 0.00	1 1.75 .05	0 0.00 0.00	3 5.26 .15	0 0.00 0.00	0 0.00 0.00	4 7.02 .19	5.92
NNW	0 0.00 0.00	0 0.00 0.00	1 1.75 .05	4 7.02 .19	0 0.00 0.00	0 0.00 0.00	5 8.77 .24	5.60
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 5.26 .15	0 0.00 0.00	0 0.00 0.00	3 5.26 .15	5.17
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	3 5.26 .15	9 15.79 .44	14 24.56 .68	19 33.33 .92	10 17.54 .48	2 3.51 .10	57 100.00 2.76	5.50

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 13.23.13.

CALLAWAY GENERATING STATION
FULTON, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	23 2.63 1.11	47 5.37 2.27	14 1.60 .68	1 .11 .05	0 0.00 0.00	85 9.71 4.11	3.87
NE	1 .11 .05	25 2.86 1.21	52 5.94 2.52	13 1.49 .63	0 0.00 0.00	0 0.00 0.00	91 10.40 4.40	3.81
ENE	1 .11 .05	13 1.49 .63	17 1.94 .82	7 .80 .34	0 0.00 0.00	0 0.00 0.00	38 4.34 1.84	3.76
E	0 0.00 0.00	5 .57 .24	8 .91 .39	23 2.63 1.11	2 .23 .10	0 0.00 0.00	38 4.34 1.84	5.31
ESE	1 .11 .05	6 .69 .29	19 2.17 .92	13 1.49 .63	3 .34 .15	0 0.00 0.00	42 4.80 2.03	4.63
SE	0 0.00 0.00	4 .46 .19	19 2.17 .92	11 1.26 .53	5 .57 .24	3 .34 .15	42 4.80 2.03	5.36
SSE	1 .11 .05	6 .69 .29	26 2.97 1.26	17 1.94 .82	6 .69 .29	0 0.00 0.00	56 6.40 2.71	5.07
S	0 0.00 0.00	5 .57 .24	16 1.83 .77	10 1.14 .48	14 1.60 .68	1 .11 .05	46 5.26 2.23	5.71
SSW	0 0.00 0.00	6 .69 .29	18 2.06 .87	17 1.94 .82	7 .80 .34	0 0.00 0.00	48 5.49 2.32	5.26
SW	1 .11 .05	5 .57 .24	20 2.29 .97	12 1.37 .58	6 .69 .29	2 .23 .10	46 5.26 2.23	5.33
WSW	1 .11 .05	2 .23 .10	13 1.49 .63	11 1.26 .53	0 0.00 0.00	6 .69 .29	33 3.77 1.60	5.71
W	0 0.00 0.00	5 .57 .24	12 1.37 .58	25 2.86 1.21	10 1.14 .48	4 .46 .19	56 6.40 2.71	6.18
WNW	3 .34 .15	9 1.03 .44	9 1.03 .44	28 3.20 1.35	28 3.20 1.35	4 .46 .19	81 9.26 3.92	6.48
NW	1 .11 .05	4 .46 .19	14 1.60 .68	23 2.63 1.11	17 1.94 .82	5 .57 .24	64 7.31 3.10	6.34
NNW	2 .23 .10	7 .80 .34	18 2.06 .87	11 1.26 .53	3 .34 .15	1 .11 .05	42 4.80 2.03	4.61
N	3 .34 .15	6 .69 .29	26 2.97 1.26	24 2.74 1.16	6 .69 .29	0 0.00 0.00	65 7.43 3.14	4.92
CALM	2 .23 .10						2 .23 .10	CALM
TOTAL	17 1.94 .82	131 14.97 6.34	334 38.17 16.16	259 29.60 12.53	108 12.34 5.22	26 2.97 1.26	875 100.00 42.33	5.10

KEY: XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-60 (Continued) (Sheet 44 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - NOVEMBER

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 13.23.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	WIND SPEED CATEGORIES (METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	5 .75 .24	15 2.25 .73	3 .45 .15	1 .15 .05	0 0.00 0.00	24 3.60 1.16	4.35
NE	0 0.00 0.00	3 .45 .15	13 1.95 .63	2 .30 .10	0 0.00 0.00	0 0.00 0.00	18 2.70 .87	3.94
ENE	0 0.00 0.00	2 .30 .10	3 .45 .15	4 .60 .19	0 0.00 0.00	0 0.00 0.00	9 1.35 .44	4.70
E	1 .15 .05	1 .15 .05	9 1.35 .44	6 .90 .29	0 0.00 0.00	0 0.00 0.00	17 2.55 .82	4.16
ESE	1 .15 .05	3 .45 .15	10 1.50 .48	10 1.50 .48	0 0.00 0.00	0 0.00 0.00	24 3.60 1.16	4.70
SE	0 0.00 0.00	4 .60 .19	10 1.50 .48	34 5.10 1.64	7 1.05 .34	3 .45 .15	58 8.70 2.81	6.06
SSE	0 0.00 0.00	3 .45 .15	17 2.55 .82	32 4.80 1.55	19 2.85 .92	0 0.00 0.00	71 10.64 3.43	6.17
S	1 .15 .05	2 .30 .10	23 3.45 1.11	63 9.45 3.05	16 2.40 .77	0 0.00 0.00	105 15.74 5.08	6.00
SSW	0 0.00 0.00	1 .15 .05	20 3.00 .97	41 6.15 1.98	20 3.00 .97	0 0.00 0.00	82 12.29 3.97	6.21
SW	0 0.00 0.00	2 .30 .10	15 2.25 .73	34 5.10 1.64	10 1.50 .48	3 .45 .15	64 9.60 3.10	6.22
WSW	0 0.00 0.00	4 .60 .19	11 1.65 .53	14 2.10 .68	1 .15 .05	0 0.00 0.00	30 4.50 1.45	4.95
W	1 .15 .05	2 .30 .10	5 .75 .24	10 1.50 .48	7 1.05 .34	0 0.00 0.00	25 3.75 1.21	5.76
WNW	0 0.00 0.00	4 .60 .19	7 1.05 .34	21 3.15 1.02	20 3.00 .97	0 0.00 0.00	52 7.80 2.52	6.48
NW	0 0.00 0.00	1 .15 .05	17 2.55 .82	19 2.85 .92	2 .30 .10	0 0.00 0.00	39 5.85 1.89	5.39
NNW	0 0.00 0.00	3 .45 .15	9 1.35 .44	9 1.35 .44	1 .15 .05	0 0.00 0.00	22 3.30 1.06	4.78
N	1 .15 .05	1 .15 .05	9 1.35 .44	10 1.50 .48	2 .30 .10	2 .30 .10	25 3.75 1.21	5.56
CALM	2 .30 .10						2 .30 .10	CALM
TOTAL	7 1.05 .34	41 6.15 1.98	193 28.94 9.34	312 46.78 15.09	106 15.89 5.13	8 1.20 .39	667 100.00 32.27	5.71

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 13.23.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	WIND SPEED CATEGORIES (METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	0 0.00 0.00	3 3.75 .15	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 3.75 .15	4.17
NE	0 0.00 0.00	0 0.00 0.00	3 3.75 .15	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 3.75 .15	4.70
ENE	0 0.00 0.00	0 0.00 0.00	2 2.50 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 2.50 .10	4.55
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ESE	0 0.00 0.00	0 0.00 0.00	1 1.25 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.25 .05	4.90
SE	0 0.00 0.00	1 1.25 .05	4 5.00 .19	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 6.25 .24	3.72
SSE	0 0.00 0.00	1 1.25 .05	5 6.25 .24	1 1.25 .05	0 0.00 0.00	0 0.00 0.00	7 8.75 .34	4.40
S	1 1.25 .05	3 3.75 .15	6 7.50 .29	7 8.75 .34	0 0.00 0.00	0 0.00 0.00	17 21.25 .82	4.62
SSW	1 1.25 .05	2 2.50 .10	2 2.50 .10	2 2.50 .10	0 0.00 0.00	0 0.00 0.00	7 8.75 .34	3.80
SW	0 0.00 0.00	5 6.25 .24	6 7.50 .29	6 7.50 .29	5 6.25 .24	0 0.00 0.00	22 27.50 1.06	5.46
WSW	0 0.00 0.00	0 0.00 0.00	1 1.25 .05	1 1.25 .05	0 0.00 0.00	0 0.00 0.00	2 2.50 .10	4.75
W	0 0.00 0.00	0 0.00 0.00	1 1.25 .05	2 2.50 .10	0 0.00 0.00	0 0.00 0.00	3 3.75 .15	4.80
WNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NW	0 0.00 0.00	1 1.25 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.25 .05	1.80
NNW	1 1.25 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.25 .05	1.30
N	0 0.00 0.00	0 0.00 0.00	1 1.25 .05	1 1.25 .05	0 0.00 0.00	0 0.00 0.00	2 2.50 .10	5.00
CALM	4 5.00 .19						4 5.00 .19	CALM
TOTAL	7 8.75 .34	13 16.25 .63	35 43.75 1.69	20 25.00 .97	5 6.25 .24	0 0.00 0.00	80 100.00 3.87	4.40

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - NOVEMBER

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 13.23.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	WIND SPEED CATEGORIES (METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	1 .35 .05	5 1.77 .24	5 1.77 .24	0 0.00 0.00	0 0.00 0.00	11 3.90 .53	4.78
NE	0 0.00 0.00	1 .35 .05	7 2.48 .34	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 2.84 .39	3.60
ENE	0 0.00 0.00	1 .35 .05	2 .71 .10	2 .71 .10	0 0.00 0.00	0 0.00 0.00	5 1.77 .24	4.60
E	0 0.00 0.00	0 0.00 0.00	2 .71 .10	1 .35 .05	0 0.00 0.00	0 0.00 0.00	3 1.06 .15	4.43
ESE	0 0.00 0.00	0 0.00 0.00	3 1.06 .15	1 .35 .05	0 0.00 0.00	0 0.00 0.00	4 1.42 .19	4.32
SE	0 0.00 0.00	2 .71 .10	7 2.48 .34	10 3.55 .48	1 .35 .05	0 0.00 0.00	20 7.09 .97	5.19
SSE	1 .35 .05	5 1.77 .24	3 1.06 .15	18 6.38 .87	4 1.42 .19	0 0.00 0.00	31 10.99 1.50	5.92
S	0 0.00 0.00	1 .35 .05	5 1.77 .24	21 7.45 1.02	9 3.19 .44	0 0.00 0.00	36 12.77 1.74	6.41
SSW	0 0.00 0.00	0 0.00 0.00	9 3.19 .44	33 11.70 1.60	7 2.48 .34	0 0.00 0.00	49 17.38 2.37	6.28
SW	3 1.06 .15	2 .71 .10	8 2.84 .39	15 5.32 .73	9 3.19 .44	0 0.00 0.00	37 13.12 1.79	5.70
WSW	0 0.00 0.00	1 .35 .05	2 .71 .10	6 2.13 .29	5 1.77 .24	0 0.00 0.00	14 4.96 .68	6.31
W	1 .35 .05	0 0.00 0.00	0 0.00 0.00	1 .35 .05	1 .35 .05	0 0.00 0.00	3 1.06 .15	5.47
WNW	1 .35 .05	2 .71 .10	1 .35 .05	16 5.67 .77	9 3.19 .44	0 0.00 0.00	29 10.28 1.40	6.42
NW	0 0.00 0.00	1 .35 .05	1 .35 .05	6 2.13 .29	0 0.00 0.00	0 0.00 0.00	8 2.84 .39	5.64
NNW	0 0.00 0.00	0 0.00 0.00	3 1.06 .15	1 .35 .05	0 0.00 0.00	0 0.00 0.00	4 1.42 .19	4.20
N	0 0.00 0.00	1 .35 .05	1 .35 .05	10 3.55 .48	0 0.00 0.00	0 0.00 0.00	12 4.26 .58	5.45
CALM	8 2.84 .39						8 2.84 .39	CALM
TOTAL	14 4.96 .68	18 6.38 .87	59 20.92 2.85	146 51.77 7.06	45 15.96 2.18	0 0.00 0.00	282 100.00 13.64	5.63

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 13.23.13.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	WIND SPEED CATEGORIES (METERS PER SECOND) 0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00	31 1.50	75 3.62	22 1.06	2 .10	0 0.00	130 6.28	4.03
NE	1 .05	30 1.45	77 3.72	15 .72	0 0.00	0 0.00	123 5.94	3.82
ENE	1 .05	17 .82	26 1.26	14 .68	0 0.00	0 0.00	58 2.80	4.01
E	1 .05	6 .29	20 .97	30 1.45	2 .10	0 0.00	59 2.85	4.93
ESE	2 .10	9 .43	34 1.64	24 1.16	3 .14	0 0.00	72 3.48	4.64
SE	1 .05	11 .53	45 2.17	56 2.71	13 .63	6 .29	132 6.38	5.52
SSE	2 .10	17 .82	53 2.56	70 3.38	33 1.59	1 .05	176 8.51	5.70
S	3 .14	11 .53	52 2.51	101 4.88	43 2.08	2 .10	212 10.25	5.94
SSW	1 .05	13 .63	59 2.85	98 4.74	35 1.69	0 0.00	206 9.96	5.75
SW	4 .19	15 .72	53 2.56	69 3.33	38 1.84	6 .29	185 8.94	5.90
WSW	3 .14	10 .48	28 1.35	34 1.64	6 .29	6 .29	87 4.20	5.26
W	3 .14	9 .43	27 1.30	41 1.98	24 1.16	5 .24	109 5.27	5.91
WNW	5 .24	18 .87	19 .92	72 3.48	67 3.24	7 .34	188 9.09	6.56
NW	1 .05	10 .48	34 1.64	56 2.71	19 .92	5 .24	125 6.04	5.87
NNW	3 .14	12 .58	33 1.59	28 1.35	5 .24	1 .05	82 3.96	4.69
N	4 .19	8 .39	37 1.79	50 2.42	8 .39	2 .10	109 5.27	5.15
CALM	16 .77						16 .77	CALM
TOTAL	51 2.46	227 10.97	672 32.48	780 37.70	298 14.40	41 1.98	2069 100.00	5.38

NUMBER OF VALID OBSERVATIONS 2069 95.79 PCT.
NUMBER OF INVALID OBSERVATIONS 91 4.21 PCT.
TOTAL NUMBER OF OBSERVATIONS 2160 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-60 (Continued) (Sheet 45 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - DECEMBER

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 13.50.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	3 .53 .15	3 .53 .15	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 1.05 .31	1.40
NE	7 1.23 .36	1 .18 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 1.40 .41	1.25
ENE	1 .18 .05	1 .18 .05	1 .18 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 .53 .15	2.30
E	4 .70 .21	6 1.05 .31	5 .88 .26	4 .70 .21	2 .35 .10	1 .18 .05	22 3.85 1.13	4.09
ESE	1 .18 .05	14 2.45 .72	21 3.68 1.08	3 .53 .15	0 0.00 0.00	0 0.00 0.00	39 6.83 2.01	3.51
SE	4 .70 .21	24 4.20 1.23	68 11.91 3.50	19 3.33 .98	0 0.00 0.00	0 0.00 0.00	115 20.14 5.92	3.82
SSE	4 .70 .21	18 3.15 .93	35 6.13 1.80	12 2.10 .62	1 .18 .05	0 0.00 0.00	70 12.26 3.60	3.85
S	1 .18 .05	9 1.58 .46	33 5.78 1.70	12 2.10 .62	0 0.00 0.00	0 0.00 0.00	55 9.63 2.83	4.28
SSW	4 .70 .21	7 1.23 .36	34 5.95 1.75	2 .35 .10	3 .53 .15	0 0.00 0.00	50 8.76 2.57	3.91
SW	3 .53 .15	16 2.80 .82	18 3.15 .93	5 .88 .26	3 .53 .15	0 0.00 0.00	45 7.88 2.31	3.87
WSW	2 .35 .10	13 2.28 .67	7 1.23 .36	1 .18 .05	0 0.00 0.00	0 0.00 0.00	23 4.03 1.18	2.94
W	3 .53 .15	29 5.08 1.49	11 1.93 .57	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	43 7.53 2.21	2.60
WNW	2 .35 .10	19 3.33 .98	15 2.63 .77	9 1.58 .46	1 .18 .05	0 0.00 0.00	46 8.06 2.37	3.57
NW	3 .53 .15	8 1.40 .41	7 1.23 .36	2 .35 .10	0 0.00 0.00	0 0.00 0.00	20 3.50 1.03	3.00
NNW	5 .88 .26	7 1.23 .36	1 .18 .05	1 .18 .05	0 0.00 0.00	0 0.00 0.00	14 2.45 .72	2.24
N	4 .70 .21	5 .88 .26	3 .53 .15	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	12 2.10 .62	2.17
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	51 8.93 2.62	180 31.52 9.26	259 45.36 13.32	70 12.26 3.60	10 1.75 .51	1 .18 .05	571 100.00 29.37	3.55

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 13.50.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NE	3 7.50 .15	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 7.50 .15	1.37
ENE	1 2.50 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.50 .05	1.50
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ESE	1 2.50 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.50 .05	1.30
SE	0 0.00 0.00	14 35.00 .72	5 12.50 .26	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	19 47.50 .98	2.92
SSE	1 2.50 .05	2 5.00 .10	4 10.00 .21	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 17.50 .36	2.90
S	0 0.00 0.00	3 7.50 .15	1 2.50 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 10.00 .21	3.05
SSW	0 0.00 0.00	2 5.00 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 5.00 .10	2.15
SW	0 0.00 0.00	0 0.00 0.00	1 2.50 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.50 .05	4.00
WSW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
W	1 2.50 .05	1 2.50 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 5.00 .10	1.55
WNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	7 17.50 .36	22 55.00 1.13	11 27.50 .57	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	40 100.00 2.06	2.65

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - DECEMBER

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 13.50.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	1 .52 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .52 .05	1.50
NE	1 .52 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .52 .05	.80
ENE	0 0.00 0.00	2 1.04 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.04 .10	2.20
E	0 0.00 0.00	5 2.59 .26	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 2.59 .26	1.70
ESE	0 0.00 0.00	2 1.04 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.04 .10	2.25
SE	1 .52 .05	5 2.59 .26	26 13.47 1.34	1 .52 .05	0 0.00 0.00	0 0.00 0.00	33 17.10 1.70	3.54
SSE	0 0.00 0.00	15 7.77 .77	15 7.77 .77	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	30 15.54 1.54	2.87
S	1 .52 .05	16 8.29 .82	15 7.77 .77	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	32 16.58 1.65	2.92
SSW	0 0.00 0.00	6 3.11 .31	21 10.88 1.08	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	27 13.99 1.39	3.35
SW	1 .52 .05	6 3.11 .31	15 7.77 .77	1 .52 .05	0 0.00 0.00	0 0.00 0.00	23 11.92 1.18	3.58
WSW	1 .52 .05	6 3.11 .31	2 1.04 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 4.66 .46	2.61
W	2 1.04 .10	9 4.66 .46	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	11 5.70 .57	1.89
WNW	3 1.55 .15	3 1.55 .15	1 .52 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 3.63 .36	1.96
NW	1 .52 .05	3 1.55 .15	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 2.07 .21	1.67
NNW	2 1.04 .10	1 .52 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 1.55 .15	1.27
N	3 1.55 .15	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 1.55 .15	1.13
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	17 8.81 .87	79 40.93 4.06	95 49.22 4.89	2 1.04 .10	0 0.00 0.00	0 0.00 0.00	193 100.00 9.93	2.91

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 13.50.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	9 .44	12 .58	27 1.31	8 .39	0 0.00	0 0.00	56 2.72	3.35
NE	18 .87	10 .48	8 .39	3 .15	0 0.00	0 0.00	39 1.89	2.41
ENE	5 .24	15 .73	5 .24	0 0.00	0 0.00	0 0.00	25 1.21	2.27
E	13 .63	28 1.36	28 1.36	7 .34	2 .10	1 .05	79 3.83	3.25
ESE	5 .24	27 1.31	45 2.18	8 .39	0 0.00	0 0.00	85 4.12	3.63
SE	10 .48	62 3.01	166 8.05	49 2.38	1 .05	0 0.00	288 13.97	3.84
SSE	8 .39	49 2.38	84 4.07	22 1.07	4 .19	0 0.00	167 8.10	3.67
S	4 .19	42 2.04	68 3.30	24 1.16	1 .05	0 0.00	139 6.74	3.82
SSW	6 .29	31 1.50	79 3.83	14 .68	4 .19	0 0.00	134 6.50	3.75
SW	7 .34	38 1.84	58 2.81	32 1.55	12 .58	0 0.00	147 7.13	4.29
WSW	5 .24	32 1.55	34 1.65	21 1.02	5 .24	0 0.00	97 4.70	4.03
W	10 .48	62 3.01	64 3.10	47 2.28	4 .19	0 0.00	187 9.07	3.85
WNW	11 .53	39 1.89	78 3.78	86 4.17	15 .73	1 .05	230 11.15	4.69
NW	10 .48	26 1.26	48 2.33	66 3.20	4 .19	0 0.00	154 7.47	4.60
NNW	8 .39	22 1.07	51 2.47	26 1.26	0 0.00	0 0.00	107 5.19	3.91
N	14 .68	19 .92	57 2.76	33 1.60	3 .15	0 0.00	126 6.11	4.07
CALM	2 .10						2 .10	CALM
TOTAL	145 7.03	514 24.93	900 43.65	446 21.63	55 2.67	2 .10	2062 100.00	3.94

NUMBER OF VALID OBSERVATIONS 2062 92.38 PCT.
NUMBER OF INVALID OBSERVATIONS 170 7.62 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-60 (Continued) (Sheet 46 of 48)

WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - DECEMBER

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 13.50.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	3 .53 .15	3 .53 .15	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	6 1.05 .31	1.40
NE	7 1.23 .36	1 .18 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	8 1.40 .41	1.25
ENE	1 .18 .05	1 .18 .05	1 .18 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 .53 .15	2.30
E	4 .70 .21	6 1.05 .31	5 .88 .26	4 .70 .21	2 .35 .10	1 .18 .05	22 3.85 1.13	4.09
ESE	1 .18 .05	14 2.45 .72	21 3.68 1.08	3 .53 .15	0 0.00 0.00	0 0.00 0.00	39 6.83 2.01	3.51
SE	4 .70 .21	24 4.20 1.23	68 11.91 3.50	19 3.33 .98	0 0.00 0.00	0 0.00 0.00	115 20.14 5.92	3.82
SSE	4 .70 .21	18 3.15 .93	35 6.13 1.80	12 2.10 .62	1 .18 .05	0 0.00 0.00	70 12.26 3.60	3.85
S	1 .18 .05	9 1.58 .46	33 5.78 1.70	12 2.10 .62	0 0.00 0.00	0 0.00 0.00	55 9.63 2.83	4.28
SSW	4 .70 .21	7 1.23 .36	34 5.95 1.75	2 .35 .10	3 .53 .15	0 0.00 0.00	50 8.76 2.57	3.91
SW	3 .53 .15	16 2.80 .82	18 3.15 .93	5 .88 .26	3 .53 .15	0 0.00 0.00	45 7.88 2.31	3.87
WSW	2 .35 .10	13 2.28 .67	7 1.23 .36	1 .18 .05	0 0.00 0.00	0 0.00 0.00	23 4.03 1.18	2.94
W	3 .53 .15	29 5.08 1.49	11 1.93 .57	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	43 7.53 2.21	2.60
WNW	2 .35 .10	19 3.33 .98	15 2.63 .77	9 1.58 .46	1 .18 .05	0 0.00 0.00	46 8.06 2.37	3.57
NW	3 .53 .15	8 1.40 .41	7 1.23 .36	2 .35 .10	0 0.00 0.00	0 0.00 0.00	20 3.50 1.03	3.00
NNW	5 .88 .26	7 1.23 .36	1 .18 .05	1 .18 .05	0 0.00 0.00	0 0.00 0.00	14 2.45 .72	2.24
N	4 .70 .21	5 .88 .26	3 .53 .15	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	12 2.10 .62	2.17
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	51 8.93 2.62	180 31.52 9.26	259 45.36 13.32	70 12.26 3.60	10 1.75 .51	1 .18 .05	571 100.00 29.37	3.55

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 13.50.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NE	3 7.50 .15	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 7.50 .15	1.37
ENE	1 2.50 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.50 .05	1.50
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ESE	1 2.50 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.50 .05	1.30
SE	0 0.00 0.00	14 35.00 .72	5 12.50 .26	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	19 47.50 .98	2.92
SSE	1 2.50 .05	2 5.00 .10	4 10.00 .21	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 17.50 .36	2.90
S	0 0.00 0.00	3 7.50 .15	1 2.50 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 10.00 .21	3.05
SSW	0 0.00 0.00	2 5.00 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 5.00 .10	2.15
SW	0 0.00 0.00	0 0.00 0.00	1 2.50 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.50 .05	4.00
WSW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
W	1 2.50 .05	1 2.50 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 5.00 .10	1.55
WNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	7 17.50 .36	22 55.00 1.13	11 27.50 .57	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	40 100.00 2.06	2.65

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - DECEMBER

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 13.50.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	1 .52 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .52 .05	1.50
NE	1 .52 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .52 .05	.80
ENE	0 0.00 0.00	2 1.04 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.04 .10	2.20
E	0 0.00 0.00	5 2.59 .26	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	5 2.59 .26	1.70
ESE	0 0.00 0.00	2 1.04 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 1.04 .10	2.25
SE	1 .52 .05	5 2.59 .26	26 13.47 1.34	1 .52 .05	0 0.00 0.00	0 0.00 0.00	33 17.10 1.70	3.54
SSE	0 0.00 0.00	15 7.77 .77	15 7.77 .77	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	30 15.54 1.54	2.87
S	1 .52 .05	16 8.29 .82	15 7.77 .77	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	32 16.58 1.65	2.92
SSW	0 0.00 0.00	6 3.11 .31	21 10.88 1.08	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	27 13.99 1.39	3.35
SW	1 .52 .05	6 3.11 .31	15 7.77 .77	1 .52 .05	0 0.00 0.00	0 0.00 0.00	23 11.92 1.18	3.58
WSW	1 .52 .05	6 3.11 .31	2 1.04 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 4.66 .46	2.61
W	2 1.04 .10	9 4.66 .46	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	11 5.70 .57	1.89
WNW	3 1.55 .15	3 1.55 .15	1 .52 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	7 3.63 .36	1.96
NW	1 .52 .05	3 1.55 .15	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 2.07 .21	1.61
NNW	2 1.04 .10	1 .52 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 1.55 .15	1.27
N	3 1.55 .15	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 1.55 .15	1.13
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	17 8.81 .87	79 40.93 4.06	95 49.22 4.89	2 1.04 .10	0 0.00 0.00	0 0.00 0.00	193 100.00 9.93	2.91

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 10.00 METERS
TABLE GENERATED: 05/23/79. 13.50.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
NNE	9 .44	12 .58	27 1.31	8 .39	0 0.00	0 0.00	56 2.72	3.3
NE	18 .87	10 .48	8 .39	3 .15	0 0.00	0 0.00	39 1.89	2.4
ENE	5 .24	15 .73	5 .24	0 0.00	0 0.00	0 0.00	25 1.21	2.2
E	13 .63	28 1.36	28 1.36	7 .34	2 .10	1 .05	79 3.83	3.2
ESE	5 .24	27 1.31	45 2.18	8 .39	0 0.00	0 0.00	85 4.12	3.6
SE	10 .48	62 3.01	166 8.05	49 2.38	1 .05	0 0.00	288 13.97	3.8
SSE	8 .39	49 2.38	84 4.07	22 1.07	4 .19	0 0.00	167 8.10	3.6
S	4 .19	42 2.04	68 3.30	24 1.16	1 .05	0 0.00	139 6.74	3.8
SSW	6 .29	31 1.50	79 3.83	14 .68	4 .19	0 0.00	134 6.50	3.7
SW	7 .34	38 1.84	58 2.81	32 1.55	12 .58	0 0.00	147 7.13	4.2
WSW	5 .24	32 1.55	34 1.65	21 1.02	5 .24	0 0.00	97 4.70	4.0
W	10 .48	62 3.01	64 3.10	47 2.28	4 .19	0 0.00	187 9.07	3.8
WNW	11 .53	39 1.89	78 3.78	86 4.17	15 .73	1 .05	230 11.15	4.6
NW	10 .48	26 1.26	48 2.33	66 3.20	4 .19	0 0.00	154 7.47	4.6
NNW	8 .39	22 1.07	51 2.47	26 1.26	0 0.00	0 0.00	107 5.19	3.9
N	14 .68	19 .92	57 2.76	33 1.60	3 .15	0 0.00	126 6.11	4.0
CALM	2 .10						2 .10	CAL
TOTAL	145 7.03	514 24.93	900 43.65	446 21.63	55 2.67	2 .10	2062 100.00	3.9

NUMBER OF VALID OBSERVATIONS 2062 92.38 PCT.
NUMBER OF INVALID OBSERVATIONS 170 7.62 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-60 (Continued) (Sheet 47 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - DECEMBER

STABILITY CLASS: PASQUILL A
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 13.50.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	1 2.38 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.38 .05	3.00
NE	0 0.00 0.00	0 0.00 0.00	1 2.38 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.38 .05	3.40
ENE	0 0.00 0.00	1 2.38 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.38 .05	2.40
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ESE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.38 .05	0 0.00 0.00	0 0.00 0.00	1 2.38 .05	6.40
SSE	0 0.00 0.00	0 0.00 0.00	1 2.38 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.38 .05	4.10
S	0 0.00 0.00	0 0.00 0.00	3 7.14 .16	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 7.14 .16	4.77
SSW	0 0.00 0.00	1 2.38 .05	1 2.38 .05	2 4.76 .10	0 0.00 0.00	0 0.00 0.00	4 9.52 .21	4.67
SW	0 0.00 0.00	0 0.00 0.00	4 9.52 .21	2 4.76 .10	1 2.38 .05	0 0.00 0.00	7 16.67 .37	5.00
WSW	0 0.00 0.00	1 2.38 .05	3 7.14 .16	1 2.38 .05	0 0.00 0.00	0 0.00 0.00	5 11.90 .26	4.38
W	0 0.00 0.00	2 4.76 .10	3 7.14 .16	3 7.14 .16	1 2.38 .05	0 0.00 0.00	9 21.43 .47	4.97
WNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 4.76 .10	0 0.00 0.00	2 4.76 .10	8.05
NW	0 0.00 0.00	0 0.00 0.00	1 2.38 .05	2 4.76 .10	1 2.38 .05	0 0.00 0.00	4 9.52 .21	6.27
NNW	0 0.00 0.00	0 0.00 0.00	2 4.76 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 4.76 .10	4.30
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.38 .05	0 0.00 0.00	0 0.00 0.00	1 2.38 .05	5.60
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	0 0.00 0.00	6 14.29 .31	19 45.24 1.00	12 28.57 .63	5 11.90 .26	0 0.00 0.00	42 100.00 2.20	4.99

STABILITY CLASS: PASQUILL C
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 13.50.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ESE	0 0.00 0.00	0 0.00 0.00	3 4.48 .16	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 4.48 .16	4.50
SE	0 0.00 0.00	0 0.00 0.00	1 1.49 .05	1 1.49 .05	0 0.00 0.00	0 0.00 0.00	2 2.99 .10	4.65
SSE	2 2.99 .10	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.49 .05	0 0.00 0.00	3 4.48 .16	3.70
S	0 0.00 0.00	0 0.00 0.00	1 1.49 .05	1 1.49 .05	0 0.00 0.00	0 0.00 0.00	2 2.99 .10	5.70
SSW	0 0.00 0.00	1 1.49 .05	2 2.99 .10	3 4.48 .16	0 0.00 0.00	0 0.00 0.00	6 8.96 .31	4.68
SW	0 0.00 0.00	0 0.00 0.00	3 4.48 .16	2 2.99 .10	2 2.99 .10	0 0.00 0.00	7 10.45 .37	5.77
WSW	0 0.00 0.00	0 0.00 0.00	3 4.48 .15	2 2.99 .10	0 0.00 0.00	0 0.00 0.00	5 7.46 .26	4.60
W	0 0.00 0.00	3 4.48 .16	6 8.96 .31	4 5.97 .21	1 1.49 .05	0 0.00 0.00	14 20.90 .73	4.53
WNW	0 0.00 0.00	2 2.99 .10	3 4.48 .16	2 2.99 .10	2 2.99 .10	0 0.00 0.00	9 13.43 .47	4.93
NW	0 0.00 0.00	0 0.00 0.00	2 2.99 .10	6 8.96 .31	7 10.45 .37	0 0.00 0.00	15 22.39 .79	7.20
NNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 1.49 .05	0 0.00 0.00	0 0.00 0.00	1 1.49 .05	6.70
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	2 2.99 .10	6 8.96 .31	24 35.82 1.26	22 32.84 1.15	13 19.40 .68	0 0.00 0.00	67 100.00 3.51	5.36

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - DECEMBER

STABILITY CLASS: PASQUILL B
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 13.50.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	0 0.00 0.00	1 2.44 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.44 .05	3.50
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ESE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
SE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.44 .05	0 0.00 0.00	1 2.44 .05	8.50
SSE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.44 .05	0 0.00 0.00	1 2.44 .05	9.40
S	0 0.00 0.00	0 0.00 0.00	1 2.44 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.44 .05	3.40
SSW	0 0.00 0.00	0 0.00 0.00	1 2.44 .05	2 4.88 .10	0 0.00 0.00	0 0.00 0.00	3 7.32 .16	5.70
SW	0 0.00 0.00	0 0.00 0.00	2 4.88 .10	3 7.32 .16	2 4.88 .10	0 0.00 0.00	7 17.07 .37	6.26
WSW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
W	0 0.00 0.00	0 0.00 0.00	2 4.88 .10	1 2.44 .05	0 0.00 0.00	0 0.00 0.00	3 7.32 .16	4.53
WNW	0 0.00 0.00	0 0.00 0.00	1 2.44 .05	5 12.20 .26	1 2.44 .05	0 0.00 0.00	7 17.07 .37	6.36
NW	0 0.00 0.00	1 2.44 .05	3 7.32 .16	4 9.76 .21	2 4.88 .10	0 0.00 0.00	10 24.39 .52	5.70
NNW	0 0.00 0.00	0 0.00 0.00	3 7.32 .16	1 2.44 .05	0 0.00 0.00	0 0.00 0.00	4 9.76 .21	4.30
N	0 0.00 0.00	0 0.00 0.00	2 4.88 .10	1 2.44 .05	0 0.00 0.00	0 0.00 0.00	3 7.32 .16	4.53
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	0 0.00 0.00	1 2.44 .05	16 39.02 .84	17 41.46 .89	7 17.07 .37	0 0.00 0.00	41 100.00 2.15	5.66

STABILITY CLASS: PASQUILL D
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79. 13.50.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	4 .43 .21	9 .96 .47	16 1.70 .84	18 1.92 .94	1 .11 .05	0 0.00 0.00	48 5.11 2.52	4.76
NE	1 .11 .05	5 .53 .26	14 1.49 .73	2 .21 .10	0 0.00 0.00	0 0.00 0.00	22 2.34 1.15	3.74
ENE	4 .43 .21	4 .43 .21	6 .64 .31	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	14 1.49 .73	2.69
E	2 .21 .10	8 .85 .42	6 .64 .31	3 .32 .16	0 0.00 0.00	0 0.00 0.00	19 2.02 1.00	3.36
ESE	4 .43 .21	5 .53 .26	24 2.56 1.26	12 1.28 .63	0 0.00 0.00	0 0.00 0.00	45 4.79 2.36	3.99
SE	3 .32 .16	10 1.06 .52	29 3.09 1.52	34 3.62 1.78	15 1.60 .79	0 0.00 0.00	91 9.69 4.77	5.26
SSE	2 .21 .10	6 .64 .31	29 3.09 1.52	21 2.24 1.10	8 .85 .42	2 .21 .10	68 7.24 3.56	5.06
S	3 .32 .16	5 .53 .26	14 1.49 .73	11 1.17 .58	4 .43 .21	0 0.00 0.00	37 3.94 1.94	4.61
SSW	0 0.00 0.00	6 .64 .31	23 2.45 1.21	9 .96 .47	10 1.06 .52	0 0.00 0.00	48 5.11 2.52	5.06
SW	1 .11 .05	5 .53 .26	16 1.70 .84	15 1.60 .79	14 1.49 .73	3 .32 .16	54 5.75 2.83	5.84
WSW	1 .11 .05	2 .21 .10	9 .96 .47	10 1.06 .52	8 .85 .42	5 .53 .26	35 3.73 1.83	6.69
W	3 .32 .16	4 .43 .21	15 1.60 .79	31 3.30 1.62	36 3.83 1.89	2 .21 .10	91 9.69 4.77	6.60
WNW	1 .11 .05	5 .53 .26	15 1.60 .79	77 8.20 4.04	30 3.19 1.57	4 .43 .21	132 14.06 6.92	6.57
NW	1 .11 .05	6 .64 .31	17 1.81 .89	41 4.37 2.15	38 4.05 1.99	4 .43 .21	107 11.40 5.61	6.66
NNW	2 .21 .10	5 .53 .26	34 3.62 1.78	17 1.81 .89	12 1.28 .63	0 0.00 0.00	70 7.45 3.67	5.11
N	0 0.00 0.00	5 .53 .26	25 2.66 1.31	18 1.92 .94	8 .85 .42	1 .11 .05	57 6.07 2.99	5.44
CALM	1 .11 .05						1 .11 .05	CALM
TOTAL	33 3.51 1.73	90 9.58 4.72	292 31.10 15.30	319 33.97 16.72	184 19.60 9.64	21 2.24 1.10	939 100.00 49.21	5.54

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

TABLE 2.3-60 (Continued) (Sheet 48 of 48)

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - DECEMBER

STABILITY CLASS: PASQUILL E
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79, 13.50.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	6 1.05 .31	6 1.05 .31	2 .35 .10	0 0.00 0.00	0 0.00 0.00	14 2.44 .73	3.49
NE	2 .35 .10	6 1.05 .31	1 .17 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	9 1.57 .47	2.33
ENE	2 .35 .10	3 .52 .16	2 .35 .10	1 .17 .05	0 0.00 0.00	0 0.00 0.00	8 1.39 .42	3.06
E	1 .17 .05	4 .70 .21	2 .35 .10	5 .87 .26	2 .35 .10	2 .35 .10	16 2.79 .84	5.61
ESE	0 0.00 0.00	2 .35 .10	10 1.74 .52	13 2.26 .68	2 .35 .10	0 0.00 0.00	27 4.70 1.42	5.14
SE	1 .17 .05	0 0.00 0.00	15 2.61 .79	68 11.85 3.56	11 1.92 .58	0 0.00 0.00	95 16.55 4.98	6.10
SSE	0 0.00 0.00	1 .17 .05	22 3.83 1.15	43 7.49 2.25	14 2.44 .73	0 0.00 0.00	80 13.94 4.19	6.10
S	0 0.00 0.00	4 .70 .21	17 2.96 .89	33 5.75 1.73	14 2.44 .73	1 .17 .05	69 12.02 3.62	6.19
SSW	1 .17 .05	2 .35 .10	3 .52 .16	22 3.83 1.15	16 2.79 .84	3 .52 .16	47 8.19 2.46	6.85
SW	0 0.00 0.00	1 .17 .05	14 2.44 .73	25 4.36 1.31	11 1.92 .58	4 .70 .21	55 9.58 2.88	6.39
WSW	0 0.00 0.00	2 .35 .10	8 1.39 .42	4 .70 .21	5 .87 .26	0 0.00 0.00	19 3.31 1.00	5.46
W	0 0.00 0.00	1 .17 .05	21 3.66 1.10	13 2.26 .68	2 .35 .10	0 0.00 0.00	37 6.45 1.94	4.98
WNW	0 0.00 0.00	0 0.00 0.00	17 2.96 .89	33 5.75 1.73	10 1.74 .52	0 0.00 0.00	60 10.45 3.14	6.03
NW	0 0.00 0.00	2 .35 .10	9 1.57 .47	12 2.09 .63	1 .17 .05	0 0.00 0.00	24 4.18 1.26	5.41
NNW	0 0.00 0.00	1 .17 .05	8 1.39 .42	1 .17 .05	0 0.00 0.00	0 0.00 0.00	10 1.74 .52	3.94
N	1 .17 .05	1 .17 .05	1 .17 .05	1 .17 .05	0 0.00 0.00	0 0.00 0.00	4 .70 .21	3.30
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	8 1.39 .42	36 6.27 1.89	156 27.18 8.18	276 48.08 14.47	88 15.33 4.61	10 1.74 .52	574 100.00 30.08	5.79

STABILITY CLASS: PASQUILL G
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79, 13.50.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
E	0 0.00 0.00	2 4.76 .10	1 2.38 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 7.14 .16	3.17
ESE	0 0.00 0.00	1 2.38 .05	1 2.38 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	2 4.76 .10	3.45
SE	0 0.00 0.00	0 0.00 0.00	3 7.14 .16	2 4.76 .10	1 2.38 .05	0 0.00 0.00	6 14.29 .31	5.28
SSE	0 0.00 0.00	0 0.00 0.00	2 4.76 .10	4 9.52 .21	0 0.00 0.00	0 0.00 0.00	6 14.29 .31	5.40
S	0 0.00 0.00	0 0.00 0.00	5 11.90 .26	2 4.76 .10	2 4.76 .10	0 0.00 0.00	9 21.43 .47	5.84
SSW	0 0.00 0.00	2 4.76 .10	5 11.90 .26	1 2.38 .05	1 2.38 .05	0 0.00 0.00	9 21.43 .47	4.30
SW	0 0.00 0.00	1 2.38 .05	0 0.00 0.00	3 7.14 .16	1 2.38 .05	0 0.00 0.00	5 11.90 .26	6.26
WSW	0 0.00 0.00	1 2.38 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.38 .05	1.80
W	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 2.38 .05	0 0.00 0.00	1 2.38 .05	7.90
WNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
NNW	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
N	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	0 0.00 0.00	7 16.67 .37	17 40.48 .89	12 28.57 .63	6 14.29 .31	0 0.00 0.00	42 100.00 2.20	5.07

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES THIS CLASS
XXX PERCENT OCCURRENCES ALL CLASSES

JOINT WIND FREQUENCY DISTRIBUTION BY STABILITY CLASS
DATA PERIOD: THREE YEARS SAME MONTHS COMBINED - DECEMBER

STABILITY CLASS: PASQUILL F
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79, 13.50.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	3 1.48 .16	1 .49 .05	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	4 1.97 .21	1.15
NE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ENE	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	1 .49 .05	0 0.00 0.00	0 0.00 0.00	1 .49 .05	5.30
E	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0.00
ESE	1 .49 .05	0 0.00 0.00	4 1.97 .21	1 .49 .05	0 0.00 0.00	0 0.00 0.00	6 2.96 .31	3.63
SE	0 0.00 0.00	2 .99 .10	1 .49 .05	10 4.93 .52	0 0.00 0.00	0 0.00 0.00	13 6.40 .68	5.68
SSE	0 0.00 0.00	1 .49 .05	7 3.45 .37	19 9.36 1.00	3 1.48 .16	0 0.00 0.00	30 14.78 1.57	5.94
S	1 .49 .05	2 .99 .10	11 5.42 .58	17 8.37 .89	1 .49 .05	0 0.00 0.00	32 15.76 1.68	5.44
SSW	0 0.00 0.00	0 0.00 0.00	10 4.93 .52	15 7.39 .79	6 2.96 .31	0 0.00 0.00	31 15.27 1.62	6.22
SW	0 0.00 0.00	2 .99 .10	5 2.46 .26	20 9.85 1.05	16 7.88 .84	0 0.00 0.00	43 21.18 2.25	6.76
WSW	0 0.00 0.00	1 .49 .05	1 .49 .05	7 3.45 .37	1 .49 .05	0 0.00 0.00	10 4.93 .52	5.67
W	0 0.00 0.00	0 0.00 0.00	2 .99 .10	9 4.43 .47	0 0.00 0.00	0 0.00 0.00	11 5.42 .58	5.55
WNW	0 0.00 0.00	0 0.00 0.00	1 .49 .05	4 1.97 .21	0 0.00 0.00	0 0.00 0.00	5 2.46 .26	5.94
NW	0 0.00 0.00	3 1.48 .16	5 2.46 .26	3 1.48 .16	0 0.00 0.00	0 0.00 0.00	11 5.42 .58	4.49
NNW	0 0.00 0.00	3 1.48 .16	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	0 0.00 0.00	3 1.48 .16	2.47
N	1 .49 .05	1 .49 .05	0 0.00 0.00	1 .49 .05	0 0.00 0.00	0 0.00 0.00	3 1.48 .16	2.93
CALM	0 0.00 0.00						0 0.00 0.00	CALM
TOTAL	6 2.96 .31	16 7.88 .84	47 23.15 2.46	107 52.71 5.61	27 13.30 1.42	0 0.00 0.00	203 100.00 10.64	5.68

ALL WINDS
DATA SOURCE: ON SITE
WIND SENSOR HEIGHT: 60.00 METERS
TABLE GENERATED: 05/23/79, 13.50.04.

CALLAWAY GENERATING STATION
REFORM, MISSOURI
UNION ELECTRIC COMPANY
DAMES AND MOORE JOB NO: 7677-093-07

WIND SECTOR	0.0-1.5	1.5-3.0	3.0-5.0	5.0-7.5	7.5-10.0	>10.0	TOTAL	MEAN SPEED
	WIND SPEED CATEGORIES(METERS PER SECOND)							
NNE	7 .34	18 .89	22 1.08	23 1.13	1 .05	0 0.00	71 3.50	4.05
NE	3 .15	12 .59	17 .84	5 .25	0 0.00	0 0.00	37 1.82	3.55
ENE	6 .30	8 .39	15 .74	3 .15	0 0.00	0 0.00	32 1.58	3.22
E	3 .15	14 .69	14 .69	9 .44	2 .10	2 .10	44 2.17	4.36
ESE	5 .25	8 .39	42 2.07	26 1.28	2 .10	0 0.00	83 4.09	4.34
SE	4 .20	13 .64	52 2.56	118 5.81	28 1.38	0 0.00	215 10.59	5.64
SSE	4 .20	8 .39	65 3.20	91 4.48	31 1.53	2 .10	201 9.90	5.69
S	4 .20	11 .54	55 2.71	66 3.25	23 1.13	1 .05	160 7.88	5.61
SSW	1 .05	12 .59	48 2.36	56 2.76	37 1.82	3 .15	157 7.73	5.86
SW	1 .05	9 .44	47 2.32	73 3.60	48 2.36	8 .39	186 9.16	6.24
WSW	1 .05	7 .34	24 1.18	31 1.53	16 .79	6 .30	85 4.19	6.04
W	3 .15	10 .49	49 2.41	66 3.25	51 2.51	2 .10	181 8.92	6.03
WNW	1 .05	7 .34	37 1.82	121 5.96	48 2.36	10 .49	224 11.03	6.49
NW	1 .05	14 .69	37 1.82	68 3.35	49 2.41	4 .20	173 8.52	6.28
NNW	2 .10	13 .64	52 2.56	19 .94	12 .59	0 0.00	98 4.83	4.67
N	2 .10	9 .44	34 1.67	28 1.38	8 .39	1 .05	82 4.04	5.06
CALM	1 .05						1 .05	CALM
TOTAL	49 2.41	173 8.52	610 30.05	803 39.56	356 17.54	39 1.92	2030 100.00	5.63

NUMBER OF VALID OBSERVATIONS 2030 90.95 PCT.
NUMBER OF INVALID OBSERVATIONS 202 9.05 PCT.
TOTAL NUMBER OF OBSERVATIONS 2232 100.00 PCT.

KEY XXX NUMBER OF OCCURRENCES
XXX PERCENT OCCURRENCES

TABLE 2.3-61 TWO-HOUR AVERAGE ACCIDENT χ/Q VALUES* AT THE EXCLUSION AREA BOUNDARY EXCEEDED 0.5 PERCENT OF THE TIME

AFFECTED SECTOR	5/4/73 TO 5/4/74	5/4/74 TO 5/4/75	3/16/78 TO 3/16/79	3 YEARS COMBINED
NNE	1.3E-04	1.2E-04	9.2E-05	1.2E-04
NE	1.5E-04	1.2E-04	1.2E-04	1.4E-04
ENE	1.4E-04	9.2E-05	7.8E-05	1.1E-04
E	1.4E-04	1.0E-04	1.2E-04	1.2E-04
ESE	8.4E-05	8.3E-05	9.2E-05	8.4E-05
SE	1.1E-04	1.1E-04	7.8E-05	8.9E-05
SSE	7.8E-05	1.0E-04	1.2E-04	9.4E-05
S	1.1E-04	1.4E-04	1.4E-04	1.3E-04
SSW	1.0E-04	1.3E-04	1.2E-04	1.2E-04
SW	1.1E-04	1.4E-04	1.7E-04	1.4E-04
WSW	7.8E-05	8.4E-05	8.4E-05	8.3E-05
W	8.4E-05	8.3E-05	9.2E-05	8.4E-05
WNW	8.6E-05	7.8E-05	9.2E-05	8.4E-05
NW	1.1E-04	1.5E-04	1.5E-04	1.4E-04
NNW	1.4E-04	1.5E-04	1.5E-04	1.5E-04
N	1.5E-04	1.3E-04	1.2E-04	1.4E-04
MAXIMUM SECTOR	1.5E-04 NE, N	1.5E-04 NW, NNW	1.7E-04 SW	1.5E-04 NNW

* In sec/m^3.

TABLE 2.3-62 ACCIDENT χ/Q AT THE LOW POPULATION ZONE EXCEEDED 0.5 PERCENT OF THE TIME

	5/4/73 TO 5/4/74					5/4/74 TO 5/4/75				
SECTOR	2 HR	8 HR	16 HR	72 HR	624 HR	2 HR	8 HR	16 HR	72 HR	624 HR
NNE	4.2E-05	1.4E-05	9.4E-06	1.3E-06	4.2E-06	3.3E-05	1.1E-05	7.6E-06	3.4E-06	1.1E-06
NE	4.5E-05	1.4E-05	9.1E-06	1.1E-06	3.8E-06	3-5E-05	1.0E-05	6.8E-06	2.8E-06	7.7E-07
ENE	4.4E-05	1.2E-05	8.1E-06	8.6E-07	3.2E-06	2.4E-05	7.0E-06	4.6E-06	1.9E-06	5.3E-07
E	4.2E-05	1.2E-05	7.8E-06	8.4E-07	3.1E-06	3.1E-05	9.0E-06	6.0E-06	2.4E-06	6.7E-07
ESE	2.5E-05	7.9E-06	5.3E-06	7.0E-07	2.3E-06	2.2E-05	7.0E-06	4.8E-06	2.1E-06	6.4E-07
SE	3.1E-05	9.5E-06	6.4E-06	8.1E-07	2.7E-06	3.1E-05	9.4E-06	6.3E-06	2.7E-06	7.7E-07
SSE	2.1E-05	6.7E-06	4.5E-06	6.0E-07	2.0E-06	2.9E-05	8.7E-06	5.8E-06	2.4E-06	6.9E-07
S	2.9E-05	8.8E-06	5.9E-06	7.3E-07	2.5E-06	4.5E-05	1.3E-05	8.5E-06	3.4E-06	9.3E-07
SSW	2.8E-05	8.7E-06	5.9E-06	7.5E-07	2.5E-06	3.5E-05	1.1E-05	7.2E-06	3.1E-06	9.0E-07
SW	3.1E-05	9.4E-06	6.3E-06	7.7E-07	2.7E-06	4.2E-05	1.2E-05	8.2E-06	3.4E-06	9.5E-07
WSW	1.9E-05	6.1E-06	4.1E-06	5.5E-07	1.8E-06	2.3E-05	7.4E-06	5.0E-06	2.2E-06	6.8E-07
W	2.4E-05	7.4E-06	5.0E-06	6.3E-07	2.1E-06	2.2E-05	7.2E-06	5.0E-06	2.2E-06	7.0E-07
WNW	2.5E-05	8.2E-06	5.6E-06	7.9E-07	2.5E-06	2.1E-05	7.1E-06	4.9E-06	2.2E-06	7.2E-07
NW	3.1E-05	1.1E-05	7.5E-06	1.2E-06	3.5E-06	4.4E-05	1.5E-05	1.0E-05	4.6E-06	1.5E-06
NNW	4.4E-05	1.5E-05	1.0E-05	1.5E-06	4.7E-06	4.4E-05	1.4E-05	9.8E-06	4.3E-06	1.3E-06
N	4.4E-05	1.5E-05	1.0E-05	1.5E-06	4.7E-06	4.2E-05	1.3E-05	9.0E-06	3.9E-06	1.2E-06

	3/16/78 TO 3/16/79					3 YEARS COMBINED				
SECTOR	2 HR	8 HR	16 HR	72 HR	624 HR	2 HR	8 HR	16 HR	72 HR	624 HR
NNE	2.3E-05	7.8E-06	5.5E-06	2.5E-06	8.2E-07	3.3E-05	1.1E-05	7.5E-06	3.4E-06	1.1E-06
NE	3.5E-05	1.0E-05	6.8E-06	2.8E-06	7.7E-07	4.3E-05	1.2E-05	8.2E-06	3.3E-06	9.2E-07
ENE	2.0E-05	6.2E-06	4.2E-06	1.8E-06	5.3E-07	3.1E-05	8.8E-06	5.8E-06	2.4E-06	6.4E-07
E	3.5E-05	1.0E-05	7.0E-06	2.9E-06	8.3E-07	3.5E-05	1.0E-05	6.8E-06	2.8E-06	7.7E-07
ESE	2.4E-05	7.6E-06	5.2E-06	2.3E-06	6.9E-07	2.4E-05	7.6E-06	5.2E-06	2.3E-06	6.9E-07
SE	2.1E-05	6.8E-06	4.6E-06	2.0E-06	6.3E-07	2.5E-05	8.0E-06	5.4E-06	2.4E-06	7.3E-07
SSE	3.5E-05	1.0E-05	7.0E-06	2.9E-06	8.3E-07	2.5E-05	7.9E-06	5.3E-06	2.3E-06	7.0E-07
S	4.2E-05	1.3E-05	8.4E-06	3.5E-06	1.0E-06	3.5E-05	1.1E-05	7.1E-06	3.0E-06	8.7E-07
SSW	3.2E-05	1.0E-05	7.0E-06	3.1E-06	9.4E-07	3.3E-05	1.0E-05	6.9E-06	3.0E-06	8.8E-07
SW	5.1E-05	1.5E-05	1.0E-05	4.2E-06	1.2E-06	4.2E-05	1.2E-05	8.3E-06	3.5E-06	9.8E-07
WSW	2.3E-05	7.6E-06	5.2E-06	2.3E-06	7.4E-07	2.2E-05	7.1E-06	4.9E-06	2.2E-06	6.7E-07
W	2.5E-05	8.2E-06	5.6E-06	2.5E-06	7.9E-07	2.4E-05	7.7E-06	5.3E-06	2.3E-06	7.2E-07
WNW	2.5E-05	8.6E-06	6.0E-06	2.8E-06	9.3E-07	2.3E-05	7.8E-06	5.4E-06	2.5E-06	8.0E-07
NW	4.5E-05	1.6E-05	1.1E-05	5.1E-06	1.7E-06	4.4E-05	1.5E-05	1.0E-05	4.6E-06	1.5E-06
NNW	4.4E-05	1.5E-05	1.0E-05	4.7E-06	1.5E-06	4.4E-05	1.5E-05	1.0E-05	4.6E-06	1.5E-06
N	3.3E-05	1.2E-05	8.3E-06	3.9E-06	1.3E-06	4.3E-05	1.4E-05	9.7E-06	4.3E-06	1.4E-06

*In sec/m^3.

(Sheet 1 of 1)

TABLE 2.3-63 ABSOLUTE MAXIMUM χ/Q VALUES* TWO-HOUR AVERAGING PERIOD

AFFECTED SECTOR	5/4/73 TO 5/4/74		5/4/74 TO 5/4/75		3/16/78 TO 3/16/79		3 YEARS COMBINED	
	EXCLUSION AREA BOUNDARY	LOW POPULATION ZONE	EXCLUSION AREA BOUNDARY	LOW POPULATION ZONE	EXCLUSION AREA BOUNDARY	LOW POPULATION ZONE	EXCLUSION AREA BOUNDARY	LOW POPULATION ZONE
NNE	8.3E-04	2.8E-04	7.3E-04	2.5E-04	3.9E-04	1.3E-04	8.3E-04	2.8E-04
NE	8.3E-04	2.8E-04	7.3E-04	2.5E-04	4.8E-04	1.4E-04	8.3E-04	2.8E-04
ENE	2.9E-04	1.0E-04	8.3E-04	2.8E-04	8.3E-04	2.8E-04	8.3E-04	2.8E-04
E	7.3E-04	2.5E-04	8.3E-04	2.8E-0	8.3E-04	2.8E-04	8.3E-04	2.8E-04
ESE	4.8E-04	1.4E-04	2.9E-04	1.0E-04	8.3E-04	2.8E-04	8.3E-04	2.8E-04
SE	4.5E-04	1.5E-04	4.2E-04	1.3E-04	7.3E-04	2.5E-04	7.3E-04	2.5E-04
SSE	3.4E-04	1.2E-04	5.3E-04	1.8E-04	4.2E-04	1.3E-04	5.3E-04	1.8E-04
S	4.5E-04	1.5E-04	7.3E-04	2.53-04	4.2E-04	1.3E-04	7.3E-04	2.5E-04
SSW	4.2E-04	1.3E-04	4.2E-04	1.3E-04	7.3E-04	2.5E-04	7.3E-04	2.5E-04
SW	7.3E-04	2.5E-04	7.3E-04	2.5E-04	7.3E-04	2.5E-04	7.3E-04	2.5E-04
WSW	4.8E-04	1.4E-04	3.1E-04	1.0E-04	7.3E-04	2.5E-04	7.3E-04	2.5E-04
W	2.9E-04	1.0E-04	5.3E-04	1.8E-04	7.3E-04	2.5E-04	7.3E-04	2.5E-04
WNW	7.3E-04	2.5E-04	2.9E-04	1.0E-04	7.3E-04	2.5E-04	7.3E-04	2.5E-04
NW	4.2E-04	1.3E-04	3.4E-04	1.2E-04	4.2E-04	1.3E-04	4.2E-04	1.3E-04
NNW	3.9E-04	1.3E-04	5.3E-04	1.8E-04	2.9E-04	1.0E-04	5.3E-04	1.8E-04
N	4.5E-04	1.5E-04	5.3E-04	1.8E-04	4.2E-04	1.3E-04	5.3E-04	1.8E-04

* In sec/m^3.

(Sheet 1 of 1)

TABLE 2.3-64 FIFTY-PERCENT χ/Q VALUES* TWO-HOUR AVERAGING PERIOD

AFFECTED SECTOR	5/4/73 TO 5/4/74 EXCLUSION AREA BOUNDARY	5/4/73 TO 5/4/74 LOW POPULATION ZONE	5/4/74 TO 5/4/75 EXCLUSION AREA BOUNDARY	5/4/74 TO 5/4/75 LOW POPULATION ZONE	3/16/78 TO 3/16/79 EXCLUSION AREA BOUNDARY	3/16/78 TO 3/16/79 LOW POPULATION ZONE	3 YEARS COMBINED EXCLUSION AREA BOUNDARY	3 YEARS COMBINED LOW POPULATION ZONE
NNE	3.5E-06	6.5E-06	3.2E-05	5.7E-06	3.3E-05	6.1E-06	3.3E-05	6.1E-06
NE	3.7E-05	6.9E-06	3.4E-05	6.1E-06	3.5E-05	6.2E-06	3.6E-05	6.5E-06
ENE	2.6E-06	1.9E-06	2.8E-05	4.9E-06	3.4E-05	6.1E-06	3.5E-05	6.2E-06
E	3.1E-05	5.3E-06	2.4E-05	3.8E-06	3.1E-05	5.3E-06	2.7E-05	4.7E-06
ESE	2.5E-05	4.0E-06	2.1E-05	3.3E-06	2.7E-05	4.4E-06	2.4E-05	3.8E-06
SE	2.3E-05	3.7E-06	2.5E-05	4.0E-06	2.4E-05	3.8E-06	2.4E-05	3.8E-06
SSE	2.7E-05	4.7E-06	2.3E-05	3.7E-06	2.9E-05	5.0E-06	2.7E-05	4.4E-06
S	2.7E-05	4.3E-06	3.2E-05	5.5E-06	3.8E-05	6.2E-06	3.2E-05	5.5E-06
SSW	3.8E-05	6.9E-06	3.7E-05	6.6E-06	3.9E-05	6.9E-06	3.8E-05	6.7E-06
SW	4.0E-05	8.4E-06	4.0E-05	7.6E-06	3.9E-05	7.6E-06	4.0E-05	7.6E-06
WSW	3.6E-05	5.7E-06	3.8E-05	7.6E-06	3.7E-05	7.1E-06	3.8E-05	7.1E-06
W	3.8E-05	7.3E-06	3.7E-05	6.6E-06	3.8E-05	7.6E-06	3.8E-05	7.3E-06
WNW	3.7E-05	7.0E-06	3.5E-05	6.2E-06	3.8E-05	7.3E-06	3.7E-05	6.9E-06
NW	3.8E-05	7.9E-06	3.8E-05	7.6E-06	3.9E-05	9.1E-06	3.8E-05	8.2E-06
NNW	3.6E-05	7.9E-06	3.8E-05	7.9E-06	4.3E-05	1.0E-05	3.9E-05	8.4E-06
N	3.6E-05	6.7E-06	3.5E-05	6.6E-06	3.8E-05	7.6E-06	3.7E-05	7.1E-06
ALL	3.6E-05	6.7E-06	3.4E-05	6.1E-06	3.7E-05	7.3E-06	3.6E-05	6.6E-06

* In sec/m^3.

TABLE 2.3-65 DELETED

(Sheet 1 of 1)

TABLE 2.3-66 TERRAIN/RECIRCULATION FACTORS-STANDARD DISTANCES GROUND RELEASE BASED ON MAY 4, 1974 TO MAY 4, 1975

DISTANCE (MILES)	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
0.25	0.77	0.77	0.84	0.71	1.03	0.91	0.72	0.72	0.77	0.72	0.85	0.74	0.92	0.60	0.75	0.73
0.50	0.90	0.91	0.99	0.90	1.24	1.08	0.87	0.82	0.92	0.90	1.08	0.94	1.01	0.72	0.94	0.92
0.75	1.00	1.00	1.08	1.03	1.38	1.19	0.98	0.89	1.03	1.03	1.24	1.09	1.07	0.80	1.07	1.06
1.00	1.08	1.04	1.10	1.07	1.35	1.24	1.00	0.88	1.12	1.07	1.29	1.13	1.05	0.80	1.10	1.02
1.50	1.20	1.11	1.12	1.13	1.31	1.31	1.04	0.87	1.26	1.12	1.36	1.20	1.02	0.81	1.15	0.98
2.00	1.19	1.05	1.10	1.06	1.41	1.32	1.04	0.90	1.13	1.12	1.38	1.22	1.06	0.83	1.14	0.99
2.50	1.19	1.00	1.09	1.01	1.49	1.32	1.04	0.92	1.04	1.12	1.39	1.23	1.09	0.85	1.13	1.00
3.00	1.24	1.01	1.01	1.02	1.37	1.34	1.07	0.93	1.01	1.08	1.45	1.19	1.10	0.81	1.11	0.99
3.50	1.28	1.01	0.95	1.02	1.27	1.36	1.10	0.93	0.99	1.04	1.51	1.15	1.11	0.78	1.09	0.98
4.00	1.20	0.98	0.94	0.99	1.26	1.31	1.20	0.93	1.01	1.03	1.29	1.12	1.08	0.79	1.08	1.02
4.50	1.14	0.96	0.94	0.96	1.25	1.27	1.29	0.93	1.02	1.03	1.13	1.09	1.06	0.80	1.07	1.05
5.00	1.13	0.95	0.95	0.93	1.22	1.27	1.26	0.89	1.03	0.98	1.16	1.06	1.03	0.78	1.06	1.03
7.50	1.11	0.94	0.98	0.81	1.09	1.29	1.16	0.76	1.08	0.83	1.26	0.94	0.91	0.70	1.01	0.94
10.00	1.11	0.94	0.90	0.79	1.00	1.27	1.02	0.69	0.85	0.77	1.20	0.90	0.93	0.69	0.99	0.88
15.00	1.10	0.96	0.80	0.75	0.90	1.24	0.85	0.60	0.61	0.69	1.11	0.84	0.96	0.67	0.96	0.81
20.00	0.96	0.76	0.87	0.70	0.93	0.94	0.79	0.54	0.53	0.68	0.98	0.81	0.91	0.64	0.98	0.87
25.00	0.86	0.64	0.93	0.67	0.96	0.76	0.75	0.49	0.47	0.67	0.89	0.79	0.88	0.61	0.99	0.93
30.00	0.78	0.62	0.97	0.56	0.90	0.64	0.73	0.44	0.45	0.59	0.78	0.65	0.87	0.58	0.97	1.00
35.00	0.72	0.61	1.01	0.49	0.86	0.56	0.71	0.40	0.43	0.53	0.70	0.55	0.85	0.56	0.96	1.07
40.00	0.63	0.56	0.88	0.43	0.74	0.52	0.69	0.37	0.41	0.52	0.71	0.59	0.86	0.51	0.80	0.96
45.00	0.57	0.53	0.78	0.38	0.64	0.49	0.67	0.34	0.40	0.51	0.72	0.64	0.87	0.47	0.68	0.87
50.00	0.63	0.53	0.60	0.33	0.59	0.48	0.54	0.29	0.36	0.47	0.66	0.58	0.74	0.45	0.62	0.77

TABLE 2.3-66A DELETED

TABLE 2.3-67 DELETED

(Sheet 1 of 1)

TABLE 2.3-68 TERRAIN/RECIRCULATION FACTORS - SPECIAL DISTANCES BASED ON MAY 4, 1974 TO MAY 4, 1975 DATA GROUND RELEASE

	RECEPTOR							
SECTOR	EXCLUSION ZONE	LOW POPULATION ZONE	NEAREST COW	NEAREST GOAT	NEAREST MEAT ANIMAL	NEAREST VEG. GARDEN	NEAREST RESIDENCE	RESTRICTED AREA
NNE	1.04	1.21	1.10	1.24	1.21	1.13	1.13	1.16
NE	1.05	1.01	1.02	1.02	1.02	1.02	1.02	1.16
ENE	1.13	1.10	1.01	1.13	1.13	1.19	1.19	1.19
E	1.08	1.02	0.91	0.91	1.03	0.99	1.13	1.15
ESE	1.43	1.51	1.23	1.23	1.44	1.44	1.44	1.31
SE	1.24	1.33	1.17	1.17	1.37	1.37	1.37	1.40
SSE	1.03	1.05	1.44	1.44	1.05	1.05	1.05	1.06
S	0.93	0.93	0.93	0.93	0.94	0.94	0.94	0.94
SSW	1.07	1.05	1.04	1.04	0.99	1.02	1.02	1.05
SW	1.08	1.13	1.08	1.13	1.13	1.13	1.13	1.08
WSW	1.29	1.40	1.11	1.11	1.27	1.39	1.27	1.26
W	1.12	1.23	1.22	1.09	1.22	1.22	1.21	1.04
WNW	1.11	1.10	1.04	1.04	1.18	1.18	1.18	1.06
NW	0.83	0.86	0.77	0.77	0.84	0.84	0.84	0.81
NNW	1.11	1.14	1.05	1.05	1.13	1.13	1.13	1.16
N	1.10	1.01	1.00	1.00	1.00	1.00	1.02	0.96

TABLE 2.3-69 THRU 2.3-80

These tables that contained average meteorological relative concentrations based on the three individual years of data have been deleted. See tables 2.3-81 thru 2.3-84 for average meteorological relative concentrations based on the three years combined.

TABLE 2.3-81 AVERAGE METEOROLOGICAL RELATIVE CONCENTRATION ANALYSIS STANDARD DISTANCES, RADWASTE BUILDING VENT RELEASE

Data Period: May 4, 1973 to May 4, 1975
and March 16, 1978 to March 16, 1979 Combined

RELATIVE CONCENTRATION, X/Q (sec/m3)

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES

SECTOR	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
S	6.203E-06	2.381E-06	1.342E-06	8.416E-07	4.438E-07	2.971E-07	2.188E-07	1.692E-07	1.365E-07	1.123E-07	9.467E-08
SSW	6.710E-06	2.723E-06	1.584E-06	1.091E-06	6.570E-07	3.825E-07	2.528E-07	1.890E-07	1.480E-07	1.239E-07	1.061E-07
SW	6.345E-06	2.705E-06	1.618E-06	1.066E-06	6.026E-07	3.926E-07	2.831E-07	2.089E-07	1.619E-07	1.333E-07	1.124E-07
WSW	5.125E-06	2.212E-06	1.327E-06	8.719E-07	4.915E-07	3.226E-07	2.339E-07	1.874E-07	1.557E-07	1.101E-07	8.122E-08
W	5.651E-06	2.459E-06	1.475E-06	9.676E-07	5.443E-07	3.566E-07	2.584E-07	1.905E-07	1.474E-07	1.180E-07	9.715E-08
WNW	7.562E-06	2.821E-06	1.547E-06	9.564E-07	4.945E-07	3.316E-07	2.446E-07	1.888E-07	1.520E-07	1.222E-07	1.009E-07
NW	9.534E-06	3.924E-06	2.280E-06	1.453E-06	7.846E-07	5.249E-07	3.865E-07	2.827E-07	2.175E-07	1.818E-07	1.554E-07
NNW	1.186E-05	5.129E-06	3.067E-06	2.007E-06	1.124E-06	7.249E-07	5.188E-07	3.908E-07	3.083E-07	2.526E-07	2.121E-07
N	1.021E-05	4.395E-06	2.628E-06	1.605E-06	8.163E-07	5.367E-07	3.900E-07	2.961E-07	2.352E-07	2.009E-07	1.750E-07
NNE	7.695E-06	3.052E-06	1.747E-06	1.193E-06	7.100E-07	4.579E-07	3.277E-07	2.611E-07	2.159E-07	1.675E-07	1.342E-07
NE	7.156E-06	2.856E-06	1.645E-06	1.092E-06	6.253E-07	3.840E-07	2.647E-07	2.045E-07	1.648E-07	1.324E-07	1.094E-07
ENE	5.479E-06	2.168E-06	1.238E-06	7.953E-07	4.347E-07	2.778E-07	1.975E-07	1.401E-07	1.051E-07	8.667E-08	7.323E-08
E	6.177E-06	2.624E-06	1.564E-06	1.027E-06	5.795E-07	3.526E-07	2.413E-07	1.858E-07	1.493E-07	1.196E-07	9.842E-08
ESE	8.214E-06	3.283E-06	1.891E-06	1.166E-06	6.006E-07	4.168E-07	3.157E-07	2.211E-07	1.640E-07	1.339E-07	1.121E-07
SE	7.176E-06	2.847E-06	1.626E-06	1.066E-06	5.993E-07	3.885E-07	2.792E-07	2.167E-07	1.753E-07	1.393E-07	1.138E-07
SSE	5.242E-06	2.128E-06	1.238E-06	8.034E-07	4.445E-07	2.879E-07	2.066E-07	1.631E-07	1.337E-07	1.201E-07	1.093E-07

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES

SECTOR	5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
S	7.818E-08	3.770E-08	2.305E-08	1.162E-08	7.020E-09	4.762E-09	3.349E-09	2.489E-09	1.928E-09	1.540E-09	1.147E-09
SSW	9.242E-08	5.480E-08	2.899E-08	1.191E-08	7.025E-09	4.678E-09	3.482E-09	2.716E-09	2.197E-09	1.823E-09	1.425E-09
SW	9.262E-08	4.428E-08	2.784E-08	1.458E-08	9.765E-09	7.173E-09	4.981E-09	3.662E-09	3.006E-09	2.527E-09	2.051E-09
WSW	7.152E-08	4.415E-08	2.814E-08	1.503E-08	8.988E-09	6.045E-09	4.194E-09	3.082E-09	2.612E-09	2.258E-09	1.801E-09
W	8.100E-08	4.048E-08	2.588E-08	1.388E-08	9.051E-09	6.510E-09	4.198E-09	2.900E-09	2.620E-09	2.397E-09	1.898E-09
WNW	8.405E-08	4.192E-08	2.864E-08	1.686E-08	1.089E-08	7.781E-09	5.974E-09	4.782E-09	4.058E-09	3.513E-09	2.594E-09
NW	1.302E-07	6.641E-08	4.402E-08	2.484E-08	1.608E-08	1.151E-08	8.621E-09	6.754E-09	5.174E-09	4.094E-09	3.434E-09
NNW	1.807E-07	9.846E-08	6.508E-08	3.659E-08	2.541E-08	1.920E-08	1.485E-08	1.196E-08	8.385E-09	6.132E-09	4.864E-09
N	1.474E-07	7.647E-08	4.820E-08	2.535E-08	1.872E-08	1.482E-08	1.256E-08	1.091E-08	8.202E-09	6.378E-09	4.953E-09
NNE	1.148E-07	6.378E-08	4.275E-08	2.453E-08	1.451E-08	9.676E-09	6.902E-09	5.191E-09	3.852E-09	2.962E-09	2.877E-09
NE	9.396E-08	5.278E-08	3.609E-08	2.130E-08	1.160E-08	7.259E-09	5.568E-09	4.454E-09	3.487E-09	2.812E-09	2.444E-09
ENE	6.365E-08	3.736E-08	2.313E-08	1.186E-08	8.766E-09	6.949E-09	5.732E-09	4.876E-09	3.568E-09	2.711E-09	1.809E-09
E	8.187E-08	4.065E-08	2.649E-08	1.461E-08	9.275E-09	6.541E-09	4.342E-09	3.074E-09	2.264E-09	1.729E-09	1.326E-09
ESE	9.371E-08	4.736E-08	2.922E-08	1.492E-08	1.053E-08	8.050E-09	5.938E-09	4.596E-09	3.309E-09	2.478E-09	1.971E-09
SE	9.812E-08	5.595E-08	3.684E-08	2.061E-08	1.057E-08	6.318E-09	4.211E-09	2.992E-09	2.335E-09	1.878E-09	1.605E-09
SSE	9.200E-08	4.783E-08	2.820E-08	1.350E-08	8.581E-09	6.052E-09	4.598E-09	3.649E-09	2.977E-09	2.489E-09	1.737E-09

TABLE 2.3-81 (Continued) (Sheet 2 of 7)

DEPLETED RELATIVE CONCENTRATIONS, X/Q (sec/m3)

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES

SECTOR	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
S	5.870E-06	2.175E-06	1.196E-06	7.367E-07	3.770E-07	2.460E-07	1.773E-07	1.344E-07	1.065E-07	8.620E-08	7.158E-08
SSW	6.350E-06	2.487E-06	1.411E-06	9.554E-07	5.579E-07	3.168E-07	2.048E-07	1.500E-07	1.155E-07	9.512E-08	8.019E-08
SW	6.005E-06	2.471E-06	1.442E-06	9.332E-07	5.117E-07	3.250E-07	2.294E-07	1.660E-07	1.264E-07	1.023E-07	8.498E-08
WSW	4.851E-06	2.020E-06	1.182E-06	7.632E-07	4.175E-07	2.671E-07	1.895E-07	1.489E-07	1.214E-07	8.451E-08	6.142E-08
W	5.349E-06	2.245E-06	1.313E-06	8.469E-07	4.624E-07	2.953E-07	2.093E-07	1.512E-07	1.150E-07	9.062E-08	7.346E-08
WNW	7.157E-06	2.576E-06	1.379E-06	8.373E-07	4.199E-07	2.746E-07	1.982E-07	1.499E-07	1.185E-07	9.378E-08	7.628E-08
NW	9.024E-06	3.584E-06	2.032E-06	1.272E-06	6.664E-07	4.347E-07	3.131E-07	2.246E-07	1.697E-07	1.395E-07	1.175E-07
NNW	1.122E-05	4.684E-06	2.733E-06	1.756E-06	9.550E-07	6.003E-07	4.202E-07	3.104E-07	2.406E-07	1.938E-07	1.603E-07
N	9.659E-06	4.013E-06	2.342E-06	1.405E-06	6.932E-07	4.445E-07	3.159E-07	2.352E-07	1.835E-07	1.542E-07	1.324E-07
NNE	7.283E-06	2.787E-06	1.557E-06	1.044E-06	6.030E-07	3.792E-07	2.655E-07	2.074E-07	1.684E-07	1.287E-07	1.014E-07
NE	6.772E-06	2.609E-06	1.466E-06	9.563E-07	5.310E-07	3.180E-07	2.144E-07	1.625E-07	1.286E-07	1.017E-07	8.269E-08
ENE	5.185E-06	1.980E-06	1.103E-06	6.962E-07	3.692E-07	2.301E-07	1.600E-07	1.113E-07	8.198E-08	6.654E-08	5.537E-08
E	5.845E-06	2.396E-06	1.394E-06	8.994E-07	4.921E-07	2.920E-07	1.954E-07	1.476E-07	1.165E-07	9.179E-08	7.439E-08
ESE	7.773E-06	2.998E-06	1.685E-06	1.020E-06	5.101E-07	3.451E-07	2.557E-07	1.756E-07	1.279E-07	1.028E-07	8.477E-08
SE	6.792E-06	2.600E-06	1.448E-06	9.334E-07	5.089E-07	3.217E-07	2.261E-07	1.721E-07	1.368E-07	1.069E-07	8.602E-08
SSE	4.961E-06	1.943E-06	1.103E-06	7.033E-07	3.775E-07	2.384E-07	1.674E-07	1.295E-07	1.043E-07	9.213E-08	8.260E-08

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES

SECTOR	5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
S	5.828E-08	2.658E-08	1.549E-08	7.224E-09	4.100E-09	2.635E-09	1.766E-09	1.256E-09	9.352E-10	7.192E-10	5.168E-10
SSW	6.889E-08	3.863E-08	1.948E-08	7.405E-09	4.103E-09	2.589E-09	1.836E-09	1.371E-09	1.065E-09	8.512E-10	6.426E-10
SW	6.903E-08	3.122E-08	1.870E-08	9.071E-09	5.704E-09	3.971E-09	2.627E-09	1.849E-09	1.458E-09	1.180E-09	9.241E-10
WSW	5.331E-08	3.112E-08	1.891E-08	9.350E-09	5.249E-09	3.345E-09	2.213E-09	1.557E-09	1.267E-09	1.055E-09	8.115E-10
W	6.037E-08	2.854E-08	1.738E-08	8.627E-09	5.284E-09	3.602E-09	2.214E-09	1.464E-09	1.271E-09	1.119E-09	8.552E-10
WNW	6.266E-08	2.956E-08	1.924E-08	1.049E-08	6.363E-09	4.306E-09	3.151E-09	2.415E-09	1.968E-09	1.640E-09	1.169E-09
NW	9.702E-08	4.682E-08	2.957E-08	1.544E-08	9.393E-09	6.369E-09	4.546E-09	3.411E-09	2.510E-09	1.912E-09	1.548E-09
NNW	1.347E-07	6.941E-08	4.372E-08	2.276E-08	1.484E-08	1.062E-08	7.829E-09	6.036E-09	4.065E-09	2.863E-09	2.192E-09
N	1.098E-07	5.391E-08	3.238E-08	1.576E-08	1.093E-08	8.203E-09	6.620E-09	5.510E-09	3.978E-09	2.979E-09	2.232E-09
NNE	8.563E-08	4.497E-08	2.872E-08	1.525E-08	8.473E-09	5.356E-09	3.640E-09	2.620E-09	1.868E-09	1.383E-09	1.297E-09
NE	7.004E-08	3.720E-08	2.425E-08	1.324E-08	6.775E-09	4.017E-09	2.937E-09	2.249E-09	1.691E-09	1.313E-09	1.101E-09
ENE	4.744E-08	2.634E-08	1.554E-08	7.376E-09	5.119E-09	3.845E-09	3.023E-09	2.462E-09	1.730E-09	1.266E-09	8.152E-10
E	6.103E-08	2.866E-08	1.780E-08	9.081E-09	5.418E-09	3.620E-09	2.290E-09	1.552E-09	1.098E-09	8.076E-10	5.974E-10
ESE	6.986E-08	3.339E-08	1.964E-08	9.281E-09	6.147E-09	4.455E-09	3.132E-09	2.321E-09	1.605E-09	1.157E-09	8.885E-10
SE	7.315E-08	3.944E-08	2.475E-08	1.281E-08	6.176E-09	3.496E-09	2.221E-09	1.510E-09	1.133E-09	8.772E-10	7.235E-10
SSE	6.858E-08	3.372E-08	1.895E-08	8.397E-09	5.011E-09	3.349E-09	2.425E-09	1.843E-09	1.444E-09	1.163E-09	7.829E-10

TABLE 2.3-81 (Continued) (Sheet 3 of 7)

RELATIVE DEPOSITION RATE, D/Q (1/m2)

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES

SECTOR	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
S	2.051E-08	7.915E-09	4.391E-09	2.670E-09	1.312E-09	8.215E-10	5.692E-10	4.163E-10	3.191E-10	2.506E-10	2.024E-10
SSW	1.885E-08	7.676E-09	4.394E-09	2.934E-09	1.646E-09	8.958E-10	5.569E-10	3.936E-10	2.930E-10	2.342E-10	1.920E-10
SW	1.534E-08	6.491E-09	3.800E-09	2.415E-09	1.264E-09	7.672E-10	5.187E-10	3.611E-10	2.654E-10	2.080E-10	1.676E-10
WSW	1.532E-08	6.594E-09	3.899E-09	2.488E-09	1.309E-09	8.038E-10	5.486E-10	4.158E-10	3.284E-10	2.217E-10	1.567E-10
W	1.819E-08	7.878E-09	4.676E-09	2.988E-09	1.576E-09	9.692E-10	6.624E-10	4.628E-10	3.412E-10	2.613E-10	2 [illegible]63E-10
WNW	2.688E-08	1.001E-08	5.435E-09	3.272E-09	1.586E-09	9.985E-10	6.950E-10	5.086E-10	3.899E-10	2.998E-10	2 [illegible]75E-10
NW	3.573E-08	1.449E-08	8.272E-09	5.107E-09	2.567E-09	1.603E-09	1.108E-09	7.657E-10	5.592E-10	4.456E-10	3.644E-10
NNW	4.370E-08	1.852E-08	1.085E-08	6.866E-09	3.571E-09	2.144E-09	1.438E-09	1.022E-09	7.646E-10	5.965E-10	4.787E-10
N	4.400E-08	1.884E-08	1.111E-08	6.587E-09	3.128E-09	1.925E-09	1.315E-09	9.449E-10	7.132E-10	5.816E-10	4.854E-10
NNE	3.496E-08	1.393E-08	7.871E-09	5.222E-09	2.903E-09	1.752E-09	1.181E-09	8.900E-10	6.996E-10	5.184E-10	3.974E-10
NE	2.712E-08	1.080E-08	6.097E-09	3.912E-09	2.076E-09	1.187E-09	7.668E-10	5.587E-10	4.267E-10	3.266E-10	2.576E-10
ENE	1.871E-08	7.397E-09	4.161E-09	2.594E-09	1.322E-09	7.892E-10	5.272E-10	3.536E-10	2.518E-10	1.982E-10	1.603E-10
E	2.441E-08	1.043E-08	6.147E-09	3.923E-09	2.065E-09	1.175E-09	7.567E-10	5.513E-10	4.211E-10	3.217E-10	2.536E-10
ESE	3.802E-08	1.546E-08	8.844E-09	5.314E-09	2.570E-09	1.676E-09	1.199E-09	7.966E-10	5.630E-10	4.398E-10	3.534E-10
SE	3.091E-08	1.236E-08	7.002E-09	4.474E-09	2.359E-09	1.438E-09	9.751E-10	7.181E-10	5.535E-10	4.206E-10	3.297E-10
SSE	2.004E-08	8.206E-09	4.713E-09	2.969E-09	1.534E-09	9.305E-10	6.291E-10	4.699E-10	3.666E-10	3.144E-10	2.743E-10

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES

SECTOR	5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
S	1.605E-10	6.695E-11	3.820E-11	1.689E-11	9.083E-12	5.560E-12	3.562E-12	2.434E-12	1.746E-12	1.299E-12	9.055E-13
SSW	1.607E-10	8.239E-11	4.068E-11	1.466E-11	7.698E-12	4.624E-12	3.138E-12	2.251E-12	1.685E-12	1.303E-12	9.534E-13
SW	1.324E-10	5.443E-11	3.178E-11	1.452E-11	8.621E-12	5.697E-12	3.596E-12	2.426E-12	1.840E-12	1.438E-12	1.091E-12
WSW	1.326E-10	7.085E-11	4.217E-11	1.979E-11	1.054E-11	6.405E-12	4.054E-12	2.741E-12	2.153E-12	1.734E-12	1.295E-12
W	1.655E-10	7.196E-11	4.313E-11	2.044E-11	1.194E-11	7.781E-12	4.593E-12	2.927E-12	2.456E-12	2.099E-12	1.559E-12
WNW	1.903E-10	8.266E-11	5.296E-11	2.757E-11	1.594E-11	1.032E-11	7.254E-12	5.359E-12	4.223E-12	3.414E-12	2.366E-12
NW	2.931E-10	1.289E-10	7.954E-11	3.928E-11	2.262E-11	1.458E-11	9.952E-12	7.168E-12	5.084E-12	3.745E-12	2.940E-12
NNW	3.913E-10	1.832E-10	1.125E-10	5.516E-11	3.397E-11	2.308E-11	1.624E-11	1.201E-11	7.784E-12	5.297E-12	3.928E-12
N	3.925E-10	1.762E-10	1.037E-10	4.784E-11	3.145E-11	2.248E-11	1.736E-11	1.389E-11	9.666E-12	7.003E-12	5.091E-12
NNE	3.270E-10	1.568E-10	9.807E-11	4.930E-11	2.593E-11	1.559E-11	1.012E-11	6.998E-12	4.805E-12	3.440E-12	3.125E-12
NE	2.121E-10	1.021E-10	6.476E-11	3.322E-11	1.600E-11	8.984E-12	6.252E-12	4.584E-12	3.313E-12	2.481E-12	2.013E-12
ENE	1.337E-10	6.774E-11	3.906E-11	1.752E-11	1.151E-11	8.213E-12	6.168E-12	4.820E-12	3.262E-12	2.306E-12	1.439E-12
E	2.026E-10	8.685E-11	5.278E-11	2.549E-11	1.439E-11	9.137E-12	5.523E-12	3.592E-12	2.447E-12	1.740E-12	1.248E-12
ESE	2.842E-10	1.249E-10	7.222E-11	3.253E-11	2.049E-11	1.417E-11	9.553E-12	6.809E-12	4.546E-12	3.174E-12	2.366E-12
SE	2.735E-10	1.357E-10	8.379E-11	4.138E-11	1.898E-11	1.026E-11	6.255E-12	4.095E-12	2.967E-12	2.227E-12	1.784E-12
SSE	2.219E-10	9.996E-11	5.507E-11	2.318E-11	1.312E-11	8.351E-12	5.788E-12	4.225E-12	3.193E-12	2.487E-12	1.624E-12

TABLE 2.3-81 (Continued)

DECAYED RELATIVE CONCENTRATION, HALF LIFE 2.26 DAYS, X/Q (sec/m3)

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES

SECTOR	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
S	6.195E-06	2.376E-06	1.336E-06	8.374E-07	4.405E-07	2.941E-07	2.161E-07	1.666E-07	1.340E-07	1.100E-07	9.253E-08
SSW	6.701E-06	2.717E-06	1.578E-06	1.086E-06	6.518E-07	3.784E-07	2.495E-07	1.859E-07	1.452E-07	1.213E-07	1.035E-07
SW	6.336E-06	2.698E-06	1.611E-06	1.060E-06	5.974E-07	3.880E-07	2.790E-07	2.053E-07	1.587E-07	1.303E-07	1.095E-07
WSW	5.119E-06	2.206E-06	1.321E-06	8.673E-07	4.877E-07	3.191E-07	2.309E-07	1.843E-07	1.528E-07	1.078E-07	7.928E-08
W	5.644E-06	2.453E-06	1.469E-06	9.629E-07	5.404E-07	3.531E-07	2.552E-07	1.876E-07	1.448E-07	1.157E-07	9.497E-08
WNW	7.554E-06	2.815E-06	1.543E-06	9.521E-07	4.911E-07	3.286E-07	2.419E-07	1.861E-07	1.495E-07	1.199E-07	9.881E-08
NW	9.528E-06	3.917E-06	2.274E-06	1.448E-06	7.805E-07	5.212E-07	3.831E-07	2.797E-07	2.148E-07	1.792E-07	1.529E-07
NNW	1.185E-05	5.121E-06	3.059E-06	2.000E-06	1.119E-06	7.199E-07	5.143E-07	3.867E-07	3.045E-07	2.490E-07	2.088E-07
N	1.020E-05	4.387E-06	2.621E-06	1.599E-06	8.121E-07	5.331E-07	3.867E-07	2.931E-07	2.323E-07	1.982E-07	1.724E-07
NNE	7.688E-06	3.047E-06	1.742E-06	1.189E-06	7.062E-07	4.546E-07	3.248E-07	2.582E-07	2.131E-07	1.651E-07	1.319E-07
NE	7.149E-06	2.850E-06	1.640E-06	1.088E-06	6.213E-07	3.809E-07	2.619E-07	2.020E-07	1.624E-07	1.303E-07	1.073E-07
ENE	5.473E-06	2.162E-06	1.233E-06	7.915E-07	4.315E-07	2.751E-07	1.951E-07	1.381E-07	1.033E-07	8.499E-08	7.163E-08
E	6.170E-06	2.618E-06	1.558E-06	1.023E-06	5.753E-07	3.492E-07	2.384E-07	1.832E-07	1.468E-07	1.172E-07	9.625E-08
ESE	8.206E-06	3.277E-06	1.885E-06	1.161E-06	5.968E-07	4.133E-07	3.123E-07	2.182E-07	1.615E-07	1.316E-07	1.099E-07
SE	7.168E-06	2.841E-06	1.621E-06	1.062E-06	5.954E-07	3.852E-07	2.761E-07	2.138E-07	1.726E-07	1.368E-07	1.115E-07
SSE	5.236E-06	2.123E-06	1.233E-06	7.998E-07	4.415E-07	2.852E-07	2.043E-07	1.608E-07	1.316E-07	1.178E-07	1.070E-07

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES

SECTOR	5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
S	7.621E-08	3.627E-08	2.189E-08	1.075E-08	6.329E-09	4.181E-09	2.864E-09	2.074E-09	1.566E-09	1.219E-09	8.848E-10
SSW	8.995E-08	5.260E-08	2.744E-08	1.096E-08	6.289E-09	4.073E-09	2.948E-09	2.237E-09	1.760E-09	1.421E-09	1.081E-09
SW	8.992E-08	4.236E-08	2.622E-08	1.332E-08	8.662E-09	6.172E-09	4.156E-09	2.964E-09	2.361E-09	1.926E-09	1.516E-09
WSW	6.963E-08	4.239E-08	2.665E-08	1.385E-08	8.055E-09	5.271E-09	3.557E-09	2.544E-09	2.097E-09	1.765E-09	1.369E-09
W	7.897E-08	3.896E-08	2.459E-08	1.284E-08	8.160E-09	5.723E-09	3.598E-09	2.422E-09	2.133E-09	1.902E-09	1.469E-09
WNW	8.213E-08	4.049E-08	2.733E-08	1.571E-08	9.914E-09	6.915E-09	5.185E-09	4.055E-09	3.361E-09	2.842E-09	2.051E-09
NW	1.279E-07	6.465E-08	4.247E-08	2.354E-08	1.498E-08	1.053E-08	7.746E-09	5.970E-09	4.493E-09	3.494E-09	2.881E-09
NNW	1.776E-07	9.590E-08	6.284E-08	3.472E-08	2.369E-08	1.759E-08	1.337E-08	1.058E-08	7.299E-09	5.250E-09	4.096E-09
N	1.448E-07	7.452E-08	4.657E-08	2.407E-08	1.746E-08	1.360E-08	1.132E-08	9.674E-09	7.148E-09	5.466E-09	4.173E-09
NNE	1.128E-07	6.204E-08	4.119E-08	2.320E-08	1.347E-08	8.819E-09	6.177E-09	4.562E-09	3.324E-09	2.511E-09	2.395E-09
NE	9.198E-08	5.111E-08	3.457E-08	1.997E-08	1.064E-08	6.518E-09	4.894E-09	3.833E-09	2.938E-09	2.320E-09	1.975E-09
ENE	6.210E-08	3.601E-08	2.202E-08	1.101E-08	7.940E-09	6.142E-09	4.944E-09	4.106E-09	2.932E-09	2.175E-09	1.417E-09
E	7.988E-08	3.918E-08	2.521E-08	1.356E-08	8.397E-09	5.774E-09	3.740E-09	2.583E-09	1.856E-09	1.383E-09	1.035E-09
ESE	9.169E-08	4.581E-08	2.795E-08	1.395E-08	9.623E-09	7.196E-09	5.190E-09	3.929E-09	2.766E-09	2.026E-09	1.576E-09
SE	9.598E-08	5.412E-08	3.523E-08	1.927E-08	9.671E-09	5.649E-09	3.682E-09	2.558E-09	1.954E-09	1.537E-09	1.286E-09
SSE	8.986E-08	4.616E-08	2.688E-08	1.257E-08	7.792E-09	5.364E-09	3.978E-09	3.082E-09	2.454E-09	2.004E-09	1.366E-09

TABLE 2.3-81 (Continued) (Sheet 5 of 7)

DECAYED RELATIVE CONCENTRATION, HALF LIFE 8.0 DAYS, X/Q (sec/m3)

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES

SECTOR	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
S	6.201E-06	2.380E-06	1.340E-06	8.404E-07	4.429E-07	2.962E-07	2.180E-07	1.685E-07	1.357E-07	1.117E-07	9.401E-08
SSW	6.707E-06	2.722E-06	1.582E-06	1.090E-06	6.555E-07	3.814E-07	2.519E-07	1.880E-07	1.472E-07	1.232E-07	1.054E-07
SW	6.343E-06	2.703E-06	1.616E-06	1.064E-06	6.011E-07	3.912E-07	2.820E-07	2.080E-07	1.610E-07	1.324E-07	1.115E-07
WSW	5.123E-06	2.211E-06	1.324E-06	8.706E-07	4.904E-07	3.216E-07	2.331E-07	1.865E-07	1.548E-07	1.094E-07	8.067E-08
W	5.650E-06	2.457E-06	1.473E-06	9.663E-07	5.432E-07	3.557E-07	2.574E-07	1.896E-07	1.466E-07	1.174E-07	9.653E-08
WNW	7.560E-06	2.819E-06	1.546E-06	9.553E-07	4.935E-07	3.308E-07	2.438E-07	1.880E-07	1.513E-07	1.215E-07	1.003E-07
NW	9.534E-06	3.922E-06	2.278E-06	1.451E-06	7.835E-07	5.238E-07	3.856E-07	2.819E-07	2.167E-07	1.811E-07	1.547E-07
NNW	1.186E-05	5.128E-06	3.064E-06	2.004E-06	1.123E-06	7.235E-07	5.175E-07	3.896E-07	3.073E-07	2.515E-07	2.111E-07
N	1.021E-05	4.393E-06	2.626E-06	1.603E-06	8.151E-07	5.357E-07	3.890E-07	2.952E-07	2.343E-07	2.001E-07	1.743E-07
NNE	7.695E-06	3.051E-06	1.745E-06	1.191E-06	7.090E-07	4.570E-07	3.269E-07	2.602E-07	2.152E-07	1.668E-07	1.335E-07
NE	7.153E-06	2.854E-06	1.644E-06	1.091E-06	6.242E-07	3.832E-07	2.639E-07	2.038E-07	1.641E-07	1.318E-07	1.088E-07
ENE	5.477E-06	2.166E-06	1.237E-06	7.943E-07	4.338E-07	2.771E-07	1.967E-07	1.395E-07	1.045E-07	8.619E-08	7.277E-08
E	6.175E-06	2.623E-06	1.563E-06	1.026E-06	5.782E-07	3.516E-07	2.405E-07	1.850E-07	1.486E-07	1.189E-07	9.774E-08
ESE	8.212E-06	3.282E-06	1.889E-06	1.164E-06	5.996E-07	4.158E-07	3.147E-07	2.203E-07	1.632E-07	1.332E-07	1.115E-07
SE	7.174E-06	2.846E-06	1.624E-06	1.065E-06	5.981E-07	3.876E-07	2.784E-07	2.159E-07	1.745E-07	1.385E-07	1.131E-07
SSE	5.240E-06	2.126E-06	1.237E-06	8.024E-07	4.437E-07	2.871E-07	2.059E-07	1.624E-07	1.331E-07	1.194E-07	1.086E-07

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES

SECTOR	5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
S	7.762E-08	3.729E-08	2.271E-08	1.136E-08	6.816E-09	4.588E-09	3.202E-09	2.362E-09	1.816E-09	1.440E-09	1.064E-09
SSW	9.171E-08	5.417E-08	2.854E-08	1.164E-08	6.809E-09	4.497E-09	3.320E-09	2.569E-09	2.061E-09	1.697E-09	1.316E-09
SW	9.185E-08	4.372E-08	2.737E-08	1.421E-08	9.438E-09	6.871E-09	4.730E-09	3.447E-09	2.805E-09	2.338E-09	1.880E-09
WSW	7.098E-08	4.365E-08	2.771E-08	1.469E-08	8.711E-09	5.814E-09	4.001E-09	2.917E-09	2.452E-09	2.103E-09	1.664E-09
W	8.042E-08	4.005E-08	2.551E-08	1.357E-08	8.784E-09	6.274E-09	4.016E-09	2.753E-09	2.469E-09	2.242E-09	1.762E-09
WNW	8.351E-08	4.151E-08	2.827E-08	1.653E-08	1.060E-08	7.522E-09	5.736E-09	4.561E-09	3.843E-09	3.304E-09	2.423E-09
NW	1.296E-07	6.591E-08	4.357E-08	2.446E-08	1.576E-08	1.122E-08	8.358E-09	6.518E-09	4.969E-09	3.910E-09	3.263E-09
NNW	1.799E-07	9.773E-08	6.444E-08	3.605E-08	2.490E-08	1.872E-08	1.441E-08	1.155E-08	8.051E-09	5.862E-09	4.627E-09
N	1.467E-07	7.591E-08	4.774E-08	2.498E-08	1.835E-08	1.446E-08	1.218E-08	1.054E-08	7.882E-09	6.099E-09	4.712E-09
NNE	1.143E-07	6.328E-08	4.230E-08	2.415E-08	1.420E-08	9.427E-09	6.684E-09	5.000E-09	3.691E-09	2.823E-09	2.727E-09
NE	9.340E-08	5.229E-08	3.565E-08	2.091E-08	1.132E-08	7.042E-09	5.365E-09	4.265E-09	3.318E-09	2.659E-09	2.297E-09
ENE	6.320E-08	3.697E-08	2.281E-08	1.161E-08	8.521E-09	6.707E-09	5.494E-09	4.641E-09	3.372E-09	2.543E-09	1.685E-09
E	8.130E-08	4.023E-08	2.612E-08	1.430E-08	9.015E-09	6.312E-09	4.160E-09	2.924E-09	2.138E-09	1.621E-09	1.234E-09
ESE	9.314E-08	4.691E-08	2.886E-08	1.463E-08	1.026E-08	7.796E-09	5.713E-09	4.393E-09	3.142E-09	2.338E-09	1.847E-09
SE	9.751E-08	5.542E-08	3.637E-08	2.021E-08	1.031E-08	6.118E-09	4.052E-09	2.859E-09	2.218E-09	1.773E-09	1.505E-09
SSE	9.138E-08	4.734E-08	2.782E-08	1.323E-08	8.344E-09	5.846E-09	4.410E-09	3.476E-09	2.816E-09	2.338E-09	1.620E-09

TABLE 2.3-81 (Continued) (Sheet 6 of 7)

DECAYED AND DEPLETED RELATIVE CONCENTRATIONS, HALF LIFE 2.26 DAYS, X/Q (sec/m3)

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES

SECTOR	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
S	5.863E-06	2.169E-06	1.191E-06	7.330E-07	3.741E-07	2.436E-07	1.751E-07	1.323E-07	1.046E-07	8.446E-08	6.995E-08
SSW	6.342E-06	2.480E-06	1.406E-06	9.503E-07	5.535E-07	3.134E-07	2.021E-07	1.477E-07	1.133E-07	9.308E-08	7.826E-08
SW	5.997E-06	2.464E-06	1.436E-06	9.279E-07	5.074E-07	3.213E-07	2.260E-07	1.631E-07	1.239E-07	9.996E-08	8.276E-08
WSW	4.844E-06	2.015E-06	1.177E-06	7.592E-07	4.141E-07	2.642E-07	1.870E-07	1.464E-07	1.192E-07	8.273E-08	5.995E-08
W	5.342E-06	2.239E-06	1.309E-06	8.428E-07	4.589E-07	2.924E-07	2.068E-07	1.490E-07	1.130E-07	8.881E-08	7.181E-08
WNW	7.149E-06	2.570E-06	1.375E-06	8.335E-07	4.171E-07	2.721E-07	1.959E-07	1.479E-07	1.167E-07	9.207E-08	7.471E-08
NW	9.012E-06	3.578E-06	2.026E-06	1.267E-06	6.628E-07	4.316E-07	3.103E-07	2.222E-07	1.676E-07	1.376E-07	1.156E-07
NNW	1.121E-05	4.677E-06	2.725E-06	1.751E-06	9.500E-07	5.961E-07	4.166E-07	3.072E-07	2.376E-07	1.911E-07	1.578E-07
N	9.652E-06	4.006E-06	2.335E-06	1.401E-06	6.897E-07	4.414E-07	3.132E-07	2.329E-07	1.813E-07	1.522E-07	1.303E-07
NNE	7.276E-06	2.783E-06	1.553E-06	1.040E-06	5.998E-07	3.765E-07	2.631E-07	2.051E-07	1.663E-07	1.267E-07	9.975E-08
NE	6.766E-06	2.603E-06	1.461E-06	9.523E-07	5.277E-07	3.154E-07	2.122E-07	1.604E-07	1.268E-07	9.996E-08	8.113E-08
ENE	5.179E-06	1.975E-06	1.098E-06	6.928E-07	3.665E-07	2.278E-07	1.580E-07	1.097E-07	8.058E-08	6.524E-08	5.416E-08
E	5.839E-06	2.391E-06	1.388E-06	8.952E-07	4.886E-07	2.892E-07	1.931E-07	1.455E-07	1.145E-07	9.002E-08	7.277E-08
ESE	7.766E-06	2.992E-06	1.679E-06	1.016E-06	5.068E-07	3.421E-07	2.530E-07	1.734E-07	1.260E-07	1.010E-07	8.313E-08
SE	6.784E-06	2.594E-06	1.443E-06	9.294E-07	5.057E-07	3.189E-07	2.237E-07	1.698E-07	1.347E-07	1.050E-07	8.433E-08
SSE	4.955E-06	1.938E-06	1.099E-06	7.001E-07	3.749E-07	2.362E-07	1.655E-07	1.277E-07	1.026E-07	9.042E-08	8.087E-08

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES

SECTOR	5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
S	5.681E-08	2.557E-08	1.471E-08	6.681E-09	3.695E-09	2.313E-09	1.511E-09	1.047E-09	7.593E-10	5.694E-10	3.989E-10
SSW	6.704E-08	3.708E-08	1.844E-08	6.817E-09	3.673E-09	2.254E-09	1.555E-09	1.129E-09	8.535E-10	6.634E-10	4.874E-10
SW	6.703E-08	2.986E-08	1.761E-08	8.286E-09	5.057E-09	3.415E-09	2.192E-09	1.497E-09	1.145E-09	8.994E-10	6.829E-10
WSW	5.190E-08	2.989E-08	1.791E-08	8.612E-09	4.705E-09	2.917E-09	1.876E-09	1.284E-09	1.017E-09	8.238E-10	6.171E-10
W	5.887E-08	2.747E-08	1.652E-08	7.988E-09	4.768E-09	3.167E-09	1.897E-09	1.223E-09	1.035E-09	8.885E-10	6.618E-10
WNW	6.122E-08	2.854E-08	1.836E-08	9.771E-09	5.790E-09	3.826E-09	2.735E-09	2.047E-09	1.630E-09	1.328E-09	9.238E-10
NW	9.531E-08	4.558E-08	2.853E-08	1.464E-08	8.743E-09	5.826E-09	4.086E-09	3.013E-09	2.179E-09	1.632E-09	1.298E-09
NNW	1.324E-07	6.761E-08	4.222E-08	2.159E-08	1.384E-08	9.734E-09	7.052E-09	5.346E-09	3.539E-09	2.452E-09	1.845E-09
N	1.080E-07	5.254E-08	3.129E-08	1.496E-08	1.020E-08	7.523E-09	5.968E-09	4.885E-09	3.466E-09	2.552E-09	1.881E-09
NNE	8.408E-08	4.373E-08	2.768E-08	1.442E-08	7.867E-09	4.882E-09	3.257E-09	2.303E-09	1.612E-09	1.173E-09	1.079E-09
NE	6.856E-08	3.603E-08	2.323E-08	1.242E-08	6.215E-09	3.607E-09	2.581E-09	1.935E-09	1.425E-09	1.083E-09	8.899E-10
ENE	4.629E-08	2.538E-08	1.479E-08	6.849E-09	4.637E-09	3.398E-09	2.608E-09	2.073E-09	1.422E-09	1.015E-09	6.384E-10
E	5.955E-08	2.762E-08	1.694E-08	8.434E-09	4.904E-09	3.195E-09	1.972E-09	1.304E-09	8.998E-10	6.458E-10	4.665E-10
ESE	6.834E-08	3.230E-08	1.878E-08	8.676E-09	5.619E-09	3.981E-09	2.737E-09	1.984E-09	1.342E-09	9.460E-10	7.103E-10
SE	7.155E-08	3.815E-08	2.367E-08	1.198E-08	5.646E-09	3.125E-09	1.942E-09	1.291E-09	9.478E-10	7.178E-10	5.796E-10
SSE	6.698E-08	3.254E-08	1.806E-08	7.813E-09	4.550E-09	2.968E-09	2.098E-09	1.556E-09	1.190E-09	9.360E-10	6.154E-10

TABLE 2.3-81 (Continued)

(Sheet 7 of 7)

DECAYED AND DEPLETED RELATIVE CONCENTRATION, HALF LIFE 8.0 DAYS, X/Q (sec/m3)

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES

SECTOR	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
S	5.868E-06	2.173E-06	1.194E-06	7.357E-07	3.762E-07	2.453E-07	1.766E-07	1.338E-07	1.059E-07	8.570E-08	7.111E-08
SSW	6.348E-06	2.485E-06	1.410E-06	9.540E-07	5.567E-07	3.158E-07	2.040E-07	1.494E-07	1.149E-07	9.453E-08	7.964E-08
SW	6.003E-06	2.468E-06	1.440E-06	9.317E-07	5.105E-07	3.240E-07	2.284E-07	1.652E-07	1.256E-07	1.017E-07	8.435E-08
WSW	4.849E-06	2.019E-06	1.181E-06	7.620E-07	4.166E-07	2.663E-07	1.888E-07	1.481E-07	1.208E-07	8.401E-08	6.100E-08
W	5.347E-06	2.244E-06	1.312E-06	8.458E-07	4.614E-07	2.945E-07	2.086E-07	1.506E-07	1.145E-07	9.011E-08	7.299E-08
WNW	7.154E-06	2.574E-06	1.378E-06	8.362E-07	4.191E-07	2.739E-07	1.975E-07	1.494E-07	1.180E-07	9.329E-08	7.583E-08
NW	9.018E-06	3.582E-06	2.030E-06	1.270E-06	6.654E-07	4.338E-07	3.123E-07	2.239E-07	1.691E-07	1.390E-07	1.170E-07
NNW	1.122E-05	4.682E-06	2.731E-06	1.754E-06	9.536E-07	5.991E-07	4.192E-07	3.095E-07	2.397E-07	1.931E-07	1.596E-07
N	9.659E-06	4.011E-06	2.339E-06	1.404E-06	6.922E-07	4.436E-07	3.151E-07	2.345E-07	1.828E-07	1.536E-07	1.318E-07
NNE	7.281E-06	2.786E-06	1.556E-06	1.043E-06	6.020E-07	3.784E-07	2.648E-07	2.067E-07	1.678E-07	1.281E-07	1.009E-07
NE	6.770E-06	2.607E-06	1.464E-06	9.552E-07	5.300E-07	3.172E-07	2.138E-07	1.619E-07	1.281E-07	1.012E-07	8.225E-08
ENE	5.184E-06	1.978E-06	1.102E-06	6.952E-07	3.684E-07	2.294E-07	1.594E-07	1.109E-07	8.158E-08	6.617E-08	5.502E-08
E	5.844E-06	2.395E-06	1.393E-06	8.982E-07	4.911E-07	2.912E-07	1.947E-07	1.470E-07	1.160E-07	9.128E-08	7.393E-08
ESE	7.771E-06	2.997E-06	1.684E-06	1.019E-06	5.092E-07	3.442E-07	2.549E-07	1.750E-07	1.274E-07	1.023E-07	8.430E-08
SE	6.789E-06	2.599E-06	1.447E-06	9.323E-07	5.080E-07	3.209E-07	2.255E-07	1.714E-07	1.363E-07	1.064E-07	8.553E-08
SSE	4.959E-06	1.942E-06	1.102E-06	7.024E-07	3.768E-07	2.377E-07	1.668E-07	1.290E-07	1.038E-07	9.164E-08	8.211E-08

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES

SECTOR	5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
S	5.786E-08	2.629E-08	1.526E-08	7.067E-09	3.980E-09	2.539E-09	1.689E-09	1.192E-09	8.805E-10	6.724E-10	4.795E-10
SSW	6.837E-08	3.819E-08	1.918E-08	7.236E-09	3.976E-09	2.488E-09	1.751E-09	1.297E-09	9.996E-10	7.924E-10	5.931E-10
SW	6.846E-08	3.082E-08	1.838E-08	8.842E-09	5.512E-09	3.804E-09	2.495E-09	1.741E-09	1.361E-09	1.092E-09	8.473E-10
WSW	5.291E-08	3.077E-08	1.861E-08	9.133E-09	5.088E-09	3.217E-09	2.110E-09	1.473E-09	1.189E-09	9.823E-10	7.498E-10
W	5.994E-08	2.823E-08	1.713E-08	8.442E-09	5.131E-09	3.472E-09	2.118E-09	1.390E-09	1.198E-09	1.047E-09	7.944E-10
WNW	6.225E-08	2.927E-08	1.898E-08	1.028E-08	6.194E-09	4.162E-09	3.025E-09	2.303E-09	1.864E-09	1.543E-09	1.091E-09
NW	9.656E-08	4.646E-08	2.927E-08	1.521E-08	9.202E-09	6.210E-09	4.409E-09	3.291E-09	2.409E-09	1.826E-09	1.470E-09
NNW	1.341E-07	6.889E-08	4.329E-08	2.241E-08	1.455E-08	1.035E-08	7.598E-09	5.829E-09	3.906E-09	2.738E-09	2.085E-09
N	1.093E-07	5.351E-08	3.207E-08	1.554E-08	1.072E-08	8.001E-09	6.425E-09	5.322E-09	3.822E-09	2.849E-09	2.123E-09
NNE	8.519E-08	4.461E-08	2.842E-08	1.502E-08	8.295E-09	5.215E-09	3.525E-09	2.525E-09	1.790E-09	1.318E-09	1.229E-09
NE	6.962E-08	3.687E-08	2.395E-08	1.300E-08	6.610E-09	3.895E-09	2.830E-09	2.154E-09	1.609E-09	1.242E-09	1.035E-09
ENE	4.711E-08	2.607E-08	1.532E-08	7.222E-09	4.976E-09	3.711E-09	2.898E-09	2.343E-09	1.635E-09	1.187E-09	7.592E-10
E	6.060E-08	2.836E-08	1.755E-08	8.893E-09	5.266E-09	3.493E-09	2.194E-09	1.476E-09	1.037E-09	7.569E-10	5.561E-10
ESE	6.942E-08	3.307E-08	1.938E-08	9.102E-09	5.991E-09	4.314E-09	3.013E-09	2.218E-09	1.523E-09	1.092E-09	8.320E-10
SE	7.269E-08	3.907E-08	2.444E-08	1.257E-08	6.020E-09	3.385E-09	2.137E-09	1.444E-09	1.076E-09	8.275E-10	6.781E-10
SSE	6.813E-08	3.337E-08	1.869E-08	8.226E-09	4.875E-09	3.235E-09	2.326E-09	1.755E-09	1.366E-09	1.092E-09	7.298E-10

(Sheet 1 of 4)

TABLE 2.3-82 AVERAGE METEOROLOGICAL RELATIVE CONCENTRATION ANALYSIS SPECIAL DISTANCES, UNIT VENT RELEASE
Data Period: May 4, 1973 to May 4, 1975 and March 16, 1978 to March 16, 1979 Combined

RELATIVE CONCENTRATION, X/Q (sec/m3)

AFFECTED SECTOR	EXCLUSION ZONE	LPZ	NEAREST[1] GOAT (TO 5 MILES)	NEAREST[1] COW (TO 5 MILES)	NEAREST[1] MEAT ANIMAL (TO 5 MILES)	NEAREST[1] VEG GARDEN (TO 5 MILES)	NEAREST[1] RESIDENCE (TO 5 MILES)	RESTRICTED AREA
S	1.023E-06	1.860E-07	7.161E-08	7.161E-08	1.222E-07	1.222E-07	1.222E-07	9.212E-07
SSW	1.177E-06	2.100E-07	8.112E-08	8.112E-08	1.386E-07	1.734E-07	1.734E-07	9.450E-07
SW	1.188E-06	2.260E-07	2.260E-07	1.728E-07	2.034E-07	2.034E-07	2.260E-07	6.264E-07
WSW	9.933E-07	1.960E-07	6.105E-08	6.105E-08	5.588E-07	3.892E-07	5.588E-07	5.796E-07
W	1.098E-06	2.214E-07	8.720E-08	4.026E-07	4.026E-07	4.026E-07	4.840E-07	6.656E-07
WNW	1.110E-06	2.090E-07	7.696E-08	7.696E-08	3.304E-07	3.304E-07	3.304E-07	6.678E-07
NW	1.660E-06	3.182E-07	1.155E-07	1.155E-07	3.696E-07	3.696E-07	3.696E-07	6.723E-07
NNW	2.220E-06	4.218E-07	1.575E-07	1.575E-07	7.119E-07	7.119E-07	7.119E-07	9.976E-07
N	1.980E-06	3.232E-07	1.300E-07	1.300E-07	1.300E-07	1.300E-07	1.428E-06	7.968E-07
NNE	1.352E-06	2.783E-07	3.348E-07	9.790E-08	3.751E-07	3.729E-07	3.729E-07	6.148E-07
NE	1.2603-06	2.121E-07	1.326E-07	1.938E-07	1.938E-07	1.938E-07	1.938E-07	6.032E-07
ENE	9.379E-07	1.650E-07	2.260E-07	5.858E-08	2.260E-07	2.975E-07	2.975E-07	3.213E-07
E	1.188E-06	2.040E-07	7.007E-08	7.007E-08	1.236E-07	1.089E-07	4.181E-07	4.600E-07
ESE	1.430E-06	2.718E-07	8.487E-08	8.487E-08	3.312E-07	3.312E-07	3.312E-07	5.895E-07
SE	1.240E-06	2.394E-07	8.073E-08	8.073E-08	2.877E-07	2.877E-07	2.877E-07	7.700E-07
SSE	9.579E-07	1.680E-07	9.216E-08	9.216E-08	1.680E-07	1.680E-07	1.680E-07	7.844E-07

DEPLETED RELATIVE CONCENTRATION, X/Q (sec/m3)

AFFECTED SECTOR	EXCLUSION ZONE	LPZ	NEAREST[1] GOAT (TO 5 MILES)	NEAREST[1] COW (TO 5 MILES)	NEAREST[1] MEAT ANIMAL (TO 5 MILES)	NEAREST[1] VEG GARDEN (TO 5 MILES)	NEAREST[1] RESIDENCE (TO 5 MILES)	RESTRICTED AREA
S	9.207E.07	1.488E.07	5.301E.08	5.301E.08	9.400E.08	9.400E.08	9.400E.08	8.178E.07
SSW	1.070E.06	1.680E.07	6.032E.08	6.032E.08	1.089E.07	1.428E.07	1.428E.07	8.295E.07
SW	1.080E.06	1.808E.07	1.808E.07	1.404E.07	1.695E.07	1.695E.07	1.808E.07	5.400E.07
WSW	8.901E.07	1.540E.07	4.551E.08	4.551E.08	4.826E.07	3.336E.07	4.826E.07	5.040E-07
W	9.744E.07	1.722E.07	6.540E.08	3.416E.07	3.416E.07	3.416E.07	4.114E.07	5.824E.07
WNW	1.032E.06	1.650E.07	5.720E.08	5.720E.08	2.714E.07	2.714E.07	2.714E.07	5.830E.07
NW	1.494E.06	2.580E.07	8.470E.08	8.470E.08	3.024E.07	3.024E.07	3.024E.07	5.751E.07
NNW	1.998E.06	3.420E.07	1.155E.07	1.155E.07	5.989E.07	5.989E.07	5.989E.07	8.584E.07
N	1.760E.06	2.626E.07	9.400E.08	9.400E.08	9.400E.08	9.400E.08	1.224E.06	6.912E.07
NNE	1.144E.06	2.178E.07	2.728E.07	7.260E.08	3.146E.07	3.164E.07	3.164E.07	5.336E.07
NE	1.155E.06	1.717E.07	9.996E.08	1.530E.07	1.530E.07	1.530E.07	1.530E.07	5.220E.07
ENE	8.326E.07	1.320E.07	1.921E.07	4.444E.08	1.921E.07	2.499E.07	2.499E.07	2.737E.07
E	1.058E.06	1.632E.07	5.187E.08	5.187E.08	9.991E.08	8.514E.08	3.503E.07	3.910E.07
ESE	1.278E.06	2.114E.07	6.273E.08	6.273E.08	2.736E.07	2.736E.07	2.736E.07	4.978E.07
SE	1.104E.06	1.862E.07	5.967E.08	5.967E.08	2.466E.07	2.466E.07	2.466E.07	6.720E.07
SSE	8.549E.07	1.365E.07	6.912E.08	6.912E.08	1.365E.07	1.365E.07	1.365E.07	6.996E.07

TABLE 2.3-82 (Continued) (Sheet 2 of 4)

RELATIVE DEPOSITION RATE, D/Q (1/m2)

AFFECTED SECTOR	EXCLUSION ZONE	LPZ	NEAREST[1] GOAT (TO 5 MILES)	NEAREST[1] COW (TO 5 MILES)	NEAREST[1] MEAT ANIMAL (TO 5 MILES)	NEAREST[1] VEG GARDEN (TO 5 MILES)	NEAREST[1] RESIDENCE (TO 5 MILES)	RESTRICTED AREA
S	4.557E-09	5.766E-10	1.674E-10	1.674E-10	3.384E-10	3.384E-10	3.384E-10	4.042E-09
SSW	4.601E-09	5.670E-10	1.664E-10	1.664E-10	3.465E-10	3.488E-10	4.488E-10	3.465E-09
SW	3.996E-09	5.198E-10	5.198E-10	3.672E-10	4.520E-10	4.520E-10	5.198E-10	1.836E-09
WSW	3.999E-09	5.460E-10	1.221E-10	1.221E-10	2.032E-09	1.334E-09	2.032E-09	2.142E-09
W	4.816E-09	6.642E-10	2.071E-10	1.464E-09	1.464E-09	1.464E-09	1.815E-09	2.704E-09
WNW	5.661E-09	7.040E-10	1.976E-10	1.976E-10	1.180E-09	1.180E-09	1.180E-09	2.968E-09
NW	8.300E-09	1.118E-09	2.926E-10	2.926E-10	1.344E-09	1.344E-09	1.344E-09	2.916E-09
NNW	1.110E-08	1.482E-09	3.885E-10	3.885E-10	2.825E-09	2.825E-09	2.825E-09	4.292E-09
N	1.100E-08	1.313E-09	3.800E-10	3.800E-10	3.800E-10	3.800E-10	7.854E-09	4.128E-09
NNE	8.216E-09	1.198E-09	1.488E-09	3.190E-10	1.815E-09	1.808E-09	1.808E-09	3.364E-09
NE	6.405E-09	7.777E-10	3.876E-10	6.834E-10	6.834E-10	6.834E-10	6.834E-10	2.784E-09
ENE	4.407E-09	5.280E-10	8.136E-10	1.414E-10	8.136E-10	1.130E-09	1.130E-09	1.190E-09
E	6.480E-09	7.650E-10	2.002E-10	2.002E-10	4.223E-10	3.564E-10	1.808E-10	2.070E-09
ESE	9.152E-09	1.208E-09	2.829E-10	2.829E-10	1.584E-09	1.584E-09	1.584E-09	3.275E-09
SE	7.316E-09	9.842E-10	2.457E-10	2.457E-10	1.260E-09	1.260E-09	1.260E-09	4.200E-09
SSE	4.944E-09	6.300E-10	2.592E-10	2.592E-10	6.300E-10	6.300E-10	6.300E-10	3.922E-09

DECAYED, HALF LIFE 2.26 DAYS, RELATIVE CONCENTRATION, X/Q (sec/m3)

AFFECTED SECTOR	EXCLUSION ZONE	LPZ	NEAREST[1] GOAT (TO 5 MILES)	NEAREST[1] COW (TO 5 MILES)	NEAREST[1] MEAT ANIMAL (TO 5 MILES)	NEAREST[1] VEG GARDEN (TO 5 MILES)	NEAREST[1] RESIDENCE (TO 5 MILES)	RESTRICTED AREA
S	1.023E-06	1.767E-07	6.975E-08	6.975E-08	1.222E-07	1.222E-07	1.222E-07	9.212E-07
SSW	1.177E-06	2.100E-07	7.904E-08	7.904E-08	1.386E -07	1.734E-07	1.734E-07	9.345E-07
SW	1.188E-06	2.260E-07	2.260E-07	1.728E-07	2.034E-07	2.034E-07	2.260E-07	6.264E-07
WSW	9.933E-07	1.960E-07	5.883E-08	5.883E-08	5.588E-07	3.892E-07	5.588E-07	5.796E-07
W	1.086E-06	2.214E-07	8.502E-08	4.026E-07	4.026E-07	4.026E-07	4.840E-07	6.656E-07
WNW	1.110E-06	2.090E-07	7.488E-08	7.488E-08	3.304E-07	3.304E-07	3.304E-07	6.678E-07
NW	1.660E-06	3.182E-07	1.078E-07	1.078E-07	3.696E-07	3.696E-07	3.696E-07	6.642E-07
NNW	2.220E-06	4.218E-07	1.575E-07	1.575E-07	7.119E-07	7.119E-07	7.119E-07	9.860E-07
N	1.980E-06	3.232E-07	1.200E-07	1.200E-07	1.200E-07	1.200E-07	1.326E-06	7.968E-07
NNE	1.352E-06	2.783E-07	3.348E-07	9.570E-08	3.751E-07	3.729E-07	3.729E-07	6.148E-07
NE	1.260E-06	2.121E-07	1.224E-07	1.938E-07	1.938E-07	1.938E-07	1.938E-07	6.032E-07
ENE	9.379E-07	1.650E-07	2.260E-07	5.757E-08	2.260E-07	2.975E-07	2.975E-07	3.213E-07
E	1.188E-06	2.040E-07	6.825E-08	6.825E-08	1.236E-07	1.089E-07	4.068E-07	4.600E-07
ESE	1.430E-06	2.718E-07	8.241E-08	8.241E-08	3.312E-07	3.312E-07	3.312E-07	5.764E-07
SE	1.240E-06	2.394E-07	7.893E-08	7.893E-08	2.877E-07	2.877E-07	2.877E-07	7.700E-07
SSE	9.579E-07	1.680E-07	9.928E-08	9.928E-08	1.680E-07	1.680E-07	1.680E-07	7.844E-07

TABLE 2.3-82 (Continued) (Sheet 3 of 4)

DECAYED HALF LIFE 8.00 DAYS, RELATIVE CONCENTRATION, X/Q (sec/m3)

AFFECTED SECTOR	EXCLUSION ZONE	LPZ	NEAREST[1] GOAT (TO 5 MILES)	NEAREST[1] COW (TO 5 MILES)	NEAREST[1] MEAT ANIMAL (TO 5 MILES)	NEAREST[1] VEG GARDEN (TO 5 MILES)	NEAREST[1] RESIDENCE (TO 5 MILES)	RESTRICTED AREA
S	1.023E-06	1.860E-07	7.068E-08	7.068E-08	1.222E-07	1.222E-07	1.222E-07	9.212E-07
SSW	1.177E-06	2.100E-07	8.008E-08	8.008E-08	1.386E-07	1.734E-07	1.734E-07	9.450E-07
SW	1.188E-06	2.260E-07	2.260E-07	1.728E-07	2.034E-07	2.034E-07	2.260E-07	6.264E-07
WSW	9.933E-07	1.960E-07	5.994E-08	5.994E-08	5.588E-07	3.892E-07	5.588E-07	5.796E-07
W	1.098E-06	2.214E-07	8.611E-08	4.026E-07	4.026E-07	4.026E-07	4.840E-07	6.656E-07
WNW	1.110E-06	2.090E-07	7.592E-08	7.592E-08	3.304E-07	3.304E-07	3.304E-07	6.678E-07
NW	1.660-E-06	3.182E-07	1.155E-07	1.155E-07	3.696E-07	3.696E-07	3.696E-07	6.723E-07
NNW	2.220E-06	4.218E-07	1.575E-07	1.575E-07	7.119E-07	7.119E-07	7.119E-07	9.976E-07
N	1.980E-06	3.232E-07	1.300E-07	1.300E-07	1.300E-07	1.300E-07	1.428E-06	7.968E-07
NNE	1.352E-06	2.783E-07	3.348E-08	9.680E-08	3.751E-07	3.721E-07	3.729E-07	6.148E-07
NE	1.260E-06	2.121E-07	1.326E-07	1.938E-07	1.938E-07	1.938E-07	1.938E-07	6.032E-07
ENE	9.379E-07	1.650E-07	2.260E-07	5.858E-08	2.260E-07	2.975E-07	2.975E-07	3.213E-07
E	1.188E-06	2.040E-07	7.007E-08	7.007E-08	1.236E-07	1.089E-07	4.181E-07	4.600E-07
ESE	1.430E-06	2.718E-07	8.364E-08	8.364E-08	3.312E-07	3.312E-07	3.312E-07	5.895E-07
SE	1.240E-06	2.394E-07	7.956E-08	7.956E-08	2.877E-07	2.877E-07	2.877E-07	7.700E-07
SSE	9.579E-07	1.680E-07	9.072E-08	9.072E-08	1.680E-07	1.680E-07	1.680E-07	7.844E-07

DECAYED AND DEPLETED, HALF LIFE 2.26 DAYS, RELATIVE CONCENTRATION, X/Q (sec/m3)

AFFECTED SECTOR	EXCLUSION ZONE	LPZ	NEAREST[1] GOAT (TO 5 MILES)	NEAREST[1] COW (TO 5 MILES)	NEAREST[1] MEAT ANIMAL (TO 5 MILES)	NEAREST[1] VEG GARDEN (TO 5 MILES)	NEAREST[1] RESIDENCE (TO 5 MILES)	RESTRICTED AREA
S	9.114E-07	1.488E-07	5.208E-08	5.208E-08	9.306E-08	9.306E-08	9.306E-08	8.178E-07
SSW	1.070E-06	1.680E-07	5.928E-08	5.928E-08	1.089E-07	1.428E-07	1.428E-07	8.295E-07
SW	1.080E-06	1.808E-07	1.808E-07	1.296E-07	1.695E-07	1.695E-07	1.808E-07	5.400E-07
WSW	8.901E-07	1.540E-07	4.440E-08	4.440E-08	4.826E-07	3.336E-07	4.826E-07	5.040E-07
W	9.744E-07	1.722E-07	6.431E-08	3.416E-07	3.416E-07	3.416E-07	4.114E-07	5.824E-07
WNW	1.032E-06	1.650E-07	5.616E-08	5.616E-08	2.714E-07	2.714E-07	2.714E-07	5.830E-07
NW	1.494E-06	2.580E-07	8.470E-08	8.470E-08	3.024E-07	3.024E-07	3.024E-07	5.670E-07
NNW	1.998E-06	3.420E-07	1.155E-07	1.155E-07	5.989E-07	5.989E-07	5.989E-07	8.468E-07
N	1.760E-06	2.626E-07	9.300E-08	9.300E-08	9.300E-08	9.300E-08	1.224E-06	6.816E-07
NNE	1.144E-06	2.178E-07	2.728E-07	7.150E-08	3.025E-07	3.164E-07	3.164E-07	5.336E-07
NE	1.155E-06	1.717E-07	9.792E-08	1.530E-07	1.530E-07	1.530E-07	1.530E-07	5.220E-07
ENE	8.362E-07	1.320E-07	1.921E-07	4.343E-08	1.921E-07	2.499E-07	2.499E-07	2.737E-07
E	1.058E-06	1.632E-07	5.096E-08	5.096E-08	9.888E-08	8.415E-08	3.503E-07	3.910E-07
ESE	1.287E-06	2.114E-07	6.150E-08	6.150E-08	2.736E-07	2.736E-07	2.736E-07	4.978E-07
SE	1.104E-06	1.862E-07	5.850E-08	5.850E-08	2.329E-07	2.329E-07	2.329E-07	6.720E-07
SSE	8.549E-07	1.365E-07	6.768E-08	6.768E-08	1.365E-07	1.365E-07	1.365E-07	6.890E-07

TABLE 2.3-82 (Continued) (Sheet 4 of 4)

DECAYED HALF LIFE 8.0 DAYS, AND DEPLETED RELATIVE CONCENTRATION, X/Q (sec/m3)

AFFECTED SECTOR	EXCLUSION ZONE	LPZ	NEAREST1 GOAT (TO 5 MILES)	NEAREST[1] COW (TO 5 MILES)	NEAREST[1] MEAT ANIMAL (TO 5 MILES)	NEAREST[1] VEG GARDEN (TO 5 MILES)	NEAREST[1] RESIDENCE (TO 5 MILES)	RESTRICTED AREA
S	9.207E-07	1.488E-07	5.301E-08	5.301E-08	9.400E-08	9.400E-08	9.400E-08	8.178E-07
SSW	1.070E-06	1.680E-07	6.032E-08	6.032E-08	1.089E-07	1.428E-07	1.428E-07	8.295E-07
SW	1.080E-06	1.808E-07	1.808E-07	1.404E-07	1.695E-07	1.695E-07	1.808E-07	5.400E-07
WSW	8.901E-07	1.540E-07	4.440E-08	4.440E-08	4.826E-07	3.336E-07	4.826E-07	5.040E-07
W	9.744E-07	1.722E-07	6.540E-07	3.416E-07	3.416E-07	3.416E-07	4.114E-07	5.824E-07
WNW	1.032E-06	1.650E-07	5.616E-08	5.616E-08	2.714E-07	2.714E-07	2.714E-07	5.830E-07
NW	1.494E-06	2.580E-07	8.470E-08	8.470E-08	3.024E-07	3.024E-07	3.024E-07	5.751E-07
NNW	1.998E-06	3.420E-07	1.155E-07	1.155E-07	5.989E-07	5.989E-07	5.989E-07	8.468E-07
N	1.760E-06	2.626E-07	9.400E-08	9.400E-08	9.400E-08	9.400E-08	1.224E-06	6.912E-07
NNE	1.144E-06	2.178E-07	2.728E-07	7.260E-08	3.146E-07	3.164E-07	3.164E-07	5.336E-07
NE	1.155E-06	1.717E-07	9.894E-08	1.530E-07	1.530E-07	1.530E-07	1.530E-07	5.220E-07
ENE	8.362E-07	1.320E-07	1.921E-07	4.343E-08	1.921E-07	2.499E-07	2.499E-07	2.737E-07
E	1.058E-06	1.632E-07	5.187E-08	5.187E-08	9.991E-08	8.514E-08	3.503E-07	3.910E-07
ESE	1.287E-06	2.114E-07	6.273E-08	6.273E-08	2.736E-07	2.736E-07	2.736E-07	4.978E-07
SE	1.104E-06	1.862E-07	5.967E-08	5.967E-08	2.329E-07	2.329E-07	2.329E-07	6.720E-07
SSE	8.549E-07	1.365E-07	6.768E-08	6.768E-08	1.365E-07	1.365E-07	1.365E-07	6.890E-07

LOCATION OF SPECIAL INTEREST POINTS (METERS)

AFFECTED SECTOR	EXCLUSION ZONE	LPZ	NEAREST1 GOAT (TO 5 MILES)	NEAREST[1] COW (TO 5 MILES)	NEAREST[1] MEAT ANIMAL (TO 5 MILES)	NEAREST[1] VEG GARDEN (TO 5 MILES)	NEAREST[1] RESIDENCE (TO 5 MILES)	RESTRICTED AREA
S	1200	4023	8047	8047	5472	5472	5472	1300
SSW	1200	4023	8047	8047	5150	4506	4506	1400
SW	1200	4023	4023	4898	4345	4345	4023	1900
WSW	1200	4023	8047	8047	1770	2414	1770	1700
W	1200	4023	7242	2575	2575	2575	2253	1600
WNW	1200	4023	8047	8047	3058	3058	3050	1700
NW	1200	4023	8047	8047	3541	3541	3541	2300
NNW	1200	4023	8047	8047	2736	2736	2736	2200
N	1200	4023	8047	8047	8047	8047	1448	2051
NNE	1200	4023	3540	8047	3219	3058	3058	2200
NE	1200	4023	5955	4345	4345	4345	4345	2100
ENE	1200	4023	3219	8047	3219	2736	2736	2600
E	1200	4023	8047	8047	5633	6115	2575	2400
ESE	1200	4023	8047	8047	3380	3380	3380	2100
SE	1200	4023	8047	8047	3540	3540	3540	1800
SSE	1200	4023	8047	8047	4023	4023	4023	1400

1 The organic receptor locations listed in this Table are historical data identified during the licensing stage of the plant. The current organic receptor locations and dispersion parameters are determined as part of the Annual Land Use Census

TABLE 2.3-83 AVERAGE METEOROLOGICAL RELATIVE CONCENTRATION ANALYSIS STANDARD DISTANCES, UNIT VENT RELEASE DATA PERIOD: MAY 4, 1973 TO MAY 4, 1975 AND MARCH 16, 1978 TO MARCH 16, 1979 COMBINED

RELATIVE CONCENTRATIONS, X/Q (sec/m3)

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES

SECTOR	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
S	4.880E-06	1.721E-06	9.841E-07	6.319E-07	3.490E-07	2.392E-07	1.801E-07	1.418E-07	1.159E-07	9.639E-08	8.196E-08
SSW	5.282E-06	1.967E-06	1.160E-06	8.178E-07	5.161E-07	3.078E-07	2.081E-07	1.583E-07	1.257E-07	1.064E-07	9.184E-08
SW	5.130E-06	1.963E-06	1.169E-06	7.827E-07	4.628E-07	3.088E-07	2.281E-07	1.717E-07	1.351E-07	1.125E-07	9.573E-08
WSW	4.018E-06	1.571E-06	9.603E-07	6.489E-07	3.872E-07	2.617E-07	1.945E-07	1.586E-07	1.336E-07	9.550E-08	7.105E-08
W	4.328E-06	1.710E-06	1.065E-06	7.253E-07	4.361E-07	2.958E-07	2.196E-07	1.647E-07	1.291E-07	1.045E-07	8.671E-08
WNW	5.770E-06	1.957E-06	1.120E-06	7.198E-07	3.972E-07	2.755E-07	2.082E-07	1.635E-07	1.333E-07	1.083E-07	9.012E-08
NW	7.584E-06	2.756E-06	1.622E-06	1.062E-06	6.102E-07	4.216E-07	3.185E-07	2.377E-07	1.855E-07	1.569E-07	1.353E-07
NNW	9.597E-06	3.629E-06	2.168E-06	1.449E-06	8.627E-07	5.745E-07	4.222E-07	3.247E-07	2.601E-07	2.155E-07	1.828E-07
N	8.012E-06	3.096E-06	1.892E-06	1.191E-06	6.425E-07	4.357E-07	3.243E-07	2.509E-07	2.020E-07	1.745E-07	1.533E-07
NNE	6.079E-06	2.188E-06	1.271E-06	8.900E-07	5.584E-07	3.700E-07	2.711E-07	2.200E-07	1.844E-07	1.447E-07	1.167E-07
NE	5.850E-06	2.080E-06	1.186E-06	7.984E-07	4.781E-07	3.008E-07	2.124E-07	1.675E-07	1.371E-07	1.114E-07	9.288E-08
ENE	4.365E-06	1.554E-06	8.946E-07	5.880E-07	3.391E-07	2.229E-07	1.623E-07	1.174E-07	8.927E-08	7.448E-08	6.348E-08
E	4.895E-06	1.885E-06	1.137E-06	7.651E-07	4.551E-07	2.846E-07	1.994E-07	1.564E-07	1.274E-07	1.032E-07	8.561E-08
ESE	6.330E-06	2.359E-06	1.399E-06	8.888E-07	4.825E-07	3.438E-07	2.661E-07	1.895E-07	1.424E-07	1.174E-07	9.904E-08
SE	5.527E-06	2.026E-06	1.191E-06	8.061E-07	4.802E-07	3.209E-07	2.359E-07	1.863E-07	1.527E-07	1.225E-07	1.009E-07
SSE	4.103E-06	1.540E-06	9.113E-07	6.057E-07	3.514E-07	2.332E-07	1.711E-07	1.374E-07	1.142E-07	1.036E-07	9.503E-08

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES

SECTOR	5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
S	6.816E-08	3.362E-08	2.082E-08	1.064E-08	6.489E-09	4.426E-09	3.125E-09	2.330E-09	1.810E-09	1.449E-09	1.081E-09
SSW	8.060E-08	4.888E-08	2.619E-08	1.092E-08	6.494E-09	4.349E-09	3.251E-09	2.544E-09	2.063E-09	1.716E-09	1.344E-09
SW	7.949E-08	3.897E-08	2.486E-08	1.323E-08	8.948E-09	6.618E-09	4.616E-09	3.406E-09	2.805E-09	2.363E-09	1.921E-09
WSW	6.302E-08	3.979E-08	2.569E-08	1.392E-08	8.389E-09	5.674E-09	3.952E-09	2.913E-09	2.475E-09	2.144E-09	1.712E-09
W	7.277E-08	3.714E-08	2.402E-08	1.305E-08	8.573E-09	6.194E-09	4.009E-09	2.776E-09	2.514E-09	2.304E-09	1.827E-09
WNW	7.558E-08	3.848E-08	2.659E-08	1.586E-08	1.032E-08	7.404E-09	5.704E-09	4.579E-09	3.893E-09	3.375E-09	2.496E-09
NW	1.142E-07	5.968E-08	4.009E-08	2.297E-08	1.501E-08	1.080E-08	8.119E-09	6.384E-09	4.905E-09	3.888E-09	3.267E-09
NNW	1.570E-07	8.777E-08	5.886E-08	3.363E-08	2.357E-08	1.792E-08	1.392E-08	1.125E-08	7.911E-09	5.800E-09	4.610E-09
N	1.300E-07	6.902E-08	4.407E-08	2.351E-08	1.749E-08	1.393E-08	1.184E-08	1.033E-08	7.784E-09	6.066E-09	4.718E-09
NNE	1.007E-07	5.722E-08	3.885E-08	2.262E-08	1.350E-08	9.050E-09	6.481E-09	4.891E-09	3.638E-09	2.804E-09	2.728E-09
NE	8.044E-08	4.637E-08	3.218E-08	1.931E-08	1.063E-08	6.697E-09	5.160E-09	4.143E-09	3.254E-09	2.630E-09	2.291E-09
ENE	5.558E-08	3.341E-08	2.097E-08	1.092E-08	8.136E-09	6.488E-09	5.375E-09	4.588E-09	3.367E-09	2.563E-09	1.714E-09
E	7.175E-08	3.646E-08	2.407E-08	1.347E-08	8.629E-09	6.117E-09	4.078E-09	2.897E-09	2.139E-09	1.637E-09	1.257E-09
ESE	8.331E-08	4.297E-08	2.682E-08	1.387E-08	9.856E-09	7.578E-09	5.611E-09	4.355E-09	3.143E-09	2.358E-09	1.878E-09
SE	8.756E-08	5.098E-08	3.396E-08	1.924E-08	9.953E-09	5.974E-09	3.996E-09	2.847E-09	2.228E-09	1.795E-09	1.536E-09
SSE	8.057E-08	4.282E-08	2.557E-08	1.241E-08	7.955E-09	5.641E-09	4.303E-09	3.426E-09	2.803E-09	2.348E-09	1.642E-09

TABLE 2.3-83 (Continued) (Sheet 2 of 7)

DEPLETED RELATIVE CONCENTRATIONS, X/Q (sec/m3)

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES

SECTOR	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
S	4.618E-06	1.572E-06	8.771E-07	5.531E-07	2.964E-07	1.981E-07	1.459E-07	1.127E-07	9.043E-08	7.399E-08	6.196E-08
SSW	4.999E-06	1.796E-06	1.034E-06	7.158E-07	4.384E-07	2.549E-07	1.686E-07	1.258E-07	9.810E-08	8.167E-08	6.944E-08
SW	4.855E-06	1.792E-06	1.042E-06	6.851E-07	3.931E-07	2.557E-07	1.848E-07	1.364E-07	1.055E-07	8.634E-08	7.238E-08
WSW	3.804E-06	1.435E-06	8.557E-07	5.680E-07	3.288E-07	2.167E-07	1.575E-07	1.260E-07	1.042E-07	7.332E-08	5.372E-08
W	4.096E-06	1.562E-06	9.488E-07	6.349E-07	3.704E-07	2.449E-07	1.779E-07	1.308E-07	1.008E-07	8.023E-08	6.556E-08
WNW	5.462E-06	1.787E-06	9.982E-07	6.301E-07	3.373E-07	2.281E-07	1.686E-07	1.299E-07	1.040E-07	8.311E-08	6.814E-08
NW	7.176E-06	2.517E-06	1.446E-06	9.301E-07	5.182E-07	3.491E-07	2.580E-07	1.887E-07	1.447E-07	1.204E-07	1.023E-07
NNW	9.081E-06	3.314E-06	1.931E-06	1.268E-06	7.327E-07	4.756E-07	3.419E-07	2.579E-07	2.030E-07	1.655E-07	1.381E-07
N	7.582E-06	2.827E-06	1.686E-06	1.042E-06	5.457E-07	3.607E-07	2.627E-07	1.994E-07	1.576E-07	1.339E-07	1.159E-07
NNE	5.753E-06	1.998E-06	1.132E-06	7.791E-07	4.742E-07	3.064E-07	2.196E-07	1.747E-07	1.439E-07	1.110E-07	8.829E-08
NE	5.537E-06	1.899E-06	1.057E-06	6.989E-07	4.060E-07	2.491E-07	1.721E-07	1.330E-07	1.070E-07	8.554E-08	7.023E-08
ENE	4.131E-06	1.419E-06	7.971E-07	5.147E-07	2.881E-07	1.846E-07	1.315E-07	9.325E-08	6.967E-08	5.716E-08	4.800E-08
E	4.633E-06	1.721E-06	1.013E-06	6.697E-07	3.865E-07	2.357E-07	1.615E-07	1.243E-07	9.945E-08	7.918E-08	6.473E-08
ESE	5.992E-06	2.154E-06	1.247E-06	7.780E-07	4.098E-07	2.847E-07	2.156E-07	1.506E-07	1.111E-07	9.009E-08	7.488E-08
SE	5.230E-06	1.850E-06	1.062E-06	7.055E-07	4.079E-07	2.658E-07	1.911E-07	1.480E-07	1.191E-07	9.402E-08	7.625E-08
SSE	3.884E-06	1.406E-06	8.121E-07	5.302E-07	2.985E-07	1.931E-07	1.386E-07	1.091E-07	8.909E-08	7.949E-08	7.185E-08

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES

SECTOR	5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
S	5.080E-08	2.370E-08	1.399E-08	6.621E-09	3.789E-09	2.449E-09	1.648E-09	1.176E-09	8.776E-10	6.768E-10	4.871E-10
SSW	6.008E-08	3.446E-08	1.760E-08	6.787E-09	3.794E-09	2.407E-09	1.715E-09	1.284E-09	1.000E-09	8.011E-10	6.059E-10
SW	5.925E-08	2.748E-08	1.670E-08	8.231E-09	5.227E-09	3.662E-09	2.435E-09	1.720E-09	1.360E-09	1.104E-09	8.657E-10
WSW	4.697E-08	2.805E-08	1.725E-08	8.655E-09	4.900E-09	3.140E-09	2.084E-09	1.471E-09	1.200E-09	1.001E-09	7.715E-10
W	5.424E-08	2.619E-08	1.614E-08	8.112E-09	5.004E-09	3.428E-09	2.114E-09	1.402E-09	1.219E-09	1.076E-09	8.233E-10
WNW	5.634E-08	2.714E-08	1.787E-08	9.857E-09	6.026E-09	4.097E-09	3.009E-09	2.311E-09	1.888E-09	1.576E-09	1.125E-09
NW	8.514E-08	4.207E-08	2.693E-08	1.428E-08	8.763E-09	5.976E-09	4.283E-09	3.224E-09	2.379E-09	1.816E-09	1.472E-09
NNW	1.170E-07	6.187E-08	3.954E-08	2.092E-08	1.377E-08	9.920E-09	7.343E-09	5.682E-09	3.836E-09	2.709E-09	2.077E-09
N	9.690E-08	4.866E-08	2.961E-08	1.462E-08	1.022E-08	7.711E-09	6.247E-09	5.217E-09	3.775E-09	2.833E-09	2.126E-09
NNE	7.509E-08	4.034E-08	2.610E-08	1.407E-08	7.880E-09	5.009E-09	3.418E-09	2.469E-09	1.764E-09	1.309E-09	1.229E-09
NE	5.996E-08	3.269E-08	2.162E-08	1.202E-08	6.205E-09	3.704E-09	2.721E-09	2.092E-09	1.578E-09	1.228E-09	1.033E-09
ENE	4.143E-08	2.355E-08	1.408E-08	6.787E-09	4.752E-09	3.590E-09	2.835E-09	2.317E-09	1.633E-09	1.197E-09	7.723E-10
E	5.348E-08	2.570E-08	1.617E-08	8.373E-09	5.039E-09	3.385E-09	2.151E-09	1.462E-09	1.037E-09	7.644E-10	5.668E-10
ESE	6.210E-08	3.029E-08	1.802E-08	8.626E-09	5.758E-09	4.194E-09	2.960E-09	2.199E-09	1.524E-09	1.101E-09	8.461E-10
SE	6.526E-08	3.594E-08	2.282E-08	1.197E-08	5.810E-09	3.306E-09	2.108E-09	1.437E-09	1.080E-09	8.384E-10	6.926E-10
SSE	6.006E-08	3.018E-08	1.717E-08	7.720E-09	4.645E-09	3.121E-09	2.270E-09	1.730E-09	1.359E-09	1.096E-09	7.394E-10

TABLE 2.3-83 (Continued) (Sheet 3 of 7)

RELATIVE DEPOSITION RATE, D/Q (1/m2)

ANNUAL AVERAGE D/Q (1/METER SQUARED) DISTANCE IN MILES

SECTOR	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
S	2.051E-08	7.915E-09	4.391E-09	2.670E-09	1.312E-09	8.215E-10	5.692E-10	4.163E-10	3.191E-10	2.506E-10	2.024E-10
SSW	1.885E-08	7.676E-09	4.394E-09	2.934E-09	1.646E-09	8.958E-10	5.569E-10	3.936E-10	2.930E-10	2.342E-10	1.920E-10
SW	1.534E-08	6.491E-09	3.800E-09	2.415E-09	1.264E-09	7.672E-10	5.187E-10	3.611E-10	2.654E-10	2.080E-10	1.676E-10
WSW	1.532E-08	6.594E-09	3.899E-09	2.488E-09	1.309E-09	8.038E-10	5.486E-10	4.158E-10	3.284E-10	2.217E-10	1.567E-10
W	1.819E-08	7.878E-09	4.676E-09	2.988E-09	1.576E-09	9.692E-10	6.624E-10	4.628E-10	3.412E-10	2.613E-10	2.063E-10
WNW	2.688E-08	1.001E-08	5.435E-09	3.272E-09	1.586E-09	9.985E-10	6.950E-10	5.086E-10	3.899E-10	2.998E-10	2.375E-10
NW	3.573E-08	1.449E-08	8.272E-09	5.107E-09	2.567E-09	1.603E-09	1.108E-09	7.657E-10	5.592E-10	4.456E-10	3.644E-10
NNW	4.370E-08	1.852E-08	1.085E-08	6.866E-09	3.571E-09	2.144E-09	1.438E-09	1.022E-09	7.646E-10	5.965E-10	4.787E-10
N	4.400E-08	1.884E-08	1.111E-08	6.587E-09	3.128E-09	1.925E-09	1.315E-09	9.449E-10	7.132E-10	5.816E-10	4.854E-10
NNE	3.496E-08	1.393E-08	7.871E-09	5.222E-09	2.903E-09	1.752E-09	1.181E-09	8.900E-10	6.996E-10	5.184E-10	3.974E-10
NE	2.712E-08	1.080E-08	6.097E-09	3.912E-09	2.076E-09	1.187E-09	7.668E-10	5.587E-10	4.267E-10	3.266E-10	2.576E-10
ENE	1.871E-08	7.397E-09	4.161E-09	2.594E-09	1.322E-09	7.892E-10	5.272E-10	3.536E-10	2.518E-10	1.982E-10	1.603E-10
E	2.441E-08	1.043E-08	6.147E-09	3.923E-09	2.065E-09	1.175E-09	7.567E-10	5.513E-10	4.211E-10	3.217E-10	2.536E-10
ESE	3.802E-08	1.546E-08	8.844E-09	5.314E-09	2.570E-09	1.676E-09	1.199E-09	7.966E-10	5.630E-10	4.398E-10	3.534E-10
SE	3.091E-08	1.236E-08	7.002E-09	4.474E-09	2.359E-09	1.438E-09	9.751E-10	7.181E-10	5.535E-10	4.206E-10	3.297E-10
SSE	2.004E-08	8.206E-09	4.713E-09	2.969E-09	1.534E-09	9.305E-10	6.291E-10	4.699E-10	3.666E-10	3.144E-10	2.743E-10

ANNUAL AVERAGE D/Q (1/METER SQUARED) DISTANCE IN MILES

SECTOR	5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
S	1.605E-10	6.695E-11	3.820E-11	1.689E-11	9.083E-12	5.560E-12	3.562E-12	2.434E-12	1.746E-12	1.299E-12	9.055E-13
SSW	1.607E-10	8.239E-11	4.068E-11	1.466E-11	7.698E-12	4.624E-12	3.138E-12	2.251E-12	1.685E-12	1.303E-12	9.534E-13
SW	1.324E-10	5.443E-11	3.178E-11	1.452E-11	8.621E-12	5.697E-12	3.596E-12	2.426E-12	1.840E-12	1.438E-12	1.091E-12
WSW	1.326E-10	7.085E-11	4.217E-11	1.979E-11	1.054E-11	6.405E-12	4.054E-12	2.741E-12	2.153E-12	1.734E-12	1.295E-12
W	1.655E-10	7.196E-11	4.313E-11	2.044E-11	1.194E-11	7.781E-12	4.593E-12	2.927E-12	2.456E-12	2.099E-12	1.559E-12
WNW	1.903E-10	8.266E-11	5.296E-11	2.757E-11	1.594E-11	1.032E-11	7.254E-12	5.359E-12	4.223E-12	3.414E-12	2.366E-12
NW	2.931E-10	1.289E-10	7.954E-11	3.928E-11	2.262E-11	1.458E-11	9.952E-12	7.168E-12	5.084E-12	3.745E-12	2.940E-12
NNW	3.913E-10	1.832E-10	1.125E-10	5.516E-11	3.397E-11	2.308E-11	1.624E-11	1.201E-11	7.784E-12	5.297E-12	3.928E-12
N	3.925E-10	1.762E-10	1.037E-10	4.784E-11	3.145E-11	2.248E-11	1.736E-11	1.389E-11	9.666E-12	7.003E-12	5.091E-12
NNE	3.270E-10	1.568E-10	9.807E-11	4.930E-11	2.593E-11	1.559E-11	1.012E-11	6.998E-12	4.805E-12	3.440E-12	3.125E-12
NE	2.121E-10	1.021E-10	6.476E-11	3.322E-11	1.600E-11	8.984E-12	6.252E-12	4.584E-12	3.313E-12	2.481E-12	2.013E-12
ENE	1.337E-10	6.774E-11	3.906E-11	1.752E-11	1.151E-11	8.213E-12	6.168E-12	4.820E-12	3.262E-12	2.306E-12	1.439E-12
E	2.026E-10	8.685E-11	5.278E-11	2.549E-11	1.439E-11	9.137E-12	5.523E-12	3.592E-12	2.447E-12	1.740E-12	1.248E-12
ESE	2.842E-10	1.249E-10	7.222E-11	3.253E-11	2.049E-11	1.417E-11	9.553E-12	6.809E-12	4.546E-12	3.174E-12	2.366E-12
SE	2.735E-10	1.357E-10	8.379E-11	4.138E-11	1.898E-11	1.026E-11	6.255E-12	4.095E-12	2.967E-12	2.227E-12	1.784E-12
SSE	2.219E-10	9.996E-11	5.507E-11	2.318E-11	1.312E-11	8.351E-12	5.788E-12	4.225E-12	3.193E-12	2.487E-12	1.624E-12

TABLE 2.3-83 (Continued)

DECAYED RELATIVE CONCENTRATION, HALF LIFE 2.26 DAYS, X/Q (sec/m3)

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES

SECTOR	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
S	4.874E-06	1.716E-06	9.806E-07	6.289E-07	3.465E-07	2.369E-07	1.779E-07	1.397E-07	1.139E-07	9.453E-08	8.014E-08
SSW	5.275E-06	1.961E-06	1.156E-06	8.136E-07	5.121E-07	3.047E-07	2.054E-07	1.559E-07	1.234E-07	1.042E-07	8.967E-08
SW	5.123E-06	1.958E-06	1.165E-06	7.783E-07	4.590E-07	3.053E-07	2.249E-07	1.688E-07	1.324E-07	1.100E-07	9.328E-08
WSW	4.013E-06	1.567E-06	9.567E-07	6.455E-07	3.843E-07	2.590E-07	1.920E-07	1.561E-07	1.311E-07	9.352E-08	6.939E-08
W	4.322E-06	1.706E-06	1.061E-06	7.218E-07	4.330E-07	2.929E-07	2.168E-07	1.624E-07	1.270E-07	1.025E-07	8.480E-08
WNW	5.764E-06	1.953E-06	1.116E-06	7.166E-07	3.946E-07	2.731E-07	2.059E-07	1.613E-07	1.312E-07	1.063E-07	8.831E-08
NW	7.578E-06	2.751E-06	1.618E-06	1.059E-06	6.070E-07	4.186E-07	3.157E-07	2.351E-07	1.832E-07	1.546E-07	1.331E-07
NNW	9.589E-06	3.624E-06	2.162E-06	1.443E-06	8.582E-07	5.705E-07	4.186E-07	3.214E-07	2.569E-07	2.126E-07	1.800E-07
N	8.004E-06	3.090E-06	1.888E-06	1.187E-06	6.393E-07	4.328E-07	3.216E-07	2.484E-07	1.997E-07	1.721E-07	1.511E-07
NNE	6.073E-06	2.184E-06	1.268E-06	8.868E-07	5.554E-07	3.674E-07	2.687E-07	2.176E-07	1.821E-07	1.426E-07	1.149E-07
NE	5.844E-06	2.076E-06	1.183E-06	7.952E-07	4.752E-07	2.983E-07	2.102E-07	1.654E-07	1.350E-07	1.096E-07	9.115E-08
ENE	4.360E-06	1.550E-06	8.914E-07	5.852E-07	3.368E-07	2.208E-07	1.604E-07	1.157E-07	8.778E-08	7.304E-08	6.212E-08
E	4.889E-06	1.880E-06	1.133E-06	7.617E-07	4.519E-07	2.820E-07	1.971E-07	1.542E-07	1.254E-07	1.012E-07	8.379E-08
ESE	6.323E-06	2.354E-06	1.395E-06	8.851E-07	4.795E-07	3.410E-07	2.634E-07	1.872E-07	1.402E-07	1.154E-07	9.715E-08
SE	5.520E-06	2.021E-06	1.188E-06	8.027E-07	4.772E-07	3.182E-07	2.335E-07	1.839E-07	1.504E-07	1.204E-07	9.891E-08
SSE	4.079E-06	1.536E-06	9.084E-07	6.031E-07	3.491E-07	2.311E-07	1.692E-07	1.355E-07	1.124E-07	1.017E-07	9.310E-08

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES

SECTOR	5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
S	6.647E-08	3.237E-08	1.979E-08	9.859E-09	5.857E-09	3.892E-09	2.678E-09	1.945E-09	1.473E-09	1.149E-09	8.360E-10
SSW	7.847E-08	4.695E-08	2.481E-08	1.006E-08	5.821E-09	3.792E-09	2.758E-09	2.099E-09	1.656E-09	1.340E-09	1.022E-09
SW	7.724E-08	3.731E-08	2.344E-08	1.211E-08	7.947E-09	5.701E-09	3.858E-09	2.762E-09	2.207E-09	1.805E-09	1.424E-09
WSW	6.138E-08	3.823E-08	2.434E-08	1.283E-08	7.528E-09	4.953E-09	3.357E-09	2.408E-09	1.991E-09	1.678E-09	1.305E-09
W	7.098E-08	3.578E-08	2.284E-08	1.209E-08	7.741E-09	5.455E-09	3.440E-09	2.323E-09	2.050E-09	1.832E-09	1.417E-09
WNW	7.388E-08	3.719E-08	2.540E-08	1.480E-08	9.402E-09	6.590E-09	4.959E-09	3.889E-09	3.231E-09	2.736E-09	1.978E-09
NW	1.122E-07	5.811E-08	3.869E-08	2.178E-08	1.398E-08	9.882E-09	7.302E-09	5.645E-09	4.260E-09	3.320E-09	2.742E-09
NNW	1.544E-07	8.552E-08	5.685E-08	3.193E-08	2.199E-08	1.643E-08	1.255E-08	9.971E-09	6.893E-09	4.970E-09	3.885E-09
N	1.279E-07	6.729E-08	4.260E-08	2.234E-08	1.634E-08	1.280E-08	1.070E-08	9.172E-09	6.795E-09	5.207E-09	3.983E-09
NNE	9.894E-08	5.569E-08	3.747E-08	2.142E-08	1.254E-08	8.262E-09	5.809E-09	4.304E-09	3.146E-09	2.381E-09	2.276E-09
NE	7.878E-08	4.493E-08	3.085E-08	1.813E-08	9.759E-09	6.018E-09	4.541E-09	3.571E-09	2.746E-09	2.174E-09	1.855E-09
ENE	5.425E-08	3.221E-08	1.996E-08	1.014E-08	7.375E-09	5.739E-09	4.640E-09	3.866E-09	2.769E-09	2.058E-09	1.344E-09
E	7.005E-08	3.516E-08	2.293E-08	1.251E-08	7.821E-09	5.409E-09	3.519E-09	2.439E-09	1.757E-09	1.312E-09	9.840E-10
ESE	8.155E-08	4.161E-08	2.567E-08	1.299E-08	9.026E-09	6.786E-09	4.913E-09	3.730E-09	2.633E-09	1.933E-09	1.506E-09
SE	8.567E-08	4.933E-08	3.250E-08	1.800E-08	9.103E-09	5.345E-09	3.497E-09	2.437E-09	1.866E-09	1.471E-09	1.232E-09
SSE	7.874E-08	4.135E-08	2.439E-08	1.157E-08	7.232E-09	5.007E-09	3.729E-09	2.899E-09	2.315E-09	1.894E-09	1.293E-09

TABLE 2.3-83 (Continued) (Sheet 5 of 7)

DECAYED RELATIVE CONCENTRATIONS, HALF LIFE 8.0 DAYS, X/Q (sec/m3)

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES

SECTOR	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
S	4.878E-06	1.720E-06	9.832E-07	6.311E-07	3.483E-07	2.386E-07	1.795E-07	1.412E-07	1.153E-07	9.583E-08	8.144E-08
SSW	5.280E-06	1.965E-06	1.159E-06	8.166E-07	5.150E-07	3.069E-07	2.074E-07	1.576E-07	1.250E-07	1.058E-07	9.122E-08
SW	5.128E-06	1.961E-06	1.168E-06	7.814E-07	4.618E-07	3.078E-07	2.271E-07	1.709E-07	1.344E-07	1.117E-07	9.503E-08
WSW	4.018E-06	1.570E-06	9.593E-07	6.478E-07	3.864E-07	2.609E-07	1.938E-07	1.579E-07	1.329E-07	9.493E-08	7.058E-08
W	4.326E-06	1.709E-06	1.064E-06	7.243E-07	4.352E-07	2.950E-07	2.188E-07	1.640E-07	1.286E-07	1.039E-07	8.616E-08
WNW	5.769E-06	1.956E-06	1.119E-06	7.190E-07	3.965E-07	2.748E-07	2.075E-07	1.629E-07	1.328E-07	1.077E-07	8.960E-08
NW	7.584E-06	2.755E-06	1.621E-06	1.061E-06	6.092E-07	4.208E-07	3.178E-07	2.369E-07	1.849E-07	1.562E-07	1.346E-07
NNW	9.597E-06	3.627E-06	2.167E-06	1.448E-06	8.615E-07	5.733E-07	4.212E-07	3.237E-07	2.592E-07	2.148E-07	1.819E-07
N	8.012E-06	3.094E-06	1.891E-06	1.190E-06	6.416E-07	4.349E-07	3.236E-07	2.502E-07	2.013E-07	1.738E-07	1.527E-07
NNE	6.077E-06	2.187E-06	1.270E-06	8.891E-07	5.575E-07	3.693E-07	2.704E-07	2.192E-07	1.837E-07	1.441E-07	1.163E-07
NE	5.849E-06	2.079E-06	1.185E-06	7.976E-07	4.773E-07	3.001E-07	2.118E-07	1.669E-07	1.365E-07	1.109E-07	9.240E-08
ENE	4.363E-06	1.553E-06	8.937E-07	5.872E-07	3.385E-07	2.224E-07	1.618E-07	1.169E-07	8.885E-08	7.407E-08	6.310E-08
E	4.893E-06	1.884E-06	1.136E-06	7.641E-07	4.541E-07	2.839E-07	1.988E-07	1.558E-07	1.269E-07	1.026E-07	8.509E-08
ESE	6.328E-06	2.357E-06	1.398E-06	8.877E-07	4.817E-07	3.430E-07	2.654E-07	1.888E-07	1.417E-07	1.168E-07	9.850E-08
SE	5.525E-06	2.025E-06	1.190E-06	8.051E-07	4.795E-07	3.202E-07	2.352E-07	1.857E-07	1.520E-07	1.219E-07	1.003E-07
SSE	4.102E-06	1.539E-06	9.105E-07	6.050E-07	3.508E-07	2.325E-07	1.706E-07	1.369E-07	1.136E-07	1.030E-07	9.448E-08

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES

SECTOR	5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
S	6.768E-08	3.325E-08	2.052E-08	1.041E-08	6.302E-09	4.266E-09	2.989E-09	2.212E-09	1.706E-09	1.355E-09	1.004E-09
SSW	7.999E-08	4.833E-08	2.579E-08	1.067E-08	6.294E-09	4.182E-09	3.101E-09	2.407E-09	1.937E-09	1.598E-09	1.242E-09
SW	7.884E-08	3.849E-08	2.444E-08	1.291E-08	8.655E-09	6.343E-09	4.385E-09	3.208E-09	2.618E-09	2.187E-09	1.763E-09
WSW	6.254E-08	3.934E-08	2.530E-08	1.360E-08	8.134E-09	5.458E-09	3.771E-09	2.758E-09	2.325E-09	1.998E-09	1.583E-09
W	7.226E-08	3.675E-08	2.368E-08	1.277E-08	8.322E-09	5.973E-09	3.837E-09	2.638E-09	2.370E-09	2.156E-09	1.697E-09
WNW	7.510E-08	3.811E-08	2.625E-08	1.555E-08	1.005E-08	7.161E-09	5.480E-09	4.368E-09	3.689E-09	3.176E-09	2.333E-09
NW	1.136E-07	5.923E-08	3.969E-08	2.263E-08	1.470E-08	1.053E-08	7.874E-09	6.160E-09	4.709E-09	3.714E-09	3.105E-09
NNW	1.563E-07	8.712E-08	5.828E-08	3.313E-08	2.311E-08	1.748E-08	1.352E-08	1.087E-08	7.602E-09	5.546E-09	4.386E-09
N	1.294E-07	6.853E-08	4.365E-08	2.317E-08	1.716E-08	1.360E-08	1.150E-08	9.983E-09	7.484E-09	5.803E-09	4.491E-09
NNE	1.002E-07	5.679E-08	3.845E-08	2.226E-08	1.321E-08	8.819E-09	6.280E-09	4.713E-09	3.488E-09	2.674E-09	2.587E-09
NE	7.997E-08	4.596E-08	3.180E-08	1.897E-08	1.037E-08	6.492E-09	4.973E-09	3.969E-09	3.098E-09	2.488E-09	2.155E-09
ENE	5.520E-08	3.307E-08	2.067E-08	1.069E-08	7.911E-09	6.264E-09	5.153E-09	4.367E-09	3.182E-09	2.405E-09	1.596E-09
E	7.126E-08	3.608E-08	2.374E-08	1.319E-08	8.390E-09	5.905E-09	3.909E-09	2.757E-09	2.021E-09	1.536E-09	1.171E-09
ESE	8.280E-08	4.258E-08	2.649E-08	1.361E-08	9.614E-09	7.342E-09	5.401E-09	4.165E-09	2.986E-09	2.225E-09	1.761E-09
SE	8.702E-08	5.050E-08	3.354E-08	1.889E-08	9.699E-09	5.787E-09	3.845E-09	2.722E-09	2.116E-09	1.694E-09	1.441E-09
SSE	8.005E-08	4.240E-08	2.522E-08	1.217E-08	7.741E-09	5.451E-09	4.130E-09	3.265E-09	2.652E-09	2.206E-09	1.532E-09

TABLE 2.3-83 (Continued) (Sheet 6 of 7)

DECAYED AND DEPLEATED RELATIVE CONCENTRATION, HALF LIFE 2.26 DAYS, X/Q (sec/m3)

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES

SECTOR	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
S	4.612E-06	1.568E-06	8.739E-07	5.505E-07	2.943E-07	1.961E-07	1.441E-07	1.110E-07	8.888E-08	7.254E-08	6.060E-08
SSW	4.992E-06	1.791E-06	1.030E-06	7.122E-07	4.350E-07	2.523E-07	1.664E-07	1.238E-07	9.630E-08	7.996E-08	6.780E-08
SW	4.848E-06	1.787E-06	1.037E-06	6.812E-07	3.898E-07	2.528E-07	1.822E-07	1.341E-07	1.033E-07	8.439E-08	7.052E-08
WSW	3.799E-06	1.431E-06	8.525E-07	5.651E-07	3.264E-07	2.145E-07	1.554E-07	1.240E-07	1.023E-07	7.179E-08	5.247E-08
W	4.091E-06	1.558E-06	9.455E-07	6.318E-07	3.677E-07	2.425E-07	1.756E-07	1.289E-07	9.908E-08	7.867E-08	6.411E-08
WNW	5.455E-06	1.783E-06	9.950E-07	6.274E-07	3.352E-07	2.261E-07	1.668E-07	1.281E-07	1.024E-07	8.163E-08	6.677E-08
NW	7.170E-06	2.512E-06	1.442E-06	9.268E-07	5.155E-07	3.467E-07	2.558E-07	1.868E-07	1.429E-07	1.187E-07	1.007E-07
NNW	9.073E-06	3.309E-06	1.927E-06	1.263E-06	7.289E-07	4.724E-07	3.390E-07	2.552E-07	2.005E-07	1.632E-07	1.360E-07
N	7.574E-06	2.822E-06	1.682E-06	1.039E-06	5.430E-07	3.583E-07	2.605E-07	1.974E-07	1.558E-07	1.321E-07	1.142E-07
NNE	5.748E-06	1.994E-06	1.129E-06	7.763E-07	4.717E-07	3.042E-07	2.177E-07	1.728E-07	1.421E-07	1.094E-07	8.688E-08
NE	5.531E-06	1.895E-06	1.054E-06	6.961E-07	4.036E-07	2.470E-07	1.703E-07	1.314E-07	1.053E-07	8.413E-08	6.893E-08
ENE	4.126E-06	1.416E-06	7.943E-07	5.122E-07	2.859E-07	1.829E-07	1.299E-07	9.191E-08	6.849E-08	5.607E-08	4.696E-08
E	4.627E-06	1.717E-06	1.010E-06	6.667E-07	3.837E-07	2.335E-07	1.596E-07	1.225E-07	9.781E-08	7.769E-08	6.336E-08
ESE	5.984E-06	2.149E-06	1.243E-06	7.748E-07	4.073E-07	2.824E-07	2.134E-07	1.487E-07	1.094E-07	8.857E-08	7.345E-08
SE	5.225E-06	1.847E-06	1.058E-06	7.027E-07	4.053E-07	2.635E-07	1.892E-07	1.461E-07	1.174E-07	9.240E-08	7.478E-08
SSE	3.879E-06	1.403E-06	8.094E-07	5.279E-07	2.965E-07	1.914E-07	1.371E-07	1.076E-07	8.769E-08	7.806E-08	7.040E-08

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES

SECTOR	5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
S	4.956E-08	2.282E-08	1.330E-08	6.133E-09	3.419E-09	2.154E-09	1.412E-09	9.823E-10	7.142E-10	5.369E-10	3.767E-10
SSW	5.850E-08	3.310E-08	1.667E-08	6.254E-09	3.400E-09	2.098E-09	1.454E-09	1.060E-09	8.030E-10	6.257E-10	4.603E-10
SW	5.757E-08	2.630E-08	1.575E-08	7.530E-09	4.641E-09	3.155E-09	2.035E-09	1.395E-09	1.070E-09	8.426E-10	6.415E-10
WSW	4.575E-08	2.695E-08	1.635E-08	7.982E-09	4.397E-09	2.741E-09	1.771E-09	1.216E-09	9.654E-10	7.837E-10	5.882E-10
W	5.291E-08	2.522E-08	1.535E-08	7.518E-09	4.521E-09	3.018E-09	1.815E-09	1.173E-09	9.942E-10	8.554E-10	6.386E-10
WNW	5.508E-08	2.622E-08	1.706E-08	9.200E-09	5.490E-09	3.647E-09	2.616E-09	1.963E-09	1.567E-09	1.278E-09	8.911E-10
NW	8.366E-08	4.096E-08	2.599E-08	1.354E-08	8.164E-09	5.469E-09	3.851E-09	2.849E-09	2.066E-09	1.550E-09	1.236E-09
NNW	1.150E-07	6.029E-08	3.820E-08	1.985E-08	1.284E-08	9.093E-09	6.618E-09	5.034E-09	3.343E-09	2.321E-09	1.750E-09
N	9.528E-08	4.744E-08	2.862E-08	1.389E-08	9.547E-09	7.080E-09	5.641E-09	4.631E-09	3.296E-09	2.431E-09	1.795E-09
NNE	7.375E-08	3.926E-08	2.517E-08	1.331E-08	7.325E-09	4.572E-09	3.064E-09	2.174E-09	1.525E-09	1.112E-09	1.026E-09
NE	5.872E-08	3.167E-08	2.072E-08	1.127E-08	5.699E-09	3.330E-09	2.395E-09	1.803E-09	1.331E-09	1.015E-09	8.358E-10
ENE	4.044E-08	2.271E-08	1.342E-08	6.305E-09	4.307E-09	3.176E-09	2.448E-09	1.952E-09	1.343E-09	9.608E-10	6.057E-10
E	5.221E-08	2.479E-08	1.540E-08	7.786E-09	4.567E-09	2.993E-09	1.856E-09	1.231E-09	8.521E-10	6.128E-10	4.436E-10
ESE	6.078E-08	2.933E-08	1.725E-08	8.076E-09	5.272E-09	3.755E-09	2.591E-09	1.883E-09	1.277E-09	9.022E-10	6.786E-10
SE	6.387E-08	3.478E-08	2.183E-08	1.120E-08	5.317E-09	2.958E-09	1.845E-09	1.230E-09	9.049E-10	6.868E-10	5.554E-10
SSE	5.870E-08	2.915E-08	1.639E-08	7.191E-09	4.223E-09	2.770E-09	1.967E-09	1.463E-09	1.123E-09	8.844E-10	5.826E-10

TABLE 2.3-83 (Continued) (Sheet 7 of 7)

DECAYED AND DEPLETED RELATIVE CONCENTRATIONS, HALF LIFE 8.0 DAYS, X/Q (sec/m3)

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES

SECTOR	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
S	4.617E-06	1.570E-06	8.762E-07	5.524E-07	2.958E-07	1.975E-07	1.454E-07	1.121E-07	8.998E-08	7.358E-08	6.157E-08
SSW	4.997E-06	1.795E-06	1.032E-06	7.148E-07	4.373E-07	2.541E-07	1.680E-07	1.253E-07	9.758E-08	8.117E-08	6.897E-08
SW	4.853E-06	1.791E-06	1.041E-06	6.840E-07	3.921E-07	2.549E-07	1.840E-07	1.358E-07	1.048E-07	8.578E-08	7.184E-08
WSW	3.802E-06	1.434E-06	8.549E-07	5.672E-07	3.282E-07	2.160E-07	1.569E-07	1.254E-07	1.037E-07	7.288E-08	5.337E-08
W	4.094E-06	1.561E-06	9.479E-07	6.340E-07	3.696E-07	2.442E-07	1.772E-07	1.303E-07	1.003E-07	7.978E-08	6.515E-08
WNW	5.460E-06	1.786E-06	9.973E-07	6.293E-07	3.367E-07	2.275E-07	1.681E-07	1.293E-07	1.036E-07	8.269E-08	6.774E-08
NW	7.176E-06	2.516E-06	1.445E-06	9.293E-07	5.174E-07	3.484E-07	2.574E-07	1.882E-07	1.443E-07	1.199E-07	1.018E-07
NNW	9.081E-06	3.313E-06	1.930E-06	1.267E-06	7.316E-07	4.747E-07	3.411E-07	2.571E-07	2.022E-07	1.648E-07	1.376E-07
N	7.582E-06	2.825E-06	1.685E-06	1.041E-06	5.449E-07	3.601E-07	2.621E-07	1.988E-07	1.571E-07	1.334E-07	1.154E-07
NNE	5.752E-06	1.997E-06	1.131E-06	7.782E-07	4.735E-07	3.058E-07	2.191E-07	1.742E-07	1.434E-07	1.106E-07	8.788E-08
NE	5.535E-06	1.898E-06	1.056E-06	6.981E-07	4.054E-07	2.485E-07	1.716E-07	1.325E-07	1.065E-07	8.514E-08	6.985E-08
ENE	4.130E-06	1.418E-06	7.964E-07	5.140E-07	2.875E-07	1.841E-07	1.310E-07	9.287E-08	6.933E-08	5.685E-08	4.771E-08
E	4.631E-06	1.719E-06	1.012E-06	6.689E-07	3.857E-07	2.351E-07	1.610E-07	1.238E-07	9.898E-08	7.876E-08	6.434E-08
ESE	5.989E-06	2.153E-06	1.246E-06	7.771E-07	4.090E-07	2.841E-07	2.150E-07	1.500E-07	1.106E-07	8.966E-08	7.447E-08
SE	5.228E-06	1.849E-06	1.061E-06	7.048E-07	4.071E-07	2.651E-07	1.906E-07	1.474E-07	1.186E-07	9.356E-08	7.583E-08
SSE	3.882E-06	1.405E-06	8.113E-07	5.295E-07	2.980E-07	1.926E-07	1.382E-07	1.087E-07	8.869E-08	7.909E-08	7.144E-08

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) DISTANCE IN MILES

SECTOR	5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
S	5.045E-08	2.344E-08	1.379E-08	6.476E-09	3.679E-09	2.360E-09	1.577E-09	1.117E-09	8.273E-10	6.330E-10	4.523E-10
SSW	5.962E-08	3.407E-08	1.733E-08	6.636E-09	3.677E-09	2.314E-09	1.636E-09	1.215E-09	9.393E-10	7.460E-10	5.596E-10
SW	5.877E-08	2.714E-08	1.642E-08	8.023E-09	5.053E-09	3.510E-09	2.313E-09	1.620E-09	1.270E-09	1.022E-09	7.946E-10
WSW	4.662E-08	2.773E-08	1.700E-08	8.458E-09	4.750E-09	3.021E-09	1.989E-09	1.393E-09	1.127E-09	9.328E-10	7.137E-10
W	5.386E-08	2.591E-08	1.591E-08	7.938E-09	4.862E-09	3.306E-09	2.024E-09	1.332E-09	1.149E-09	1.007E-09	7.649E-10
WNW	5.598E-08	2.687E-08	1.764E-08	9.666E-09	5.868E-09	3.963E-09	2.890E-09	2.206E-09	1.789E-09	1.483E-09	1.051E-09
NW	8.467E-08	4.176E-08	2.667E-08	1.407E-08	8.584E-09	5.826E-09	4.154E-09	3.111E-09	2.284E-09	1.734E-09	1.399E-09
NNW	1.165E-07	6.142E-08	3.915E-08	2.061E-08	1.350E-08	9.672E-09	7.126E-09	5.486E-09	3.687E-09	2.590E-09	1.977E-09
N	9.644E-08	4.831E-08	2.932E-08	1.441E-08	1.002E-08	7.525E-09	6.067E-09	5.041E-09	3.629E-09	2.710E-09	2.024E-09
NNE	7.470E-08	4.003E-08	2.583E-08	1.385E-08	7.717E-09	4.880E-09	3.313E-09	2.380E-09	1.691E-09	1.249E-09	1.166E-09
NE	5.960E-08	3.240E-08	2.136E-08	1.180E-08	6.057E-09	3.593E-09	2.623E-09	2.004E-09	1.502E-09	1.162E-09	9.707E-10
ENE	4.115E-08	2.332E-08	1.389E-08	6.646E-09	4.620E-09	3.466E-09	2.718E-09	2.205E-09	1.543E-09	1.123E-09	7.194E-10
E	5.312E-08	2.544E-08	1.595E-08	8.200E-09	4.899E-09	3.268E-09	2.061E-09	1.392E-09	9.799E-10	7.171E-10	5.278E-10
ESE	6.172E-08	3.002E-08	1.780E-08	8.465E-09	5.615E-09	4.063E-09	2.849E-09	2.103E-09	1.448E-09	1.039E-09	7.938E-10
SE	6.486E-08	3.560E-08	2.252E-08	1.174E-08	5.664E-09	3.202E-09	2.028E-09	1.374E-09	1.026E-09	7.911E-10	6.492E-10
SSE	5.967E-08	2.989E-08	1.695E-08	7.566E-09	4.521E-09	3.017E-09	2.178E-09	1.648E-09	1.286E-09	1.031E-09	6.900E-10

(Sheet 1 of 4)

TABLE 2.3-84 AVERAGE METEOROLOGICAL RELATIVE CONCENTRATION ANALYSIS SPECIAL DISTANCES, RADWASTE BUILDING VENT RELEASE
Data Period: May 4, 1973 to May 4, 1975 and March 16, 1978 to March 16, 1979 Combined

RELATIVE CONCENTRATION, X/Q (sec/m3)

AFFECTED SECTOR	EXCLUSION ZONE	LPZ	NEAREST[1] GOAT (TO 5 MILES)	NEAREST[1] COW (TO 5 MILES)	NEAREST[1] MEAT ANIMAL (TO 5 MILES)	NEAREST[1] VEG GARDEN (TO 5 MILES)	NEAREST[1] RESIDENCE (TO 5 MILES)	RESTRICTED AREA
S	1.395E-06	2.232E-07	8.184E-08	8.184E-08	1.410E-07	1.410E-07	1.410E-07	1.222E-06
SSW	1.605E-06	2.520E-07	9.360E-08	9.360E-08	1.683E-07	2.142E-07	2.142E-07	1.260E-06
SW	1.728E-06	2.825E-07	2.825E-07	2.052E-07	2.599E-07	2.599E-07	2.825E-07	8.316E-07
WSW	1.419E-06	2.380E-07	6.882E-08	6.882E-08	7.366E-07	5.004E-07	7.366E-07	7.812E-07
W	1.568E-06	2.583E-07	9.701E-08	5.002E-07	5.002E-07	5.002E-07	6.050E-07	8.840E-07
WNW	1.554E-06	2.420E-07	8.528E-08	8.528E-08	4.012E-07	4.012E-07	4.012E-07	8.790E-07
NW	2.324E-06	3.870E-07	1.309E-07	1.309E-07	4.620E-07	4.620E-07	4.620E-07	8.910E-07
NNW	3.219E-06	5.244E-07	1.785E-07	1.785E-07	9.153E-07	9.153E-07	9.153E-07	1.276E-06
N	2.750E-06	3.939E-07	1.400E-07	1.400E-07	1.400E-07	1.400E-07	1.938E-06	1.056E-06
NNE	1.872E-06	3.388E-07	4.092E-07	1.100E-07	4.598E-07	4.633E-07	4.633E-07	8.004E-07
NE	1.680E-06	2.626E-07	1.530E-07	2.448E-07	2.448E-07	2.448E-07	2.448E-07	8.004E-07
ENE	1.243E-06	1.980E-07	2.825E-07	6.767E-08	2.825E-07	3.808E-07	3.808E-07	4.165E-07
E	1.620E-06	2.448E-07	8.008E-08	8.008E-08	1.545E-07	1.287E-07	5.198E-07	5.865E-07
ESE	2.002E-06	3.171E-07	9.471E-08	9.471E-08	3.888E-07	3.888E-07	3.888E-07	7.467E-07
SE	1.736E-06	2.793E-07	9.009E-08	9.009E-08	3.562E-07	3.562E-07	3.562E-07	1.008E-06
SSE	1.339E-06	2.100E-07	1.051E-07	1.051E-07	2.100E-07	2.100E-07	2.100E-07	1.060E-06

DEPLETED RELATIVE CONCENTRATION, X/Q (sec/m3)

AFFECTED SECTOR	EXCLUSION ZONE	LPZ	NEAREST[1] GOAT (TO 5 MILES)	NEAREST[1] COW (TO 5 MILES)	NEAREST[1] MEAT ANIMAL (TO 5 MILES)	NEAREST[1] VEG GARDEN (TO 5 MILES)	NEAREST[1] RESIDENCE (TO 5 MILES)	RESTRICTED AREA
S	1.209E-06	1.767E-07	6.045E-08	6.045E-08	1.128E-07	1.128E-07	1.128E-07	1.128E-06
SSW	1.498E-06	2.100E-07	6.968E-08	6.968E-08	1.287E-07	1.632E-07	1.632E-07	1.155E-06
SW	1.512E-06	2.260E-07	2.260E-07	1.620E-07	2.034E-07	2.034E-07	2.260E-07	7.236E-07
WSW	1.225E-06	1.960E-07	5.106E-08	5.106E-08	6.477E-07	4.309E-07	6.477E-07	6.804E-07
W	1.344E-06	2.091E-07	7.303E-08	4.270E-07	4.270E-07	4.270E-07	5.203E-07	7.800E-07
WNW	1.443E-06	1.980E-07	6.344E-08	6.344E-08	3.304E-07	3.304E-07	3.304E-07	7.738E-07
NW	2.075E-06	3.182E-07	9.240E-08	9.240E-08	3.780E-07	3.780E-07	3.780E-07	7.452E-07
NNW	2.886E-06	4.218E-07	1.365E-07	1.365E-07	7.684E-07	7.684E-07	7.684E-07	1.125E-06
N	2.420E-06	3.232E-07	1.100E-07	1.100E-07	1.100E-07	1.100E-07	1.632E-06	8.928E-07
NNE	1.664E-06	2.662E-07	3.348E-07	8.360E-08	3.872E-07	3.842E-07	3.842E-07	6.844E-07
NE	1.575E-06	2.121E-07	1.224E-07	1.938E-07	1.938E-07	1.938E-07	1.938E-07	6.844E-07
ENE	1.130E-06	1.650E-07	2.373E-07	5.050E-08	2.373E-07	3.213E-07	3.213E-07	3.451E-07
E	1.512E-06	1.938E-07	6.006E-08	6.006E-08	1.133E-07	9.900E-08	4.407E-07	5.060E-07
ESE	1.716E-06	2.567E-07	7.011E-08	7.011E-08	3.312E-07	3.312E-07	3.312E-07	6.419E-07
SE	1.488E-06	2.261E-07	6.669E-08	6.669E-08	2.877E-07	2.877E-07	2.877E-07	8.820E-07
SSE	1.133E-06	1.680E-07	7.776E-08	7.776E-08	1.680E-07	1.680E-07	1.680E-07	9.328E-07

TABLE 2.3-84 (Continued) (Sheet 2 of 4)

RELATIVE DEPOSITION RATE, D/Q (1/m2)

AFFECTED SECTOR	EXCLUSION ZONE	LPZ	NEAREST[1] GOAT (TO 5 MILES)	NEAREST[1] COW (TO 5 MILES)	NEAREST[1] MEAT ANIMAL (TO 5 MILES)	NEAREST[1] VEG GARDEN (TO 5 MILES)	NEAREST[1] RESIDENCE (TO 5 MILES)	RESTRICTED AREA
S	4.557E-09	5.766E-10	1.674E-10	1.674E-10	3.384E-10	3.384E-10	3.384E-10	4.042E-09
SSW	4.601E-09	5.670E-10	1.664E-10	1.664E-10	3.465E-10	4.488E-10	4.488E-10	3.465E-09
SW	3.996E-09	5.198E-10	5.198E-10	3.672E-10	4.520E-10	4.520E-10	5.198E-10	1.836E-09
WSW	3.999E-09	5.460E-10	1.221E-10	1.221E-10	2.032E-09	1.334E-09	2.032E-09	2.142E-09
W	4.816E-09	6.642E-10	2.071E-10	1.464E-09	1.464E-09	1.464E-09	1.815E-09	2.704E-09
WNW	5.661E-09	7.040E-10	1.976E-10	1.976E-10	1.180E-09	1.180E-09	1.180E-09	2.968E-09
NW	8.300E-09	1.118E-09	2.926E-10	2.926E-10	1.344E-09	1.344E-09	1.344E-09	2.916E-09
NNW	1.110E-08	1.482E-09	3.885E-10	3.885E-10	2.825E-09	2.825E-09	2.825E-09	4.292E-09
N	1.100E-08	1.313E-09	3.800E-10	3.800E-10	3.800E-10	3.800E-10	7.854E-09	4.128E-09
NNE	8.216E-09	1.198E-09	1.488E-09	3.190E-10	1.815E-09	1.808E-09	1.808E-09	3.364E-09
NE	6.405E-09	7.777E-10	3.876E-10	6.834E-10	6.834E-10	6.834E-10	6.834E-10	2.784E-09
ENE	4.407E-09	5.280E-10	8.136E-10	1.414E-10	8.136E-10	1.130E-09	1.130E-09	1.190E-09
E	6.480E-09	7.650E-10	2.002E-10	2.002E-10	4.223E-10	3.564E-10	1.808E-09	2.070E-09
ESE	9.152E-09	1.208E-09	2.829E-10	2.829E-10	1.584E-09	1.584E-09	1.584E-09	3.275E-09
SE	7.316E-09	9.842E-10	2.457E-10	2.457E-10	1.260E-09	1.260E-09	1.260E-09	4.200E-09
SSE	4.944E-09	6.300E-10	2.592E-10	2.592E-10	6.300E-10	6.300E-10	6.300E-10	3.922E-09

DECAYED, HALF LIFE 2.26 DAYS, RELATIVE CONCENTRATION, X/Q (sec/m3)

AFFECTED SECTOR	EXCLUSION ZONE	LPZ	NEAREST[1] GOAT (TO 5 MILES)	NEAREST[1] COW (TO 5 MILES)	NEAREST[1] MEAT ANIMAL (TO 5 MILES)	NEAREST[1] VEG GARDEN (TO 5 MILES)	NEAREST[1] RESIDENCE (TO 5 MILES)	RESTRICTED AREA
S	1.395E-06	2.232E-07	7.998E-08	7.998E-08	1.410E-07	1.410E-07	1.410E-07	1.222E-06
SSW	1.605E-06	2.520E-07	9.048E-08	9.048E-08	1.683E-07	2.040E-07	2.040E-07	1.260E-06
SW	1.728E-06	2.825E-07	2.825E-07	2.052E-07	2.486E-07	2.486E-07	2.825E-07	8.316E-07
WSW	1.419E-06	2.380E-07	6.660E-08	6.660E-08	7.366E-07	5.004E-07	7.366E-07	7.686E-07
W	1.456E-06	2.583E-07	9.483E-08	5.002E-07	5.002E-07	5.002E-07	6.050E-07	8.840E-07
WNW	1.554E-06	2.420E-07	8.320E-08	8.320E-08	4.012E-07	4.012E-07	4.012E-07	8.798E-07
NW	2.324E-06	3.870E-07	1.232E-07	1.232E-07	4.536E-07	4.536E-07	4.536E-07	8.910E-07
NNW	3.219E-06	5.244E-07	1.785E-07	1.785E-07	9.153E-07	9.153E-07	9.153E-07	1.276E-06
N	2.750E-06	3.939E-07	1.400E-07	1.400E-07	1.400E-07	1.400E-07	1.836E-06	1.056E-06
NNE	1.768E-06	3.267E-07	4.092E-07	1.089E-07	4.598E-07	4.633E-07	4.633E-07	7.888E-07
NE	1.680E-06	2.626E-07	1.530E-07	2.346E-07	2.346E-07	2.346E-07	2.346E-07	8.004E-07
ENE	1.243E-06	1.980E-07	2.825E-07	6.565E-08	2.825E-07	3.808E-07	3.808E-07	4.046E-07
E	1.620E-06	2.448E-07	7.826E-08	7.826E-08	1.442E-07	1.287E-07	5.198E-07	5.865E-07
ESE	2.002E-06	3.171E-07	9.225E-08	9.225E-08	3.888E-07	3.888E-07	3.888E-07	7.336E-07
SE	1.736E-06	2.793E-07	8.775E-08	8.775E-08	3.425E-07	3.425E-07	3.425E-07	1.008E-06
SSE	1.339E-06	2.100E-07	1.022E-07	1.022E-07	2.100E-07	2.100E-07	2.100E-07	1.049E-06

TABLE 2.3-84 (Continued) (Sheet 3 of 4)

DECAYED HALF LIFE 8.00 DAYS, RELATIVE CONCENTRATION, X/Q (sec/m3)

AFFECTED SECTOR	EXCLUSION ZONE	LPZ	NEAREST[1] GOAT (TO 5 MILES)	NEAREST[1] COW (TO 5 MILES)	NEAREST[1] MEAT ANIMAL (TO 5 MILES)	NEAREST[1] VEG GARDEN (TO 5 MILES)	NEAREST[1] RESIDENCE (TO 5 MILES)	RESTRICTED AREA
S	1.395E-06	2.232E-07	8.091E-08	8.091E-08	1.410E-07	1.410E-07	1.410E-07	1.222E-06
SSW	1.605E-06	2.520E-07	9.256E-08	9.256E-08	1.683E-07	2.142E-07	2.142E-07	1.260E-06
SW	1.728E-06	2.825E-07	2.825E-07	2.052E-07	2.599E-07	2.599E-07	2.825E-07	8.316E-07
WSW	1.419E-06	2.380E-07	6.771E-08	6.771E-08	7.366E-07	5.004E-07	7.366E-07	7.812E-07
W	1.568E-06	2.583E-07	9.701E-08	5.002E-07	5.002E-07	5.002E-07	6.050E-07	8.840E-07
WNW	1.554E-06	2.420E-07	8.424E-08	8.424E-08	4.012E-07	4.012E-07	4.012E-07	8.790E-07
NW	2.324E-06	3.870E-07	1.309E-07	1.309E-07	4.536E-07	4.536E-07	4.536E-07	8.910E-07
NNW	3.219E-06	5.244E-07	1.785E-07	1.785E-07	9.153E-07	9.153E-07	9.153E-07	1.276E-06
N	2.750E-06	3.939E-07	1.400E-07	1.400E-07	1.400E-07	1.400E-07	1.836E-06	1.056E-06
NNE	1.872E-06	3.267E-07	4.092E-07	1.100E-07	4.598E-07	4.633E-07	4.633E-07	8.004E-07
NE	1.680E-06	2.626E-07	1.530E-07	2.448E-07	2.448E-07	2.448E-07	2.448E-07	8.004E-07
ENE	1.243E-06	1.980E-07	2.825E-07	6.666E-08	2.825E-07	3.808E-07	3.808E-07	4.046E-07
E	1.620E-06	2.448E-07	7.917E-08	7.917E-08	1.545E-07	1.287E-07	5.198E-07	5.865E-07
ESE	2.002E-06	3.171E-07	9.417E-08	9.417E-08	3.888E-07	3.888E-07	3.888E-07	7.336E-07
SE	1.736E-06	2.793E-07	9.009E-08	9.009E-08	3.526E-07	3.526E-07	3.526E-07	1.008E-06
SSE	1.339E-06	2.100E-07	1.037E-07	1.037E-07	2.100E-07	2.100E-07	2.100E-07	1.060E-06

DECAYED AND DEPLETED, HALF LIFE 2.26 DAYS, RELATIVE CONCENTRATION, X/Q (sec/m3)

AFFECTED SECTOR	EXCLUSION ZONE	LPZ	NEAREST[1] GOAT (TO 5 MILES)	NEAREST[1] COW (TO 5 MILES)	NEAREST[1] MEAT ANIMAL (TO 5 MILES)	NEAREST[1] VEG GARDEN (TO 5 MILES)	NEAREST[1] RESIDENCE (TO 5 MILES)	RESTRICTED AREA
S	1.209E-06	1.767E-07	5.952E-08	5.952E-08	1.128E-07	1.128E-07	1.128E-07	1.128E-06
SSW	1.498E-06	1.995E-07	6.760E-08	6.760E-08	1.287E-07	1.632E-07	1.632E-07	1.155E-06
SW	1.512E-06	2.260E-07	2.260E-07	1.620E-07	2.034E-07	2.034E-07	2.260E-07	7.236E-07
WSW	1.225E-06	1.820E-07	4.995E-08	4.995E-08	6.350E-07	4.170E-07	6.350E-07	6.804E-07
W	1.344E-06	2.091E-07	7.194E-08	4.148E-08	4.148E-07	4.148E-07	5.203E-07	7.696E-07
WNW	1.443E-06	1.980E-07	6.240E-08	6.240E-08	3.304E-07	3.304E-07	3.304E-07	7.632E-07
NW	2.075E-06	3.096E-07	9.240E-08	9.240E-08	3.696E-07	3.696E-07	3.696E-07	7.371E-07
NNW	2.775E-06	4.218E-07	1.365E-07	1.365E-07	7.684E-07	7.684E-07	7.684E-07	1.125E-06
N	2.420E-06	3.131E-07	1.100E-07	1.100E-07	1.100E-07	1.100E-07	1.632E-06	8.928E-07
NNE	1.664E-06	2.662E-07	3.348E-07	8.140E-07	3.872E-07	3.842E-07	3.842E-07	6.844E-07
NE	1.575E-06	2.121E-07	1.224E-07	1.938E-07	1.938E-07	1.938E-07	1.938E-07	6.844E-07
ENE	1.130E-06	1.540E-07	2.373E-07	4.949E-07	2.373E-07	3.213E-07	3.213E-07	3.451E-07
E	1.404E-06	1.938E-07	5.824E-08	5.824E-08	1.133E-07	9.801E-08	4.407E-08	4.945E-07
ESE	1.716E-06	2.567E-07	6.888E-08	6.888E-08	3.168E-07	3.168E-07	3.168E-07	6.288E-07
SE	1.488E-06	2.261E-07	6.552E-08	6.552E-08	2.877E-07	2.877E-07	2.877E-07	8.680E-07
SSE	1.133E-06	1.680E-07	7.632E-08	7.632E-08	1.680E-07	1.680E-07	1.680E-07	9.328E-07

TABLE 2.3-84 (Continued) (Sheet 4 of 4)

DECAYED HALF LIFE 8.0 DAYS, AND DEPLETED RELATIVE CONCENTRATION, X/Q (sec/m3)

AFFECTED SECTOR	EXCLUSION ZONE	LPZ	NEAREST1 GOAT (TO 5 MILES)	NEAREST[1] COW (TO 5 MILES)	NEAREST[1] MEAT ANIMAL (TO 5 MILES)	NEAREST[1] VEG GARDEN (TO 5 MILES)	NEAREST[1] RESIDENCE (TO 5 MILES)	RESTRICTED AREA
S	1.209E-06	1.767E-07	6.045E-08	6.045E-08	1.128E-07	1.128E-07	1.128E-07	1.128E-06
SSW	1.498E-06	2.100E-07	6.864E-08	6.864E-08	1.287E-07	1.632E-07	1.632E-07	1.155E-06
SW	1.512E-06	2.260E-07	2.260E-07	1.620E-07	2.034E-07	2.034E-07	2.260E-07	7.236E-07
WSW	1.225E-06	1.960E-07	5.106E-08	5.106E-08	6.477E-07	4.309E-07	6.477E-07	6.804E-07
W	1.344E-06	2.091E-07	7.303E-08	4.270E-07	4.270E-07	4.270E-07	5.203E-07	7.800E-07
WNW	1.443E-06	1.980E-07	6.344E-08	6.344E-08	3.304E-07	3.304E-07	3.304E-07	7.632E-07
NW	2.075E-06	3.182E-07	9.240E-08	9.240E-08	3.780E-07	3.780E-07	3.780E-07	7.452E-07
NNW	2.886E-06	4.218E-07	1.365E-07	1.365E-07	7.684E-07	7.684E-07	7.684E-07	1.125E-06
N	2.420E-06	3.232E-07	1.100E-07	1.100E-07	1.100E-07	1.100E-07	1.632E-06	8.928E-07
NNE	1.664E-06	2.662E-07	3.348E-07	8.250E-08	3.872E-07	3.842E-07	3.842E-07	6.844E-07
NE	1.575E-06	2.121E-07	1.224E-07	1.938E-07	1.938E-07	1.938E-07	1.938E-07	6.844E-07
ENE	1.130E-06	1.650E-07	2.373E-07	5.050E-08	2.373E-07	3.213E-07	3.213E-07	3.451E-07
E	1.512E-06	1.938E-07	5.915E-08	5.915E-08	1.133E-07	9.900E-08	4.407E-07	4.945E-07
ESE	1.716E-06	2.567E-07	7.011E-08	7.011E-08	3.312E-07	3.312E-07	3.312E-07	6.288E-07
SE	1.488E-06	2.261E-07	6.669E-08	6.669E-08	2.877E-07	2.877E-07	2.877E-07	8.680E-07
SSE	1.133E-06	1.680E-07	7.776E-08	7.776E-08	1.680E-07	1.680E-07	1.680E-07	9.328E-07

LOCATION OF SPECIAL INTEREST POINTS (METERS)

AFFECTED SECTOR	EXCLUSION ZONE	LPZ	NEAREST1 GOAT (TO 5 MILES)	NEAREST[1] COW (TO 5 MILES)	NEAREST[1] MEAT ANIMAL (TO 5 MILES)	NEAREST[1] VEG GARDEN (TO 5 MILES)	NEAREST[1] RESIDENCE (TO 5 MILES)	RESTRICTED AREA
S	1200	4023	8047	8047	5472	5472	5472	1300
SSW	1200	4023	8047	8047	5150	4506	4506	1400
SW	1200	4023	4023	4898	4345	4345	4023	1900
WSW	1200	4023	8047	8047	1770	2414	1770	1700
W	1200	4023	7242	2575	2575	2575	2253	1600
WNW	1200	4023	8047	8047	3058	3058	3050	1700
NW	1200	4023	8047	8047	3541	3541	3541	2300
NNW	1200	4023	8047	8047	2736	2736	2736	2200
N	1200	4023	8047	8047	8047	8047	1448	2051
NNE	1200	4023	3540	8047	3219	3058	3058	2200
NE	1200	4023	5955	4345	4345	4345	4345	2100
ENE	1200	4023	3219	8047	3219	2736	2736	2600
E	1200	4023	8047	8047	5633	6115	2575	2400
ESE	1200	4023	8047	8047	3380	3380	3380	2100
SE	1200	4023	8047	8047	3540	3540	3540	1800
SSE	1200	4023	8047	8047	4023	4023	4023	1400

1 The organic receptor locations listed in this Table are historical data identified during the licensing stage of the plant. The current organic receptor locations and dispersion parameters are determined as part of the Annual Land Use Census

(Sheet 1 of 1)

TABLE 2.3-85 ATMOSPHERIC RELATIVE CONCENTRATIONS UNIT VENT RELEASE GRAZING SEASON

Receptor Location		Relative Concentration X/Q (sec/m^3)	Depleted Relative Concentration X/Q (sec/m^3)	Relative Deposition Rate D/Q (1/m^2)	2.26 Day Decayed X/Q (sec/m^3)	8.00 Day Decayed X/Q (sec/m^3)	2.26 Day Decayed and Depleted X/Q (sec/m^3)	8.00 Day Decayed and Depleted X/Q (sec/m^3)
Direction Sector	Distance (meters)							
Data Periods: 5/4/73 through 12/15/73; and 4/15/74 through 5/4/74								
NNE	3540	4.531E-07	3.697E-07	1.789E-09	4.531E-07	4.531E-07	3.697E-07	3.697E-07
W	2574	3.852E-07	3.250E-07	1.011E-09	3.852E-07	3.852E-07	3.250E-07	3.250E-07
NNW	2735	9.275E-07	7.786E-07	3.893E-09	9.161E-07	9.275E-07	7.672E-07	7.786E-07
Data Periods: 5/4/74 through 12/15/74; and 4/15/75 through 5/4/75								
NNE	3540	4.054E-07	3.339E-07	1.789E-09	4.054E-07	4.054E-07	3.339E-07	3.339E-07
W	2574	4.213E-07	3.611E-07	1.324E-09	4.213E-07	4.213E-07	3.611E-07	3.611E-07
NNW	2735	8.130E-07	6.870E-07	3.206E-09	8.015E-07	8.130E-07	6.756E-07	6.756E-07
Data Periods: 4/15/78 through 12/15/78								
NNE	3540	3.339E-07	2.743E-07	1.312E-09	3.339E-07	3.339E-07	2.743E-07	2.743E-07
W	2574	4.695E-07	3.972E-07	1.565E-09	4.695E-07	4.695E-07	3.972E-07	3.972E-07
NNW	2735	9.733E-07	8.130E-07	3.206E-09	9.619E-07	9.733E-07	8.130E-07	8.130E-07
Data Periods: 3 Years Combined								
NNE	3540	3.935E-07	3.220E-07	1.669E-09	3.935E-07	3.935E-07	3.220E-07	3.220E-07
W	2574	4.333E-07	3.611E-07	1.324E-09	4.213E-07	4.333E-07	3.611E-07	3.611E-07
NNW	2735	9.046E-07	7.557E-07	3.435E-09	8.932E-07	9.046E-07	7.557E-07	7.557E-07

(Sheet 1 of 1)

TABLE 2.3-86 ATMOSPHERIC RELATIVE CONCENTRATIONS RADWASTE BUILDING RELEASE GRAZING SEASON

Receptor Location		Relative Concentration X/Q (sec/m^3)	Depleted Relative Concentration X/Q (sec/m^3)	Relative Deposition Rate D/Q (1/m^2)	2.26 Day Decayed X/Q (sec/m^3)	8.00 Day Decayed X/Q (sec/m^3)	2.26 Day Decayed and Depleted X/Q (sec/m^3)	8.00 Day Decayed and Depleted X/Q (sec/m^3)
Direction Sector	Distance (meters)							
Data Periods: 5/4/73 through 12/15/73; and 4/15/74 through 5/4/74								
NNE	3540	5.605E-07	4.651E-07	1.789E-09	5.605E-07	5.605E-07	4.531E-07	4.651E-07
W	2574	4.815E-07	4.093E-07	1.011E-09	4.815E-07	4.815E-07	4.093E-07	4.093E-07
NNW	2735	1.145E-06	9.733E-07	3.893E-09	1.145E-06	1.145E-06	9.619E-07	9.619E-07
Data Periods: 5/4/74 through 12/15/74; and 4/15/75 through 5/4/75								
NNE	3540	4.889E-07	4.054E-07	1.789E-09	4.889E-07	4.889E-07	4.054E-07	4.054E-07
W	2574	5.296E-07	4.454E-07	1.324E-09	5.296E-07	5.296E-07	4.454E-07	4.454E-07
NNW	2735	1.019E-06	8.588E-07	3.206E-09	1.019E-06	1.019E-06	8.588E-07	8.588E-07
Data Periods: 4/15/78 through 12/15/78								
NNE	3540	4.054E-07	3.339E-07	1.312E-09	4.054E-07	4.054E-07	3.339E-07	3.339E-07
W	2574	5.898E-07	4.935E-07	1.565E-09	5.898E-07	5.898E-07	4.935E-07	4.935E-07
NNW	2735	1.260E-06	1.053E-06	3.206E-09	1.260E-06	1.260E-06	1.042E-06	1.042E-06
Data Periods: 3 Years Combined								
NNE	3540	4.889E-07	3.935E-07	1.669E-09	4.770E-07	4.889E-07	3.935E-07	3.935E-07
W	2574	5.296E-07	4.574E-07	1.324E-09	5.296E-07	5.296E-07	4.454E-07	4.454E-07
NNW	2735	1.145E-06	9.619E-07	3.435E-09	1.134E-06	1.145E-06	9.504E-07	9.619E-07

2.4 HYDROLOGIC ENGINEERING

2.4.1 HYDROLOGIC DESCRIPTION

2.4.1.1 Site and Facilities

The Callaway Plant site is located about 10 miles southeast of Fulton in Callaway County, Missouri, on a plateau lying about 5 miles north of the Missouri River. The plateau has elevations varying from about 830 to 850 feet MSL. The elevation of the Missouri River floodplain near the site is about 525 feet MSL. The plant grade elevation is established at 840 feet MSL and the standard plant floor elevation of the safety-related facilities at 840.5 feet MSL. The center of the non-safety related natural draft cooling tower is located about 1,200 feet to the northeast of the reactor building at a grade elevation of 845 feet MSL (Figure 2.1-4). The site and local topography are shown on Figures 2.1-3 and 2.1-4; a larger area surrounding the site is shown on Figure 2.5-14. Locations of and topographic profiles showing the relationship between the Callaway Plant site and the Missouri River Valley are illustrated on Figures 2.4-1 and 2.4-2, respectively. The site physiography is discussed in Section 2.5.1.2.1.

The Missouri River, the principal source of makeup water for the cooling tower system, is discussed in detail in Section 9.2. Makeup water will be withdrawn through an inlet located at about Missouri River mile 115 (Figure 2.1-2). It will be pumped to the site via a pipeline, as shown on Figure 2.1-2, and the blowdown water from the cooling water system will be discharged through a separate pipeline to the Missouri River about 100 feet downstream from the intake structure. Emergency safe shutdown of the reactor would be accomplished with a Category I mechanical draft ultimate heat sink (UHS) cooling tower utilizing water from the UHS retention pond located adjacent to the power plant facilities. Consequently, the intake structure at the Missouri River and the supply and discharge pipelines to and from the plant site are not Category I structures.

The Category I structures include the reactor, fuel, control, diesel generator, and auxiliary building; the essential service water system (ESWS) pipelines; the ESWS electrical duct banks including manholes; the refueling water storage tank; the UHS mechanical draft cooling tower; the UHS retention pond; the ESWS pumphouse and the ESWS supply lines yard vault. The locations of these safety-related components are shown on Figure 2.1-4.

The UHS retention pond is an excavation in natural soils located about 400 feet southeast of Unit I, as shown on Figure 2.1-3, and contains about 56.03 acre-feet of water for use as makeup water for the Category I mechanical draft cooling tower system during an emergency safe shutdown. The water surface area in the pond is about 4.1 acres, the design water surface elevation is 836.0 feet, and the design depth of the water is 18 feet. The target (nominal) UHS retention pond level is maintained between the low and high UHS water level alarms. The pond site area is underlain by accretion-gley and glacial till of extremely low permeability. Seepage losses will have no significant effect on

storage. The permeability of the natural soils surrounding the pond is discussed in Section 2.5.6.2.2.4.

Natural surface runoff surrounding the Callaway Plant site area flows in an easterly direction into the Logan Creek drainage basin, northwesterly into the Cow Creek and Auxvasse Creek drainage basins, and south-southwesterly into the watershed area of Mud Creek. At the location of the power plant facilities, the surface drainage is controlled by a low swale which drains runoff into the Logan Creek drainage basin. Slightly higher topography to the southwest, west, and north-west of the plant site area forms a natural drainage divide with the other basins (Figures 2.4-3 and 2.4-4).

The Callaway Plant site area has been graded during construction to level the existing terrain and establish a uniform yard grade; however, there has been no major modification to the natural drainage conditions. The surface drainage pattern in the site area will insure that all surface runoff from the power plant structures and areas surrounding the UHS retention pond and the cooling tower continues to flow generally in an easterly direction into the Logan Creek drainage basin, as shown on Figure 2.4-3. Surface runoff from the switchyard area is to be diverted into the Mud Creek watershed. Site grading operations have been conducted so that no significant surface runoff from the vicinity of the power plant structures flows west or north into receiving streams in the Auxvasse Creek or Cow Creek drainage basins.

A description of the site grading and earthwork is presented in Section 2.5.4.5.

2.4.1.2 Hydrosphere

2.4.1.2.1 Surface Water

Although the plateau on which the site is located is relatively level, peripheral streams have deeply dissected its flanks in a dendritic pattern. Since the plateau is the topographic high in the area, surface runoff from the site vicinity drains radially into small intermittent streams. These small streams are branches of local streams that include Logan Creek to the east, Mud Creek to the south-southwest, Cow Creek to the north, and Auxvasse Creek to the west (Figure 2.4-5). Mud Creek is tributary to Logan Creek in Section 35, T46N, R8W, and Cow Creek is tributary to Auxvasse Creek in Section 22, T47N, R8W. Logan and Auxvasse creeks have relatively steep channel gradients and drain directly into the Missouri River. The drainage areas and confluence points with the Missouri River for Logan and Auxvasse creeks are noted in Table 2.4-1, and illustrated on Figure 2.4-5.

2.4.1.2.1.1 Auxvasse Creek

Auxvasse Creek, which collects runoff from the western and northern portions of the plant site area, drains about 317 square miles excluding its tributary, Cow Creek. It flows in a southerly direction to its confluence with the Missouri River at river mile 120.6. The creek drops about 350 feet in elevation over its length and approaches to within about

2.5 miles of the site on the west. The floodplain of Auxvasse Creek from near the site to the mouth ranges in width from about 1/4 to 1/2 mile.

2.4.1.2.1.2 Cow Creek

Cow Creek, a major tributary of Auxvasse Creek, is located about 5 miles north and northwest of the plant site and drains about 29.7 square miles. It flows generally in a westerly direction to its confluence with Auxvasse Creek. Cow Creek, characteristically an intermittent stream, exhibits a milder slope than the streams that drain generally in a southerly direction in the vicinity of the site.

2.4.1.2.1.3 Mud Creek

Mud Creek collects surface drainage from about 8.3 square miles, including areas to the south and the southwest portion of the plant site area. It is an intermittent stream that begins at a point about 1.5 miles south of the site, first flowing southerly and then easterly for a distance of about 5 miles to its confluence with Logan Creek, about 2.5 miles south of the site. In this distance, Mud Creek drops about 350 feet in elevation; in one 1/2-mile reach, it drops more than 200 feet. Mud Creek is deeply incised within narrow valley walls.

2.4.1.2.1.4 Logan Creek

Logan Creek drains the central and eastern portions of the plant site area and is within 2 miles of the plant at its nearest point. It drains approximately 16.7 square miles and flows generally in a southerly direction for about 11 miles, entering the Missouri River at about river mile 114.7. Logan Creek is deeply incised into the plateau. The floodplain of Logan Creek, which is from 500 to 1,000 feet wide from near the site to its mouth, slopes from an elevation of about 570 feet MSL approximately 4.5 miles above its junction with the floodplain of the Missouri River to about elevation 525 feet MSL where it joins the river floodplain.

2.4.1.2.1.5 The Missouri River

The Missouri River is formed by the junction of the Jefferson, Madison and Gallatin rivers near Three Forks, Montana (Figure 2.4-6). It flows generally in a southeasterly direction for about 2,315 river miles to its confluence with the Mississippi River about 15 miles upstream from St. Louis, Missouri (Missouri Basin Inter-Agency Committee, 1969; Figure 2.4-6). The Callaway Plant site is located about 5 miles north of the Missouri River at about river mile 115. The two gauging stations on the Missouri River nearest to the site are the USGS stations at Hermann (06934500) and Boonville (06909000), Missouri (Figure 2.4-7). At the Hermann gauging station, located downstream approximately 17 river miles at Missouri River mile 97.9, continuous streamflow records have been collected since October 1897. The average flow at Hermann over a 26-year period of record (1952 to 1977) is 72,200 cfs for regulated flow conditions. The maximum estimated flow at Hermann, 892,000 cfs, occurred in June 1844; the maximum recorded

flood had a discharge of 676,000 cfs and occurred on June 6 and 7, 1903. The minimum recorded flow was 4,200 cfs during an ice jam on January 10-12, 1940. At the Boonville gauging station, about 82 river miles upstream from the site, streamflow records have been kept since October 1925; the average flow for a 52-year period, 1925 to 1977, is 57,700 cfs. There is some regulation of flow from many upstream reservoirs. (USGS, 1978). The approximate drainage areas of the Missouri River at Hermann and at Boonville, as well as at the location of the water supply intake for the Callaway Plant site, are noted in Table 2.4-2.

The Gasconade River enters the Missouri River at about Missouri River mile 104.5 (Figure 2.4-7 and Table 2.4-1). The total drainage area of the Gasconade River is about 3,500 square miles. The drainage area of the Gasconade River above the USGS gauging stations at Jerome, Missouri (06933500) and near Rich Fountain, Missouri (06934000; discontinued in October 1959) are approximately 2,840 and 3,180 square miles, respectively. The average flow of the Gasconade River at Jerome for the periods 1903 through 1905 and 1922 through 1977 is 2,490 cfs. The maximum and minimum flows recorded at Jerome during the same period were 101,000 cfs on April 15, 1945, and 254 cfs on September 21 and 22, 1956, respectively. The maximum estimated discharge outside the period of record is 120,000 cfs and occurred on January 6, 1897. The average discharge of the Gasconade River near Rich Fountain for a 38-year period of record (1921 to 1959) is 2,939 cfs. The maximum and minimum discharges recorded near Rich Fountain were 96,400 cfs on April 16, 1945, and 271 cfs on September 19, 1954, respectively (USGS, 1978 and 1964).

Upstream between the Callaway Plant site and Boonville, the major tributary is the Osage River, which joins the Missouri River at about Missouri River mile 129.9 (Figure 2.4-7 and Table 2.4-1). The total drainage area of the Osage River is about 14,900 square miles. The drainage area of the river above the USGS gauging station near St. Thomas, Missouri (06926500) is approximately 14,500 square miles. The average flow of the Osage River near St. Thomas for a 46-year period is 10,010 cfs. Maximum and minimum flows recorded near St. Thomas for the same period were 216,000 cfs on May 20, 1943, and 346 cfs on July 12, 1959. Flow in the lower Osage River has been regulated since the completion of Bagnell Dam in 1931 (USGS, 1978).

Bagnell Dam (Figure 2.4-7), owned by Union Electric Company of Missouri, is a concrete gravity dam located on the Osage River about 82 river miles above its confluence with the Missouri River. The Lake of the Ozarks, which was formed by the dam, has a usable capacity of 1,218,000 acre-feet and dead storage capacity of 708,800 acre-feet (USGS, 1978). The Lake of the Ozarks approaches the toe of the Harry S. Truman Dam (Figure 2.4-7), which is scheduled for completion in 1982. Flood control operation in the Harry S. Truman reservoir will be fully effective during the summer of 1979 (U.S. Army Corps of Engineers, 1979).

Significant flood control measures were implemented in the upper reaches of the Missouri River Basin during the early 1950s. The discharge pattern along the main stem of the river system was altered as the impoundment of significant quantities of water in

the Fort Randall Reservoir, located in South Dakota (Figure 2.4-6), began in 1952. Significant changes in the pattern of streamflow continued with the construction of each new storage reservoir on the main stem of the Missouri River, such as Garrison Reservoir in 1953; Lewis and Clark Lake in 1955; Oahe Reservoir in 1958 (refer to Figure 2.4-6). By 1965, there were 107 major reservoirs and 1,387 smaller reservoirs (individual storage capacities less than 25,000 acre-feet) either completed or under construction in the Missouri River Basin (Missouri Basin Inter-Agency Committee, 1969). Together, these reservoirs provide over 112,000,000 acre-feet of storage capacity as well as flood control, municipal and industrial water supply, irrigation, hydroelectric power, navigation, enhancement of fish and wildlife habitats, and improvement of recreational facilities. From Sioux City, Iowa, to its mouth, extensive channel improvement has been carried out on the Missouri River in the interest of bank stabilization and navigation. Improvement measures include channel bank revetment, permeable dikes to contract and stabilize the waterway, cutoffs to eliminate long bends, closing of minor channels, removal of snags, and dredging as required. A 9-foot channel depth and a minimum width of 300 feet is also maintained in accordance with the River and Harbor Act of March 2, 1945 (U.S. Army Corps of Engineers, 1978). To maintain a 9-foot channel depth, flow rates of 25,000 to 31,000 cfs at Sioux City, and 31,000 to 41,000 cfs at Kansas City, Missouri, are required during the navigation season (March through November). The Reservoir Control Center of the U.S. Army Corps of Engineers currently manages river flows to maintain a normal low flow of 40,000 cfs and a minimum low flow of 35,000 cfs at Kansas City during the navigation season (Claire, 1974).

There are no reservoirs and lakes on the main stem of the Missouri River downstream from Sioux City. The Gavins Point Dam in South Dakota, which forms Lewis and Clark Lake at about Missouri River mile 811, is the nearest main stem dam to the site, located about 696 river miles upstream.

2.4.1.2.2 Water Use

In the mid-Missouri region, water supplies are used for domestic and industrial needs, transportation, power, recreation, and irrigation. However, no major municipal or industrial water users are located within five miles of the site. The nearest municipal users are at Chamois, Mokane, and Fulton; the only nearby major industrial user is the Central Electric Power Cooperative Chamois Plant. These municipal users utilize ground-water supplies only. The Central Electric Power Cooperative Chamois Plant utilizes both Missouri River and alluvium water supplies. Within a 5-mile radius of the site, local streams are presently used for irrigation and livestock watering.

In the Callaway Plant site area, the predominant water withdrawal from the Missouri River is by the Central Electric Power Cooperative Chamois Plant for power generation (Table 2.4-3). Virtually all of the water used for this purpose is returned (Table 2.4-4). Also, transportation requirements on the river near the site are generally met during the navigation season.

For noting liquid pathways to man from accidental radwaste releases from the Callaway Plant (Section 2.4.12), Missouri River water users were identified along the entire length of the river downstream from the Callaway Plant site. Dischargers were also identified. These are identified in Tables 2.4-3 and 2.4-4. The locations of these water withdrawals and water discharge points are shown on Figures 2.4-8 and 2.4-9. The closest municipal user of Missouri River water downstream from the Callaway Plant site is St. Louis City (Howard Bend), whose water intake is located at Missouri River mile 36.8, approximately 78 river miles downstream of the site. The cities of Hermann, New Haven, and Washington, all within 50 miles downstream of Logan Creek, are the major dischargers to the Missouri River; however, these communities derive their municipal water supplies from deep wells only. The nearest irrigation user that utilizes Missouri River water is located 50 miles downstream from the confluence of Logan Creek and the Missouri River at Missouri River mile 61.4.

Because water users upstream of the Callaway Plant site can alter flows at the site and downstream from it, and because relocation of contaminated or potentially contaminated materials upstream in the physical environment (such as occurs in dredging operations) could potentially affect the conditions near the site (NRC, 1977 and 1976), Missouri River water users and dischargers upstream from the site were also sufficiently identified to the best extent possible. These are included in Tables 2.4-3 and 2.4-4 and are shown on Figure 2.4-9. No potential contaminant source areas were identified.

Stage-discharge rating curves for the Missouri River at Hermann, at Boonville, and near the Callaway Plant site at Missouri River mile 115 are shown on Figures 2.4-10, 2.4-11, and 2.4-12, respectively. The estimated average river flow near the site is 69,000 cfs, based on adjustment of flow for the Gasconade River, a major tributary to the Missouri River between the site and Hermann (Figure 2.4-7). This discharge corresponds to a water surface elevation of about 507 feet MSL near the site at Missouri River mile 115 (refer to Figure 2.4-12).

Also, the NRC Regulatory Guide 1.113 (1977) suggests identification of the following features in relation to a nuclear plant site:

> 1) surface water uses* upstream and downstream of the plant site, (2) major tributaries and their junctions, (3) streamflow gauging stations (including their periods of record), and (4) major reservoirs and diversions upstream and downstream of the plant site. Approximate contributing drainage areas and types of water use for all points identified should be shown on the diagram or tabulated separately.

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* Use types include drinking water, irrigation process water (consumed by such users as breweries and soft drink manufacturers), recreation areas, and fisheries. Ground-water users with wells whose zones of influence extend to streams should also be included (NRC, 1977).

This section presents a description of surface water uses in the region surrounding the Callaway Plant site, based on the best available data, both published and unpublished. Groundwater use in the region is discussed in detail in Section 2.4.13.2. Descriptions of the Missouri River and its major tributaries, streamflow gauging stations, and major reservoirs in this region are discussed in Section 2.4.1.2. All of the above were considered for modeling the Missouri River under present conditions and for evaluating the impacts to water users from accidental releases of radwaste from plant facilities (Section 2.4.12 and 2.4.13).

Substantial quantities of ground water underlie the Callaway Plant site in the aquifer systems. The local ground-water environment is discussed in detail in Section 2.4.13, and a list of ground-water users accompanies Section 2.4.13.2. While the ample available ground-water supply at the site was a factor in site selection, utilization of ground water for project purposes is projected only to meet an estimated maximum demand of about 400 gpm during the construction of the plant. No ground-water use is projected during operational stages of Unit 1.

The presence of the plant and its operation will not adversely affect water wells near the site as discussed in detail in Section 2.4.13.1. Effluent from the plant will be discharged into the Missouri River only after suitable treatment. Accidental discharges of liquid radioactive effluents to the local surface- and ground-water environments and nearby users are discussed in Sections 2.4.12 and 2.4.13.

2.4.2 FLOODS

2.4.2.1 Flood History

No local flood history record on streams is available for the Callaway Plant site near Missouri River mile 115. It was not until 1897 that streamflow recording of the Missouri River was begun at Hermann on a continuous basis. Despite a lack of records prior to that time, the flood of 1844 is considered to be the largest reported for the lower Missouri River. This flood is estimated to have had a peak flow of about 892,000 cfs at Hermann where the gauging station is now located (USGS, 1978). A flood of this discharge is estimated to reach elevation 539 feet MSL near the plant site at Missouri River mile 115 under present channel conditions (refer to Figure 2.4-12). Major flood discharges and river stages reported by the USGS at the Hermann gauging station are listed in Table 2.4-5 and indicated on Figure 2.4-10.

The probable magnitude and frequency of floods on the lower Missouri River have been evaluated by the U.S. Army Corps of Engineers based on the historical record of floods at Hermann and other gauging stations on the lower Missouri River and major tributaries. Estimated flood peak discharges at Hermann and at Missouri River mile 115 for various recurrence intervals are presented in Table 2.4-6 and are based on existing conditions of river development. All Federal reservoirs and levees in the river basin are assumed to operate together. The recurrence interval is the average interval of time within which the magnitude of an event (flood discharge) will be equaled or exceeded once. Potential

maximum Standard Project Flood (SPF) and Probable Maximum Flood (PMF) peak discharges are included in Table 2.4-6, based on U.S. Army Corps of Engineers data (1979). * However, no recurrence intervals are associated with these events. It should be noted that because of the significant flood control measures implemented in the upstream areas of the Missouri River Basin since 1952, the flow rates indicated in Table 2.4-6 are less than what would occur under natural flow conditions.

The most common type of flooding that occurs in the lower Missouri River is the result of runoff from the large contributing drainage area due to heavy rainfall and snowmelt during the spring and early summer seasons. During a large flood, the river spills over its banks onto the broad floodplain areas of the valley. Consequently, numerous flood control programs have been instituted. Although many individual flood control projects were planned and constructed prior to 1944, it was in that year that the Pick-Sloan Plan for the Missouri River Basin was adopted as the 1944 Flood Control Act of the Federal Government (U.S. Army Corps of Engineers, 1971a). Much of the original plan has been completed, and many new projects have been added. By 1965, 228 federally constructed projects involving direct flood control measures were completed or under construction in the basin. These included 53 major reservoirs, 57 channel and levee projects, and 118 upstream watershed projects. Throughout the basin, the channel and levee projects include approximately 1,200 miles of levee construction and about 800 miles of channel improvements (Missouri Basin Inter-Agency Committee, 1969).

In June of 1964, the Missouri Basin Inter-Agency Committee assumed the responsibility of providing a framework plan for the development of water resources in the basin. In the future, as more water resources projects are completed, floodwaters will be better controlled and channel flow more regulated.

2.4.2.2 Flood Design Considerations

The Callaway Plant is located at about elevation 840 feet MSL and all safety-related (Category I) components and structures at 840.5 feet MSL or above on an upland plateau approximately 5 miles north of the Missouri River. Since the highest flood of record on the Missouri River near the site was about 300 feet below this elevation (see Section 2.2.1), it is anticipated that river flooding should never affect the plant. The plant site is dry with respect to major flooding on the Missouri River, and only a localized PMP storm was considered for flood design protection of safety-related facilities.

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* The Standard Project Flood (SPF) represents the flood that may be expected from the most severe combination of meteorologic and hydrologic conditions that are considered reasonably characteristic of the geographical region involved, excluding extremely rare combinations (Chow, 1964).

The Probably Maximum Flood (PMF) represents the flood event that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are considered reasonably possible in the region (NRC, 1977)

The plant is located more than 250 feet above the floodplains of Auxvasse and Logan creeks, and extreme floods on these tributary creeks would not affect the site. Therefore, potential flooding conditions in these creeks were not analyzed.

Since the plant facilities are located on the crest of a plateau that has a well-developed natural drainage system and because final grading of the site area is integrated with this natural system, potential local flooding, even from extremely heavy rainfall, will be controlled by the plant site drainage system, as discussed in Section 2.4.2.3.2.

The possibility of scour or sedimentation in or around the cooling water intake structure (non-Category I) was examined during final design; necessary provisions were made to minimize their effects.

2.4.2.3 Effects of Local Intense Precipitation

The local Probable Maximum Precipitation (PMP) provides the design base for controlling surface runoff from safety-related structures at the Callaway Plant site and is discussed in Sections 2.4.2.3.1 and 2.4.3.1. The PMP is defined as "the theoretical greatest depth of precipitation for a given duration that is physically possible over a particular drainage area for a certain time of year" according to the American Meteorological Society (1959). Cumulative PMP rainfall amounts applicable to the plant site area for durations of 6, 12, 24, and 48 hours are presented in Table 2.4-7. Since the plant site drainage area is only about 75 acres, an all-season 6-hour rainfall with an accumulation of 25.4 inches is the governing PMP event affecting the surface runoff aspects of the safety-related structures. The hourly rainfall depths for this 6-hour PMP event are presented in Table 2.4-8. These time distributions of maximum PMP depths were derived from the applicable portion of the Standard Project Storm (SPS) rainfall tables (Chow, 1964).

Details on the design bases for the plant site drainage area are discussed in Section 2.4.2.3.2. Adequate drainage capacity will be provided to prevent flooding of safety-related facilities and to convey flood waters on the roofs and the buildings away from the plant site area.

The roof design of the safety-related buildings and safety-related equipment has included consideration of the accumulation of snow and ice. The design bases of snow and ice accumulations are discussed in Sections 2.3.1.2.2 and 2.3.1.2.4, respectively.

2.4.2.3.1 Precipitation Distribution

The all-season PMP storm values developed for the Callaway Plant site drainage area of approximately 75 acres as presented in Table 2.4-7 were based on Hydrometeorological Report (HR) No. 33 (U.S. Weather Bureau, 1956). PMP values for the winter months of December, January, February, and March were also determined. The adjusted all-season and winter-month PMP values for various durations are presented in Tables 2.4-7 and 2.4-8. Maximized all-season and winter-month PMP storm distributions were

obtained by following the recommended procedure for the Standard Project Storm (SPS) rainfall distribution as outlined by the U.S. Army Corps of Engineers (Chow, 1964). The sequences of rainfall increments as referenced would produce critical runoff from the plant site drainage area. The areal distribution of the rainfall over the plant site area is considered to be uniform because of the small contributing drainage area.

At the time the construction permit was issued, HR No. 33 was the most applicable publication to derive the design PMP values referenced above. Since that time, however, an additional publication, HR No. 51, has become available. Use of HR No. 51 would predict higher design PMP values than those which appear in Table 2.4-7 and constitute the design bases in Section 2.4.2.3.2 and 2.4.2.3.3. The original HR No. 33 design PMP values have not, however, been updated because a formal NRC staff position has not been promulgated on HR No. 51.

2.4.2.3.2 Site Drainage

Site drainage was determined by application of the rational method, which is commonly used in the design of urban storm water drainage systems for small watersheds. The rational formula used to relate runoff to rainfall is noted below:

$$Q = ciA \qquad (2.4\text{-}1)$$

where: Q = Peak rate of discharge in cfs;

c = Runoff coefficient dependent upon watershed characteristics;

i = Rainfall intensity for a period equal to the runoff time of concentration* in inches per hour, ;

A = Drainage area in acres.

* Time of concentration is the time required for surface runoff from the most remote part of a watershed to reach an outlet, or another point under consideration.

Application of the rational formula in this study depends on certain inherent assumptions which are listed below (Merritt, 1968):

a. The maximum rate of runoff for a particular rainfall intensity occurs if the duration of rainfall is equal to or greater than the time of concentration.

b. The maximum rate of runoff from a specific rainfall intensity, whose duration is equal to or greater than the time of concentration, is directly proportional to the rainfall intensity.

c. The frequency of occurrence of the peak discharge is the same as that of the rainfall intensity from which it was calculated.

d. The peak discharge per unit area decreases as the drainage area increases, and the intensity of rainfall decreases as its duration increases.

Natural drainage from the plant site area slopes downgrade and radially outward to adjacent stream systems. A plant site storm drainage system has been designed to drain storm runoff away from plant buildings by the use of catch basins, contour grading, drainage ditches and storm drain pipes to natural water courses as shown on Figure 2.4-3. Roof-drain design of safety-related structures for locally intense precipitation as severe as that of the PMP is provided so that safety-related facilities would not be affected.

Since the area surrounding the UHS retention pond is graded so as to prevent surface runoff from entering the pond, the pond drains only its own water surface area of about 4 acres. A spillway will be provided to route excess water from the pond to a natural watercourse (Figure 2.4-3).

The rational formula is a rather reliable and common means of determining runoff for minor hydraulic structures such as storm drains and culverts. It is often considered acceptable for use for drainage areas of less than 200 acres or where the runoff is spread over the surface and picked up by a number of inlets, as is the case for the plant area drainage system. Common recommended runoff coefficients usually are values that are a function of the soil, ground cover, and the rainfall intensity equal to the runoff time of concentration, and are usually developed for design floods with 5- and 10-year recurrence intervals. It is recommended that higher values be used for less frequent high-intensity storms due to the lesser effect of initial losses and infiltration rates on the peak discharges (Chow, 1964; Wright-McLaughlin Engineers, 1969).

The maximum runoff coefficient assumed for a recurrence interval of 100 years for the site area under natural drainage conditions is estimated at 0.86, based upon a detailed development of the rational method by M. Barnard in 1938 (Linsley et al., 1949). Barnard proposed an equation for the variation of the runoff coefficient with recurrence interval and geomorphological factors reflecting basin shape, stream pattern, and channel characteristics.

The plant site drainage system is designed to convey runoff from a 100-year storm away from the plant area. The design rainfall intensities for a 100-year storm used for sizing drainage structures, culverts and ditches were determined from the U.S. Department of Commerce Weather Bureau's Technical Papers Nos. 25 and 40, "Rainfall Intensity - Duration Frequency Curves" and "Rainfall Frequency Atlas of the United States,"

respectively, and are noted in Table 2.4-9. Runoff times of concentration were computed from Kirpich's formula noted below (Chow, 1964):

$$t_c = 0.00013\frac{L^{0.77}}{S^{0.385}} \qquad (2.4\text{-}2)$$

where:

t_c = Time of concentration in hours;

L = Length of the watershed in feet, measured along the watercourse from the design point and in a direct line from the upper end of the watercourse to the farthest point on the watershed;

S = Ratio in feet to L of the fall of the watershed from the farthest point on the watershed to the outlet of runoff.

The runoff coefficient used for the 100-year storm was selected as 0.86, discussed previously. Manning's equation, discussed in Section 2.4.3.5, was used to estimate the velocities of flow in ditches and culvert pipes. Catch basins and culvert pipes were investigated for inlet and outlet control, and ponding areas and elevations determined.

All finished grades within the plant site area are sloped away from buildings as shown on Figures 2.4-3 and 2.4-4. Plant grade is established at elevation 840.0 feet MSL and the standard plant floor elevation of the safety-related facilities at 840.5 feet MSL. However, locally intense precipitation of the severity of a PMP event occurring at the site would produce overflow conditions in the plant site drainage system. Storm runoff in excess of the design capacity of the plant site drainage system would overflow the roads and railroad tracks. The locations of these roads, railroad tracks, and overflow points on the plant site are shown on Figure 2.4-3.

For evaluating potential local flooding conditions in the plant site area from a local PMP event, the plant area was divided into several drainage areas as shown on Figure 2.4-3. Since a reliable recurrence interval cannot be associated with the PMP event, precipitation losses were not estimated and an extremely conservative assumed runoff coefficient value of unity was selected for design purposes (Chow, 1964). The ratio of direct runoff to rainfall would tend to a maximum during a storm event of such magnitude. This choice is consistent with the project significance and is assumed to remain constant on a seasonal basis. Runoff times of concentration were computed as before. Estimated rainfall depths for the PMP storm analysis were determined for durations equal to estimated runoff times of concentration at specific locations within the plant site area. The rainfall depths were converted to average rainfall intensities, expressed in inches per hour, and used in the determinations of peak discharge rates at selected outlet locations. It was also conservatively assumed that the plant site drainage system would

not function and all runoff due to the PMP would flow over the peripheral roads and railroads. If the drainage system was considered to be functioning at its capacity, or in part, the water levels due to site ponding of the PMP runoff would be lower than those indicated in the PMP analysis.

Estimated peak rates of discharge at selected locations in the plant area for the all-season PMP event were computed based on the above considerations. Local PMP flows over the peripheral roads and railroad tracks were estimated using a broad-crested weir formula noted as follows:

$$Q = CLH^{3/2} \tag{2.4-3}$$

where:

Q = Discharge over the roads or railroad tracks in cfs;

L = Length over which flow would occur in feet;

H = Head over the roads or tracks in feet; and

C = Coefficient of discharge (2.5 assumed).

The estimated potential maximum ponding elevation, due to PMP runoff, is calculated using these extremely conservative assumptions. The site PMP calculations document this ponding elevation to be maintained less than the elevation 840.5 MSL, which represents the ground floor elevation of the standard plant safety related facilities. Water surface ponding elevations, overflow points and drainage areas are calculated using the methodology and the broad-crested weir formula as described above. Figure 2.4-3 represents the PMP Grading and Drainage areas and identifies the overflow weir locations. Modifications to site grading and roadway elevations, that represent significant elevation changes, are evaluated to ensure that the PMP design basis is not adversely affected and the safety-related structures are protected from flooding.

The maximum winter PMP storm results are discussed in Section 2.4.2.3.3.

2.4.2.3.3 Ice and Snow

Historical data for snow-on-ground at Columbia, Missouri, are available from the publication "Climatological Data-Missouri" (U.S. Weather Bureau, 1949-1978). Data for this station include the amount of snow, ice pellets, and sleet recorded on the ground. The maximum observed snowpack on the ground in Columbia was 16 inches on March 16, 1960.

The development of an extreme winter-month snowpack load for the Callaway Plant site is discussed in Section 2.3.1.2.11. To provide a conservative structural design for the roofs of safety-related buildings, it was assumed that the extreme winter-month

snowpack weight is the antecedent condition to the superimposed maximum winter-month PMP with a duration of 48 hours (Table 2.4-7). The weight of the 48-hour maximum winter-month PMP is 102.4 pounds per square foot (psf). As the amount of icing in this area is anticipated to be small, it would not contribute significantly to the total snow load considered. This is particularly apparent in comparison with the 48-hour PMP value used, which is extremely conservative.

The calculated snow load on the ground and the weight of the 48-hour PMP storm event (no losses assumed) are 21.0 and 102.4 psf, respectively. The combined load is 123.4 psf. This extreme winter climatological condition governs the structural design basis for the roofs of the safety-related buildings.

The rational method was again employed in computing peak rates of discharge at the selected outlet locations in the plant site area for the maximum winter-month PMP event. Consideration was also given to assumed coincident instantaneous melting of the estimated monthly antecedent snowpack condition. The estimated maximum peak discharge rate in the plant site area for the winter period is estimated at 169 cfs and would occur in Area 31 (Figure 2.4-3). It is anticipated that site drainage of seasonal PMP events from the plant site area during the winter months would be adequate even if site drainage outlets are blocked by ice jams or the formation of severe ice cover. Drainage facilities will direct runoff away from the plant area to adjacent natural drainage systems as shown on Figure 2.4-3. Consideration in the plant drainage system design is given to ice accumulation on the roofs of safety-related structures and on exposed safety-related equipment. These design bases have been discussed in Section 2.3.1.2.4.

2.4.3 PROBABLE MAXIMUM FLOOD (PMF) ON STREAMS AND RIVERS

The Probable Maximum Flood (PMF) represents the flood event that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are considered reasonably possible in the region (NRC, 1977). The PMF is usually evaluated by estimating the PMP over the subject drainage basin in critical periods of time, and computing the residual runoff hydrograph likely to result with critical conditions of ground saturation and related factors. Because of the large size of the Missouri River Basin above the Callaway Plant site (approximately 523,200 square miles) and the degree and complexity of river regulation, it would be extremely difficult to derive a meaningful PMF hydrograph for the Missouri River near the site. Therefore, the PMF peak discharge at Missouri River mile 115 was estimated based on data provided by the U.S. Army Corps of Engineers (1979) on its hypothetical flood studies for the Missouri River, as noted below and discussed in subsequent sections. Also, the potential maximum PMF stage in the Missouri River near the site was estimated from a developed stage-discharge curve, as discussed in Section 2.4.3.5. The potential maximum PMF water level in the Missouri River at river mile 115 associated with an estimated PMF peak discharge of 1,300,000 cfs is estimated to be 548 feet MSL. This flood stage will not

reach the Callaway Plant facilities because of the large difference in elevation between the plant grade of 840 feet MSL and the estimated maximum river stage.

LOCATION	FLOOD	E	EN	END
Mississippi River at St. Louis, MO	52-A	1,900,000	1,670,000	1,585,000
Mississippi River at St. Louis, MO	M 52-A	1,380,000	1,180,000	1,080,000
Missouri River at Hermann, MO	M 52-A	980,000	790,000	700,000

Group E (Existing) - Reservoirs that were existing and under construction in 1959, at the start of model testing.

Group N (Near future) - Reservoirs scheduled for construction and expected to be operable by 1970, based on study and construction schedule available in the late 1950's.

Group D (Distant future) - Reservoirs that are expected to become operable after 1970 that will complete the ultimate system of reservoirs. Reservoirs in Group D were estimated in the late 1950's, based on upcoming planning studies.

Group EN is considered to best represent the current condition of the Mississippi River. The actual reservoirs in operation today include a few from the D group. Some reservoirs in the N group have not been constructed.

2.4.3.1 Probable Maximum Precipitation (PMP)

The Probable Maximum Precipitation (PMP) values applicable to the site are discussed in Section 2.4.2.3.2. The estimated all-season and winter-month PMP values for various durations are presented in Tables 2.4-7 and 2.4-8.

2.4.3.2 Precipitation Losses

Precipitation losses for the Missouri River flood studies were taken into consideration in the U.S. Army Corps of Engineers studies discussed in Section 2.4.3.4, and are, therefore, not treated further in this section.

2.4.3.3 Runoff and Stream Course Models

The PMF peak discharge in the Missouri River was estimated from the U.S. Army Corps of Engineers' hypothetical flood studies for the Missouri River basin, as noted in Section 2.4.3. Since the Corps of Engineers had rigorously applied their flood routing computer program in the hypothetical flood studies, their flood routing model was adopted for study

purposes. Consequently, it was not necessary to reestablish a new PMF hydrograph for the Missouri River for purposes of analysis.

2.4.3.4 Probable Maximum Flood Flow

The hypothetical flood studies by the U.S. Army Corps of Engineers were based on runoff estimates from major rain-producing storms, transposition of storms, and combinations of selected storm runoff amounts. For the Missouri River Basin, these were used to produce a hypothetical hydrograph(s) for the Missouri River at Hermann. A hypothetical flood discharge of 790,000 cfs was estimated for the Missouri River at Hermann using Hypo-Flood M 52-A. Although an SPF has not been developed for the Missouri River, the peak flow of 790,000 cfs at Hermann is considered a reasonable representative discharge that might be experienced from a storm of standard project proportions over the Missouri River Basin (U.S. Army Corps of Engineers, 1979).

The drainage area of the Missouri River at its confluence with the Mississippi River is approximately 529,000 square miles; at Hermann, approximately 524,200 square miles; and near the Callaway Plant site at Missouri River mile 115, approximately 523,200 square miles. It is assumed that the SPF near the site is conservatively established at 780,000 cfs, based on adjustment for the estimated contribution of 10,000 cfs from the Gasconade River between the site and Hermann. In lieu of detailed PMF investigations for the main stem lower Missouri River, it is further assumed that the SPF peak discharge is 60 percent of the PMF peak discharge (see Chow, 1964). Therefore, the PMF peak discharge in the Missouri River near the site is estimated to be 1,300,000 cfs.

2.4.3.5 Water Level Determinations

Water levels for various flooding conditions in the Missouri River at river mile 115 were obtained by utilizing pertinent data provided by the U.S. Army Corps of Engineers in their recent flooding studies (1979). Also, potential maximum SPF and PMF water levels were estimated, based on the assumed peak discharges noted previously, using the Manning formula. Water levels for low-flow conditions at Missouri River mile 115 were estimated based on analyses of historical flow data. A developed stage-discharge rating curve is shown on Figure 2.4-12.

The stage-discharge relationships for the USGS gauging stations at Hermann and Boonville are plotted on Figures 2.4-10 and 2.4-11, respectively, and are based on the USGS data after 1960 when river regulation and channel improvement measures became more effective. Extreme recorded values of low flow and high flow and those before 1960 are also shown on the figures. It should be noted that the rating curve for any point between the stations at Hermann and Boonville cannot be readily established by linear interpolation of the data available at these two stations because of the nonlinear nature of the river flow. This is particularly true with consideration to both the Osage and Gasconade rivers that join the Missouri River between these two stations (Figure 2.4-7). The rating curve for the Missouri River at river mile 115 near the site was established, in part, through hydraulic analysis of the recorded low flows at the Hermann gauging station

and other gauged sites. Simplified calculations were utilized to determine the rating curve since the great difference in elevation of the site and Missouri River flood plain would not require a detailed computerized analysis.

Extrapolation of historical data from the streamflow record at Hermann rather than at Boonville to Missouri River mile 115 near the site was considered more suitable for the following reasons: the Osage River is a much larger river than the Gasconade River; also, Hermann is only about 17 river miles downstream from Missouri River mile 115 with a 1 percent difference in drainage area while Boonville is about 82 river miles upstream with a 4 percent smaller drainage area. The theoretical water surface profile of the Missouri River in the vicinity of the site would resemble a complex series of gradually-varied flow lines dependent upon the channel geometry and local topography. For the purposes of this study, a representative cross section of the Missouri River at river mile 115 under existing conditions was determined from pertinent data provided by the U.S. Army Corps of Engineers (1979) and also from USGS topographic maps. In particular, this cross section was required to determine the stage-area relationships for very extreme events (i.e., potential maximum SPF and PMF water levels). Flow under existing channel conditions was modelled as uniform steady flow.

The depth of flow at a cross section can be calculated by various analytical techniques. Due to the site characteristics and simplified flow regime, the slope-area method (Henderson, 1966) was selected in preference to a more sophisticated analysis. The flow regime, based on the Manning equation, may be expressed for uniform flow by the following equation:

$$Q = \frac{1,486}{n} A R^{2/3} S^{1/2} \qquad (2.4\text{-}4)$$

where:

A = Cross-sectional area of flow in square feet (ft^2);

R = Hydraulic radius in feet (ft);

S = Slope of the energy gradient in the direction of flow in ft/ft;

n = Hydraulic roughness coefficent, dimensionless; and

Q = Discharge in cfs.

The values of the Manning roughness coefficients for the lower Missouri River have been established by the U.S. Army Corps of Engineers in their recent flooding studies. The n values for both channel and overbank areas at Hermann and at Missouri River mile 115

are noted below. The n values vary with the flood recurrence interval, noted in parentheses.

	MISSOURI RIVER AT HERMANN	MISSOURI RIVER AT RIVER MILE 115
Channel n Value	0.022 (2)	0.022 (2)
	0.022 (5)	0.022 (5)
	0.020 (10)	0.020 (10)
	0.018 (25)	0.018 (25)
	0.018 (50)	0.018 (50)
	0.018 (100)	0.018 (100)
Left Overbank n Value (looking downstream)		0.05-0.07 (500-2)
Right Overbank n Value (looking downstream)		0.04-0.07 (500-2)

The Manning n values noted for the 100-year flood were considered to represent average conditions for the extreme SPF and PMF flooding events on the Missouri River in this reach. Consequently, these values were used for evaluating potential maximum SPF and PMF water levels at Missouri River mile 115 near the site.

The slope used in the Manning formula to compute the stage-discharge relationships of extreme floods on the Missouri River near the site was determined from water surface profile data on various flooding conditions as studied by the U.S. Army Corps of Engineers. The average slope of the energy gradient in the vicinity of the site, based on the Corps of Engineers flooding studies, was estimated to be 0.77 feet/mile or 0.00015 ft/ft. Because the flow is nonuniform, the water surface slope may not necessarily be equal to the average channel slope.

In the computations to establish the stage-discharge relationships on the Missouri River near the site for the extreme SPF and PMF flood flow conditions, stages were computed for the estimated SPF and PMF discharges noted previously. The potential maximum SPF and PMF water levels near the site are estimated at 537 and 548 feet MSL, respectively. With a plant grade elevation of 840 feet MSL, the potential maximum PMF flood elevation is still about 290 feet below this level.

The stage-discharge relationships for low flows in the Missouri River at river mile 115 were obtained by analyzing historical data, as noted previously. Because the Gasconade River has a much smaller contributing drainage area than the Missouri River at their confluence, the flow of the Missouri River near the site is smaller than that at Hermann. Historically, the low flows in the Missouri River recorded at Hermann do not coincide with the recorded low flows in the Gasconade River. For example, during the lowest flow recorded at Hermann on January 10 to 12, 1940 (about 4,200 cfs), the flow recorded at the Jerome gauging station, located on the Gasconade River about 107 river miles above its confluence with the Missouri River, ranged from 580 to 645 cfs. The second lowest flow at Hermann was 6,210 cfs on December 23, 1964. On that day the flow at Jerome was 395 cfs. The lowest flow recorded at Jerome was 254 cfs on September 21 and 22, 1956, while it was 35,200 cfs at Hermann. Since the low flows in the Missouri River commonly occur in December and January, a conservative way to estimate extreme low flow conditions near the site is to subtract the mean value of the daily minimum flows for December and January in the Gasconade River from the low flows at Hermann. The December-January mean low flow at Jerome for the water years 1961 to 1970 is 738 cfs. By using a value of 700 cfs, the lowest estimated flow likely to have occurred under natural flow conditions near the site and corresponding to 4,200 cfs at Hermann is 3,500 cfs. For other low discharges of the Missouri River, the corresponding contribution from the Gasconade River is considered to be obtained by linearly interpolating or extrapolating the above value. Considering the much smaller size of the Gasconade River Basin as compared to that of the Missouri River Basin at Hermann, the above assumption is considered to be adequate.

Data from two minor gauges, located at the Chamois Power Plant (Missouri River mile 117) and at the City of Gasconade (Missouri River mile 104.8), were considered in the analysis for estimating low river stages near the site. These gauges are located between the Osage and Gasconade rivers. The proposed intake structure is also located between these minor gauge stations. Interpolation of data between these two gauges results in a better estimate of a low flow elevation at the intake structure. Based on the U.S. Army Corps of Engineers data on Missouri River profiles, dated October 1974, the minimum stage of record for Missouri River mile 117 is elevation 497.0 feet MSL and that at river mile 104.8 is elevation 486.0 feet MSL. Interpolating between these two gauges results in a minimum stage elevation of 495.6 feet MSL at river mile 115.4.

A review of the Chamois gauge records for the period January 1959 to March 1974 indicated that the minimum stage of record was elevation 496.7 feet MSL and occurred in December 1963. On December 23, 1963, the lowest stage was also recorded for the USGS gauge at Hermann. The stage elevation recorded was 481.4 feet MSL for a flow

of 6,210 cfs. Interpolating between these two elevations results in an estimated stage elevation of 495.4 at Missouri River mile 115.4. On the day the 6,210 cfs was recorded at Hermann, the flow recorded on the Gasconade River at Jerome was 395 cfs. Thus, the interpolated elevation of 495.4 at Missouri River mile 115.4 is considered to represent an estimated flow of 5,815 cfs. It should be noted that the lowest recorded flow at Hermann occurred during January 1940 and was 4,200 cfs. The recorded stage elevation was 482.7 feet MSL. This occurred prior to major reservoir regulation in the upper Missouri River Basin.

The intake structure located at Missouri River mile 115.4, which will provide makeup water for the plant but which is not safety-related, is protected against the occurrence of a 200-year flood with 2 feet of freeboard. A 200-year flood would have an estimated peak discharge of about 690,000 cfs near the site and an estimated water surface elevation of 535 feet MSL.

2.4.3.6 Coincident Wind Wave Activity

Since the maximum PMF flood elevation was determined to be approximately 290 feet below the plant grade elevation, no analysis of coincident wind wave activity is necessary.

2.4.4 POTENTIAL DAM FAILURES, SEISMICALLY INDUCED

As mentioned in Section 2.4.1.2.1.5, the nearest dam to the site on the main stem of the Missouri River is the Gavins Point Dam in South Dakota, about 696 river miles upstream from Missouri River mile 115. Considering the distance and enormous amount of channel and valley storage capacity available, even under the most severe mode of dam failure conditions, it is inconceivable that any significant threat could occur to the Callaway Plant site worse than that due to a severe flood from precipitation, such as the PMF discussed previously. The subject of dam failure, therefore, is addressed only in regards to Bagnell Dam and Harry S. Truman Dam on the Osage River. The condition considered is a SPF superimposed upon full reservoirs and a failure in dam integrity due to excessive earthquake loading.

Appendix A of Regulatory Guide 1.59 has been replaced by ANSI Standard N170-1976, "Standards for Determining Design Basis Flooding at Power Reactor Sites." Sections 6 and 9 of that standard, "Nonhydrologic Dam Failures," and "Combined Events Criteria," respectively, have been followed in this analysis. Coincident and domino-type failures have been considered and evaluated, including instantaneous removal of major dams.

2.4.4.1 Reservoir Descriptions

Bagnell Dam is located about 97 river miles from the site, which includes about 15 river miles upstream on the Missouri River to its confluence with the Osage River, and from this confluence point, about 82 river miles upstream in the Osage River (Figure 2.4-7). It is a concrete gravity dam and has a total storage capacity behind the dam at the top of

the gates (elevation 660 feet MSL) of approximately 1,927,000 acre-feet. This water is used mainly for generating electricity (USGS Water-Supply Paper No. 2119, 1972). The crest of the dam is about 1,180 feet long and the difference in tailwater level to the maximum reservoir level is about 110 feet. The Lake of the Ozarks is formed behind Bagnell Dam. At full reservoir capacity, it extends to near the toe of the Harry S. Truman Dam.

Harry S. Truman Dam (Figure 2.4-7), an earth-fill structure, has a main dam length of about 5,000 feet and a dike extending about another 7,500 feet in length. The total storage capacity behind the dam at the top flood control elevation of 739.5 feet MSL is estimated at 5,200,000 acre-feet. At full reservoir capacity, the water level at the dam will be about 125 feet above the streambed. The reservoir will serve multipurpose functions including flood control, power generation, and recreation.

2.4.4.2 Dam Failure Permutations

The existing upstream dams on the Osage River considered in this investigation are described in Section 2.4.4.1. These dams are situated in an area which has experienced relatively few earthquakes, all of which were low in intensity. The history of recorded earthquakes within 200 miles of the Callaway Plant site is discussed in Section 2.5.4. Because of the low seismicity within 50 miles of the site, and because an earthquake of a magnitude which could cause severe damage or complete failure of these dams is unlikely, the probability of seismic-related dam failures is low. However, for the purpose of this study, two dam failure permutations were postulated, and the resulting flood waves were evaluated.

As a conservative assumption, complete failure of dams due to an assumed SPF condition was considered. It was not necessary to relate seismic failure to either the Safe Shutdown Earthquake or the maximum historic earthquake, because the assumption of complete, instantaneous removal of each dam was considered. The flood wave resulting from a partial erosion failure of the earth embankments at the Harry S. Truman Dam due to overtopping or from a seismically induced breaching of earth embankments would not be as severe as the case of a complete dam failure coincident with a SPF.

Due to the relative distances between the dams and the Callaway Plant site, both single dam failure and multiple dam failures were considered for the purpose of demonstrating that the plant and its safety-related components and structures would not be endangered even under the most extreme combination of flood-causing events discussed previously.

In the first hypothetical case, it was conservatively assumed that Bagnell Dam would fail suddenly with the Lake of the Ozarks at its full capacity coincident with a SPF in the Missouri River. Under a downstream dry bed condition, which is unrealistic but more critical than a submerged bed, and a maximum reservoir depth of 110 feet and dam width of 1,180 feet, the theoretical instantaneous peak discharge at the failing dam would be 2,270,000 cfs (Stoker, 1957; Henderson, 1966). The corresponding water depth at the toe of the dam would be 49 feet, or about 4/9 of the upstream water depth in the

reservoir. The peak discharge and depth at the dam would remain constant until the negative wave from the dam would be reflected back from the upstream end of the reservoir. For the Lake of the Ozarks, this wave propagation would take about 4-1/2 hours.

It is conservative to consider that the maximum "bore" (abrupt change of water surface) height which could possibly occur as a result of sudden failure would be 49 feet immediately downstream from Bagnell Dam. Assuming that no mechanisms other than those due to a change in channel width would be involved in modifying the "bore," and with a dam width of 1,180 feet and the flood plain of the Missouri River having a width of about 12,500 feet near the Callaway Plant site, the estimated height of a flood wave near the site for the failure of Bagnell Dam was calculated to be about only 8.5 feet, utilizing the method presented by Henderson (1966).

Although it is considered highly improbable, the second hypothetical case considers the effect of flood waves near the plant site as the result of a domino-type failure of both Harry S. Truman and Bagnell dams. The conditions considered are an instantaneous failure of Bagnell Dam due to flood waves resulting from a sudden failure of Harry S. Truman Dam when both reservoirs are at full capacity coincident with a SPF condition on the Missouri River. Assuming a failure length of 10,000 feet at the Harry S. Truman Dam, it was estimated that a "bore" height of 38 feet would be formed downstream from the Harry S. Truman Dam (Henderson, 1966) and that the predicted rise of water level at the Bagnell Dam would be 68 feet (Henderson, 1966). The total water depth at the Bagnell Dam prior to a dam break release would be 178 feet. Under a dry bed condition downstream of Bagnell Dam, the maximum "bore" height would be 4/9 of the upstream water depth or about 79 feet. Using the widths for Bagnell Dam and the Missouri River flood plain as noted in the previous paragraph, the estimated height of a flood wave near the site at Missouri River mile 115 for the domino failure of first the Harry S. Truman Dam and then Bagnell Dam was calculated to be about 13.6 feet. This is about 5.1 feet higher than the estimated height of a flood wave from the single dam failure of Bagnell Dam.

As a dam fails suddenly over a submerged riverbed, which is more realistic than a dry bed, a "bore" would be observed. As the "bore" propagates downstream, it would be rapidly attenuated as the result of energy dissipation and change in channel geometry. In the hypothetical cases above, the attenuation would be particularly obvious in view of the effect of the Missouri River. Near the plant site, one would observe a gradual rise of water level in the Missouri River similar to a normal flood wave until a crest was reached.

2.4.4.3 Unsteady Flow Analysis of Potential Dam Failures

The postulated nonhydrologic failure of upstream non site-related dams is discussed in Section 2.4.4.2. Consequently, unsteady flow analysis is not utilized herein.

2.4.4.4 Water Level at Plant Site

The potential maximum SPF water level for the Missouri River at river mile 115 was estimated at 537 feet MSL for the estimated SPF peak discharge of 780,000 cfs. The estimated height change of a flood wave near the site due to a dominotype failure of Harry S. Truman and Bagnell dams, described in Section 2.4.4.2 for the second hypothetical case, was computed at 13.6 feet. The potential maximum water level due to the combined effect of a SPF on the Missouri River and the postulated combined upstream dam failures would be about 551 feet MSL, which is only slightly higher than the estimated potential maximum PMF water level of 548 feet MSL, as discussed in Section 2.4.3.5.

Since the maximum dam failure flood elevation would be approximately 290 feet below the plant grade elevation, no analysis of coincident wind wave activity is necessary.

2.4.5 PROBABLE MAXIMUM SURGE AND SEICHE FLOODING

Structures for the protection of safety-related facilities against surges, seiches, and wave action are not required. Safety-related facilities consisting of the reactor, fuel, control, diesel generators, and auxiliary buildings, the UHS mechanical draft cooling towers, the UHS retention pond, the ESWS pumphouse, the ESWS pipelines, ESWS supply lines yard vault, the ESWS electrical duct banks including manholes, and the emergency fuel oil and refueling water storage tanks are located on the site plateau about 320 feet above the Missouri River floodplain and are not subject to flooding or other water-related phenomena associated with the Missouri River.

The only body of water on the site is the UHS retention pond with a water surface area of about 4.1 acres and a capacity of about 56.03 acre-feet. An overflow spillway is designed to maintain a water level below Elevation 836.5 feet. The graded ground elevation around the UHS retention pond provides a 4-foot minimum free board at normal pond water level. In addition, the plant yard is graded away from the pond to prevent site runoff from entering the pond. The excavated pond slopes are covered with riprap for protection against wave action. The UHS retention pond is a small body of water and is not subject to significant surges and seiches.

The design basis considerations for the UHS, including the derivation of probable maximum winds, are discussed in Section 2.4.8.2.

2.4.6 PROBABLE MAXIMUM TSUNAMI FLOODING

The site is located far inland from coastal areas and therefore is not subject to tsunami flooding.

2.4.7 ICE EFFECTS

No safety-related facilities are expected to be affected by ice flooding. Other potential ice-related effects, however, are discussed below.

2.4.7.1 UHS Retention Pond

The UHS retention pond is a safety-related structure and is subject to ice formation in winter. Ice formation, however, does not affect the operation of the UHS retention pond for the following reasons:

a. During winter operation, the cooling phase provided by the UHS cooling towers on the heated return loop can be bypassed to assure that warmer water will be discharged to accelerate deicing.

b. The invert elevation of the ESWS pumphouse is approximately 26 feet below the design water level of the UHS retention pond, and the invert of the discharge pipes is approximately 17.5 feet below the design water surface.

The effect of ice on the UHS retention pond dependability is discussed in Section 2.4.11.6. A description of the UHS retention pond is included in Section 9.2.5.

2.4.7.2 UHS Pond Structures

The pond structures at the water surface are in contact with surface ice that can form during prolonged subfreezing periods. Ice expansion and wind drag on the ice surface exert forces on these structures. The following sections address the approach used in evaluating the ice thickness and the forces on the ESWS pumphouse and the pond outlet structure caused by the presence of ice.

2.4.7.2.1 Ice Layer Thickness

Determination of the ice thickness in the retention pond is based on the analysis of the total number of degree days below freezing, defined as the number of days per month times the difference between 32°F and the mean monthly temperature for the months of December, January, and February. These values are summed to obtain the accumulated number of degree days since freeze-up for each year of record. Accumulated degree days are then subjected to a frequency analysis to determine the degree days for various recurrence intervals. The data used in the analysis are mean monthly air temperatures at Columbia, Missouri, which is located about 35 miles northwest of the site, for the years 1934 to 1973. The ice thickness is then determined for various recurrence intervals using Assur's empirical method (Chow, 1964). Based on this analysis, the calculated ice layer thicknes at the pond surface ranges from 15 inches to 24 inches for recurrence intervals of 10 years and 100 years, respectively.

2.4.7.2.2 Ice Thrust Due to Thermal Expansion

Evaluation of thrust forces due to the expansion of the ice cover as the result of a rise in the air temperature is based on the U.S. Army Corps of Engineers Cold Region monograph (Michel, 1970). The ice thrust force is determined based on a conservatively assumed hourly temperature rise of 5°F with no lateral restraint and with solar energy consideration. The calculated forces on the retention pond structures are presented in Section 3.8.4.3.1.

2.4.7.2.3 Drag Forces Due to Wind

The wind drag force on the ice surface is determined by considering a wind speed ranging from 40 to 60 mph for winter months over the 24-inch thick ice in the pond. The drag coefficient is evaluated considering turbulent flow over the ice (smooth surface) and using the drag coefficient values given in Schlichting (1968). The drag force computation assumes that the entire pond surface is covered with ice and that the thrust force is transmitted to the structure, as discussed in Section 3.8.4.3.1.

2.4.7.3 River Structures

The water supply intake and water discharge structures on the Missouri River are not safety-related structures, but they are subject to varying amounts of floating ice during the winter low-flow season. River gauge records show that some freezing of the Missouri River between Boonville and Hermann can be expected about every fourth winter. This freezing, however, is not anticipated to cause ice flooding to exceed the probable 200-year high water elevation established for final design of the intake structure. Ice or ice flooding will be no problem at the discharge structure, as the warm discharge water will keep the outfall open.

2.4.8 COOLING WATER CANALS AND RESERVOIRS

2.4.8.1 Canals

No canals are present at the site.

2.4.8.2 Reservoirs

The UHS retention pond is the only reservior on the site. The pond is excavated to a total depth of 22 feet with side slopes of 3 to 1. The storage capacity of the pond at the design water level of Elevation 836.0 feet is 56.03 acre-feet. During emergency shutdown, the pond water is utilized to supply makeup water to the UHS cooling towers. Description of the UHS is provided in Section 9.2.5. Hydrologic conditions during PMP and coincident wind wave activities are discussed in Section 2.4.8.2.1. Consideration of probable maximum winds is discussed in Section 2.4.8.2.2. These activities are evaluated at a water level corresponding to Elevation 836.0 feet which is the design water level of the UHS.

2.4.8.2.1 Probable Maximum Flood Design Considerations

The information on PMP as provided in Section 2.4.2.3 is applicable to the UHS retention pond. For the UHS retention pond with a water level of Elevation 836.0 feet, the probable maximum water level due to a 48-hour PMP on the pond and outflow over the 6-foot wide, broad-crested weir spillway reaches Elevation 837.7 feet, as discussed in Section 2.4.8.2.1.1. A sustained windspeed of 40 mph coincident with the maximum water level results in a maximum run up on the riprap-covered slopes to Elevation 838.3 feet, as discussed in Section 2.4.8.2.1.2.

2.4.8.2.1.1 Water Level Determination

The UHS retention pond, which provides water for emergency plant shutdown, is a Category I safety-related structure. Its hydrologic design is controlled by PMP and associated water level. The 48-hour PMP on the pond of 35 inches is distributed as shown in Table 2.4-7, utilizing Hydrometeorological Report 33 (U.S. Weather Bureau, 1956a). The precipitation is redistributed using 1/2-hour time increments and arranged to maximize the water level using the U.S. Army Corps of Engineers

Procedure (U.S. Army Corps of Engineers, 1965a). The resulting rainfall is converted to equivalent inflow discharge to the pond and is routed through storage to determine the maximum resulting water level. The outlet structure, which is a 6-foot wide, broad-crested spillway (Figures 3.8-16 and 3.8-17), has a crest elevation of 836.5 feet. The discharge coefficient used in the weir equation is 2.65 (Brater and King, 1976). The flood routing is based on the initial pond water level at the spillway crest.

Flood routing indicates that the probable maximum water level in the pond will reach Elevation 837.7 feet with a peak outflow of about 30 cfs based upon an initial level corresponding to 836.0 feet.

2.4.8.2.1.2 Coincident Wind Wave Activity

Discussion in this section is limited to consideration of the UHS retention pond since it is the only safety-related hydrologic element at the site which is subject to wind wave activity. Wind wave activity does not constitute major concern in the design of the UHS retention pond because the pond has relatively short dimensions with riprapped side slopes.

The hydrometeorological events considered in the analysis are a sustained wind speed of 40 mph occurring coincidentally with the probable maximum water level at Elevation 837.7 feet. The UHS retention pond has a water surface length of 636 feet, a width of 286 feet, and a depth of 18 feet at the evaluated water level. Using the curve provided in the U.S. Army Corps of Engineers Shore Protection Manual (1973), the maximum effective wind fetch, F_e, is estimated to be 410 feet. For a wind speed, U of 40 mph and a maximum depth, D, of 19.7 feet, the wind setup is negligible (U.S. Army Corps of Engineers, 1966b). Significant wave height, H_s, and wave period, T, are computed using

the procedure and relationships presented in the U.S. Army Corps of Engineers Shore Protection Manual (1973).

Waves generated by a sustained wind speed of 40 mph have a significant wave height of 0.7 feet, a wave period of 1.5 seconds, and a corresponding wave length of 11.2 feet. The maximum wave height, Hm, which is 1.67 times the significant wave height, is about 1.2 feet.

The wave run up value is estimated from the wave height and period using the graphical presentation in the Shore Protection Manual (U.S. Army Corps of Engineers, 1973). The calculated maximum wave run up on the 3 to 1 riprapped slope is 0.6 feet. Thus, maximum run up reaches Elevation 838.3 feet which is below the plant grade elevation of 840.0 feet.

2.4.8.2.2 Probable Maximum Wind Design Considerations

2.4.8.2.2.1 Probable Maximum Winds

Using the method of Thom (1968), the annual extreme fastest mile wind speed at the Callaway Plant site was indicated in Table 2.3-8 to have a maximum value of 85 mph at 30 feet above ground level and can be expected to occur once in 100 years. This method, considered the best available measure of wind for design purposes, assumes that:

a. Surface friction is uniform for a fetch of 25 miles;

b. Extreme winds result only from extratropical cyclones or thunderstorms; and

c. Extreme winds from tornadoes are not included in this analysis.

Maximum winds in the site area are associated mainly with thunderstorms and squall lines rather than hurricanes or other cyclonic storms. Although these winds are usually considered local in nature, they can cause wind setup and generate large waves in water bodies.

It is believed that a wind speed with a return period of 1,000 years constitutes a conservative design basis for safetyrelated elements. Based on Thom's model, this design wind speed applicable to the site was computed to be 118 mph with a duration of 1 minute (Table 2.3-8).

The probable maximum wind was determined based on the method of Thom (1968). Thom used meteorological data collected over a 21-year period from 150 monitoring stations to provide isotachs of the 0.50, 0.10, 0.04, 0.02, and 0.01 quantiles for the annual extreme fastest wind speed for the United States. Thom then provided an empirical method to use these data to determine the fastest wind speed for other

quantiles at any U.S. location. This method was used to determine the fastest wind speed likely to occur at the 0.001 quantile; the 1000-year mean recurrence interval.

The data provided by Thom do not allow the calculation of the 95 percent confidence interval for estimates of wind speed at this quantile.

Since Thom's isotach's and statistics are based on a specific 21-year data base, more recent data cannot be taken into account, except as a comparison of actual extreme speeds with those predicted by Thom.

As an example, the fastest mile wind speed recorded by the National Weather Service station at Columbia, Missouri from August 1889 through 1979 (a 90-year period) was 63 miles per hour. This compares with values determined from Thom's method of 72 miles per hour (50-year recurrence interval) and 85 miles per hour (100-year recurrence interval).

2.4.8.2.2.2 Wave Action

In the analysis of wave action, an extreme wind speed with a 1,000-year return interval occurring coincidentally with a UHS retention pond design water level corresponding to an elevation of 836.0 feet is considered a conservatively postulated combination of hydrometeorological events. This design wind, as discussed in Section 2.4.8.2.2.1, has a 1-minute average speed of 118 mph.

Using the methods described in Section 2.4.8.2.1.2, the waves generated by the above hydrometeorological combinations have a significant wave height, H_s, of 2.4 feet, a length of 32 feet, and a wave period of 2.5 seconds. The maximum wave height is 4.0 feet. For a riprapped slope of 3 to 1, designed to resist this wave action, the maximum wave run up is calculated to be 2.0 feet. Including the wind setup value of 0.1 feet, the top of the run up would reach Elevation 838.1 feet.

The riprap thickness was determined using the procedure outlined in the U.S. Army Corps of Engineers, EM 1110-2-2300 (1971b). A double filter, designed according to the criteria presented in U.S. Bureau of Reclamation, Design of Small Dams (1973), is required to provide a free-draining transition to minimize effects of erosion.

The riprap and filter design configuration for the pond slope is shown on Figure 2.4-31. The riprap stone layer thickness is 18 inches. The double filter thickness is 12 inches consisting of 6 inches of fine filter and 6 inches of coarse filter. The protection extends from the top of the slope to Elevation 828.0 feet. The gradation requirements for the riprap and filter are shown on Figure 2.4-31. The gradation curves for the riprap and filter are shown on Figure 2.4-32.

The riprap consists of dumped stone - hard, durable, and angular in shape. The specification for the stone requires a percentage loss of not more than 40 after 500 revolutions as tested by ASTM C 535, Resistance to Abrasion of Large Size Coarse

Aggregate by Use of the Los Angeles Machine. The stone sizes vary from a maximum of approximately 18 inches to a minimum of 1 inch (to fill voids), and have a 50-percent size of 12 inches. The maximum stone size is 500 pounds, and the specific gravity is greater than 2.60.

The fine filter layer is placed on the prepared embankment slope in a single lift. The fine filter gradation shown on Figure 2.4-31 satisfies the requirements of ASTM C 33, Concrete Aggregates.

The coarse filter layer is placed in a single lift on top of the finished fine filter layer, which has a surface free from mounds or windrows. The coarse filter gradation shown on Figure 2.4-31 satisfies the requirements of ASTM D 448, Standard Sizes of Coarse Aggregate for Highway Construction, Size No. 467.

Stone for riprap is placed on the surface of the finished coarse aggregate filter layer in a manner which produces a reasonably well-graded mass of stone with the minimum practicable percentage of voids. Riprap is places to its full course thickness in one operation to avoid displacing the underlying material. All material comprising the riprap is so placed and distributed that there are no large accumulations of either the larger or smaller sizes of stone.

2.4.8.2.2.3 Resonance

At the evaluated level of elevation 836.0 feet, the UHS retention pond has an approximate length of 630 feet and an average depth of 18 feet. The natural period of such a pond is computed to be about 52 seconds (U.S. Army Corps of Engineers, 1966b), which is approximately 22 times as great as the significant wave period discussed in Section 2.4.8.2.2.2. In addition, the pond side slopes are covered with riprap which acts as a wave energy absorber. For these reasons, resonance of the pond is not anticipated.

2.4.9 CHANNEL DIVERSIONS

The Missouri River is strictly managed and highly regulated. Since the cooling makeup water inlet is related closely to the main river channel, the concern of channel diversion is coincident with multiple purpose usage of the river. It is extremely improbable that naturally occurring or man-made diversions would be allowed to continue unchecked or uncontrolled. This is reflected by the projections made in the study by the Missouri Basin Inter-Agency Committee (June 1969) which forecasted that the minimum flow at Hermann in the year 2020 would be about 7,500 cfs, as shown on Figure 2.4-13. A river flow projection study was recently made by the U.S. Army Corps of Engineers, as discussed in Section 2.4.11.4.1, which accounted for additional water consumption of 3,000,000 acre-feet per year associated with coal gasification in the river basin (Claire, 1974). The study indicated that, for a projected level of basin development in year 2020, the probability is 0.004 that river flow at Hermann will be lower than 10,000 cfs. The probability that the river flow will be less than 5,000 cfs approaches zero (U.S. Army

Corps of Engineers, 1974, written communication). The corresponding river flows at Missouri River mile 115 for the same probabilities are estimated as 9,210 and 4,290 cfs, respectively (see Table 2.4-10). Such projections can only be predicated upon full future control and management of the Missouri River.

2.4.10 FLOODING PROTECTION REQUIREMENTS

As discussed in Section 2.4.2.2, all safety-related facilities are situated on an upland plateau. The elevation of the plateau is about 280 feet above the expected highest flood level of the Missouri River; therefore, protection of the safety-related facilities from floods on the Missouri River is not necessary.

The safety-related UHS is located on the southeast side of Unit No. 1, as shown on Figure 2.1-4. Grading around the UHS retention pond is sloped to keep storm surface water from entering the pond. To prevent an overflow caused by malfunction of the makeup system or by rainfall accumulation in the UHS retention pond, an outlet structure and spillway are provided to drain excess storage when the water surface in the pond exceeds the outlet crest elevation of 836.5 feet. For other information related to the UHS, see Sections 2.4.8, 3.4.1.1, and 9.2.5 and Figure 2.4-3.

The water supply intake and pumphouse structure at the Missouri River, as indicated on Figure 2.1-4, is not a safety-related facility. However, the pipe intake and pumphouse structure is designed to sustain the anticipated 200-year flood, as discussed in Section 2.4.3.5. In order to insure a dry access to the pipe intake and pumphouse structure, a service road is provided. This road begins about one mile north of Highway 94 and bridges over the Missouri, Kansas and Texas Railroad track, and then extends in a southeasterly direction to the intake and pumphouse structure. The finished grade of the service road is above the estimated maximum 200-year flood water level at Missouri River mile 115.4. The fill slope of the service road in the river flood plain is protected from erosion by riprap and other means.

2.4.11 LOW WATER CONSIDERATIONS

The makeup water will be obtained from the Missouri River at river mile 115.4. Low water considerations are discussed in the following pertinent sections.

2.4.11.1 Low Flow in Streams

The projection of the probable minimum flow rate for the Missouri River near the site is difficult because of the large size of the upstream drainage area and the increasing extent of river regulation to meet various uses. As a result, low flow discharge prediction is based upon the historic low flow data and upon previous studies of water allocation for the entire Missouri River Basin carried out by various government agencies.

The probable water levels corresponding to low flow discharges for the Missouri River at river mile 115 near the site can be obtained by using the developed stage-discharge

rating curve shown on Figure 2.4-12. The development of this rating curve has been discussed in Section 2.4.3.5.

The capacity of the Missouri River system to meet the present and future demands for water supply, water quality, navigation and flood control up to the year 2020 was analyzed in the Comprehensive Framework Study of the Missouri River Basin (Missouri Basin Inter-Agency Committee, 1969). This operational study was based upon the records of river flow from 1897 to 1968 that included extended periods of low flow due to drought and ice formation. The study demonstrated that the river system would be able to meet water requirements for all basin development up to the year 2020. Flow-duration curves were generated in this analysis at selected locations along the river's main stem. The curves for the Missouri River at Hermann during the winter season are shown on Figure 2.4-13. From the curves, it can be estimated that by the year 2020, the minimum flow at Hermann that approaches a 100 percent chance of being equaled or exceeded will be approximately 7,500 cfs. The corresponding flow at Missouri River mile 115 near the site is then estimated at 7,250 cfs (the contribution from the Gasconade River is estimated at 250 cfs based on USGS low flow data, 1979). The corresponding river stage near the site, as read from the rating curve (Figure 2.4-12), is 495.5 feet MSL (noted in Table 2.4-11).

The record low discharge of 4,200 cfs for the Missouri River at Hermann was observed from January 10 to 12, 1940, during a period of extensive river freezing. The low river discharge near the site is estimated at 3,500 cfs for the same period, as discussed in Section 2.4.3.5. For this discharge, the river stage near the site, or more specifically at the water supply intake location (Figure 2.1-3), as obtained from the developed rating curve (Figure 2.4-12), would have been about 494.3 feet MSL (noted in Table 2.4-11).

The magnitude and frequency of consecutive low flows at Hermann for various durations has been analyzed by the USGS using the period of record 1953-1973 and by best fitting the log-Pearson Type III distribution. The results are presented in Table 2.4-10. Also included in Table 2.4-10 are the estimated low flows at Missouri River mile 115 using the method described in Section 2.4.3.5. These discharges are representative of the significant regulation of flow in the Missouri River since 1952. Additionally, Table 2.4-11, which summarizes relevant low flow information discussed in this section, indicates that in the Missouri River near the site, an estimated flow rate, considered to represent a severe drought condition, of 11,100 cfs lasting for 30 days could possibly occur once in 100 years. This discharge is higher than the 1-day, 30-year low flow of 5,500 cfs selected as the preliminary low flow design base for the water supply intake on the Missouri River. The 11,100 cfs discharge was selected to represent a conservative low flow for evaluating transport of radionuclides in the Missouri River from an accidental release of radwaste from the refueling water storage tank at the Callaway Plant, as discussed in Section 2.4.12. The corresponding river stage estimated from Figure 2.4-12 is 496.0 feet MSL.

2.4.11.2 Low Water Resulting from Surges, Seiches or Tsunami

Surges and seiches will not occur in the Missouri River near the Callaway Plant site because it is an open flowing body of water not connected to any nearby large body of water. Tsunami will not occur because the site is located far inland from coastal areas. The possibility of ice jam formation on the Missouri River will not adversely affect the ability of the safety-related UHS to function properly.

2.4.11.3 Historical Low Water

Historic low water stages on the Missouri River have been caused by combinations of low flows resulting from drought and/or ice blockage (USGS, 1938; Skelton, 1966). The five lowest river discharges recorded and their corresponding stages on the Missouri River at Boonville and Hermann are listed in Table 2.4-12.

The lowest observed discharge in the Missouri River at Hermann was 4,200 cfs on January 10 to 12, 1940, which may be considered as the probable minimum flow in the Missouri River at this station for the period of record prior to regulated flow conditions. The lowest river stage observed at Hermann was 481.4 feet MSL in December 1963 for a discharge of 6,210 cfs. This is the minimum observed flow at Hermann for regulated flow conditions.

2.4.11.4 Future Controls

The Missouri River drains approximately 529,000 square miles (Missouri Basin Inter-Agency Committee, 1969) in areas within 10 states and a small area in Canada (Figure 2.4-6). Because control of the river is vested in a complex interactive web of state and federal agencies, it is almost impossible to determine which is the ultimate authority on the question of future control. The problems of future control as related to low flow could be related to historical hydrological data if the river were not controlled. However, the river is one of the most highly regulated in the United States, and the historical flows cannot be projected into the future without also considering factors of regulation, increasing consumption, and changes in the patterns of usage brought about through a dynamic technology and a shift in the direction of national priorities.

Because such factors are beyond the scope of this study, a simpler approach was used.

Since ultimate authority cannot readily be defined, actual operational control is the responsibility of the U.S. Army Corps of Engineers. Policies affecting future control are dictated by the populace needs as assessed and administered through the various state and federal agencies and their related coordinating and advisory committees.

The diagram of the water resource organization and communication for Missouri as shown on Figure 2.4-14 (U.S. Army Corps of Engineers, 1970) indicates the large number and variety of state agencies interested in the control of waters of the state. These Missouri agencies assess requirements for water usage within the state and

interact with those regional committees in establishing river control policies. They also interact with federal agencies such as the U.S. Army Corps of Engineers, which administers operational programs for river control. Figure 2.4-14 illustrates the complexity of input to the issue of future control.

Under Missouri state law, the right to withdraw and use surface waters, such as the Missouri River, is founded in the doctrine of riparian rights wherein this right accrues to and is vested in the ownership of lands on the banks of the watercourse. A user needs only to meet the test of "reasonable use" without harming similar rights enjoyed by downstream users (Missouri Basin Inter-Agency Committee, 1969).

2.4.11.4.1 Management of the Missouri River

When the U.S. Congress enacted the 1944 Flood Control Act, river management was placed in the hands of the U.S. Army Corps of Engineers. The chief functions of the control of the Missouri River, as expressed in the Act, are (1) to provide flood control, and (2) to enhance navigation (Claire, 1974).

In order to control flooding, the U.S. Army Corps of Engineers has constructed a series of dams, mostly in the middle and upper reaches of the river, which provide storage capacity used to regulate the levels of river flow and to generate electrical power. It is this series of reservoirs which is used to control floods and to increase the navigability of the river in times of low flow or drought. Periods of low river flow are controlled only during a 9-month navigation season, which extends from March through November. The criteria for control of the river during the navigation season are that the U.S. Army Corps of Engineers tries to maintain a flow of 40,000 cfs at Kansas City and does not permit the flow to fall below 35,000 cfs. Should the river flow ever fall below this level, most navigation would be impossible. It is projected that such flow conditions would occur only if a drought similar to that during the period 1930 to 1941 would recur. Various estimates of the recurrence interval have been made by the U.S. Army Corps of Engineers, but are of wide range in both probability and confidence limits and consequently are ambiguous in their interpretation (Claire, 1974).

The best available projections of future Missouri River low flows have been computed by the Reservoir Control Center of the U.S. Army Corps of Engineers at the Omaha district office (Claire, 1974; Duscha, 1974). The model of the river which was used to make the projections is based largely upon a predecessor model developed for the Missouri River Basin Comprehensive Study (MRBCS). The model as developed for the MRBCS was based on the concept that all possible withdrawals which could be conceived of at the time the study was made would be incorporated in the model regardless of how feasible or viable the projected use might be. Consequently, the MRBCS model was more conservative and speculative than the present U.S. Army Corps of Engineers' model. The model which was derived through removal of more speculative or impractical projected future withdrawals and which is currently used by the U.S. Army Corps of Engineers is considered to be more realistic and provides a practical model for actual river management.

Recently the U.S. Army Corps of Engineers updated its projections for future withdrawals to determine the effect of future withdrawals in the upper Missouri River Basin for coal gasification. Using their model, the Corps of Engineers superimposed three levels of withdrawal at 700,000, 1,400,000 and 3,000,000 acre-feet (the greatest projectable withdrawal for this purpose) and projected low flows for the length of the Missouri River in the years 1980, 2000 and 2020. The computer analyses included a data base of historical monthly averages for the three low flow drought years of 1939 through 1941. Advance copies of the results were provided by the Corps for inclusion in this report (Duscha, 1974). Table 2.4-13 presents the projected estimated low river flows and their probabilities of occurrence near the Callaway Plant site for the years 1980, 2000, and 2020. These were adjusted from flows of 10,000 cfs and 5,000 cfs at the Hermann gauging station.

Thus, under anticipated river management through the year 2020, it may be expected that low flow at Missouri River mile 115 never would be less than 4,290 cfs and at a probability level of 0.999 would be higher than 9,210 cfs. These are higher, respectively, than the low flows predicted in Section 2.4.11.1 based on historical data which indicate historical low flows of 3,500 cfs from freezing and 7,250 cfs from winter drought.

2.4.11.4.2 Future Control and Utilization Policy

In 1945, the Missouri River Basin Inter-Agency Committee was formed to interchange information and coordinate the activities of federal and state agencies in the planning and development of water and related land resources throughout the Missouri River Basin. In June 1964, a standing committee was organized to prepare a comprehensive study of the basin. This became the first comprehensive study to be made under the Water Resources Planning Act of 1965 (Missouri Basin InterAgency Committee, 1969).

The work of the Standing Committee culminated in 1969 with the publication of the Missouri River Basin Comprehensive Framework Study, in seven volumes. While the work is too extensive to be summarized herein, it is the most comprehensive source work for projections of future usage and demand and constitutes the base for later studies by the U.S. Army Corps of Engineers. It is significant that the study (Missouri Basin Inter-Agency Committee, 1969) states:

"Future investments by the public or private sectors for the future generation of electricity will be made primarily in accordance with economic considerations. As such, developments required are economically feasible under the concepts of both the national and regional objectives. Since most, if not all, future power generation in the basin will be thermalelectric, the only questions are availability of water for cooling and the effects on the environment. The framework plan considers that cooling water requirements will be met in total, and that water temperature quality standards will be fulfilled."

As the study was the result of extensive coordination of the various agencies involved or interested in the future development of Missouri River waters, it is reasonable to conclude that the Callaway Plant falls within the intent of the statement above; therefore,

the needs of the Callaway Plant will be a factor requiring consideration in future river management.

2.4.11.5 Plant Requirements

2.4.11.5.1 Minimum Safety-Related Cooling Water Flow

The minimum safety-related cooling water flow required for plant shutdown or cooldown under emergency conditions is about 15,000 gpm. The service water systems, with a capacity of 38,000 gpm supply water flow for normal plant operation and plant shutdown or cooldown under emergency conditions. Whenever a service water system is not available, the essential service water system (ESWS) of that unit supplies the minimum safety-related cooling water flow. The essential service water system, draws water from the UHS retention pond. Refer to Section 9.2.5 for the heat dissipation method, water safety factors, and other details related to the UHS and to Section 9.2.1 for a discussion of the essential service water systems.

The minimum operating level of the UHS retention pond, based on the 8-foot minimum ESW pump submergence, is Elevation 819.0 feet. Taking no credit for makeup water, this minimum elevation of 819.0 feet would not be reached within the required 30 days of operation following a design-basis accident.

2.4.11.5.2 Minimum Normal Operating Water Flow

2.4.11.5.2.1 Plant Requirements

The plant water consumption will be about 20,000 gpm (45 cfs) when the unit is operating at base load. This water will be drawn from the Missouri River through the water supply intake and pumphouse structure located about 5.5 miles southeast of the plant (Figure 2.1-3). The water will then be pumped to a water treatment plant located at the plant site and then to the plant facilities as required. Refer to Figure 2.4-15 for the plant water use diagram.

2.4.11.5.2.2 Missouri River Flow

The 1-day, 30-year average low flow, as discussed in Section 2.4.11.1, was established as the preliminary low-flow design base for the water supply intake structure. This flow was estimated to be 5,500 cfs. Under these conditions, the normal depth in the Missouri River at river mile 115 is estimated to be at elevation 495.0 feet MSL. The potential maximum water level of the 200-year flood in the river is estimated at elevation 535 feet MSL.

Based on comparison of the low flow conditions discussed previously, and because of the degree of regulated flow conditions on the lower Missouri River, the preliminary design base provides sufficient means for a dependable nonsafety-related water supply. The supply is anticipated to be adequate for the life of the project.

Extreme high- or low-flow levels in the Missouri River will not immediately affect plant operation. However, should river conditions prevent obtaining a water supply adequate for plant requirements, high and low level monitors in the river are provided to give sufficient notice to the main control room operators to allow an orderly reduction or shutdown of plant operation.

2.4.11.5.2.3 Water Supply Intake and Pumphouse Structure

The water supply intake and pumphouse structure is located near Missouri River mile 115 (Figure 2.1-3). The pumps will supply 40,000 gpm to the water treatment plant at a design head of 430 feet. The water treatment plant is located on the plant site at about elevation 850 feet MSL. The structure, as designed, will accommodate the estimated 30-day, 100-year low flow that is considered representative of a severe drought condition, and will not be submerged by a 200-year flood occurrence.

2.4.11.5.2.4 Water Treatment Plant Clearwell Pumps Station

Clarified water from the water treatment plant will flow into the clearwell. The clearwell will provide water to the cooling tower basins, to the UHS retention pond, and for other plant uses as shown on Figure 2.4-15. Since the water treatment plant is the "midpoint" of the water-use system, water level indication is provided to the main control room operators to allow determination of the extent that the water supply system is not maintaining flow for plant requirements.

2.4.11.5.2.5 Service Water Systems

The service water system will provide an estimated flow of 38,000 gpm.

2.4.11.5.2.6 Circulating Water System

The Circulating Water System flow is estimated at 530,000 gpm. Refer to Section 10.4.5 for complete details of this system.

2.4.11.5.2.7 Cooling Tower Low-Water Levels

At this site, a low-water level in the circulating water system cooling tower basin would be a critical condition. The large tower basin, about 500 feet in diameter, would contain sufficient water to provide adequate lead time between alarms for extremes of high or low river flow or Water Treatment Plant Clearwell low levels and the requirement for reducing or shutting down the plant operation. Preliminary calculations indicate that the tower basin would hold enough water to allow 1 hour's full-capacity operation for each foot of basin depth. If blowdown were to be stopped, full operation would be maintained for 1-1/2 hours for each foot of basin depth. Under the latter condition, a 6-foot deep basin would allow nearly 9 hours of operation during periods of the highest evaporative cooling requirements. A low-level alarm would be provided to the main control room operators as soon as the basin fell below the normal operating level. Continuous

level-indication would also be provided for the operators so that the rate of level decline could be established and exact lead times determined.

If it were determined that the water flow would not meet plant requirements (about 1 hour before the cooling tower basin water supply was exhausted), the operators would initiate plant shutdown and the cooling procedures culminating in the use of the essential service water systems and the UHS.

2.4.11.5.3 Plant Water Effluent

The plant water effluent will consist mainly of the blowdown from the cooling tower (Figure 2.4-15). The effluent will enter the Missouri River from a submerged pipe, terminating at the left bank, located about 100 feet downstream of the water supply intake. Discharge velocity will be sufficient to mix the effluent with the river water, for a 7-day, 10-year low flow condition (9,900 cfs, Table 2.4-10), in order to minimize thermal effects. These anticipated discharge conditions meet the existing Missouri Water Quality standards.

2.4.11.6 Heat Sink Dependability Requirements

The UHS retention pond will be the source of water for the essential service water systems (Section 9.2.1).

The plant water requirements discussed in Section 2.4.11.5 are supplied from the Missouri River. The low flow conditions in this river do not influence the dependability of the UHS retention pond. Assuming minimum required initial level the pond is designed to provide 30 days' water supply with 12% margin without makeup during the worst 30 days of evaporation.

Prediction of the UHS cooling tower evaporation is based upon the unit undergoing a design basis LOCA. Pond evaporation for 30 days is based on the model described in calculation NAI-1508-001 which uses a wind speed function that accounts for quiescent evaporation taken from C00-2224-1, “Generic Emergency Cooling Pond Analysis: Emergency Cooling Pond Analysis and the Theoretical Basis of the GEPA Computational Program,” J. E. Edinger, et al, University of Pennsylvania, School of Engineering and Applied Science, Civil Engineering, May 1972 - October 1972. The meteorological data for 30 days of maximum evaporation are obtained from the records at Columbia, Missouri, from July 2, 1954 to July 31, 1954. The wind speed used is based on the maximum 1-day wind speed of 12.8 mph, which is higher than the average 30-day wind speed of 10.5 mph.

The analysis indicates that total water requirements for 30 days, including cooling tower evaporation, seepage and other water uses, pond evaporation, and cooling tower drift, would be 40.9 acre-feet. This is less than the 48.2 acre-feet usable pond volume contained above Elevation 834.0 feet. This elevation (low water level) provides the 8-foot

minimum submergence for the ESW pumps. Details of the evaporation and transient temperature analyses are presented in Section 9.2.5.

The pond is excavated below the surrounding plant grade and thus cannot lose water due to dam failure.

Flooding of the pond and related structures is precluded since the pond is about 280 feet above the PMF level in the Missouri River and site grading is designed to direct all runoff, including that from probable maximum precipitation, away from the pond. Slope stability during seismic events and seepage analysis are presented in Sections 2.5.5 and 2.5.4.6, respectively.

Ice will form on the surface of the UHS retention pond during severe winter periods, as discussed in Section 2.4.7. No provision is made to prevent ice formation on the pond because the surface of the ice will be about 24 feet above the ESW pump suction end. When the ESWS operates with such ice cover, water from the pond is withdrawn from below the ice formation and the warm water returned from the power block is discharged near the pond bottom. This arrangement precludes any interruption of water supply to the ESWS.

Potential of ice submergence at the ESWS intake due to currents induced from the pump operation is also analyzed. This analysis considers a pond water depth of 18 feet at a pond level of Elevation 836.0 feet, along with ice thicknesses corresponding to different recurrence intervals up to 100 years. In the presence of a 24-inch ice cover (Section 2.4.7.2.1), the resulting induced velocity due to a two-unit pumping rate of 60,000 gpm (assuming all four pumps operating) is about 0.13 fps. The corresponding Froude number of the approaching flow is 0.004. For this Froude number and utilizing the method of Uzner (Uzner and Kennedy, 1972), there is no potential for ice flows to submerge. Thus, there is no possibility for pump blockage by ice. With the cancellation of Unit 2 this analysis remains conservative.

The potential for frazil ice formation in the pond is also analyzed. Frazil ice will form when: (1) the meteorological conditions are such that the pond will become supercooled, (2) there is a high degree of turbulence in the pond, and (3) nuclei are present to initiate formation (Muller, 1978). The meteorological data at Columbia, Missouri, were researched to find periods of rapid change in meteorological conditions (drop in air temperature below freezing, minimal cloud cover, low relatively humidity) concurrent with strong and sustained winds. An analysis of heat transfer, using the method of Paily et al. (1974), reveals that under the meteorological conditions selected, the degree of supercooling in the pond is greater than 0.01 C/hr. This is sufficient for frazil ice formation (Williams, 1959). However, the turbulence created by 40 mph wind-wave activity, based on maximum 3-hour winds observed at Columbia, Missouri, is insufficient to extend the supercooling to more than a 1- to 2-foot depth below the surface of the pond (Carstens, 1970). The frazil ice formation is limited to this layer.

The potential of frazil ice withdrawal into the ESWS pumps is analyzed considering a design pond water depth of 18 feet, a skimmer wall at the pump intake, an average velocity in the pond due to a two-pump operation of 0.638 fps, and a water temperature of 32°F. Using the method of Harleman (Harleman and Stolzenbach, 1967), the analysis reveals that no frazil ice will be withdrawn into the ESWS pumps. Thus, the clogging of the ESWS strainers by frazil ice is precluded and the normal operation of the ESWS is assured.

The fire protection system described in Section 9.5.1 does not draw water from the UHS retention pond. The ESW system does provide the water source for a fire hose station in each ESW pumphouse room.

Applicability and compliance with Regulatory Guide 1.127 is discussed in Table 2.4-14.

2.4.12 DISPERSION, DILUTION, AND TRAVEL TIMES OF ACCIDENTAL RELEASES OF LIQUID EFFLUENTS IN SURFACE WATERS

2.4.12.1 Accident Effects

2.4.12.1.1 Introduction

Analysis of accidental releases of liquid radwaste, as related to existing or potential future water users, must consider the ability of both the surface- and ground-water environments in dispersing, diluting or otherwise concentrating radioactive effluents. Consideration of an accidental release whereby the liquid radwaste enters the ground-water environment is addressed in Section 2.4.13.3.

For the analysis of accidental releases of radioactive liquids from the Callaway Plant site to surface waters, a postulated rupture of the refueling water storage tank, which contains the highest curie inventory of the radioisotopes of relatively long half lives, was assumed. The tank is located between the radwaste building and the turbine-reactor complex. Pertinent details of this tank are presented in Table 2.4-15.

The event of a failure producing a subsequent release of the liquid radwaste in the refueling water storage tank to the Missouri River was considered. It was postulated that the liquid content of the refueling water storage tank above 840 feet MSL, corresponding to a volume of 357,700 gallons, would spill into the local Callaway Plant drainage system. It was conservatively assumed that this radwaste would reach the Missouri River without dilution, seepage, or evaporation losses, and be essentially nondecaying. It was further conservatively assumed that the total volume of radwaste would be instantaneously released as a slug discharge at the river bank, which would maximize local concentrations in the Missouri River.

2.4.12.1.2 Description of Surface-Water Analytical Model

A transient release transport model was utlized for evaluating the dispersion, dilution, and travel time of liquid radwaste accidentally released to the Missouri River from the postulated rupture of the refueling water storage tank. This model, based on Equation (9) in Regulatory Guide 1.113 (NRC, 1977), applies to nontidal river/stream systems.

Application of the transient release model for evaluating an accidental radwaste releases was based on simplifying assumptions of idealized rectangular stream channel geometry and velocity in the Missouri River under assumed steady and uniform flow conditions. The Missouri River is not gauged for streamflow in the immediate vicinity of the Callaway Plant site, and only channel velocity distributions are known several miles downstream at the USGS gauging station at Hermann.

For steady open-channel flow, the lateral turbulant diffusion coefficient K can be estimated from hydrodynamic properties of the channel by using Elder's empirical formula (NRC, 1977):

$$K_y = \beta u^* d \qquad (2.4\text{-}5)$$

where:

d = River depth

u* = Shear velocity; and

β = Dimensionless constant.

The dimensionless constant, β, reportedly has a value of approximately 0.23 for straight natural stream channels (NRC, 1977). For curved channels, however, secondary flows can lead to increased lateral mixing, and the value of β is reportedly larger (Fischer, 1969; Yotsukura et al., 1970; Sayre and Yeh, 1973). Fischer (1969) has demonstrated that the lateral mixing coefficient can be increased in bending streams, varying inversely as the square of the radius of curvature. In order to obtain realistic transport estimates, values of the lateral mixing coefficient should be determined by field tracer studies. The dimensionless parameter, β, as determined by field investigations, is reportedly 0.6 to 0.7 for a gradually curving reach of the Missouri River near Blair, Nebraska (Yotsukura et al., 1970). Another field investigation conducted near Brownsville, Nebraska, for a first reach containing a very sharp bend reported average and maximum values of equal to 3.3 and 10, respectively (Sayre and Yeh, 1973).

The longitudinal turbulent diffusion coefficient, K_x, can be determined from (NRC, 1977):

$$K = \beta u^* d \qquad (2.4\text{-}6)$$

where:

d	=	River depth
u*	=	Shear velocity; and
β	=	Dimensionless constant.

For straight rectangular stream channels, β has a reported value of about 5.93 (Fischer, 1968). The value of β, however, reportedly increases in curved channels and should be determined by field tracer studies (Fischer, 1969; Yotsukura, et al., 1970; Sayre and Yeh, 1973). Such an investigation conducted for the Missouri River between Sioux City, Iowa, and Plattsmouth, Nebraska, determined a value of β equal to 5,600 (Yotsukura et al., 1970).

The certified computer program, DISPERN, was used for performing the accident analysis. This program is based on the transient release model.

2.4.12.1.3 Selection of Surface-Water Model Parameters

A summary of the parameters adopted in the accident analysis is presented in Table 2.4-16. Analysis was based upon the extremely conservative postulated instantaneous and complete release of liquid radwaste into the Missouri River, as discussed in Section 2.4.12.1.1. The minimum values of β, 0.23 and 5.93, for determining K and K , respectively, were not considered appropriate to use since they apply specifically to straight natural stream channels and ignore secondary flows which have been experimentally found, on the Missouri River, to lead to increased lateral and longitudinal mixing. A value of β equal to 0.65 for determining K_y was adopted, as found experimentally for a gradually curving reach of the Missouri River upstream of the Callaway Plant site. A value of β equal to 5,600 for determining K_x was likewise adopted, as found experimentally during the same study (Yotsukura et al., 1970).

The analysis considered a flow of 69,000 cfs in the Missouri River, corresponding to the average flow condition as discussed in 2.4.1. This represents the most likely flow condition during a postulated accident that could conceivably occur at any time. The additional physical characteristics of the Missouri River used in the analysis are given in Table 2.4-16.

2.4.12.1.4 Results of Analysis

In the postulated accident analysis, peak radwaste concentrations in the Missouri River would be rapidly diluted to several orders of magnitude below the input concentration of 0.709×10^{-1} Ci/ft^3 (Table 2.4-16). Figure 2.4-16 shows the predicted peak radwaste concentrations for 50 river miles in the Missouri River downstream from the Callaway Plant site. Corresponding dilution factors for this radwaste discharge are illustrated on

Figure 2.4-17. The speed of travel for the centroid of the radwaste slug in the Missouri River is estimated at 4.5 ft/sec.

In the vicinity of the Callaway Plant site, the theoretical peak radwaste concentrations shown on Figure 2.4-16 would occur only along the near shore of the Missouri River. Radwaste concentrations at the far shore in the vicinity of the site would probably be undetectable. Due to this lateral concentration gradient, the average radwaste concentrations at cross sections in the Missouri River would be much lower than the peak values shown on Figure 2.4-16, particularly near the plant site. The lateral concentration gradient would become less pronounced at locations further downstream where the radwaste would become more fully mixed across the river width. As was discussed in Section 2.4.1.2.2, the closest user of Missouri River water is located about 50 miles downstream from the Callaway Plant site. Due to the tremendous amount of dilution that would have occurred up to this distance for the slug release in transit (Figure 2.4-17), no significant impacts are anticipated for downstream water users.

2.4.13 GROUND WATER

2.4.13.1 Description and On Site Use

2.4.13.1.1 Aquifer Systems

2.4.13.1.1.1 Regional Ground-Water Systems

Missouri has been divided into three ground-water provinces (Fuller et al., 1967): the Alluvial Valleys; the Saline Ground-Water Province; and the Ozarks Province, which includes the Springfield Plateau (Figure 2.4-18). Regional aquifers that occur within 50 miles of the Callaway Plant site lie within the Ozarks and Alluvial Valley of the Missouri River ground-water provinces.

The hydrogeologic characteristics of the aquifers are summarized in Table 2.4-17. A detailed description of their geology is given in Section 2.5.1.1.4. On a regional basis, from the Precambrian up through the St. Peter Sandstone, the entire sequence of rocks exhibits characteristics of a single leaky artesian aquifer system. Above the St. Peter Sandstone, a leaky unconfined aquifer system is found locally at the site. The unconfined aquifer system is discussed in Section 2.4.13.1.1.2. The following is a description, in descending order, of the individual aquifers in the region (after Fuller et al., 1967):

a. Recent alluvium in the Missouri River Basin is composed of silt, sand, and gravel. The alluvium is a major aquifer, yielding in excess of 500 gpm per well. The thickness of the alluvium varies from 0 to 120 feet. The Missouri River is located about 5 miles south of and about 350 feet lower in elevation than the plant;

b. The St. Peter Sandstone of the Ordovician System is a medium- to coarse-grained sandstone with yields of 50 to 75 gpm to industrial and

small municipal wells. Its thickness varies considerably in the region. It is a major aquifer to the east and northeast of the site where it may be as much as 200 feet thick. In the site vicinity, the St. Peter Sandstone is not continuous. It occurs only as erosional remnants in the subsurface sequence;

c. The Cotter-Jefferson City Dolomite of the Ordovician System is a fine- to medium-grained, jointed dolomite that yields flows to domestic and agricultural wells of 10 to 15 gpm. Its thickness in the site area ranges from 300 to 550 feet. The Cotter-Jefferson City Dolomite constitutes a minor aquifer;

d. The Roubidoux Formation of the Ordovician System consists of a fine- to coarse-grained sandstone with interbedded cherty dolomite. Its thickness ranges from 100 to 250 feet. The Roubidoux Formation is a major aquifer, yielding 25 to 350 gpm to industrial and municipal wells.

e. The Gasconade Dolomite and the Gunter Sandstone Member of the Ordovician System consist of a cherty dolomite averaging 300 feet thick and a medium-grained sandstone averaging 25 to 30 feet thick, respectively. The Gasconade Dolomite and basal Gunter Sandstone Member typically produce yields for municipal and industrial water supplies ranging from 50 to 75 gpm. These two units are considered a major aquifer. Well yields are as high as 1,000 gpm in some areas;

f. The Eminence Dolomite of the Cambrian System is a medium- to coarse-grained, vuggy, fractured, crystalline dolomite with a thickness ranging from 200 to 350 feet. Water yields for domestic and farm wells are commonly 15 to 20 gpm. The Eminence is considered as a minor aquifer. It is commonly used with the Gasconade and Potosi formations as a water source for municipal and industrial uses;

g. The Potosi Dolomite of the Cambrian System is a vuggy and drusy, fine- to coarse-grained dolomite averaging from 50 to 230 feet in thickness. Large industrial and public water supply wells draw as much as 500 gpm or more from this major aquifer;

h. The Derby-Doe Run, Davis (an aquitard) and Bonneterre formations have a total thickness varying from 420 to 725 feet. Generally, only the fine- to medium-grained dolomite of the Bonneterre Formation serves as a source of water. Yields to domestic and farm wells typically are from 20 to 25 gpm. This formation is commonly included with the Lamotte as a water source. The Bonneterre Formation itself is considered to be a minor aquifer; and

i. Lamotte Sandstone of the Cambrian System is a fine-to coarse-grained, well-cemented sandstone with an average thickness of about 200 feet. It is

a major aquifer and typically yields about 65 gpm to domestic, municipal, and industrial water wells.

Throughout much of the Ozarks Province, the ground-water regime exhibits the characteristics of a leaky artesian aquifer system. Ground-water elevations in wells intersecting various aquifers below the Cotter-Jefferson City Formation decrease toward the Missouri River. This applies to areas adjacent to the Missouri River on both the north and south side. Based on water level readings obtained from these wells, a regional potentiometric surface map was developed as shown on Figure 2.4-19. The similarity of ground-water elevations in wells intersecting different aquifers supports the concept of a single regional aquifer system. A generalized schematic diagram of the regional aquifer system is shown on Figure 2.4-20.

In areas throughout the region, zones of lower permeability may occur as a result of changes in lithology. This is particularly evident in the area north of the Missouri River where artesian pressures have developed in the aquifers immediately underlying the upper part of the Cotter-Jefferson City Formation (Fuller, 1973).

In the region north of the Missouri River, ground-water supplies for domestic and farm supply are obtained primarily from the Cotter-Jefferson City Formation and to a minor extent from the weathered bedrock beneath the Quaternary deposits. High capacity wells in the deeper bedrock aquifers serve municipal needs, such as at Fulton, where production is derived primarily from the Eminence Dolomite.

2.4.13.1.1.2 Local Ground-Water Systems

The hydrogeologic characteristics of the geologic formations encountered in the site area are discussed in Section 2.4.13.2.3.2.1. A generalized schematic diagram of the local ground-water environment in the vicinity of the plant is shown on Figure 2.4-21. The near surface materials in the vicinity of the site consist of a sequence of Quaternary deposits including modified loess, accretion-gley, and clayey glacial till (Section 2.5.1.2.2). Infiltration rates through these units into the underlying older sediments are very low (permeabilities range from 4.6 x 10^{-7} to 5.5 x 10^{-9} cm/sec).

Under the till lies the Graydon chert conglomerate (Section 2.5.1.2.2.2). The Graydon represents a weathered product of the Burlington Limestone (Section 2.5.1.2.2.3.1). This weathering extends in some places to the bottom of the Burlington but rarely to the Bushberg Sandstone Formation (Section 2.5.1.2.2.3.1), which lies below.

The Bushberg Sandstone, although not found in some borings, effectively drains the overlying deposits within most of the plant vicinity. This unit varies from 0 to 8 feet in thickness. Some water is stored in the Bushberg Sandstone,. which is underlain by the Snyder Creek Shale Formation (Section 2.5.1.2.2.3.2). The Snyder Creek Shale Formation has a lower permeability and acts as an aquitard, or a barrier to the downward movement of water. The permeability of the Bushberg Sandstone is one to three orders of magnitude greater than the underlying shale. The bulk of water moves downward from

the overlying deposits and is transmitted laterally in the Bushberg toward the Missouri River rather than continuing downward through the shale. The Bushberg, however, because of its irregularity and variations in permeability as shown in borings and by pumping tests, could not be used as a source of water supply.

The Snyder Creek Shale, Callaway Limestone, St. Peter Sandstone and paleokarst rubble, where they occur, and upper Cotter-Jefferson City Formation represent a strata thickness of about 250 to 270 feet with low permeability. The potentiometric surfaces and permeabilities in these units are discussed in detail in Section 2.4.13.2.3.2.1. The permeabilities and potentiometric surfaces indicate that these bedrock units as a whole can generally be considered an aquitard to depths of 320 to 350 feet below ground surface. The units contain zones of unsaturated rock resulting from the small amount of downward seepage allowed through this low permeability sequence.

The St. Peter Sandstone and paleokarst rubble were encountered in only some borings at the site. During field geologic mapping, the St. Peter Formation was observed to crop out about 2 1/2 miles to the east-southeast and 3 miles southwest of the plant site. Unklesbay (1955) reported the occurrence of the St. Peter Formation in the Fulton Quadrangle as erosional remnants on the unconformable top of the Cotter Jefferson City Formation; this fact has been confirmed within the site area (Section 2.5). This accounts for the sporadic occurrence and localized use of the St. Peter Formation as an aquifer throughout this region.

Water level response during the pumping tests conducted at the site indicated that yields from the combined Bushberg, Snyder Creek, Callaway and upper Cotter-Jefferson City formations to a depth of about 300 feet were no greater than 1 gallon per minute through a 3-inch hole. A sustained well yield of about 8 gallons per minute was obtained from a 400-foot deep, 6-inch diameter well that was sealed from the top of the Callaway Formation to the surface. A detailed account of the pumping test is given in Section 2.4.13.2.3.2.4.

The presence of the Cotter-Jefferson City, Roubidoux, Gasconade-Gunter, and Eminence aquifers within a 5-mile radius of the site has been confirmed by the Missouri Geological Survey (Knight, 1973) from records of well drillers' logs and samples. Fulton, the nearest municipality to the plant site (11 miles) obtains its water supply from these deep aquifers. The Potosi, Bonneterre and Lamotte formations are probably present beneath the site (Fuller et al., 1967) at depths projected from 1,400 to 2,000 feet below ground surface.

In the vicinity of the plant, streams act as both recharge and discharge features, depending on the intensity and duration of the precipitation event and the antecedent soil moisture conditions. Streams in the area such as Logan Creek, Mud Creek, and Cow Creek, where the Cotter-Jefferson City Formation constitutes the stream beds, commonly flow on exposed bedrock (Figure 2.4-7). Fuller et al., (1967) report that, in general, the carbonate formations are recharged where they crop out.

2.4.13.1.2 On-Site Use

The plant will be deriving all its water requirements directly from the Missouri River during operation except for potable water and lube water for the intake pumps. During construction, a source of construction water was developed by drilling one well into the Derby-Doerun formation and another into the Eminence formation. A third well was drilled to the Eminence formation to fill the UHS pond, and after construction was completed it is used to provide potable water to the plant and as a source of water for the demineralized water makeup system. One shallow well at the river intake structure, penetrating the Missouri River alluvium was drilled to provide intake lube water. This shallow well was replaced with a deep well terminating in the Eminence formation. The amount of water use varies but does not adversely affect shallower aquifers used by local residents. The two construction wells and the river intake shallow well will not be abandoned and will remain in a standby status for possible future use.

2.4.13.2 Sources

2.4.13.2.1 Regional Ground-Water Use

2.4.13.2.1.1 Present Use

Ground-water supplies serving as sources of water for municipalities within a radius of 50 miles of the site and north of the Missouri River are shown on Figure 2.4-22. The water plant capacity and user data for municipalities are presented in Table 2.4-18. Similar data for the water supply districts are listed in Table 2.4-19. These wells account for most of the ground-water pumpage in the region. The majority of these wells are located in deep aquifers and have no effect on water users deriving their supply from the Cotter-Jefferson City Formation or unconsolidated surficial deposits.

Major ground-water users nearest the Callaway Plant site are the Fulton Municipal Supply and the Callaway County Water District No. 1. Total use of ground water by municipalities within 50 miles and north of the Missouri River averages about 18.230 million gallons per day (Table 2.4-18).

Total industrial pumpage from ground water within 50 miles of the Callaway Plant site is 1.6 million gallons per day (Missouri Department of Natural Resources, 1969-1978). For the area south of the Missouri River, industrial use is approximately 0.65 million gallons per day (Harvey, 1973).

Total ground-water pumpage for rural domestic and livestock use within 50 miles of the site is on the order of 3.3 and 3.05 million gallons per day, respectively (Harvey, 1973).

2.4.13.2.1.2 Future Use

The Missouri River Basin Inter-Agency Committee Report on the present and future needs of ground water (1969) predicts a population growth from a 1965 level of 2.423

million to 5.73 million by 2020 in the Lower Missouri Subbasin as defined in the Inter-Agency Report, and an estimated increase in demand for central water services by a factor of about 3.01. However, the report maintains that 75 percent of the increased demand will be concentrated in the areas of urban development. As the plant site is far from the large urban centers of St. Louis and Kansas City, the demand for water use would be anticipated to increase by a factor of not more than 3.01 in the nonurban areas.

2.4.13.2.2 Local Ground-Water Use

For this report, a well inventory was made of 48 wells within 5 miles of the Callaway Plant site of which seven were dug, 40 were drilled, and one well was driven. There were 10 enclosed springs in use. A list of these water supplies is given in Table 2.4-20. The well inventory map is shown on Figure 2.4-23. The average depth of the dug wells is 25 feet. Generally, the dug wells are located within the top weathered zone of the soil and bedrock formations. The average depth of the wells drilled into the Cotter-Jefferson City Formation is about 320 feet. A generalized map of the potentiometric surface for the Cotter-Jefferson City Formation in the region of the site and surrounding area has been compiled on the basis of the field inventory conducted in August 1973 of the existing wells (Figure 2.4-24). The water level contours should be considered only as close approximations due to variations of depth of well casing and depth of penetration into the Cotter-Jefferson City Formation. The water level in the test well drilled at the plant site in October 1973 is within a localized depression of the general piezometric surface caused by heavy pumping at well No. 41. This depression in the piezometric surface is a local feature and represents the core of depression created by pumping well No. 41.

2.4.13.2.2.1 Present Use

Within a 5-mile radius of the site, there are seven wells supplying small quantities of water (0.5 to 5 gallons per minute) from the weathered Quaternary deposits and shallow rock formations (Table 2.4-20). These are dug wells with diameters of 3 to 6 feet and depths ranging from 10 to 65 feet. Total usage from dug wells averaged about 2,400 gallons per day or 343 gallons per well per day. One driven well taps the alluvial deposits along the Missouri River.

Most farming operations in the region use wells drilled from about 100 to 500 feet deep into the Cotter-Jefferson City Formation for their water supply. About 39 such wells exist within a 5-mile radius of the site (Figure 2.4-23, Table 2.4-20). Yields from these wells, based on water well drillers' logs (Fuller and Knight, 1973; Fuller et al., 1967), range from 10 to 30 gpm. Variations in permeability alter this yield locally. Total usage from wells drilled into the Cotter-Jefferson City Formation averages about 17,000 gallons per day or about 447 gallons per well per day.

Some springs flow from the Cotter-Jefferson City Formation and are used as sources of water for domestic purposes. The average yield from the springs, based on the well inventory conducted for this study, is less than 5 gallons per minute. Such flows are typical of the springs in the vicinity of the site.

Lost Canyon Lake, a recreational facility, located about 2 miles north of the plant site (Figure 2.4-23), has a well drilled into the Roubidoux Formation (Knight, 1973). Typical yields from the Roubidoux in this area north of the Missouri River range from 25 to 350 gallons per minute (Knight, 1962). Casing was set to 450 feet, sealing off the upper formations. The owner of this well was informed by the drillers that the well is capable of yielding up to 300 gallons per minute (Toffon, 1973). This agrees with the general characteristics of the Roubidoux Formation.

2.4.13.2.2.2 Future Use

Future local use of ground water for domestic and livestock purposes should remain relatively unchanged and probably will decrease in the vicinity of the plant site due to land purchase by the utility.

Any large increase in ground-water use would occur mainly in the Columbia, Jefferson City, and Fulton urban and semiurban areas, which are 35, 24, and 11 miles respectively from the site. Based on existing areas of influence (Figure 2.4-19) and the distances involved, it is anticipated that any such increase will not affect the water levels in the vicinity of the plant. Two water wells were used to supply an estimated 75 to 100 gallons per minute during construction activities at the site. Deep well #3 has a maximum pumping capacity of 500 gallons per minute, however from exploration data obtained from the Potosi aquifer a charging capacity of greater than 500 gallons per minute can be expected. The intake lube water deep well has a pumping capacity of 200 gpm and draws from the Eminence formation, which pump tests show a capacity of greater than 600 gpm. Therefore, plant operation will not affect ground-water users. Conversely, local ground-water users will not affect operation of the plant. Therefore, alteration of direction in hydraulic gradients due to use is not anticipated.

2.4.13.2.3 Ground Water Flow Regimes

2.4.13.2.3.1 Regional Conditions

The Missouri River Alluvium is a major regional aquifer that trends in a northwest-southeast direction. The alluvial aquifer is within 5 miles south of the plant and ranges in thickness from 0 to 120 feet. Recharge to the alluvium is essentially derived from ground water from the CotterJefferson City Dolomite which discharges water into the alluvial material along both sides of the Missouri River (Fuller, 1973). Some recharge to the alluvium occurs from local precipitation and the river when the stage is above the ground water in the alluvium. However, ground-water normally discharges from the alluvial aquifer into the river (Fuller, 1973), as the ground-water gradients regionally slope toward the river. Discharge from the alluvium also occurs through wells yielding in excess of 500 gallons per minute per well (Fuller, 1973).

The upper part of the leaky artesian aquifer system, which is the principal regional aquifer system studied, extends from about the middle of the Cotter-Jefferson City

Dolomite at the plant site to the base of the Derby-Doe Run Formation. This leaky artesian system is approximately 1,500 feet thick.

The uppermost unit of this system is the Cotter-Jefferson City Dolomite, which crops out regionally and is the aquifer unit specifically discussed in the following paragraphs. A more detailed discussion of the Cotter-Jefferson City Dolomite occurring in the area of the site is given in Section 2.5. Water in this aquifer unit is confined under artesian pressure by the low permeability of the upper Cotter-Jefferson City Dolomite.

Recharge is from precipitation. The gradient of the piezometric surface slopes southeastwardly, averaging 45 feet per mile toward the Missouri River, which serves as a ground-water sink. At locations distant from the site, intensive pumping has created reversals in the natural ground water gradient in the Cotter-Jefferson City Dolomite in the upper part of the leaky artesian aquifer system. Evidence of drawdown is shown on Figure 2.4-24 in the following areas:

a. At Columbia, 35 miles northwest of the site, a drawdown of about 150 feet has resulted in a significant cone of depression extending from 2 to 5 miles from the city. Currently, Columbia is in the process of changing its water supply to wells in the alluvium of the Missouri River at McBaine (Hahn, 1973);

b. At Jefferson City, 24 miles southwest of the site, a recent increase in pumpage has resulted in pumping levels in wells being drawn down as much as 100 feet during the past year (Miller, 1973);

c. At Fulton, 11 miles northwest of the site, pumping for municipal supplies has resulted in localized drawdown within a few miles of the wells. The cone of depression, however, has not affected any of the surrounding users (Knight, 1973); and

d. Along State Highway 19 between the towns of Martinsburg and Jonesburg, 20 miles northeast of the site, pumping for municipal supplies has indented the gradient of the piezometric surface about 50 feet (Knight, 1973).

The hydrogeologic characteristics of the upper part of the leaky artesian system in the northern part of the Ozarks Province suggest that concentrated high rates of pumpage will produce regional effects only if continued over prolonged periods. No lowering of the water table at the site is expected as a result of pumpage from any of the surrounding ground-water users (Knight, 1973).

The lower part of the leaky artesian aquifer system, which extends from the top of the Bonneterre Formation down through the base of the Lamotte Formation at the top of the Precambrian, is about 500 feet thick (Fuller et al., 1967). Recharge is from precipitation in the area of the St. Francois Mountains over 100 miles south of the plant (Fuller et al.,

1967). Within the region no known wells in the lower part of the system exist because higher yielding aquifers are found at shallower depths.

2.4.13.2.3.2 Local Conditions

Local hydrogeologic conditions have been assessed by water levels in piezometers, falling head permeameter tests, borehole pressure tests, and pumping tests; the resulting data were used for the calculations of permeabilities, hydraulic gradients, and flow rates.

2.4.13.2.3.2.1 Local Hydrogeologic Conditions

A generalized schematic diagram of the local hydrogeologic conditions is shown on Figure 2.4-21. The schematic illustration of preconstruction site conditions is based on information obtained from drilling, piezometer water level readings, borehole pressure testing (Table 2.4-21), permeameter (Table 2.4-22), and pump testing which were conducted at the site.

During excavation for site construction the Quaternary deposits were removed from beneath the plant.

Preconstruction data indicate the Quaternary deposits at the site have low vertical and horizontal permeabilities. Values of vertical permeability determined from laboratory tests of the modified loess, accretion-gley, and glacial till ranged from 5.5 x 10^{-9} to 4.6 x 10^{-7}cm/sec. The results of 17 falling head permeameter tests performed in seven piezo meters situated in the overburden at the site indicated horizontal permeabilities ranging from 4.5 x 10^{-8} to 4.8 x 10^{-6} cm/sec with an average of 1.6 x 10^{-6} cm/sec (Table 2.4-22). Water-level fluctuations in piezometers installed in these units are presented in Table 2.4-23.

The Graydon chert conglomerate underlies the Quaternary deposits at the site. The degree and depth of weathering is variable throughout the site, extending in some instances to the base of the Burlington but rarely into the underlying Bushberg Sandstone. The vertical permeability of the Graydon based on three laboratory tests, ranged from 1.6 x 10^{-8} to 3.1 x 10^{-8} cm/sec. The horizontal permeability based on three falling head permeameter tests in three peizometers located wholly in this unit ranged from 6.0 x 10^{-7} to 2.4 x 10^{-5} cm/sec (Table 2.4-22). Similar tests conducted in piezometers, including other geologic units but primarily in the Graydon indicated permeability values in the range of 3.8 x 10^{-7} to 5.1 x 10^{-6} cm/sec (Table 2.4-22).

Ground-water levels used for the potentiometric surface map of the Graydon chert conglomerate, shown on Figure 2.4-25, indicate the flow in the Graydon is towards the west. Localized depressions in the potentiometric surface of the Graydon chert conglomerate in the vicinity of the site appear related to areas where the depth of the Graydon chert conglomerate extends to the Bushberg Sandstone with no Burlington

Limestone present. In the area where the Burlington Limestone is not present, the Bushberg Sandstone is causing a more rapid drainage of water from the overlying materials.

Underlying the Graydon chert conglomerate is the Burlington Limestone, which contains minor vugs and clay layers, resulting from erosional conditions prior to the latest glaciation. However, no appreciable permeability has been developed in this unit. Falling head permeameter tests performed in piezometers primarily located in this unit but intersecting other formations indicate permeabilities on the order of 10^{-6} to 10^{-7} cm/sec.

The Bushberg Sandstone, which underlies the Graydon chert conglomerate, is also fully saturated. This unit has variable thickness and permeability in the plant site vicinity. The permeability variations are likely the result of variable clay content, which is estimated to range from 10 to 20 percent based on field observation of core. A pumping test conducted in an interval containing 1 foot of Bushberg Sandstone and 2 feet of Snyder Creek Shale yielded about 1/3 to 1/2 gpm and indicated a permeability of about 5.66 x 10^{-4} cm/sec. Procedures for the pumping test are described in Section 2.5.6 and Section 2.4.13.2.3.2.4. Falling head permeameter tests in seven piezometers intersecting the Bushberg and intervals of the Snyder Creek Shale and other formations range on the order of 10^{-7} to 5 x 10^{-6} cm/sec (Table 2.4-22), suggesting the permeability value from the pumping test is higher than the average permeability values for this unit.

Figure 2.4-26, the potentiometric surface map of the Bushberg Sandstone and upper Snyder Creek Shale shows that general flow of ground water is towards the west and southwest in the vicinity of the site. In stream valleys, the Bushberg Sand stone is commonly partially saturated, and ground water seeps from the valley walls into the creek beds.

The underlying Snyder Creek Shale with its low permeability acts as an aquitard and restricts downward percolation of the ground water. Values of horizontal permeability based on the results of borehole pressure tests (Table 2.4-21) and falling head permeameter tests (Table 2.4-22) indicate a range from about 1.0 x 10^{-9} to 7.5 x 10^{-6} cm/sec with an average of about 2.0 x 10^{-6} cm/sec.

Borehole pressure tests and field permeameter tests give values that more closely approximate the horizontal component of permeability. Vertical permeability of shales are commonly several times lower than horizontal permeability, except in the instance of abundant vertical or subvertical fractures.

An examination of core from the Snyder Creek Shale in the plant site area indicates rare instances of vertical sandfilled fractures in the upper few feet of the Snyder Creek Shale. These features are not evident at depths of 5 feet below the top of this unit. Horizontal and subhorizontal fractures are rarely found throughout the Snyder Creek Shale. It is likely that these features do not provide vertical continuity as ground-water flow pathways. Therefore, the values of vertical permeability are at least one and probably

two or more orders of magnitude lower than the calculated horizontal values. Therefore, calculated horizontal values are conservative for actual vertical permeabilities of the Snyder Creek Shale. The amount of seepage downward from the Snyder Creek Shale to the underlying Callaway Formation is very slow because of the low permeability of the shale unit. The permeability of the Callaway Limestone, determined from pressure testing, ranged from about 1 x 10^{-9} to 1.9 x 10^{-5} cm/sec with an average of about 4.1 x 10^{-6} cm/sec (Table 2.4-21).

Field permeameter tests conducted in two piezometers wholly in the Callaway Formation indicate a permeability of about 2 x 10^{-7} cm/sec (Table 2.4-22). Tests in piezometers, intersecting primarily the Callaway but including thicknesses of Snyder Creek and Cotter-Jefferson City, indicate permeability values in the range of 1.5 x10^{-7} to 1.5 x 10^{-6} cm/sec (Table 2.4-22).

The pumping test was conducted with an open hole penetrating 65 feet of the Snyder Creek and Callaway formations. The test indicated an average permeability value of about 8.8 x 10^{-6} cm/sec for this interval. It is evident that the Snyder Creek and Callaway formations have very low permeabilities and will act as effective barriers retarding the movement of ground water both in a horizontal and vertical direction. The potentiometric surface in the Callaway Formation, shown on Figure 2.4-27, indicates that movement of any ground water in this unit is probably towards the east and south in the site vicinity.

The Cotter-Jefferson City Formation and, in two areas, the St. Peter Sandstone and associated paleokarst rubble underlie the Callaway Limestone at the site. The occurrence of the St. Peter and paleokarst rubble represent in-fillings of paleokarst features developed in the Cotter-Jefferson City Formation.

The Cotter-Jefferson City Formation, tested in areas near or adjacent to the St. Peter Sandstone and paleokarst rubble, had permeability values similar to the St. Peter Sandstone and paleokarst rubble. The Cotter-Jefferson City permeability values in these areas ranged from 2.7 x10^{-7} to 1.3 x10^{-5} cm/sec with an average of 3.2 x 10^{-6} cm/sec compared with an average permeability of 2.2 x 10^{-6} for the St. Peter Sandstone and paleokarst rubble (Table 2.4-21). The permeability values of the upper Cotter-Jefferson City Formation adjacent or near the St. Peter do not differ appreciably from those for similar stratigraphic horizons farther from the St. Peter bodies. For example, the permeabilities in the upper 20 feet of Cotter-Jefferson City Formation for Borings P-69 and P-74 were about 9.8 x 10^{-7} and 1.6 x 10^{-6} cm/sec, respectively. These borings are located at respectively increasing distances from the St. Peter Sandstone encountered beneath Callaway Plant Unit 1. Therefore, permeability variations in the Cotter-Jefferson City Formation are not related to its proximity to the paleokarst features.

A falling head permeameter test was performed at piezometer P-2 situated at a depth of 10 to 50 feet into the Cotter-Jefferson City Formation. The permeability calculated from this test was 3.0 x 10^{-7} cm/sec (Table 2.4-22).

Permeabilities as high as 10^{-4} cm/sec were measured in zones of the Cotter-Jefferson City Formation at a depth of about 350 feet below ground surface at the Callaway Plant site. These zones correspond to the regionally developed Cotter-Jefferson City Formation aquifer zones used for domestic and stock water supply.

This depth is about 50 feet below the maximum depth of St. Peter encountered at the site. Pressure tests for the interval from about 50 feet below the base of the St. Peter to the more highly permeable horizon of the Cotter-Jefferson City Formation indicate permeabilities range from about 2.7×10^{-7} to about 7.2×10^{-6} cm/sec. Tests were performed in borings in the vicinity of both Units 1 and 2 (Table 2.4-21). Tests results outined a zone in the Cotter-Jefferson City Formation at least 50 feet thick with a maximum permeability of about 5×10^{-6} which separated the St. Peter Sandstone and paleokarst rubble from the deeper and more highly permeable zones in the Cotter-Jefferson City Formation. Geological evidence indicates that zones in the vicinity of the paleokarst features have been recemented, accounting for the low permeabilities adjacent to the St. Peter Sandstone and paleokarst rubble. The low permeabilities in the upper Cotter-Jefferson City Formation act as an aquitard between the ground-water regime of the St. Peter Sandstone and paleokarst rubble. This restricts water movement to and from the deeper zones in the Cotter-Jefferson City Formation, which are utilized regionally as a water supply source.

During drilling of the hole for the pumping test at the plant site 251 feet of Cotter-Jefferson City Formation was exposed at depths from 149 to 400 feet below ground surface. The results of the test pumping indicate a transmissivity of about 86 gallons per day per foot. If this transmissivity value is divided by the total length of open hole, a calculated permeability value of 1.61×10^{-5} cm/sec is obtained. However, observations recorded during drilling of this well indicated that the main water bearing zone was between depths of 337 and 400 feet in the hole. Based on the pumping test results, a value of 6.5×10^{-5} cm/sec can be suggested for the bottom part of the Cotter-Jefferson City Formation. Values in the upper 200 feet of this unit probably are an order of magnitude lower in the range of 5×10^{-6} cm/sec, which correspond with the results of pressure testing (Table 2.4-21).

The Callaway and Cotter-Jefferson City formations each contain unsaturated and underlying saturated zones. This is demonstrated by the fact that water levels in both the Callaway and the upper part of the Cotter-Jefferson City formations are well below the top of the effective intervals of the piezometers (Table 2.4-23). Ground water from saturated zones in the higher Snyder Creek, Callaway and Cotter-Jefferson City formations slowly flows downward under gravity into a lower saturated zone.

Natural discharge from the Cotter-Jefferson City Dolomite and overlying units occurs in the valleys of tributaries to the Missouri River and along the bluffs north of the Missouri River. As discussed in Section 2.4.13.2.2.1, springs flow from these units within 5 miles of the site and are used as supplies for domestic and agricultural purposes (Figure 2.4-28 and Table 2.4-20). No springs with an average flow greater than about 8 gpm

have been found north of the Missouri River in the Ozarks Ground Water Province (Fuller et al., 1967).

Pumpage from the Cotter-Jefferson City Dolomite within 5 miles of the plant produced cones of depression that extend 1/4 to 1/2 mile from some wells. During the inventory, conducted by Dames & Moore, of the local ground-water users, well owners reported that no significant decreases had been observed in the pumping levels of nearby wells. No wells had to be deepened subsequent to drilling and testing. During high pumpage water levels in nearby Cotter-Jefferson City wells may be lowered. Pumpage from the wells will result in a lowering of the static water level, and a cone of depression will form in the vicinity of each pumping well. However, the aquifer has sufficient water to limit the drawdown to the immediate vicinity of the well without affecting the regional water table. The depression at the plant site, shown on Figure 2.4-24 is a local feature resulting from heavy domestic use and stock watering in the site area, and consequently, the piezometric surfce should return to its normal configuration when use of these wells is discontinued.

There are no wells that produce from the Eminence formation or below within 5 miles of the plant site with the exception of one construction well which terminates in the Derby-Doerun, a second construction well, deep well #3 and the river intake deep well which termiante in the Eminence formation. However, based on data obtained during the exploration for the construction wells, it is expected that large quantities of ground water capable of providing pumpage rates in excess of 500 gpm can be anticipated in the Potosi Dolomite at depths of 1,200 to 1,500 feet beneath the site (Fuller et al., 1967). Pump tests of the lube water deep well show that the ground water at the Eminence formation is capable of a capacity greater than 600 gpm.

2.4.13.2.3.2.2 Piezometer Installations

Fifty four piezometers were installed in preconstruction borings within the site area. Their locations are shown on Figure 2.4-29. During preconstruction investigative phases, the piezometers were utilized to evaluate different groundwater parameters. The ground-water levels varied with changing rates of precipitation and with the drawdown influence of pumping tests. Readings of water levels in the preconstruction piezometers are given in Table 2.4-23. Prior to start-up of construction, the piezometers were sealed from the bottom to the surface and abandoned.

Ten permanent monitoring piezometers are installed within the plant exclusion area boundary. These piezometers were utilized for monitoring ground-water levels and water quality as required. Piezometer monitoring locations are shown on Figure 2.4-30. To provide a monitoring system that encircles the plant area, locations were selected on the basis of general ground-water gradients. Average permeabilities of the formations monitored are presented in Table 2.4-24. Initial water level readings and intervals monitored are presented in Table 2.4-25.

Potentiometric surface maps of the water levels observed in the overburden glacial till, Graydon chert conglomerate, Bushberg and Upper Snyder Creek formations, and the Callaway and Upper Cotter-Jefferson City formations, based on data from December 1974 and January 1975, are shown on Figures 2.4-24 through 2.4-27. The piezometers required from 1 to 3 weeks to stabilize either after installation or after falling head permeameter tests were run. After reaching a static level, the water levels generally had greater fluctuations in the upper units down to and including the Bushberg Sandstone than in the underlying Callaway and Cotter-Jefferson City formations.

2.4.13.2.3.2.3 Hydraulic Gradients

Representative hydraulic gradients from potentiometric maps of formations are as follows.

	FORMATIONS	HYDRAULIC GRADIENT
a.	Overburden glacial till	90 to 100 feet per mile generally towards thenorth, south, and west.
b.	Graydon chert conglomerate	50 to 100 feet per mile generally towards the south, southwest, and west.
c.	Bushberg & Upper Snyder Creek formations	240 to 265 feet per mile toward the west and southwest.
d.	Callaway Formation	150 feet per mile toward the northwest; 130 feet per mile toward the southwest; and 50 feet per mile toward the south.
e.	Cotter-Jefferson City Formation	175 feet per mile toward the southeast.

2.4.13.2.3.2.4 Pumping Tests

Constant rate pumping tests were conducted in October 1973 in a test well located halfway between Piezometers P-1 and P-2 (Figure 2.4-29) at three horizons underlying the plant.

The first pumping test was conducted in a 10-inch diameter well at the base of the Bushberg Sandstone and top of the Snyder Creek Shale. The slotted interval was located in the Bushberg Sandstone from about 83 to 84 feet and in the upper Snyder Creek Shale from 84 to 86 feet. The test was terminated after 36 minutes with extremely low yields of 0.25 to 0.33 gpm. No drawdown occurred in the adjoining observation wells, P-1 and P-2, 150 feet away. The maximum transmissivity of this interval, based on drawdown and recovery data, was 36 gallons per day per foot, indicating a permeability of about 5.66×10^{-4} cm/sec.

The second pumping test was conducted in the lower Snyder Creek Shale and Callaway Formation in a fully penetrating, 8-inch diameter, open hole from 86 to 149 feet with all beds above and up to the surface cased and grouted. The final sustained yield was 0.36 gpm and the test was terminated after 84 minutes.

There was no change detected in water levels at the observation wells. The pumping and recovery tests showed an average transmissivity of 23.5 gallons per day per foot indicating an average permeability of about 8.8 x10^{-6} cm/sec.

The third pumping test was conducted in the Cotter-Jefferson City Formation. The test well was cased and grouted from 149 feet to the surface, and a 6-inch diameter hole was drilled into the Cotter-Jefferson City Formation to a total depth of 400 feet. At 337 feet, there was a marked increase in water from 0.5 to 5 gpm.

The hole was cleaned and pumped for 5 days at a constant discharge of 8.5 gpm during the test. Using the Cooper-Jacob (Cooper and Jacob, 1946) method as in the other test analysis of recorded data showed transmissivity of 86 gallons per foot per day. A discussion of the permeability for this interval is included above in Section 2.4.13.2.3.2.1.

After pumping was stopped, the water level rose under artesian pressure to 272 feet. The specific capacity of the 63 feet of saturated rock is 0.13 gpm per foot.

There are over 300 feet of low-permeability beds above the Cotter-Jefferson City Formation preventing any measurable water from the surface at the site from entering the regional Cotter-Jefferson City aquifer.

As a result of these pumping tests, the following is concluded:

a. Yields from the Snyder Creek Shale and the Callaway Formation are less than 1/2 gpm;

b. A weak hydraulic connection exists between the Graydon, Bushberg, Snyder Creek, and the Callaway; this hydraulic connection is believed to be attributable to extremely low flow through minor joints and fractures;

c. Yields from the Cotter-Jefferson City to a depth of 400 feet approach 10 gpm in a 6-inch well; and

d. The upper Cotter-Jefferson City serves as a confining zone which restricts water movement from the lower Cotter-Jefferson City, which contains the regional aquifer.

2.4.13.2.3.2.5 Ground-Water Quality

All aquifers yield water suitable for domestic and public water supply. Results of chemical analyses of well water drawn from selected locations listed in Table 2.4-26. Results of

chemical analyses of water from six preconstruction piezometers located in the Graydon chert conglomerate are given in Table 2.4-27. The permanent monitoring piezometers have been designed and installed in a manner such that water quality may be sampled as required.

2.4.13.3 Accident Effects

2.4.13.3.1 Introduction

Radioactive liquids from the plant are postulated to enter the ground water as a result of the accidental rupture of specific tanks containing liquid radwaste. The effects of this accidental contamination have been examined at the nearest groundwater discharge locations: streams and local wells.

The three tanks postulated to rupture will contain the highest curie inventory of the radioisotopes with relatively long half-lives that are of concern to human health: strontium 90 (Sr-90), cesium-137 (Cs-137), cobalt-60 (Co-60), and tritium (H-3). These tanks are as follows:

a. The spent resin storage tank (primary);

b. The boron recycle holdup tank (A or B); and

c. The refueling water storage tank.

The first two tanks are located in the radwaste building, while the refueling water storage tank is located between the radwaste building and the turbine-reactor complex. Highest curie contents for Sr-90, Cs-137, and Co-60 are expected in the spent resin storage tank (primary). The highest concentration of H-3 is expected in the boron recycle holdup tank (A or B), and the greatest curie content of H-3 is expected in the refueling water storage tank. In the accident analysis, we have postulated the ruptures of each of these three tanks have been postulated as separate, isolated events. Details of the tanks and their curie content for important radionuclides are given in Table 2.4-28.

Once a tank ruptures, the liquid contents are assumed to merge immediately with the ground water. To be conservative, the water table at the plant is assumed to be 5 feet below plant grade, at elevation 835 feet. The base of the spent resin storage tank and the boron recycle holdup tank is at elevation 812 feet, approximately at the contact of the glacial till layer with the underlying Graydon chert conglomerate. The liquid contents of each of these two tanks are postulated to flow down-gradient in the ground water within the Graydon chert conglomerate and possibly within the underlying Burlington and Bushberg Formations.

The base of the refueling water storage tank is at approximately elevation 835 feet. Therefore, the liquid radwaste from that tank would seep directly into the granular structural fill. The conservative assumption made in this analysis is that the contents of

this tank would percolate rapidly through the granular stuctural fill to the Graydon chert conglomerate, and would move down-gradient in that unit.

The nearest surface-water bodies that can be affected by accidental releases at the plant are a tributary to Mud Creek and a tributary to Logan Creek. Piezometric level data obtained at the site indicate that in the Graydon chert conglomerate the predominant direction of ground-water flow is approximately S80 W. However, there is some indication of a possible gradient on the northeast side of the plant site toward the northeast. As a result, it is conservatively assumed that contaminant transport in the ground water could occur in either direction. Flow toward the southwest is assumed to discharge at elevation 770 feet in one of the tributaries to Mud Creek at a point closest to the radwaste tanks (4,500 feet). Flow toward the northeast is assumed to discharge at elevation 770 feet into one of the tributaries to Logan Creek at a point closest to the radwaste tanks (4,400 feet).

The nearest down-gradient well is Well 23 (Figure 2.4-23), located approximately 8,700 feet S83°W from the radwaste tanks. In the analysis, the ground-water flow path is assumed to extend directly from the tanks to the well.

The results of the analysis show that, with the exception of H-3 and Sr-90 concentrations, ground water contaminated by accidental radioactive releases at the plant site will have radionuclide concentrations below the maximum permissible concentrations (MPC) of 10 CFR 20, Appendix B, for unrestricted areas by the time the contaminated ground water reaches the nearest stream tributaries. The dilution capability of these streams is shown to reduce the concentration of these two radionuclides to below the MPC limits before their confluences with the respective main streams. Computed concentrations at Well 23 were below the MPC limits for unrestricted areas. The effects of hydrodynamic dispersion, fluid convection, and radionuclide decay were included in the analysis. In addition, for the cases of Sr, Co, and Cs, cation exchange hold-back was included.

2.4.13.3.2 Description of Analytical Model

In the case of a slug of solution containing radionuclides which is introduced instantaneously into the ground-water system in an infinitesimally small volume, the following equation is applicable (Baetsle and Souffriau, 1967):

$$\frac{c}{m} = \frac{1/n}{(4\pi D't)^{3/2}} \exp - \frac{(x - u_x't)^2}{4D't} + \frac{(y - u_y't)^2}{4D't} + \frac{(z - u_z't)^2}{4D't} + \lambda t \qquad (2.4\text{-}7)$$

where:

c = Quantity of radionuclide cation per milliliter of interstitial solution, at any time, t, and at any point x, y, z (microcuries);

m = Total quantity of radionuclide introduced with the slug (microcuries);

n = Total porosity of the aquifer (dimensionless);

t = Time since introduction of the slug (days);

x = Distance from point of injection in direction of ground-water flow (centimeters);

y = Distance laterally, perpendicular to ground-water flow (centimeters);

z = Distance vertically, from center of slug (centimeters);

λ = Decay coefficient = $0.693/T_{1/2}$, where $T_{1/2}$ is the radionuclide half-life, in days;

u_x', u_y', u_z' = Average velocities of the radionuclide in the x, y, and z directions, respectively (centimeters per day);

For example, $u_x' = u_x R_f'$

where:

u_x = Average velocity of water in the pores (cm/day);

R_f = The reduction factor due to cation exchange.

$$= \frac{1}{1 + \frac{(\rho b)}{n} \frac{(Q)}{C_{Ca}} E} \quad \text{(Kaufman, 1973);}$$

where:

ρ_b = Bulk density of the aquifer (grams per milli-liter);

Q = Concentration of calcium adsorbed on the exchange complex of the aquifer material (milliequivalents per gram) (closely approximated by the cation exchange capacity, for cases where the radio-nuclide concentration is low relative to the cation concentration of the native ground water);

C_{Ca} = Total concentration of dissolved native cations in the ground water at equilibrium (milliequivalents per milliliter), assumed conservatively to consist entirely of calcium;

E = Equilibrium exchange constant for exchange process for the radionuclide displacing calcium on the exchange complex;

D' = Reduced dispersion coefficient

λ = DR (Lai and Jurinak, 1972),

where: D is the average dispersion coefficient

$$= (D_x \, D_y \, D_z)$$

and where D_x , D_y, and D_z are the dispersion coefficients valid for the x, y, and z directions, respectively.

By integrating Equation (2.4-7) over the dimensions x_o, y_o,and z_o, of a slug of finite prismatic volume, we obtain Equation (2.4-8), the analytical model used in this analysis:

$$c = \frac{m}{8nx_oy_oz_o}\text{erf}\left[\left(\frac{x + \frac{x_o}{2} - u_x't}{\sqrt{4Dx'^t}}\right) - \text{erf}\left(\frac{x - \frac{x_o}{2} - u_x't}{\sqrt{4Dx'^t}}\right)\right]$$

$$\text{erf}\left[\left(\frac{y + \frac{y_o}{2}}{\sqrt{4Dy'^t}}\right) - \text{erf}\left(\frac{\frac{y_o}{2}}{\sqrt{4Dy'^t}}\right)\right]$$

$$\text{erf}\left[\left(\frac{z + \frac{z_o}{2}}{\sqrt{4Dz'^t}}\right) - \text{erf}\left(\frac{z - \frac{z_o}{2}}{\sqrt{4Dz'^t}}\right)\right]$$

$$\exp[(-\lambda t)]$$

where:

$x_{o'}$ $y_{o'}$ $z_{o'}$ = The dimensions of the slug in the soil at time 0, along the respective axes, and D_x'=D_xR_f, D_y'=D_zR_f. The Equation (2.4-8) parameters are as defined for Equation (2.4-7) above. Equation (2.4-8) was derived under the assumption that u_y=u_z=0.

The analyses performed used a certified computer program (SLUG3D), which solves Equation (2.4-8), with several different output options.

2.4.13.3.3 Selection of Model Parameters

A summary of the discharge points, flow paths, and parameter values selected for the model simulations is provided in Table 2.4-29.

2.4.13.3.3.1 Average Hydraulic Gradient (i)

To be conservative, the piezometric level in the Graydon chert conglomerate at the plant was assumed to be just 5 feet below plant grade at elevation 835 feet. The ground-water elevation assumed at the discharge points (stream or well) was 770.0 feet. Thus, for example, the average gradient (i) from the radwaste building to the discharge point on the Mud Creek tributary was computed as follows:

$$i = \frac{835 - 770}{4,500} = 0.144$$

where 4,500 feet is the shortest distance from the radwaste building to the discharge point on the Mud Creek tributary.

2.4.13.3.3.2 Horizontal Permeability (K_h)

Of the three geologic units in which flow could occur -- the Graydon chert conglomerate, the Burlington Limestone, and the Bushberg Sandstone -- the Bushberg Sandstone has the highest measured permeability, 6.0×10^{-4} cm/sec (see Section 2.4.13.1.1.2). As discussed in Section 2.4.13.3.1, there is a possibility that accidentally introduced liquid radwaste could migrate below the Graydon chert conglomerate and the Burlington Limestone into the Bushberg Sandstone, and flow laterally, at least in part, in the latter unit. For this reason, and to be conservative, the value of 6.0×10^{-4} cm/sec (approximately 52 cm/day) was used for the average coefficient of horizontal permeability.

2.4.13.3.3.3 Porosity

Total porosity (n) was estimated on the basis of bulk density measurements on samples of Graydon chert conglomerate obtained at the site. The highest value for density (providing the lowest computed porosity) was found to be 2.31 g/cm . Total porosity (n) was computed from Equation (2.4-9).

$$n = 1 - \rho_b / \rho_s \qquad (2.4\text{-}9)$$

where:

ρ_b is the bulk density and ρ_s is the specific gravity of the solids, assumed to be 2.7 g/cm^3.

The result was a computed total porosity of 0.15.

Effective porosity (n_e) was estimated to be 80 percent of total porosity. Thus, n_e was assumed to be 0.12. This is the value used to compute u_x in Equation (2.4-8), in which

$$u_x = \frac{K_h i}{n_e} \tag{2.4-10}$$

2.4.13.3.3.4 Dispersion Coefficients (D)

The dispersion coefficient in the direction of flow (D) was estimated using the approximate equation given by Fried and Combarnous (1971):

$$D_x = \left[0.67 + 0.5\left(\frac{u_x d_{50}}{D_m}\right)\right] D_m \tag{2.4-11}$$

where:

d_{50} = the median grain size; and

D_m = the molecular diffusion coefficient in water, 0.864 cm^2/day.

For the Graydon chert conglomerate, the geometric mean value for d_{50}, based on determinations on seven samples, was 0.0058 cm.

For the flow paths to the Mud Creek and Logan Creek tributaries, D_x was computed to be 0.59 cm^2/day. For the flow path to Well 23, D_x was computed to be 0.58 cm^2/day.

Based on Figure 7 of Lenda and Zuber (1970), the ratio of D_x / D_y was estimated to be 1.0 in each case. Thus, $D_y = D_x$.

The value for D_z was set arbitrarily low, 1.0×10^{-6} cm^2/day, to ensure that no dispersion would occur vertically beyond the upper or lower boundaries of the water-table aquifer.

2.4.13.3.3.5 Cation Concentration (C_{Ca})

Ground-water quality data for the site area are provided in Table 2.4-27. To be conservative, the highest cation concentration values were selected, because the value of R_f increases as C_{Ca} increases.

CATION	MAXIMUM VALUE (mg/l)	MAXIMUM VALUE (meq/ml)
Ca	90	0.0045
Mg	26.2	0.0022
K	16.4	0.0004
Na	135	0.0059
	Total	0.0130

It is a conservative simplification to assume that calcium is the only native cation in the soil exchange complex with which injected strontium, cesium, and cobalt cations would have to compete. The concentration term (C_{Ca}) in the reduction factor (R_f) refers to the equilibrium concentration of calcium in the interstitial fluid. Thus, C_{Ca} was set equal to 0.013 meq/ml.

2.4.13.3.3.6 Cation Exchange Capacity (Q)

Clay minerals are present in the Graydon chert conglomerate, the Burlington Limestone, and the Bushberg Sandstone. The approximate composition of the clay minerals from six samples of the Graydon chert conglomerate is about 34 percent kaolinite and 66 percent illite (Table 2.5-34). Clay minerals from three samples of the Burlington Limestone had average compositions of about 26 percent kaolinite, about 66 percent illite, and one other expansive clay mineral (Table 2.5-34). The clay composition of the Bushberg Sandstone is considered to be lower in illite than the overlying formations and, to be conservative, is assumed to be about 80 percent kaolinite and about 20 percent illite.

Clay minerals make up about 20 to 60 percent of the nonchert fraction of the Graydon chert conglomerate (Section 2.4.12). About 15 to 20 percent of the Burlington Limestone is filled with clay zones that are the result of weathering. The clay content of the Bushberg Sandstone ranges from about 10 to 20 percent based on visual estimates of cores.

As the radionuclide concentration at the discharge points increases as Q decreases, it is assumed conservatively that only 10 percent of the unit in which ground-water flow will occur is composed of clay minerals. This is the most conservative case that would result if all the flow were restricted to the Bushberg Sandstone. It is further assumed,

conservatively, that the clay of the entire unit consists of 80 percent kaolinite and 20 percent illite.

Grim (1953) states that the range of cation-exchange capacities for the two clay minerals are:

a. Illite, 10 to 40 milliequivalents per 100 grams; and

b. Kaolinite, 3 to 15 milliequivalents per 100 grams.

To be conservative, the lowest exchange capacity for each mineral is assumed. Using the bulk percentage of each mineral results in cation-exchange capacities for illite and kaolinite of 0.0020 and 0.0024 milliequivalents per gram of formation material, respectively. Therefore, the total assumed cationexchange capacity of the entire unit is very conservatively selected as 0.0044 milliequivalents per gram.

2.4.13.3.3.7 Equilibrium Exchange Constants (E)

The equilibrium exchange constant for strontium (E_{Sr}-$_{Ca}$) was estimated on the basis of experimental data for illite and kaolinite provided by Heald (1960). The weighted average value for E_{Sr}-$_{Ca}$ was 1.00.

To estimate the exchange constants for cobalt and cesium, data on distribution coefficients (k_d) for cobalt and cesium, as well as strontium, were analyzed and compared. The data was derived from experimental investigations reported by Parker, et al. (1960), Tamura (1972), and Webster (1975). For each clay mineral (kaolinite and illite), k_d values were calculated from data obtained under similar experimental conditions. Then, weighted k_d values for each isotope were obtained on the basis of the proportion of the clay minerals, that was assumed in the previous section for the entire water-bearing unit. The resulting estimated k_d values for the unit are as follows:

a. k_d (Sr) = 3,241;

b. k_d (Cs) = 7,153; and

c. k_d (Co) = 3,760.

Considering that the materials and conditions of the experiments from which these values are derived were essentially the same, it is reasonable to estimate the exchange constants for Cs and Co using E_{Sr}-$_{Ca}$ as the standard, on the assumption that E is linearly proportional to k_d. Therefore:

$$E_{Cs-Ca} \sim \frac{7,153}{3,241}(1.00) = 2.21$$

and

$$E_{Co-Ca} \sim \frac{3,760}{3,241}(1.00) = 1.16$$

2.4.13.3.3.8 Dimensions of Slug (V_o)

The volume (V_o) occupied by the slug in the soil at time t=0 will be approximately

$$V_o = \frac{\text{Volume of Liquid Contents}}{n}$$

For example, for the boron recycle holdup tank, the volume of liquid contents equals $1.69x10^{-8}$ ml. Thus

$$V_o = \frac{1.696X10^8}{0.15} = 1.131x10^9 ml$$

For a cuboid slug, $x_o = y_o = z_o$; hence

$$x_o = y_o = z_o = (1.131x10^9)^{1/3} = 1,042 \text{ cm}$$

In a similar manner, the $x_o = y_o = z_o$ dimensions for the cuboid slug from the spent resin storage tank (primary) were calculated to be 375.3 cm.

Because of the large size of the refueling water storage tank, it was not reasonable to select a cuboid slug, that would have resulted in a z_o (vertical dimension of the slug in the soil) of 2,160 cm (71 feet) greater than the thickness of the Graydon-Burlington-Bushberg unit at the plant. Therefore, z_o was taken as 1,219 cm (40 feet), the approximate saturate thickness of the unit. This resulted in an x (=y_o) of 2,676 cm.

2.4.13.4 Results of Analysis

The results of the model simulations are presented in Tables 2.4-30 and 2.4-31. Peak concentrations at the discharge points and the times to attain these concentrations are provided for each important radionuclide. Cation exchange (E greater than 0) was included in the simulations only for Sr-90, Cs-173, and Co-60.

A peak H-3 concentration of 0.12 μCi/ml and 0.086 μCi/ml was computed for ground water discharging to the Mud Creek tributary as a result of the rupture of the boron recycle holdup tank (A or B) and therefueling water storage tank, respectively. The corresponding peak H-3 concentrations for ground water discharging to the Logan Creek

tributary were 0.14 and 0.10 μCi/ml from the boron recycle holdup tank and the refueling water storage tank, respectively.

Peak Sr-90 concentrations resulting from the postulated rupture of the spent resin storage tank (primary) were computed to be 3.6x10-5 and 5.4x10-5 μCi/ml, at the Mud Creek tributary and the Logan Creek tributary, respectively.

Table 2.4-31 shows that the peak H-3 and Sr-90 concentrations computed at Well 23 are more than two orders of magnitude lower than the MPC limits for unrestricted areas.

Significant dilution is expected to occur in the Mud Creek and Logan Creek tributaries during periods when contamination from ground water will occur. When the water table is sufficiently low as to not permit ground-water discharge into the streams, no contamination of the streams or streambeds can occur. When the streams are flowing, dilution is sufficient to reduce the peak H-3 and Sr-90 concentrations from ground water in the streams below the limits for unrestricted areas. The results of calculations of dilutions that could occur in the two tributaries are provided in Table 2.4-32.

A description of the dilution calculation method is given here, using the H-3 concentration in the Mud Creek tributary as an example. Model runs on Program SLUG3D showed that at the time of the peak point concentrations of H-3, resulting from the rupture of the refueling water storage tank, the <u>average</u> H-3 concentration of ground water entering the Mud Creek tributary would be approximately 4.7×10^{-2} μCi/ml over a reach of 177 feet, the width of the plume. It was assumed that the average ground-water discharge into the Mud Creek tributary is uniform per unit length of an arbitrary curvilinear line drawn roughly west to east and connecting the upstream ends of the valleys contributing on the northeast to Mud Creek. The length of this line is 9,300 feet, compared to the plume width of 177 feet. Thus, the dilution ratio for this group of tributaries is estimated to be 9,300/177, or 52.5. And by the time the waters with the peak H-3 concentration would reach a chosen confluence point in Mud Creek (approximately 11,500 feet S35°W of the center of the plant), the expected H-3 concentration would be only $4.7 \times 10^{-2}/52.5$, or 8.9×10^{-4} μCi/ml.

Similar calculations were performed for the peak concentration of H-3 in the Logan Creek tributary and for peak Sr-90 concentrations in both the Mud Creek and Logan Creek tributaries. The details of these calculations are summarized in Table 2.4-32.

2.4.13.5 <u>Design Bases for Subsurface Hydrostatic Loadings</u>

Piezometer readings indicate that the normal water table will range from 10 to 30 feet below the ground surface at the plant site depending on the topography and local hydraulic gradient (Figure 2.4-19). There will be some natural fluctuation in the ground water levels due to climatic conditions. At the plant site, the ground water surface is in the glacial deposits overlying the Graydon chert conglomerate.

Design for full hydrostatic loading should include all substructures below elevation 840 feet. Granular fill and backfill surrounds and underlies the plant substructures. The highly permeable granular fill and backfill could become saturated with water to an elevation of about 840 feet due to infiltration from surface runoff. As the fill and backfill is much more permeable than the surrounding clays and Graydon chert conglomerate, the fill will act as an artificial sump. Ground water in the sump at an elevation above the natural hydraulic gradient will slowly drain into the natural ground water to reestablish the hydraulic gradient over extremely long periods of time, as discussed in Section 2.4.13.3.

No wells are proposed for safety-related structures.

Due to the very low permeabilities of the earth materials excavated, no special dewatering techniques were required.

No permanent underdrain or ground water dewatering systems are installed or planned at the site.

2.4.14 TECHNICAL SPECIFICATION AND EMERGENCY OPERATION REQUIREMENTS

There are no Technical Specifications nor Emergency Procedures required for plant shutdown to minimize the consequences of an accident resulting from hydrologic phenomena such as floods. The site drainage system provides adequate drainage capacity to prevent flooding of safety-related facilities.

REFERENCES - SECTION 2.4

Published References

American Meteorological Society, 1959, Glossary of meteorology.

_____, 1962, Extremes of snowfall in the United States. American Meteorological Society, Weatherwise, vol. 1, no. 6, p. 246-292 (December).

American National Standards Institute, 1972, Building code requirements for minimum design loads in building and other structures. American National Standards Institute, AS 58-1.

Baetsle, L.H., and Souffriau, J., 1967, Installation of chemical barriers in aquifers and their significance in accidental contamination, in Disposal of radioactive wastes into the ground. Proceedings of a Symposium, May 29 - June 2, 1967, International Atomic Energy Agency, Vienna.

Bennett, Iven, 1959, Glaze -- its meteorology and climatology, geographical distribution and economic effect. U.S. Army Headquarters, Quartermaster's Research and Engineering Command, Natick, Massachusetts, Technical Report ER-105.

Bowie, J.E. and Petri, L.R., 1969, Travel of solutes in the lower Missouri River. Hydrologic Investigations Atlas HA-332.

Brater, E.F. and King, H.W., 1976, Handbook of hydraulics. McGraw-Hill, Inc., New York.

Carstens, T., 1970, Heat exchanges and frazil formation. International Association of Hydraulics Research Symposium, Reykjavik-Iceland, September.

Chow, Ven Te, 1959, Open channel hydraulics. McGraw Hill, Inc., New York.

_____, 1964, editor, Handbook of applied hydrology. McGraw-Hill, Inc., New York.

Cooper, H.H., Jr., and Jacob, C.E., 1946, A generalized graphical method for evaluating formation constants and summarizing well field history. Trans. American Geophysical Union, Washington, D.C., vol. 27, no. 4, p. 526-534.

Coordinating Committee on Missouri River Main Stem Reservoir Operations, 1973, Missouri River main stem reservoirs. 1973-74 annual operating plan.

Dames & Moore, 1979, Certified computer programs DISPERN and DISPLOT.

East-West Gateway Coordinating Council, 1978, Water quality management plan, St. Louis, Missouri.

Environmental Health Services, 1971, 1972, 1977, Census of public water supplies in Missouri. Division of Health, Section of Environmental Health Services, Jefferson City, Missouri.

REFERENCES - SECTION 2.4 (Continued)

Environmental Health Services, Division of Health Records, Jefferson City, Missouri, Unpublished. Compiled October, 1973, and April, 1978.

Fischer, Hugo B., 1968, Dispersion predictions in natural streams. Journal of the Sanitary Engineering Division.

_____, 1969, The effects of bends on dispersion in streams. Water Resources Research vol. 5, no. 2, p. 496-506.

Fried, J.J., and Combarnous, M.A., 1971, Dispersion in porous media, in Advances in hydroscience. Ven Te Chow, ed., Academic Press.

Fuller, D.L., Knight, R.D., and Harvey, E.J., 1967, Ground water, in Mineral and water resources of Missouri. United States Geological Survey, Missouri Division of Geological Survey and Water Resources, Rolla, Missouri, Document no. 19, vol. XLII, 2nd series, p. 281-313.

Grim, R.E., 1953, Clay mineralogy. McGraw-Hill Book Company, New York.

Gumble, E., 1954, Statistical theory of extreme value and some practical applications. National Bureau of Standards, Applied Mathematical Series no. 33.

Harleman, D.R.F. and Stolzenbach, K.D., 1967, A model study of thermal stratification produced by condenser water discharge. M.I.T., October.

Heald, W.R., 1960, Characterization of exchange reactions of strontion or calcium on four clays. Soil Science Society of American Proceedings, p. 103-106.

Henderson, F.M, 1966, Open channel flow. McMillan, New York.

Ippen, A., ed., 1966, Estuarine and coastal hydrodynamics. McGraw-Hill, New York.

Kaufman, W.J., 1973, Notes on radionuclide pollution of ground waters. Water Resources Engineering Series, University of California, Berkeley.

Knight, R.D., 1962, Map of the groundwater areas of Missouri. Missouri Division of Geological Survey and Water Resources, Rolla, Missouri.

Lai, S., and Jurinak, J.J., 1972, The transport of cations in soil columns at different pore velocities. Soil Science Society of America Proceedings, vol. 36, p. 730-733.

Lenda, A. and Zuber, A., 1970, Tracer dispersion in groundwater experiments. Isotope Hydrology 1970, International Atomic Energy Agency, Vienna, p. 619-641.

Linsley, Kohler, and Paulhus, 1949, Applied hydrology. McGraw-Hill, Inc., New York.

Linsley, R.K., et al., 1958, Hydrology for engineers. McGraw-Hill, New York.

REFERENCES - SECTION 2.4 (Continued)

Meramec Regional Planning Commission, 1972, Water and sewer plan, 1972-1992, Rolla, Missouri.

Merritt, Frederick A., 1968, editor, Standard handbook for civil engineers. McGraw-Hill, New York.

Michel, B., 1970, Ice pressure on engineering structures. Cold Regions Science and Engineering, Monography III-B16, U.S. Army Corps of Engineers.

Mid-Missouri Regional Planning Commission, 1972, Regional water and sewer plan, Jefferson City, Missouri.

Missouri Basin Inter-Agency Committee, 1969, The Missouri River basin comprehensive framework study. U.S. Government Printing Office, Washington, D.C., vol. 5 (June; published in December 1971).

Missouri, Department of Natural Resources, 1969-1978, County water use reports. Unpublished.

Missouri Geological Survey and Water Resources, unpublished, Well logs for Callaway County, Missouri.

Muller, A., 1978, Frazil ice formation in turbulent flow. Institute of Hydraulic Research, University of Iowa, Report No. 214, June.

Paily, P.P., et al. 1974, Winter regime surface heat loss from heated streams. Institute of Hydraulic Research, Report No. 155, University of Iowa, March.

Parker, F.L., et al., 1960, Clinch River studies. Health Physics Division, Annual progress report for the period ending July 31, 1960, Oak Ridge National Laboratory, ORNL-2994, p. 45-57.

Ryan, P.J. and Harleman, D.R.F., 1973. An analytical and experimental study of transient cooling pond behavior. Ralph M. Parsons Laboratory for Water Resources and Hydrodynamics, Report No. 161., January.

Sayre, W.W. and Yeh, T.P., 1973, Transverse mixing characteristics of the Missouri River downstream from the Cooper Nuclear Station. University of Iowa, Iowa Institute of Hydraulic Research, Report No. 145, Iowa City, Iowa.

Schlichting, H., 1968, Boundary layer theory. McGraw Hill, Inc., New York.

Skelton, J., 1966, Low flow characteristics of Missouri streams, in Water resources report 20. U.S. Geological Survey Water Resources Division and Missouri Geological Survey and Water Resources.

REFERENCES - SECTION 2.4 (Continued)

_____, 1976, Missouri stream and springflow characteristics, low-flow frequency and flow duration. Water Resources Report No. 32, U.S. Geological Survey, Water Resources Division and Missouri Geological Survey and Water Resources

Stoker, J.J., 1957, Water waves. Wiley-Interscience, New York.

Tamura, T., 1972, Sorption phenomena significant in radioactive-waste disposal, in Underground waste management and environmental implications. Proceedings of the Symposium held December 6-9, 1973, Memoir 18, AAPG.

Thom, H.C.S., 1966, Distribution of maximum annual water equivalent of snow on the ground. Monthly Weather Review, vol. 94, no. 4, p. 265-271 (April).

_____, 1968, New distribution of extreme winds in the United States, in Journal of structural division. Proceedings of the American Society of Civil Engineers, vol. 94, no. st. 7 (July).

_____, 1969, Design snow loads for the contiguous United States. National Weather Records Center, Asheville, North Carolina, unpublished paper.

Unklesbay, A.G., 1955, The geology of the Fulton Quadrangle, Missouri. Missouri Division of Geological Survey and Water Resources, Rolla, Missouri, Report of Investigation, no. 19.

U.S. Army Corps of Engineers, unpublished, Open file material, Department of Army Permits for the Missouri River, Jefferson City, Missouri.

_____, 1965a, Engineering and design standard project flood determinations, EM-1110-2-1411, Revised March.

_____, 1965b, Review report (interim) on flood protection to agricultural areas, Mississippi River, mile 195 to mile 300 above Ohio River, appendix, in Hydrology and hydraulics, St. Louis District.

_____, 1966a, Shore protection planning and design, in Technical report no. 4. Coastal Engineering Research Center.

_____, 1966b, Computation of freeboard allowances for waves in reservoirs, in Engineering technical letter no. 1110-2-8 (August).

_____, 1970, Upper Mississippi River comprehensive basin study. UMRCBS Coordinating Committee, North Central Division.

_____, 1971a, Water resources development by the U.S. Army Corps of Engineers in Missouri. Missouri River Division, Omaha, Nebraska (January).

_____, 1971b, Earth and rockfill dams. EM-1110-2-2300.

REFERENCES - SECTION 2.4 (Continued)

_____, 1973, Shore protection manual. U.S. Army Coastal Engineering Center.

_____, 1978, 1977 Missouri River hydrograph survey, Rulo, Nebraska, to the mouth. Kansas City District.

_____, 1978, 1978 project maps, part 1, river and harbor projects. Kansas City District.

U.S. Bureau of Reclamation, 1973, Design of small dams.

U.S. Dept. of Commerce, 1949-1978, Climatological data, Missouri. U.S. Weather Bureau, vol. 53, no. 1 through vol. 77, no. 12.

U.S. Department of Commerce, 1979, Local climatological data, annual summaries for 1979. National Oceanic and Atmospheric Administration, Asheville, North Carolina.

U.S. Environmental Protection Agency, unpublished, 1976 survey of needs for municipal wastewater facilities. Washington, D.C.

U.S. Geological Survey, 1938, Drought of 1936, in Water-supply paper 820.

_____, 1964, Compilation of records of surface waters of the United States, October 1950 to September 1960, part 6-B. Missouri River basin below Sioux City, Iowa. Water Supply Paper 1730.

____, 1968, Magnitude and frequency of floods in the United States, part 6-B. Missouri River basin below Sioux City, Iowa. Water Supply Paper 1680.

_____, 1972, Surface water supply of the United States, 1966-1970, part 6, Missouri River Basin, vol. 6, Missouri River Basin below Nebraska City, Nebraska, in Water-supply paper 2119. Department of the Interior, U.S. Geological Survey, Washington, D.C.

_____, 1973, Water resources data for Missouri, water year 1973.

_____, 1978, Water resources data for Missouri, water year 1977.

U.S. Nuclear Regulatory Commission, 1976, Regulatory guide 1.102, Revision 1, flood protection for nuclear power plants.

_____, 1977, Regulatory guide 1.113, Revision 1, estimating aquatic dispersion of effluents from accidental and routine reactor releases for the purpose of implementing Appendix I.

_____, 1978, Regulatory guide 1.70, Revision 3, standard format and content of safety-analysis reports for nuclear power plants.

U.S. Weather Bureau, 1949-1978, Climatological data, Missouri.

REFERENCES - SECTION 2.4 (Continued)

U.S. Dept. of Commerce, vol. 53, no. 1 through vol. 77, no. 12.

U.S. Weather Bureau, 1954-1974, Local climatologial data, Columbia, Missouri. U.S. Department of Commerce.

_____, 1956, Seasonal variation of the probable maximum precipitation east of the 105th Meridian for areas from 10 to 1,000 square miles and durations of 6, 12, 24, and 48 hours. U.S. Department of Commerce, Washington, D.C., Hydrometerological Report No. 33 (April.

_____, 1963, Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years. U.S. Department of Commerce, Technical Paper no. 40.

_____, no date, Rainfall intensity-duration frequency curves. U.S. Department of Commerce, Technical Paper no. 25.

Uzuner, M.S. and Kennedy, J.F., 1972, Stability of floating ice blocks. Proceeding of ASCE Hydraulics Division, December, p. 2117-2133.

Water Resources Council Hydrology Committee, 1967, A uniform technique for determining flood flow frequencies. Water Resources Council, Bulletin no. 15 (December).

Webster, D.A., 1975, Draft of preliminary report. A review of the burial grounds and related hydrology at Oak Ridge National Laboratory, Tennessee. USGS.

Williams, G.P., 1959, Frazil ice - A review of its properties with a selected bibliography. The Engineering Journal, November.

Wright-McLaughlin Engineers, 1969, Urban storm drainage criteria manual, volume 1. Urban Drainage and Flood Control District, Denver, Colorado.

Yotsukura, M., Fischer, H.B., and Sayre, W.W., 1970, Measurement of mixing characteristics of the Missouri River between Sioux City, Iowa, and Plattsmouth, Nebraska.

U.S. Geological Survey, Water Supply Paper 1899-G. Yotsukura, M. and Sayre, W.W., 1976, Transverse mixing in natural channels. Water Resources Research vol. 12, no. 4 (August).

<u>Personal Communications</u>

Claire, Maurice, 1974, Corps of Engineers, Reservoir Control Center, Missouri River Division, Department of the Army, personal communication (January 3).

REFERENCES - SECTION 2.4 (Continued)

Duscha, Lloyd A., 1974, Chief, Corps of Engineers, Engineering Division of Missouri River Division, Department of the Army, Omaha, Nebraska, written communication (January 17).

Fuller, D.L., 1973, Hydrogeologist, Missouri Division of Geological Survey and Water Resources, personal communication (August)

Hahn, D.W., 1973, Water engineer, Columbia Water and Light Department, Columbia, Missouri, personal communication (October 25).

Harvey, N., 1973, Head, Water Resources Division, U.S. Geological Survey, Rolla, Missouri, personal communication (October 25).

Homyk, Anthony, 1973, U.S. Geological Survey, Water Resources Division, Rolla, Missouri, personal communication (December).

Huff, B., 1979, Plant Manager, Chamois Power Plant, Central Electric Power Coop, personal communication (April 7).

Jones, T., 1978, Missouri Department of Natural Resources, personal communication (May).

Knight, R.D., 1973, Hydrogeologist, Missouri Division of Geological Survey and Water Resources, personal communication.

Michael, C.P., 1979, Resource Planner, Missouri Department of Natural Resources, personal communication.

Miller, D., 1973, Hydrogeologist, Missouri Division of Geological Survey and Water Resources, personal communication (August).

National Weather Service, U.S. Department of Commerce, Columbia, Missouri, 1974. David Horner, meteorolgist, personal communication (March 15).

Pearce, Robert, 1973, U.S. Army Corps of Engineers, Kansas City District, personal communication (August).

Toffon, E. 1973, Owner, Lost Canyon Lake, personal communication (August).

_____, 1974, personal communication (January 17).

_____, 1979, personal communications.

U.S. Army Corps of Engineers, 1973, Kansas City District, personal communication.

U.S. Army Corps of Engineers, 1979, St. Louis District, personal communication.

U.S. Geological Survey, 1979, personal communication.

TABLE 2.4-1 FOUR TRIBUTARY STREAM SYSTEMS OF THE MISSOURI RIVER NEAR THE CALLAWAY PLANT SITE

STREAM SYSTEM	APPROXIMATE DRAINAGE AREA (sq mi)	CONFLUENCE POINT WITH THE MISSOURI RIVER (river mile)
Logan Creek	16.7	114.7
Auxvasse Creek	317	120.5
Gasconade River	3,500	104.5
Osage River	14,900	129.9

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TABLE 2.4-2 MISSOURI RIVER DRAINAGE BASIN

LOCATION	APPROXIMATE DRAINAGE AREA (sq mi)	MISSOURI RIVER MILE
At Mouth	529,000	0
At Hermann	528,200	97.9
Near Callaway Plant Site	523,200	115.0
At Boonville	505,700	197.1

TABLE 2.4-3 MISSOURI RIVER AND ALLUVIUM WATER SUPPLIES[a]

MAP KEY[b]	MISSOURI RIVER MILE	FACILITY	SOURCE	PLANT CAPACITY (MGD)	AVERAGE CONSUMPTION (MGD)
S1	20.5	St. Louis Co.	Missouri River	76.0	22.974
S1	29.0	St. Charles City	Missouri River	NA	0.442
S3	29.0	St. Charles City	3 Alluvial Wells	6.0	4.203
S4	33.0	St. Charles Co.	3 Alluvial Wells	2.0	0.466
S5	36.0	St. Louis Co.	Missouri River	125.0	90.71
S6	36.8	St. Louis City	Missouri River	120.0	58.4
S7	43.0	St. Charles Co.	2 Alluvial Wells	0.72	0.178
S8	55.0	St. Charles Co. (Weldon Springs)	5 Alluvial Wells	22.5	0.020
S9	58.1	Union Electric Company	Missouri River	NA	991.13
S10	61.4	Clarence Patke (Irrigation)	Missouri River	NA	NA
S11	64.5	D & G Struckhoff (Irrigation)	Missouri River	NA	NA
S12	117.1	Central Electric Power Coop.	1 Alluvial Well and Missouri River	NA	72.0
S13	140.0	(Unknown) (Irrigation)	1 Alluvial Well	NA	NA
S14	144.0	Jefferson City	Missouri River	6.5	4.25
S15	155.0	City of Hartsburg	3 Alluvial Wells	c	c

TABLE 2.4-3 (Continued) (Sheet 2 of 2)

MAP KEY[b]	MISSOURI RIVER MILE	FACILITY	SOURCE	PLANT CAPACITY (MGD)	AVERAGE CONSUMPTION (MGD)
S16	171.0	City of Columbia	7 Alluvial Wells	16.000	7.36
S17	197.0	City of New Franklin	2 Alluvial Wells	0.144	0.072
S18	197.1	City of Boonville	Missouri River	1.73	0.992
S19	225.6	Robert Reich (Irrigation)	Missouri River	NA	NA
S20	226.7	City of Glasgow	Missouri River	0.576	0.240

Source: Huff, 1979; Meramec Regional Planning Commission, 1972; Missouri DNR, 1977; Michael, 1979; Missouri Geological Survey and Water Resources unpublished; US Army Corps of Engineers, unpublished; US Environmental Protection Agency unpublished; and Mid-Missouri Regional Planning Commission, 1972.

Note: NA = No information available.

a From the mouth to river mile 226.7. Discharge of Callaway site is located at river mile 115.4.

b See Figures 2.1-35 and 2.1-36 for locations.

c See Table 2.1-29, Boone Co. Conservation Public Water Supply No. 01.

TABLE 2.4-4 MISSOURI RIVER DISCHARGES[a]

MAP KEY[b]	MISSOURI RIVER MILE	FACILITY	DESIGN DISCHARGE (MGD)	AVERAGE DISCHARGE (MGD)
D1	7.0	Metropolitan Sanitation District (MSD) Earth City	1.0	NA
D2	7.0	MSD, Lagoon	1.0	NA
D3	20.5	MSD, Fee Fee Sewage Treatment Plant	10.0	NA
D4	26.0	City of St. Charles	5.5	2.0
D5	33.0	St. Charles Co. (Duckett Creek)	0.61	NA
D6	57.9	Union Electric Company	NA	991.13
D7	66.0	City of Washington	1.8	NA
D8	82.0	City of New Haven	0.164	0.15
D9	97.0	City of Hermann	0.350	NA
D10	117.1	Central Electric Power Coop.	NA	72.0
D11	142.0	Jefferson City	6.2	6.1
D12	196.0	City of Boonville	1.9	NA

TABLE 2.4-4 (Continued) (Sheet 2 of 2)

MAP KEY[b]	MISSOURI RIVER MILE	FACILITY	DESIGN DISCHARGE (MGD)	AVERAGE DISCHARGE (MGD)
D13	226.0	City of Glasgow	0.238	NA

Source: East-West Gateway Coordinating Council, 1978; Huff, 1979; Meramec Regional Planning Commission, 1972; Mid-Missouri Regional Planning Commission, 1972; Michael, 1979; Jones, 1978; Missouri Geological Survey and Water Resources, unpublished; U.S. Army Corps of Engineers unpublished; U.S. Environmental Protection Agency unpublished.

Note: NA = No information available.

a From the mouth to river mile 226.

b See Figures 2.1-35 and 2.1-36 for locations.

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TABLE 2.4-5 MAJOR RECORDED FLOODS AT HERMANN, MISSOURI

DATE OF OCCURRENCE	DISCHARGE (cfs)	GAGE READING (feet)	STAGE ABOVE MSL[a] (feet)
June 1844	892,000[b]	35.5	517.1
June 6-7, 1903	676,000[b]	29.5	511.1
May 21, 1943	550,000	31.20	512.76
April 28, 1944	577,000	30.90	512.46
July 19, 1951	618,000	33.33	514.89
April 25, 1973	500,000	33.70	515.26

a Datum of gage is 481.56 feet above mean sea level (MSL), datum of 1929.

b Computed by U.S. Army Corps of Engineers.

References: U.S. Geological Survey, 1968, 1973, and 1978.

TABLE 2.4-6 ESTIMATED MAGNITUDE AND FREQUENCY OF FLOODS IN MISSOURI RIVER FOR EXISTING CONDITIONS

ANNUAL PROBABILITY OF NOT BEING EQUALLED OR EXCEEDED	RECURRENCE INTERVAL (years)	DISCHARGE AT HERMANN, MISSOURI (cfs)	DISCHARGE AT MISSOURI RIVER MILE 115 (cfs)
.500	2	222,000	218,000
.423	2.33[a]	241,000	237,000
.200	5	325,000	319,000
.100	10	405,000	398,000
.040	25	485,000	477,000
.020	50	555,000	545,000
.010	100	620,000	610,000
	SPF[b,c]	790,000	780,000
	PMF[d]	1,320,000	1,300,000

a Mean annual flood.

b The Standard Project Flood (SPF) represents the flood that may be expected from the most severe combination of meteorologic and hydrologic conditions that are considered reasonably characteristic of the geographical region involved, excluding extremely rare combinations (Chow, 1964).

c No recurrence interval is associated with this event.

d The Probable Maximum Flood (PMF) represents the flood event that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are considered reasonably possible in the region (U.S. NRC, 1977).

Additional Reference: U.S. Army Corps of Engineers, 1979.

TABLE 2.4-7 PROBABLE MAXIMUM PRECIPITATION (PMP) AT THE SITE*

DURATION IN HOURS	PMP IN INCHES				
	ALL-SEASON	DECEMBER	JANUARY	FEBRUARY	MARCH
6	25.4	9.5	7.4	7.8	9.3
12	30.0	12.6	11.3	11.9	14.2
24	32.5	15.4	14.4	15.3	17.0
48	35.0	19.7	18.7	19.6	20.8

* Based on Hydrometeorological Report No. 33 (U.S. Weather Bureau, 1956)

TABLE 2.4-8 HOURLY DISTRIBUTION OF MAXIMUM 6-HOUR INCREMENT WITHIN 48-HOUR PMP STORM*

TIME IN HOURS	INCREMENTAL PMP IN INCHES				
	ALL-SEASON	DECEMBER	JANUARY	FEBRUARY	MARCH
12-13	1.5	0.6	0.4	0.5	0.6
13-14	2.0	0.8	0.6	0.6	0.7
14-15	3.6	1.3	1.1	1.1	1.3
15-16	14.0	5.2	4.1	4.3	5.1
16-17	2.8	1.0	0.8	0.8	1.0
17-18	1.5	0.6	0.4	0.5	0.6
Total	25.4	9.5	7.4	7.8	9.3

* Based on Chow, 1964.

TABLE 2.4-9 RAINFALL INTENSITIES AT CALLAWAY PLANT SITE FOR 100-YEAR STORM AND PROBABLE MAXIMUM PRECIPIATION STORM*

RUNOFF TIME OF CONCENTRATION	RAINFALL INTENSITY IN INCHES/HOUR	
	100-YEAR STORM	PMP STORM
5 minutes	9.9	39.0
10 minutes	8.4	33.0
15 minutes	7.2	27.0
20 minutes	6.4	24.0
30 minutes	5.4	20.0
40 minutes	4.4	17.5
50 minutes	3.9	15.5
1 hour	3.4	14.0
2 hours	2.1	9.5
3 hours	1.5	7.3
6 hours	0.9	4.5

* Based on S&P data, 1979.

(Sheet 1 of 2)

TABLE 2.4-10 ESTIMATED MAGNITUDE AND FREQUENCY OF CONSECUTIVE ANNUAL LOW FLOWS FOR VARIOUS DURATIONS IN THE MISSOURI RIVER[a]

LOCATION	PERIOD OF RECORD	DURATION OF FLOW (DAYS)	ANNUAL LOW FLOW IN cfs FOR INDICATED RECURRENCE INTERVAL IN YEARS				
			2	5	10	20	100
			(0.500)[b]	(0.200)[b]	(0.100)[b]	(0.050)[b]	(0.010)[b]
Missouri River at Hermann	1953-73	7	18,500	12,500	10,300	8,800	6,600
		14	20,200	14,300	12,100	10,700	8,600
		30	24,200	17,700	15,300	13,700	11,400
		60	29,100	20,600	17,400	15,200	11,800
		90	33,000	22,800	18,900	16,200	12,200
		120	36,500	25,300	20,800	17,800	13,200
		183	44,200	31,800	26,800	23,300	17,900
		365	65,900	48,800	41,200	35,500	26,500

TABLE 2.4-10 (Continued) (Sheet 2 of 2)

LOCATION	PERIOD OF RECORD	DURATION OF FLOW (DAYS)	ANNUAL LOW FLOW IN cfs FOR INDICATED RECURRENCE INTERVAL IN YEARS				
			2	5	10	20	100
			(0.500)[b]	(0.200)[b]	(0.100)[b]	(0.050)[b]	(0.010)[b]
Missouri River near Callaway Plant Site (Missouri River Mile 115)	1953-73	7	17,900	12,100	9,900	8,500	6,300
		14	19,600	13,900	11,700	10,400	8,300
		30	23,600	17,200	14,900	13,300	11,100
		60	28,400	20,100	17,000	14,800	11,500
		90	32,200	22,200	18,400	15,800	11,900
		120	35,600	24,700	20,300	17,400	12,800
		183	43,000	31,000	26,200	22,800	17,500
		365	62,900	46,800	39,700	34,200	25,500

a Based on USGS data for period 1953-73; 1979.

b Probability of not being exceeded.

TABLE 2.4-11 ESTIMATED MINIMUM DISCHARGES AND STAGE ELEVATIONS DURING LOW FLOW CONDITIONS FOR THE MISSOURI RIVER NEAR THE CALLAWAY PLANT SITE AT MISSOURI RIVER MILE 115

LOW FLOW CONDITION	DISCHARGE (cfs)	RIVER STAGE (feet MSL)
Historic low flow due to freezing	3,500	494.3
Winter Drought Low flow (minimum flow that approaches a 100 percent change of being equaled or exceeded)[a]	7,250	495.5
1-day, 30-year recurrence interval low flow[b]	5,500	495.0
30-day, 100-year recurrence interval annual low flow[c]	11,100	496.0

a Based on operational study (Missouri Basin Inter-Agency Committee, 1969) and USGS low flow data (1979).

b Preliminary design base for Callaway Plant water supply intake on the Missouri River.

c Based on USGS data (1979).

(Sheet 1 of 1)

TABLE 2.4-12 RECORDED MINIMUM DISCHARGES AND STAGES ON THE MISSOURI RIVER AT BOONVILLE AND HERMANN, MISSOURI

STATION	YEAR	MONTH/ DAY	MINIMUM DISCHARGE (cfs)	GAGE READING (feet)	STAGE ELEVATION (feet MSL)
Boonville, Missouri (period of record: 1927-1977)	1936	12/31	5,140	-0.40	565.0
	1937	1/13	5,400	-0.75[a]	564.7
	1938	12/13	4,100	0.00[b]	565.4
	1940	1/10	1,800	2.70[b]	568.1
	1963	12/21-22	5,000	3.30[c]	568.7
				2.80[c]	568.3
Hermann, Missouri (period of record: 1930-1977)	1938	12/17	8,300	2.90[b]	484.5
	1940	1/10-12	4,200	1.07[b]	482.7
				1.68[b]	483.3
				1.45[b]	483.1
	1957	1/22	9,000	0.53[d]	482.1
	1963	1/24	7,500	0.05[b]	481.7
	1963	12/23	6,210	-0.25	481.4

a Gage height computed from graph drawn through U.S.A.E. readings.

b Stage-discharge relation affected by ice.

c From graph based on daily wire-weight gage readings.

d Stage estimated from rating curve 9-28-56

Source: Skelton, 1966; USGS, 1938.

TABLE 2.4-13 PROJECTED ESTIMATED LOW FLOW PROBABILITES OF MISSOURI RIVER AT RIVER MILE 115[a]

FUTURE YEAR	LOW FLOW DISCHARGE[b] (cfs)	PROBABILITY[c] (percent)
1980	9,210	99.9
	4,290	100.0
2000	9,210	99.8
	4,290	100.0
2020	9,210	99.6
	4,290	100.0

a Based upon "Missouri River Main Stem Reservoir Regulation Study, 1-74 services as provided by Chief, Engineering Division, Department of the Army, Missouri River Division, Corps of Engineers, Omaha, Nebraska, by written communication dated January 17, 1974, to Dames & Moore.

b Adjusted from flows of 10,000 cfs and 5,000 cfs at Hermann.

c Probability expressed as percent of time indicated discharge is estimated to be equaled or exceeded.

TABLE 2.4-14 COMPARISON OF REGULATORY POSITION OF REGULATORY GUIDE 1.127, REVISION 1, DATED MARCH 1978, TITLED "INSPECTION OF WATER-CONTROL STRUCTURES ASSOCIATED WITH NUCLEAR POWER PLANTS" AND SNUPPS - CALLAWAY POSITION FOR ULTIMATE HEAT SINK RETENTION POND

REGULATORY GUIDE 1.127 POSITION	SNUPPS - CALLAWAY POSITION
1. ENGINEERING DATA COMPILATION	COMPLIES: Refer to the following:
a. General Project Data	Callaway Addendum FSAR Sections 2.1.1.2, 9.2.5
b. Hydrologic and Hydraulic Data	Callaway Addendum FSAR Sections 9.2.1, 9.2.5
c. Foundation Data	Callaway Addendum FSAR Sections 2.5.1.2, 2.5.5.1, 2.5.5.3
d. Properties of Foundation Materials	Callaway Addendum FSAR Sections 2.5.4.2, 2.5.5.1
e. Concrete Properties	SNUPPS FSAR Section 3.8.1.6
f. Electrical and Mechanical Equipment	Callaway Addendum FSAR Sections 9.2.1, 9.2.5
g. Pertinent Construction Records	Construction records of UHS retention pond, including progress photos, alterations, and modifications
h. Water Control Plan	NOT APPLICABLE
i. Earthquake History	Callaway Addendum FSAR Sections 2.1, 2.5.3.3
j. Principal Design Assumptions and Analysis	Callaway Addendum FSAR Sections 2.4.5, 2.4.7, 2.4.10, 2.4.11.6, 2.5.4.6, 2.5.5.2
2. ONSITE INSPECTION PROGRAM	
a. Concrete Structures in General	(Applies to outlet structures only.)
(1) and (2) Concrete Surfaces and Structural Cracking	COMPLIES: Inspect outlet structure visually for cracking, chipping, or other deterioration of concrete.
(3) Movement: Horizontal and Vertical Alignment	COMPLIES: Inspect outlet structure visually for any movements of concrete.

* Refer to Regulatory Guide 1.127, Revision 1, for complete explanation of Regulatory Guide Position.

TABLE 2.4-14 (Continued) (Sheet 2 of 4)

REGULATORY GUIDE 1.127 POSITION	SNUPPS - CALLAWAY POSITION
(4) Junctions	COMPLIES: Inspect outlet structure visually for any movement of adjacent riprap, protected slopes, or unusual condition of the joints.
(5) Drains: Foundation, Joint, Face	NOT APPLICABLE
(6) Water Passages	COMPLIES: Inspect outlet structure visually for cracking, spalling, chipping, or other deterioration of concrete. Inspect the channel downstream of the structure for erosion and its effect on the stability of the structure.
(7) Seepage or Leakage	COMPLIES: Inspect outlet structure visually for any unusual wet areas or seepage in the structure vicinity.
(8) Monolithic Joints, Construction Joints	COMPLIES: Inspect outlet structure for unusual condition of the joints.
(9) Foundations	NOT APPLICABLE
(10) Abutments	NOT APPLICABLE
b. Embankment Structures	(Categorize walls of dug pond as embankment structure for inspection purposes only.)
(1) Settlement	COMPLIES: Inspect the top of the slopes visually (for a distance of about 80 feet from the slope, where possible) for any unusual features such as cracks or depressions on the ground surface. Before pond filling, establish four to eight survey benchmarks around the pond at yard level. Monitor the vertical and lateral movement of these benchmarks before the filling and for several months after the filling.
(2) Slope Stability	NOT APPLICABLE: (Pond contains no downstream slope. Exposed part of upstream slope inspected under Para. 2.b.(5) "Slope Protection").
(3) Seepage	COMPLIES: (Limited applicability to downstream of outlet structure): Inspect outlet structure visually for any unusual wet areas or seepage in the structure vicinity
(4) Drainage Systems	COMPLIES (Limited applicability): Inspect the top of the slopes visually for any unusual features such as cracks or depressions on the ground surface.
(5) Slope Protection	COMPLIES: Inspect visually the riprap and filter protecting the pond slopes for any significant movement of riprap causing visible changes in the riprap layer thickness and for any special exposed areas of filter layer due to complete or partial removal of riprap.

TABLE 2.4-14 (Continued) (Sheet 3 of 4)

REGULATORY GUIDE 1.127 POSITION	SNUPPS - CALLAWAY POSITION
c. Spillway Structures and Outlet Works	
(1) Control Gates and Operating Machinery	NOT APPLICABLE
(2) Unlimited Saddle Spillways	NOT APPLICABLE
(3) Approach and Outlet Channels	COMPLIES: Inspect crest of outlet structure for any blockage by debris, siltation, and undesirable vegetation.
(4) Stilling Basin (Energy Dissipators)	COMPLIES: Inspect energy dissipator and riprap downstream of outlet for erosion or any blockage by debris, siltation, and undesirable vegetation.
(5) Intake Structure	NOT APPLICABLE
(6) Conduits, Sluices, Water Passages, etc.	NOT APPLICABLE
(7) Drawdown Facilities	NOT APPLICABLE
d. Reservoirs	NOT APPLICABLE
e. Cooling Water Channels and Canals and Intake and Discharge Structures	
(1) Channels and Canals	COMPLIES: Inspect channel downstream of outlet for erosion or blockage by debris, siltation, and undesirable vegetation.
(2) Intake and Discharge Structures	COMPLIES: Make periodic soundings near the pond discharge structures and the pumphouse forebay sill after system operation to assess the silting or erosion of the pond.
f. Safety and Performance Instrumentation	COMPLIES: Inspect visually the riprap and filter protecting
(1) Headwater and Tailwater Gages	NOT APPLICABLE
(2) Horizontal and Vertical Alignment Instrumentation (Concrete Structures)	NOT APPLICABLE
(3) Horizontal and Vertical Movement, Consolidation and Pore-Water Pressure Instrumentation (Embankment Structures)	COMPLIES: Before filling the pond, establish four to eight benchmarks around the pond at yard level. Monitor vertical and lateral movements of the benchmarks before and for several months after filling. Establish three to four observation wells around the pond to periodically monitor ground-water level.
(4) Uplift Instrumentation	NOT APPLICABLE

TABLE 2.4-14 (Continued) (Sheet 4 of 4)

REGULATORY GUIDE 1.127 POSITION	SNUPPS - CALLAWAY POSITION
(5) Drainage System Instrumentation	NOT APPLICABLE
(6) Seismic Instrumentation	NOT APPLICABLE
g. Operation and Maintenance Features	NOT APPLICABLE
h. Postconstruction Changes	COMPLIES: Document and report postconstruction changes that might influence project safety.
3. TECHNICAL EVALUATION	COMPLIES: After each general inspection of the pond, the findings of the inspection will be evaluated with respect to engineering data reviewed in the initial inspection report and pond conditions that existed previously. If this evaluation indicates that significant changes have occurred, the existing conditions will then be evaluated to assess impact on hydraulic performance and structural stability. This evaluation will include assessment of existing unacceptable conditions, such as changes in ground-water levels, siltation, settlement, erosion, etc. Recommendations for additional investigations, analyses, or remedial measures will be made when required.
4. FREQUENCY OF INSPECTIONS	COMPLIES: The initial inspection will begin with baseline readings taken at least 2 weeks prior to pond impoundment and shall continue with readings at decreasing intervals during impoundment and throughout the first year of service. Subsequent inspections and measurements will be made at approximately 1-year intervals after the issue of the initial inspection report, for the next 5 years, and then extended to 5 years thereafter. However, special inspections will be performed after the occurrence of earthquakes equal to or greater than the OBE, tornadoes striking the site, and other similar severe environmental conditions.
5. INSPECTION REPORT	COMPLIES: The initial preservice report will include the inspection conducted before, during, and after pond filling, and the data compiled during the first 3 months after water impoundment. The report contents will include: a general description of the pond and associated structures; instrumentation description; results and discussions of visual inspection of each feature; and presentation and technical evaluation of results of measurements and instrumentation data. Each subsequent report will include updated data plots and results of each subsequent inspection. Each will include a discussion of measurement data, any maintenance performed, and any unusual observances of structures that have been noted since the previous inspection.

TABLE 2.4-15 PERTINENT DETAILS OF REFUELING WATER STORAGE TANK

Elevation of Bottom Slab (feet MSL)	835.5
Diameter (feet)	40.0
Volume in Liquid Contents in gallons	400,000*
Total Curie Content	3.7900642×10^3

* Based on at least 80 percent of vessel usable volume.

TABLE 2.4-16 PARAMETER VALUES USED IN SURFACE-WATER TRANSPORT OF LIQUID RADWASTE IN MISSOURI RIVER FOLLOWING POSTULATED RUPTURE OF REFUELING WATER STORAGE TANK

Average Width of River, B (feet)	1,100
Average Depth of River, D (feet)	14
Discharge in River, Q (cfs)	69,000*
Average River Bed Slope, S (ft/ft)	0.000165
Distance from Near Shore for Source, YS (feet)	0
β for Determining K_y	0.65
β for Determining K_x	5,600
Radwaste Concentration in Tank (Ci/ft^3)	0.709×10^{-1}

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* Values noted are for regulated river flow conditions near the Callaway Plant site.

(Sheet 1 of 2)

TABLE 2.4-17 AQUIFER CHARACTERISTICS IN CALLAWAY PLANT SITE VICINITY

ROCK UNITS AND AGE	PHYSICAL PROPERTIES[a]	APPROXIMATE[a] THICKNESS (feet)	WATER YIELD[b] CHARACTERISTICS	HYDROLOGIC[b] UNIT	TYPICAL[b] YIELD (gpm)	TYPICAL[c] WELL DEPTH (feet)
Alluvium[d] (Recent)	Clay, sand & gravel sediments generally coarser with depth	50-120	Adequate for municipal & industrial supply	Major Acquifer	500	10-120
St. Peter[d] (Ordovician)	Medium- to coarse-grained sandstone	0-200	Adequate for small towns & industries	Major Acquifer	75	400
Cotter-Jefferson[d] City (Ordovician)	Fine- to medium-grained jointed dolomite; interbedded shale in upper 100 feet; chert layers	300-500	Adequate for domestic and livestock supply	Minor Aquifier	10-15	250-950
Roubidoux (Ordovician)	Fine- to coarse-grained sandstone; occasional interbedded cherty dolomite	100-250	Variable yield, adequate for farm supply and small towns	Major Aquifer	25-350	700-900
Gasconade (Ordovician)	Fine-grained dolomite, coarse-grained near base	300	Adequate for small towns and industry	Major Aquifer	50-75	800-1,000
Gunter (Ordovician)	Medium-grained sandstone	25-30				
Eminence (Cambrian)	Medium- to coarse-grained, vuggy, fractured dolomite	200-350	Adequate for farm & domestic supply; rarely municipal and industrial supply	Minor Aquifer	15-20	1,000-1,400

TABLE 2.4-17 (Continued)(Sheet 2 of 2)

ROCK UNITS AND AGE	PHYSICAL PROPERTIES[a]	APPROXIMATE[a] THICKNESS (feet)	WATER YIELD[b] CHARACTERISTICS	HYDROLOGIC[b] UNIT	TYPICAL[b] YIELD (gpm)	TYPICAL[c] WELL DEPTH (feet)
Potosi (Cambrian)	Fine- to coarse-grained, vuggy dolomite	0-450	Adequate for municipal and industrial supply	Major Aquifer	500	1,400-1,600
Derby-Doerun (Cambrian)	Thin- to medium-bedded dolomite; interbedded siltstone and shale	0-200	Adequate for domestic supply	Minor Aquifer	5e	1,550-1,800
Davis (Cambrian)	Interbedded siltstone, shale, sandstone and dolomite	150-225	Rarely used as a supply of water	Aquitard	None	
Bonneterre (Cambrian)	Fine- to medium-grained, Medium-bedded dolomite	400-1,600	Adequate for domestic supply; commonly used with Lamotte	Minor Aquifer	20-25	1,800-1,950
Lamotte (Cambrian)	Fine- to coarse-grained, cross-bedded, well-cemented sandstone	300-500	Adequate for municipal and industrial supply	Major Aquifer	65	350-2,600
	Metasediments and gneissic granites	Unknown	No Yield	Aquiclude	None	None

a Information from Unklesbay, 1955; Hayes, 1961; Hayes & Knight, 1961; Martin, Knight & Hayes, 1961; Fuller et al., 1967.

b Information from Fuller et al., 1967.

c Estimated from information in Fuller et al., 1967 and Robertson, 1962.

d Aquifers utilized locally in immediate site vicinity.

TABLE 2.4-18 MUNICIPAL WATER SUPPLIES WITHING 50 MILES OF PLANT

MAP KEY	SUPPLY FACILITY	POPULATION SERVED[a]	SOURCE OF SUPPLY[a]	WELL DEPTH[b] (FT)	CASING DEPTH[b] (FT)	PRINCIPAL WATER-BEARING HORIZON(S)[b]	PLANT CAPACITY[a] (MGD)	AVERAGE CONSUMPTION[a] (MGD)	FINISHED WATER STORAGE[a] (MG)
AUDRAIN COUNTY									
1	Farber	470	Four Wells				0.138	0.050	0.003
			Well No. 1	630	200	St. Peter			
			Well No. 2	632	255	St. Peter			
			Well No. 3	NA	NA	NA			
			Well No. 4	440	431	Jefferson City			
2	Laddonia	745	Two Wells				0.144	0.051	0.011
			Well No. 1	525	400	St. Peter			
			Well No. 2	528	158	St. Peter			
3	Martinsburg	320	One Well	1,150	500	Roubidoux	0.144	0.025	0.050
4	Mexico	13,562	Three Wells				3.110	1.700	1.000
			Well No. 1	1,173	70	Roubidoux			
			Well No. 2	1,208	50	Gasconade			
			Well No. 3	1,500	399	Eminence			
5	Rush Hill	150	One Well	1,140	550	Roubidoux	0.144	0.011	0.017
6	Vandalia	3,160	Two Wells				0.444	0.300	1.220
			Well No. 1	1,385	440	Roubidoux			
			Well No	700	425	St. Peter			
7	Vandiver	See Mexico, Audrain County							
BOONE COUNTY									
1	Ashland	970	Three Wells				0.235	0.06	0.053
			Well No. 1	476	146	Jefferson City			
			Well No. 2	930	383	Gasconade			
			Well No. 3	980	468	Gasconade			

Note: NA = Information Not Available.
[a] Information from Missouri State Division of Environmental Health, 1971, 1972, and 1977.
[b] Information from Missouri State Division of Environmental Health, 1973 and 1978; and Robertson, 1962.

TABLE 2.4-18 (Continued) (Sheet 2 of 7)

MAP KEY	SUPPLY FACILITY	POPULATION SERVED[a]	SOURCE OF SUPPLY[a]	WELL DEPTH[b] (FT)	CASING DEPTH[b] (FT)	PRINCIPAL WATER-BEARING HORIZON(S)[b]	PLANT CAPACITY[a] (MGD)	AVERAGE CONSUMPTION[a] (MGD)	FINISHED WATER STORAGE[a] (MG)
BOONE COUNTY (continued)									
2	Centralia	4,000	Four Wells				1.170	0.600	0.650
			Well No. 1	1,105	400	Gasconade			
			Well No. 2	1,338	431	Gunter			
			Well No. 3	1,377	462	Gunter			
			Well No. 4	1,420	600	Gunter			
3	Columbia	60,000	Eight Deep Wells				16.0	6.040	13.0
			Well No. 1	1,200	500	Eminence			
			Well No. 4	1,505	500	Eminence			
			Well No. 5	1,200	500	Eminence			
			Well No. 6	1,100	500	Eminence			
			Well No. 7	1,150	600	Eminence			
			Well No. 8	1,437	703	Cotter-V. Gasconade			
			Well No ^	1,354	NA	Roubidoux-Derby			
			Well No. 10	1,360	601	Roubidoux-Derby			
			Six Shallow Wells						
			Well No. 1	100	70	Alluvium			
			Well No. 2	104	69	Alluvium			
			Well No. 3	103	68	Alluvium			
			Well No. 4	103	68	Alluvium			
			Well No. 5	104	69	Alluvium			
			Well No. 6	103	68	Alluvium			
4	Hallsville	800	One Well	1,040	443	Roubidoux	0.144	0.060	0.050
5	Harrisburg	160	One Well	1,000	600	Roubidoux	0.144	0.010	0.004
6	Hartsburg	- - - - - - - - - - See Boone County Conservation PWSD No. 01 (5), Table 2.4-19 - - - - - - - - - - -							
7	Midway	- - - - - - - - - - See Boone County Conservation PWSD No. 01 (8), Table 2.4-19 - - - - - - - - - - -							
8	Prathersville	- - - - - - - - - - See Boone County Conservation PWSD No. 01 (8), Table 2.4-19 - - - - - - - - - - -							
9	Rocheport	307	One Well	NA	NA	NA	0.060	0.012	0.028
10	Sturgeon	- - - - - - - - - - - - - - See Boone County PWSD No. 10, Table 2.4-19 - - - - - - - - - - - - - -							

TABLE 2.4-18 (Continued) (Sheet 3 of 7)

MAP KEY	SUPPLY FACILITY	POPULATION SERVED[a]	SOURCE OF SUPPLY[a]	WELL DEPTH[b] (FT)	CASING DEPTH[b] (FT)	PRINCIPAL WATER-BEARING HORIZON(S)[b]	PLANT CAPACITY[a] (MGD)	AVERAGE CONSUMPTION[a] (MGD)	FINISHED WATER STORAGE[a] (MG)
CALLAWAY COUNTY									
1	Auxvasse	800	Two Wells				0.276	0.090	0.030
			Well No. 1	1,390	400	Eminence			
			Well No. 2	1,385	400	Eminence			
2	Calwood	See Callaway County PWSD No. 2 NE, Table 2.4-19							
3	Cedar City	502	One Well	935	275	Potosi	0.241	0.050	0.050
4	Fulton	3,000	Three Wells				5.328	1.500	2.075
			Well No. 3	1,350	299	Eminence			
			Well No. 4	1,175	380	Eminence			
			Well No. 5	1,190	402	Eminence			
5	Holts Summit	See Callaway County PWSD No. 1, Table 2.4-19							
6	Mokane	400	One Well	NA	NA	NA	0.070	0.025	0.002
7	New Bloomfield	429	One Well	1,065	275	Gunter	0.129	0.040	0.050
8	Tebbetts	See Callaway County PWSD No. 1, Table 2.4-19							
COLE COUNTY									
1	Centertown	277	One Well	NA	NA	NA	0.266	0.018	0.055
2	Elston	See Cole County PWSD No. 3, Table 2.4-19							
3	Eugene	175	One Well	750	NA	NA	0.144	0.023	0.015
4	Jefferson City	33,000	Missouri River	-	-	-	6.500	4.25	2.396
5	Osage City	See Cole County PWSD No. 4, Table 2.4-19							
6	Russellville	650	One Well	NA	NA	NA	0.252	0.048	0.050
7	St. Martins	See Cole County PWSD No. 3, Table 2.4-19							
8	St. Thomas	See Cole County PWSD No. 5, Table 2.4-19							
9	Taos	See Cole County PWSD No. 4, Table 2.4-19							
10	Wardsville	250	One Well	NA	NA	NA	0.144	0.012	0.047

TABLE 2.4-18 (Continued)

MAP KEY	SUPPLY FACILITY	POPULATION SERVED[a]	SOURCE OF SUPPLY[a]	WELL DEPTH[b] (FT)	CASING DEPTH[b] (FT)	PRINCIPAL WATER-BEARING HORIZON(S)[b]	PLANT CAPACITY[a] (MGD)	AVERAGE CONSUMPTION[a] (MGD)	FINISHED WATER STORAGE[a] (MG)
COOPER COUNTY									
1	Prairie Home	250	One Well	NA	NA	NA	0.150	0.020	0.004
2	Woolridge	See Cooper County PWSD No. 1, Table 2.4-19							
FRANKLIN COUNTY									
1	Beaufort	See Franklin County PWSD No. 4, Table 2.4-19							
2	Berger	230	One Well	NA	NA	NA	0.108	0.017	0.040
3	Gerald	900	Two Wells	NA	NA	NA	0.266	0.100	0.050
4	Krakow	See Franklin County PWSD No. 1, Table 2.4-19							
5	Leslie	See Franklin County PWSD No. 4, Table 2.4-19							
6	New Haven	1,474	Two Wells	NA	NA	NA	0.677	0.150	0.440
7	Oak Grove Village	360	One Well	803	NA	NA	NA	0.029	NA
8	Sullivan	5,100	Five Wells	NA	NA	NA	1.020	0.775	1.000
9	Union	5,183	Three Wells and Bourbeuse River				2.454	0.555	0.126
			Well No. 1	1,000	NA	NA			
			Well No. 2	795	NA	NA			
			Well No. 3	850	NA	NA			
10	Washington	9,500	Five Wells	1,000 each	NA	NA	3.285	1.364	3.350
GASCONADE COUNTY									
1	Bland	670	Two Wells	800	NA	NA	0.237	0.036	0.050
2	Gasconade	235	One Well	NA	NA	NA	0.144	0.018	0.010
3	Hermann	2,600	Two Wells				0.943	0.273	0.487
			Well No. 1	1,205	NA	NA			
			Well No	~7	NA	NA			

TABLE 2.4-18 (Continued)

MAP KEY	SUPPLY FACILITY	POPULATION SERVED[a]	SOURCE OF SUPPLY[a]	WELL DEPTH[b] (FT)	CASING DEPTH[b] (FT)	PRINCIPAL WATER-BEARING HORIZON(S)[b]	PLANT CAPACITY[a] (MGD)	AVERAGE CONSUMPTION[a] (MGD)	FINISHED WATER STORAGE[a] (MG)
GASCONADE COUNTY (continued)									
4	Morrison	234	One Well	750	NA	NA	0.244	0.013	0.058
5	Owensville	2,416	Three Wells				0.821	0.222	0.400
			Well No. 1	692	NA	NA			
			Well No. 2	900	NA	NA			
			Well No. 3	1,000	NA	NA			
6	Rosebud	358	Two Wells				0.194	0.015	0.006
			Well No. 1	508	NA	NA			
			Well No [illegible]	700	NA	NA			
LINCOLN COUNTY									
1	Argentville	See Lincoln County PWSD No. 1, Table 2.4-19							
2	Hawk Point	450	One Well	620	275	St. Peter	0.080	0.025	0.016
3	Moscow Mills	199	One Well	875	480	St. Peter	0.180	0.040	0.016
4	Silex	275	One Well	545	400	St. Peter	0.050	0.008	0.020
5	Troy	2,538	Five Wells				0.500	0.300	0.303
			Well No. 3	764	495	St. Peter			
			Well No. 4	812	400	St. Peter			
			Well No. 5	750	360	St. Peter			
			Well No [illegible]	750	410	St. Peter			
			Well No. 7	1,470	440	NA			
MARIES COUNTY									
1	Belle	1,200	Two Wells	806	421	NA	0.436	0.120	0.065
2	Vienna	505	One Well	670	NA	NA	0.120	0.060	0.060
MONITEAU COUNTY									
1	California	4,000	Five Wells	NA	NA	NA	5.000	0.750	0.225
2	Clarksburg	350	One Well	NA	NA	NA	0.100	0.025	0.006
3	Jamestown	275	One Well	NA	NA	NA	0.122	0.012	0.003

TABLE 2.4-18 (Continued) (Sheet 6 of 7)

MAP KEY	SUPPLY FACILITY	POPULATION SERVED[a]	SOURCE OF SUPPLY[a]	WELL DEPTH[b] (FT)	CASING DEPTH[b] (FT)	PRINCIPAL WATER-BEARING HORIZON(S)[b]	PLANT CAPACITY[a] (MGD)	AVERAGE CONSUMPTION[a] (MGD)	FINISHED WATER STORAGE[a] (MG)
MONITEAU COUNTY (continued)									
4	Kliever	See Moniteau County PWSD No. 2, Table 2.4-19							
5	McGirk	See Moniteau County PWSD No. 2, Table 2.4-19							
MONROE COUNTY									
1	Paris	1,442	Salt River	-	-	-	1.008	0.265	0.415
MONTGOMERY COUNTY									
1	Bellflower	430	One Well	555	294	Jefferson City	0.129	0.037	0.019
2	High Hill	200	One Well	1,085	325	Roubidoux	0.173	0.024	0.004
3	Jonesburg	476	Two Wells	1,050	435	Roubidoux	0.155	0.050	0.050
4	Middleton	235	One Well	615	393	St. Peter	0.086	0.013	0.055
5	Montgomery City	2,100	Two Wells				0.504	0.223	0.300
			Well No. 1	800	150	St. Peter			
			Well No. 2	1,076	300	Roubidoux			
6	New Florence	635	One Well	993	323	Roubidoux	0.072	0.056	0.050
7	Wellsville	1,565	Two Impoundments	-	-	-	0.403	0.192	0.120
OSAGE COUNTY									
1	Bannots Mill	See Osage County PWSD No. 1, Table 2.4-19							
2	Chamois	620	Two Wells				0.489	0.067	0.100
			Well No. 1	223	NA	NA			
			Well No. 2	350	NA	NA			
3	Frankenstein	50	One Well	NA	NA	NA	0.058	0.004	0.001
4	Freeburg	560	One Well	900	NA	NA	0.141	0.039	0.050
5	Linn	1,500	Two Wells	NA	NA	NA	0.389	0.111	0.055

TABLE 2.4-18 (Continued) (Sheet 7 of 7)

MAP KEY	SUPPLY FACILITY	POPULATION SERVED [a]	SOURCE OF SUPPLY [a]	WELL DEPTH [b] (FT)	CASING DEPTH [b] (FT)	PRINCIPAL WATER-BEARING HORIZON(S) [b]	PLANT CAPACITY [a] (MGD)	AVERAGE CONSUMPTION [a] (MGD)	FINISHED WATER STORAGE [a] (MG)
OSAGE COUNTY (continued)									
6	Loose Creek	See Osage County PWSD No. 1, Table 2.4-19							
7	Meta	400	One Well	NA	NA	NA	0.432	0.030	0.100
8	Westphalia	See Osage County PWSD No. 1, Table 2.1-29							
PIKE COUNTY									
1	Curryville	337	Two Wells				0.086	0.010	0.004
			Well No. 1	450	175	St. Peter			
			Well No	¯60	175	St. Peter			
RALLS COUNTY									
1	Perry	860	Two Impoundments	-	-	-	0.216	0.072	0.111
RANDOLPH COUNTY									
1	Clark	300	One Well	NA	NA	NA	0.120	0.015	NA
ST. CHARLES COUNTY									
1	Augusta	See St. Charles County PWSD No. 2, Table 2.4-19							
2	Wentzville	3,300	Four Wells	NA	NA	NA	0.504	0.360	0.375
WARREN COUNTY									
1	Dutzow	See Warren County PWSD No. 1, Table 2.4-19							
2	Marthasville	413	One Well	NA	NA	NA	0.187	0.017	0.050
3	Truesdale	See Warrenton, Warren County							
4	Warrenton	3,500	Three Wells	1,150	NA	NA	0.820	0.420	0.300
5	Wright City	1,150	Three Wells				0.712	0.258	0.250
				1,300	NA	NA			
				1,400	NA	NA			

TABLE 2.4-19 MUNICIPAL WATER SUPPLIES WITHING 50 MILES OF PLANT

SUPPLY FACILITY [a]	POPULATION SERVED [a]	SOURCE OF SUPPLY [b]	WELL DEPTH [b] (FT)	CASING DEPTH [b] (FT)	PRINCIPAL WATER-BEARING HORIZON(S)[a]	PLANT CAPACITY[a] (MGD)	AVERAGE CONSUMPTION[a] (MGD)	FINISHED WATER STORAGE[a] (MG)
AUDRAIN COUNTY								
PWSD No. 1	See Mexico, Audrain County, Table 2.4-18							
PWSD No. 2	See Mexico, Audrain County, Table 2.4-18							
BOONE COUNTY								
PWSD No. 1	2,500	One Well	1,082	425	Roubidoux	0.936	0.143	0.200
PWSD No. 2	2,015	Two Wells				0.360	0.157	0.050
		Well No. 1	NA	NA	NA			
		Well No. 2	1,375	700	Gunter			
PWSD No. 4	3,200	Three Wells				0.600	0.030	0.110
		Well No. 1	1,155	655	Roubidoux			
		Well No. 2	1,350	655	Roubidoux			
		Well No [illegible]	1,500	655	Roubidoux			
Conservation PWSD No. 01 (5) (formerly PWSD No. 5)	2,100	Two Wells				1.152	0.105	0.114
		Well No. 1	1,100	350	Eminence			
		Well No. 2	1,100	573	Eminence			
Conservation PWSD No. 01 (6) (formerly PWSD No. [illegible])	5,530	Two Wells				1.370	0.432	0.150
		Well No. 1	1,165	360	Eminence			
		Well No. 2	1,190	400	Eminence			
PWSD No. 7	1,400	Two Wells				0.396	0.060	0.070
		Well No. 1	1,400	560	Gunter			
		Well No	310	555	Gunter			
Conservation PWSD No. 01 (8) (formerly PWSD No. 8)	2,975	NA	NA	NA	NA	0.242	NA	NA
PWSD No. 9	5,880	Two Wells	1,300	550	Gunter	1.300	0.398	0.276
		Well No. 1						
		Well No. 2						
PWSD No. 10	See Boone County PWSD No. 4							

Note: NA = Information not available.
[a]Information from Missouri State Division of Environmental Health, 1971, 1972, and 1977.
[b]Information from Missouri State Division of Environmental Health, 1973 and 1979.

TABLE 2.4-19 (Continued) (Sheet 2 of 3)

SUPPLY FACILITY[a]	POPULATION SERVED[a]	SOURCE OF SUPPLY[b]	WELL DEPTH[b] (FT)	CASING DEPTH[b] (FT)	PRINCIPAL WATER-BEARING HORIZON(S)[a]	PLANT CAPACITY[a] (MGD)	AVERAGE CONSUMPTION[a] (MGD)	FINISHED WATER STORAGE[a] (MG)
CALLAWAY COUNTY								
PWSD No. 1	4,000	One Well	990	530	Gunter	1.728	0.500	1.080
PWSD No. 2 NE	600	One Well	1,200	350	Gunter	0.306	0.030	0.011
PWSD No. 2 SW	1,300	One Well	NA	NA	NA	0.252	0.090	0.003
COLE COUNTY								
PWSD No. 1	4,300	Two Wells	NA	NA	NA	1.224	0.350	0.200
PWSD No. 2	6,000	Three Wells	NA	NA	NA	1.728	0.060	0.130
PWSD No. 3	550	One Well	1,300	NA	NA	0.158	0.044	0.053
PWSD No. 4	960	One Well	1,050	NA	NA	0.144	0.040	0.038
PWSD No. 5	200	One Well	NA	NA	NA	0.086	0.008	0.004
COOPER COUNTY								
PWSD No. 1	380	One Well	NA	NA	NA	0.010	0.002	0.003
FRANKLIN COUNTY								
PWSD No. 1	1,400	Two Wells				0.410	0.102	0.100
		Well No. 1	1,130	NA	NA			
		Well No. 2	1,060	NA	NA			
PWSD No. 4	3,000	One Well	NA	NA	NA	0.835	0.165	0.200
HOWARD COUNTY								
PWSD No. 1	675	One Well	NA	NA	NA	0.060	0.044	0.048
LINCOLN COUNTY								
PWSD No. 1	3,450	Two Wells				0.549	0.149	0.170
		Well No. 1	1,757	712	St. Peter			
		Well No. 2	1,180	425	St. Peter			
MONITEAU COUNTY								
PWSD No. 1	225	One Well	NA	NA	NA	0.216	0.010	0.050

TABLE 2.4-19 (Continued) (Sheet 3 of 3)

SUPPLY FACILITY [a]	POPULATION SERVED [a]	SOURCE OF SUPPLY [b]	WELL DEPTH [b] (FT)	CASING DEPTH [b] (FT)	PRINCIPAL WATER-BEARING HORIZON(S) [a]	PLANT CAPACITY [a] (MGD)	AVERAGE CONSUMPTION [a] (MGD)	FINISHED WATER STORAGE [a] (MG)
MONITEAU COUNTY (continued)								
PWSD No. 2	700	See California, Moniteau County Table 2.1-28	NA	NA	NA	NA	0.005	NA
MONROE COUNTY								
PWSD No. 2	1,050	Salt River	NA	NA	NA	NA	0.068	0.061
OSAGE COUNTY								
PWSD No. 1	640	One Well	NA	NA	NA	0.144	0.020	0.037
PWSD No. 2	750	Two Wells	NA	NA	NA	0.245	0.043	0.048
PWSD No. 3	700	See Linn Osage County Table 2.1-28	NA	NA	NA	NA	0.035	0.037
PWSD No. 4	750	One Well	NA	NA	NA	0.245	0.030	0.048
PHELPS COUNTY								
PWSD No. 1	300	One Well	NA	NA	NA	0.058	0.019	0.059
PWSD No. 2N	400	One Well	NA	NA	NA	0.310	NA	0.068
PWSD No. 2S	300	One Well	NA	NA	NA	0.120	NA	0.023
ST. CHARLES COUNTY								
PWSD No. 1	600	One Well	1,170	600	Roubidoux	0.125	0.030	0.050
PWSD No. 2E	- - - - - - - - - - - - - - See Weldon Springs, St. Charles County, Table 2.4-3 - - - - - - - - - -							
PWSD No. 2N	6,300	Four Wells	NA	NA	NA	1.786	0.535	1.403
PWSD No. 2W	375	One Well	NA	NA	NA	0.248	0.011	0.320
PWSD No. 4	- - - - - - - - - - - - - - See Weldon Springs, St. Charles County, Table 2.4-3 - - - - - - - - - -							
WARREN COUNTY								
PWSD No. 1	255		NA	NA	NA	0.144	0.003	0.028

(Sheet 1 of 3)

TABLE 2.4-20 WELL INVENTORY WITHIN 5 MILES OF PLANT

LOCATION[a]	WELL DEPTH (FT)	APPROXIMATE LAND SURFACE ELEVATION	DEPTH TO WATER LEVEL (FT)	APPROXIMATE ELEVATION OF WATER LEVEL	TYPE OF WELL	ESTIMATED PUMPAGE RATE (GALLON S/DAY)	NAME OF OWNER OR TENANT[b]
A-10	40	600	20	500	Dug	190	A. Leisinger
A-11	86	660	15	645	Drilled	200	C. Bush
A-13	300	615	70	545	Drilled	200	M. Gibson
A-16	252	620	60	560	Drilled	280	L. Dickrader
A-18	Surface	625	0	625	Enclosed Spring	320	J. Garett
A-23	28	525	20	505	Drove	200	W. Vandelicht
A-25	Surface	525	0	525	Enclosed Spring	700	F. Eueltzau
A-31	Surface	600	0	600	Enclosed Spring	790	W. Mealy
A-32	Surface	600	0	600	Enclosed Spring	860	E. Farely
A-34	340	525	62	463	Drilled	410	J. Shepherd
A-35	160	525	60	465	Drilled	200	R. Miller
A-37	20	525	15	510	Dug	450	M. Hoorman
A-39	20	525	6	519	Dug	100	O. Becker
A-43	360	600	60	540	Drilled	320	K. Mealy
A-44	200	680	14	566	Drilled	300	J. Dick
A-46	47	521	17	504	Drilled	NA	USGS
A-47	520	807	NA	NA	Drilled	NA	R. Nichols[c]
A-48	250	795	130	665	Drilled	NA	G. Bezler[c]
B-2	149	620	72	548	Drilled	500	J. Waggoner
B-4	Surface	660	0	660	Enclosed Spring	200	J. Krebs
B-5	150	660	49	611	Drilled	200	B. Harvey
B-10	275	720	85	635	Drilled	300	S. Ward
B-14	345	800	165	635	Drilled	550	B. Mealy
B-16	342	760	182	578	Drilled	200	L. Maddox

Note: NA = Information not available.

a Location shown on Figure 2.4-23

b Based on 1973 field investigations by Dames & Moore with the exception of those noted.

c Based on Missouri Geological Survey and Water Resources unpublished.

TABLE 2.4-20 (Continued) (Sheet 2 of 3)

LOCATION[a]	WELL DEPTH (FT)	APPROXIMATE LAND SURFACE ELEVATION	DEPTH TO WATER LEVEL (FT)	APPROXIMATE ELEVATION OF WATER LEVEL	TYPE OF WELL	ESTIMATED PUMPAGE RATE (GALLON S/DAY)	NAME OF OWNER OR TENANT[b]
B-19	465	720	182	538	Drilled	300	C. Ready
C-3	300	820	178	642	Drilled	520	Krenzel
C-8	Surface	800	0	800	Enclosed Spring	420	L. Danbs
C-11	600	775	214	561	Drilled	900	H. Vandeloecht
C-15	Surface	720	0	720	Enclosed Spring	580	B. Crabtree
C-16	482	640	205	435	Drilled	200	C. O'Neal
C-17	300	795	140	655	Drilled	250	C. Krebs
C-19	404	780	207	573	Drilled	200	C. Klingman
C-23	450	740	210	530	Drilled	NA	L. Maddox
D-18	348	840	230	610	Drilled	800	R. Ballard
D-19	460	800	210	590	Drilled	200	C. Davis
D-26	465	824	255	569	Drilled	NA	Davis Brothers[c]
D-27	320	836	305	531	Drilled	NA	H. Davis
E-1	230	660	4	656	Drilled	550	Burns
E-3	15	600	4	596	Dug	100	Klosterman
E-7	260	662	35	627	Drilled	800	H. Smith[c]
E-9	12	700	8	695	Dug	300	R. Schmidt
E-10	316	745	118	627	Drilled	260	H. Arnold
E-17	290	660	40	620	Drilled	200	P. Galatins
E-17	Surface	660	0	660	Enclosed Spring	200	P. Galatins
E-20	275	545	4	541	Drilled	NA	L. Klasterman[c]
E-21	205	587	6	581	Drilled	NA	E. Lee[c]
E-22	295	580	40	540	Drilled	NA	P. Gaffatin[c]
F-1	NA	840	272	568	Drilled	400	J. Powers
F-5	405	820	200	620	Drilled	1,380	P. Garrett
F-6	Surface	815	0	815	Enclosed Spring	410	J. Masek
F-15	378	842	NA	NA	Drilled	1,200	C. Holland
F-Unknown	1,510	NA	NA	NA	Drilled	NA	Union Electric[c]

TABLE 2.4-20 (Continued) (Sheet 3 of 3)

LOCATION[a]	WELL DEPTH (FT)	APPROXIMATE LAND SURFACE ELEVATION	DEPTH TO WATER LEVEL (FT)	APPROXIMATE ELEVATION OF WATER LEVEL	TYPE OF WELL	ESTIMATED PUMPAGE RATE (GALLON S/DAY)	NAME OF OWNER OR TENANT[b]
F-Unknown	1,135	NA	NA	NA	Drilled	NA	Union Electric[c]
G-10	330	801	230	571	Drilled	NA	V. Cope
H-1	65	820	20	800	Dug	950	W. Davidson
H-3	350	800	116	684	Drilled	NA	O. Morgan
H-7	755	760	215	545	Drilled	60,000	Curia Land Sales
H-17	Surface	620	0	620	Enclosed Spring	1,650	C. Brooks (Lost Canyon Lake)
H-6	325	761	200	521	Drilled	NA	M. Nickels[c]
H-21	705	795	NA	NA	Drilled	NA	Beaufort Transfer Co.[c]
H-22	755	782	225	557	Drilled	NA	Lost Canyon Estate[c]
H-23	177	740	NA	NA	Drilled	NA	NA[c]
J-8	375	740	125	615	Drilled	760	Schulte
J-9	276	740	60	680	Drilled	100	Snyder
J-12	460	700	140	560	Drilled	250	M. Brown
J-19	420	815	70	745	Drilled	1,110	R. Masek
J-20	400	800	100	700	Drilled	380	D. Bridges
J-23	300	NA	180	NA	Drilled	NA	W. Herring
J-23	375	830	246	584	Drilled	NA	A. Breeden[c]
J-24	500	779	200	579	Drilled	NA	Church of God[c]
J-25	39	700	NA	NA	Drilled	NA	NA[c]
K-4	20	760	15	745	Dug	300	T. Lamons
K-6	297	720	100	620	Drilled	910	A. Diehl
K-11	300	720	100	620	Drilled	400	J. Flowers
K-17	117	640	3	637	Drilled	480	S. Bernard
K-18	118	660	22	638	Drilled	680	C. Bradley
K-26	300	785	220	565	Drilled	NA	C. Diehl[c]

(Sheet 1 of 4)

TABLE 2.4-21 PERMEABILITY OF SITE GEOLOGIC UNITS BASED ON PRECONSTRUCTION BOREHOLE PRESSURE TESTS

CALLAWAY LIMESTONE		DEPTH		PERMEABILITY
BORING	TEST #	FROM	TO	(cm/sec)
P-69	2	102.0	122.0	2.3×10^{-6}
	3[a]	122.0	142.0	3.6×10^{-7}
P-74	3	102.0	122.0	6.3×10^{-7}
	4	122.0	142.0	6.2×10^{-7}
P-147	2[b]	117.0	137.4	2.1×10^{-6}
	3[a]	137.0	157.4	1.2×10^{-6}
P-70	2[b]	106.0	126.0	6.6×10^{-6}
	3	127.0	147.0	1.8×10^{-5}
	4[a]	141.0	161.0	1.9×10^{-5}
P-143	3[b]	107.0	127.4	5.4×10^{-6}
	4[c]	127.0	147.4	1.4×10^{-6}
	5[c]	147.0	167.4	2.6×10^{-6}
P-144	2[b]	106.0	126.4	negligible[d]
	3	126.0	146.4	4.6×10^{-7}
	4[c]	146.0	166.4	9.8×10^{-7}

Range: 1.0×10^{-9} to 1.9×10^{-5} cm/sec

Average: 4.1×10^{-6} cm/sec

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a Interval tested includes part of the upper Cotter-Jefferson City Formation.

b Interval tested includes part of the basal Snyder Creek Shale.

c Interval tested includes part of the upper St. Peter Sandstone.

d No flow detected in interval tested. Conservative value of 1×10^{-9} cm.sec assigned for purposes of data reduction.

TABLE 2.4-21 (Continued) (Sheet 2 of 4)

SNYDER CREEK SHALE		DEPTH		PERMEABILITY (cm/sec)
BORING	TEST #	FROM	TO	
P-69	1[e]	83.0	103.0	2.8×10^{-6}
P-74	1	75.0	95.0	1.6×10^{-6}
	2[e]	82.0	102.0	1.5×10^{-6}
P-147	5[f]	78.0	98.4	1.7×10^{-6}
	1	101.0	121.4	5.9×10^{-7}
P-70	1	87.0	107.0	7.5×10^{-6}
	2	106.0	126.0	6.6×10^{-6}
P-143	1	79.0	99.4	1.5×10^{-6}
	2	88.0	108.4	negligible[d]
P-144	1	86.0	106.4	negligible[d]

Range: 1.0×10^{-9} to 7.5×10^{-6} cm/sec
Average: 2.4×10^{-6} cm/sec

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e Interval tested includes part of the upper Callaway Limestone.

f Interval tested includes part of the Bushberg Sandstone.

TABLE 2.4-21 (Continued) (Sheet 3 of 4)

ST. PETER SANDSTONE AND PALEOKARST RUBBLE		DEPTH		PERMEABILITY (cm/sec)
BORING	TEST #	FROM	TO	
P-70[g]	5	161.0	103.0	4.9×10^{-6}
	6	181.0	201.0	5.0×10^{-6}
	7	201.0	221.0	4.5×10^{-6}
	8	221.0	241.0	4.2×10^{-6}
	9	241.0	261.0	3.9×10^{-6}
P-143	5[h]	147.0	167.4	2.6×10^{-6}
	6	160.0	180.4	2.0×10^{-6}
	7[i]	178.0	198.4	1.8×10^{-6}
	8[i]	198.0	218.4	3.3×10^{-6}
	9[i]	206.0	226.0	1.9×10^{-6}
	10[i]	222.0	242.0	5.8×10^{-7}
P-144	5	166.0	186.4	3.9×10^{-7}
	6	181.0	201.4	3.6×10^{-7}
	7	201.0	221.4	3.2×10^{-7}
	8	219.5	239.9	2.9×10^{-7}
P-147	3	137.0	157.4	1.2×10^{-6}
	4[i]	153.0	173.4	3.8×10^{-7}

Range: 2.9×10^{-7} to 5.0×10^{-6} cm/sec

Average: 2.2×10^{-6} cm/sec

<u>Rubble</u>

Range: 5.8×10^{-7} to 3.3×10^{-6} cm/sec

Average: 1.8×10^{-6} cm/sec

<u>St. Peter</u>

Range: 2.9×10^{-7} to 5.0×10^{-6} cm/sec

Average: 2.4×10^{-6} cm/sec

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g Values based on reevaluation of field pressure test data.

h Tested section includes part of the basal Callaway Limestone.

i Denotes interval zones tested in Paleokarst rubble zone.

TABLE 2.4-21 (Continued) (Sheet 4 of 4)

COTTER-JEFFERSON CITY FORMATION		DEPTH		PERMEABILITY (cm/sec)
BORING	TEST #	FROM	TO	
P-143	11[j]	240.0	260.4	2.7×10^{-7}
P-69	4[j]	141.0	161.0	9.8×10^{-7}
	5	160.0	180.0	1.4×10^{-6}
	6	179.0	199.0	5.0×10^{-6}
	7	198.0	218.0	4.7×10^{-6}
	8[k]			1.3×10^{-5}
	9[k]	218.0	238.0	3.9×10^{-6}
	10[k]	238.0	258.0	3.6×10^{-6}
	11[k]	258.0	278.0	3.4×10^{-6}
	12[k]	278.0	298.0	3.2×10^{-6}
	13[k]	298.0	318.0	3.0×10^{-6}
	14	318.0	338.0	1.9×10^{-5}
	15	338.0	358.0	9.5×10^{-6}
P-74	4[h]	122.0	142.0	6.2×10^{-7}
	5	142.0	162.0	1.6×10^{-6}
	6	161.0	181.0	1.7×10^{-6}
	7	180.0	200.0	1.3×10^{-6}
	8[k]	200.0	220.0	1.5×10^{-6}
	9	219.0	239.0	4.2×10^{-6}
	10[k]	238.0	258.0	3.9×10^{-6}
	11[k]	256.0	276.0	3.6×10^{-6}
	12	270.0	290.0	3.4×10^{-6}
	13[k]	289.0	309.0	3.3×10^{-6}
	14[k]	305.0	325.0	2.0×10^{-5}
	15[k]	328.0	348.0	2.0×10^{-5}
	16	347.0	367.0	5.1×10^{-4}

Range: 2.7×10^{-7} to 5.1×10^{-4} cm/sec

Range (above 300 ft): 2.7×10^{-7} to 4.7×10^{-6} cm/sec

Average: 2.5×10^{-5} cm/sec

Average (above 300 ft): 3.2×10^{-6} cm/sec

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j Intervals at depths adjacent to or underlying St. Peter Sandstone.

k Values based on reevaluation of field results.

(Sheet 1 of 3)

TABLE 2.4-22 PERMEABILITY OF SITE GEOLOGIC UNITS BASED ON PRECONSTRUCTION FALLING HEAD PERMEAMETER TESTS

GEOLOGIC UNIT(s)[a]	PIEZOMETER[b]		PERMEABILITY[c] (cm/sec)
Qu	HS-1		6.8×10^{-8}
	HS-4		2.7×10^{-6}
	P-80T		4.8×10^{-6}
	P-104T		2.5×10^{-7}
	P-104AG		1.9×10^{-7}
	P-80M		3.4×10^{-6}
	P-104M		4.5×10^{-8}
		AVERAGE	1.6×10^{-6}
Pgc	R-1-20		2.4×10^{-5}
	HS-2		9.2×10^{-7}
	HS-3		6.0×10^{-7}
		AVERAGE	8.5×10^{-6}

a Geologic units are designated as follows: Qu - Quaternary deposits; ML - Modified loess; Ag - Acretion-gley; T - Glacial Till; Pgc - Pennsylvanian Graydon chert conglomerate; Mbr - Mississippian Burlington Limestone; Mbs - Mississippian Bushberg Sandstone; Dsc - Devonian Snyder Creek Shale; Dc- Devonian Callaway Limestone; Ojc - Ordovician Cotter-Jefferson City Formation.

b Piezometer effective intervals are given in PSAR Table 2.4-15. Piezometer locations are shown on PSAR Figures 2.4-17 and 2.4-83.

c Permeability values based on the results of falling head permeameter tests conducted in the field.

d Piezometer not operational - permeability values suspect and, therefore, not included in calculation of range or average value for particular units.

TABLE 2.4-22 (Continued) (Sheet 2 of 3)

GEOLOGIC UNIT(s)[a]	PIEZOMETER[b]		PERMEABILITY[c] (cm/sec)
Pgc & Mbr	P-6A-83		6.6×10^{-7}
	P-2-69		3.8×10^{-7}
	P-9-75		9.5×10^{-7}
	R-2-49		2.1×10^{-6}
	P-4-47[d]		5.4×10^{-7}
	P-15-78[d]		9.1×10^{-7}
		AVERAGE	1.0×10^{-6}
Qu & Pgc	R-5-68		1.1×10^{-6}
Pgc & Mbs	P-12-81[d]		2.1×10^{-6}
	P-11-82		5.1×10^{-6}
Pgc, Mbr	P-16-78[d]		1.5×10^{-6}
Mbs & Dsc	P-5A-89		4.5×10^{-6}
Pgc, Mbs & Dsc	P-13-73		4.4×10^{-6}
Mbs & Msc	P-4-120		1.5×10^{-7}
	P-1A-97		2.7×10^{-6}
		AVERAGE	1.4×10^{-6}
Dsc	R-1-84		4.2×10^{-7}
Dc	P-17-127		2.3×10^{-7}
	P-6A-135		1.9×10^{-7}
		AVERAGE	2.1×10^{-7}
Dsc & Dc	P-2-135		3.0×10^{-7}
Dc & Ojc	P-10-145		1.5×10^{-6}
	P-5A-154		6.1×10^{-7}
	P-3-155		3.0×10^{-7}
		AVERAGE	8.3×10^{-7}

TABLE 2.4-22 (Continued) (Sheet 3 of 3)

GEOLOGIC UNIT(s)[a]	PIEZOMETER[b]		PERMEABILITY[c] (cm/sec)
Dsc, Dc & Ojc	R-4-127		2.1×10^{-7}
Dc & Ojc	R-1-148		1.5×10^{-7}
	P-3-155		3.0×10^{-7}
		AVERAGE	2.2×10^{-7}
Ojc	R-6-208		3.0×10^{-7}

TABLE 2.4-23 PRECONSTRUCTION PIEZOMETER WATER LEVEL READINGS

PIEZOMETER	DATE	WATER LEVEL DEPTH	WATER LEVEL ELEVATION
R-1-20	9-17-73	3.6	788.3
	9-18-73	9.7	785.2
Interval: 5-20	9-19-73	8.3	786.6
(3-22)	9-22-73	14.9	780.0
	9-27-73	19.9	775.0
Graydon chert	10-06-73	22.8	772.1
conglomerate	10-16-73	22.4	772.5
	11-07-73	22.8	772.1
	1-08-74	22.5	772.4
	2-24-74	Dry	
	6-24-74	Dry	
	8-29-74	Dry	
	10-30-74	Dry	
R-1-83	9-17-73	13.6	778.3
	9-18-73	33.1	762.1
Interval: 47-83	9-19-73	32.8	762.4
(44-84)	9-22-73	35.8	759.4
	9-27-73	34.5	760.7
Snyder Creek Formation	10-07-73	34.2	761.0
	10-16-73	34.2	761.0
	11-07-73	34.6	760.6
	1-08-74	33.9	761.3
	2-24-74	34.5	760.7
	6-24-74	Dry	
	8-29-74	32.8	762.4
	10-30-74	33.5	761.7
R-1-148	9-17-73	110.2	681.7
	9-18-73	115.8	679.2
Interval: 115-148	9-19-73	111.8	680.2
(107-148)	9-22-73	120.6	674.4
	9-27-73	123.1	671.9
Joachim Formation to	10-07-73	127.5	667.5
Cotter-Jefferson City	10-16-73	131.9	663.1
Formation	11-07-73	142.0	653.0
	1-08-74	147.4	647.6
	2-24-74	148.0	647.0
	6-24-74	Dry	

Effective interval given in parenthesis following slotted interval if intervals differ. Interval depths reported are to the nearest foot.

TABLE 2.4-23 (Sheet 2)

PIEZOMETER	DATE	WATER LEVEL DEPTH	WATER LEVEL ELEVATION
R-1-148 (cont'd)	8-29-74	Dry	
	10-30-74	Dry	
R-2-49	9-15-73	6.8	795.3
	9-19-73	32.9	772.5
Interval: 29-49	9-22-73	39.9	765.5
(25-49)	9-27-73	39.8	765.6
	10-07-73	39.8	765.6
Graydon chert	10-16-73	39.9	765.5
conglomerate to	11-07-73	41.1	764.3
Burlington Formation	1-08-74	Frozen above ground surface	
	2.24-74	43.0	762.4
	6-24-74	43.7	761.7
	8-29-74	24.7	780.7
	10-30-74	36.1	769.3
R-2-179	9-15-73	123.5	678.6
	9-19-73	166.4	639.0
Interval: 114-179	9-22-73	162.8	642.6
(109-179)	9-27-73	173.7	631.7
	10-07-73	180.0	624.4
Callaway Formation to	10-16-73	181.2	624.2
Cotter-Jefferson City	11-07-73	182.0	623.4
Formation	1-08-74	181.4	624.0
	2-24-74	Dry	
	8-29-74	Dry	
	10-30-74	Dry	
R-4-127	8-23-73	63.2	755.5
	9-13-73	72.0	749.9
Interval: 60-127	9-14-73	72.3	749.7
	9-18-73	58.0	764.0
Snyder Creek Formation	9-19-73	55.1	766.9
to Cotter-Jefferson	9-22-73	56.3	765.7
City Formation	9-27-73	57.0	765.0
	10-07-73	60.1	761.9
	10-16-73	62.4	759.6
	11-07-73	67.1	754.9
	1-08-74	74.9	747.1
	2-24-74	80.5	741.5
	6-24-74	Dry	
	8-29-74	92.6	729.4
	10-30-74	95.4	726.6

TABLE 2.4-23 (Sheet 3)

PIEZOMETER	DATE	WATER LEVEL DEPTH	WATER LEVEL ELEVATION
R-5-68	8-23-73	21.5	802.5
	9-13-73	25.5	801.6
Interval: 40-68	9-14-73	25.5	801.6
(5-68)	9-19-73	24.9	802.2
	9-22-73	25.0	802.1
Loess, Accretion gley	9-27-73	25.2	801.9
to Graydon chert	10-07-73	25.3	801.8
	10-16-73	25.5	801.6
	11-07-73	26.2	800.9
	1-08-74	26.4	800.7
	2-24-74	26.6	800.5
	6-24-74	24.8	802.4
	8-29-74	24.7	802.4
	10-30-74	25.3	801.8
R-6-208	9-06-73	169.3	663.5
	9-13-73	192.6	642.5
Interval: 185-208	9-19-73	199.9	635.2
(180-208)	9-22-73	200.9	634.2
	9-27-73	201.7	633.4
Cotter-Jefferson	10-07-73		Plugged @ 45'
City Formation	10-16-73	202.6	632.5
	10-07-73	203.2	631.9
	1-08-74	203.4	631.7
	2-24-74	203.7	631.4
	6-25-74	203.3	631.8
	8-29-74	203.0	632.1
	10-30-74	203.0	632.1
	2-07-75	200.4	632.4
	8-23-73	64.3	787.0
P-1-87	8-30-73	64.8	786.5
	9-06-73	67.0	784.3
Interval: 77-87	9-06-73	67.0	784.3
	9-14-73	67.7	785.7
Graydon chert	9-18-73	63.4	790.0
conglomerate to	9-19-73	68.1	785.3
Bushberg Formation	9-22-73	65.8	787.6
	9-27-73	66.7	786.7
	10-03-73	66.5	786.7
	10-04-73	66.6	786.8
	10-04-73	66.6	786.8
	10-05-73	66.9	786.5
	10-05-73	66.8	786.6
	10-08-73	66.7	786.7

TABLE 2.4-23 (Sheet 4)

PIEZOMETER	DATE	WATER LEVEL DEPTH	WATER LEVEL ELEVATION
R-1-87 (cont'd)	10-09-73	66.6	786.8
	10-11-73	66.6	786.8
	10-12-73	66.5	786.9
	11-07-73	67.3	786.1
	1-03-74	66.7	786.7
	2-24-74	67.7	785.7
	6-25-74	69.0	784.4
	8-29-74	67.9	785.5
	10-29-74	62.8	790.6
	2-06-75	Dry	
P-1-287	8-23-73	211.2	642.2
	8-30-73	211.4	642.0
Interval: 170-287	9-06-73	210.0	643.4
(143-287)	9-14-73	213.3	640.1
	9-18-73	213.4	640.0
Callaway Formation to	9-19-73	213.3	640.1
Cotter-Jefferson City	9-22-73	213.2	640.2
Formation	9-27-73	213.9	639.5
	10-03-73	213.3	640.1
	10-04-73	212.9	640.5
	10-05-73	213.1	640.3
	10-08-73	212.9	640.5
	10-09-73	219.0	634.4
	10-11-73	220.5	632.9
	10-12-73	220.2	633.2
	11-07-73	224.7	628.7
	1-03-74	223.2	630.2
	2-24-74	224.5	628.9
	6-25-74	230.0	623.4
	8-29-74	253.9	599.5
	10-29-74	225.1	626.2
	2-06-75	222.8	628.5
P-1A-27	8-23-73	57.9	793.4
	8-30-73	58.4	792.9
Interval: 87-97	9-06-73	58.0	793.3
(85-97)	9-13-73	60.1	794.0
	9-14-73	61.1	793.0
Graydon chert con-	9-19-73	60.7	793.4
glomerate to Snyder	9-22-73	60.9	793.2
Creek Formation	9-27-73	60.7	793.4
	10-03-73	60.4	793.8
	10-04-73	60.9	793.2
	10-05-73	61.2	792.9

TABLE 2.4-23 (Sheet 5)

PIEZOMETER	DATE	WATER LEVEL DEPTH	WATER LEVEL ELEVATION
R-1A-27 (cont'd.)	10-05-73	61.1	793.0
	10-08-73	60.9	793.2
	10-09-73	60.6	793.5
	10-11-73	60.7	793.4
	10-12-73	60.8	793.3
	11-07-73	61.6	792.5
	1-03-74	61.6	792.5
	6-25-74	63.3	790.8
	8-29-74	60.2	793.9
	10-29-74	69.1	782.2
	2-06-75	66.9	784.4
	8-23-73	33.5	816.2
P-2-69	8-30-73	33.2	816.5
	9-06-73	36.5	813.2
Interval: 41-69	9-13-73	38.3	814.0
(47-69)	9-14-73	38.5	814.0
	9-19-73	38.0	814.3
Graydon chert con-	9-22-73	38.8	813.5
glomerate to	9-27-73	38.1	814.2
Burlington Formation	10-04-73	38.3	814.0
	10-04-73	38.1	814.2
	10-05-73	38.6	813.7
	10-05-73	38.6	813.7
	10-08-73	38.3	814.0
	10-09-73	38.6	813.7
	10-11-73	38.2	814.1
	10-12-73	38.3	814.0
	11-07-73	39.2	813.1
	1-03-74	37.5	814.8
	2-24-74	37.3	815.0
	8-28-74	36.4	815.9
	10-29-74	37.2	816.4
	2-06-75	34.5	815.2
P-2-135	8-23-73	112.6	737.1
	8-30-73	112.5	737.2
Interval: 115-135	9-06-73	110.0	739.7
(106-135)	9-13-73	113.6	738.7
	9-14-73	113.4	738.9
Snyder Creek Formation	9-19-73	111.7	740.6
to Callaway Formation	9-22-73	111.6	740.7
	9-27-73	112.1	740.2
	10-04-73	112.5	739.8
	10-04-73	112.4	739.9
	10-05-73	112.7	739.6

TABLE 2.4-23 (Sheet 6)

PIEZOMETER	DATE	WATER LEVEL DEPTH	WATER LEVEL ELEVATION
P-2-135 (cont'd.)	10-05-73	112.6	739.7
	10-08-73	112.5	739.8
	10-09-73	112.5	739.8
	10-11-73	112.4	739.9
	10-12-73	112.4	739.9
	11-07-73	114.5	737.8
	1-03-74	115.8	736.5
	2-24-74	117.6	734.7
	8-28-74	120.0	732.3
	10-29-74	126.7	725.6
	2-06-75	130.0	719.7
P-3-155	9-13-73	155.3	701.1
	9-15-73	155.9	700.6
Interval: 153-155	9-19-73	156.0	700.4
(149-155)	9-22-73	156.0	700.4
	9-27-73	155.6	700.8
Cotter-Jefferson	10-03-73	155.6	700.8
City Formation	10-05-73	155.9	700.5
	10-08-73	155.8	700.6
	10-11-73	155.8	700.6
	10-12-73	156.0	700.4
	11-07-73	157.5	598.9
	1-03-74	158.0	698.4
	2-24-74	Dry	
	6-25-74	Dry	
	8-28-74	Dry	
	10-28-74	Dry	
	2-06-75	Dry	
P-4-115	8-30-73	38.7	815.0
	9-06-73	35.3	818.4
Interval: 95-115	9-13-73	36.1	817.6
(93-120)	9-15-73	36.0	817.7
	9-19-73	35.7	818.0
Bushberg Formation to	9-22-73	35.5	818.2
Snyder Creek Formation	9-27-73	34.9	818.8
	10-04-73	34.7	819.0
	10-12-73	34.8	818.9
	11-07-73	35.1	818.6
	1-03-74	34.1	819.6
	2-24-74	33.1	820.6
	6-25-74	32.9	820.8
	8-29-74	32.3	821.4
	10-29-74	33.5	820.2
	2-06-75	30.8	820.6

TABLE 2.4-23 (Sheet 7)

PIEZOMETER	DATE	WATER LEVEL DEPTH	WATER LEVEL ELEVATION
P-5A-89	9-14-73	23.0	820.1
	9-17-73	62.0	783.2
Interval: 77-89	9-19-73	61.2	784.0
(72-89)	9-22-73	63.8	781.4
	9-27-73	62.8	782.4
Graydon chert con-	10-03-73	62.9	782.3
glomerate to Snyder	10-04-73	63.0	782.2
Creek Formation	10-05-73	63.3	781.9
	10-08-73	62.9	782.3
	10-11-73	63.4	781.8
	10-12-73	62.8	782.4
	11-07-73	63.4	781.8
	1-03-74	63.0	782.2
	2-24-74	62.9	782.3
	6-25-74	61.1	784.1
	10-29-74	62.1	781.0
	2-07-75	59.1	784.0
P-5A-153	9-14-73	83.5	759.6
	9-17-73	119.9	725.6
Interval: 113-153	9-19-73	130.2	715.3
(107-156)	9-22-73	136.5	709.0
	9-27-73	145.8	699.7
Callaway Formation	10-03-73	146.0	699.5
to Cotter-Jefferson	10-04-73	146.2	699.3
City Formation	10-05-73	146.4	699.1
	10-08-73	146.2	699.3
	10-11-73	146.1	699.4
	10-12-73	146.3	699.2
	11-07-73	147.7	697.8
	1-03-74	154.8	690.7
	2-24-74	Dry	
	6-25-74	147.0	698.5
	8-28-74	Dry	
	10-29-74	Dry	
	2-07-75	152.8	690.3
P-6-91	8-08-73	79.0	767.8
	8-15-73	82.3	764.5
Interval: 77-91	8-23-73	82.9	763.9
(74-91)	8-30-73	83.5	763.3
	9-06-73	83.0	763.8
Burlington Formation	9-13-73	86.6	763.2
to Snyder Creek	9-14-73	86.5	763.3
Formation	9-19-73	80.9	768.9

TABLE 2.4-23 (Sheet 8)

PIEZOMETER	DATE	WATER LEVEL DEPTH	WATER LEVEL ELEVATION
P-6-91 (cont'd)	9-22-73	82.7	767.1
	9-27-73	84.2	765.6
	10-04-73	84.9	764.9
	10-05-73	85.0	764.8
	10-08-73	85.4	764.4
	10-09-73	85.7	764.1
	10-11-73	90.0	759.8
	10-12-73	85.7	764.1
	11-07-73	86.7	763.1
	1-03-74	87.2	762.6
	2-24-74	88.3	761.5
	6-25-74	88.5	761.3
	8-28-74	Dry	
	10-28-74	Dry	
	2-06-75	Dry	
P-6A-83	9-13-73	38.8	811.1
	9-17-73	40.6	809.3
Interval: 13-83	9-19-73	38.6	811.3
(5-83	9-22-73	45.1	804.8
	9-27-73	61.6	788.3
Loess, Accretion gley	10-04-73	67.2	782.7
to Burlington Formation	10-05-73	67.8	782.1
	10-08-73	68.4	781.5
	10-09-73	68.6	781.3
	10-11-73	68.7	781.2
	10-12-73	69.0	780.9
	11-07-73	72.9	777.0
	1-03-74	73.3	776.6
	2-24-74	72.5	777.4
	6-25-74	80.6	769.3
	8-29-74	72.5	777.4
	10-28-74	74.6	775.3
		Piezometer Plugged @ 77.5'	
P-6A-123	9-13-73	122.1	728.0
	9-17-73	125.3	724.8
Interval: 113-123	9-19-73	130.2	719.9
(109-123)	9-22-73	107.8	742.3
	9-27-73	117.5	732.6
Callaway Formation	10-04-73	121.0	729.1
	10-05-73	121.5	728.6
	10-08-73	122.5	727.6
	10-09-73	125.6	724.5
	10-11-73	122.9	727.2

TABLE 2.4-23 (Sheet 9)

PIEZOMETER	DATE	WATER LEVEL DEPTH	WATER LEVEL ELEVATION
P-6A-123 (cont'd)	10-12-73	122.9	727.2
	11-07-73	126.1	724.0
	1-03-74	125.0	725.1
	2-24-74	PVC Pipe blocked @ 2.2'	
P-7-47	8-23-73	27.0	824.5
	8-30-73	Dry	
Interval: 42-47	9-06-73	Dry	
(41-47)	9-13-73	48.6	804.7
	9-15-73	48.6	804.7
Till To Graydon	9-18-73	45.7	807.6
chert conglomerate	9-19-73	28.2	825.1
	9-22-73	34.1	819.2
	9-27-73	39.6	813.7
	10-03-73	43.1	810.2
	10-04-73	43.1	810.2
	10-05-73	44.3	809.0
	10-08-73	44.7	808.6
	10-11-73	44.9	808.4
	10-12-73	45.0	808.3
	11-07-73	47.9	805.4
	1-03-74	Dry	
	2-25-74	Dry	
	6-25-74	Dry	
	8-29-74	Dry	
	10-28-74	Dry	
	2-06-75	Dry	
P-8-155	8-31-73	110.3	746.2
	9-06-73	137.0	719.5
Interval: 116-155	9-24-73	155.6	703.6
(113-155)	9-27-73	156.4	702.8
	10-03-73	157.0	702.2
Callaway Formation	10-05-73	157.2	702.0
to Cotter-Jefferson	10-08-73	157.3	701.9
City Formation	10-11-73	157.2	702.0
	10-12-73	157.2	702.0
	11-07-73	157.6	701.6
	1-03-74	157.1	702.1
	2-25-74	157.6	701.6
	6-25-74	Dry	
	8-29-74	Dry	
	10-28-74	Dry	
	2-06-75	155.0	701.5

TABLE 2.4-23 (Sheet 10)

PIEZOMETER	DATE	WATER LEVEL DEPTH	WATER LEVEL ELEVATION
P-9-75	8-23-73	35.8	812.5
	8-30-73	36.5	811.8
Interval: 65-75	9-06-73	33.2	815.0
(40-75)	9-13-73	38.3	811.7
	9-15-73	38.9	811.1
Graydon chert	9-19-73	38.3	811.7
conglomerate to	9-22-73	38.5	811.5
Burlington Formation	9-27-73	38.3	811.7
	10-04-73	38.6	811.4
	10-05-73	38.8	811.2
	10-08-73	38.6	811.4
	10-11-73	38.5	811.6
	10-12-73	38.4	811.6
	11-07-73	39.1	810.9
	1-03-74	39.1	810.9
	2-24-74	42.5	807.5
	6-25-74	37.5	812.5
	8-28-74	38.2	811.8
	10-29-74	39.3	809.0
	2-07-75	36.2	812.1
P-10-145	8-23-73	46.8	801.5
	8-30-73	54.3	794.0
Interval: 125-145	9-06-73	71.8	776.5
(111-145)	9-13-73	73.0	777.1
	9-15-73	73.4	776.7
Snyder Creek Formation	9-19-73	54.8	795.3
to Cotter-Jefferson	9-22-73	56.9	793.2
City Formation	9-27-73	59.9	790.2
	10-04-73	62.0	788.1
	10-05-73	62.5	787.6
	10-08-73	63.0	787.1
	10-11-73	63.6	786.5
	10-12-73	63.8	786.3
	11-07-73	68.2	781.9
	1-03-74	70.0	779.4
	2-24-74	71.7	778.4
	6-25-74	Dry	
	8-24-74	72.7	777.4
	10-29-74	75.4	772.9
	2-07-75	75.6	772.7

TABLE 2.4-23 (Sheet 11)

PIEZOMETER	DATE	WATER LEVEL DEPTH	WATER LEVEL ELEVATION
P-11-82	8-23-73	74.8	776.2
	8-30-73	74.7	776.3
Interval: 77-82	9-06-73	78.2	772.8
(75-82)	9-13-73	80.7	772.3
	9-15-73	81.2	771.8
Graydon chert con-	9-19-73	80.6	772.4
glomerate to Snyder	9-22-73	80.5	772.5
Creek Formation	9-27-73	80.6	772.4
	10-04-73	82.3	770.7
	10-05-73	82.7	770.3
	10-08-73	84.3	768.7
	10-11-73	83.3	769.7
	10-12-73	83.3	769.7
	11-07-73	83.9	769.1
	1-03-74	83.5	769.5
	2-24-74	83.1	769.9
	6-25-74	80.5	772.5
	8-28-74	83.4	769.6
	10-29-74	Dry	
	2-07-75	82.0	769.0
P-12-81	8-23-73		Piezometer Inoperative plugged @ 2.3'
Interval: 45-81			
(41-81)			
Graydon chert conglomerate			
P-13-73	8-23-73	29.2	818.8
	8-30-73	31.4	816.6
Interval: 63-73	9-06-73	31.0	817.0
(61-73)	9-13-73	32.6	817.2
	9-15-73	33.0	816.7
Graydon chert con-	9-19-73	33.0	816.7
glomerate to Snyder	9-22-73	33.9	815.8
Creek Formation	9-27-73	32.7	817.0
	10-04-73	32.8	816.9
	10-05-73	33.1	816.6
	10-08-73	32.8	816.9
	10-11-73	33.5	816.2
	10-12-73	32.6	817.1
	11-07-73	33.1	816.6
	1-03-74	32.7	817.0
	2-25-74	32.1	817.6
	6-25-74	31.6	818.1

TABLE 2.4-23 (Sheet 12)

PIEZOMETER	DATE	WATER LEVEL DEPTH	WATER LEVEL ELEVATION
P-13-73 (cont'd)	8-28-74	31.4	818.3
	10-29-74	33.1	816.6
P-15-78	8-30-73	49.0	804.8
	9-06-73	75.0	778.8
Interval: 42-78	9-13-73	77.3	777.7
	9-15-73	Dry	
Graydon chert conglomerate	9-19-73	74.9	780.1
	9-22-73	75.5	779.5
	9-27-73	76.9	778.1
	10-03-73	77.5	777.5
	10-05-73	78.8	776.2
	10-08-73	77.8	777.2
	10-11-73	78.5	776.6
	10-12-73	77.9	777.1
	10-13-73	76.8	778.2
	11-07-73	78.8	776.2
	1-03-74	79.5	775.5
	2-24-74	Dry	
	6-25-74	Dry	
	8-29-74	Dry	
	10-28-74	Dry	
	2-07-75	Dry	
P-16-78	8-30-73	31.4	812.0
	9-13-73	41.0	803.5
Interval: 53-78	9-15-73	42.0	802.5
	9-19-73	37.6	806.9
Graydon chert conglomerate to Bushberg Formation	9-22-73	39.3	805.2
	9-27-73	42.2	802.3
	10-03-73	45.7	798.8
	11-07-73	47.6	796.9
	1-03-74	47.2	797.3
	2-25-74	Dry	
	6-25-74	Dry	
	8-29-74	Dry	
	10-28-74	Piezometer Plugged @ 47.5'	
	9-13-73	119.2	719.5
P-17-127	9-15-73	120.6	718.1
	9-19-73	117.4	721.3
Interval: 97-127	9-22-73	117.9	720.8
	9-27-73	115.0	723.7
Callaway Formation	10-04-73	116.8	722.0
	10-05-73	118.8	719.9

TABLE 2.4-23 (Sheet 13)

PIEZOMETER	DATE	WATER LEVEL DEPTH	WATER LEVEL ELEVATION
P-17-127 (cont'd)	10-08-73	118.3	720.5
	10-11-73	118.7	720.0
	10-12-73	118.7	720.0
	11-07-73	121.7	717.1
	1-03-74	121.2	717.5
	2-25-74	121.9	716.8
	6-25-74	122.5	716.2
	10-28-74	Dry	
	2-07-75	119.6	716.7
P-22-304	9-21-73	244.2	600.7
	9-22-73	262.8	582.1
Interval: 130-304	9-27-73	269.5	575.4
(122-304)	10-03-73	269.3	575.6
	10-05-73	269.6	575.3
Callaway Formation to	10-08-73	269.0	576.0
Cotter-Jefferson City	10-11-73	269.2	575.7
Formation	10-12-73	269.3	575.6
	11-09-73	270.1	574.8
	1-03-74	269.6	575.3
	2-25-74	270.1	574.8
	6-25-74	262.0	582.9
	8-29-74	267.8	577.1
	10-28-74	270.7	574.2
PS-1A-51.3	12-13-73	53.6	787.0
	12-22-73	54.0	786.6
Interval: 26-51	1-04-74	54.9	785.7
(24-53)	1-08-74	53.8	785.8
	2-25-74	Dry	
Graydon chert	6-26-74	29.1	811.5
conglomerate	8-29-74	26.3	814.3
	10-28-74	28.5	812.1
	12-23-74	25.6	815.0
PS-1B-20	12-13-73	Dry	
	12-22-73	Dry	
Interval: 5-19	1-04-74	Dry	
(5-20)	1-08-74	Dry	
	2-25-74	Dry	
Loess, Accretion	6-26-74	12.4	828.1
gley, Till	8-29-74	Dry	
	10-28-74	Dry	
	12-23-74	Dry	
	2-07-75	Dry	

TABLE 2.4-23 (Sheet 14)

PIEZOMETER	DATE	WATER LEVEL DEPTH	WATER LEVEL ELEVATION
PS-2-33	12-13-73	30.2	809.7
	12-22-73	23.9	816.0
Interval: 29-33	1-04-74	19.7	820.2
(28-33)	1-08-74	19.1	820.8
	2-25-74	17.6	822.3
Graydon chert	6-26-74	21.4	818.5
conglomerate	8-29-74	15.3	824.6
	10-28-74	19.0	820.9
	12-23-74	15.7	824.2
	11-19-75	12.0	820.5
	1-28-76	14.0	822.5
	2-23-76	14.0	822.5
	3-26-76	17.0	823.5
PS-3-35	12-13-73	29.4	813.3
	12-22-73	25.8	816.9
Interval: 30-35	1-04-74	24.2	818.5
(29-35)	1-08-74	24.0	818.7
	2-25-74	23.9	818.8
Graydon chert	6-26-74	26.7	816.0
conglomerate	8-28-74	24.4	818.3
	10-28-74	25.0	817.7
	12-23-74	25.2	817.5
	2-06-75	25.3	817.4
	11-19-75	22.0	814.1
	1-22-76	23.0	815.1
	2-23-76	23.0	815.1
	3-26-76	24.0	816.1
PS-4A-84.5	12-17-73	31.4	817.8
	12-22-73	30.0	819.2
Interval: 38-85	1-04-74	30.3	818.9
	1-08-74	29.6	819.6
Graydon chert	2-25-74	28.7	820.5
conglomerate	6-26-74	32.4	816.8
	8-29-74	22.1	827.1
	10-28-74	29.6	819.6
	12-23-74	27.0	822.2

TABLE 2.4-23 (Sheet 15)

PIEZOMETER	DATE	WATER LEVEL DEPTH	WATER LEVEL ELEVATION
PS-4B-32.5	12-17-73	26.5	822.6
	12-22-73	26.3	822.8
Interval: 7-33	1-04-74	26.6	822.5
(5-33)	1-08-74	26.3	822.8
	2-25-74	26.1	823.0
Loess, Accretion	6-26-74	25.6	823.5
gley, Till	8-29-74	24.8	824.3
	10-28-74	27.8	821.3
	12-23-74	24.8	824.3
	2-07-75	25.1	824.0
PS-5-40	12-15-73	37.6	814.1
	12-22-73	37.1	814.6
Interval: 36-40	1-04-74	30.1	821.6
(35-41)	1-08-74	29.6	822.1
	2-25-74	29.2	822.5
Graydon chert	6-26-74	27.3	824.4
conglomerate	8-29-74	27.2	824.5
	10-28-74	30.3	821.4
	12-23-74	30.3	821.4
	12.23-74	26.8	824.9
	11-19-75	21.0	819.1
	1-28-76	25.0	823.1
	2-29-76	26.5	824.6
	3-26-76	Under Water	
PS-6-36.7	12-17-73	26.5	821.4
	12-22-73	26.5	821.4
Interval: 32-37	1-04-74	26.7	821.2
	1-08-74	26.5	821.4
Graydon chert	2-24-74	26.1	821.8
conglomeratge	6-25-74	28.5	819.4
	8-29-74	24.5	823.4
	10-29-74	28.2	819.7
	12-23-74	25.7	822.2
	11-19-75	22.0	818.5
	1-22-76	23.0	819.5
	2-23-76	24.0	820.5
	3-26-76	25.0	821.5

TABLE 2.4-23 (Sheet 16)

PIEZOMETER	DATE	WATER LEVEL DEPTH	WATER LEVEL ELEVATION
HS-1-31	12-18-73	Dry	
	12-22-73	Dry	
Interval: 5-31	1-04-74	Dry	
(5-32)	1-08-74	Dry	
	2-25-74	9.0	841.3
Modified Loess,	6-25-74	18.0	832.3
Accretion gley, Till	8-28-74	19.8	830.5
	10-28-74	21.9	828.4
	12-23-74	22.6	827.7
	2-06-75	22.5	827.8
	11-19-75	17.0	822.3
	1-28-76	Under Water	
	2-29-76	20.0	827.3
	3-26-76	Under Water	
HS-2-33	12-17-73	Dry	
	12-22-73	Dry	
Interval: 31-33	1-04-74	35.1	810.4
(31-34)	1-08-74	34.8	810.7
	2-25-74	11.1	834.4
Graydon chert	6-25-74	23.1	822.4
conglomerate	8-28-74	24.5	821.0
	10-28-74	24.6	820.9
	12-23-74	24.3	821.2
	2-06-75	24.2	821.3
HS-3-30.7	12-18-73	Dry	
	12-22-73	32.4	808.5
Interval: 29-31	1-04-74	27.5	813.4
(28-31)	1-08-74	26.6	814.3
	2-25-74	16.9	824.0
Graydon chert	6-25-74	20.4	820.0
conglomerate	8-28-74	19.6	821.3
	10-28-74	19.2	821.7
	12-23-74	18.6	822.3
	2-06-75	20.5	820.4
HS-4-19.5	12-18-73	18.7	818.9
	12-22-73	6.9	830.7
Interval: 5-20	1-04-74	5.9	831.7
	1-08-74	5.6	832.0
Modified Loess,	2-25-74	6.2	831.4
Accretion gley, Till	6-25-74	6.5	831.1
	8-28-74	7.3	830.3
	10-28-74	8.6	829.0

TABLE 2.4-23 (Sheet 17)

PIEZOMETER	DATE	WATER LEVEL DEPTH	WATER LEVEL ELEVATION
HS-4-19.5 (cont'd.)	12-23-74	6.5	831.1
	1-14-75	7.8	829.8
	2-06-75	5.3	832.3
P-80ML	12-19-74	5.0	834.7
	12-20-74	4.5	835.2
Interval: 4-8	12-23-74	5.1	834.6
(3-9)	1-06-75	4.1	835.6
	1-07-75	4.2	835.5
Modified Loess	1-14-75	5.1	834.6
	1-17-75	4.1	835.6
	1-18-75	4.1	835.6
	1-20; 1-21; 1-22; 1-24-75	4.1	835.6
	1-25-75	4.1	835.6
P-80AG	12-19; 12-20-74	Dry	
	12-23-74	Dry	
Interval: 14-17	1-06-75	Dry	
(13-18)	1-07-75	Dry	
	1-14-75	Dry	
Accretion gley	1-17-75	Dry	
	1-18-75	Dry	
	1-20; 1-21; 1-22; 1-24-75	Dry	
	1-25-75	Dry	
P-80T	12-19-74	16.3	823.4
	12-20-74	16.3	823.4
Interval: 23-27	12-23-74	16.5	823.2
(22-28)	1-06-74	16.1	823.6
	1-07-75	17.2	822.5
Till	1-14-75	16.4	823.3
	1-18-75	16.4	823.3
	1-18-75	16.4	823.3
823.3	1-20; 1-21; 1-22;;1-24-75	16.4	823.3
	1-25-75-	16.4	823.3

TABLE 2.4-23 (Sheet 18)

PIEZOMETER		DATE	WATER LEVEL DEPTH	WATER LEVEL ELEVATION
P-104ML		12-19-74	Dry	
		12-20-74	Dry	
Interval:	4-9	12-23-74	Dry	
	(3-10)	1-06-75	Dry	
		1-07-75	Dry	
Modified Loess		1-14-75	Dry	
		1-15-75	Dry	
		1-17-75	Dry	
		1-18-75	Dry	
		1-20; 1-21;		
		1-22; 1-24-75	Dry	
		1-25-75	Dry	
P-104AG		12-19-74	15.9	824.5
		12-20-74	16.0	824.4
Interval:	14-17	12-23-74	16.2	824.2
	(13-18)	1-06-75	16.3	824.1
		1-07-75	16.4	824.0
Accretion		1-14-75	16.5	823.9
		1-15-75	16.3	824.1
		1-17-75	16.7	823.7
		1-18-75	16.6	823.8
		1-20; 1-21;		
		1-22; 1-23-75	16.6	823.8
		1-25-75	16.6	823.8
P-104T		12-19-74	25.1	815.2
		12-20-74	24.3	816.0
Interval:	24	12-23-74	23.6	816.7
	(23-28)	1-06-75	22.8	817.5
		1-07-75	22.8	817.5
Till		1-14-75	22.8	817.5
		1-15-75	22.8	817.5
		1-17-75	22.7	817.6
		1-18-75	22.6	817.7
		1-20; 1-21;		
		1-22; 1-24-75	22.6	817.7
		1-15-75	22.6	817.7

(Sheet 1 of 1)

TABLE 2.4-24 AVERAGE PERMEABILITY FOR PERMANENT MONITORING PIEZOMETERS

GEOLOGIC UNIT(s)[a]	PIEZOMETER[b]	AVERAGE PERMEABILITY[c] (cm/sec)
Dc, Ojc	M1	8.3×10^{-7}
Mbs, Dsc	M2	1.4×10^{-6}
Mbs, Dsc, Ojc	M3	8.5×10^{-7}
Pgc	M4	8.5×10^{-6}
Ojc (Middle)	M5	3.4×10^{-6}
Pgc	M6	8.5×10^{-6}
Dc	M7	4.1×10^{-6}
Ojc (Upper)	M8	3.7×10^{-6}
Ojc (Middle)	M9	3.4×10^{-6}
Pgc	M10	8.5×10^{-6}

a Geologic units are designated as follows:
Pgc - Pennsylvanian Graydon Chert Conglomerate;
Mbs - Mississippian Bushberg Sandstone;
Dsc - Devonian Snyder Creek Shale;
Dc - Devonian Callaway Limestone;
Ojc - Ordovician Cotter - Jefferson City Formation.

b Piezometer effective intervals are given in FSAR Table 2.4-25. Piezometer locations are shown on FSAR Figure 2.4-30.

c Averages taken from similar depths tested.

(Sheet 1 of 1)

TABLE 2.4-25 PERMANENT PIEZOMETER WATER LEVEL READINGS

PIEZOMETER	EFFECTIVE INTERVAL* (feet)	UNITS SCREENED	TOP OF CASING ELEVATION (MSL)	DATE	WATER LEVEL DEPTH (BELOW TOP OF CASING) (feet)	WATER LEVEL ELEVATION (MSL)	REMARKS
M1	97 - 169	Callaway Upper Cotter-Jefferson City	845.2	7/25/79 8/9/79	--- ---	--- ---	Dry Dry
M2	83 - 138	Bushberg Snyder Creek Callaway	853.02	7/25/79 8/9/79	82.69 82.84	770.33 770.78	
M3	72 - 125	Bushberg Snyder Creek Callaway	847.41	7/25/79 8/9/79	119.20 126.17	728.21 721.24	Possibly not stabilized
M4	35 - 58	Graydon	847.96	7/25/79 8/9/79	51.81 57.05	796.15 790.91	Possibly not stabilized
M5	234 - 300	Middle Cotter-Jefferson City	848.37	7/25/79 8/9/79	--- 263.37	--- 585.05	7/25/79 not completed
M6	24 - 45	Graydon	829.42	7/25/79 8/9/79	32.74 33.05	796.68 796.37	
M7	95 - 126	Callaway	829.81	7/25/79 8/9/79	124.68 125.68	705.13 704.13	
M8	130 - 170	Upper Cotter-Jefferson City	829.57	7/25/79 8/9/79	117.72 117.77	711.85 711.80	
M9	230 - 296	Middle Cotter-Jefferson City	829.90	7/25/79 8/9/79	267.79 266.83	562.11 563.07	
M10	40 - 51	Graydon	845.12	7/25/79 8/9/79	34.18 34.90	810.94 810.22	

* Effective interval depths reported to nearest foot below ground.

(Sheet 1 of 1)

TABLE 2.4-26 SELECTED GROUND WATER QUALITY ANALYSES FROM PUBLIC AND DOMESTIC WATER SUPPLIES[a]

FORMATION	MAP KEY	SUPPLY FACILITY	pH	ALKA-LINITY	IRON (Fe)	SODIUM (Na)	POTAS-SIUM (K)	CAL-CIUM (Ca)	MAGNE-SIUM (Mg)	NI-TRATE (NO_3)	SUL-PHATE (SO_4)	CHLO-RIDE (Cl)	FLUO-RIDE (F)	TOTAL DIS-SOLVED SOLIDS (TDS)	TOTAL HARD-NESS (TH)
St. Peter	Q1	Montgomery City	7.7	341.0	0.04	224.5	5.0	20.8	11.7	0.0	146.9	52.5	1.64	768.	100
	Q3	Middletown	7.4	465.0	0.30	200.0	19.4	36.8	22.4	1.3	153.5	10.9	1.00	888.	134
Cotter-Jefferson City	Q3	Bellflower	7.5	429.0	0.14	57.5	6.8	77.6	37.9	0.0	43.8	6.7	0.93	477.	350
	Q4	Portland (Private Supply)	7.7	316.5	0.30	4.2	1.8	74.0	41.2	0.0	14.0	4.2	0.0	432.	354
Roubidoux	Q5	Jonesburg	8.1	295.0	0.06	56.0	8.8	61.6	31.4	0.0	85.0	27.8	2.80	541.	284
	Q6	Hallsville	7.5	357.0	0.04	57.5	7.8	75.2	32.6	0.4	56.8	30.7	1.08	529.	322
Gasconade (Including Gunter Member)	Q7	New Bloomfield	7.6	328.0	0.10	20.0	3.0	68.8	30.1	0.0	17.5	4.8	0.60	414.	296
	Q8	Callaway County PWSD #1	7.2	328.0	0.09	20.0	5.4	76.0	33.5	0.3	36.0	4.9	0.95	449.	628
Eminence	Q9	Fulton	7.7	326.0	0.01	40.0	5.4	64.8	31.1	0.6	38.7	16.6	1.16	441.	290
	Q10	Auxvasse	7.6		0.14	25.5	6.8	60.8	33.0	0.0	14.4	7.4	0.74	350.	263
Potosi	Q11	Cedar City	7.9	289.0	0.45	54.5	5.4	57.6	24.3	0.0	34.8	28.6	1.08	477.	244
	Q12	Cole County PWSD #1	7.8	278.0	0.30	2.5	0.9	64.0	31.6	0.0	18.7	3.5	0.16	344.	290

TABLE 2.4-27 GROUND WATER QUALITY ANALYSES OF SAMPLES FROM THE GRAYDON CHERT CONGLOMERATE

	PIEZOMETER PS-5	PIEZOMETER PS-4A	PIEZOMETER PS-6	PIEZOMETER PS-1A	PIEZOMETER HS-3
pH	8.2	7.7	7.4	7.3	7.8
Total Alkalinity (ppm)	376	331	368	428	436
Bicarbonate Alkalinity (ppm)	458.2	404.5	448.7	521.4	530.9
Total Hardness (ppm)	133	223	333	291	231
CA (ppm)	35.6	53.2	90.0	78.4	57.6
Mg (ppm)	10.7	24.3	26.2	23.1	21.1
Cl (ppm)	20.3	16.8	15.4	47.6	7.4
Na (ppm)	135	71.5	100.0	117.5	98.0
K (ppm)	6.2	0.7	4.2	0.7	16.4

Piezometers bailed January 29, 1975. Piezometers sampled January 30, 1975. Samples analyzed by Missouri Department of Natural Resources, Division of Environmental Health, Jefferson City, Missouri, January 30, January 31, 1975.

(Sheet 1 of 1)

TABLE 2.4-28 DETAILS OF TANKS POSTULATED TO RUPTURE IN ACCIDENT ANALYSIS FOR CALLAWAY PLANT

		SPENT RESIN STORAGE TANK (PRIMARY)	BORON RECYCLE HOLDUP TANK (A OR B)	REFUELING WATER STORAGE TANK
Location		In Radwaste Building	In Radwaste Building	Outside; between Radwaste Building and the Turbine-Reactor Complex
Elevation of Bottom Slab (ft above MSL)		812.0	812.0	835.5
Diameter (ft)		7.0	20.0	40.0
Filled Height (ft)		7.3	19.1	36.8
Volume of Liquid Contents (gal)		2,095	44,800	400,000
Volume of Liquid Contents (ml)		7.929×10^{6}	1.696×10^{8}	1.514×10^{9}
Curie Content for Radionuclides				
Radionuclide	Half-Life (days)			
H-3	4,478	Negligible*	5.92×10^{2}	3.79×10^{3}
Mn-54	303	8.73E+01	1.12×10^{-3}	6.99×10^{-6}
Co-58	71.3	1.83E+03	5.36×10^{-2}	3.36×10^{-4}
Co-60	1,924.9	7.68E+02	7.37×10^{-3}	4.58×10^{-5}
Sr-89	52.0	2.94E+01	9.67×10^{-3}	5.92×10^{-5}
Sr-90	10,263.5	4.05E+00	3.08×10^{-4}	1.92×10^{-6}
Nb-95	35.2	9.00E+00	1.75×10^{-4}	1.31×10^{-6}
Zr-95	65.0	6.36E+00	1.99×10^{-4}	1.25×10^{-6}
I-131	8.07	3.51E+03	3.99×10^{0}	2.34×10^{-2}
Cs-134	748.8	5.34E+03	9.29×10^{0}	1.39×10^{-2}
Cs-137	11,099.9	4.44E+03	6.75×10^{0}	1.01×10^{-2}
Ba-140	12.8	4.89E+00	4.05×10^{-3}	2.56×10^{-5}

* This source term was developed by increasing the tank inventory stated in Table 11.1-6, Sheet 17 by a factor of 3 to ensure that the source term would bound allowable plant operating conditions

(Sheet 1 of 2)

TABLE 2.4-29 PARAMETER VALUES USED IN MODELING GROUND-WATER TRANSPORT OF RADIONUCLIDES FOLLOWING POSTULATED RUPTURE OF LIQUID RADWASTE TANKS AT CALLAWAY PLANT

ORIGIN	SPENT RESIN STORAGE TANK (PRIMARY), BORON RECYCLE HOLDUP TANK (A OR B), OR REFUELING WATER STORAGE TANK		
Destination	Tributary to Mud Creek	Tributary to Logan Creek	Well 23
Direction from origin	S50°W[a]	N40°E[b]	S83°W[b]
Distance (ft) along flow path to destination (discharge point)	4,500[a]	4,400[b]	8,700[b]
Average hydraulic gradient, i	0.0144[a]	0.0148[b]	0.0075[b]
Horizontal permeability (cm/day) K_h	52.0	52.0	52.0
Total porosity, n	0.15	0.15	0.15
Effective porosity, n_e	0.12	0.12	0.12
Dispersion coefficients (cm^2/day)			
D_x	0.589	0.589	0.583
D_y	0.589	0.589	0.583
D_z	$1.0x10^{-6}$	$1.0x10^{-6}$	$1.0x10^{-6}$
Total concentration of cations in ground water (meq/ml) C_{Ca}	0.013	0.013	0.013

TABLE 2.4-29 (Continued) (Sheet 2 of 2)

ORIGIN	SPENT RESIN STORAGE TANK (PRIMARY), BORON RECYCLE HOLDUP TANK (A OR B), OR REFUELING WATER STORAGE TANK		
Destination	Tributary to Mud Creek	Tributary to Logan Creek	Well 23
Cation exchange capacity (meq/g). Q	0.0044	0.0044	0.0044
Equilibrium exchange constants, E			
Co-Ca	1.16	1.16	1.16
Sr-Ca	1.00	1.00	1.00
Cs-Ca	2.21	2.21	2.21
Initial dimensions of slug in formation (cm)			
Spent Resin Storage Tank (Primary) x_o (=y_o =z_o)	375.3	375.3	375.3
Boron Recycle Holdup Tank (A or B) x_o (=y_o =z_o)	1,042	1,042	1,042
Refueling Water Storage Tank			
x_o (=y_o)	2,878	2,878	2,878
z_o	1,219	1,219	1,219

a From Unit No. 1 (closest unit to discharge point).

b From Unit No. 2 (closest unit to discharge point).

(Sheet 1 of 2)

TABLE 2.4-30 RESULTS OF COMPUTER SIMULATION OF GROUND-WATER MOVEMENT OF RADIONUCLIDES TO DISCHARGE LOCATIONS IN NEAREST STREAMS

	AT NEAREST POINT ON TRIBUTARY TO MUD CREEK		AT NEAREST POINT ON TRIBUTARY TO LOGAN CREEK	
RADIONUCLIDE	C (a) max	t (b) max	C (a) max	t (b) max
A. POSTULATED RUPTURE OF THE SPENT RESIN STORAGE TANK (PRIMARY				
H-3	(c)	(c)	(c)	(c)
Mn-54	9.3×10^{-22}	2.19×10^{4}	9.9×10^{-21}	2.09×10^{4}
Co-58(d)	$< 10^{-50}$	1.5×10^{5}	$< 10^{-50}$	1.5×10^{5}
Co-60(d)	1.08×10^{-22}	1.51×10^{5}	1.23×10^{-21}	1.45×10^{5}
Sr-89(d)	$< 10^{-50}$	1.3×10^{5}	$< 10^{-50}$	1.3×10^{5}
Sr-90(d)	3.6×10^{-5}	1.33×10^{5}	5.4×10^{-5}	1.27×10^{5}
Nb-95	$< 10^{-50}$	2.19×10^{4}	$< 10^{-50}$	2.09×10^{4}
Zr-95	$< 10^{-50}$	2.19×10^{4}	$< 10^{-50}$	2.09×10^{4}
I-131	$< 10^{-50}$	2.2×10^{4}	$< 10^{-50}$	2.1×10^{4}
Cs-134(d)	$< 10^{-50}$	2.7×10^{5}	$< 10^{-50}$	2.6×10^{5}
Cs-137(d)	1.65×10^{-5}	2.68×10^{5}	3.3×10^{-5}	2.57×10^{5}
Ba-140	$< 10^{-50}$	2.2×10^{4}	$< 10^{-50}$	2.1×10^{4}
B. POSTULATED RUPTURE OF THE BORON RECYCLE HOLDUP TANK (A OR B)				
H-3	1.2×10^{-1}	2.19×10^{4}	1.4×10^{-1}	2.09×10^{4}
Mn-54	1.2×10^{-27}	2.19×10^{4}	1.0×10^{-26}	2.09×10^{4}
Co-58(d)	$< 10^{-50}$	1.5×10^{5}	$< 10^{-50}$	1.5×10^{5}
Co-60(d)	1.1×10^{-28}	1.51×10^{5}	1.2×10^{-27}	1.44×10^{5}
Sr-89(d)	$< 10^{-50}$	1.3×10^{5}	$< 10^{-50}$	1.3×10^{5}
Sr-90(d)	2.2×10^{-10}	1.33×10^{5}	3.3×10^{-10}	1.27×10^{5}

TABLE 2.4-30 (Continued) (Sheet 2 of 2)

RADIONUCLIDE	AT NEAREST POINT ON TRIBUTARY TO MUD CREEK C_{max} (a)	t_{max} (b)	AT NEAREST POINT ON TRIBUTARY TO LOGAN CREEK C_{max} (a)	t_{max} (b)
Nb-95	$< 10^{-50}$	2.19×10^{4}	$<10^{-50}$	2.09×10^{4}
Zr-95	$< 10^{-50}$	2.19×10^{4}	$<10^{-50}$	2.09×10^{4}
I-131	$< 10^{-50}$	2.2×10^{4}	$<10^{-50}$	2.1×10^{4}
Cs-134	$< 10^{-50}$	2.67×10^{5}	$<10^{-50}$	2.55×10^{5}
Cs-137	2.1×10^{-9}	2.68×10^{5}	4.5×10^{-9}	2.56×10^{5}
Ba-140	$< 10^{-50}$	2.2×10^{4}	$< 10^{-50}$	2.2×10^{4}
C. POSTULATED RUPTURE OF THE REFUELING WATER STORAGE TANK				
H-3	8.6×10^{-2}	2.18×10^{4}	1.0×10^{-1}	2.08×10^{4}
Co-60(d)	1.0×10^{-31}	1.50×10^{5}	1.1×10^{-30}	1.43×10^{5}
Sr-90(d)	1.7×10^{-13}	1.33×10^{5}	2.5×10^{-13}	1.27×10^{5}
Cs-137(d)	4.0×10^{-13}	2.66×10^{5}	8.4×10^{-13}	2.55×10^{5}

(a) C_{max} = peak concentration in μCi/ml at specified discharge point.

(b) t_{max} = time of peak concentration, in days after occurrence of postulated rupture.

(c) Present in tank only in negligible amounts.

(d) Cation exchange hold-back included in simulation.

TABLE 2.4-31 RESULTS OF COMPUTER SIMULATION OF MOVEMENT OF RADIONUCLIDES TO WELL 23[a]

SOURCE	RADIONUCLIDE	C_{max}[b] (µCi/ml)	t_{max}[c] (days)
Boron Recycle Holdup Tank (A or B)	H-3	9.5×10^{-6}	8.16×10^{4}
Refueling Water Storage Tank	H-3	8.4×10^{-6}	8.14×10^{4}
Spent Resin Storage Tank (Primary)	Sr-90	3.0×10^{-16}	4.96×10^{5}

[a] Cation exchange hold-back included in simulation.

[b] C_{max}= peak concentration at the well.

[c] t_{max}= time of peak concentration after occurrence of postulated tank rupture.

TABLE 2.4-32 DETAILS OF DILUTION CALCULATIONS FOR GROUND WATER DISCHARGING TO TRIBUTARIES

RADIO-NUCLIDE	SOURCE	DISCHARGE LOCATION	AVERAGE CONCENTRATION ACROSS PLUME IN DISCHARGING WATER*(μCi/ml)	PLUME WIDTH AT DISCHARGE LOCATION W_p (ft)	LENGTH OF CURVILINEAR LINE CONNECTING UPSTREAM ENDS OF VALLEYS (ON PLANT SIDE) L_c (ft)	DILUTION RATIO L_c/W_p	ESTIMATED ATTENUATED CONCENTRATION AT CHOSEN CONFLUENCE POINT (μCi/ml)	CHOSEN CONFLUENCE POINT LOCATION
		Mud Creek Tributary, 4,500 ft from Radwaste Bldg.	4.7×10^{-2}	177	9,300	52.5	8.9×10^{-4}	In Mud Creek, 11,500 ft. S35°W of plant center
H-3	Refueling Water Storage Tank	Logan Creek Tributary, 4,400 ft from Radwaste Bldg.	5.4×10^{-2}	177	6,400	36.2	1.5×10^{-3}	In Logan Creek, 11,500 ft N45°E of plant center
		Mud Creek Tributary, 4,500 ft from Radwaste Bldg.	5.4×10^{-6}	108	9,300	86.1	6.3×10^{-8}	In Mud Creek, 11,500 ft S35°W of plant center
Sr-90	Spent Resin Storage Tank (Primary)	Logan Creek Tributary, 4,400 ft from Radwaste Bldg.	8.1×10^{-6}	108	6,400	59.3	1.38×10^{-7}	In Logan Creek, 11,500 ft N45°E of plant center

* At time of peak concentration.

2.5 GEOLOGY, SEISMOLOGY, AND GEOTECHNICAL ENGINEERING

The Callaway Plant site is located in Callaway County, Missouri, approximately 10 miles southeast of the town of Fulton (Figure 2.5-1). The site is located in the Central Stable Region a region which was subjected to gentle structural uparching and downwarping during the Paleozoic and Mesozoic eras. The arches, basins, and other structures of the Central Stable Region were formed, with few exceptions, by vertical block tectonics during the Paleozoic Era. Geotechnical investigations conducted at the site and in the surrounding region have not identified the existence of any faults closer to the site than 12 miles.

Bedrock at the site is overlain by nonindurated glacial and postglacial deposits averaging 30 to 40 feet in thickness. These deposits consist of a modified loess accretion-gley, and glacial till. The uppermost bedrock unit at the Callaway Plant site is the Pennsylvanian Graydon chert conglomerate which consists of gravel- to boulder-size chert particles in a clay or silt matrix. The deposits are underlain by Mississippian limestone and sandstone of the Burlington and Bushberg formations respectively, and limestone, siltstone, and shale of the Devonian Snyder Creek and Callaway formations.

The total thickness of the Paleozoic section at the site, including underlying Cambrian and Ordovician sedimentary units, is approximately 2,000 feet. The underlying Precambrian basement rocks 10 miles south of the Callaway Plant consist of highly altered serpentine which becomes porphyritic with depth and is underlain by rhyolite porphyry and tuff.

Gentle warping of the rocks at the site is indicated by the presence of numerous erosional unconformities in the stratigraphic section and the gentle tilting that the strata exhibit. The regional dip is 5 to 10 feet per mile toward the northwest, with dips in the site area of up to 70 feet per mile.

The Callaway Plant site occupies a plateau area where elevations range from about 800 to 850 feet above mean sea level (MSL). The Missouri River passes about 5 miles south of the site at an elevation approximately 300 feet lower than the plant area. The topography surrounding the plateau, particularly between the site and the river, has been maturely dissected by intermittent streams whose gradients locally exceed 400 feet per mile. Glacial and postglacial sediments averaging 30 to 40 feet in thickness cap the plateau where the site is located. The Callaway Plant site is located in an area of the central United States which has been relatively stable seismically. No historic earthquake epicenter has been reported within about 40 miles of the plant site. Only four earthquakes have been reported within 60 miles of the Site since the beginning of the 19th century, none of which were greater than Modified Mercalli Intensity (MMI) V. The 1811-1812 New Madrid event occurred approximately 200 miles southeast from the site with a maximum intensity of MMI XI-XII. Based on seismic investigations which were conducted, a Safe Shutdown Earthquake (SSE) has been determined for safety related structures. The SSE would generate a horizontal ground acceleration of 0.20g in above-average foundation supporting materials. The specified SSE is derived from

consideration of the possible effects of an Intensity XII event occurring at the closest approach of the New Madrid Seismogenic Region to the site a distance of approximately 175 miles; an Intensity VII event occurring anywhere within the Chester-Dupo or Ste. Genevieve seismotectonic regions approximately 70 miles east-southeast of the site; or an MMI V event occurring within the Missouri Random Region near the site.

The results of comprehensive geotechnical investigations at the site demonstrate that competent foundation materials are present for establishing conservative design and construction criteria for support of the Category I facilities. All major Category I structures are supported on competent rock. There are no geologic features at or near the site that would preclude its use for the construction and operation of the nuclear power station.

The geologic investigations for this report included reviews of published and unpublished data, communication with individuals, agencies, and companies knowledgeable about the region or Callaway Plant site area, aerial photographic and Earth Resources Technology Satellite (ERTS) imagery interpretation, reconnaissance geologic mapping, test borings, subsurface correlation, field testing surface and borehole geophysics, and laboratory testing of soils and rock. The firms who performed the work and their respective contributions are shown in the following list.

Investigations	Performed by
Geologic Literature Review	Dames & Moore; T. C. Buschbach - Illinois Geological Survey
Aerial Photographic and ERTS Imagery Interpretation	Dames & Moore
Reconnaissance Geologic Mapping	Dames & Moore
Test Borings	Dames & Moore; Test Drilling Service, Inc.; Raymond International Wabash Drilling Company
Excavation Mapping	Dames & Moore
Field Testing	Dames & Moore
Geophysical Explorations	Dames & Moore
Borehole Geophysical Logging	Dames & Moore Birdwell Division, Seismograph Service Corp
Rock Quarry Studies	Dames & Moore

Investigations	Performed by
Laboratory Soil Tests	Dames & Moore; Geo-Testing, Inc.; M. L. Silver - University of Illinois at Chicago Circle; K. Majidzadeh - Ohio State University
Laboratory Rock Tests	Geo-Testing, Inc.; Richard C. Mielenz; Walter H. Flood & Co., Inc.; Erlin Hime Co; Pittsburgh Testing Laboratory; Daniel International Corp.
Vibratory Ground Motion	Dames & Moore

2.5.1 BASIC GEOLOGIC AND SEISMIC INFORMATION

2.5.1.1 Regional Geology

2.5.1.1.1 Regional Physiography

The site area straddles the boundary between the Dissected Till Plains Physiographic Section to the north and the Ozark Plateaus Physiographic Province to the south. The Dissected Till Plains is a division of the Central Lowland Physiographic Province (Fenneman, 1946). The region surrounding the site encompasses all or portions of numerous physiographic units which are discussed in the following paragraphs. Figure 2.5-2 shows the location of the site with respect to these physiographic units. Site area physiography is discussed in Section 2.5.1.2.1.

Iowa, northern Missouri, and most of Illinois were covered by various glacial advances during Pleistocene time (see Figure 2.5-3). Deposits of glacial till and loess buried a topographic surface of moderate relief and left a featureless plain. The resulting depositional topography is not bedrock controlled; however, some preglacial landforms are reflected through the glacial cover and form minor aspects on the terrain. The glaciated area which occupies the Central

Lowlands Physiographic Province, is divided into the Till Plains and the Dissected Till Plains sections primarily on the basis of drainage development.

The southern boundary of the Dissected Till Plains Section, as defined by the southern limit of glaciation, passes through the site area. As the name implies, this section is well dissected by existing stream drainage. Glacial deposits within the region of study are Wisconsinan and older in age. streams on the older glacial tills are better established and, as a result, have more deeply eroded valleys. A notable feature of this physiographic section is the absence of end moraines. The Till Plains Section lies east of the Mississippi River in Illinois. The topography is characterized by an undulating surface with low relief. Numerous end moraines are present but not strongly developed. They are

the result of an oscillating ice front and vary from faint topographic swells to ridges that stand 100 to 150 feet above the surrounding till plain. Drainage is moderately integrated; however, dissection is not well developed except along major streams.

The Ozark Plateaus region extends across the state of Missouri from the Missouri and Mississippi rivers to northern Arkansas and northeastern Oklahoma an includes the Salem and Springfield plateaus and the Boston Mountains. Topographic forms are the product of maturely dissected, gently dipping, sedimentary rocks of variable hardness. A series of inwardfacing escarpments arranged concentrically around the central Ozark Dome has developed on the more resistant formations.

The Salem Plateau completely encircles the St. Francois Mountains. This region was once a continuous rolling upland surface with elevations from 1,500 to 1,700 feet MSL; however, only remnants remain today. Numerous streams have eroded much of the plateau and cut valleys hundreds of feet deep. Despite extensive dissection, numerous interstream tracts (known locally as "prairies") justify the section being designated a plateau rather than hills. Local relief on the Salem Plateau uplands is seldom as much as 100 feet, but relief adjacent to major streams may be as great as 500 feet. This deep and intricate dissection is one of the features that distinguishes the Salem Plateau from the Springfield Plateau (Thornbury, 1965).

The St. Francois Mountains lie at the center of the Ozark Uplift. Rugged hills of Precambrian igneous rocks rise above the Salem Plateau to a maximum elevation of 1,772 feet MSL, the highest point in Missouri (U.S. geological Survey and Missouri Division of Geological Survey and Water Resources, 1967).

The Springfield Plateau is elevated between 1,000 and 1,500 feet MSL, with moderate to low topographic relief. Much of the plateau consists of flat interfluvial "prairies", separated by stream valleys cut 200 to 300 feet below the upland surface.

Outliers of Pennsylvanian rock locally stand a few hundred feet above the plateau surface and represent persistent remnants of an older, higher land surface that has been interpreted as a peneplain (Thornbury, 1965). The Springfield Plateau is bounded on the south by a prominent escarpment that marks the northern front of the Boston Mountains.

The Boston Mountains rise above the Springfield Plateau to form a prominent, northward-facing, irregular escarpment that attains a height of 800 feet. There are numerous steep cliffs and deep, narrow valleys throughout the province.

A portion of the Coastal Plain Province lies within the study region and consists of the Mississippi Alluvial Plain and East Gulf Coast physiographic sections. The Mississippi Alluvial Plain called the Southeast Lowlands in southeastern Missouri borders the eastern edge of the Ozark Plateaus. This physiographic section lies within the alluvial valley of the Mississippi River and is bounded by prominent valley walls that rise as much as 200 feet above the valley floor. The East Gulf Coast Section displays a series of belted features consisting of several parallel lowlands and cuestas that swing across

Alabama and Mississippi (Lobeck, 1950). The lowlands are rich agricultural belts, and the sandy upland cuestas support extensive tracts of pine forests.

The Interior Low Plateaus Province occupies a transitional region between the Appalachian Plateau and the Central Lowlands. Within the study region, it consists essentially of low, maturely dissected plateaus with silt-filled valleys.

The Osage Plains lie west of the Ozark Plateaus and extend northward from northern Texas across Oklahoma, and into Kansas and Missouri south of the glaciated areas. Much of the Osage Plains section can most aptly be described as scarped plains. The topography ranges from a nearly featureless plain and low escarpments a few hundred feed high to bold escarpments rising as much as 600 feet above adjacent plains (Thornbury, 1965).

The Eastern Lake Section embraces the eastern four of the Great Lakes along with their adjacent lowlands. This section is shown on Figure 2.5-2; however, it lies entirely outside the study region.

Regional drainage in Missouri and Arkansas is toward the east and south into the Missouri, Arkansas, and Mississippi rivers. In Illinois, regional drainage flows west and south into the Illinois and Mississippi rivers.

2.5.1.1.2 Regional Geologic Setting

The area of investigation is within the Central Stable Region of North America as shown on Figure 2.5-4 and discussed by King (1959). This vast region has had a relatively gentle tectonic history since the beginning of Cambrian time, as contrasted with long records of crustal mobility in other parts of the continent.

Precambrian rocks are exposed at the surface within the Canadian Shield. The eroded Precambrian surface dips beneath the Central Stable Region and is overlain by a southward thickening wedge of Paleozoic and younger sedimentary rocks. About 75 miles south of the site, the Precambrian basement is exposed in the core of the Ozark Uplift.

The arches, basins, and other structures of the Central Stable Region, with few exceptions, were formed by vertical block tectonics during the Paleozoic Era. Many of them yield evidence of a prolonged history of development (Eardley, 1962).

The site area is situated along the northern flank of the Ozark Uplift. The Illinois Basin lies to the east in Illinois, while the Forest City and Cherokee basins, separated by the Bourbon Arch, are to the west in Missouri and Kansas. These and other structural features are illustrated on Figure 2.5-5 and discussed in detail in Section 2.5.1.1.

The site is adjacent to the Missouri River at the southern edge of glaciation in North America. The area is characterized by gently rolling upland that has been dissected by

downcutting of the Missouri River and its tributary streams. Glacial and postglacial sediments overlie older unconsolidated deposits and lithified formations of Paleozoic age.

2.5.1.1.3 Regional Geologic History

The study area lies in a geologic region of broad uplifts and basis within which the continental plate and the overlying sedimentary rocks have interacted throughout geologic time. The regional geologic framework is reflected in the paleotopography, the lithology of the rock units, the tectonic history and the geomorphic development of the modern land surface as contained in the geologic record. The following discussions are intended to provide a generalized historical framework for more specific considerations of regional structural geology, seismotectonics, and plant site geology.

2.5.1.1.3.1 The Precambrian Era

The basement rocks of the study region are Precambrian volcanic rocks, intrusive rocks, and metamorphic rocks that are similar to the cratonic assemblage exposed in the Canadian Shield. The oldest rocks are regionally metamorphosed rocks of high metamorphic facies. These rocks are similar to the granulites and schists of the Grenville Province of the Canadian Shield but yield slightly younger radiometric ages (1.46 billion years, Merriam, 1963). Although the precise distribution of basement lithotypes is unknown, the scattered subsurface data available indicate that metamorphic rock types predominate in the area surrounding the Ozark Region.

The only surface exposures of Precambrian rocks of any large areal extent in the midcontinent region are those at the crest of the Ozark Uplift. These exposures are made up entirely of igneous rocks. They consist of large volumes of acidic extrusive rocks that accumulated on the Precambrian surface around volcanic centers in the St. Francois Mountains. This large mass of extrusive rocks was subsequently intruded by granitic bodies that were perhaps derived from the same magmatic source as the extrusive rocks.

A long period of erosion followed the end of volcanic activity in the Ozark Region. A deeply incised dendritic drainage pattern (local relief of at least 500 feet) developed on the flanks of the Precambrian Ozark highland. This topographic surface was exhumed by erosion and generally coincides with the present surface in the most rugged parts of the St. Francois Mountains (Dake and Bridge, 1932). This period of exposure and erosion lasted for several million years until Late Cambrian time when Paleozoic marine seas at least partly submerged the ancestral Ozark highland. Present day structural relief between the St. Francois Region and the Central Illinois Basin is a minimum of 13,000 feet. Relative uplift and subsidence of these areas subsequent to Cambrian time is undoubtedly responsible for much of this relief. The original relief of the ancestral Ozarks above the surrounding region is impossible to estimate.

Precambrian tectonic activity imprinted the terrain in the area with a strong structural fabric. This fabric is expressed as fracture patterns (Robertson, 1940, Kisvarsanyi, 1974b), Precambrian faults known from mine working in Iron County Missouri (Gerdemann, 1966), and in the geometry of Late Precambrian ultrabasic dikes, which are among the most common structural features in the area (Graves, 1938; Gibbons, 1973). Most elements of this fabric are vertical and trend northeasterly or northwesterly.

The site lies on the northern flank of the composite regional structure high known as the Ozark Uplift or the southeast Missouri high (Kisvarsanyi, 1974a). Depth to basement at the site is approximately 2,000 feet. The basement surface has a gentle northward regional slope of a few feet to the mile.

2.5.1.1.3.2 Paleozoic Era

Geologic events that affected the region of the study during the Paleozoic Era are discussed below under the seven subordinate time periods: Cambrian, Ordovician, Silurian, Devonian, Mississippian, Pennsylvanian, and Permian.

Major tectonic movements in the central United States resulted in erosion during the Precambrian, followed by slow subsidence and deposition throughout most of the Paleozoic Era, and finally stability at or near the close of the Pennsylvanian Period. Snyder (1968) stated that the major elements in the time interval that followed the broad uplift and deep erosion during Late Precambrian time included successively:

a. Slow subsidence of the entire midcontinent;

b. Development of major arches and basins with intermittent subsidence and uplift;

c. Regional fragmentation thorough subdivision of the basins by minor arches;

d. Marine oscillation leading to cyclical deposition;

e. Final uplift and stability.

2.5.1.1.3.2.1 <u>Cambrian Period</u>

Due to the absence of Lower and Middle Cambrian rocks throughout most of the Midwest, it is assumed that the long period of erosion that occurred at the close of the Precambrian continued through Early and Middle Cambrian time.

Clastic sediments that predate the Upper Cambrian have been identified in Vernon and Bates counties in western Missouri. Since the exact age of these sediments is not known, they have been dated only as pre-Upper Cambrian (Skillman, 1948), and may be as old as Precambrian.

At the beginning of Late Cambrian time, the Midcontinent surface consisted of a narrow highland belt of volcanic rock flanked by broad, low, gently undulating plains that sloped toward the Keweenawan and Appalachian basins (Snyder, 1968). The Keweenawan Basin extended southwestward along eastern Minnesota, through central Iowa, across southeastern Nebraska, and into Kansas. The Appalachian Basin extended along the region now occupied by the Appalachian Mountains in the eastern United States. The Precambrian lowlands throughout the study area were submerged by shallow seas. Upper Cambrian sandstone was the first Paleozoic sedimentary rock to be deposited over most of the Midcontinent (Snyder, 1968). The Eastern Interior Basin, comprising much of Michigan, Indiana and Illinois, subsided more rapidly than adjacent areas during the Late Cambrian.

The St. Francois Mountains in Missouri remained a topographic high through Cambrian time as indicated by the absence of Upper Cambrian rocks in local areas. The remainder of the Ozark area subsided, however, and sediments transgressively overlapped the higher peaks.

The Cherokee and Forest City basins in northwestern Missouri and eastern Kansas began to subside, resulting in tilting movements down to the southeast (Merriam, 1963).

Major ancestral arches and basins of the central United States began to develop in the latter part of Late Cambrian time and continued into Early Ordovician time. The arches were areas that experienced less subsidence than the adjacent basins (Snyder, 1968).

2.5.1.1.3.2.2 Ordovician Period

Much of Missouri as well as most of the Midwest, remained submerged under a shallow sea at the end of the Cambrian. Sedimentation continued either unbroken or with only minor unconformity into Early Ordovician time (U.S. Geological Survey and Missouri Division of Geological Survey and Water Resources, 1967).

Between the Early and Middle Ordovician, regional uplift occurred throughout a vast region, as reflected by renewed upward movements of the Ozark Uplift in Missouri, along with significant rise of the Wisconsin Dome in central Wisconsin, the Nashville and Lexington domes in Tennessee and Kentucky and the central Kansas Uplift in Kansas. As a result, the seas receded form the Midwest and widespread erosion was initiated. A strong unconformity is recorded within the study region at the close of Early Ordovician time.

Following a long period of erosion during which well developed river systems and solution depressions formed in portions of the Midwest, the sea advanced again over the existing erosional topography. Unconsolidated sediments were reworked and sand was deposited unconformably on the erosion surface over a vast area. Renewed Middle and Late Ordovician deposition in Missouri was not as widespread as during the Early Ordovician, being generally restricted to the northern and eastern parts of the state (U.S.

Geological Survey and Missouri Division of Geological Survey and Water Resources, 1967).

The Ordovician Period ended with uplift and erosion occurring throughout the study region. A major unconformity is present between the Ordovician and Silurian sedimentary rocks.

2.5.1.1.3.2.3 Silurian Period

After an erosional interval of long duration, the region was again inundated by the sea in Silurian time. In Missouri, Silurian and Devonian deposits are relatively thin, restricted in occurrence, and separated below, above, and internally by unconformities (U.S. Geological Survey and Missouri Division of Geological Survey and Water Resources, 1967). In Illinois data indicate that marine waters advanced from the south during Alexandrian time.

Carbonate deposits predominate throughout the region, but sandstones and shales are also present. Reef deposits were laid down in shallow seas around the emergent Ozark Uplift.

The Silurian Period ended in Illinois with widespread emergence. It appears that the region remained above sea level throughout Late Silurian time since no marine deposits of this age are known within the area (Willman and Payne, 1942). In Missouri, widespread uplift and erosion accompanied by faulting occurred at the end of Early Devonian time obscuring the record of Silurian sedimentation (U.S. Geological Survey and Missouri Division of Geological Survey and Water Resources, 1967). In Kansas, Silurian rocks are confined primarily to the northeast quarter of the state.

2.5.1.1.3.2.4 Devonian Period

In northern Illinois, erosion continued from the late Silurian through Early Devonian time. Middle Devonian deposition began with a major transgression of the sea. During this period, the Sangamon and Kankakee arches were formed and acted as barriers to sediment transport. Sedimentation continued through the late Devonian in Illinois with accumulations of calcareous materials and relatively thick Upper Devonian deposits of silt and mud that extend across the Sangamon Arch.

In Missouri, marine deposition continued from Late Silurian time through Early Devonian at which time widespread uplift began with accompanying erosion. In central Missouri, the Middle and Upper Devonian rocks rest unconformably on beds as old as Early Ordovician (U.S. Geological Survey and Missouri Division of Geological Survey and Water Resources, 1967).

The earliest record of vertical movement of crustal blocks in the Ozark Region is preserved in post-Middle Devonian rocks along the eastern flank of the Ozark Uplift. Relative movements among blocks bounded by the southern and central parts of the Ste.

Genevieve Fault Zone result in the preservation of abnormally thick sections of Devonian strata on what are now remnants of the downthrown fault blocks. Subsequent changes in the locus of displacement within the fault zone have isolated these fragments and make their stratigraphic relationships with other rocks of similar age in the region unclear.

In Kansas, Devonian rocks are confined primarily to the northeast quarter of the state.

The Eastern Interior Basin was divided into the Michigan and Illinois basins during Devonian time by continued subsidence of areas adjacent to the Kankakee Arch.

The Devonian Period ended with regional uplift, emergence above seal level, and subsequent erosion. This period of erosion appears to have removed many of the Devonian rocks in northern Illinois.

2.5.1.1.3.2.5 Mississippian Period

The Mississippian Period was a time of widespread shallow submergence throughout the region. The deposition of a more or less uniform and thick sequence of marine carbonate rocks with chert and some sandstone and shale is evident in the stratigraphic sequence over a large part of the area. In some adjacent areas, such as northern Illinois, Mississippian age deposits are rare, since Mississippian seas may never have advanced completely over this region. The Illinois Basin of southern Illinois contains more than 1,400 feet of Late Mississippian strata.

The Cap au Gres Faulted Flexure developed during the Mississippian Period. The Pittsfield-Hadley Anticline in Pike County, Illinois, probably developed at this time, although lack of overlapping Pennsylvanian strata makes the dating somewhat uncertain.

At the close of Mississippian time, the Ozark region rose again and the resultant widespread erosion stripped nearly all the Mississippian rocks from the uplifted area, beveling them over much of the rest of Missouri (U.S. Geological Survey and Missouri Division of Geological Survey and Water Resources, 1967). Pronounced karst topography was developed or exhumed in the Ozarks and stream valleys were eroded into the Mississippian surface. All the borders of the Illinois Basin were uplifted to some extent. The Cincinnati Arch was raised sufficiently to have Chesterian age strata eroded.

2.5.1.1.3.2.6 Pennsylvanian Period

Conditions controlling sedimentation during the Pennsylvanian were considerably different from those during earlier Paleozoic periods. Throughout Pennsylvanian time, highland areas existed along the eastern and southern parts of North America. The continental interior was a plain that was repeatedly submerged by the sea or lay a short distance above it (Willman and Payne, 1942). When the plain was submerged, streams from the highland areas carried rock debris into the sea. As the sea receded, deposition continued in a terrestrial environment. The newly emerged plain became covered by

swamps that extended unbroken for hundreds of miles. Vegetation flourished and accumulated in thick deposits to form coal layers. Eventually the sea returned to initiate another cycle of sedimentation. Each cycle was therefore partly marine and partly terrestrial. Numerous cycles of deposition, many of which are separated by localized erosional unconformities, are recorded in the Pennsylvanian stratigraphy.

Sometime after the end of the Mississippian Period but before Middle Pennsylvanian time, the Bourbon Arch divided the North Kansas Basin into the present Forest City and Cherokee basins. The Forest City Basin became separated from the Salina Basin to the west through development of the Nemaha Uplift (Snyder, 1968). Pennsylvanian deposits in Illinois thin over the LaSalle Anticline, indicating some continued tectonic movement of this structural feature. Deepening of the Illinois Basin and accentuation of the smaller structures continued through the Pennsylvanian Period. Differential subsidence within the basin appears to have produced the DuQuoin Monocline which developed gradually throughout Early and Middle Pennsylvanian time.

In central Missouri, Pennsylvanian strata were deposited over the karst topography and in sinkholes that had formed on the Mississippian rock surface. Stream valleys that had eroded into the Mississippian surface were buried by Pennsylvanian deposits.

An erosional unconformity between Pennsylvanian and Permian strata, where observable, suggests that some uplift and erosion of Pennsylvanian rocks occurred prior to Permian deposition.

2.5.1.1.3.2.7 Permian Period

Permian rocks are rare within the study region but are present in Nebraska, Kansas, Arkansas, and Oklahoma. The Permian is represented in Missouri by the Indian Cave Sand stone of Early Permian age (U.S. Geological Survey and Missouri Division of Geological Survey and Water Resources, 1967). It is not known if Permian strata ever blanketed much of the study region. The existence of marine and nonmarine Permian beds in both the eastern and western United States suggests that these strata may have been deposited in the study region and subsequently removed by erosion.

The last important structural readjustments of the Illinois Basin occurred at the close of the Paleozoic Era in association with mountain building in the Ouachita Region. These events may have overlapped into the Permian; however, the absence of rocks of this period within the region precludes the possibility of a precise age determination. At this time, the Illinois Basin was separated from its original southward continuation by uplift of the Pascola Arch. Rocks as old as Cambrian were eroded from the crest of the arch, and Pennsylvanian strata were removed as far north as the southern tip of Illinois. Major post-Paleozoic faulting appears to radiate into Illinois and northwestern Kentucky from a focus beneath the Cretaceous deposits of western Kentucky. The Rough Creek Lineament, which trends across the southern margin of the Illinois Basin, has been attributed by Heyl et al (1965) to horizontal compression. Gibbons (1972) on the basis of limited reconnaissance during his study of the tectonics of the eastern

Ozarks suggests that the Rough Creek Lineament is a zone of upthrust faults similar to the Ste. Genevieve Fault Zone. Pre-existing structures such as the LaSalle Anticline and the Cap au Gres Faulted Flexure were also accentuated at this time.

2.5.1.1.3.3 Mesozoic Era

The Mesozoic Era is subdivided into the Triassic, Jurassic, and Cretaceous periods.

2.5.1.1.3.3.1 Triassic Period

Geologic events within the study region during Triassic time are difficult to determine. No rocks of Triassic age are known within the region, and it is probable that erosion was the predominant geologic process.

2.5.1.1.3.3.2 Jurassic Period

Jurassic rocks are not present within the study region, and they were probably never deposited. Erosion appears to have been the predominant geological process.

2.5.1.1.3.3.3 Cretaceous Period

Post-Pennsylvanian uplift again raised Missouri above sea level, and no marine deposition has taken place since then except in the area of the Mississippi Embayment (southeast lowlands of Missouri). There, rather sharp downwarping in Late Cretaceous time permitted the sea to advance form the Gulf of Mexico over a peneplained surface of deeply weathered Paleozoic rocks (U.S. Geological Survey and Missouri Division of Geological Survey and Water Resources, 1967).

Cretaceous rocks of reported marine origin have been preserved in west central Illinois (Figure 2.5-1). These deposits consist of uncemented sand and gravel unformably overlying strata of Mississippian and Pennsylvanian age. Their presence suggests that downwarping of the Mississippi Embayment may have been sufficient to allow Cretaceous seas to advance almost to the Iowa-Illinois boundary.

In the western part of the Midcontinent, the basins and arches that were active during the Paleozoic became dormant. The entire area as far east as Iowa, Kansas, and Nebraska subsided slowly and received only a thin blanket of Cretaceous sediment before final uplift.

2.5.1.1.3.4 Cenozoic Era

The Cenozoic Era is subdivided into the Tertiary and Quaternary periods.

2.5.1.1.3.4.1 Tertiary Period

Erosion continued throughout most of the study region during the Tertiary. The amount of erosion that occurred after Pennsylvanian time cannot be determined, but it may have removed much of the pre-existing Pennsylvanian strata as well as younger deposits.

In the Mississippi Embayment, beds of the Paleocene Epoch unconformably overlie the Cretaceous formations. Some bentonite beds are present as a result of distant volcanic action. In southeastern Missouri, sediments of the Eocene Claiborne Group have been tentatively identified for the first time in a deep test well drilled east of Portageville (Russ and Crone, 1979). The last widespread inundation of the Embayment occurred by the close of the Eocene, and the area has remained above sea level since that time (Cushing et al., 1964).

Brown chert gravels containing minor amounts of sand and red clay either as lenses or as a matrix are widely distributed in southeastern Missouri from the Mississippi Embayment north to St. Louis. These deposits are referred to as the Lafayette gravels and they unconformably overlie all older rocks at elevations generally well above the present streams. They seem to represent remnants of stream deposits formed prior to Pleistocene time, and are tentatively regarded as Pliocene in age (U.S. Geological Survey and Missouri Division of Geological Survey and Water Resources, 1967). Scattered remnants of deposits of possible Tertiary age are present in western Illinois as alluvial gravels now found at high topographic levels.

2.5.1.1.3.4.2 Quaternary Period

Glaciation within the study region began in the Pleistocene Epoch about 2 million years ago. Glacial deposits of Nebraskan, Kansan, Illinoian, and Wisconsinan stages are present within the study region; however, Illinoian and older deposits predominate. The limits of the various glacial advances are shown on Figure 2.5-3.

During each advance, the glaciers eroded preexisting deposits. Debris was deposited from the melting ice in the form of till plains, moraines, and outwash during the advance and retreat of the ice. Melt water flowing away from the glacier front was responsible for eroding, reworking, and redepositing many of these materials. Windblown silt, derived from the outwash, was widely distributed over the land surface well beyond the glacier front. Sand dunes developed locally. Between major glacial advances, the climate returned to more temperate conditions. Streams developed more integrated drainage systems. Initially, stream positions were largely controlled by surface features left by the retreating glaciers. As these materials were exposed, weathering processes began modifying them. The thickness and character of the resulting soils are largely functions of climate and duration of the interglacial age.

Northern Missouri was glaciated during the Nebraskan and Kansan stages. Glacial deposits, including till and outwash sand and gravel, are present throughout northern Missouri with a maximum recorded thickness of nearly 400 feet. These deposits are

associated with and overlie a pre-Pleistocene drainage system that is in part unrelated to the modern topography. Some glacial till of Illinoian age is present in the St. Louis area. The Peoria and other loess (windblown silt) deposits are prominent along the Missouri and Mississippi river bluffs. A regional loess distribution map is presented on Figure 2.5-7. The southern part of Missouri was not glaciated and did not receive any of the characteristic glacial deposits, but it was influenced by changes related to glaciation. The alluvial fill in the modern Missouri and Mississippi river valleys is considered to be mostly Wisconsinan in age (U.S. Geological Survey and Missouri Division of Geological Survey and Water Resources, 1967).

2.5.1.1.4 Regional Stratigraphy

Deposits representing all of the systems in the geologic column, except Jurassic and Triassic, are found within the study region (see Table 2.5-1). surface exposures of Precambrian rocks are largely confined to the St. Francois Mountains area of the Ozark Uplift in Missouri. Paleozoic rocks, with the exception of Permian, form thick deposits over major portions of the study region. Younger deposits such as Cretaceous and Tertiary are limited in extent. A major portion of the study region is blanketed by Quaternary sediments that were deposited during various Pleistocene glacial advances. Quaternary sediments consisting primarily of sand and gravel, occur along existing drainages.

The discussions of regional stratigraphy in the following paragraphs are confined to major time-stratigraphic units. Data on stratigraphy were compiled principally from Figure 2.5-8; Howe et al., 1961; U.S. Geological Survey and Missouri Division of Geological Survey and Water Resources, 1967; and Buschbach, 1973. Figure 2.5-1 illustrates the distribution of major time-stratigraphic units. More detailed discussions involving rock-stratigraphic units are included under Site Geology, Section 2.5.1.2. Regional geologic columns are presented on Figures 2.5-8, 2.5-9, 2.5-10, and 2.5-11.

2.5.1.1.4.1 Precambrian Rocks

Igneous, metamorphic, and small bodies of clastic sedimentary rock form the Precambrian basement throughout the region (Kisvarsanyi, 1974a). The crystalline rocks are chiefly granitic in composition with some older metamorphosed volcanic rocks and younger gabbros present. Radioactive dating indicates that much of the metamorphic and intrusive rock in the Ozark region was formed 1,200 to 1,460 million years ago. A long period of erosion preceded the deposition of Cambrian sediments, and much of the region was reduced to a relatively flat plain. Numerous isolated hills several hundreds of feet high were present in eastern Missouri and in western and southern Illinois. The Ozark region stood as an island, locally as much as 2,000 feet above the first Cambrian seas that reached the region.

2.5.1.1.4.2 Paleozoic Rocks

Paleozoic rocks are subdivided into major rock units called systems beginning with the Cambrian Period and ending with the Permian Period. The thickness, character, and stratigraphic relationships of these various rock systems within the study region are discussed in the following sections. A more detailed discussion of site stratigraphy is presented in Section 2.5.1.2.

2.5.1.1.4.2.1 Cambrian System

No rocks of Lower or Middle Cambrian age have been identified in the region. Upper Cambrian strata overlie the Precambrian rocks in pronounced unconformity. The basal unit is an arkosic and conglomeratic quartz sandstone that is widespread throughout the region. The sandstone is more than 1,500 feet thick toward the northeast in Illinois. It is only a few feet to a few hundred feet thick in the study region, and thin to absent over the isolated hills of the Precambrian surface. The sandstone grades upward to dolomite, indicating continued advance of the shallow seas. Although dolomite predominates in the remaining several hundred feet of Cambrian strata, some fine-grained sandstones, siltstones, and shales also occur. Much of the region, including the Ozark area, remained submerged at the end of the Cambrian, and sedimentation continued unbroken or with minor interruption into Early Ordovician time.

Clastic sediments that predate the Upper Cambrian have been identified in Vernon and Bates counties in western Missouri. They have been dated only as pre-Upper Cambrian since the exact age of these sediments is not known and may be as old as Precambrian (Skillman, 1948).

2.5.1.1.4.2.2 Ordovician System

Early Ordovician strata consist chiefly of cherty dolomites with some interbedded quartz sandstones. They are several hundred feet thick in most of the region, but thicken to several thousand feet toward the southeast. These strata are separated from younger sediments by a marked unconformity, the result of uplift and erosion throughout the region. Karst features were developed on the uplifted carbonates before Middle Ordovician sandstones and carbonates were deposited. Some abnormal thicknesses (several hundreds of feet) of sandstones are preserved in sinkholes. The Middle Ordovician carbonates, chiefly limestone, but with some dolomite, are widespread and evenly bedded. Shale partings and some fine-grained sandstone are present locally, but they generally account for only a small percentage of the section. Uplift and some truncation occurred at the end of Middle Ordovician time. Late Ordovician strata were deposited unconformably on a relatively flat surface. The strata consist chiefly of shale, silt stone and carbonates that range from a few to about 200 feet thick. Although these strata were deposited over large areas in the region, uplift and erosion at the end of Ordovician time subsequently removed portions of Late Ordovician strata from many areas.

2.5.1.1.4.2.3 Silurian System

Silurian strata consist mostly of light gray dolomite and limestone with zones of abundant chert. They disconformably overlie the Ordovician rocks and are restricted in thickness and distribution. They were probably not deposited over the Ozark Uplift, but more than 400 feet of Silurian strata are present in the Illinois and Forest City basins. Reefs were abundant on the submerged platforms surrounding the Ozark region. The Silurian carbonates are difficult to separate from the overlying Devonian carbonates, and many studies combine them under the general designation of Hunton Group or Supergroup. Uppermost Silurian and Lower Devonian strata are generally absent in the region, indicating a period of non-deposition and/or erosion between the times of deposition of the Silurian and Devonian sediments.

2.5.1.1.4.2.4 Devonian System

A long hiatus occurs in the record following Silurian deposition. The Ozark region, as well as its northern extensions along the Lincoln Fold and the Mississippi River Arch, were uplifted prior to the advance of Late Middle Devonian seas. More than 1,000 feet of cherty limestone and dolomite were deposited in the southern part of the Illinois Basin during Early Devonian time, but rocks of this age are generally absent from the remainder of the region.

Middle Devonian sediments were deposited in the Illinois and Forest City basins. They are composed chiefly of limestone that is locally very fossiliferous and range from a few feet to a few hundred feet. The Devonian limestone is distinguished from the underlying Silurian carbonates by the presence of thin beds of sandstone or sandy limestone. In southeastern Iowa, anhydrite and gypsum are also present in Middle Devonian strata.

Upper Devonian and lowermost Mississippian sediments unconformably overlie Middle Devonian carbonates. They consist of widespread, dark brown to black, sporebearing shales with some siltstone and limestone. Their maximum thickness is commonly less than 300 feet. They have been removed by erosion from broad areas within the region.

2.5.1.1.4.2.5 Mississippian System

The Early Mississippian began with continued submergence of most of the region beneath shallow seas. During the Middle Mississippian, shales and thin sandstones gave way to widespread deposits of shallow-water carbonates, chiefly limestone, that are cherty and fossiliferous. They are several hundred feet thick over much of the region and thicken to more than 1,000 feet in the Illinois Basin, where some oolitic limestone and anhydrite are included in the upper part of the section.

Most of the region was uplifted to form a broad, low plateau during the Late Mississippian; deposition occurred chiefly in the Illinois Basin where more than 1,400 feet of strata are present. The deposits in the basin are thin, discontinuous, alternating beds of shale, limestone, and sandstone. They consist of about one-half shale and

one-fourth each of limestone and sandstone. The units thicken southward to the present southern limits of the Illinois Basin, where they have been truncated by post-Mississippian erosion.

At the close of Mississippian time, widespread uplift occurred and erosion removed the Mississippian deposits in many parts of the region. Sinkholes and erosional stream channels were formed in the carbonates on the flanks of the Ozark Uplift.

2.5.1.1.4.2.6 Pennsylvanian System

Deposition during the Pennsylvanian took place in widespread, shallow seas and contiguous swamps and deltas. The deposits are decidedly different from older rocks. They consist of thin units of shale, siltstone, limestone, and coal that can be traced over wide areas. Sandstones are present, commonly as channel fill. Deposition was cyclical, with each cycle composed of both marine and terrestrial sediments. Fossils include both marine invertebrates and land plants. The aggregate thickness of Pennsylvanian strata was more than 3,000 feet in the Forest City and Illinois basins. Post-Pennsylvanian erosion has removed these rocks from the Ozark Uplift and the Mississippian Arch, and has caused considerable thinning in many other areas.

Throughout much of the region where cherty carbonate rocks, such as those deposited during Mississippian time, have been exposed to erosion, weathering has formed a deposit consisting of iron-rich insoluble clay containing resistant chert layers and nodules. This chert conglomerate has largely developed by continued weathering of the parent rock. Colluvial and stream action reworked the chert conglomerate during Pennsylvanian and possibly post-Pennsylvanian time. Additional weathering of the reworked deposits may have produced a secondary residuum in some localities.

2.5.1.1.4.2.7 Permian System

Permian rocks are rare in the region. Some sandstone-filled channels in northwestern Missouri are cut into Upper Pennsylvanian beds and have been identified as being Permian in age. West of the study region, Permian rocks conformably overlie Pennsylvanian deposits. They grade upward from an alternating marine and nonmarine sequence to dominantly terrestrial red beds, indicating a general emergence during that period. The entire region apparently remained above sea level most of the time until Late Cretaceous seas invaded the Mississippi Embayment.

2.5.1.1.4.3 Mesozoic Rocks

Mesozoic rocks are poorly represented within the study region. Of the three rock systems that were formed during Mesozoic time (Triassic, Jurassic, and Cretaceous), only the Cretaceous is present.

2.5.1.1.4.3.1 Triassic System

No rocks of Triassic age are known within the study region.

2.5.1.1.4.3.2 Jurassic System

No rocks of Jurassic age are known within the study region.

2.5.1.1.4.3.3 Cretaceous System

Downwarping and faulting along the present course of the Mississippi River permitted Late Cretaceous seas to advance at least as far north as southern and southwestern Illinois and perhaps as far north as the Iowa-Illinois boundary. Cretaceous sediments unconformably overlie rocks ranging from Pennsylvanian age in southern Illinois to those of Cambrian age along the crest of the Pascola Arch in southeastern Missouri and western Tennessee. Cretaceous sediments are several thousand feet thick just south of the region of study but they thin regularly northward.

2.5.1.1.4.4 Cenozoic Rocks

The Cenozoic rocks are divided into the Tertiary and Quaternary system.

2.5.1.1.4.4.1 Tertiary System

Paleocene sandstone, limestone, and claystone unconformably overlie the Cretaceous rocks. They are found principally in the Mississippi Embayment and are commonly less than 200 feet thick in the region. The overlying Eocene strata are sandstone with interbedded claystone, siltstone and lignite. They range up to 450 feet thick just south of the study region. Sediments of the Eocene Claiborne Group and two formation of the Eocene Wilcox Group have been tentatively identified for the first time in southeastern Missouri in a deep test well (Russ and Crone, 1979).

2.5.1.1.4.4.2 Quaternary System

Pleistocene deposits up to several hundred feet thick unconformably overlie bedrock in the northern and eastern portions of the study region. They consist of glacial tills, outwash sands and gravels, and loess. Quaternary alluvial deposits occur along existing drainage courses.

2.5.1.1.5 Regional Tectonic Structures

Tectonic features over 200 miles from the site area are shown on Figure 2.5-5. Tectonic features within the study region are illustrated on Figures 2.5-12, 2.5-13, and 2.5-14. An attempt has been made to show as many structural features within the study region as possible; however, some generalization has been necessitated by the small-scale

mapping of closely spaced features such as zones of intense faulting in southern Illinois, some distance from the site area.

Data tabulations for all tectonic features illustrated or discussed in this report are presented in Tables 2.5-2 and 2.5-3, with references to additional data sources. Folds and faults within 50 miles of the site are tabulated in Tables 2.5-4 and 2.5-5.

Available evidence indicates that the structural style of the entire Ozark Region is block or upthrust faulting. Basement "rooted" upthrust faults form the boundaries of blocks a few or a few tens of miles on a side. Minor faults and folding associated with basement rooted faults of all scales are present as subsidiary features within blocks. Block boundaries display a strong preferred orientation, trending northeasterly and northwesterly and having structural relief as a few tens to more than a thousand feet between blocks.

All elements of the structural geometry of the region appear to have been inherited from a Precambrian structural fabric (Gibbons, 1972; Graves, 1938; Robertson, 1940; Tikrity, 1968; Heyl, 1977). Displacements along the individual features represent localized Paleozoic uplift and subsidence.

Based upon the work of Dake and Bridge (1932), the Ozark Region has been a topographically positive region since at least early middle Cambrian time. The relief present at that time probably represented the erosional resistance of the thick, silicic extrusive volcanics that comprise the Precambrian core of the St. Francois Mountains. The surface of the Precambrian rocks was deeply incised by streams before the onset of Cambrian sedimentation at least 500 feet of relief (Dake and Bridge, 1932). The Cambrian and Ordovician sedimentary rocks were deposited and subjected to differential compaction over the preexisting topography. Much of the structural geometry of the region is a result of this pronounced paleotopographic effect (Dake and Bridge, 1932; Weller and St. Clair, 1928; Tikrity, 1968).

The tectonic character of the region is the result of a sequence of episodes of relative vertical uplift, subsidence, and tilting of crustal blocks which are bounded by upthrust faults. The geometry of the blocks appears to be inherited from an older, possibly Grenvillian, structural fabric. The traces of steeply dipping block-bounding faults, associations with faulted monoclines, the strikes of vertical Precambrian dikes, fracture patterns in Precambrian rocks, fracture patterns in the sedimentary rocks of the region, and traces of minor faults all reflect a consistent geometry (Graves, 1938; Robertson, 1940; Gibbons, 1972). The majority of folding in the region is either the result of the passive draping of relatively weak sedimentary rocks over the edges of fault blocks, or of the previously mentioned paleotopographic effects.

In only one area are any features present that represent a tectonic style other than that described above. Several strike slip faults have been noted by mine geologists in the working of St. Joe Minerals corporation in the Missouri lead belt. These features are restricted to a zone along the strike of the Simms Mountain Fault in the downthrown

Farmington block (Figure 2.5-15). Only a few such features are known. All strike at a high angle to the Simms Mountain Fault and are essentially vertical. Horizontal slickensides and mullions are evident in several cases. In the St. Joe Mineral Corporation's Des Lodge Mine, one fault laterally offsets the crest of a reef in the Bonneterre Formation by 600 feet. No evidence of strike-slip faulting is present anywhere else in the eastern Ozark Region. The strike-slip faults appear to be the product of local compression of the edge of the Farmington block resulting from the rotation of that edge of the block against the Simms Mountain block when it was tilted during uplift. This tilting is the result of greater uplift along the eastern edge of the block than along the western edge. Westerly primary dips of sedimentary rocks in the Farmington block have been reversed; the oblique nature of the displacement along the Big River Fault substantiates this interpretation (Gibbons, 1972).

The geometry and boundaries of the major blocks represent inherited zones of weakness. Some segmentation of blocks by minor faults has occurred, but blocks several tens of miles on a side have generally acted as cohesive tectonic units. Where major, persistent features have acted as boundaries of several adjacent blocks (Ste. Genevieve Fault, Simms Mountain Fault) their role has been passive (see Figure 2.5-15). These features represent kinematic surfaces which have responded to the episodic uplift of contiguous individual blocks throughout Paleozoic time. The vertical stratigraphic separation and sense of vertical offset along any segment of these features is a reflection of the vertical motions of blocks responding to local uplift, rather than to uniform motion along the entire length of the major faults (Gibbons, 1972).

The response of the sedimentary rocks overlying the faults has been entirely passive. A characteristic assemblage of monoclinal folds, curving reverse fault planes, compensatory normal faults, and minor low angle normal faults illustrate passive response to repeated vertical movements along nearly vertical basement discontinuities (Gibbons, 1972).

The gross regional structural pattern of this portion of the continental interior appears to be the result of local uplift and subsidence of blocks, or groups of blocks, along pre-existing structural discontinuities. The dome and basin character of the region is the direct expression of deep crustal or subcrustal adjustments. These adjustments have produced relief on the basement surface through vertical displacement of basement blocks which inherited their geometry and which appear to have persisted as structural units through the entire history of the region. The tectonics of the region must, therefore, be based upon an understanding of vertical kinematics rather than to lateral or horizontal compressive forces.

The structural features shown on Figures 2.5-12 and 2.5-13 probably reflect basement structures and the features must all be considered deep seated. It is possible that some of these features may have been caused or influenced by other mechanisms, such as the differential compaction of sedimentary beds emplaced over a Precambrian surface that has substantial topographic relief. However, it is not possible to definitely delineate

such origins for individual structural features with the present level of information available regarding the structural geology of central Missouri.

Much of the information regarding the structural geology in the region around the site is derived form investigations conducted some time ago, as reflected by many early dates for the FSAR structural references. These studies, although generally excellent, present information based on scattered surface exposures and limited subsurface control. As a result, information in this early literature on many structures is often tentative or incomplete with regard to their exact location, magnitude, age, and origin. McCracken (1971) presented a composite structural map of Missouri; however, her report is essentially a compilation of previous studies and relatively little new information is presented. Many of the structural features in central Missouri have not been studies in greater detail since the original investigations due to the lack of economic incentives and to the region's isolation from densely populated areas. Dames & Moore, with the help of the Missouri Geological Survey and Water Resources, gathered available field and subsurface data in order to compile contour maps to better understand and define structures mentioned in the literature.

The structural features in the region of the site were probably formed by differential uplift and settlement of crustal blocks in a manner similar to that which resulted in the formation of the Ozark Uplift. The relationship between these small features and the Ozark Uplift is imperfectly understood due to the poor exposures and lack of subsurface information. It is nevertheless clear that the forces that formed the Ozark Uplift also were instrumental in the formation of these minor structures. The tectonic forces were essentially vertical and are considered by some investigators to have resulted from isostatic adjustment. That these forces acted upon blocks of considerable size has been demonstrated by Gibbons (1972).

The blocks described by Gibbons within the central area of the Ozark Uplift demand comparison to the concept of crustal blocks as proposed by McGinnis (1970). It is conceivable that the uplift and subsidence of crustal blocks is a direct result of vertical forces originating in the mantle. It also might be speculated that the smaller features were formed contemporaneously with the Ozark Uplift and that, consequently, there is a direct relationship. However, this is not necessarily true and it could also be reasonable to speculate that minor faulting and folding near the site were formed independently by vertical forces working on discrete, independent crustal blocks.

Most faulting and folding in the study region is Late Paleozoic in age, but some structures are postulated to be post-Paleozoic. Exact dating cannot be determined for some structures due to the absence of younger sedimentary sections overlying features.

Hayes (1962) proposed major structural lineaments in the Precambrian rocks of Missouri based upon exposed structures, magnetic and gravity features, and sparse information from drill holes to the Precambrian. These lineaments may be related to structures which are part of the Precambrian structural fabric which has controlled the structural geometry

of the region. There are no structures which can readily to related to the lineament nearest the site, along the Missouri River.

At the junctions of Precambrian lineaments some cryptoexplosive structures exist. No proven cryptoexplosive structure is present, however, at the lineament junction nearest the site. This junction is associated with the Wardsville Fault and occurs 30 miles west-southwest of the site. The nearest cryptoexplosive structure is the Crooked Creek structure 60 miles to the south-southeast. No recorded seismic activity has been attributed to these two lineament junctions, but two epicenters have been reported near the Palmer Fault System where it joins the Crooked Creek structure.

No regional tectonic structures significantly adverse to the site have been identified.

2.5.1.1.5.1 Regional Folding

Discussions of regional folding are confined primarily to folds within 50 miles of the site area; however, distant or very large features, such as the Mississippi Embayment, that have a bearing on the various regional and site considerations with regard to geology and seismology are also included. Regional folding is tabulated in Tables 2.5-2 and 2.5-4 which include reference to data sources, and is shown on Figures 2.5-5, 2.5-12, and 2.5-14. In addition, data were obtained through written communications (Buschbach, 1973).

Regional tectonic relationships suggest that most of the folding within the study region is Paleozoic in age (Gibbons 1972). Post-Paleozoic movement on some folds is suggested; however, the age of movement for some folds cannot be defined due to the absence of a younger rock sequence. The only area in the study region where past-Paleozoic folding can be demonstrated is in the Mississippi Embayment, where major movements occurred during the Cretaceous and Early Tertiary (see Section 2.5.1.1.5.1.10).

Movement of the Ozark Uplift during Late Paleozoic time has slightly affected the regional attitude of the rock strata. Within the site vicinity, a slight regional dip of 5 to 10 feet per mile to the northwest, away from the Ozark Uplift has been reported (Unklesbay, 1955). Folding in the site vicinity is discussed in Section 2.5.1.2.3.1.

2.5.1.1.5.1.1 Dupo-Waterloo Anticline

The Dupo-Waterloo Anticline (No. 3 in Illinois on Figure 2.5-12) has an axial trend to the north-northwest. It extends from Monroe County, Illinois at its southern end, through St. Louis, Missouri and terminates before reaching the Cap au Gres Faulted Flexure about 12 miles north of St. Louis (Buschbach, 1974; Laclede Gas Company, 1974; Tikrity, 1968). Outcrops in the Dupo area reveal that the eastern flank of the structure has a dip of 2 to 3 degrees and the western flank has dips of up to 30 degrees. The anticline was probably active intermittently from Silurian time to post-Pennsylvanian time. Major movements appear to have occurred in late Mississippian or in pre-Pennsylvanian, and

pre-Pleistocene time (Bell, 1929). Near Waterloo, total structural relief is at least 500 feet.

Based upon outcrops and boring data, the southern end of the anticline is terminated in central Monroe County, Illinois about 35 miles north of the Ste. Genevieve Fault Zone. Movements of the Ste. Genevieve Fault Zone occurred during the same period as did movements on the Dupo-Waterloo Anticline. Both structures may have resulted from the stresses established during elevation of the Ozark Uplift and downwarp of the Illinois Basin. No structural link, however is known or suspected to exist between the Dupo-Waterloo Anticline and the Ste. Genevieve Fault System.

2.5.1.1.5.1.2 Illinois Basin

The Illinois Basin (see Figure 2.5-5) is a spoon-shaped structural basin surrounded by the Cincinnati Arch to the east, Wisconsin Arch and uplands to the north, Mississippi River Arch to the northwest, and the Ozark Uplift to the southwest. Most of the Paleozoic systems thicken toward the center of the present Illinois basin. Before they were uplifted and truncated by erosion at the end of the Paleozoic, the systems continued to thicken an unknown distance farther to the south. The southern limits of the Illinois Basin formed at about the end of Paleozoic time when the rocks in southeastern Missouri and northwestern Tennessee, between the Ozark Uplift and the Nashville Dome, were uplifted to form the Pascola Arch. The limit of the Illinois Basin is best defined by the -500 MSL contour on top of the Ordovician Galena Group (see Figure 2.5-9). This places the southern limits of the basin along the Ste. Genevieve Fault Zone to the west, through Pulaski County, Illinois, southeast to Callaway County, Kentucky, eastward to include Stewart and Montgomery counties, Tennessee, and northeast through Robertson County, Tennessee and Barren County, Kentucky (Buschbach, 1974). The Precambrian basement rocks are 11,000 to more than 13,000 feet lower at the center of the basin than at the positive areas bordering it.

2.5.1.1.5.1.3 LaSalle Anticlinal Belt

The LaSalle Anticlinal Belt (Figure 2.5-5) is an extensive asymmetrical fold that extends in Illinois from Lee County in the northwest to Lawrence County in the southeast. The west limb dips sharply into the deeper part of the Illinois Basin, while the east limb dips gently into the eastern shelf of the basin. The crest of the anticline plunges to the south-southeast. Initial deformation along the LaSalle Anticlinal Belt took place in post-Mississippian time. Deformation continued through Early Pennsylvanian time, particularly at the southern part of the structure. Renewed activity occurred after Pennsylvanian time, probably at the close of the Paleozoic Era.

2.5.1.1.5.1.4 Mississippi River Arch

The Mississippi River Arch (Figure 2.5-5) is a broad, corrugated fold that extends generally north-south through the bulge of western Illinois. To the north, it blends with the Wisconsin uplands and to the south it intercepts the Lincoln Anticline. The arch

separates the Illinois Basin from the Forest City Basin. Dating of movements along the arch is difficult because erosion has removed the Pennsylvanian strata. It appears, however, that the Mississippi River Arch existed early in Pennsylvanian time and was probably subjected to additional deformation at the end of Paleozoic time. The arch is cut by numerous cross folds that trend northwest-southeast and plunge southeastward into the Illinois Basin.

2.5.1.1.5.1.5 Sangamon Arch

The Sangamon Arch (Figure 2.5-5) was formed by uplift in central and western Illinois during Devonian and Early Mississippian time. The arch extends from the Mississippi River Arch eastward to Macon and DeWitt counties in central Illinois. Although several hundred feet of Devonian and Silurian strata, normally present in surrounding areas, were either not deposited over or were eroded from the arch, later movements have masked the arch so that it does not show on structure maps of the area. It is a relic structure that is interpreted from stratigraphic evidence in the region.

2.5.1.1.5.1.6 Bourbon Arch

Merriam (1963) states that this is a low, indistinct, seemingly up-arched feature that rends almost east-west in eastern Kansas through parts of Bourbon, Allen, Anderson, Coffey, Woodson, Lyon, and Chase counties, separating the Forest City Basin on the north from the Cherokee Basin on the south (Figure 2.5-5). It is supposedly pre-Middle Pennsylvanian, post-Mississippian in age.

2.5.1.1.5.1.7 Cherokee Basin

The Cherokee Basin was formed by mild downwarp in Pennsylvania time (Merriam, 1963). It is bounded on the north by the Bourbon Arch and on the west by the Nemaha Uplift. It is the northern extension of the McAlester or Arkoma Basin of Oklahoma that developed in pre-Middle Pennsylvanian, post-Mississippian time. The maximum thickness of the sedimentary sequence in the basin is about 3,500 feet and consists of Permian and older rocks.

2.5.1.1.5.1.8 Nemaha Anticline

The Nemaha Anticline, or the Nemaha Uplift, is probably the most significant structural feature in Kansas. It is a major pre-Middle Pennsylvanian, post-Mississippian element that extends across Kansas from Nemaha County on the north to Summer County on the south and into Nebraska and Oklahoma (Merriam, 1963). The Nemaha has been subjected to extensive exploration. It is recognizable in surface rocks of Permian and Pennsylvanian age along most of its length but is more pronounced in the subsurface. The structure is faulted along the east side by both high angle reverse and normal faults. Precambrian rocks lie within 600 feet of the surface along the crest of the uplift but plunge farther below the surface toward the south (Merriam, 1963).

2.5.1.1.5.1.9 Forest City Basin

The Forest City Basin (Figure 2.5-5) is located in northwest Missouri and adjacent portions of Nebraska, Kansas and Iowa. It contains beds of Pennsylvanian and Permian age that dip toward a common center located near Forest City, Holt County, Missouri (McCracken 1971). The structure is bounded on the west by the Nemaha Uplift, on the south by the Bourbon Arch,, and on the north in Iowa by the Thurman-Redfield structural zone. To the east, the boundary is indistinct.

Lee (1943) believed the Forest City Basin was originally both a structural and topographic basin that did not come into existence until after Mississippian time. The basin was formed by rejuvenation of the Nemaha Anticline prior to Pennsylvanian deposition which was associated with downwarping of a post-Mississippian peneplain that had been formed by long continued erosion.

2.5.1.1.5.1.10 Mississippi Embayment

This feature (Figure 2.5-5) has been described as a spoonshaped depression area extending north from the Gulf Coast Embayment generally parallel to the Mississippi River in which sediments of Late Cretaceous and Early Tertiary age have been preserved. The structure is pre-Late Cretaceous (Gulfian) in age and was subjected to increased deepening in Early Tertiary time until the close of the Eocene (McCracken, 1971; Cushing et al., 1964; Olive, 1972). Development of the structure may have begun as early as the end of the Paleozoic with tectonic movement associated with the Alleghenian Orogeny (Cushing et al., 1964). The eroded surface of Paleozoic rocks slopes from the Ozark escarpment southward under the Cretaceous and younger rocks at an average rate of 35 feet per mile.

2.5.1.1.5.1.11 Ozark Uplift

The Ozark Uplift (Figure 2.5-5) is the dominant structural feature in Missouri. The structural center of this uplift is in Iron County, Missouri; however, the topographic axis extends northeast from Barry to Iron county. The boundaries of the Ozark Uplift are not well defined locally, particularly to the north and northwest; however, they generally correspond to the Ordovician-Mississippian rock contacts to the east and west and to the Mississippi Embayment on the south.

The Ozarks have been the subject of geological study since the early nineteenth century. Several hypotheses about the structural nature of the Ozarks have been advanced. Broadhead (1889) published the earliest comprehensive geological history of the Ozark region which mentions an upwarping or uplifting of the basement rocks to form the uplift. Broadhead cites "vertical uplifting forces" which he also calls "upthrusting" as the mechanism of uplift. He describes the Ozark region as an "anticlinal" form which becomes "monoclinal" at its edge (which edge is not specified). Keyes (1894) called the Ozarks a geanticline and cited horizontal compression as the mechanism of formation,

drawing an analogy with the Ouachitas. Keyes' hypothesis seemingly was not accepted as it was not mentioned again in the literature of the late 1800's and early 1900's.

Schuchert (1910) proposed that the ultimate cause of uplift was isostatic compensation for sedimentary loading of the continent in other areas. Twenhofel (1926) suggested that intrusion at depth produced the uplift, and he drew an analogy to the Rose Dome in southeastern Kansas. Dake (1927) pointed out that "doming" was episodic, with one main phase ending at the close of Bonneterre time. Their conclusion is based on the onlap relationship between the Potosi and the Bonneterre formations. Flint (1918) proposed that the only other important activity occurred during the Mississippian. Weller and St. Clair (1928) interpreted the block faulting (which they asserted was of Devonian age) as the result of "tension" arising from the extension of sedimentary rocks over the rising dome. Weller and St. Clair did an excellent job of mapping in Ste. Genevieve County. They recognized that some major faults were reverse faults, but contended that they were unrelated to the Ozark Dome. Wheeler (1965) advanced the hypothesis that the Ozarks are a huge klippe of an overthrust sheet rooted in the Ouachitas. His ideas have been generally rejected by most geologists (Franks, 1966; Muehlberger, 1966). McCracken (1971) described the Ozark Uplift as a broad, slightly asymmetrical, quaquaversal fold. Structural mapping on the Roubidoux Formation (McCracken, 1967) suggested that the Ozarks were fractured in the form of a ruptured dome centered in Iron County, with movements continuing from post or late Paleozoic time.

Dake and Bridge (1932) concluded that the Ozark Region was a topographically positive region prior to early middle Cambrian time. The relief present at that time probably represented the erosional resistance of the thick silicic volcanics which comprise the Precambrian core of the St. Francois Mountains. The surface of the Precambrian rocks was deeply incised by streams before the onset of Cambrian sedimentation (at least 500 feet of relief, Dake and Bridge, 1932). The Cambrian and Ordovician sedimentary rocks were deposited over the preexisting topography and subjected to differential compaction. Much of the structural geometry of the region is a result of this pronounced paleotopographic effect (Dake and Bridge, 1932; Weller and St. Clair, 1928).

The tectonic character of the region is the result of a sequence of episodes of relative vertical uplift, subsidence, and tilting of crustal blocks which are bounded by upthrust faults. The geometry of the blocks appears to be inherited from an older possibly Grenvillian, structural fabric. The traces of steeply dipping block-bounding faults, associations with faulted monoclines, the strikes of vertical Precambrian intrusives, fracture patterns in Precambrian rocks, fracture patterns in the sedimentary rocks of the region, and traces of minor faults all reflect a consistent geometry (Graves, 1938; Robertson, 1940; Tikrity, 1968; Gibbons, 1972). Folding in the region is mainly the result of the passive draping of relatively weak sedimentary rocks over the edges of fault blocks or to the previously mentioned paleotopographic effects.

2.5.1.1.5.1.12 Auxvasse Creek Anticline

The Auxvasse Creek Anticline (see No. 2 in Missouri on Figure 2.5-12, and also Figures 2.5-16 and 2.5-17) is a structure in Township 8 North, Range 8 West, Callaway County, Missouri. It trends about North 75° West and is asymmetrical with a relatively steep (average of 6°) southwest limb and a gently dipping (1°) northeast limb. Devonian rocks occur at the surface along the axis of the fold, which has about 175 feet of structural relief. Formation of the anticline occurred during Mississippian and possible as early as Devonian time. Pennsylvanian strata are deformed on the structure, indicating that the folding continued into Pennsylvanian time. No evidence of faulting has been reported. Water well data on the structure is sparse and does not indicate any evidence of faulting.

2.5.1.1.5.1.13 Big Spring Anticline

The Big Spring Anticline (see No. 4 in Missouri on Figures 2.5-12 and 2.5-16) trends North 60° West in Sections 24 and 25, Township 47 North, Range 5 West, Montgomery County, Missouri. The fold is gentle, but brings a broad area of St. Peter Sandstone to the surface where it is surrounded by younger strata.

2.5.1.1.5.1.14 Brown Station Anticline

The Browns Station Anticline (see No. 9 in Missouri on Figure 2.5-12) trends northwest across northern Boone County, Missouri. It is a faulted asymmetrical anticline (Figures 2.5-17 and 2.5-18) with dips up to 35° on the southwest flank. Total structural relief is approximately 400 feet. Movement occurred recurrently in Mississippian time (Unklesbay, 1952). Maximum movement probably took place at the end of the Mississippian. Significant movements continued at least into Pennsylvanian time, and perhaps there was some post-Pennsylvanian movement. The structural deformation can be seen in surface outcrops. Based on structure contours drawn on top of the Mississippian age Sedalia Formation (Figure 2.5-8) from water well data obtained from the Missouri Geological Survey and Water Resources, the Browns Station Anticline terminates in Township 48 North, and Range 11 West, near the boundary between Boone and Callaway counties.

2.5.1.1.5.1.15 Cuivre Anticline

The Cuivre Anticline (see No. 18 in Missouri on Figure 2.5-12) is a small structure located southwest of the Lincoln Fold in Townships 49 and 50 North, Rages 1 West and 1 East, Lincoln County, Missouri. It is separated form the Lincoln Fold by the Troy-Brussels Syncline. The axis of the Cuivre Anticline strikes North 80° West and plunges southeast at about 40 feet per mile. The anticline has about 200 feet of structural relief and was mapped from borehole data in the area (Gross, 1949).

2.5.1.1.5.1.16 Davis Creek Anticline

The Davis Creek Anticline (see No. 19 in Missouri on Figure 2.5-12) is a northwest trending structure in Townships 50 and 51 North, Ranges 9, 10, and 11 West, Audrain County. The anticline is covered by glacial drift and its presence has been established from borehole data. Pennsylvanian strata have been eroded from the crest of the structure, leaving an inlier of Mississippian rocks that is masked by glacial drift.

2.5.1.1.5.1.17 Eureka-House Springs Anticline

The Eureka-House Springs Anticline (see No. 21 in Missouri on Figures 2.5-12 and 2.5-17) extends northwestward from House Springs, Missouri, Section 3, Township 42 North, Range 4 East, through Eureka, Missouri, Section 36, Township 44 North, Range 3 East. The structure is best developed between Eureka and House Springs and appears to plunge both to the northwest and southeast. The structure persists in a northwest direction in several outcrops of the Chouteau Group between Wentzville and Wright City, Missouri. Wells drilled in the town of Laddonia encountered Mississippian strata immediately under a thin veneer of drift or alluvium (McCracken, 1971). The age of the anticline is postulated to be Late or post-Paleozoic.

2.5.1.1.5.1.18 Fish Creek Anticline

The Fish Creek Anticline (see No. 23 on Figure 2.5-12) trends northwest through northeastern Saline County, Missouri. It is part of the Saline County Arch. The structure is asymmetrical with a steep southwest flank. Uplift of more than 100 feet has brought the Mississippian Chouteau Formation to the surface. The anticline plunges gently to the southeast and terminates in Township 48 North, Range 14 West (Figure 2.5-9.2) based on well data available from the Missouri Geological Survey and Water Resources.

2.5.1.1.5.1.19 Saline County Arch

Although shown as a prominent tectonic feature on the Structural Features Map of Missouri (McCracken, 1971), the Saline County Arch is actually the southwest flank of the Fish Creek Anticline, and should not be considered as a separate and distinct structural feature. It is bounded on the southwest by the parallel-trending Saline City Fault.

2.5.1.1.5.1.20 Kruegers Ford Anticline

The Kruegers Ford Anticline (see No. 36 in Missouri on Figure 2.5-12 and Figures 2.5-17 and 2.5-20) is a fold in Gasconade and Osage counties, Missouri. The structure strikes northeast and has a steep southeast flank. There is about 50 feet of structural relief that brings the Ordovician Roubidoux Formation to the surface where the crest crosses the Gasconade River. Some movement along the structure occurred in post-Pennsylvanian time.

2.5.1.1.5.1.21 Lincoln Fold

The Lincoln Fold (see No. 42 in Missouri on Figure 2.5-12) is a major positive structural feature in Missouri. With the Mississippi River Arch, it forms a discontinuous arcuate succession of highs between the Ozark Uplift to the south and the Wisconsin highlands to the north. This succession of highs separates the Illinois Basin on the east from the Forest City Basin on the west.

The Lincoln Fold is an asymmetrical anticline with a regional trend of about North 45!m!xo!m!x West. The southwest flank has steep dips and some faulting, whereas the northeast flank as gentle dips with no known faulting. The fold extends for 165 miles from the Cap au Gres Faulted Flexure on the south to Knox County on the north. Subsurface records and surface outcrops show the fold to have a maximum structural relief of 1,000 feet. Geophysical records and a few boreholes that reach Precambrian rocks suggest that a basement ridge existed beneath the present position of the Lincoln Fold before Cambrian sediments were deposited in the region. At the end of Silurian time, the fold appears to have begun to develop as a unique structural feature. Recurrent episodes of folding, erosion and deposition occurred throughout the Devonian and are responsible for much of its configuration. A long period of erosion followed this major movement, and the fold was tilted to the northwest. Mississippian strata were eroded along the axis of the fold, and in places they were almost completely removed. Pennsylvanian sediments covered the area after the post-Mississippian erosion. They were subsequently gently arched and most of them have been eroded away. No faulting affecting Pennsylvanian beds is known along the Lincoln Fold.

2.5.1.1.5.1.22 Mexico Anticline

The Mexico Anticline (see No. 45 in Missouri on Figure 2.5-12) strikes northeast through the town of Mexico, Audrain County, Missouri. The structure was mapped from subsurface records, and there appears to be more than 200 feet of structural relief present on the Mississippian strata. Marked erosion of the Mississippian rocks occurred on top of the structures prior to deposition of the overlying Pennsylvanian strata. However, the latter were also involved in the folding, indicating that movement occurred during or after the close of Pennsylvanian time as well as at the close of Mississippian time.

2.5.1.1.5.1.23 Mineola Dome

The Mineola Dome (see No. 46 in Missouri on Figures 2.5-12 and 2.5-16) is a closed anticline or asymmetrical dome, possibly faulted on its southwestern side, with a short north-south axis. It is located in Township 48 North, Range 6 West, Montgomery County, Missouri. It has a steep south-southwest dip and a more gentle north-northeast dip. The Mineola structure brings Cotter (Lower Ordovician) rocks to the surface in Loutre Creek, where they are surrounded by rocks ranging in age from Middle Ordovician to Pennsylvanian (McCracken, 1971)

2.5.1.1.5.1.24 Pascola Arch

The name Pascola Arch (see No. 52 in Missouri on Figure 2.5-12) was given by Grohskopf (1955) to a subsurface structural feature affecting the Paleozoic rocks of southeast Missouri. The arch appears to have at least 8,000 and possibly as much as 12,000 feet of sedimentary rock removed by erosion in post-Paleozoic time and later subsided to form part of the upper Mississippi Embayment (Schwalb, 1978). Stearns and Marcher (1962) estimated that about 4,000 feet of Paleozoic sediments had been eroded from the arch by late Cretaceous time. Paleozoic rocks in the center of the arch are Cambrian in age with rocks of Ordovician age surrounding the core of the structure. It is possible that the Pascola Arch of Grohskopf is a separate domed area similar to the Farmington or Proctor anticlines in Missouri, but it is, in general, a part of the overall Ozark Uplift (McCracken, 1971). Buschbach (1978) pointed out that the epicenters of the 1811-1812 New Madrid earthquakes as well as much of the recent seismic activity in the New Madrid region are located in the structurally complex area where the Pascola Arch intersects the Reelfoot Rift and Mississippi Embayment. Stauder et al. (1976) found that northwest trending linear seismically active zones had been detected by a regional microearthquake network in the New Madrid Seismic Zone. They determined that these trends are parallel to and possible related to the crest of the Pascola Arch.

2.5.1.1.5.1.25 Pershing-Bay-Gerald Anticline

The Pershing-Bay-Gerald Anticline (see Figure 2.5-20) was thought to be a regional structure trending generally northwest from western Franklin County through Gasconade County, Missouri (McQueen, 1943). In an attempt to define the Pershing-Bay-Gerald structure, logs of wells in the area from the Missouri Geological Survey and Water Resources files were examined. Based on this data, a structure contour map was drawn on top of the Roubidoux Formation, a reliable, easily recognizable, and conformable horizon over a large area. The resulting structure map did not show a northwest-southeast trending structure comparable to McQueen's Pershing-Bay-Gerald Anticline. In light of this subsurface data, which was not available to McQueen in 1943, it is concluded that there is not sufficient structural definition in the subsurface to warrant the designation of a northwest-southeast trending Pershing-Bay-Gerald Anticline.

2.5.1.1.5.1.26 Proctor Anticline

The Proctor Anticline (see No. 56 in Missouri on Figure 2.5-12) is the main structural feature in Morgan County, Missouri. It trends North 25° to 30° West and extends to the southeast into Camden County. The steeper west flank dips about 4°, whereas, the east flank dips about 1°. The Cambrian Eminence Dolomite was brought to the surface in late Paleozoic or early Mesozoic time (Marbut, 1907). From Marbut's (1907) structure map, there appears to be about 200 feet of structural relief on the anticline.

2.5.1.1.5.1.27 Troy-Brussels Syncline

The Troy-Brussels Syncline (see No. 65 in Missouri on Figure 2.5-12) separates the Cap au Gres Faulted Flexure from the Ozark Uplift. The syncline extends westward from just south of Alton, Illinois, to Troy, Lincoln County, Missouri with its deepest part against the eastern flank of the Cap au Gres Structure (see Section 2.5.1.1.5.2.7). The synclinal axis plunges eastward and climbs gradually westward toward the Ozarks. The Troy-Brussels Syncline apparently formed as a result of drag along the downthrown side of the Cap au Gres Flexure (Rubey, 1952) from late Mississippian to post-Pennsylvanian time.

2.5.1.1.5.1.28 Warren County Anticline

The Warren County Anticline (see No. 66 in Missouri on Figure 2.5-12) trends north-south in Township 4 North, Range 2 West, Warren County, Missouri. The Mississippian-age Chouteau Formation is exposed at the crest with younger Burlington Limestone surrounding the inlier. Major movement occurred in post-Mississippian time.

2.5.1.1.5.1.29 Florissant Dome

The most productive oil field in Missouri is located on the Florissant Dome (see No. 24 in Missouri on Figure 2.5-12). This nearly circular, closed structure lies on a larger northwest-southeast trending structure, the Dupo-Waterloo Anticline, which passes through eastern St. Louis County, Missouri from the Cap au Gres Faulted Flexure, southeast to Dupo and Waterloo, Illinois. The Laclede Gas Company maps of the dome indicate 100 feet of closure on the St. Peter Formation. The structure was drilled by Laclede Gas Company of St. Louis as an underground natural gas storage facility. The reservoir rock is the St. Peter Formation Sandstone of Middle Ordovician age.

2.5.1.1.5.1.30 Cuba Anticline

The Cuba Anticline (see No. 68 in Missouri on Figure 2.5-12 and 2.5-16) is adjacent and immediately to the west of the Cuba Fault (Section 2.5.1.1.5.2.8). It extends approximately 25 miles from Township 39 North, Range 6 West in Maries County north-northwest to Township 43 North, Range 7 West in Osage County, where it terminates. It has over 100 feet of relief based on contours on top of the Roubidoux Formation. Data for the Roubidoux map were obtained from the well log files at the Missouri Geological Survey and Water Resources and from Donald E. Miller, geologist, Missouri Geological and Water Resources.

2.5.1.1.5.2 Regional Faulting

Discussions on regional faulting include faults within 50 miles of the site area. Distant features that have a bearing on the various regional and site considerations with regard to geology and seismology are also included. Regional faults are tabulated in Tables 2.5-3 and 2.5-5, which include reference to sources of data and are shown on Figure

2.5-13. In addition, data were obtained through personal communications (Buschbach, 1973).

2.5.1.1.5.2.1 Centralia Fault

The Centralia Fault (see No. 1 in Illinois on Figure 2.5-13) trends nearly north-south parallel to and 1 mile east of the DuQuoin Monocline in Marion and Jefferson counties, Illinois. It is a zone of several parallel faults. Net displacement is downward to the west, with maximum displacement of about 200 feet. The faults can be seen in several coal mines in the Centralia area, but they are not visible at the land surface. The faults appear to have developed after folding took place on the DuQuoin Monocline. Relief of the stresses was upward on the east side, opposed to the east dip of the monocline. The faulting occurred in post-Pennsylvanian, pre-Pleistocene time (Buschbach, 1973).

2.5.1.1.5.2.2 Fluorspar Area Fault Complex

The Fluorspar Area Fault Complex (see No. 2 in Illinois on Figure 2.5-13) is an area of numerous northeast to nearly east trending faults centered in Hardin and Pope counties, Illinois, and in Crittenden and Livingston counties in Kentucky. The complex extends southward from the Rough Creek Lineament to some focal point beneath the Cretaceous deposits of the Mississippi Embayment in western Kentucky. Maximum displacements of about 2,000 feet are present on the northeast trending faults. Numerous cross faults with lesser displacements form a complex mosaic pattern (Baxter et al., 1963; Baxter and Desborough, 1965; and Baxter et al., 1967). Although the faulting is reported to be dominantly normal, some faults have been formed by thrust (compression) faulting. Slickensides along the fault planes suggest that there have been important horizontal components in the movements. Displacements along some faults appear to have taken place at different angles at different times.

The Lusk Creek Fault Zone trends North 35° East from the northeastern corner of Massac County, Illinois and extends into Hardin County, Illinois where it terminates against the Herod Fault and the Shawneetown Fault Zone (Stonehouse and Wilson, 1955). According to Weller et al. (1952) and Lusk Creek Fault Zone is a complex structure consisting of normal and reverse faults.

Closely spaced drilling has shown that faulting is more abundant and more complex than surface features indicate. The faulting cuts Pennsylvanian strata and the southern end of the Lusk Creek Fault Zone is overlain by unfaulted Cretaceous deposits (Willman et al., 1967). The faults are considered to be younger than igneous dikes which have intruded the sedimentary strata (Grogan and Bradbury, 1968). The igneous intrusions have been dated from stratigraphic relationships as later than Middle Pennsylvanian (Clegg and Bradbury, 1956) and from K-Ar methods as Permian or older (Zartman et al, 1967). From the history of crustal movements in the Illinois basin, faulting is post-Pennsylvanian, pre-Late Cretaceous, or possibly Paleocene (Atherton, 1971). There are a few faults in Kentucky near the Lusk Creek Fault Zone that displace Cretaceous deposits and

possibly some Paleocene deposits (Olive, 1972). Olive shows no faults displacing the Claiborne Formation of Eocene age.

The southwestern part of the complex is in a seismically active area, and several workers have associated modern earthquakes with the faults. The intensity of these earthquakes, however, is lower than in the New Madrid Seismotectonic Region to the south (see discussion in Section 2.5.2).

Field work has been performed by the Illinois State Geological Survey in an effort to provide evidence which might support or negate the existence of structural continuity between the New Madrid Seismic Zone and the faulting in the Fluorspar Area Fault Complex. Faulting of the Paleozoic rocks on the northeast where they are exposed at the surface was confirmed as being post-Paleozoic and pre-Late Cretaceous in age. Examination of apparent faulting in unconsolidated Tertiary and Quaternary deposits that overlie the Paleozoic rocks to the southwest beneath the Mississippi Embayment has been examined. However, it has yielded no unequivocal evidence of tectonic faulting in the Illinois part of the Mississippi Embayment during or after Late Cretaceous time. Faulting found in the overlying unconsolidated deposits was attributed to landslides and solution collapse (Kolata, 1978; Kolata et al., 1979).

2.5.1.1.5.2.3 Rough Creek Lineament

The Rough Creek Lineament (see No. 3 in Illinois on Figure 2.5-13) is a series of faults and fault zones extending generally east-west through western Kentucky and southern Illinois. In Kentucky, it includes the Rough Creek Fault Zone (Sutton, 1953; Stonehouse and Wilson, 1955). In Illinois, it includes the east-west portion of the Shawneetown Fault Zone to the east and the Cottage Grove Fault System to the west.

Heyl (1972, 1977) suggests that strike-slip faulting or wrench faulting is a major component in the Rough Creek Lineament. He tentatively includes the lineament in a line or zone of faults, monoclines, and igneous intrusions. The line extends east-west for 800 miles along the 38th parallel from West Virginia to at least as far west as the Ozark Uplift in south-central Missouri. In the Illinois-Missouri-Kentucky region the lineament appears as a complex of faults, associated magnetic and gravity anomalies, and breaks in magnetic anomaly patterns (Lidiak and Zietz, 1976; Hinze et al., 1977; Braile et al., 1978; Heyl, 1977).

The Rough Creek Lineament appears to form the northern boundary of the Rough Creek Graben that developed in Precambrian rocks before late Cambrian time. The zone of weakness was reactivated near the close of the Paleozoic Era (Buschbach, 1978). North of this lineament in southeastern Illinois is the Fairfield Basin, the deepest part of the Illinois Basin.

In Illinois, the lineament is dominated by numerous high angle reverse faults with the south side upthrown and there are a number of normal faults (Weller et al., 1952). The faults display evidence of some horizontal movement. The eastern part of the lineament,

the Shawneetown Fault Zone, is dominated by thrust faulting. Displacement is locally as great as 3,400 feet and may be considerably more. The Shawneetown Fault Zone extends westward along the prominent hills in southern Gallatin County, curves southward from Cave Hill in Saline County, leaves the Rough Creek Lineament and joins the southwest-trending Herod Fault to the Lusk Creek Fault Zone.

The Shawneetown Fault Zone cuts Pennsylvanian strata and is presumed to be post-Pennsylvanian in age (Willman et al., 1967). The southern end of the Lusk Creek Fault is overlain by unfaulted deposits of Cretaceous age and therefore, it is inferred that the most recent faulting within the Shawneetown Fault Zone is post-Pennsylvanian, pre-Late Cretaceous (Buschbach, 1973).

The western portion of the lineament, the Cottage Grove Fault System, extends from Saline County westward to Jackson County, Illinois and appears to have formed at roughly the same time as the Shawneetown. Displacements are diminished, with maximum displacements of about 250 feet. Pennsylvanian strata are cut by the faulting and therefore the age of faulting along the Cottage Grove Fault Zone is presumed to be post-Pennsylvanian, pre-Late Cretaceous (Willman et al., 1967; Buschbach, 1973).

The geometry described by Heyl (1972, 1977) does not coincide with the geometries of buried strike slip faults in analogous situations in other localities (Ottawa-Bonechere structure, Oklahoma en echelon fault zone, Montana Lineaments). These features display lineaments composed of en echelon normal faults, giving rise to an elongated belt of horst and graben terrain. No reverse faulting is predicted by dynamic models of such structures (Friedman, 1967; Billings, 1972). Limited reconnaissance by Gibbons (1972) during his study of the eastern Ozarks suggested strong similarities with the structural style of the Set. Genevieve Fault System. Upthrust faulting and minor features observed by Heyl. Large vertical displacements associated with reverse faulting, compensatory normal faults, monoclines and horizontal movements along minor faults are all common features in upthrust terrains (Prucha, et al., 1965). This feature lies within a structural province with demonstrated upthrusting associations. It is, therefore, likely that the Rough Creek-Cottage Grove-Shawneetown System may represent a series of upthrust faults along block boundaries similar to those in the eastern Ozarks.

2.5.1.1.5.2.4 Wabash Valley Fault System

The Wabash Valley Fault System (see No. 5 in Illinois on Figure 2.5-13) is a 15- to 30-mile wide zone of generally parallel faults that extends north-northeastward for approximately 60 miles on the eastern flank of the Fairfield Basin from the Rough Creek Lineament in Gallatin to Wabash Counties in southeastern Illinois, roughly paralleling the Wabash River. The easternmost faults extend into southwestern Indiana (Bristol and Treworgy, 1978).

The faults, which are high angle and normal, have been observed in mines, boreholes, and surface exposures. Maximum known displacement on the faults is up to 480 feet (Bristol and Treworgy, 1978), although displacements of a few to 200 feet are more

common. The throw of the faults appears to be the same in Mississippian and Pennsylvanian strata, and they are clearly post-Pennsylvanian in age. Displacement along the faults decreases toward the south. Since no displacement has been recognized in Pleistocene deposit, the faulting appears to have occurred in pre-Pleistocene time. No evidence has been found in Illinois during recent studies to warrant extending the Wabash Valley fault system across the Cottage Grove-Shawneetown fault zone south to the Mississippi Valley fault system (Bristol and Treworgy, 1978).

2.5.1.1.5.2.5 Chesapeake Fault Zone

The Chesapeake Fault (see No. 1 in Kansas and No. 8 in Missouri on Figure 2.5-13) is a major structure that is best developed in eastern Lawrence County, Missouri (McCracken, 1971). Rutledge (1924) first located the fault as extending from the center of the eastline of Section 12, Township 27 North, Range 25 West, about 25 miles generally northwest across Lawrence County into Dade County. He named the fault and dated it as Late Mississippian because the Pennsylvanian age channel sandstone crossing the fault is not displaced.

McCracken and McCracken (1965) extended the fault to the Kansas line by structure contouring of widely scattered drill hole data on the base of the Roubidoux Formation. Cole (1962, 1976) extended the fault into Bourbon County, Kansas and shows approximately 100 feet of downward displacement to the northeast. The control for extending this structure into eastern Kansas is extremely sparse and therefore, the extension of this fault into Kansas is inferred.

A small fault, also trending northwest from the Kansas/Missouri border located north of the Chesapeake Fault, has been inferred from sparse control (Cole, 1976). It had been previously interpreted as a bedrock valley. An extension of this fault is not mapped to the southeast in Missouri (Missouri Geological Survey, 1979; McCracken 1971).

2.5.1.1.5.2.6 Bolivar-Mansfield Fault System

The Bolivar-Mansfield Fault System (see No. 5 in Missouri on Figure 2.5-13) is a broad zone of discontinuous, generally parallel faulting that extends northwest from Douglas through St. Clair and Bates counties, Missouri into Kansas. Many of the individual faults in this system have been named separately. This zone may extend southeastward into Arkansas (McCracken, 1971) and has been extended northwestward through Bates County by Gentile (1965, 1976). The Eldorado Springs North fault has been extended from Bates County into Kansas (McCracken, 1971) and is shown as an unnamed fault on the top of the Precambrian in Linn County, Kansas by Cole (1976). It had previously been interpreted as a valley on the basement surface (Cole, 1962). The system appears to border the southwest flank of the Ozark Uplift. Faulting is mostly high angle normal, with throws of up to 300 feet (McCracken, 1971). The faulting involves beds ranging in age from early Pennsylvanian (Cherokee Group) to early Ordovician (Roubidoux Formation).

2.5.1.1.5.2.7 Cap au Gres Faulted Flexure

The Cap au Gres Faulted Flexure (see No. 7 in Missouri on Figure 2.5-13) is a sharp monoclinal fold that extends east-southeast through Lincoln County, Missouri, then generally east through southern Calhoun and Jersey counties in Illinois. The rocks dip steeply on the southern flank of the structure, and the maximum amount of structural relief is 1,000 to 1,200 feet. Faults that occur along the flexure generally are downthrown to the south and have displacements from a few to a few hundred feet. Limited exposures in the area make it difficult to determine the extent and continuity of the faults. Major deformation along the Cap au Gres Faulted Flexure took place in post-Middle Mississippian, pre-Pennsylvanian time. A minor amount of deformation occurred in post-Pennsylvanian, pre-Pleistocene time. Pennsylvanian strata south of the flexure are considerably lower than outliers of similar strata north of the flexure. In addition, the Calhoun peneplain bevels the edges of tilted Pennsylvanian strata in the area, indicating post-Pennsylvanian movement. Displacement probably occurred in Pliocene time and amounts to little more than 100 feet. No evidence has been found to indicate any deformation of Pleistocene deposits in the area (Buschbach, 1975). A pair of northwest-trending anticlines, the Dupo-Waterloo Anticline to the south and the Lincoln Fold to the north, end abruptly against the flexure. Both anticlines have their steeper flanks to the west, and they appear to have similar geologic histories. The crests of the anticlines are offset about 30 miles (Cole, 1961).

2.5.1.1.5.2.8 Cuba Fault

The Cuba Fault (see No. 10 in Missouri on Figure 2.5-13 and Figure 2.5-16) passes 3 miles west of Cuba, Missouri, across Crawford and Gasconade counties to Township 43 North, Range 7 East in Osage County, Missouri (McQueen, 1943). Fox (1954) proposed that the fault extends to the south and possibly joins the Crooked Creek Structure (see No. 9 in Missouri on Figure 2.5-13). Current work refutes Fox's concept. James A. Martin and James H. Williams of the Missouri Geological Survey and Water Resources accompanied James W. Smith of Dames & Moore in verifying the position of the fault essentially as mapped by McQueen (1943).

The Cuba Fault is downthrown on the east side with a vertical displacement from 125 to 150 feet (McCracken, 1971). As Pennsylvanian strata may be cut by the fault, the age of the last movement is Pennsylvanian or younger.

2.5.1.1.5.2.9 Cuba Graben

McCracken (1971) states that the Cuba Graben (see No. 11 in Missouri on Figure 2.5-13) is the downthrown area between the Cuba and Leasburg faults which has protected Pennsylvanian beds from erosion. The Cuba Graben is probably not due to horizontal tensional forces as with most grabens but is more likely due to vertical movements, since the bounding faults have associated anticlines (Figure 2.5-16).

Portions of both bounding faults of the Cuba Graben were found by subsurface contours drawn on the top of the Roubidoux Formation. This was substantiated by Donald E. Miller of the Missouri Geological Survey and Water Resources.

Because the bounding faults may cut Pennsylvanian strata, the youngest mapped formations in the area, the last movement of the Cuba Graben may be Pennsylvanian or younger.

2.5.1.1.5.2.10 Fox Hollow Fault

This is a small fault striking slightly east of north and becomes a monocline both to the north and south (see No. 16 in Missouri on Figure 2.5-13). It is a normal fault with a throw of approximately 120 feet. Chouteau beds (Mississippian) are faulted against Jefferson City Dolomite (Ordovician) (McCracken, 1971).

2.5.1.1.5.2.11 Jeffriesburg Fault

The Jeffriesburg Fault is a short, northwest-trending fault that lies 3.5 miles east of the Leasburg Fault (Section 2.5.1.1.5.2.12) in Township 43 North, Ranges 1 and 2 West, Franklin County, Missouri (see No. 22 in Missouri on Figure 2.5-13, Figures 2.5-16, and 2.5-21). On the surface, Pennsylvanian sandstone is faulted against Jefferson City dolomite (McCracken, 1971). According to subsurface contours on top of the Roubidoux Formation (data collected from the well logs on file at the Missouri Geological Survey and Water Resources), the southwest side of the fault appears to have been upthrown at least 100 feet. The fault, determined from Roubidoux contours, appears to terminate to the southeast in Section 36, Township 43 North, Range 1 West, and to the northeast in Section 11, Township 43 North, Range 2 West. Displaced Pennsylvanian rocks indicate the age of faulting to be Pennsylvanian or younger.

2.5.1.1.5.2.12 Leasburg Fault

The Leasburg Fault (see No. 24 in Missouri on Figure 2.5-13 and Figure 2.5-16) generally trends from Section 22, Township 30 North, Range 2 West in Crawford County to Section 20, Township 43 North, Range 2 West, Franklin County, Missouri (McCracken, 1971). It appears to change strike several times from northeast to northwest but persists for a distance of some 40 miles. McQueen (1943) describes the fault as downthrown to the northwest. The preservation of Pennsylvanian age sediments within the Cuba Graben suggests that the faulting is Late or post-Pennsylvanian in age.

2.5.1.1.5.2.13 Mississippi Valley Faults

A series of faults located in the Mississippi Valley (see No. 42 on Figure 2.5-13) in the Upper Mississippi Embayment has been described by Bond et al. (1971).

According to the interpretation and description by H. Schwalb, in the work by Bond et al:

"Many faults are exposed in the Paleozoic rocks around the northeastern edge of

> the embayment (Figure 25); some of these faults probably extend into the Reelfoot basin beneath the Mesozoic and Cenozoic strata. Because of the sparse subsurface control, only the major displacements can be plotted in the embayment area. A fault that trends northeast is downthrown on the west, has 700 to 800 feet (210 to 240 m) of displacement, and follows the course of the Mississippi River. A very large fault trending slightly south of east crosses the Mississippi River fault near the junction of the Missouri-Arkansas-Tennessee boundaries. Displacement exceeds 4,000 feet (1,220 m) at the Mississippi River and decreases eastward; the downthrown side is on the south, but the fault may scissor to the east, reversing the displacement. A third fault is mapped in Missouri almost parallel with the Mississippi River fault. The downthrown side is on the east, producing a graben within the Mississippi River flood plain. South of the major east-west fault, another displacement follows the trend of the Mississippi River, but downthrow is on the east."

These faults are shown as a group on Figure 2.5-13 as fault No. 42. Detailed discussion of the relationship of the Mississippi Valley Faults to other structures is presented in Section 2.5.2.3.1.1.2.

2.5.1.1.5.2.14 Newburg Fault Zone

The Newburg Fault Zone (see No. 26 in Missouri on Figure 2.5-13) is a series of faults trending northwest to west for about 4 miles in Townships 36 and 37, North, Ranges 8 and 9 West, Phelps County, Missouri. This zone consists of three areas of faulting. The southern portion of the fault zone is a graben with the faults striking North 58 West. Maximum displacement is 60 feet. An intermediate zone occurs north of this feature. A normal fault farther to the northwest strikes almost due east. The downthrown side is to the south. Maximum throw along this segment is 100 feet. Ordovician age Gasconade and Roubidoux formations are present in fault blocks at the surface.

2.5.1.1.5.2.15 St. Genevieve Fault System

The Ste. Genevieve Fault System is a complex fault zone of variable character (see No. 38 in Missouri on Figure 2.5-13). At various points along its trace, from two to four steeply dipping reverse faults and a faulted monocline account for most of the structural relief across the feature. Compensatory normal faults are generally present in the edge of the upthrown block. The character of the monocline changes form a small flexure whose steep limb dips approximately 40° northeast to a large feature with the steep limb overturned at lest 50 southwest. The dips of the reverse faults in the fault zone vary from vertical to 50°. The fault zone is uniformly upthrown on the west although evidence for minor reversals in the sense of movement along the fault does exist. Stratigraphic displacement varies from approximately 450 feet along the edge of the Potosi block, 900 feet along the edge of the Farmington block, to a possible maximum of 2,000 feet along the edge of the Perryville block. The Ste. Genevieve Fault Zone is interpreted as a boundary for several of the crustal blocks in the eastern Ozarks. It trends straight along the edges of the blocks, but may bend sharply where it intersects another block

boundary, as at its intersection with the Big River and Saint Mary's Fault Systems (Figure 2.5-15).

The Ste. Genevieve Fault System is probably an inherited feature, the strike of whose segments represent a Precambrian structural grain and its position controlled by the dynamics of subcrustal block uplift. It has probably existed as an inter-related series of faults that comprise a major structural discontinuity in the region since at least late Precambrian time. It represents a major element in the limb between the Ozark Uplift and the Illinois Basin. Structural and magnetic lineaments of the 38th Parallel lineament discussed by Lidiak and Zietz (1977) were found to be interrupted by the prominent northwest trending magnetic anomalies associated with the Ste. Genevieve Fault. Northwest trending gravity anomalies also associated with the Ste. Genevieve Fault zone were recognized by Keller and Austin (1977).

The extension of the Ste. Genevieve Fault System into Illinois has been called the Rattlesnake Ferry Fault (see No. 4 in Illinois on Figure 2.5-13). Presently it is called the Ste. Genevieve Fault Zone.

2.5.1.1.5.2.16 Wardsville Fault

McCracken (1971) stated that the Wardsville Fault (see No. 41 in Missouri on Figure 2.5-13) trends from Section 7, Township 43 North, Range 11 West (west of Wardsville, Missouri) northeast to Section 35, Township 44 North, Range 12 West in Cole County, Missouri. The fault is downthrown 100 feet to the northeast as substantiated by water well borings at the town of Wardsville.

Surface work by Martin (Missouri Geological Survey staff member) in the area east of the water well at Wardsville showed a collapse structure with Burlington Limestone preserved. The findings point to an extension of the Wardsville Fault beyond St. Martins, Missouri, and suggest the age of the fault to be post-Early Mississippian in age.

2.5.1.1.5.2.17 Reelfoot Lake Fault

Finch (1971) mapped an extensive concealed fault in southwestern Kentucky and northern Tennessee (see No. 1 in Kentucky on Figure 2.5-13 and Table 2.5-3). This area lies just north of the Reelfoot Lake region of faulting in Tennessee described by Fuller (1905), and is thought to be part of the same system. Although Finch found no evidence in the mapped quadrangle, he felt it reasonable to assume that this fault was active during the creation of Reelfoot Lake by the 1811-1812 earthquakes. Correlation of loess deposits has shown nearly 200 feet of vertical displacement in the main fault, which Finch postulates as a landslide block. A displacement of 70 feet was proven in a shorter, associated fault. No movement has been recorded since the 1811-1812 earthquakes.

Zoback (1979) has interpreted faulting in the Reelfoot Lake area from seismic reflection profiles. These faults have increased offset with depth, with maximum displacement of Paleozoic marker beds of 265 feet measured. Local thinning of Cretaceous and Tertiary

sections and the greater offsets in other strata indicate that deformation has continued since late Cretaceous time.

2.5.1.1.5.2.18 Kingdom City Fault

The Kingdom City Fault (see No. 48 in Missouri on Figure 2.5-13 and Figure 2.5-16) is proposed to trend east-northeast in Township 49 North, Range 9 West, Callaway County, Missouri. Based on data from well log No. 26595 in the Missouri Geological Survey and Water Resources well log files, it is a reverse fault and cuts the St. Peter Formation twice, displacing it 300 feet. On the basis of surrounding well information, the southeast side was downthrown.

2.5.1.1.5.2.19 Ste. Mary's Fault

Mateker (1956) recognized a strong gravity gradient that trended northeasterly and crossed the Mississippi River at Ste. Mary's, Missouri (see No. 53 in Missouri on Figure 2.5-10). No faulting was recognized at the surface until road cuts for Interstate Route 50 were completed. Tikrity (1968) described 200 to 400 feet of downward displacement to the southeast, toward the Illinois Basin, and considered it to be a northeast extension of the Ste. Genevieve Fault System. A wide fault zone that includes steeply dipping fault zones and monoclines was noted during reconnaissance for this study. This fault zone coincides with the gravity gradient noted by Mateker (1974) and with the southern boundary of the Farmington block (Figure 2.5-15) (Gibbons, 1972).

2.5.1.1.5.2.20 Simms Mountain Fault

The Simms Mountain Fault separates the Precambrian terrain of the St. Francois Mountains from the Cambrian sedimentary rocks of the Missouri lead belt (see No. 37 in Missouri on Figure 2.5-10 and Figure 2.5-15). The brittle basement rocks and dolomites along the fault trace have been severely shattered and a broad, gentle valley has been eroded along the fault trace along most of its length. The sedimentary rocks immediately adjacent to the fault trace dip approximately 45!m!xo!m!x to the east, probably representing the remnant of a faulted monocline. The fault is uniformly upthrown to the west and dips steeply, since its trace crosses topographic features of considerable relief without deflection. Total vertical stratigraphic separation is probably less than 200 feet.

2.5.1.1.5.2.21 Big River Fault

The Big River Fault is a steeply dipping reverse fault. Its trace defines the boundary between the Farmington and Potosi blocks (see No. 3 in Missouri on Figure 2.5-13 and Figure 2.5-15). Total structural relief across the feature is 280 feet at Bonneterre, Missouri. Structural relief decreases along strike to the southwest, reflecting the tilting of the Farmington block. The Big River Fault terminates against the Ste. Genevieve Fault on the northeast and the Simms Mountain Fault on the southwest.

2.5.1.1.5.2.22 Black Fault

The Black Fault is a steeply dipping fault whose trace trends northwesterly (see No. 4 in Missouri on Figure 2.5-10). Poor exposure makes precise definition of fault geometry impossible. The fault is downthrown to the west, and near the town of Black, Missouri, the entire vertical stratigraphic separation is within the thickness of the Bonneterre Formation (approximately 100 feet). The Black Fault defines the western boundary of the St. Francois block (Figure 2.5-15) and represents the easternmost structure on the western limb of the Ozark Uplift.

2.5.1.1.5.2.23 Anthonies Mill Fault

The Anthonies Mill Fault is described by McCracken (1971) as being observed at the surface. Its existence was substantiated by drilling near the Pea Ridge iron deposit. The fault extends from Section 19, Township 39 North, Range 1 West, Washington County, Missouri, to Section 11, Township 39 North, Range 2 West, Crawford County, Missouri. The displacement on the fault is 150 to 200 feet with the downthrown side on the southwest (see No. 49 in Missouri on Figure 2.5-13).

2.5.1.1.5.2.24 Catawissa Fault

The Catawissa Fault (see No. 50 in Missouri on Figure 2.5-13 and Figure 2.5-16) is based on boring information from the Missouri Geological Survey and Water Resources well log files. It is located in the southwestern portion of Township 43 North, Range 2 East, Franklin County, Missouri. It has a displacement of 150 feet with the northwestern side downthrown.

2.5.1.1.5.2.25 Browns Station Fault

The Browns Station Fault, which is located on the southwestern limb of the Browns Station Anticline (see No. 51 in Missouri on Figure 2.5-13 and Figure 2.5-16), Callaway County, Missouri, is interpreted as having 300 feet of displacement. The southwestern block is downthrown (Laclede Gas Company, 1974).

2.5.1.1.5.2.26 Mineola Fault

The Mineola Fault (see No. 52 in Missouri on Figure 2.5-13 and Figure 2.5-16) is located in the southwestern portion of Township 48 North, Range 6 West, Montgomery County, Missouri on the flank of the Mineola Dome. Interpretation of well log data from the Missouri Geological Survey and Water Resources files (1974) indicates that 200 feet of downward displacement to the southwest.

2.5.1.1.5.2.27 Cryptoexplosive Structures in Missouri

McCracken (1971) locates and discusses several cryptoexplosive or diatreme features in Missouri. The Avon diatremes, Crooked Creek structure, Decaturville Structure, Dent

Branch structure, Furnace Creek structure, and Weaubleau Creek structure are shown on Figure 2.5-13 and listed in Table 2.5-3. McCracken also locates numerous miscellaneous structures; however, she indicates that these are generally local features that may be related to solution activity.

The cryptoexplosive structures occur on a line that trends approximately east-west through central Missouri. They all occur in Paleozoic formations. No evidence of activity since their origin has been found, and no satisfactory explanation for their origin has yet been determined.

2.5.1.1.5.3 Regional Jointing

Regional joint or fracture patterns are consistent and well developed throughout the region. Two systems of fractures are prevalent. The most common and the most widely distributed fracture system is made up of two sets that parallel the general regional structural trends (northwest and northeast). This system is present in the basement rocks and is represented there by fractures intruded by ultrabasic rocks of known Precambrian age. The second system is subordinate and has two joint sets that strike north-northwest and east-northeast. The two systems are statistically difficult to distinguish in large samples and may represent local variants of the same system. The near right angle of intersection and vertical attitude of both systems suggest that these are regional orthogonal fracture systems common to areas that have been uplifted by upthrust tectonics (Gibbons, 1972).

2.5.1.1.5.4 Regional Stability

The region surrounding the site is stable. No earthquakes have occurred within 40 miles of the plant site. No potential zones of instability, either natural or caused by man's activities, have been found that adversely and significantly affect construction and operation of the plant at the site.

2.5.1.1.5.4.1 Natural Features

Regional solution activity by ground water is discussed in Section 2.5.1.1.6.1. Solution and weathering features at the site are discussed in Section 2.5.1.2.5.3. There are no natural geologic features at or sufficiently near the site that adversely affect its use for a nuclear power facility.

2.5.1.1.5.4.2 Man's Activities

Man's activities in the study region include surface and subsurface mining of both metallic and nonmetallic minerals, production of fuels such as coal, oil, and gas, and withdrawal of water from subsurface aquifers. None of these activities have taken place near the site area with the exception of minor quarrying of limestone and clay, located sufficient distances from the site as to cause no concern with regard to stability. The effects of man's activities at the site are discussed in Section 2.5.1.2.5.6.

2.5.1.1.5.4.3 Regional Warping

As discussed in regional geologic history (Section 2.5.1.1.3), and reflected by unconformities in the geologic column of Missouri, the study region has experienced uplift and warping several times during the Paleozoic Era. The effects on the site area are reflected by erosional unconformities and gentle tilting of the rock strata, with a reported regional dip of 5 to 10 feet per mile to the northwest, away from the Ozark Uplift (Unklesbay, 1955).

Regional warping or rebound due to unloading of glacial ice may be occurring in northern portions of the study region where glacial deposits are extensive and still display evidence of overconsolidation. At the site, rebound is not considered significant. The presence of thin glacial deposits in the site area suggests that the advancing ice sheet was relatively thin and/or of short duration. The glacial till is believed to have been deposited during Kansan time, approximately 0.7 million years ago (see Section 2.5.1.2.2.1).

2.5.1.1.6 Regional Ground Water

A detailed treatment of ground water and surface water hydrology is presented in Section 2.4.

Abundant ground water is contained in the alluvial deposits within the Missouri and Mississippi River valleys and in the Mississippi Alluvial Plain Physiographic Section.

An extensive area occupied by the Ozark Plateaus Section is underlain by more than 2,000 feet of Paleozoic carbonates and sandstones that dip away from the Precambrian core of the Ozark Uplift. In this area, recharge to aquifers is by infiltration of precipitation. Natural discharge is commonly by springs abundant throughout the Ozarks. The Osage Plains Section generally contains relatively small quantities of highly mineralized ground water. Within the Till Plains and Dissected Till Plains sections, limited ground water is locally available from sand and gravel outwash deposits associated with Pleistocene glaciation. The most important water-bearing areas, however, occupy buried valleys that are filled with clean granular outwash deposits.

Regionally, water quality becomes poorer in areas away from the Ozark Plateaus Section due to an increase in total dissolved solids from less than 200 parts per million to over 40,000 parts per million in some areas of the study region. (U.S. Geological Survey and Missouri Division of Geological Survey and Water Resources, 1967).

2.5.1.1.6.1 Regional Solution Activity by Ground Water

Large scale solution activity has taken place in the thick carbonate sequence south of the Missouri River as evidenced by the numerous large springs and caves found in that region (Figure 2.5-22). There is, however, a notable decrease in the number of caves and size of springs in areas north of the Missouri River and in a large area of west central

Missouri. This marked reduction in the number of caves and large springs reflects a regional change in solution activity which can be directly correlated with changes in both surface and subsurface soil and rock stratigraphy.

Where springs are large and numerous, (see Figure 2.5-22) the underlying rock units consist primarily of cherty limestone and dolomite which range from Mississippian to Cambrian in age. Some sandstone units are present but shale rarely occurs (Figure 2.5-8). The surficial soil deposits contain characteristically high percentages of residual chert. Precipitation is readily channeled through the permeable, cherty soils and into the underlying thick carbonate rock sequence in which karst features, springs, and caves are developed by solution activity.

In those areas shown on Figure 2.5-22 where springs are small or absent and caves are few, the underlying stratigraphic section contains formation that consist largely or entirely of shale. These shale units retard or block the vertical movement of groundwater and effectively reduce solution activity. Pennsylvanian-age deposits in Missouri are largely impervious shale and clay (Figure 2.5-8). The areas in northern and western Missouri in which Pennsylvanian rocks occur are illustrated on Figure 2.5-22. In these areas, springs are small and many are highly mineralized (U.S. Geological Survey and Missouri Division of Geological Survey and Water Resources, 1967).

The Mississippian-age rocks of northeastern Missouri also contain shaley units such as the Hannibal and Warsaw formations which retard groundwater movement. By contrast, the Mississippian-age rocks of southwestern Missouri contain relatively little shale (Missouri Geological Survey and Water Resources, 1961) and a corresponding increase is noted in the number of springs and caves (Figure 2.5-22). The middle Devonian Snyder Creek Shale which occurs in the site area, retards the downward percolation of ground water as discussed in Section 2.4.13.2.3.2.1, Local Hydrologic Conditions.

Soil type and thickness are significant factors which contribute to reduced solution activity in northern Missouri. The occurrence of relatively impermeable glacial and lacustrine soils which were deposited during Pleistocene time beginning approximately 1 million years ago, generally thicken northward from the southern limit of glaciation (Figures 2.5-3 and 2.5-22). These clayey soil deposits blanket vast areas and severely retard the downward movement of precipitation into the underlying rock units, thereby significantly reducing solution activity.

2.5.1.1.6.1.1 <u>Springs</u>

Some of the world's largest springs are found within the study region (Figure 2.5-22). The Salem and Springfield plateaus of the Ozark region contain the largest and greatest number. Springs are also present in the Pennsylvanian rocks of the Osage Plateau; however, these are small and highly mineralized.

Surface and subsurface conditions are favorable to the development of the large Ozark spring system. The surface conditions include large areas of porous material and

depressed areas (sinks) with no surface drainage outlets that are conducive to collecting and channeling precipitation into the subsurface. Subsurface conditions include thick layers of fractured limestone and dolomite. Springs may be concentrated along zones of fractures (Figure 2.5-23). Most of the Ozark area springs are outlets of subterranean stream that have been intersected by erosional valleys. As a result, most of the large springs are found at or near the local valley floor level of the principal streams.

2.5.1.1.6.1.2 Caves

There is no agreement as the exact definition of a cave with regard to size and shape; however, it is generally accepted that most subsurface caves result from ground water activity in soluble carbonate bedrock. Most caves are low-gradient underground stream channels originating at or below the water table. Regional uplift and subsequent stream erosion exposes the subterranean water-filled channel and forms a large spring. The cavity gradually drains as the water table adjusts to a lower level.

Very few of the Ozark caves are increasing in size today. Roof collapse, sinkhole debris, dripstone deposits, and alluvial or colluvial sediments have acted to partially fill or block many cave chambers. Present day cave development can be observed in the large springs that emerge at the bottoms of major valleys. In areas where significant quantities of impermeable cohesive soils or shale form a protective cap over the soluble carbonate formations, solution activity and karst development is minimized.

2.5.1.2 Site Geology

The small-scale topographic map on Figure 2.5-24 shows the site relative to major cultural features. A reconnaissance geologic map of the site area is shown on Figure 2.5-25.

Geologic and geophysical studies were performed at the site to determine the lithologic, stratigraphic, and structural geologic conditions. Surface conditions at the site were investigated by using surveying and reconnaissance geologic techniques and by use of topographic maps, aerial photographs, and ERTS imagery. Subsurface conditions were investigated by means of test borings, laboratory testing and analysis, subsurface correlations and field test programs. Boring locations are shown on Figures 2.5-26, 2.5-27, and 2.5-28. Detailed geologic mapping of excavations and construction monitoring has verified the results of the above investigations.

Piezometers were installed in borings at various depths throughout the area to monitor groundwater in all soil and rock units penetrated by drilling. A vibratory groundmotion study was done to evaluate seismic characteristics of soil, older sediments, and lithified formations underlying the site.

2.5.1.2.1 Site Physiography

The site area straddles the boundary between the Dissected Till Plains Physiographic Section to the north and the Ozark Plateaus Physiographic Province to the south (see Figure 2.5-2). The plant site is blanketed by glacial deposits and lies within the Dissected Till Plains.

During Early Pleistocene time, the site area was largely a glacial till plain. Subsequent erosion and downcutting of the Missouri River and its tributary streams has dissected the plain, leaving a nearly isolated plateau between 6 to 8 square miles in size.

Topographic relief on the plateau varies form about elevation 800 feet MSL near the perimeter to a maximum of 858 feet MSL southwest of Reform (see Figure 2.5-26). The highest elevations are found along a very broad, low ridge in the southern and western portions of the area, where the terrain is generally higher than elevation 840 feet MSL. The plateau is higher than any surrounding land feature within a radius of 6 miles.

The Missouri River is about 5 miles south of the plant. Its floodplain is about 2 1/2 miles wide and has an average surface elevation of about 525 feet MSL. The normal flow level of the Missouri River is about 509 feet above mean sea level.

The area between the plateau and the Missouri River flood plain is highly dissected. Mud Creek and its intermittent stream branches have incised deeply into the southern flank of the plateau with stream gradients that drop more than 200 feet within a distance of less than 1/2 mile. Topographic relief is more than 150 to 200 feet between valleys and ridges, and the overall drop in elevation between the crest of the plateau and the river is about 350 feet.

Surface drainage east and northeast of the site area is intercepted by Logan Creek. Logan Creek is deeply incised and has developed a 1,000-foot-wide floodplain. Numerous intermittent streams have cut deeply into the eastern flank of the plateau, resulting in more than 200 feet of rugged local relief.

Auxvasse Creek, a major tributary of the Missouri River, is located about 2 miles west of the site area and intercepts all the surface drainage from the western and northern flanks of the plateau. The creek is more than 30 miles long and has developed a number of fairly large tributary branches. Adjacent to the site, the stream flows within entrenched meanders on a 1/4- to 1/2-mile-wide floodplain at an approximate elevation of 530 feet MSL. Numerous intermittent streams about 1 1/2 miles long have cut deeply into the western and northwestern flanks of the plateau, resulting in more than 250 feet of rugged local relief.

2.5.1.2.2 Site Stratigraphy

The sequence and character of the soil, older sediments, and lithified formations underlying the site area are shown on the composite stratigraphic column (Figure

2.5-29). This column is based on data obtained from Dames & Moore borings in the site area (Tables 2.5-6 and 2.5-6.1), on observations of soil and rock exposures at the site and in the surrounding area, and on published literature. Subsurface geologic cross sections that show relationships between the various stratigraphic units underlying the site are illustrated on Figures 2.5-30 through 2.5-35 and 2.5-36. In addition, a regional geologic cross section is shown on Figure 2.5-37. Logs of over 165 borings drilled at the site during the various Dames & Moore site geologic investigations are discussed in detail in Section 2.5.6.1.1. The unified soil classification along with a key to the test data is shown at the end of Section 2.5.

Borings C5-1 through C5-8 were drilled during the initial site investigation in March 1972. Borings R-1 through R-8 and P-1 through P-67 were drilled during the site reconnaissance and detailed foundation phases of site investigation from July 9, 1973, through January 7, 1974. Borings P-68 through P-148 were drilled during a period from October 22, 1974, through February 8, 1975, in order to investigate the filling of ancient karst features below the plant site.

Additional site stratigraphic data were obtained in connection with on-site quarry and underground mine studies that have been presented in "Report, On-Site Rock Quarry Site Selection and Feasibility Study, Source of Coarse Aggregate, Callaway Plant Units 1 and 2, for Union Electric Company" dated April 11, 1975; "Report, Engineering Geology Investigation, Proposed On-Site Production Mine Quarry, Source of Coarse Aggregate Callaway Plant, Units 1 and 2, for Union Electric Company" dated July 31, 1975; "Report Addendum, Engineering Geology Investigation, Proposed On-Site Production Mine Quarry Source of Coarse Aggregate, Callaway Plant Units 1 and 2" dated June 2, 1977; "Report, Results of Detailed Excavation Mapping, Callaway Plant, Units 1 and 2" dated August 24, 1976; and "Interim Report Results of Detailed Excavation Mapping, Ultimate Heat Sink Excavations, Callaway Plant, Units 1 and 2, for Union Electric Company," dated April 25, 1979.

Borings Q-1 through Q-26 were drilled south and northeast of the plant during the course of the on-site quarry investigations. Borings Q-27 through Q-48 were drilled northeast of the plant in the area of a proposed mine quarry in order to obtain information on the physical characteristics of the Callaway Formation. Borings Q-49 through Q-66 were drilled in the same area to evaluate the feasibility of portal development in a relocated mine portal area and to examine the development of filled solution features in the Callaway Formation which could result in spalling of the roof rock in the mine and present a safety hazard to mining.

Borings A-1 through A-6 were drilled off-site in 1976 at the quarry of the Auxvasse Stone and Gravel Co., 17 miles north of the plant, to retrieve samples for testing to determine the suitability of the Callaway Limestone from that quarry for use as Category I coarse concrete aggregate. Excess fines from the aggregate production from this quarry were also used as Category I pipe bedding material. Two sets of borings were drilled at a quarry 4.5 miles north of the site on Auxvasse Creek. Borings H-1 to H-16 were completed in 1977 at the MoCon of Fulton, Inc. quarry, to evaluate the physical

properties and available quantities of the Callaway Limestone for Category I Granular Structural Fill and Backfill. Borings H-17 through H-27 were drilled in this same quarry in 1979, then known as Mertens Quarry, to acquire samples for testing to determine the suitability of the Callaway Limestone from the alternate source for use as Category I coarse concrete aggregate.

2.5.1.2.2.1 Glacial and Postglacial Soil Deposits

Deposits of Quaternary age within the site area consist of soils that are associated either directly or indirectly with Pleistocene glaciation. Geologic discussions of glacial and postglacial soil deposits are presented below. Engineering properties of these soils are discussed in Section 2.5.4.2.

2.5.1.2.2.1.1 Modified Loess

Most of the plateau area is blanketed by a fairly continuous layer of mottled reddish brown and gray silty clay that varies in thickness from 3 to 15.5 feet. This soil was deposited over the site during the Wisconsinan and/or Illinoian glacial stages as a windblown silt known as loess. The loess was deposited on an irregular topographic surface. Subsequent erosion, resulting in the present surface features, has stripped the loess from some areas. Weathering has altered the original physical properties of the loess at most locations to form a silty clay. Engineering properties of the loess are presented in Section 2.5.4.2.

2.5.1.2.2.1.2 Accretion-gley

The modified loess is underlain by a deposit of moderately plastic, gray, silty clay. The exact origin of this material has been a question of debate among geologists for many years. The concept of accretion-gley, which was first developed by Frye et al. (1960) and further discussed by Howe and Heim (1968), appears to be the most reasonable theory of origin for the clay, on the basis of site observations. The accretion-gley is postulated to be the product of slow accumulation of predominantly fine-textured material in poorly drained or undrained areas on the surface of the till plain left after retreat of the glacier. In the site area, glacial till deposited during the Kansan stage of glaciation forms the surface on which the accretion-gley rests. Furthermore, the accretion-gley at the site is fine textured, massive bedded, and is not a product of intense in situ weathering.

The upper and lower boundaries of the accretion-gley are former erosional surfaces on which some topographic relief was developed. Consequently, the thickness of the deposit, as determined by borings, various across the plateau area from 0 to about 28.5 feet. The highest elevation at which the top of the unit was encountered was 845.1 feet and the lowest was 811.2 feet. Lens-shaped deposits of silt and sand which had been encountered in test borings, were locally observed and mapped at the top of the accretion-gley during geologic mapping of excavations. These lenses are approximately 3 to 5 feet in thickness with apparent widths of 38 to 120 feet in the reactor excavations. These deposits were probably formed by streams prior to deposition of the overlying

loess. The accretion-gley is slightly preconsolidated by desiccation. Engineering properties of the accretion-gley are presented in Section 2.5.4.2.

2.5.1.2.2.1.3 Glacial Till

A layer of glacial till consisting of reddish brown silty clay containing some sand and gravel underlies the accretion-gley deposit in topographically high portions of the site area. The till has been identified as Kansan in age on the basis of paleomagnetic investigations (Kukla, 1974). The till was observed to vary in thickness from 0 to 27.2 feet in the test borings and was generally encountered between elevations of 827 and 800 feet. Sand lenses in the basal portion of the till were observed and mapped during geologic mapping of the reactor excavation. These lenses vary in apparent width from 5 to 35 feet and have a maximum thickness of 6 feet. The deposits are stratified and are probably outwash stream deposits that formed in advance of Kansan glaciation of the site. It is slightly preconsolidated and hard. Engineering properties of the glacial till are presented in Section 2.5.4.2.

2.5.1.2.2.2 Older Sediments--Pennsylvanian?

For this report, the name Graydon chert conglomerate applies to deposits for cherty clay, sandstone, and sandy chert conglomerate that occur in the site area between the underlying Burlington Limestone and the overlying glacial deposits. The Graydon consists of buff, red, purple, and greenish gray silty to sandy clay with 5 to 90 percent gravel- to boulder-size chert particles and having some well-indurated sandstone or sandy chert conglomerate developed in widely scattered and localized areas. It is present in the topographically high areas surrounding the site and was encountered in all plant site test borings. This somewhat variable unit represents a complex series of geologic events that have not been completely revealed by this investigation. Available published data is sparse and inconclusive. Unklesbay (1955) discusses exposures of residuum, chert conglomerate, and sandstone which occur between the Burlington Limestone and Cheltenham Clay of the Fulton quadrangle and states that these deposits have been commonly called "Graydon", but are now provisionally referred to as Krebs Group of Pennsylvanian age by Searight et al. (1953). Branson (1944) describes the Graydon as a coarse sandstone to a conglomerate made up of mainly chert cobbles in a matrix of sand and clay. According to Branson, the Graydon in Polk County, Missouri, occurs as patchy depression fillings on Burlington or other formations and is overlain locally by Cheltenham fire clay of Pennsylvanian age. The Missouri Geological Survey and Water Resources (1961) does not recognize the "Graydon" as a distinct stratigraphic unit but describes the basal Cheltenham Clay as containing sandstone, chert conglomerate, and chert rubble or residuum and calls it the "rimrock" of the filled sink-type deposits.

North of the plant site, deposits identical to Graydon are overlain by Cheltenham Clay of Pennsylvanian age; however, data for direct correlation with the plant site, such as continuous mappable exposures or extended boring coverage, are not available.

Data obtained during the site investigation suggest that the Graydon is composed of material that has in part been transported before deposition, while other portions reveal a residual (weathered-in-place) nature. Bedding can be observed only in the localized, well-indurated sandstone and sandy chert conglomerate portions of the Graydon. No joints or bedding planes have been observed in the nonindurated clayey and cherty Graydon that underlies the site. At the site, it is extremely difficult to visually distinguish chert and clay of residual origin from transported chert and clay. Separation, however, can be made on the basis of clay mineralogy. A high percentage of kaolinite is characteristic of residuum produced by weathering, while high percentages of illite suggest transportation and deposition (Missouri Geological Survey and Water Resources, 1973). X-ray analyses of nine selected Graydon samples from borings and outcrop were completed as shown in Table 2.5-20. Test results revealed that some samples contain a high percentage of illite, and others are high in kaolinite. This indicates that both residual and transported clays are present in the Graydon in the site area.

It appears likely that during the period of uplift, which occurred at the close of Mississippian time (Section 2.5.1.1.3.2.5), significant quantities of chert and residual clays were produced by weathering of the exposed Mississippian rock surface in the site area. Depositional processes initiated in Pennsylvanian time probably reworked most or all of the Mississippian chert and residual soil. It is possible that some portions of extensive residual deposits remained undisturbed and were subsequently buried by Pennsylvanian and younger deposits. Basal Pennsylvanian strata consist primarily of rounded chert gravels, cobbles, and boulders within a matrix of multi-colored clay, which is high in illite content. Locally, streams deposited sand and chert that are now well indurated sandy chert conglomerates. Exposures of these basal Pennsylvanian deposits occur in the northern portion of the site area and are comparable to those described by Unklesbay (1955). It is also possible that some residual soils have been produced by reworking and weathering of the Pennsylvanian cherty clays during Cretaceous or even Tertiary time. The Graydon chert conglomerate at the plant site is probably Pennsylvanian in age; however, this cannot be stated with certainty due to the absence of overlying Pennsylvanian strata. The Graydon chert conglomerate was observed to vary in thickness from 4.2 to 49.9 feet and was generally encountered between elevations of 814.6 and 789.2 feet throughout the site area. Contours on the top of the Graydon are shown on Figures 2.5-38 and 2.5-39. An isopach map of this unit is shown on Figure 2.5-40.

The Graydon chert conglomerate, with the exception of local deposits of indurated sandstone and sandy chert conglomerate, is not indurated as are the underlying rock strata belonging to the Burlington and older formations; however, the cherty clay deposits that largely form the Graydon in the site area are millions of years old. As such, they are hard and competent. It has been described as a clay containing roughly 5 to 90 percent by volume of irregular, rounded chert fragments. The chert fragments vary in size from pebbles to boulders nearly 2 feet in diameter. No open spaces or voids have been detected between rock fragments in the borings, test pits and excavations that have

been completed to date, nor have they been observed in exposures of the deposit that crop out around the perimeter of the plateau.

Core recovery in the Graydon chert conglomerate varied between 28.0 and 92.5 percent as averaged in individual borings. An overall average core recovery from a total of 102 borings was 67.0 percent. These values are relatively low in comparison with those of the underlying rock units. Poor core recovery in the Graydon is due to the nature of the material. For the most part, it is a cherty to sandy hard clay containing cobble to boulder size chert fragments. It is extremely difficult to maintain good core recovery. As chert fragments are encountered, the driller must increase bit and water pressure in order to core through them. Once the chert is penetrated, the increased water pressure and rotary action of the drill bit blasts away the clay matrix until pressure adjustments can be made by the driller. In addition, the chert fragments often loosen from the clay matrix and turn under the bit during coring. This action grinds away the clay and reduces core recovery.

Drilling fluid losses were experienced in the Graydon chert conglomerate in only 8 of the total 165 test borings in which it was encountered. The Graydon, which is devoid of soluble carbonate material, was cored without the use of casing. Fluid losses in the Graydon were temporary and confined to zones of 1 to 7 feet in thickness. The losses are attributed to scattered and irregular zones of high chert content (80-90 percent) and thin, discontinuous sandy layers that have somewhat higher permeabilities. Since no casing was used in the Graydon, some fluid losses are also attributed to seepage at or near the ground surface. There appears to be no relationship between drilling fluid losses and zones of low core recovery in the Graydon.

Engineering properties of the Graydon chert conglomerate are discussed in Section 2.5.4.2. The results of plate load and borehole pressuremeter tests are presented in Sections 2.5.4.2.2.1.1 and 2.5.4.2.2.2 respectively.

Well-indurated sandstone and sandy chert conglomerate were encountered in Boring C5-7 (Figure 2.5-136) and tentatively identified as Pennsylvanian in age. Well-indurated chert conglomerates have been observed above the Burlington Limestone in widely scattered exposures during reconnaissance geologic mapping of the site area. Field evidence suggests that they represent Early Pennsylvanian stream deposits that formed in valleys carved on the Mississippian rock surface. The sandy chert conglomerates appear to be alluvial in origin. Marine fossils preserved in the reworked chert fragments indicate the chert source to be primarily Mississippian-age carbonate rocks.

A buried channel deposit containing chert conglomerate and sandstone may occur in the northern portion of the site area as indicated by Boring C5-7; however, its dimensions and course are poorly defined. Field data based on observations of very limited exposures of sandy chert conglomerate similar to that encountered in Boring C5-7 suggest that a roughly east-west trending alluvial deposit, some 600 feet wide, may occur north of Reform along County Highway "O", as shown on the Reconnaissance Geologic Map, Figure 2.5.15. No evidence of similar channel deposits was encountered

in other site borings. No buried alluvial channels are present in the immediate plant site area.

2.5.1.2.2.3 Lithified Formations

Approximately 2,000 feet of Paleozoic rock strata underlie the site area between the ground surface and Precambrian basement. The formations range in age from Mississippian to Cambrian. The units penetrated by test borings at the site are illustrated on the Site Stratigraphic Column, Figure 2.5-29. The bedrock surface for the site area and plant site is shown on Figures 2.5-41 and 2.5-42.

2.5.1.2.2.3.1 Mississippian System

The sedimentary rock strata that occur immediately below the Graydon chert conglomerate and form the uppermost lithified formations throughout almost all of the site area are Mississippian in age. Two formations are present: the Burlington and Bushberg.

The Burlington Formation of Middle Mississippian age is limestone. It is light tan to brownish gray, medium to massive bedded, coarse grained, and contains layers and nodules of white, fossiliferous chert. An abundance of crinoid fossils is characteristic.

The Burlington Formation generally forms the top of rock in the plant site. Based on data from 121 plant-site test borings that were drilled through the horizon of the Burlington Formation, the unit varies in thickness from 0 to 41.7 feet. It was entirely absent in about 25 percent of the borings as a result of pre-Pennsylvanian weathering and erosion over 300 million years ago. The average thickness of the Burlington in the 92 borings in which it was encountered is 11 feet, while the average thickness for all 121 test borings is 8 feet. Contours on top of rock (Figures 2.5-41 and 2.5-42) reveal a somewhat irregular surface, which is unconformable with the overlying Graydon chert conglomerate. The Burlington Limestone, together with the overlying Graydon chert conglomerate, forms a resistant layer that caps and sustains the topographically high portions of the site area.

The Burlington Limestone typically is weathered and contains solution features formed by a period of weathering and erosion that occurred prior to deposition of the overlying Graydon chert conglomerate, over 300 million years ago. The solution features are now filled with hard green to brown, silty to sandy clay with some limestone and chert fragments. Weathered zones were observed to vary in thickness from 0 and 27.2 feet, generally averaging about 7.5 feet in thickness.

Core recovery in the Burlington ranged from 0 percent to 100 percent. The average recovery for all borings in the Burlington was greater than 80 percent. The lower core recoveries in the formation were typically obtained in the upper zone where clay filled solution features and fractures were the most abundant.

Losses of drilling fluid while coring in the Burlington, were observed in only 8 of the 92 test borings that penetrated through the unit. In all cases, the losses were temporary and confined to zones of 1 to 5 feet in thickness. Full drilling fluid circulation returned in each of the 8 test borings after the test boring was advanced a few feet. The losses are attributed to the presence of jointing and fracturing or to zones of very thin bedding, as observed in the rock cores, and to occasional small, isolated solution features along bedding planes and joints that have not been completely filled with clay. Since the Burlington was cored before the casing was advanced below the shallow soil horizons, it is very likely that some fluid losses can be attributed to seepage around the casing into the near surface soils. In general, losses of drilling fluids show no relationship with zones of low core recovery in the Burlington. In only one of the 92 borings that cored through the Burlington a temporary loss of drilling fluid was correlated with a corresponding core recovery of 75 percent. No bit drop was experienced in this interval.

More than 1,000 feet of core was drilled in the Burlington Formation in 92 test borings throughout the plant site. During all of this drilling, only two bit drops of 0.1 and 0.25 foot each were experienced. No water loss was observed in connection with the 0.1 foot drop and only a temporary loss with the 0.25 foot drop, indicating the presence of small, isolated solution features that were not completely filled with clay. Falling head permeameter tests in the Burlington indicate low permeabilities as discussed in Section 2.4.13.2.3.2.1.

The Bushberg Formation is a thin, persistent basal Mississippian sandstone which occurs throughout the site area. Field data suggest that it is conformable with the overlying Burlington Limestone. The Bushberg varies in thickness from a few inches to approximately 8 feet. Average thickness throughout the site is 2.7 feet. The formation consists of a greenish white to yellowish brown, fine-to medium-grained sandstone, moderately cemented, and argillaceous in zones. It rests unconformably on beds of Devonian age.

Some additional site stratigraphic information on the Mississippian Burlington and Bushberg rock units was obtained during on-site quarry investigations and is presented in the Quarry Site Selection and Feasibility Study and the On-Site Production Mine Quarry reports.

2.5.1.2.2.3.2 Devonian System

The Snyder Creek Formation underlies the Bushberg Sandstone throughout the site area. At the top, the Upper Devonian Snyder Creek consists of a light gray to brown limestone that averages less than 5 feet in thickness. It is generally silty, massive bedded, and contains numerous brachiopod fossils. The silty limestone is underlain by a calcareous siltstone that grades downward from brown to purple and greenish gray in color. Thin layers of silty limestone are common. The basal Snyder Creek becomes shaley and typically contains some zones that have weathered to clay. Due to erosion of the upper surface, the formation as a whole ranges in thickness from 10.3 to 47.5 feet,

averaging about 30 feet, as observed in test borings at the site. Contours on top of the Snyder Creek are shown on Figures 2.5-43 and 2.5-44.

The Callaway Formation of Middle Devonian age unconformably underlies the Snyder Creek and rests with pronounced unconformity on Ordovician-age Joachim, St. Peter, or Cotter-Jefferson City formations in the site area. It typically consists of limestone but may grade to dolomite in zones. The Callaway is light gray to brownish gray, fine to coarse grained, and medium to massive bedded. Stylolites are common and numerous and the presence of sell-preserved corals is characteristic. Pyrite inclusions are encountered in the upper beds of the Callaway. Pinpoint to 2-inch diameter, calcite-filled and open vugs may be occasionally found in the unit. The vugs, which often occur in irregular zones, are discontinuous and generally average less than 15 percent of the total rock core. Sandy limestone or beds of white, well-cemented, fine to medium grained sandstone are common at the base.

The Callaway Formation was observed in test borings to range from 11 to 47.5 feet in thickness. Average thickness is about 35 feet. Detailed data indicate that a brief period of erosion occurred in the site area before Snyder Creed deposition, producing a minor unconformity. This conclusion is based on observations of sedimentary breccia in the basal Snyder Creek at some localities, such as in Borings P-25 and P-67. Also, the contact between the Callaway and Snyder Creek is extremely abrupt and generally angular instead of gradational and horizontal, as would be expected if deposition had been continuous. In addition, the upper zones of the Callaway at a few locations, such as in Borings P-24 and P-31, contain inactive solution features that are completely filled with hard, green clay similar to those observed in the "weathered zones" of the Burlington Limestone. Core recovery from these intervals in Borings P-24 and P-31 was 100 percent. No significant fluid loss was experienced during drilling. Contours on top of the Callaway are shown on Figures 2.5-45 and 2.5-46. Additional site stratigraphic information on the Devonian Snyder Creek and Callaway rock units was obtained during on-site quarry investigations and is presented in the Quarry Site Selection and Feasibility Study, the On-Site Production Mine Quarry reports and in the addendum to the latter report (see Section 2.5.1.2.2).

It was found that ancient filled solution features, pre-Snyder Creek in age, exist in the upper 10 feet of the Callaway Formation in the mine quarry area northeast of the plant. The solution features were found to be concave upward and to be filled with disoriented siltstone, shale, and limestone fragments.

Lower Devonian rocks are not present in the site area. It appears likely they were deposited and subsequently removed by a period of erosion that was initiated by regional uplift at the close of Early Devonian time (Section 2.5.1.1.3.2.4).

2.5.1.2.2.3.3 Silurian System

Silurian rocks are not present at the site. Since they are present in adjacent regions (Figure 2.5-1), it is possible that they occurred within the site area at one time. The

period of erosion that accompanied uplift throughout central Missouri at the close of Early Devonian time may have removed all of the Silurian rocks, as well as Lower Devonian rocks.

2.5.1.2.2.3.4 Ordovician System

The oldest rocks penetrated by on-site borings are of Ordovician age. Three formations were observed in borings: the Joachim, St. Peter, and Cotter-Jefferson City formations. The underlying Roubidoux and Gasconade formations are also of Ordovician age but were not penetrated by borings at the site.

The Joachim Formation is present at the site in thin, scattered, and isolated patches. This unit was encountered in 9 borings as indicated on Table 2.5-6 and ranges in thickness from 3.0 to 10.2 feet. It occurs as a dolomite that unconformably underlies the Callaway and rests with apparent conformity on the St. Peter Formation, if present, or unconformably on the Cotter-Jefferson City formations. The Joachim Dolomite is brown to gray, fine grained, silty, and fossiliferous. Small vugs are common.

The St. Peter Formation is present in the site area in the form of isolated depression fillings on the eroded Cotter-Jefferson City surface. The depressions reflect ancient buried karst (paleokarst) features that developed during a period of uplift and erosion that occurred in Ordovician time, approximately 425 million years ago. The St. Peter is a white, fine grained, sugary sandstone, generally crossbedded and friable. On exposed surfaces, it weathers yellowish brown and becomes resistant to erosion as a result of secondary cementation.

The St. Peter Formation was observed in numerous locations throughout the site area and was encountered in Borings P-48, P-70, P-72, P-143, and P-144. These occurrences are discussed in detail in Section 2.5.1.2.5.3. No voids were observed. Surface exposures are typically rounded in form and in all cases appear to be isolated depression fillings. Some of the largest exposures occur just north of Steedman, as shown on

Figure 2.5-25, where they are about 400 to 500 feet in diameter. It is not possible to visually determine the thickness of these depression fillings with any degree of accuracy; however, the larger deposits may have attained a thickness of 30 to 100 feet as revealed by present day erosion.

A zone of pre-St. Peter/post-Cotter-Jefferson City paleokarst rubble separates the St. Peter Sandstone from the underlying Cotter-Jefferson City Dolomite, as observed in the paleokarst features that underlie the plant site (see Section 2.5.1.2.5.3). The rubble consists of interbedded layers, lenses, slump blocks, and recemented disoriented debris consisting of dolomite, sandstone, siltstone, and shale. Bedding angles vary from horizontal to vertical. No voids have been observed in the rubble and no losses of drilling flud were experienced while drilling through it.

The Cotter-Jefferson City formations underlie the entire site area and crop out in the rugged terrain surrounding the plant site. These formations form prominent bluffs along the sides of the Missouri River. The cotter lies conformably on the underlying Jefferson City. Because it is difficult, however, to differentiate between the two formations, they are often designated as a combined unit. Site test borings have penetrated only 154.7 feet of the Cotter-Jefferson City formation; however, their combined average thickness throughout Missouri is reported to be about 400 feet (Missouri Geological Survey and Water Resources, 1961). The Cotter-Jefferson City is typically a light gray, fine grained, thin bedding planes, becoming numerous and closely spaced in some zones. Dark gray and white banded chert is present in thin layers. Siltstone and sandstone beds are present at some locations.

Some additional site stratigraphic information on the Ordovician Joachim, St. Peter, and Cotter-Jefferson City formations was obtained during on-site quarry investigations and is presented in the Quarry Site Selection and Feasibility Study and the On-Site Production Mine Quarry reports (see Section 2.5.1.2.2).

Approximately 1,400 feet of Ordovician and Cambrian age rocks underlie the site between the basal Cotter-Jefferson City and the top of Precambrian basement rocks. These rock units are illustrated on the Site Stratigraphic Column, Figure 2.5-29. Descriptions and thicknesses are based entirely on data published by the Missouri Geological Survey and Water Resources (1961).

The Roubidoux Formation underlies the Cotter-Jefferson City formations. It consists of sandstone, dolomitic sandstone, and cherty dolomite. In central Missouri, it is predominantly a quartzose sandstone. The sandstone is composed of fine to medium grained quartz sand that characteristically is subrounded and frosted. Gray and brown colors are predominant on weathered surfaces, but the color of the fresh sandstone is commonly light yellow, tan, or red at the surface and white in the subsurface. The dolomite in the Roubidoux is finely crystalline, light gray to brown in color, and thinly to thickly bedded. Individual beds contain brown to gray, banded, oolitic sandy chert. The thickness of the Roubidoux ranges from 100 to 250 feet. The formation's greatest thickness is at the southwestern part of the Ozarks, and its least thickness is along the northeastern part of the area.

The Gasconade Formation underlies the Roubidoux and is the basal formation of Ordovician age. It is predominantly a light brownish gray, cherty dolomite. The formation contains a persistent sandstone unit in its lowermost part that is designated the Gunter Member. The lower part of the dolomite that overlies the Gunter Member is coarsely crystalline and characterized by large amounts of chert that often exceed 50 percent of the total volume of the rock. in contrast, the upper part of the dolomite is dominantly, finely crystalline and contains smaller amounts of chert. In the central Ozark Region, the average thickness of the Gasconade is 300 feet.

2.5.1.2.2.3.5 Cambrian System

All of the Cambrian strata in Missouri are regarded as being Late Cambrian in age. The combined thickness of the Upper Cambrian Series totals approximately 1,000 feet. Six formations are present. The youngest, the Eminence Formation, unconformably underlies the Gunter Member of the Gasconade Formation. It is composed primarily of medium to massively bedded, light gray, medium to coarse grained dolomite. It contains a small amount of chert in the form of small nodules and angular fragments are present mostly in the upper half of the formation. In some areas, the Eminence Formation contains large massive chert boulders and blocks as much as 6 feet in diameter. White oolitic chert is locally present in the upper part of the formation. Molds and casts of gastropods are commonly found in the Eminence chert, and in places masses of Crypotozoan occur near the top of the formation. The Eminence throughout most of Missouri has an approximate thickness of from 200 to 250 feet.

The Potosi Formation conformably underlies the Eminence. The similarity of their lithologies and other characteristics tends to obscure their actual contact. The Potosi is a massive, thick bedded, medium- to fine-grained dolomite that characteristically contains an abundance of quartz druse or so-called "mineral blossom" that is associated with chert. Druse-free chert is uncommon. The rock is typically brownish gray in color and weathers to a light gray. A notable characteristic of the Potosi, as well as of a few other Lower Paleozoic formations, is that the freshly broken rock gives off a pronounced bituminous odor. The Potosi is present in the subsurface throughout most of the state, but at widely scattered localities, it is thin or absent. The Potosi Formation conformably overlies the Derby-Doe Run formations.

The Derby and the overlying Doe Run Formation were originally defined in 1908 from exposures in the vicinity of mines operated by the Derby Lead Company and the Doe Run Lead Company in the Lead Belt area at that time. However, the conformable relationship and similar lithology of the two units has since led most stratigraphers to consider them as a single unit, and the combination of the two names, Derby and Doe Run, is now accepted as the formation name: Derby-Doe Run. It its outcrop area in southeast Missouri, the Derby-Doe Run consists of thin- to medium-bedded dolomite that alternates with thin-bedded siltstone and shale. The dolomite beds are medium to fine grained, buff to brown, argillaceous, and silty. the chert content of the formation is very low, accounting for less than 10 percent of the rock by volume. Glauconite is present in the lower 40 to 50 feet of the formation. The thickness of the Derby-Doe Run is approximately 150 feet; however, it ranges in thickness from 0 to 200 feet.

The Davis Formation is conformable with both the overlying Derby-Doe Run and the underlying Bonneterre formations. The Davis contains shale, siltstone, fine-grained sandstone, dolomite, and limestone conglomerate. Much of the siltstone and fine-grained sandstone is glauconitic and has a "salt and pepper" appearance. "Flat-pebble" and edgewise conglomerates are characteristic of the Davis. The "flat-pebble" conglomerates consist of rounded disc-like pebbles of fine-grained limestone that are

embedded in a medium-grained limestone matrix. The formation averages 170 feet in thickness. Its maximum recorded thickness is 225 feet.

The Bonneterre Formation is typically a light gray, medium- to fine-grained, medium-bedded dolomite which locally can consist of relatively pure limestone. In places, it is very coarse grained and contains small cavities lines with dolomite rhombs. Locally, parts of the Bonneterre are glauconitic and shaly with the shale occurring in beds less than 2 inches thick. The lower part of the Bonneterre consists of alternating beds of dolomite and arenaceous dolomite with the amount of sand increasing toward the base. The Bonneterre occurs in the subsurface throughout most of the state of Missouri and rests conformably on the Lamotte Formation.

The Lamotte Formation rests unconformably on Precambrian basement rocks. It is persistent in the subsurface throughout much of Missouri, but regional variations in thickness have been recognized. It is predominantly a quartzose sandstone that in many places grades laterally into arkose and conglomerate. Pebbles and boulders of felsite are the chief constituents of the conglomerates that immediately overlie Precambrian rocks in many places. The color of the sandstone ranges from light gray or white to yellow, brown or red. Red to purple silty shale is locally present, and lenses of arenaceous dolomite are scattered through the upper part of the formation. The Lamotte is commonly 100 to 400 feet thick in Missouri, although it is absent due to nondeposition over scattered Precambrian hills.

2.5.1.2.2.3.6 Precambrian Basement Rocks

The nearest exposures of Precambrian age rocks are located in the St. Francois Mountains, about 75 miles southeast of the site. The nearest boring that reached Precambrian rocks (Robertson, 1974) is the Continental Ozark No. CO-10 located in the NE quarter of the NE quarter of Section 3, Township 44 North, Range 8 West, approximately 10 miles south of the plant site. This boring was drilled in 1969 to a total depth of 1,955 feet. Precambrian basement was reached at a depth of 1,844 feet, 1,214 feet below MSL. At this location the Precambrian rocks consist of slightly to highly altered serpentine, which becomes porphyritic with depth and is underlain by rhyolite porphyry and tuff.

2.5.1.2.3 Site Structural Geology

Geologic studies to determine the site structural characteristics have been performed utilizing data obtained from site borings, excavation mapping and geophysical surveys. In addition, bedrock exposures were mapped throughout the site vicinity. Contacts between formations were located horizontally and vertically utilizing topographic maps and aerial photographs. dip and strike measurements were taken on bedding planes and joints where possible. A thorough search for faulting was made throughout the site area. Subsurface sections (Figures 2.5-30 through 2.5-37) were prepared correlating both boring data and rock exposures. Detailed mapping of all Category I excavations was also

performed. No major structures have been encountered that would adversely affect construction and operation of the plant.

2.5.1.2.3.1 Site Folding

The effect of regional warping on the site area has been discussed in Section 2.5.1.1.5.4.3.

Gentle warping of Pennsylvanian and older strata appears to have occurred in the site vicinity. A structure contour map drawn on the base of the Callaway Formation is illustrated on Figure 2.5-47. The horizon is one of unconformity as discussed in Section 2.5.1.2.2.3.2. A detailed examination of this surface in a localized area, such as at the plant site, would reveal ancient erosional irregularities, which completely mask any gentle structural expression related to folding; however, the use of widely scattered rock exposures as control points seems to average out the local irregularities and indicates the presence of broad, gentle flexures.

At the site, the age of the broad fixtures cannot be determined precisely. Devonian and Mississippian age rocks appear to be involved. Reconnaissance geologic field data suggests that the Graydon chert conglomerate also reflects the gentle flexures, as shown on Figure 2.5-24. If the tentative age of Early Pennsylvanian is correct for the Graydon, the age of warping must be Late or post-Pennsylvanian. There is no evidence to support any of these gentle movements during Pleistocene time.

Subsurface sections are illustrated on Figures 2.5-30 through 2.5-37 and located on Figure 2.5-25. The structure contour map (Figure 2.5-24) and subsurface sections are based on reconnaissance level control points. Structural features with gentle dips, ranging from 5 to 70 feet per mile (a one degree dip is 92.16 feet per mile), are present. One very gentle flexure, with dips that average about 20 feet per mile, extends southwest from the plant site toward Auxvasse Creek and suggests a somewhat indistinct structural high that my occur between the towns of Mokane and Steedman, some 5 miles southwest of the site. A more prominent structural high with dips of about 50 feet per mile appears to be present in the vicinity of Section 16 of Township 46 North, Range 7 West, 3 miles east of the site.

The rocks at the site generally dip gently toward the north and northwest. This is compatible with regional dips as discussed in Section 2.5.1.1.5.1 on Regional Folding.

Local irregularities in structure are shown in the vicinity of Logan Creek, 2 miles northeast of the site, in Sections 6 and 7 of Township 46 North, Range 7 West, and in the vicinity of Auxvasse Creek about 4 miles west-northwest of the site in Sections 5 and 8 of Township 46 North, Range 8 West. Geologic field work concentrated in these areas revealed no evidence of faulting. In the vicinity of the Auxvasse Creek irregularity, mappable contacts are poorly exposed and difficult to observe except in small and widely scattered locations. The irregularity is based on elevation differences of 10 to 20 feet between points spaced approximately 1 mile apart. No strike or dip measurements could

be taken at these locations. In the vicinity of the Logan Creek irregularity, mappable contacts are well exposed on either side of the creek. The contact between the Callaway and Cotter-Jefferson City formations was traced almost continuously for several thousand feet. Dips between 0 and 15 degrees were observed, but no vertical displacements in the rocks were discovered. The Auxvasse and Logan creeks irregularities are believed to be only two of numerous local irregularities in the Cotter-Jefferson City rocks that resulted from differential subsidence related to erosion and groundwater solution prior to Middle Devonian time (Sections 2.5.1.2.4.3 and 2.5.1.2.5.3).

Numerous minor local variations in the attitude of the rock strata have been noted in the site area. The location of these observations are shown on the reconnaissance geologic map, Figure 2.5-25, as dip and strike symbols. Additional observations, not shown on Figure 2.5-25, were made at these points along the bluffs adjacent to the Missouri River floodplain; 1/4 mile east of Steedman, immediately west of Auxvasse Creek, and 1 mile southwest of Mokane. Detailed examinations of changes in attitude were conducted. Dip and strike data were recorded. Photographs were taken where possible. Rock exposures were traced horizontally and vertically as far as possible in order to determine the magnitude and possible origin of the features. No faulting other than minor slump faults (Section 2.5.1.2.3.2) and no unusual concentrations of fractures were noted in the vicinity of these local changes in rock attitude. Aerial photographs revealed no lineations associated with these features. At some locations, such as in the bluffs southwest of Mokane, strata in the Cotter-Jefferson City Formation can be observed to change in attitude from horizontal to 15 degrees and back to horizontal within a lateral distance of only a few hundred feet. This phenomenon appears to be relatively common in the Cotter-Jefferson City rocks. At all site area locations, changes in attitude of rock strata appear to be related to deposition on irregular karst topography and/or subsequent subsidence that may have occurred in Early Devonian time, over 300 million years ago. This conclusion appears to be supported by other studies in the area. Unklesbay (1955) discusses local deformation of the Jefferson City Formation. Based on his observations, he indicates that such features are localized, that they appear to have resulted from slumping and subsidence subsequent to or accompanying groundwater solution, and that they appear to have no regional significance. Harlan (1951) also discusses low folds and small faults in the Jefferson City Formation as being caused by solution and differential settling which occurred before Middle Devonian time.

2.5.1.2.3.2 Site Faulting

No faulting, except for slumping into ancient karst features, has been revealed within 5 miles of the site either by drilling, by reconnaissance field mapping, by detailed excavation geologic mapping, or by the study of aerial photographs and ERTS imagery. The reconnaissance geologic map on Figure 2.5-25 covers an area of approximately 100 square miles. There is no evidence of faults within the mapped area.

The possibility that pre-Pleistocene faulting might exist in the vicinity of Boring P-48 (see Figure 2.5-30) has been considered. A subsurface analysis of the plant site utilizing

contours on the tops of various formations (Figures 2.5-39, 2.5-42, 2.5-44, and 2.5-46), combined with the occurrence of St. Peter Sandstone in Borings P-48, P-70, P-143, and P-144 reasonably indicates that irregularities in the configuration of formation boundaries and top of rock are due to the following sequence of events.

a. Uplift and erosion during Early Ordovician time that produced a karst feature at the plant site;

b. Middle Ordovician deposition of pre-St. Peter paleokarst rubble, St. Peter Sandstone, and Joachim Dolomite as karst fillings, followed by periods of regional uplift, erosion, and possible renewed solution activity from Late Ordovician through the Early Devonian;

c. Deposition of Middle Devonian Callaway on the irregular (unconformable) Cotter-Jefferson City and Joachim surfaces, followed by brief regional uplift, which initiated minor erosion of the Callaway;

d. Deposition of the Late Devonian Snyder Creek on the irregular Callaway surface, again followed by brief regional uplift that caused minor erosion of the Snyder Creek;

e. Deposition of the Bushberg and Burlington formations on the uneven Snyder Creek surface, followed by continued deposition and eventually by regional uplift that initiated major erosion and weathering in the site area;

f. Deposition of Graydon chert conglomerate on the irregular, eroded Mississippian surface;

g. Glaciation.

Small-scale slump faulting directly related to a pre-Devonian solution feature can be observed in the bluff exposure of the Cotter-Jefferson City Formation adjacent to the Missouri River floodplain. The solution feature is located on Figure 2.5-25 in Section 35 of Township 46 North, Range 8 West, about 3.5 miles south of the site. The slump faults are downthrown toward the solution feature in all cases and display vertical displacements of 1 to 3 feet, which diminish and fade out vertically. The faults are contained within the Ordovician rocks and as such are pre-Middle Devonian in age (over 350 million years). They are not related to tectonic activity, and there is no likelihood of recurrence since the ancient solution features in the area appear completely filled, lithified, and inactive.

Detailed examinations of surface exposures in the erosional valleys surrounding the plant site revealed no evidence of faulting. Lineaments in the site vicinity, which can be projected through the plant site, are believed to be related to jointing.

A detailed foundation investigation has been completed at the plant location. Based on analysis of soil samples and continuous rock cores from closely spaced borings and excavation mapping, no faulting was revealed in the subsurface of the immediate plant site.

2.5.1.2.3.3 Site Jointing

Joints measured within approximately 5 miles of the plant site are nearly all are high angle to vertical (75 to 90 dip), planar to slightly irregular and consist primarily of four systematic sets. These sets differ significantly between the Ordovician and post-Ordovician strata. In the Ordovician Cotter-Jefferson City Formation, the predominant strike ranges from approximately North 15 East to North 10 West with a secondary set from North 50 West to North 75 West. The joints are more closely spaced than in the overlying units, averaging locally 8 to 10 inches, but are commonly several feet apart. In the post-Ordovician units, the predominant strike ranges from approximately North 70 East to East-West with a secondary set from North 5 West to North 15 West. The heavy concentration of easterly strikes of the post-Ordovician is shown on the contour diagram (Figure 2.5-25). In these units, joint spacing locally ranges from 6 to 18 inches, but is commonly several feet. Additional joint measurements were obtained in connection with on-site quarry investigations and are presented in the On-Site Production Mine Quarry report (see Section 2.5.1.2.2). These additional measurements are in approximate agreement with the joint measurements previously presented. The joint pattern of the site location appears to be representative of the regional jointing pattern as discussed in Section 2.5.1.1.5.3.

2.5.1.2.4 Site Geologic History

The geologic history of the site is interpreted through study of the stratigraphy and structure of the subsurface units. Regional geologic events, such as periods of uplift and erosion, are useful in site history interpretation.

2.5.1.2.4.1 Precambrian

A history of geologic events has been discussed in Section 2.5.1.1.3.1 under Regional Geologic History. Data are insufficient to determine precisely what occurred within the site vicinity during Precambrian time; however, it is assumed that many of the same geologic events revealed by Precambrian exposures in central and northern Wisconsin also took place within the site area.

2.5.1.2.4.2 Cambrian period

No on-site borings have penetrated rocks of Cambrian age. Geologic events during Cambrian time at the site must be inferred from observations in adjacent areas. It is likely that the period of erosion that closed the Precambrian time continued through Early and Middle Cambrian times. Late Cambrian sedimentation in transgressing seas began with the deposition of the Lamotte Sandstone on the eroded Precambrian basement surface.

This appears to have been followed by the deposition of a thick carbonate sequence that began with deposition of the Bonneterre Formation, followed by the Davis, Derby-Doe Run, Potosi, and Eminence formations. These units consist principally of cherty dolomite, indicative of a long continued marine environment. The site area probably remained submerged at the end of Cambrian time.

2.5.1.2.4.3 Ordovician Period

The carbonate deposition that characterized Cambrian time was interrupted briefly during the initial Ordovician deposition as indicated by the Gunter Sandstone Member. Deposition of a thick carbonate sequence continued during Early Ordovician time. The Gasconade and Cotter-Jefferson City formations were deposited in a marine environment, which was temporarily altered during Roubidoux time as near-shore sands were deposited.

Between Early and Middle Ordovician time, regional uplift initiated erosion and solution activity at the site that removed all post-Cotter-Jefferson City deposits and produced an irregular karst topography having scattered, rubble-lined sinkholes.

During Middle Ordovician time, the sea advanced over the erosional topography of the site area. Deposition of the St. Peter Sandstone in sinkholes was followed by deposition of the dolomite of the Joachim Formation over wider areas. Significant quantities of carbonates were probably deposited in post-Joachinm time, but uplift and erosion at the end of the Ordovician period removed unknown quantities of Upper or Middle Ordovician sediments from the site area.

2.5.1.2.4.4 Silurian Period

Rocks of Silurian age are not present at the site. They are present in adjacent areas as shown on the Regional Geologic Map, Figure 2.5-1. The regional occurrence of Silurian rocks is discussed in Section 2.5.1.1.4.2.3. It is possible that Silurian deposits occupied the site area at one time, but were removed by a subsequent period of erosion.

2.5.1.2.4.5 Devonian Period

The regional geologic event discussed in Section 2.5.1.1.4.2.4 indicate that the site area was subjected to uplift and erosion at the end of Early Devonian time. At the site, Middle Devonian rocks rest unconformably on beds of Middle to Lower Ordovician age. It appears likely that the periods of erosion, which occurred at the close of Ordovician time and again at the end of Early Devonian time, removed all of the Silurian rocks as well as Lower Devonian and significant quantities of Ordovician rocks.

Middle Devonian seas advanced over an erosional surface. The Callaway Limestone was deposited over the Cotter-Jefferson City Formation and the patchy deposits of Joachim and St. Peter formations. After a brief period of erosion that ended Callaway deposition, marine conditions changed and silty sediments were laid down to form the

calcareous shale, siltstone, and impure limestone of the Upper Devonian Snyder Creek Formation. The Devonian Period at the site ended with uplift and emergence.

2.5.1.2.4.6 Mississippian Period

Initial sedimentation during Mississippian time consisted of the deposition of thin Bushberg sands as the sea transgressed over the site area. The sand deposition was followed by deposition of a thick sequence of cherty Burlington Limestone.

Uplift at the close of Mississippian time resulted in widespread stream erosion and possible development of karst topography in some areas. Significant quantities of post-Burlington and Burlington rocks were probably removed from the site area. Extensive deposits of cherty clay residuum may have formed at this time.

2.5.1.2.4.7 Pennsylvanian Period

Sedimentary processes initiated during Pennsylvanian time probably resulted in reworking of most or all of the chert and clay residuum that accumulated earlier during a period of uplift at the end of Mississippian time. Sandstone and sandy chert conglomerate appear to have been deposited locally in buried valleys which were cut in the Mississippian rock surface. The chert and clay deposits, along with the local sandstone and sandy chert conglomerate, collectively from the Graydon chert conglomerate, which is discussed in Section 2.5.1.2.2.2 under Site Stratigraphy. The Graydon is tentatively assigned the age of Early Pennsylvanian on the basis of similarity with deposits that are overlain by Cheltenham Clay and underlain by the Burlington Limestone in the northern portion of the area shown on Figure 2.5-25.

Regional events during Pennsylvanian time are discussed in Section 2.5.1.1.3.2.6. Pennsylvanian deposits are thin in the site area. Little is known of the geologic events that occurred at the site during the approximately 300 million years (Table 2.5-1), which separates the Lower Pennsylvanian from the overlying Pleistocene deposits at the site. Regional events during this period are discussed in Sections 2.5.1.1.3.2.7 through 2.5.1.1.3.4.1.

2.5.1.2.4.8 Quaternary Period

Glaciation occurred at the site during the Kansan stage of Pleistocene time, some 700,000 years ago, as discussed in Section 2.5.1.2.2.1.3. The deposits are thin at the site and absent to the south.

Deposits of post-Kansan accretion-gley, also of Pleistocene age, indicate lacustrine, poorly drained, or undrained environments existed at the site for a considerable time following deposition of the glacial till, perhaps in response to damming of glacial melt water as the Kansan ice sheet retreated northward.

Windblown soil (loess) of Illinoian and/or Wisconsinan age occupies the topographically high portions of the site area. These soils were transported from major drainages, such as the Missouri River, following the retreat of the last of the Pleistocene ice sheets.

2.5.1.2.5 Site Engineering Geology

2.5.1.2.5.1 Evidence of Prior Earthquakes

Minor to moderate earthquake ground motion has been experienced at the site; however, there is no evidence from geomorphologic, lithologic, stratigraphic, structural geologic or geophysical studies to substantiate such motion.

2.5.1.2.5.2 Deformational Zones

Geologic studies related to site structure are discussed in Section 2.5.1.2.3. Minor flexing of the lithified formations appears to have occurred (Section 2.5.1.2.3.1). Faulting in the site area is confined to minor displacements related to ancient solution features (Section 2.5.1.2.3.2). No major structures or zones of deformation have been encountered that adversely affect construction and operation of the plant.

2.5.1.2.5.3 Solution and Weathering Features

Examination of bedrock exposures in areas adjacent to the plant site revealed several geologic features related to solution activity in the Cotter-Jefferson City Formation of Early Ordovician age. It appears likely that these features formed during a period of erosion that was initiated by regional uplift prior to Middle Ordovician time, over 400 million years ago (Table 2.5-1). The sinkholes or karst topography, which were then developed on the Ordovician bedrock surface, are now filled with rock consisting of angular, disoriented blocks of dolomite, sandstone, and conglomerate that are tightly and completely cemented within a calcareous matrix. A well-exposed solution feature is located along the Cotter-Jefferson City bluffs adjacent to the Missouri River floodplain in Section 35 of Township 46 North, Range 8 West, about 3.5 miles south of the site. At this location, the solution filling is more resistant to erosion that the normal sequence of strata adjacent to it. Small scale slump faulting was also observed as discussed in Section 2.5.1.2.3.2. These minor faults, which have displacements of 1 to 3 feet, are demonstrated to be at least preMiddle Devonian in age. They are not related to tectonic activity and there is no likelihood of recurrence since the ancient solution feature is completely filled, lithified, and inactive.

Sandstone of the St. Peter Formation was deposited in many of these ancient solution features during Middle Ordovician time, over 425 million years ago (Table 2.5-1), as discussed in Section 2.5.1.2.4.3. The location of twelve isolated, oval-shaped patches of St. Peter Sandstone are shown on the reconnaissance geologic map, Figure 2.5-25.

An examination of Cotter-Jefferson City exposures in bluffs along the Missouri River floodplain, 3.5 miles south of the site, revealed interbedded, irregular, and discontinuous

lenses containing disoriented dolomite rubble and chert debris within a matrix of silty to sandy shale. These deposits appear to be ancient cavity fillings at depth within the Cotter-Jefferson City Formation. They are well indurated and contain no significant voids.

The intensity of solution activity, which occurred on and within the Cotter-Jefferson City Dolomite prior to Middle Ordovician time, is indicated by the presence of sandstone and rubble-filled sinks and caves within the site area. The occurrence of St. Peter Sandstone shows that many of these features were filled during Middle Ordovician time. It is not known if additional solution activity occurred in the site area during the period of erosion that ended Early Devonian time. However, it appears that the marine deposition during Middle Devonian time, over 350 million years ago, completely filled any remaining solution features. Based on direct observations of rock cores and rock exposures, these features are now solidly filled and stable, and represent no hazard to plant safety.

Boring P-48 encountered a paleokarst feature on the Cotter-Jefferson City surface as illustrated by subsurface sections (Figure 2.5-30 and 2.5-31). Additional drilling revealed that this feature underlies Unit No. 2 in the approximate position as outlined on Figure 2.5-28. The upper surface of the feature is interpreted as having an elongated oval shape and a plan dimension of approximately 200 by 400 feet. The elongate axis of the feature trends about North 80 degrees West, consistent with one set of jointing in the Cotter-Jefferson City Formation (see Section 2.5.1.2.3.3). It appears likely that solution activity along joints in the Cotter-Jefferson City Formation prior to the deposition of the Middle Ordovician St. Peter Sandstone, approximately 425 million years ago, was responsible for the formation of this ancient karst feature that now lies buried approximately 100 feet below the proposed reactor foundation grade and 80 feet below the top of the lithified formations. The paleokarst feature was completely and solidly filled with St. Peter Sandstone and pre-St. Peter rubble before the end of Ordovician time, about 425 million years ago.

As shown on Subsurface Sections I-I', J-J', and K-K' which are illustrated on Figures 2.5-31 through 2.5-33 and located on Figure 2.5-28, a zone of post-Cotter-Jefferson City, pre-St. Peter rubble lies along the sides and bottom of the paleokarst feature. The rubble consists of interbedded layers, lenses, slump blocks and recemented, disoriented debris consisting of dolomite, sandstone, siltstone, and shale. Bedding angles vary from horizontal to vertical. No voids were encountered in the rubble zone and no fluid losses were experienced while drilling through it. Core recovery in the rubble zone ranged between 36 and 100 percent and averaged approximately 90 percent. The completeness of filling, competency, and lithologic character of the paleokarst rubble, as observed in the rock cores, is similar to a paleokarst feature that is exposed in the bluffs adjacent to the Missouri River floodplain and that was observed by Mr. Emanuel A. Licitra, Dr. J. Carl Stepp, and Dr. Richard McMullen during the AEC (NRC) site safety visit on November 22, 1974. Pressure testing in the rubble indicated low permeabilities. These are discussed in detail in the hydrology section of this report.

The maximum observed thickness of the St. Peter Sandstone was in Boring P-70, where 100.3 feet were cored (see Subsurface Sections I-I', J-J' and K-K'). Borings P-48, P-143,

and P-144 encountered 11, 20, and 63 feet of St. Peter Sandstone, respectively. Core recoveries of the St. Peter in all four borings vary between 80 and 100 percent and average over 90 percent. No voids were encountered while drilling through the St. Peter; however, drilling fluid losses of up to 40 percent were recorded in Boring P-70 while coring the sandstone. these losses of drilling fluid, although experienced while coring the St. Peter, must be attributed to some other subsurface horizon because:

a. Pressure test results indicate the St. Peter sandstone in P-70 and in other borings is not sufficiently permeable to absorb significant quantities of drilling fluid.

b. No drilling fluid losses were experienced while coring the St. Peter Sandstone in Borings P-48, P-72, P-143, and in P-144, which penetrated 63 feet of sandstone only 50 feet from Boring P-70.

Fluid losses in Boring P-70 are partially attributed to the upward movement of fluid, past the base of the casing and into the Bushberg Sandstone and Graydon chert conglomerate and partially to the presence of a zone of somewhat higher permeability, which was revealed by pressure testing in the Callaway Formation (see Section 2.4.13.2.3.2.1).

Pressure testing was performed in Borings P-70, P-143, and P-144. Test results in all three borings indicated that the St. Peter Sandstone has a low permeability. Pressure testing is discussed in detail in Section 2.4.13.2.3.2.1.

The Cotter-Jefferson City Formation, which underlies and is adjacent to the paleokarst feature, was continuously cored to a depth of 107.6 feet below the deepest extent of the pre-St. Peter rubble (see log of Boring P-70, Figure 2.5-215). Occasional zones of isolated vugs ranging from pinpoint to 2 inches in size were encountered. Vugs as large as 2 inches were rare. No drops in the drill bit occurred during coring, and the core revealed no evidence of solution activity such as interconnected channels and staining or widening of fractures. Drilling fluid losses of up to 60 percent in Boring P-74 were experienced in the Cotter-Jefferson City Formation; however, these fluid losses were experienced at elevations between 480 to 520 feet, corresponding to the regionally developed Cotter-Jefferson City Formation aquifer as discussed under the section of hydrology. At least 50 feet of low permeability Cotter-Jefferson City rock separates the regional aquifer from the deepest extent of the paleokarst feature, as illustrated on Subsurface Section I-I' (see Figure 2.5-31).

Core recoveries ranged between 93 and 100 percent and averaged 99 percent. Pressure testing indicated low permeabilities. The results of pressure testing are discussed in detail in the hydrology section of this report (Section 2.4.13.2.3.2.1).

Based on correlations between borings, the stratigraphic units younger than St. Peter can be shown to be continuous over the paleokarst feature. There is no evidence for vertical displacement in any unit. The Joachim Formation is present over the St. Peter

Sandstone but appears to be absent over the Cotter-Jefferson City Formation beyond the border of the paleokarst feature. The upper surface of the Callaway Formation is slightly depressed over the paleokarst feature, as indicated by Figure 2.5-46, Contours on Top of the Callaway Formation. This phenomenon has been discussed previously and related to possible post-depositional solution activity and slumping, which may have extended through Devonian time. The additional deep drilling revealed that while the Callaway surface is depressed over the paleokarst feature, the unit also increases in thickness in the same area. This relationship strongly suggests that the depression of the Callaway surface is a result of depositional factors rather than post-depositional processes. The Middle Devonian age Callaway Formation very likely reflects deposition on a "scoured out" (unconformable) Ordovician age surface. It is noteworthy that this paleokarst effect on overlying deposits decreases upward and by Pennsylvanian time, about 300 million years ago, its effects are no longer discernible (see Subsurface Section J-J', Figure 2.5-32). Finally, the surface blanket of Pleistocene-age deposits completes the concealment of the deeply buried paleokarst feature. Finally, the surface blanket of Pleistocene-age deposits completes the concealment of the deeply buried paleokarst feature.

In addition to those borings drilled to further study the paleokarst feature under Unit 2, a number of additional deep borings were drilled in the foundation area of Units 1 and 2 in order to determine if other paleokarst features were present. Boring P-72, located at the extreme southern corner of Unit 1 (see Figure 2.5-28), encountered 13 feet of St. Peter Sandstone underlain by 5 feet of pre-St. Peter rubble (see Subsurface Section M-M', Figure 2.5-35). Borings P-146 and P-147 were drilled in order to determine if this second paleokarst feature extended northward under the foundation area of Unit No. 1. Pressure testing was performed in Boring P-147 and is discussed in detail in the hydrology section of this report (see Section 2.4.13.2.3.2.1).

As illustrated on Section M-M', the second paleokarst feature thins northward from Boring P-72. Borings P-146 and P-147 encountered only a thin zone of pre-St. Peter rubble between the Callaway and Cotter-Jefferson City formations. It appears likely that the main body of this second paleokarst feature lies south of Unit No. 1. It is also very likely that this second feature is similar in geological and hydrological character to the paleokarst feature that underlies Unit No. 2 and that has been studied in detail. Contours on top of the Callaway Formation (see Figure 2.5-46), however, suggest that this second feature may be somewhat smaller in size than the first and may be oriented in a northeast direction.

Core recoveries in Borings P-72, P-146, and P-147 averaged 97 percent for the St. Peter Sandstone, 96 percent for the pre-St. Peter rubble, and 99 percent for the Cotter-Jefferson City Formation. No evidence of active carbonate solution was observed in any of the cores. No significant fluid losses were experienced while drilling Borings P-72 and P-147; however, a 100 percent loss of drilling fluid was experienced at a depth of 132.5 feet below the ground surface in a basal sandstone unit of the Callaway Formation (see Figure 2.5-291, Log of Boring P-146). A 3-inch drop in the drill bit was experienced at the base of the Callaway Limestone, indicating a void having a horizontal

dimension larger than the 4-inch core barrel. The void with associated loss of drilling fluid indicates the presence of a joint or bedding plane, which has been enlarged by solution weathering. This is the only significant solution feature that has been encountered in all of the 165 test borings and the 25 quarry investigation borings that have been drilled in the site, producing more than 14,000 feet of rock core for analysis. Pressure testing was performed in Boring P-147 located about 50 feet from Boring P-146. The test results indicate low permeabilities for the entire rock section. Pressure test results are discussed in detail in the hydrology section of this report (see Section 2.4.13.2.3.2.1).

Considerable time was expended in order to investigate paleokarst features below foundations for Units 1 and 2. Sixteen deep borings were drilled, more than 3,500 feet of rock core were analyzed and described in detail, subsurface maps and cross sections were prepared by correlating between borings, water pressure tests were performed, and permeability values were calculated. Important geologic and hydrologic data were obtained; and conclusions regarding solution activity and weathering, subsurface stability, and movements of ground water remain essentially unchanged. The detailed investigation of paleokarst features has, however, added greatly to the scientific evidence in support of the following conclusions:

a. The drilling data indicate that no voids or active solution channels occur within the filled paleokarst features and that no voids or solution channels occur in the carbonate rocks below or adjacent to the paleokarst features as a result of either incompletely filled ancient channels or regenerated secondary solution activity in post-Ordovician time.

b. There is no possibility of the formation of sinkholes, or subsurface cavities resulting in subsidence or collapse of overlying soil and rock in the plant area. Based on detailed analysis of borings, there are no geologic features that could possibly affect construction and operation of a nuclear power plant.

c. Conclusions regarding site faulting (see Section 2.5.1.2.3.2) remain unchanged. The additional site investigations have revealed no evidence of faulting except in relationship to slumping.

d. The results of pressure tests in and adjacent to the paleokarst features indicate that regenerated secondary solution activity is not present and cannot occur under the present geologic and hydrologic site conditions.

e. The Snyder Creek and Callaway formations have very low permeabilities and essentially act as an aquitard restricting the vertical movement of ground water (see Section 2.4.13.2.3.2).

f. No significant hydraulic connection exists between the sandstone-filled paleokarst features and deeper aquifers beneath the site. The paleokarst features and the adjacent and immediately underlying Cotter-Jefferson City

Formation have similar, low permeabilities in the range of about 3 x 10^{-7} to 5 x 10^{-6} centimeters per second (see Section 2.4.13.2.3.2).

Subsurface investigations in the south portion of the site revealed another paleokarst feature in the Cotter-Jefferson City Formation, which is illustrated on Figure 5 of the Quarry Site Selection and Feasibility Study (see Section 2.5.1.2.2). As illustrated by Section B-B' on Figure 5 of the Quarry Study, the paleokarst feature contains St. Peter Sandstone and is overlain by the Joachim and Callaway formations. A sagging effect similar to that shown on Figure 2.5-46 and previously discussed in this section is evident; however, it is also accompanied by a rapid thickening of the Joachim and Callaway rock units directly over the feature. This study presents additional data indicating that the apparent downwarping and corresponding thickening observed over the paleokarst feature under Unit 2 is the result of marine deposition on a scoured-out friable sandstone surface.

With the possible exception of the Burlington-Bushberg and Joachim-St. Peter contacts, all formational boundaries that were penetrated by test borings are unconformable. These unconformable surfaces represent periods of exposure to weathering and erosion that occurred prior to deposition of the overlying strata. Weathering has been observed in almost all lithified units to some degree. Based on observation of cores from test borings, the maximum weathering zones occur at the top of the lithified formations. At this horizon, the depth of weathering was observed to vary between 0 and 27 feet.

The Burlington Limestone is the youngest completely lithified formation in the site area. The upper zones are highly weathered. Solution channels and cavities were formed at one time, but are now filled with green silty to sandy clay containing chert and limestone fragments. The clay is hard and easily sampled by coring. A total of 92 borings penetrated the Burlington Formation. No open voids larger than 2 inches were encountered. No drops in the drill bit were experienced during drilling. Core recovery generally ranged from 45 to 100 percent and had an overall average of better than 80 percent. A high percentage of recovery of the clay solutional fillings was not unusual. Some low core recoveries of 25 to 45 percent were obtained in Borings P-6, P-32, P-42, and P-53 and are attributed to weathered rock conditions and to the presence of numerous clay-filled fractures and clay solutional fillings. No noticeable drilling fluid losses can be associated with the low core recoveries.. Drilling fluid loss on the order of 50 to 100 percent was experienced in the Burlington in Borings P-2 and P-33. These fluid losses, which represent approximately 20 to 40 gallons per minute (Raymond International), were temporary and confined to intervals of 1 to 5 feet in thickness. Observations of core recovered from these zones of fluid loss revealed the presence of fractures; however, no solution cavities were present.

The basal Mississippian Bushberg Sandstone unconformably overlies the Snyder Creek Formation. The Bushberg Sandstone is, in general, moderately friable, well-indurated, and not subject to cavity formation by solution or weathering. Fissures that developed in upper beds of Snyder Creek during a pre-Mississippian period of erosion were filled with

sandstone, probably at the same time the Bushberg was being deposited. The lower portion of the Snyder Creek consists of siltstone and silty shale. Weathering has altered thin zones of these strata to clay.

The upper surface of the Middle Devonian Callaway Formation is also unconformable as discussed in Section 2.5.1.2.2.3.2. Solution channels and cavities, similar to those in the Burlington, were developed during a period of erosion and solution activity. The voids that formed prior to Snyder Creek time apparently were filled with silt and clay as the Snyder Creek was being deposited. Vuggy zones ranging from a few inches to a few feet in thickness and having a maximum estimated porosity of 30 percent were observed. No vugs larger than 2 inches in diameter were encountered in the Callaway Limestone, with the exception of the single 3- to 4-inch void that was penetrated in Boring P-146 (see Section 2.5.1.2.5.3). No other open solution channels, large cavities, or caves were encountered in the Callaway, wither in borings or in rock exposures of the site area. A description of recent solution weathering on hillsides as observed during rock excavation at Test Pit 1 is presented in the On-Site Production Mine Quarry report (see Section 2.5.1.2.2).

The Cotter-Jefferson City formations reveal evidence of past solution activity as discussed in Section 2.5.1.2.4.3; however, little evidence of weathering is present with the exception of thin clay fillings in fractures.

Based on detailed rock core examinations and laboratory testing, there are no zones of weathering in the lithified formations that could adversely affect construction and operation of a nuclear power plant. In general, no voids larger than 2 inches in diameter were ever encountered during the test drilling, with the exception of the 3- to 4-inch void that was encountered in Boring P-146. All of the smaller voids are attributed to isolated vugs, pinpoint to 2 inches in diameter, occurring in random zones as identified on the boring logs. The maximum porosity of any of the zones was determined to be 30 percent.

Caves occur in the Cotter-Jefferson City Formation along the prominent bluffs adjacent to the Missouri River floodplain. These caves range in size from small animal burrows to circular openings some 3 to 5 feet in diameter and extending horizontally into the rock bluff some 5 to 10 feet. They are formed by a process of differential erosion. The caves occur in thin-bedded and shaley layers of rock which are more easily affected by erosional processes than are the overlying and underlying massive bedded and relatively pure carbonate layers. Elongate undercuttings tend to form in the rock face along the more easily eroded zones. There are locally enlarged and deepened by freezing and thawing, wind action, and burrowing animals. These caves are dry. There is no evidence to suggest that solution activity was ever involved in their formation.

Two caves were observed to have formed in isolated remnants of St. Peter Sandstone. The largest of these is the "Research Cave" located on Figure 2.5-25 in the southeast corner of Section 19, Township 46 North, Range 7 West, about 2.5 miles southeast of the site. The St. Peter caves are also formed by differential erosion. Under proper topographic conditions, the upper surface of the sandstone becomes well indurated by a

process of weathering and secondary cementation. The underlying friable sandstone weathers to a white sugary-textured sand and is gradually removed by surface erosion. The well-indurated crust remains to form an arched cavern structure. This type of cavern forms only in the St. Peter where it has been exposed to erosion at or near the head of present day erosional valleys.

Differential erosion is a common geologic phenomenon restricted to surface exposures and bears little relationship to the formation of caves by subsurface solution activity. Site borings and reconnaissance field investigations have not revealed any caves or significant open cavities in the carbonate rocks of the area. There is no evidence to suggest that any caves or voids exist that could jeopardize the structural integrity of the plant.

2.5.1.2.5.4 Residual Stresses

Since no faults, folds or shear zones of any significance were encountered in the project area, and since the site is located on a nearly isolated plateau with deeply incised drainages on all sides, no unrelieved residual stresses in the rock strata were detected.

2.5.1.2.5.5 Site Stability

The site is underlain by glacial and postglacial soils, older sediments, and a thick sequence of lithified formations consisting of limestone, sandstone, shale and dolomite.

Field exploration programs, which have been completed to date, show no evidence of any actual or potential surface or subsurface subsidence, uplift, or collapse resulting from tectonic depressions or cavernous terrain at the site. No voids or active solution channels occur within the filled paleokarst features or in the carbonate rocks below or adjacent to them as a result of either incompletely filled ancient channels or regenerated secondary solution activity in post-Ordovician time.

Since the project area is within the Central Stable Region, it is not anticipated that any significant regional warping or differential uplift would occur during the design life of the project.

The glacial and postglacial soils at the site generally exhibit low to moderate compressibility, and the modified loess, accretion-gley and till are overexcavated and replaced with compacted granular structural fill beneath all major power plant and Class I structures. Settlement analyses indicate that consolidation of soil and rock strata beneath the structures will not exceed the tolerable settlement limits.

During the field and laboratory programs, none of the soil or rock samples indicated any potential for instability because of mineralogy, lack of consolidation or water content. The liquefaction potential of the subsurface material, as discussed in Section 2.5.4.8, is nil. Undesirable response characteristics such as thixotropy, differential consolidation, cratering and fissuring were not encountered.

2.5.1.2.5.6 Effects of Man's Activities

Investigations at the site have not revealed any adverse geologic conditions that can be attributed to man's activity. The addition or withdrawal of subsurface fluids, including ground water, at the site has not been significant. Material extraction in the site vicinity has consisted of minor amounts of surface quarrying of limestone and fire clay. The location of local mining activities which occurred in the past are shown on Figure 2.5-25. At present, there are no active mining operations within 4.5 miles of the plant site.

There has been no mining or petroleum production in the site area that would cause any surface or subsurface subsidence. Based on current knowledge of the area, no mining or petroleum activity is anticipated. Central Missouri is not a promising area for oil or gas production (American Association of Petroleum Geologists, 1971). All petroleum explorations within 50 miles of the site are shown on Figure 2.5-48. The nearest producing oil or gas well is located in the Florissant Field, 70 miles from the plant site. There is no potential for gas storage in structures around the site due to the absence of suitable reservoir and cap rock units.

2.5.1.2.6 Site Ground Water

A detailed discussion of the regional and local groundwater environment is given in Section 2.4.13. Groundwater conditions at the site are summarized in this section.

A total of 49 piezometers were installed at the site during the period August, 1973, through December, 1974. The piezometers were installed at various depths throughout the area, monitoring the soil and rock units. In addition, permeameter tests in the field borings (Section 2.5.6.1.2.3), borehole pressure tests (Section 2.5.6.1.2.4) and pump tests (Section 2.4.13.2.3.2.4) were conducted to determine the hydrologeologic characteristics of the formations beneath the plant site to a depth of about 400 feet. The results of these testing programs are summarized in Tables 2.4-20, 2.4-21, and 2.4-22.

In 1979 eleven piezometers were installed to monitor post-construction water levels in rock units ranging from the Cotter-Jefferson City through the Graydon chert conglomerate. These are summarized in Table 2.4-23 and their locations are shown on Figure 2.4-27.

A program of water level measurements was conducted on these 49 piezometers from August, 1973 through February, 1975. In early 1975 all but five of the 49 piezometers were destroyed and grouted because they interfered with the power block excavation and construction activities. Water level measurements continued on the remaining five piezometers, located in the Ultimate Heat Sink area, until they too were destroyed and grouted early 1976. The results of this program are shown on Figures 2.4-18 and 2.4-26 and in Table 2.4-22.

The shallow water table ranges from 5 to 30 feet below ground surface in the Quaternary deposits (Figure 2.4-18). The depth to the shallow water table responds slowly to

precipitation and varies a few feet. The zone of saturation extends from the Quaternary deposits through the Graydon chert conglomerate, Bushberg, and to the base of the Snyder Creek (Figure 2.4-17).

Water percolates downward from the base of the Snyder Creek into the underlying Callaway Formation. The rate of vertical percolation is very low due to the low permeabilities of the Snyder Creek Shale and underlying units. The Snyder Creek Shale, Callaway Limestone, St. Peter Sandstone and upper Cotter-Jefferson City Formation to depths of about 350 feet below ground surface at the site are of low permeability and saturated conditions exist at zones in the Callaway and Cotter-Jefferson City formations (Figure 2.4-12).

At depths below about 340 feet in the Cotter-Jefferson City Formation, at an elevation of about 500 feet (MSL), a regional aquifer system is present (Figure 2.4-17). The formations between the lower part of the Cotter-Jefferson City and the Lamotte formations form part of the regional aquifer.

None of the formation above the lower part of the Cotter-Jefferson City Formation are capable of producing more than about 1 gallon per minute in a 6-inch borehole. A 6-inch test well in the Cotter-Jefferson City Formation drilled to a depth of about 400 feet below ground level was pumped over a 5 day period at about 8 gallons per minute. Total drawdown during this period was about 85 feet.

At greater depths in the regional aquifer system, yields as great as 500 gallons per minute per well could be expected based on information from Fuller et al. (1967) and Knight (1962).

2.5.2 VIBRATORY GROUND MOTION

The vibratory ground motions at the site in central Missouri, for which aseismic design criteria have been established, are based upon the postulated recurrence of the maximum historic earthquakes occurring in several defined seismotectonic regions. The earthquakes affecting the site and governing aseismic design are identified as:

a. A Modified Mercalli Intensity (MMI) XI-XII event (Table 2.5-6) occurring anywhere within the New Madrid Seismotectonic Region located in extreme southeastern Missouri and portions of the adjacent states. The closest approach of the boundary of this source region is 175 miles southeast of the site.

b. An MMI VII event occurring anywhere within the Chester-Dupo or the Ste. Genevieve Seismotectonic regions located in eastern Missouri. The closest approach of these regions lies 70 miles to the east-southeast of the site.

c. An MMI V event occurring within the Missouri Random Region near the site.

The design event superseding all other considerations is taken as a recurrence of the New Madrid event 175 miles from the site. In order to provide an appropriate degree of conservatism, the Safe Shutdown Earthquake (SSE) is defined as a horizontal ground acceleration at foundation level of 0.20g. This is equivalent to an intensity approaching MMI VIII (Modified Mercalli Intensity - see Table 2.5-6) at foundation level. The operating Basis Earthquake (OBE) is a recurrence of the New Madrid earthquake at its historic epicenter. Consistent with the conservatism developed for the Safe Shutdown Earthquake, the maximum horizontal acceleration for the OBE will be 0.12g. These levels are used to anchor the appropriate design response spectra.

2.5.2.1 Seismicity

A list of historical earthquakes with epicenters located within a distance of about 200 miles from the site is presented in Table 2.5-7. This list presents all reported earthquakes within 50 miles of the site, and significant shocks having MMI V or greater within 200 miles of the site. The epicenters of these shocks are plotted on Figure 2.5-49. Table 2.5-8 lists the historic earthquakes that are considered significant to the site. Since the beginning of the nineteenth century only four earthquakes have been reported within 60 miles of the site. None of these events exceeded MMI V in intensity; the nearest one to the site was a distance of 40 miles. Eighteen earthquakes of MMI V or greater have been reported within 100 miles of the site, and 60 shocks of MMI VI or greater have been reported within 200 miles. Few earthquakes were of sufficient intensity to cause damage to well built structures.

Although the site has been within the limits of perceptibility of at least 22 shocks within the past 2 centuries, the site intensity has exceeded MMI V only during the historic series of seismic events in the New Madrid area in the years 1811, 1812, and 1895 (Tables 2.5-7 and 2.5-8).

2.5.2.1.1 New Madrid Earthquakes

The upper Mississippi Embayment region has probably been the locus of large earthquakes prior to the destructive events of modern record in 1811 and 1812. According to Fuller (1912), Lyell (1849) reported Indian legends recounting a great earthquake in the Mississippi Valley. This tends to be corroborated by Heinrich (1941), who describes a great ancient Mississippi River shock that was reported to have occurred in 1699 in the same region affected by the 1811-1812 events. The reported epicentral location, however, was in western Tennessee.

The three earthquakes that occurred on December 16, 1811, and January 23 and February 7, 1812 near New Madrid, Missouri are thought to have been the largest ever to occur in the central and eastern United States. These shocks probably generated an intensity as high as MMI XI-XII, were reportedly felt in an area of about 2,000,000 square miles, and changed the surficial topography in an area of about 30,000 to 50,000 square miles. Structural damage from these earthquakes was small due to the sparse population

and related absence of dwellings and other structures. The body wave magnitudes of these events were estimated to be 7.3, 7.2, and 7.5 (Nuttli et al., 1979).

In a report entitled "The New Madrid Earthquake," published by the U.S. Geological Survey in 1912, Fuller apparently gives the most factual and complete account of the historical events that occurred during the years 1811 and 1812. Although criticized by some workers, Fuller made every effort within the scientific standards and state-of-the-art of his period to present facts as best he could. Although he did his field work in 1904, he was able to preserve the basic historical reports that might otherwise have been lost to present day workers.

In the USGS report, he gave many descriptions of the results of the earthquakes in terms of physical features that recorded the intensity of otherwise transitory seismic events. Fuller recognized the fact that ground motion from the New Madrid events was amplified by river alluvium. In describing the damage of the December 16, 1811 shock, he cites Drake's description of the damage near Cincinnati and quotes him as follows:

> "It (the violent earth motion) seems to have been stronger in the valley of the Ohio than in the adjoining uplands. Many families living in the elevated ridges of Kentucky, not more than 20 miles from the river (the Ohio River), slept during the shock; which can not be said, perhaps, of any family in town."

Fuller later describes the amplification of alluvial materials:

> "In the more remote districts the action was less intense, producing only vibrations and tremors. There appears, however, to have been more or less of surface movements, as the shocks were much more distinctly felt by those living in the alluvial flats of the valleys than by those on the rock uplands, notwithstanding that it is only through the rocks that the shocks could be transmitted to the distances observed. The slight vibrations in the latter must, therefore, have been greatly magnified on transmission to the alluvial masses. The intensities in the valley and upland differed sufficiently to be noticeable at the time. Drake, speaking of Cincinnati, says: 'The convulsion was greater along the Mississippi, as well as along the Ohio, than in the uplands. The strata in both valleys are loose. The more tenacious layers of clay and loam spread over the adjoining hills, many of which are composed of horizontal limestone, suffered but little derangement.'"

It is significant to the subsequent evaluation of the intensity of the New Madrid events that in the preparation of the isoseismal maps and attentuation curves presented by various workers herein, most of the data points are from town and settlements situated within alluvial valleys of rivers and streams, such as Cincinnati, St. Louis, Saline, Ste. Genevieve, Louisville, Natchez, and Pittsburgh.

Event the most distant cities where shocks were felt, (such as Washington, D.C., Boston, Philadelphia, and Charleston, South Carolina), were also situated along rivers or on coastal plain deposits where amplification could be expected due to the properties of the

underlying materials. As a result, the intensities so derived can be judged to be the maximum intensities which could have been noted; in nearby highlands or where ground was more competent, the intensities appear to have been substantially less.

The ground motion felt in the vicinity of the site from the 1811-1812 New Madrid events was the highest of any known to have affected the site and probably induced a site intensity on the order MMI VI-VII (Nuttli, 1973a).

Nuttli's early work (1973a), as shown on the isoseismal map for the December 16, 1811 event, is shown on Figure 2.5-50. As this map used by Nuttli had no data points for the largely uninhabited region west of the Mississippi River, Dames & Moore undertook an extensive investigation of historical archives in an attempt to obtain new data points. Old maps, newspapers, diaries, letters and other documents were examined to substantiate an estimate of the intensity of the events in the general region of the site. This effort was partially successful in revealing heretofore unpublished information at three locations: St. Louis, St. Charles, and Defiance. In his early evaluation of damage reports after the New Madrid events, Nuttli (1973a) had listed an intensity of MMI VII-VIII at St. Louis. As a result of further analysis, he now considered (Nuttli, 1973b) that these intensities were based upon reports from the old town of St. Louis where it lay on the banks of the Mississippi River (Figures 2.5-51 and 2.5-52); that his previous estimate did not take into account amplification through the underlying alluvial materials; that the intensity in nearby areas underlain by rock would necessarily have been less; and that consequently, the intensity for St. Louis should now be considered MMI VII. The lowering of the intensity at St. Louis is supported by the knowledge that the village of Herculaneum, 50 miles closer to New Madrid than St. Louis, reported an intensity of only MMI VI, which suggests that the intensity at St. Louis might be lowered further. At St. Charles, about 70 miles from the site, the Kibbee house, the first brick building to be built in St. Charles (about the year 1810), sustained damage indicating an intensity of MMI VII (Olson, 1968, 1973). At Defiance, 56 miles from the site, Daniel Boon's home, which was extant at the time of the 1811-1812 events (Andreas, 1973; Oliver, 1973), sustained damage estimated at an intensity of MMI VII. The St. Charles and Defiance data points lie about 160 miles from New Madrid; the site lies about 200 miles from New Madrid, 40 miles beyond the new data points with their intensities of MMI VII. Based upon these factors, the site must be considered to have been subjected to ground motion of MMI VII or less.

In this research effort, although three definitive data points were discovered, other locations were revealed that were populated at the time of the 1811-1812 events but yielded no reports upon which intensities could be defined. The absence of reports that would surely have been made had damage been noteworthy is, in a sense, significant, even though such negative data cannot be used in intensity definition. Nevertheless, it is useful to show the size and distribution of the population during the years 1811-1812 because if noteworthy damage had been incurred it probably would have been recorded, reported, or retold. Settlements known to exist in the region that is now Missouri are shown on Figure 2.5-53.

During the War of 1812, the British burned the 1810 U.S. Census records stored in Washington D.C. The following population figures, however, were found in "View of Louisiana" by Henry Marie Brackenridge, published in 1814 and corroborated in "Darby's Universal Gazetteer," edition of 1827; Bradford's Illustrated Atlas of the United States; "History of the Discovery and Settlement of the Valley of Missouri" by John Monette, M.D., published in 1846; and "The Influence of the Environment on the Settlement of Missouri" by James Fernando Ellis, Ph.D., published in 1929:

St. Charles	3,505
St. Louis	5,667
Ste. Genevieve	4,620
Cape Girardeau	3,888
New Madrid	3,103
Hope Field and St. Francis	183
Arkansas	874
Troops at Military Posts in Territory (est)	200
Hunting and Trading Parties up the Missouri and Mississippi (est.)	300
Remote Families not found by Sheriff (est.)	300
Total	22,640

Of this total population, 8,011 were slaves. The number of civilized Indians and mixed nationals, while not known, could not have been considerable (Brackenridge, 1814).

Cote Sans Dessein, now called Bakersville, was settled on the banks of the Missouri River by about 20 French families (Brackenridge, 1814). Cote Sans Dessein lies only 16 miles from the site, and both the settlement and the site lie about 200 miles northwest of New Madrid. New Franklin, in the vicinity of Booneville, Missouri (about 55 miles from the site, a colony of Kentuckians numbering about 150 families settled on the Missouri River in Cooper's Bottom in 1810. At the same, about 150 people settled at Booneslick in the area which later was established as Booneville and (Old) Franklin.

During 1811, other settlers immigrated into the area and erected cabins and forts for protection against Indians (History of Callaway County, 1884). Booneslick was situated about 55 miles northwest of the site and about 225 miles from New Madrid, or about 30 miles further from New Madrid than the site. It is significant that none of these settlements reported damage at the time of 1811-1812 events.

At the time of the 1811-1812 New Madrid earthquakes, several old lead mines in the region 40 to 65 miles southwest of Ste. Genevieve, were being worked and were located directly between New Madrid and the site (Figure 2.5-53).

At all of these historic locations, sufficient population and structures existed so that had the 1811-1812 series of earthquakes been of sufficient intensity to cause damage, they would have been noted. Reports would have eventually reached the river cities and would have been published. The implications are that the intensity of earth motion to the northwest of New Madrid was probably lower than previously thought. Therefore, based on Nuttli's reduction of the St. Louis intensity to MMI VII and the establishment of MMI VII at Defiance, Nuttli's original isoseismal map is herein revised. Both Nuttli's original map and the revised map are shown on Figure 2.5-50. According to the revised map, the site intensity was about MMI VI-VII.

In work by Stearns and Wilson (1972), the data points for the New Madrid events were interpreted in a different manner. Their isoseismal maps for the December 16, 1811, and February 7, 1812, earthquakes are shown on Figures 2.5-54 and 2.5-55. Their composite for the New Madrid events is shown on Figure 2.5-56.

It is significant that in both Nuttli's and in Stearns and Wilson's interpretations, the attenuation patterns are elongated toward the east and northeast respectively. This pattern is particularly well developed in Stearns and Wilson's interpretation. It is diagnostic that the data points where damage was reported lie along the Ohio River where the most populated towns were located and where amplification through river alluvium would be expected.

2.5.2.1.2 Other Earthquakes Significant to the Site

Other events which were probably felt at the site are included in the list shown in Table 2.5-8 and discussed below.

In 1843, an earthquake with a maximum intensity of MMI VIII occurred in western Tennessee and was felt from Rhode Island to Mississippi and Iowa. The intensity at the site was probably about MMI II. Memphis, Tennessee, close to the epicenter, suffered the most damage (Coffman and von Hake, 1973). In 1878, an MMI VI shock in southeastern Missouri is estimated by Docekal (1970) to have had an intensity at the site between MMI I and MMI III. The maximum disturbance from this event was in the Mississippi Valley between Memphis, Tennessee, and Cairo, Illinois. Another shock in the Mississippi Valley occurred in 1895 at Charleston, Missouri, where 4 acres of ground sank and formed a lake. This shock, which was felt by people in parts of 23 states and had a maximum intensity at its epicenter of MMI VIII, is estimated to have produced ground motion at the site with an intensity of MMI V-VI (Nuttli, 1974). An isoseismal map for this event prepared by Nuttli (1973c) is shown on Figure 2.5-57. A recent reevaluation of the Charleston, Missouri earthquake indicates that ground motion at the site may have had an intensity of MMI VI (Hopper and Algermissen, 1980, Plate 1). On November 4, 1903, an MMI VII event occurred near Charleston, Missouri, and was felt over an area of

about 135,000 square miles. It is estimated from Docekal's work (1970) that the intensity at the site was between MMI II and MMI III. In 1905, an MMI VI event was recorded at Sikeston, Missouri, and was felt over an area of 125,000 square miles. Based on Docekal's data (1970), the intensity at the site was at the bounds of perceptibility. The next shock to be felt at the site occurred in November of 1956 in the Mississippi Valley. At its epicenter in Wayne County, Missouri, the shock was of MMI VI and is estimated to have produced an intensity at the site of between MMI II and MMI III (Docekal, 1970). On March 3, 1963, an earthquake with an epicentral intensity of MMI VI occurred in southeastern Missouri where chimneys and windows were cracked. At the site, it is estimated to have been MMI II to MMI III (Docekal, 1970). On October 1, 1971, an Intensity V shock near Seogwick, Arkansas may have been felt at the site with an intensity of I-III. A similar site effect is estimated to have been felt from the marked tree, Arkansas event of March 25, 1976. The Strawberry, Arkansas earthquake sequence began on February 27, 1979 and continued until March 3, 1979. The largest shock in this sequence had a maximum intensity of MMI VI near Powhatan, Arkansas (NOAA, 1981; Zollweg and Johnston, 1980). The epicentral area corresponds to the physiographic boundary between the Ozark Uplift and the Mississippi Embayment, which appears to be a southwestward extension of the boundary between the Border and West Embayment seismotectonic regions (Section 2.5.2.3.1.2). Intensities of MMI III at Lake Charles and MMI II at Walnut Ridge and Hoxie, indicate rapid attenuation toward both the northwest and northeast (Zollweg and Johnston, 1980, Figure I-4).

From the year 1900 through the present, several shocks have occurred in the upper Mississippi Valley which were probably felt at the site. The first occurred in 1902 near St. Louis, Missouri, with an epicentral intensity of MMI VI. Based on Docekal's work (1970), the site intensity is estimated to have been between MMI II and MMI III. In 1903, an MMI VI earthquake occurred near Murphysboro, Illinois. This shock was felt over 65,000 square miles and produced a site intensity at the limits of perceptibility (Docekal, 1970). In 1917, an MMI VI earthquake occurred with an epicenter near St. Mary's, Missouri, about 50 miles south of St. Louis. The earthquake, felt over an area of 210,000 square miles, is estimated to have had an intensity of MMI IV at the site (Docekal, 1970). An isoseismal map for this event is shown on Figure 2.5-58. Three MMI V events in 1920, 1939, and 1946, centered at St. Louis, Missouri, Griggs, Illinois, and Chloride, Missouri, respectively, were felt at the site. The first could have been felt at the site as MMI III to MMI IV, the second and third as MMI I to MMI III (Docekal, 1970). An earthquake centered near Sparta, Illinois, in 1955, had an intensity of MMI VI and was felt in the site area with an intensity of MMI I. In 1978, an earthquake near Webster Groves, Missouri had an intensity of V and was felt over most of the St. Louis area (St. Louis Univ. Geophys. Obs., 1981). The site intensity is conservatively calculated as MMI III (Table 2.5-8).

In 1965, an earthquake occurred near Centerville, Missouri, about 90 miles south-southwest of St. Louis. At the epicenter, the maximum intensity was MMI VI while the site intensity was MMI IV to MMI V (Docekal, 1970). This earthquake was felt over 245,000 square miles. An isoseismal map (Eppley, 1965) for this event is shown on Figure 2.5-59. A 1976 earthquake near Farmington, Missouri had an epicentral intensity

of MMI V. A conservative estimate indicates a site intensity of MMI II (Table 2.5-8). In 1977, an earthquake centered near Jackson, Missouri had a maximum intensity of MMI VI. Estimates indicate a site intensity of MMI IV (Table 2.5-8).

Three other earthquakes at distant locations were perceptible in the vicinity of the site during the 19th Century. In 1867, an earthquake with an intensity of MMI VII occurred with its epicenter at Manhattan, Kansas, and was felt as far away as Chicago (Docekal, 1970). It produced an intensity at the site on the order of MMI I to MMI III (Docekal, 1970). The famous 1886 earthquake(s) near Charleston, South Carolina, had a maximum epicentral intensity of MMI X and was felt from Boston, Massachusetts, to New Orleans, Louisiana. The maximum intensity at the site probably was MMI I to MMI II (Bollinger, 1977).

A recent event perceptible at the site occurred on November 9, 1968, in the Wabash Valley. This earthquake had an epicentral intensity of MMI VII and produced an intensity at the site of MMI IV (Heigold, 1968). An isoseismal map for the 1968 event was prepared by Gordon et al. (1970) and is shown on Figure 2.5-60. The 1974 earthquake near Olney, Illinois had an epicentral intensity of MMI VI and produced a site intensity of MMI IV.

The epicenter of the September 27, 1981 earthquake in southern Illinois has been relocated to the vicinity of Mt. Vernon and reevaluated as a MMI VII event (Street, 1980). An isoseismal map for this event indicates no felt reports from the site area (Street, 1980, Figure 1). Other Illinois Basin earthquakes with epicentral intensities of MMI V occurred during 1974 and 1978 with conservatively estimated site intensities of III and II, respectively (Table 2.5-8).

2.5.2.2 Geologic Structure and Tectonic Activity

2.5.2.2.1 Regional Tectonic Setting

The Central Stable region surrounding the site is described by Eardley (1962) as a region consisting of a veneer of sediments overlying Precambrian crystalline rocks which have been formed into arches, basins, and other structures primarily as a result of Paleozoic epeirogenic activity. This system of broad arches and basins extends from the eastern Appalachian Mountain Chain to the western Rocky Mountains where it is truncated by the later Laramide Orogeny. To the north, folded Precambrian rocks are exposed at the surface in the Canadian Shield Province. The southern border is defined by the limit of onlapping Cretaceous and Tertiary sediments that characterize the adjacent Coastal Plain Tectonic Province. The Mississippi Embayment to the southeast of the site is delineated by a northeast-trending reentrant of these Coastal Plain deposits up into the Mississippi River drainage basin.

The tectonic character of the region is the result of a sequence of episodes of relative vertical uplift, subsidence, and tilting of crustal blocks bounded by upthrust faults. The geometry of the blocks appears to be inherited from an older, possibly Grenvillian,

structural fabric. The traces of steeply dipping block-bounding faults, associations with faulted monoclines, the strikes of vertical Precambrian intrusives, fracture patterns in Precambrian rocks, fracture patterns in the sedimentary rocks of the region, and traces of minor faults all reflect a consistent geometry (Graves, 1938; Robertson, 1940; Gibbons, 1972).

The geometry and boundaries of the major blocks represent inherited zones of weakness. Some segmentation of blocks by minor faults has occurred, but blocks several tens of miles on a side have generally acted as cohesive tectonic units. Where major, persistent features have acted as boundaries (Ste. Genevieve Fault, Simms Mountain Fault) their role has been passive. These features represent kinematic surfaces which have responded to the episodic uplift of contiguous individual blocks throughout Paleozoic time. The vertical stratigraphic separation and sense of vertical offset along any segment of these features is a reflection of the vertical motions of blocks responding to local uplift, rather than to uniform motion along the entire length of the major faults (Gibbons, 1972).

Folding in the region is either the result of the passive draping of relatively weak sedimentary rocks over the edges of fault blocks, or of the previously mentioned paleotopographic effects (Section 2.5.1.1.5). There is no evidence of any folding in the region due to basement-transmitted horizontal principal stresses or to thin-skinned gravity tectonics. A characteristic assemblage of monoclinal folds, curving reverse fault planes, compensatory normal faults, and minor low angle normal faults illustrate passive response to repeated vertical movements along nearly vertical basement discontinuities (Gibbons, 1972). The tectonics of the region must, therefore, be based upon an understanding of vertical kinematics rather than on lateral or horizontal compressive forces.

The structural features discussed and illustrated in Section 2.5.1 probably reflect basement structures and the features must all be considered deep-seated. Some of these features have probably been caused or influenced by other mechanisms, such as the differential compaction of sedimentary beds emplaced over a Precambrian surface that has substantial topographic relief. However, it is not possible to verify such origins for individual structural features with the present level of information available regarding the structural geology of central Missouri.

The structural features in the region of the site were probably formed by differential uplift and settlement of crustal blocks in a manner similar to that which resulted in the formation of the Ozark Uplift, the major structural feature in the site area. The relationship between these small features and the Ozark Uplift is imperfectly understood due to the poor exposures and lack of subsurface information. It is nevertheless clear that the forces that formed the Ozark Uplift also were instrumental in the formation of these other minor structures. That these forces acted upon blocks of considerable size has been demonstrated by Gibbons (1972).

The idea of the structural blocks described by Gibbons within the central area of the Ozark Uplift demands comparison to the concept of crustal blocks as proposed by McGinnis (1970). It is conceivable that the uplift and subsidence of crustal blocks is a direct result of vertical forces originating in the mantle. It also might be speculated that the smaller features were formed contemporaneously with the Ozark Uplift and that, consequently, there is a direct relationship. However, this is not necessarily true and it might be reasonable to speculate that minor faulting and folding near the site were formed subsequently by vertical forces working on independent crustal blocks.

The gross geologic structure of the Ozark Uplift is described by the structures on the basement surface as discussed and illustrated in Section 2.5.1.

2.5.2.2.2 Tectonic Setting of the Site Locale

The site straddles the boundary between the Dissected Till Plains Physiographic Province to the north and the Ozark Province to the south, being situated on a plateau about 5 miles north of and 305 to 325 feet above the flood plain of the Missouri River.

The Ozark Region has been a topographically positive region since at least early middle Cambrian time (Dake and Bridge, 1932). The relief present at that time probably represented the erosional resistance of the thick, silicious extrusive volcanics which comprise the Precambrian core of the St. Francois Mountains. The surface of the Precambrian rocks was deeply incised by streams before the onset of Cambrian sedimentation (at least 500 feet of relief (Dake and Bridge, 1932). The Cambrian and Ordovician sedimentary rocks were deposited and subjected to differential compaction over the pre-existing topography. Much of the structural geometry of the region is a result of this pronounced paleotopographic effect (Dake and Bridge, 1932; Weller and St. Clair, 1928).

In the area of the site, 25 to 50 feet of glacial and post-glacial soils overlie a 4- to 50-foot thick layer of chert conglomerate with clay matrix. This in turn overlies a series of limestones, dolomites, sandstones, and shales ranging in age from Mississippian to Cambrian. These lie upon the Precambrian basement at a depth of about 2,000 feet below the surface at the site. Within the immediate region of the site, the sediments are nearly horizontal, reflecting the regional dip of about 5 to 10 feet per mile to the northwest. The only known fold structures near the site are the Browns Station (Section 2.5.1.1.5.1.14), Davis Creek (Section 2.5.1.1.5.1.16), Mexico (Section 2.5.1.1.5.1.22), Auxvasse Creek (Section 2.5.1.1.5.1.12), Mineola (Section 2.5.1.1.5.1.23), Big Springs (Section 2.5.1.1.5.1.13) and Kruegers Ford (Section 2.5.1.1.5.1.20) anticlines. There is no evidence to support the presence of the Pershing Bay-Gerald Anticline as discussed in Section 2.5.1.1.5.1.25. The Auxvasse Creek Anticline, which lies about 10 miles north of the site, represents a gentle fold parallel to the Browns Station Anticline. Along its axial trend to the northwest, the Auxvasse Creek Anticline projects into the Davis Creek Anticline. No folds are in evidence to the southwest. These structures are all very gentle. The Auxvasse Creek Anticline has 175 feet of structural relief and the Browns Station

Anticline only 100 feet. The indicated time of deformation is from Mississippian to Late or post-Pennsylvanian.

The site lies at a considerable distance northwest of the center of the Ozark Uplift and from most of the major structural features in the surrounding region. Although the same forces that formed the Ozark Uplift during the Paleozoic probably also formed such structures as the Davis Creek and the Browns Station Anticlines, uplift of the former feature was in the range of 5,000 feet, whereas the flexures of the latter features were in the range of only 100 to 200 feet. Clearly, the forces that formed the Ozark Uplift were considerably greater than those that formed the gentle features near the site.

McCracken's (1967) discussion on tectonics of the site region terminates with the following:

> Dips everywhere in Missouri are gentle except in the immediate vicinity of some of the faults. The most prominent structure north of the Ozark dome is the Lincoln fold. This, together with the other larger structures such as the Proctor Anticline, Saline County arch, and Browns Station Anticline... trend northwesterly parallel to the principal direction of the Precambrian grain and to the early elongation of the Ozark Uplift. It is believed that they originated in block-fault structures in the basement over which the Paleozoic sediments draped to produce the anticlinal and synclinal folds that persist to the surface (Hinds, 1912).

Geologic investigations within 5 miles of the site have revealed no faulting. The closest faults to the site are the Fox Hollow Fault 30 miles west, the Wardsville Fault 30 miles southwest, the Kingdom City Fault 12 miles northwest, and the Cuba Fault about 18 miles to the south. The Fox Hollow and Wardsville faults have displacements of 120 and 100 feet respectively, and are found in Mississippian sediments. The trend of the former is about north and the trend of the latter about northwest; if projected neither would approach the site closer than 30 miles. The Kingdom City Fault has a displacement of 300 feet and is Middle Ordovician or younger in age. The proposed trend of the fault is northeast, which if projected would approach the site no closer than 12 miles. The Cuba Fault is considered to be Pennsylvanian or younger. This fault, which bounds the west side of the Cuba Graben, diminishes northward and cannot be traced more than a few miles northwest of the Gasconade River (McQueen, 1943). At this point, it lies about 18 miles south-southeast of the site. If the Cuba Fault were to be projected along it northernmost strike of North 50 West, it would approach no closer than 10 miles to the site (Fox, 1954).

2.5.2.2.3 Behavior During Prior Earthquakes

It is known that minor to moderate earthquake ground motion has been experienced at the site; however, there is no evidence from lithologic, stratigraphic, structural, or geophysical studies to substantiate such earthquake motion. Also, no evidence from surface mapping has been found that would indicate recent faulting.

2.5.2.3 Correlation of Epicenters with Geologic Structures

The large structural elements within the vast Central Stable Region apparently localize areas of stress relief as marked by characteristic seismicity in certain subregions. While knowledge of the exact seismogenic nature of these subregions is incomplete, the concentrations of seismicity displayed by certain seismogenic zones afford diagnostic observation of what is currently taking place in the crustal rocks. Because such active areas should be recognized, and can for the most part be spatially related to a consistent structural regime, and since the correlation of individual events with specific structures (faults) is lacking, the relationship of earthquakes to geologic structures is better developed on the basis of the historical distribution and gross tectonic regimes, or seismotectonic regions.

2.5.2.3.1 Seismotectonic Regions

Seismotectonic regionalization of the seismically active areas significant to the site has been prepared using the basic approach by Gubin (1967). Data were obtained principally from the literature and supported by personal communication with individuals of the scientific community, a list of whom is contained in the bibliography. Seismotectonic boundaries were delineated by comparison of seismicity, structure, fault plane solutions, and, in the New Madrid Seismotectonic Region, by comparison of gravity, magnetics, ERTS imagery, geomorphology and the resulting distribution or confluence of apparent complementary characteristics.

The term "seismotectonic region" is generally used to describe a tectonic region where seismic activity has occurred in relation to known geologic structures and where earthquake generating forces may still be present. Some large tectonic regions have been the sites of only a few earthquakes, usually relatively small, infrequent and occurring throughout the area without apparent relation to any particular structure. These regions are designated as random regions. There are some stable regions that exhibit extremely low seismicity. In the following sections, individual seismotectonic regions, as shown on Figure 2.5-61, are discussed. The characteristics and seismic activity of these regions are discussed below and summarized in Table 2.5-9.

2.5.2.3.1.1 New Madrid Seismotectonic Region

This region lies about 175 miles southeast of the site. However, earthquake activity in this area historically control seismic design in a large part of the midcontinent due to its dense seismicity and the large destructive "New Madrid" earthquakes previously discussed.

The primary evidence for the New Madrid Seismotectonic Region is the concentration of high intensity earthquakes that have occurred in the Upper Mississippi Embayment near the town of New Madrid, Missouri and their spatial relation to identified faulting and other structures. Earthquakes that have occurred in historic times near New Madrid with intensities MMI V and greater are shown on Figure 2.5-49. All known perceptible New

Madrid events are shown on Figures 2.5-62 and 2.5-63, and are listed in Table 2.5-10. In the discussions which follow, various data are presented and/or discussed in separate subsections so that they can be referred to from time to time in subsequent analyses of the seismotectonic nature of the New Madrid region.

2.5.2.3.1.1.1 Summary Geologic History of the Mississippi Embayment

The historical genesis that led to the present structural conditions in the upper Mississippi Embayment are discussed in Section 2.5.1 and summarized as follows: uplift and erosional beveling of the Pascola Arch prior to Lower Devonian time; subsidence with accompanying deposition of Paleozoic limestones; rejuvenation of the Ozark Uplift to the northwest and the Nashville Dome to the southeast, and the subsidence of the intervening structural trough which became the Mississippi Embayment; advancement of the Cretaceous seas to create the Gulf Coast onlap; and deposition filling of the upper Mississippi Embayment with a series of Cenozoic sands, silts, and clays that included the remarkably uniform and massive Porters Creek Clay of Paleocene age. Surficial geology is shown on Figure 2.5-64. Stratigraphy in the upper Mississippi Embayment is shown in Table 2.5-11. The New Madrid area is the locus of many structural features, some or all of which may contribute to the high seismicity of this area, as discussed below.

2.5.2.3.1.1.2 Tectonic Structures Near New Madrid

Recent and on-going geophysical studies in the upper Mississippi Embayment are characterizing the gross tectonic framework which apparently hosts the high level of seismic activity noted in the area. Figure 2.5-65 presents the structural synthesis of the most recent evaluations, and serves as a basis for bounding the New Madrid Seismotectonic region, as subsequently developed.

The northwest and southeast limits of the "Reelfoot Rift" (Embayment) as shown on Figure 2.5-65, are delineated by Hildenbrand et al. (1977), from available studies. The northwestern boundary is marked by an alignment of intrusives presumed on the basis of well-defined magnetic and gravity highs which lie outside or along the boundary of the rift. The Proposed "rift" zone itself is expressed in the Precambrian basement by a broad zone of subdued magnetic expression (Figure 2.5-67). According to Hildenbrand et al. (1977), this low gradient zone implies 1.1 to 2.4 km of relief between basement inside the zone and basement outside the zone. The southeast margin of the zone also includes magnetic and gravity highs associated with mafic or ultramafic igneous intrusions. To the northeast, the zone of low gradient terminates against a northwest-trending low that is inferred to represent the buried extension of the northwest-southeast-trending Ste. Genevieve fault zone in western Kentucky (Figure 2.5-66). To the north, the Rough Creek fault zone appears to mark the northern boundary of a large northwest-trending graben in the Precambrian basement. The graben is a major structural feature which appears to have formed initially in late Precambrian to early Paleozoic time (Soderberg and Keller, 1981). O'Leary and Hildenbrand (1978) observe that aeromagnetic data indicate a morphological configuration of the Precambrian basement totally unexpressed

by either Paleozoic or post Paleozoic rocks. The authors propose that current embayment seismicity is genetically related to buried regional fault systems which, in turn, are related to trough structure in the basement. The areal distribution of present earthquake activity, the configuration of lineaments, and the morphology and depth of magnetic basement imply such a relationship.

Known faults and folds near New Madrid are shown on Figure 2.5-66. (Note: In the following discussion on faults, the numbers in parentheses refer to map index numbers on Figure 2.5-66.) The faults that lie close the area of intense seismicity include the Greenville Fault (18), the English Hill Fault (15), the Aquilla Fault (2), the Idalia Fault (20), the three (First, Second and Third) Mississippi Valley faults (42), the Jackson Fault (21), the Black Fault (4), the Ste. Genevieve Fault System (38), the Fluorspar Fault Complex (Illinois 2), the Rough Creek Lineament (Illinois 3), and the Wabash Valley Fault System (Illinois 5).

The Greenville Fault (18) was inferred by McCracken and McCracken (1965) during preparation of a structure map for Missouri. Although the exact strike of the fault is not discernible due to thick mantle cover, the workers gave a mapped trend direction of about North 45° East. The Greenville Fault lies outside the seismically-active area near New Madrid, well within the elevated crustal blocks that form the St. Francois Massif. It therefore has no relationship to the northeasterly trending faults which have been displaced by recent activity in the area of New Madrid.

The English Hill Fault (15) was mapped by Steward (1942) and by Grohskopf (1955) in the same area as the Idalia Fault (20) (Farrar and McManamy, 1937) and another described as the Albright Creek Fault. Grohskopf (1955) inferred the connection between the short segments of the English Hill, Idalia, and Albright Creek Faults to form a continuous fault zone, as marked by Crowleys Ridge, a topographic feature striking northeast with a length of over 30 miles. However, recent seismic surveys and subsequent drilling (Zoback, 1979) have not determined any offset of bedding at depth across the Crowleys Ridge structure, and its definition as a major fault system is unwarranted at this time. The Aquilla Fault has a very short mapped trace and cross-cuts the main trend with an approximate strike of North 60° West.

About 10 miles southeast of the Idalia and English Hill faults lies another fault having a parallel strike trend. This fault is the westernmost of three major Mississippi Valley Faults (Section 2.5.1.1.5.2.13) and will be termed here the "First Mississippi Valley Fault". It has a strike direction of about

North 40° East and an inferred length of about 40 miles. This "First" fault has a bifurcation with a strike direction of roughly North 30° East and a length described as about 20 miles; it closely coincides with a line of epicenters and constitutes a line of seismic contract. This line, as discussed in Sections 2.5.2.3.1.1.6 and 2.5.2.3.1.1.7, is considered to be the northwestern boundary of the New Madrid Seismotectonic Region as described by this study. The Second Mississippi Valley Fault is located slightly east of the Mississippi River and east of the town of New Madrid. It has a strike direction at its

southern end of about North 30° East changing to about North 10° West at its northern end. This "Second" fault has an inferred length of about 95 miles. The "Third" Mississippi Valley Fault lies south and southeast of the first two and displays a crosscutting strike to the first two Mississippi Valley faults. It has a mapped length of about 80 miles with a South 75° East trend, sub-parallel to the axis of the Pascola Arch near its southeastern extremity.

The Jackson Fault was identified by McQueen (1939) who described a graben with a displacement of 200 feet, but who was unable to identify the strike direction. Gealy (1955) further detailed this fault. It has a strike of about North 75° West and a described length of 15 miles (Dake, 1930; James, 1951; Kiilsgaard, 1963), and a mapped strike direction of about North 80° West.

The closest approach to the site of the Ste. Genevieve Fault System (38) is that segment in Illinois known as the Rattlesnake Ferry Fault lying about 70 miles north of the town of New Madrid. The total length of the Ste. Genevieve Fault System is about 100 miles. Although it has an overall trend direction of North 60° West, the system is highly imbricated and displays many strike directions throughout its length.

The well-known Fluorspar Fault Complex lies from 90 to about 160 miles to the east of the Ste. Genevieve fault system. Although the individual faults of this complex have strikes about North 40° East, in aggregate they cover a broad area about 50 miles long and 25 miles wide. Recent investigations indicate that some of the northeast-trending faults displace Paleozoic rocks in the Fluorspar District and extend southwestward beneath late Cretaceous sediments of the Mississippi Embayment in south Illinois. The relatively uniform thickness of the Cretaceous sediments and the configuration of their base indicate that essentially all of the displacement on faults in the underlying Paleozoic rock occurred prior to the deposition of the Cretaceous sediments (Kolata, Treworgy and Masters, 1981; IL State Geological Survey, 1973).

The Rough Creek Fault System lies about 95 miles north of New Madrid. It has an overall trend direction of North 75° West and a length of about 180 miles (Section 2.5.1.1.5.2.3). The Wabash Valley Fault System lies about 110 miles northeast of New Madrid.

The Pascola Arch (Section 2.5.1.1.5.1.24) lies about 30 miles southwest of New Madrid and has an axial trend of about North 45 West. The Moorman Syncline, which lies about 90 miles northeast of New Madrid, generally reflects the change in trend direction between the Fluorspar Fault Complex and the Rough Creek Fault System. Three hinge lines or "Bending Zones" (Stearns, 1973) form folds at the center of the upper Mississippi Embayment and its junctures with the Ozark and Nashville domes (Section 2.5.2.3.1.1.7). Lineations that may reflect tectonic structures are discernible from ERTS imagery, from geomorphological trends in topography, and from geophysics. A magnetic map and a gravity map for the region around New Madrid are shown on Figures 2.5-67 and 2.5-68, respectively. Lineations after O'Leary and Hildenbrand (1978) are shown on Figure 2.5-69.

2.5.2.3.1.1.3 Well Logs Near New Madrid

The logs from drillholes near New Madrid provide the basic data upon which structural contour maps have been prepared by Stearns (1974). The information from these wells is shown in Table 2.5-12 and the locations are shown on Figure 2.5-70. For each well, the following data are presented: name of the property owner, name of the drilling company, completion date, location by section, township and range, surface elevation, total depth and sea level elevation of formation boundary. The authority for formation boundaries is the Missouri Geological Survey, except for those marked by an asterisk. These were picked for this study from sample or electric logs in the Missouri Geological Survey file. The wells are listed alphabetically by county and sequentially by township and range. Abbreviations are standard except for stratigraphic boundary "picks": TPC stands for top of the Porters Creek Clay (of Paleocene age); TPAL stands for base of Cretaceous (relatively soft) sands and clays and top of undifferentiated Paleozoic formations.

2.5.2.3.1.1.4 Fuller's Report

Fuller's USGS report (1912) is useful in delineating areas of maximum disturbance for technical discussion and evaluations of ground motion, as discussed below and in Section 2.5.2.1. Among those features Fuller described were fissures, faults, landslides, the uplift of domes and the depression of "sunk lands," and the phenomenon he termed "extrusion," which resulted in the ejection of water, sand, mud, and gas. The most noticeable features of these phenomena that remain today are "sand blows" that, through erosion, are beginning to lose their distinctive appearance, and thus do not convey to the modern observer the violence associated with their formation. Fuller quotes a description by an engineer names Bringier who witnessed this unusual event and told how:

> (the water forced its way through the surface deposits) ... blowing up the earth with loud explosions. It rushed out in all quarters, bringing with it an enormous quantity of carbonized wood, reduced mostly into dust, which was ejected to the height of from 10 to 15 feet, and fell in a black shower, mixed with the sand, which its rapid motion had forced along; at the same time the roaring and whistling produced by the impetuosity of the air escaping from its confinement seemed to increase the horrible disorder. In the meantime the surface was sinking and a black liquid was rising to the belly of my horse.

The mechanism that caused this phenomenon is related to the disruption of the ground by faulting or fissuring within an area of loose sand saturated with water. Due to the influence of the energy from strong ground motion, the sands were subjected to liquefaction and were extruded through the fissures at the surface into the air. The area of "sand blows" and other earthquake features is well shown on Fuller's original map, which is reproduced as Figure 2.5-71. The area of "sand blows" together with the other features of ground disturbance mapped by Fuller are significant, for they define the area of violent motion.

2.5.2.3.1.1.5 Fault Plane Solutions Near New Madrid

Using variations in the technique for determining fault plane mechanisms indicated by seismic waves, Street et al. (1974), and Herrmann (1978, 1979) have presented maps showing several fault plane solutions for recent earthquakes in the area of southeastern Missouri, including the area around New Madrid. A composite map of available solutions is shown on Figure 2.5-72 and a list of parameters is shown in Table 2.5-13. The symbols shown represent the usual stereographic plot of the data; however, the white quadrant represents compression and the black quadrant tension. These solutions will be referred to from time to time to evaluate fault trends and relative motion.

2.5.2.3.1.1.6 Distribution of Current Seismic Activity

Numerous seismic recording instruments operate in, or are proposed for the mid-continent site region, particularly in the active portion of the highly seismic Mississippi Valley. The Central Mississippi Valley seismic network operated by the Department of Earth and Atmospheric Sciences at St. Louis University consists of 21 stations in the Mississippi Embayment, 4 stations in the Upland region and 8 stations in southeastern Illinois. A seismograph was installed at St. Louis in the year 1909, whereas other stations belonging to St. Louis University began operating in 1962 and later. The other permanent cooperative regional stations are ROL (Rolla), operated by the University of Missouri at Rolla since 1962; FAV (Fayetteville), operated by the University of Arkansas since 1952; LWK (Lawrence), operated by the University of Kansas since 1950; MHK (Manhattan), operated by Kansas State University since 1962; DBQ (Dubuque), operated by Loras College since 1962 and TUL (Tulsa), operated by Oklahoma Geophysical Observatory since 1961.

Recent installations and those proposed for the near future are shown on Figure 2.5-73. In view of the large number of seismographs around the plant site, as described above, it is expected that any sizable seismic event in the site region can be easily detected and monitored.

On the basis of the several years' dense instrumental coverage in the New Madrid region, additional evidence for defining the areal extent of seismogenic structure is presented. Figure 2.5-74 shows all recorded earthquakes in the area between July 1974 and March 1978. Figures 2.5-74.1 through 2.5-74.3 show all earthquakes recorded during 1978 through 1980, respectively. The density of activity clearly outlines a gross northeast trend of activity along the axis of the embayment, broken by a short northwest trend in the Reelfoot region before continuing again along the preferred structural grain. The northwestern extent of the activity stops abruptly near the First Mississippi Valley Fault zone or the west side of Bending Zone 2 (as subsequently described), becoming suddenly diffuse to the northwest. The suggested solutions for focal mechanisms shown on Figure 2.5-72 for this area are somewhat correlative with the pattern shown on Figure 2.5-7.

It is now though (Aggarwal, 1977) that the distribution of relatively small earthquakes determined from a dense network of stations over a short period of time may be a reasonably reliable indicator of the major features of the long-term earthquake distribution. Aggarwal (1977) has noted such a correlation in New York State and southern Quebec. Tarr (1977) also has suggested that the currently active (and monitored) zone of seismicity in the Charleston, South Carolina area is closely associated with the rupture surface of the large destructive shocks of 1886. It can be observed on Figures 2.5-74 and 2.5-66 that immediately northwest of the westernmost (First) Mississippi Valley fault the activity is suddenly subdued to absent. This diminished activity suggests that stresses are being (and probably will be) relieved in the more central portion of the embayment along the seismogenic structures that have generated the major historical earthquakes. The apparent northwestern limit of dense seismicity, also bounded by the west side of the rift zone (Figure 2.5-65), lies more than 175 miles from the site.

2.5.2.3.1.1.7 Analyses and Determination of Boundaries of New Madrid Seismotectonic Region

The spatial distribution of the highly-seismic area generating historical earthquakes around New Madrid should be examined in light of all known geologic structures or features. A multiplicity of coincident interfaces obtained from independent data sources tends to confirm a discrete seismogenic zone, outside which large events are not expected to occur.

Earlier work by Stearns (1973, 1974) indicated that the crust underlying the New Madrid area is a focus of several intersecting tectonic elements. He suggested that recent northeasterly trending faulting, which may be associated with the New Madrid events, coincides with a zone of weakness rooted in the Paleozoic sediments that form the trough of the upper Mississippi Embayment, and that these events are further localized by an intersection with the southeast-trending Pascola Arch. Subsidence of the trough was promoted by an increasing sediment load. He presented the following evidence and drew his conclusions as follows:

a. The Pascola Arch, as discussed in Section2.5.1.1.5.1.24 was formed in the Early Paleozoic and was beveled by erosion before Lower Devonian time. Contours drawn on top of the Knox Dolomite, as shown on Figure 2.5-75, reveal the configuration of the structure. It has an axial trend of about North 45 West. The axial crest is well delineated and lies only 15 miles southwest of New Madrid.

b. In the geologic section across the Mississippi Embayment, as shown on Figure 2.5-76, the sediments have a chevron shape in the central area of the Embayment and flatten to the northwest in the vicinity of the Ozark Escarpment and to the southeast in the area of the Nashville Dome. Stearns (1973) interpreted the three reversals of curvature as hinge lines, or as he preferred, bending zones. The bending zones are revealed

through interpretation of the contour map on the top of the Paleozoic rocks (Figure 2.5-77). Bending Zone 1 (Figure 2.5-83) is seen as a sharp break in the contour along the western flank of the Nashville Dome. Bending Zone 2 is shown by the bottom of the trough. Bending Zone 3 is shown by the broadening of contours along the trend of the Ozark Escarpment.

c. In a similar treatment of the Cenozoic sediments of Figure 2.5-77, uninterpreted contours on top of the Paleocene Porters Creek Clay are shown on Figure 2.5-78. Bending Zones 1 and 3 lie beyond the limits of the formation; however, Bending Zone 2 is evident as the trough of the syncline.

d. Analysis of the structural contours, as produced from the well data in Table 2.5-12, reveals anomalous areas both in the contours on top of the Paleozoic sediments of Figure 2.5-77 and in those of the Porters Creek Clay of Figure 2.5-78. The anomalous areas are outlined on Figure 2.5-79.

e. Lineations compiled from topographic maps and from ERTS imagery are shown on Figure 2.5-69.

f. Interpretation of the combined information from the above figures is embodied in a revised contour map for the Paleozoic sediments on Figure 2.5-80 and for the Porters Creek Clay on Figure 2.5-81. The Pliocene and younger faults from Figure 2.5-81 are shown alone on Figure 2.5-82.

g. The contours at the base of the Cretaceous sediments become more widely spaced and define a lineament on each side at the embayment. The contours on top of the Porters Creek Clay become more widely spaced and form a second lineament, again on each side of the embayment. These are shown in relationship to the three bending zones on Figure 2.5-83.

h. The east and west boundaries of Bending Zone 2 are coincident with the line where the contours on top of the Porters Creek Clay become more widely spaced;

i. The various features discussed above are superimposed upon a single map, as shown on Figure 2.5-84. On this figure are shown: the structure contours on top of the Knox Dolomite at an elevation of 3000 feet below sea level and defining the Pascola Arch at seal level; the western end limits of the northeast-trending faults as shown for the Paleozoic and Pliocene and younger faults (Figures 2.5-81, 2.5-82, and 2.5-83); the east and west side of Bending Zone 2; epicenters of earthquakes over MMI VII; and the area of sand blows.

The area of strong ground motion is well delineated by the areal extent of the sand blows (Section 2.5.2.3.1.1) as shown on Figure 2.5-85. Work by

Stearns and Zurawski (1974) showed that the extent of the sand blows was not limited by the availability of the water or sand required for liquefaction to occur. Subsurface geologic and hydrologic conditions to the northeast, southeast and southwest are similar to those in the sand blow area and would not have imposed a limiting factor. To the northwest, the sand blow area abuts against Crowleys Ridge where conditions are not suitable for liquefaction; however, the geologic terrane northwest of Crowleys Ridge is not significantly different from that of the sand blow area east of Crowleys Ridge. Had strong enough ground motion occurred to the northwest of Crowleys Ridge, liquefaction and sand blows would have occurred.

The geologic and hydrologic conditions are shown in plan on Figure 2.5-85 and geologic cross sections, modified after Fisk (1944), are presented on Figure 2.5-86. The drill holes shown of Figure 2.5-85 indicate the depth to the water table, depth of clay and silt cohesive soils, and the depth of sand.

j. Using the above as a base, Stearns (1973) derived a definition for the Reelfoot Seismotectonic Structure, as shown on Figure 2.5-87. The northern boundary lies at the -3000-foot contour on top of the Knox Dolomite on the northern flank of the Pascola Arch. The same -3000-foot contour, on the south flank of the Pascola Arch, forms the southern boundary. The eastern boundary is formed by the eastern limit of the northeast-trending faults that coincide with the eastern side of Bending Zone 2. The western boundary is the western limit of the northeast trending faults, the southern end of which is project southward parallel to the area of sand blows until the line intersects the -3000-foot contour on the southern flank of the Pascola Arch.

The work by Stearns in describing his Reelfoot Seismotectonic structures had considerable merit. However, analysis of Stearns' work in light of more recent data indicates that the basic concept can be refined even more.

Further analysis for this report was pursued by superimposing upon Stearns' map of Figure 2.5-84 the following information:

a. All of the faults presented by Stearns for the Paleozoic, Pliocene and younger formations on Figures 2.5-80 and 2.5-82.

b. All the epicenters shown on Figure 2.5-63;

c. The First, Second, and Third Mississippi Valley faults as depicted on Figure 2.5-88;

d. The principal outlines of the significant magnetic and gravity anomalies shown on Figures 2.5-67 and 2.5-68;

e. The lineations from ERTS and topography (O'Leary and Hildenbrand, 1979) shown on Figure 2.5-69;

f. Pertinent fault plane solutions taken from Street, Herrmann and Nuttli (1974) and Herrmann (1978, 1979) as shown on Figure 2.5-72; and

g. An analysis of the relative strain release of the New Madrid area in terms of cumulative energy released by all tectonic earthquakes since the New Madrid events of 1811-1812, as shown on Figure 2.5-89.

The composite plot of these factors is shown on Figure 2.5-90.

Analysis of the composite plot and background data indicates that:

a. Intrusive masses lie along, or just west of a line of faulting that corresponds to the First Mississippi Valley Fault and the northwestern boundary of the rift zone, both of which have a trend of about North 45° East passing northwest of Charleston, Missouri.

b. Crowleys Ridge and its pronounced lineaments, as discerned from the investigation of topography and ERTS photography, are coincident with the English Hill and Idalia Fault trends. This topographic feature has an overall linear trend of North 47° East but probably does not represent major structure at depth (Zoback, 1979; Kolata, 1978; Bristol, 1978).

c. Crowleys Ridge and the First Mississippi Valley Fault are parallel and lie about 10 miles apart. A distinctive line of epicenters lies along the northeasterly trend of the latter. Although Stearns (1973) chose a line of presumed faulting along Crowleys Ridge to define the northwestern boundary of his Reelfoot Seismotectonic Region, this work redefines this region of high intensity motion as the New Madrid Seismotectonic Region and conservatively places the northwestern boundary at the First Mississippi Valley Fault, which is preferentially chosen on the basis that:

    1. The principal seismic activity is bounded to the northwest by the westernmost northeast-trending zones of major structure in the embayment rather than by the Crowleys Ridge, which probably does not represent major faulting.

    2. Faulting southeast of this boundary is recent and active as evidenced by the seismic history and Holocene disruption (Russ, 1979).

    3. Seismic monitoring in the embayment region defines a distinct zone of epicenters (Figure 2.5-74) marking the western limit of stress

relief. The westward extension of this zone is contained by the First Mississippi Valley Fault.

4. The change in the seismicity alignment from the preferred northeast trend to a primarily northwest trend occurs at the intersection of the Reelfoot rift with the axis of the Pascola Arch. Further, this zone of major seismicity occurs between the Bloomfield and Covington plutons (Figure 2.5-65) which are related to the anomalous structural conditions (rifting) of the crust in this locale. This circumstance of major earthquake area and extensive gravity highs and associated magnetic anomalies has been noted by Kane (1977) in or near seven major seismic areas in the eastern United States. This coincidence of structure and seismicity is contained to the northwest by the First Mississippi Valley Fault.

d. The eastern boundary of the New Madrid Seismotectonic Region is delineated by the coincidence of the change in the density of epicenters toward the southeast with the fault that is identified as the Second Mississippi Valley fault in the discussion of Section 2.5.2.3.1.1 and as shown on Figures 2.5-10, 2.5-88, and 2.5-90. To the south, the trend of the second Mississippi Valley Fault projects into a series of lineations that coincide with a line beginning at the south end of the North 40° East faults described above, and extending in a curving line until it merges with the line of faults that Stearns (1973) describes as the East Limit of the northeastern trending faults. As the southern end of the New Madrid Seismotectonic Region is beyond the scope of this study, Stearns' southwestern seismotectonic boundary serves as a reasonable boundary and is so accepted for the purpose of this report.

The northern extent of the New Madrid seismic zone is here in terminated (pinches out) at the Fluorspar Fault Complex and the western Kentucky Faulted belt. Investigations in the extreme southern tip of Illinois (Kolata et al., 1977, 1981) have disclosed no recent tectonic movement in the faults of this area, most of which have been displaced in post-Paleozoic to pre-late Cretaceous time. Closely spaced drilling at two localities in Pulaski County disclosed that faults in the immediate area are probably due to landslides or solution cavity collapse (Kolata et al., 1977).

Bending Zone 2 has been defined by Stearns (1973, 1974) as the synclinal axis of the Mississippi Embayment (Section 2.5.2.6.1.1.6). The structural significance of Stearns' Bending Zone 2 is that it coincides with a series of unique and anomalous tectonic features including: a zone of northeast-southwest trending faulting; the area of sand blows, the zone of concentrated epicenters for violent seismic events; and a location at the trough of the Mississippi Embayment. The location of Bending Zone 2 is spatially coincident with the combined New Madrid-Reelfoot Seismotectonic regions such that they occupy the full width of Bending Zone 2. This may be clarified by noting on Figure

2.5-91 that the line indicating the First Mississippi Valley Fault is also approximately coincident with the west side of Bending Zone 2.

Stearns considers that Bending Zone 2 provides evidence of the presence of an underlying zone of tectonic weakness and instability. Whether or not the Bending Zone by itself constitutes a mechanism for the generation of strong motion events is not of great importance; rather it is more important to note that it is coincident with a focus of multiple anomalous conditions. Thus it cannot be demonstrated whether the Bending Zone is a contributary agent to the strong motion events at this focus or, rather, a result of the forces that cause the seismicity. In any case, the coincident presence of Bending Zone 2 with other anomalous features appears significant even though the ultimate mechanism for strong motion events has not yet been recognized.

In summary, as shown on Figure 2.5-91, the New Madrid Seismotectonic Region is bounded on the northwest by the First Mississippi Valley Fault, the west side of Bending Zone 2, and the rift boundary. On the east, it is bounded by the eastern (Second) Mississippi Valley Fault. To the north, it is bounded by the changes in strain release along the northwest trend coincident with the -3000-foot contours on the northern flank of the Pascola Arch. This bounded region is characterized by strong motion earthquakes with intensities of MMI IX and greater superimposed upon a background of repetitive lower-intensity events.

Historical and current seismicity data, together with this analysis, indicate that strong motion events greater than MMI VII are limited to the New Madrid Seismotectonic Region as defined herein and will approach the site no closer than about 175 miles.

2.5.2.3.1.2 Other Seismotectonic Regions

Although there is much evidence available to delineate the New Madrid Seismotectonic Region, other areas of the surrounding region have not been so intensively studies; the boundaries of seismotectonic regions, therefore, are not completely established. Nevertheless, certain gross trends can be discerned, and it is useful to delineate them in the light of present knowledge even though they are subject to refinement as more data become available.

2.5.2.3.1.2.1 Reelfoot Seismotectonic Region

Some seismicity is related to the region east of the New Madrid Seismotectonic Region as herein defined. However, it is characterized by fewer and lower-intensity events that separate it from the New Madrid Region. The New Madrid Seismotectonic Region is characterized by strong ground motion of about MMI IX or higher, whereas the region to the east is characterized by events MMI VI or less, with no earthquake to the east having generated ground motion greater than MMI VII. The contrast in seismicity lies along the line of the eastern (Second) Mississippi Valley Fault (approximately along the Mississippi River) and constitutes the boundary of the lower intensity events.

According to O'Leary and Hildenbrand (1979), geomorphologically, the northern part of the Mississippi Embayment is divided into two distinct terrains. The authors observe:

> "The half of the embayment east of the Mississippi River has normal basinal features: tributaries that drain down the dipslope toward the axis of the basin; a crenulated, eroded contact of basin sediments on Paleozoic "basement" rocks; development of a shallow cuesta on the most resistant unit. The western half on the other hand, has tributaries to the Mississippi that flow S20W, parallel to the axis of the basin; the contact with the Paleozoic border rocks is a very subdued fall line; the uppermost sediments are less than a million years old and surround inliers of older rock; earthquake epicenters are thickly concentrated near the river and less so to the west. These features all suggest that the west half of the embayment is presently undergoing a tectonic development independent of the east half."

A preliminary analysis indicates that the eastern border of this region of lower intensity lies approximately coincident with Stearns' (1972) eastern limit of faulting, as shown on Figure 2.5-82. The northern boundary abuts the Fluorspar Fault Complex and the Western Kentucky Faulted Belt, which are regions of complex structural conditions lying south of the east-west trending Rough Creek Fault System (Section 2.5.1.1.5.2.3).

This area of lower seismic activity is herein described as the Reelfoot Seismotectonic Region. It consists of a triangular area bounded on the west by the New Madrid Seismotectonic Region, on the east by the East Embayment Block (discussed in Section 2.5.2.3.1.2.2.), and to the north by the Fluorspar Fault Complex and Kentucky Faulted Belt (Section 2.5.2.3.1.2.4).

2.5.2.3.1.2.2 East Embayment Seismotectonic Region

The East Embayment Seismotectonic Region is generally coincident with the eastern portion of the Mississippi Embayment. This area has had no known fault movement since Cretaceous time and only a very minor history of local seismic events (Stearns and Wilson, 1972). The eastern boundary of this region is the Nashville Dome and coincides with the edge of the Mississippi Embayment and with the escarpment of the Nashville Dome (Cumberland Plateau), all of which constitutes Stearns and Wilson's (1972) Bending Zone 1. This boundary apparently represents a physiographic and old tectonic border and it does not appear to be related to significant modern seismic activity (Stearns and Wilson, 1972).

The northern boundary is a continuation of the edge of the Mississippi Embayment as it curves westward and abuts against the Western Kentucky Faulted Belt and further west against the southern edge of the Fluorspar Fault Complex. There is little contrast in seismicity across the northern boundary, although incidence of seismicity is somewhat higher to the north. The western boundary with the Reelfoot Seismotectonic Region lies along Stearns' (1972) eastern limit of northeast trending faults.

2.5.2.3.1.2.3 Nashville Dome

The Nashville Dome is largely unfaulted and represents a major tectonic uplift initiated in the Paleozoic. It is now a structurally stable area and essentially aseismic (Stearns and Wilson, 1972). The eastern boundary of this region with the East Embayment Block lies along Stearns' Bending Zone 1, which coincides with the escarpment of the Nashville Dome.

The northern boundary between the Nashville Dome and the Western Kentucky Faulted Belt is geologic and represents the margin of the tectonic dome. To the north, there are many mineralized faults and the seismicity is somewhat higher (Stearns and Wilson, 1972). The eastern and southern boundaries of the Nashville Dome are not critical to the purpose of this report.

2.5.2.3.1.2.4 Fluorspar Fault Complex and the Western Kentucky Faulted Belt Seismotectonic Region

The Fluorspar Fault Complex and the Western Kentucky Faulted Belt are two complex systems of faults that lie in southern Illinois and western Kentucky. The faults of the Fluorspar Fault Complex are characterized by a series of faults having a North 40° East trend covering an area 40 miles wide by about 60 miles long. This series of faults extends from beneath the late Cretaceous sediments of the Mississippi Embayment on the south to the east-west trending Rough Creek Fault Zone on the north. The Western Kentucky Faulted Belt is characterized by faults having a trend of about North 60° East, and lying in an area about 80 miles long east to west and about 40 miles north to south. The north boundary of this region is considered as lying along the Rough Creek Fault Zone. The Wabash Valley Seismotectonic Region, as discussed in Section 2.5.2.3.1.2.5, lies to the north. The southern boundary lies along the northern boundaries of the Reelfoot, the East Embayment Seismotectonic regions, and the northern flank of the Nashville Dome. The eastern boundary of the Illinois Basin Random Region and the Ste. Genevieve Seismotectonic Region lies along the projection to the northeast of the Northwestern boundary of the New Madrid Seismotectonic Region, as discussed in Section 2.5.2.3.1.1, and corresponds to a line of contrast in seismicity. To the west lies the Illinois Basin Random Region, where seismic activity is low with a few random events that have reached a maximum of MMI VII, the Ste. Genevieve Region, and the Border Region.

The region of the Fluorspar Fault Complex and the Western Kentucky Faulted Belt is a basically stable area with only a few low intensity, randomly-occurring earthquake epicenters (Baxter et al., 1973; Stearns and Wilson, 1972). The pattern of seismicity is diffuse and historic earthquake epicenters appear to show no relationship to know faults (Kolata, Treworgy and Masters, 1981).

2.5.2.3.1.2.5 Wabash Valley Seismotectonic Region

The Wabash Valley Seismotectonic Region consists of the area surrounding the Wabash Valley faults. This system is generally parallel set angle normal faults that bound horst and grabens. The region has moderate seismic activity; the maximum earthquake associated with the region is of MMI VII (Figure 2.5-49). Some authors have proposed that this region represents a northern extension of the New Madrid Fault Zone. However, recent studies (Bristol and Treworgy, 1978) conclude that the Wabash Valley fault system, although adjacent to several other major fault systems to the south (Shawneetown-Rough Creek fault zone, Fluorspar fault complex, Kentucky fault zone, New Madrid fault zone), is the result of different faulting mechanisms. The amount of displacement along Wabash Valley faults appears to decrease toward the south. In addition, the authors state that the Wabash Valley faults do not extend to, or intersect, the Shawneetown fault zone immediately to the south. Also, the lower level of seismicity of the Fluorspar Fault Complex - Western Kentucky Faulted Belt tends to refute such a connection. The boundary of this region to the northwest is with the Illinois Basin Random Region and is based on the absence of northeast-trending faults to the west, the change in degree of seismicity, and the lack of correlation of structures with epicenters to the west. The boundary of this region to the south is discussed in Section 2.5.2.3.1.2.4. The boundary to the east lies beyond the scope of this report.

2.5.2.3.1.2.6 Illinois Basin Random Region

The Illinois Basin Random Region comprises the Illinois Basin tectonic province. This region has low seismic activity but has produced a few events of intensity as high as MMI VII. In general, the earthquakes cannot be related to known structural features and must be considered as having a random occurrence anywhere within the region. Work by McGinnis and Ervin (1974) led them to believe that earthquakes may more often occur between crustal blocks as delineated by steep gradients on gravity maps. To the west, the Illinois Basin Random Region is separated form the Ste. Genevieve and Chester-Dupo Seismotectonic regions and the Missouri Random Region by the structural change that separates the Illinois Basin from the Ozark Uplift (Section 2.5.1.1.5.1.11) and the Lincoln Fold (Section 2.5.1.1.5.1.21). The bordering Ste. Genevieve and Chester-Dupo Seismotectonic regions exhibit greater total seismicity than the Illinois Basin Random Region.

In contrast, the Missouri Random Region has much less total seismicity that the Illinois Basin Random region and has had no seismic event greater than Intensity MMI V. The boundary between these two regions is marked by a series of structures that closely follow the Mississippi River, including the Cap au Gres Fault (Rubey, 1952; Tikrity, 1968) and the Lincoln Fold (McQueen et al., 1941).

The borders with the Fluorspar Faulted Complex and the Wabash Valley Seismotectonic Region are discussed above (Sections 2.5.2.3.1.2.4 and 2.5.2.3.1.2.5). The boundaries of the Illinois Basin Random Region to the north, northeast, and northwest are beyond the scope of this report.

2.5.2.3.1.2.7 West Embayment Seismotectonic Region

The West Embayment Seismotectonic Region lies between the New Madrid Seismotectonic Region, as described in Section 2.5.2.3.1.1, and the northwestern edge of the Mississippi Embayment (Section 2.5.1.1.5.1.10). It is a seismotectonic region of low to moderate activity, with a maximum associated event of MMI VI (Figure 2.5-49). Earthquakes in this region cannot be related to known geologic structures. Fault plane solutions in this region exhibit varying mechanisms as shown by Solutions 3, 5, and 21 (Figure 2.5-72). Fault plane Solution 3 is believed to be associated with the north-south fault, which probably bound the west sides of Anomalies A and B, as discussed in Section 2.5.2.3.1.1.7.

The northwest boundary of this region is delineated by the western edge of the upper Mississippi Embayment, which coincides with the Ozark Escarpment and which also lies along Stearns and Wilson's (1972) Bending Zone 3.

The low to moderate seismic activity of this region contrasts with the strong motion events of the New Madrid Seismotectonic Region to the southeast and with the historically low seismic activity of the Border Region to the northwest. The extent of the West Embayment Region to the southwest is unknown and is beyond the scope of this report.

2.5.2.3.1.2.8 Border Seismotectonic Region

The Border Region is a stable area lying along the southeastern flank of the Ozark Uplift. It is historically of low seismicity with earthquakes being infrequent and of MMI IV or less. This region is bordered on the southeast by the northwestern boundary of the New Madrid Seismotectonic Region along the edge of the upper Mississippi Embayment and coincident with Bending Zone 3 described by Stearns (1974) and discussed in Section 2.5.2.3.1.1.7. To the northeast, the region is bounded by the southwesternmost faulting associated with the Ste. Genevieve Fault System (Section 2.5.1.1.5.2.15). To the northwest, the region is bounded by the core of the St. Francois Mountains along the interface of the northeast trending Greenville Fault (No. 18 on Figure 2.5-66) (McCracken and McCracken, 1965). The extent of the region towards the southwest is unknown and beyond the scope of this report.

2.5.2.3.1.2.9 St. Francois Seismotectonic Region

The St. Francois Seismotectonic Region is a region of low seismicity related to faults on the margin of the St. Francois Mountains. Differential uplift between the St. Francois Mountains and the remainder of the Ozark Uplift probably created the residual stresses that have generated the moderate seismic events. The seismicity of the St. Francois Seismotectonic area is characterized by a maximum intensity of MMI VI.

As shown on Figure 2.5-66, the faults that surround the margin of the St. Francois Mountains include the Simms Mountain Fault Zone (No. 37) to the northeast, the

Greenville Fault (No. 18) to the southeast, the Black (No. 4) and the Ellington (No. 14) faults to the southwest, and the Big River Fault System (No. 3) to the northwest.

Comparison of the fault plane solutions of Figure 2.5-72 with the faulting shown on Figure 2.5-66 indicates that the Simms Mountain Fault is coincident with Solution 36; the Black Fault lies northeast of Solutions 13 and 15; and the Ellington Fault appears to be coincident with Solutions 18 and 19. These solutions all indicate that the northwesterly trending faults may have a normal oblique fault mechanism. Solution 16 is coincident with the Ellington Fault but does not match Solutions 18 and 19. Solution 22 does not appear to be related to any known fault.

2.5.2.3.1.2.10 Ste. Genevieve Seismotectonic Region

The Ste. Genevieve Seismotectonic Region is related to and defined by the imbricated Ste. Genevieve Fault System. The Ste. Genevieve Fault System is discussed in Section 2.5.1.1.5.2.15, by Tikrity (11968), and by Gibbons (1972), and is shown on Figure 2.5-66.

The Ste. Genevieve Fault System, including the Rattlesnake Ferry extension in Illinois, is about 100 miles long from end to end. It has a sinuous trace that has an overall strike trend direction of about North 30° West. Although the system contains some horsts and locally exhibits high angle compensatory normal faults, the main displacements consist of high angle faults. These faults demonstrate uplift of the crustal blocks to the southwest relative to the downthrown crustal blocks to the northeast, which are also tilted into the Illinois Basin. Vertical offsets along the upthrust fault system reach a maximum of nearly 2000 feet near the center of the fault system and diminish considerably along its trace to the northwest and southeast.

Faults and structures that are part of the Ste. Genevieve Fault Zone include the Ditch Creek Fault System (Warfield, 1953) and Valles Mines-Vineland Fault Zone (Parizek, 1949), the Rugley School Fault (Pike, 1929), the Cruise Mill-Fertile Fault Zone (Parizek, 1949), the Menfro faults (Flint, 1926), the Omete Creek Fault (Flint, 1926), the Mahken Branch Fold (Flint, 1926), the Richwoods Fault Zone (Warfield, 1953), Pleasant Creek Monocline (Flint, 1926).

The Ste. Genevieve Fault Zone and its possible extension, the Ditch Creek Fault, end in the vicinity of the town of St. Clair in Franklin County. In this vicinity, the character of the geologic terrane changes along a line trending northeast-southwest, roughly coincident with the course of the Meramec River. Work in this study area appears to indicate that this line demarcates the northwestern boundary of the crustal block that Gibbons (1972) has designated the Potosi Block. We suggest that this line of demarcation, or lineament, be designated as the Meramec River Lineament.

The Meramec River Lineament is a major dividing line separating the Potosi Block--which constitutes one of the main crustal blocks which have been elevated in the heart of the Ozark Uplift--from the other blocks in the northwestern flank of the Ozark Uplift in the area of the Cuba Graben. To the southeast of the Meramec River Lineament,

the movement in Paleozoic time along the Ste. Genevieve Fault Zone resulted from differential uplift of blocks in the Ozark Uplift to the southwest and blocks in the Illinois Basin to the northeast.

Strong northeasterly trending features (faults, lineaments in structural contours, change in trends of surface outcrop belts, change in strike of the Leasburg structure) indicate that a major crustal block boundary transects and terminates the Ste. Genevieve Fault along a zone roughly corresponding to the position of the Meramec River. Further, it is considered significant that the indicated Meramec Lineament is roughly coincident with the northwestern margins of the Chester-Dupo, Ste. Genevieve, and St. Francois Seismotectonic regions shown on Figure 2.6-61. It is probable that the Meramec Lineament constitues the northwestern margin of seismic activity associated with these regions. The Meramec River Lineament nearly coincides with a gravity gradient lineament, the St. Louis Lineament (Figure 2.5-69). Also parallel to these two lineaments are other linear features resulting from structure, alignment of epicenters, outcrop pattern, topographic linears, ERTS imagery linears, cave trends, and alignment of springs.

Analysis of the Bouguer gravity map of southeastern Missouri (Figure 2.5-68) reveals a prominent gravity gradient between St. Louis and Rolla, Missouri, which Phelan (1968) had interpreted as resulting from a difference in crustal thickness. The thin and thick crustal blocks are separated by a structurally weak zone. This corresponds very closely with the structural concepts of Gibbons (1972). Parallel to the lineaments between Rolla and St. Louis is a zone of structural disturbance. Beds are more highly folded as shown by structure contours drawn on top of the Roubidoux Formation. Major fold axes trend northwest, but there is a nosing trend eastnorth-eastward. Also the major faults trend northwest, but there are some (Virginia Mines Fault, Catawissa Fault, and portions of the Leasburg Fault; Figure 2.5-66) that trend east-northeast near the St. Louis Lineament. Very possibly related to this structurally disturbed zone is a concentration of springs along this zone that extends further southwest across the state (Figure 2.5-23). Also, there is a northeast trend to many ERTS, topographic linears, and to the alignment of some caves.

Earthquakes of the Ste. Genevieve Seismotectonic Region exhibit a characteristic maximum intensity of MMI VI, and there is no direct evidence that the Ste. Genevieve Fault System is capable. No fault plane solutions from Street and Herrmann (1974) and Herrmann (1978, 1979), shown on Figure 2.5-72, are found to coincide with the trace of the Ste. Genevieve Fault.

The boundary of this region with the St. Francois Seismotectonic Region to the southwest is based on a change in seismicity coincident with a change in structure related to the Farmington Block as identified by Gibbons (1972). The seismic events to the south appear to be related to the Simms Mountain and related faults at the north margin of the St. Francois Mountains. The change in character from the Ste. Genevieve to the St. Francois regions is transitional, but there is a definite structural break along the Simms Mountain Fault (Tikrity, 1968).

The boundary with the Border Region to the south is largely based on the contrast of seismicity and is poorly defined; however, the boundary is spatially related to the seismicity coincident with the Ste. Genevieve Fault System. The boundary to the north with the Illinois Basin Random Region also is based largely on the contrast in seismicity. The boundary with the Chester-Dupo Seismotectonic Region to the north is based upon changes both in seismicity and structure as discussed in Section 2.5.2.3.1.2.11. The southeastern border of the Fluorspar Faulted Complex-Western Kentucky Faulted Belt Seismotectonic Region is not well defined since the Ste. Genevieve Fault System dies out before it reaches the Fluorspar Faulted Complex. A continuation of the Ste. Genevieve Fault System into Tennessee has been hypothesized by Heyl (1965) and Hildenbrand et al. (1977) based on interpretation of geophysical data; however, this has not been substantiated. For the purpose of this report, the Ste. Genevieve Seismotectonic Region is extended along this projected direction of the Ste. Genevieve Fault to its abutment against the northwestern edge of the Fluorspar Faulted Complex. To the northwest, the Ste. Genevieve Seismotectonic Region ends at the Meramec River Lineament.

2.5.2.3.1.2.11 Chester-Dupo Seismotectonic Region

The Chester-Dupo Seismotectonic Region (a name originally proposed by Nuttli, 1973c) encompasses and area underlain by folding and some know faulting in the vicinity of St. Louis, Missouri.

The Dupo Anticline (No. 20 on Figure 2.5-12) together with the Dupo-Waterloo Anticline in Illinois (No. 3 on Figure 2.5-13), and the Florissant Dome (No. 24 on Figure 2.5-12) have an overall axial trend of about North 15° West. The Cheltenham Syncline (no. 13 on Figure 2.5-12) lies to the southwest of the Dupo structure. The St. Louis Fault (No. 39 on Figure 2.5-13; Frank, 1948, Brill et al., 1960) lies in the same area, but is a much smaller structure (discussed as item 39 under Missouri in Table 2.5-3); it has a displacement of only 10 feet, and appears to have a crosscutting relationship to the Dupo Anticline. The St. Louis Fault does, however, lie along the trend of the Plattin Anticline (No. 55 on Figure 2.5-12) (Pike, 1929). The relationship of the faulting and folding to seismicity is not clear; nevertheless, the coincidence of faulting, folding, and epicentral locations provides an overall north-south trend.

The Chester-Dupo Seismotectonic region is one of moderate seismicity characterized by a maximum MMI of VI. Recent work by Nuttli (1973c) has shown that some of the old historic earthquakes originally attributed to this region actually occurred further east in the Illinois Basin Random Region near Centralia, Illinois. To the south, the Chester-Dupo Seismotectonic Region borders on the Ste. Genevieve Seismotectonic Region. This border is delineated by a change in the trend directions along which the seismic events have occurred. To the north of this boundary, the epicenters are aligned along north-south trends parallel and subparallel to the structures described above. To the south of this boundary, the epicenters appear to be aligned along a southeast trend that parallels the Ste. Genevieve trend and its associated structures such as the Valles Mines-Vineland Fault Zone (Parizek, 1949), the Ditch Creek Fault System (Warfield,

1953) and the Rugley School Fault (Pike, 1929). To the east, the Chester-Dupo Seismotectonic Region is bounded by the transition from the folds described in this section to the deeper portions of the Illinois Basin along the hinge line, which separates the basin from the front elements of the Ozark Uplift. To the north, the Chester-Dupo Seismotectonic Region appears to be bounded by the eastward projection of the Cap au Gres Fault (No. 7 on Figure 2.5-13) along its apparent strike of about South 80° East. To the west, the boundary with the Missouri Random Region is based upon a distinct change in seismicity, coincident with the Meramec River Lineament.

2.5.2.3.1.2.12 Missouri Random Region

The site lies in an area of central Missouri characterized by random seismic events of maximum MMI V which are not associated with known geologic structures. This region is herein designated as the Missouri Random Seismotectonic Region. As shown on Figure 2.5-61, the Missouri Random Region borders upon the Chester-Dupo, Ste. Genevieve, St. Francois, and the Border Seismotectonic regions.

Inspection of the Bouguer gravity anomalies shown on Figure 2.5-68 reveals a mosaic pattern which McGinnis (1974) describes as being characteristic of undisturbed regions of the midcontinent. According to McGinnis, the mosaic pattern is produced by mass concentrations that were emplaced in Precambrian time by mechanisms that are not completely understood. A convective overturn of crust involved in plate motions similar to those occurring at the present time is probably the most likely explanation.

Such mosaic gravity regions of the mid continent are generally associated with regions of random or infrequent seismicity. These mosaic patterns outline blocks of Precambrian crust the differ slightly in density, a differential of about 0.1 gm/cm^3.

Boundaries of the Missouri Random Region to the north, west and south are not herein defined.

2.5.2.3.1.3 Identification and Description of Capable Faults

The term "capable fault" as defined in NRC Guideline 10 CFR 100, December 5, 1973, supersedes previous use of the term "Active fault" for this report. For all practical purposes, the New Madrid Seismotectonic Region, as defined, must be considered capable of producing large earthquakes, although no events can be associated with a specific structure at this time.

Outside of the described New Madrid Seismotectonic Region, there is no irrefutable evidence establishing capability of any known structure in the entire mid-continent region. In the New Madrid Seismotectonic Region, however, capability should be assumed, from a practical standpoint, on the basis of the sheer number and dense distribution of instrument recorded events, along as yet unidentified discrete structures (Figure 2.5-74).

The capability of near-surface structures near Reelfoot Lake (Russ, 1979; Zoback, 1979) has been suggested and somewhat corroborates the assumption of capable structures in this area of intense seismic activity.

An evaluation of the earthquake potential of such a capable structure is not necessary for this report, since a recurrence of the largest New Madrid event (1812) is assumed for this seismotectonic province. According to Nuttli and Herrmann (1978), its magnitude of 7.5 saturates the mb scale and represents a truly major event, similar to the great earthquakes associated with movements along lithospheric plate boundaries.

Faulting in the Mississippi Embayment area is considered to be capable, as described in Section 2.5.1.1.5.2.13 and in the discussions in Sections 2.5.2.3.1.1. and 2.5.2.3.1.3.

The faults in the New Madrid Seismotectonic Region are discussed in detail in Section 2.5.2.3.1.1.7. The Intensity X to XII New Madrid earthquakes of 1811-1812 altered the topography of 30,000 to 50,000 square miles of unconsolidated alluvial material of the Mississippi Embayment (Section 2.5.1.1.5.1.19) and may have been responsible for the faulting near Reelfoot Lake described by Olive (1969). Recent investigations indicate that little or no near-surface fault movement occurred along the Reelfoot Scarp during the 1811-1812 events (Stearns, 1980; Russ, 1979; Zoback, 1979). Similar disruption occurred during the MMI VIII Charleston, Missouri, earthquake of 1895, but on a much smaller scale.

2.5.2.3.2 Recurrence Intervals

Recurrence intervals for seismic events in the various seismotectonic regions are presented only to demonstrate the contrasting characteristics of frequency of return for different seismotectonic regions. These have been plotted on Figure 2.5-92 as Modified Mercalli Intensity versus the log of the number of earthquakes for a given seismotectonic region, expressed as number of events per 1,000 square kilometers per 100 years. Due to the brevity of the record, the recurrence curves are not intended to be used to calculate exact earthquake return periods. Rather, they are considered to be useful as a way of comparing the characteristics of the various seismotectonic regions. Thus the curves show relative characteristics of size, frequency, and maximum earthquakes for each region. From Figure 2.5-92, it is seen that the frequency of occurrence for seismic events is greatest for the New Madrid Seismotectonic Region and is least for the Missouri Random Region. Although the historical data base is relatively short in comparison to geologic time, the data are not unmeaningful when compared to the projected 40-year operational life of the proposed facility.

Recent work on earthquake recurrence by Nuttli and Herrmann (1973) gives an estimate of the return period of earthquakes in a study area centered in southeast Missouri. These data indicate the recurrence of a New Madrid-type event to be around 800 to 1000 years in the seismically active zone around the Mississippi Embayment. A recent study of fault displacement in younger sediments in western Tennessee (Russ, 1978) concluded that major earthquakes in the area have an average recurrence period of 666 years.

Therefore, geologic evidence is in fairly good agreement with seismicity data (Nuttli and Herrmann, 1978). Johnston (in press) indicates that the average recurrence rates (63% probability of occurrence) for large new Madrid earthquakes with body wave magnitudes m_b = 7.0 - 7.3 are 912 - 1687 years/events.

2.5.2.4 Maximum Earthquake Potential

In order to establish criteria for the Safe Shutdown Earthquake, an examination has been made of the degree of ground motion that is possible considering both the seismic history and geologic structure of the region and the specific site area. To summarize, the seismogenic regions within 200 miles of the site as discussed in the previous section are listed below, with their maximum historical event and closest approach to the site (see Figure 2.5-49).

REGION	MAX. HIST. EVENT	CLOSEST SITE APPROACH
St. Francois	VI	65 miles
Ste. Genevieve	VI	70 miles
Chester-Dupo	VI	70 miles
Illinois Basin Random	VII	70 miles
Border	IV or less	140 miles
West Embayment	VI	160 miles
New Madrid	XI - XII	175 miles
Wabash Valley	VII	180 miles
Fluorspar Fault Complex	low	180 miles
Reelfoot	VII	185 miles
Missouri Random	V	site

While there are substantial differences in the seismic characteristics of many of the regions listed above, there is perhaps insufficient geologic evidence to define many of them as discrete seismotectonic provinces. The structure and seismicity of the New Madrid area, however, clearly describes a seismotectonic province, the closest approach to the site of which is fairly distinct for purposes of this study, and is consistent with an appropriate level of conservatism. It is also seen that no events outside this seismic zone (within the area of influence of the site) have exceeded Intensity VII. Elsewhere in the

Central Stable region of the mid-continent, earthquakes as high as Intensity VII-VIII have been reported, but can be confined to zones or structures that preclude their consideration for recurrence in the site vicinity. Also, there are no geologic structures which would tend to localize earthquakes in the site vicinity.

Considerations for the maximum potential earthquake, then, include (1) a random Intensity V occurring adjacent to the site (Missouri Random Region), (2) conservatively, an Intensity VII, a minimum distance of 70 miles from the site, and (3) a recurrence of the New Madrid Intensity XI-XII shock 175 miles from the site. On the basis of attenuation studies of the historical effects of the New Madrid event, it is concluded that such a recurrence would supersede the design considerations imposed by the lesser events specified in (1) and (2) above.

It is appropriate, then, to examine the possible site effect from this large candidate event in terms of historical data and recent attenuation studies.

2.5.2.4.1 Attenuation Studies

Attenuation studies for the eastern and central United States have been concerned with the diminuation of Modified Mercalli Intensity with distance, since the bulk of the data is in terms of intensity or damage. However, later studies, because of the increased instrumental coverage in recent years, have calculated the attenuation of ground motion parameters (acceleration, velocity) directly with distance in various characteristic geologic regimes. To avoid confusion in this study, the intensity at the site from a recurring design event will be addressed initially, while the intimately related levels of ground motion will be addressed in a subsequent section.

The most recent studies of mid-continent attenuation admittedly calculate levels of ground motion that are unrealistic when applied to large events like the New Madrid experience. By way of example, recent relationships for the attenuation of intensity with distance for the mid-continent region have been published by Gupta and Nuttli (1976) and Gupta (1976), and are, respectively, as follows:

$$IR = IO + 3.7 - .0011R - 2.7 \log R \ (R \geq 20 \text{ km}) \qquad (2.5\text{-}1)$$

$$IR = IO + 2.35 - .00316R - 1.79 \log R \ (R \geq 20 \text{ km}) \qquad (2.5\text{-}2)$$

where

IR = MM Intensity at distance R from the maximum epicentral Intensity, IO.

Both formulas calculate an intensity of over VIII at the site from a recurrence of a New Madrid event (XI-XII) at 175 miles. However, these formulas were developed from alluvial response to central U.S. earthquakes, the largest of which was Intensity VIII. Thus, as shown in a later Section 2.5.2.6, an extrapolation of these correlations to the

large New Madrid event is unrealistic, resulting in site intensities for the subject foundation materials that far exceed the actual historical experience discussed below.

It should be also considered that historic attenuation of the New Madrid events is greater to the northwest and southwest than it is to the northeast and east. The formula above are based on an average radius and would thus yield high values to the northwest (site direction) of the epicentral zone of the 1811-1812 shocks.

In consideration of the recommended limitations of the above relationships, the attenuation for the large New Madrid events can be examined using the actual historic data available from several investigations.

The first curves investigated are those by Weston Geophysical Company for the Stearns and Wilson report (1972), as shown on Figure 2.5-93. This range is representative of California type earthquakes having relatively rapid attenuation. The same figure, which gives attenuation in various directions from the epicenter, shows the attenuation curves derived from Stearns and Wilson's isoseismal map for the New Madrid earthquake of 1811. Attenuation for the 1812 New Madrid earthquake is shown on Figure 2.5-94. Ranges and composite attenuation in the east and southeast directions where more data points were available are shown on Figures 2.5-95 and 2.5-96. Figure 2.5-97 shows a composite range of attenuations for the major 1811-1812 New Madrid earthquakes.

The attenuation curves developed form the historical data points for the 1811-1812 events are conservative due to the geomorphic and physiographic conditions influencing wave amplification and attenuation within the floodplain valleys throughout the midwest. Application of these curves to determine either bedrock or surface intensity at the power plant site, located on the upland terrain on better-than-average foundation support conditions, is also considered to be conservative.

In none of the synthesized New Madrid attenuation studies from Stearns and Wilson (1972) do intensities at the site exceed MMI VI-VII from a recurrence of the New Madrid earthquake either at its historic epicenter or at the margin of the New Madrid Seismotectonic Region, located about 175 miles to the southeast.

2.5.2.4.2 Maximum Intensity at the Site

Recent attenuation studies based on mid-continent events such as the one shown on Figure 2.5-98 apparently overestimate effects at the site when extrapolated to the New Madrid design event of Intensity XI-XII. Thus, the relationships suggest a site intensity of over VIII for an Intensity XI-XII event at 175 miles. However, based on the actual historic site effects, and ground motion levels associated with such an intensity in well instrumented areas at equivalent distances in other areas, the calculated site effect of VII + is considered unrealistic. A design event of maximum Intensity VII at the site more nearly represents a viable, but conservative level of ground motion upon which to determine a design level of acceleration and is compatible with the historic experience in the site area. This will be discussed in a later section.

2.5.2.5 Engineering Properties of Materials Underlying the Site

The subsurface soil and rock at the site were explored through the drilling of 165 test borings, 131 of which were drilled within the immediate area of the proposed Callaway Plant. The field and laboratory programs and the analyses of the engineering properties of the subsurface materials are discussed in detail in Section 2.5.4.

The soil deposits encountered at the site are primarily of glacial and postglacial origin; the different units are variable in their engineering properties. These deposits are about 25 to 35 feet thick at the location of the proposed plant.

Development of the power plant and appurtenant facilities included earthwork and grading operations. Site preparations and earthwork for Units 1 and 2 consisted of stripping, excavating, dewatering and backfilling operations to attain a nominal plant grade of elevation 840 feet. All glacial and postglacial soils beneath the power plant and associated Category I structures were excavated to the top of the Graydon chert conglomerate. In order to improve foundation support conditions, the overexcavated soils were replaced with compacted granular structural fill consisting of crushed limestone aggregate. All Category I and heavy structures except the Ultimate Heat Sink (UHS) Retention Pond and Category I pipelines are founded directly upon the Graydon Chert conglomerate or granular structural fill. A discussion of the stability of the subsurface materials including plot plans, subsurface sections and engineering properties of the natural deposits and the fill is presented in Section 2.5.4.

2.5.2.6 Safe Shutdown Earthquake

Based on the above discussions, the maximum intensity at the site would be generated by a recurrence of the largest historical events in the New Madrid seismogenic region, at the closest approach of 175 miles from the site. This motion would supersede that from any credible random events (maximum V-VI) in the region surrounding the site, or the attenuated motion from any events which can be restricted to minimum distances from the site.

On the basis of applicable "historical" attenuation studies, the site intensity for the design event would be less than VII, a level which is corroborated by studies of the effects of the New Madrid events in 1811-1812, as discussed previously.

The foundation support conditions for plant construction are considered to be above average since the plant will be supported, as shown on Figures 2.5-120 through 2.5-122, on a thin layer of crushed rock structural fill placed upon the Graydon chert conglomerate.

The ground motion from the Safe Shutdown Earthquake would consist primarily of surface seismic waves with periods between 1 and 3 seconds, having a total duration of between 1 and 2 minutes. The maximum acceleration from these waves would be realized for only a few seconds with the remainder of the ground motion being at

considerably lower levels of amplitude (Nuttli, 1975; Herrmann, 1975; Nuttli and Herrmann, 1978).

The level of ground motion to which the site will be subjected as a result of the maximum site intensity of Intensity VII is now discussed.

Directly applying recent Intensity/Acceleration correlations to the (conservative) site design intensity of VII (Trifunac and Brady, 1975; O'Brien et al., 1977), a mean peak horizontal acceleration value between 0.10 and 0.13g is calculated for the Safe Shutdown Earthquake (SSE) as shown on Figure 2.5-99. These values are considered conservative for the design event at 175 miles for the following reasons.

Trifunac and Brady (1975), particularly, have based their mean of 0.12g (for Intensity VII) on maximum peak amplitudes of accelerations taken, in many instances, from instruments sited near the epicenter, of a few larger events. Thus, their mean is weighted somewhat toward the near field wherein one or several sharp spikes of acceleration associated with short periods and high frequencies are typical. Such peaks are not usually evident at distances of concern here; rather, at such distances, a significant portion of the seismic energy is in the form of long-period, large amplitude surface waves where spectral accelerations are proportionately reduced so that the velocity (and displacement) characteristics may become more critical to structural response.

Recently, Nuttli and Herrmann (1978) developed a formula for the attenuation of acceleration with epicentral distance from a given magnitude m_b event. This equation is based largely on their intensity attenuation relationship previously discussed in Section 2.5.2.4 for the mid-continent, and is their Equation (7).

$$\log A^h \text{ (cm/sec}^2\text{)} = 0.84 \quad (2.5\text{-}3)$$

$$+ 0.52\, m_b - 1.02 \log R \text{ (R} \geq 15 \text{ km)}$$

which results in a calculated site acceleration level of under 18 percent g.

However, the authors state:

> "Equation (7) was based on data from earthquakes and accelerograph sites in the Mississippi Embayment. Thus Equation (7) may not in fact represent bedrock motions. It is also of interest to note that large accelerations result when Equation (7) is extrapolated to estimate accelerations due to the New Madrid earthquakes of 1811-1812. There is no existing data which can be used to verify the extrapolations to such large magnitude earthquakes. However, we can have confidence in the use of Equation (7) for earthquakes of m_b = 6 and less."

Earlier, Nuttli (1973a) presented an analysis that gave the following values as maximum horizontal accelerations specifically for a New Madrid-type event at 175 miles: 0.03g for

0.3-second waves, 0.04g for 1-second waves, and 0.02g for 3-second waves. Taking the largest value indicates a maximum horizontal acceleration of 0.04g.

The notable difference between the estimated 0.04g above and an extrapolation of Nuttli and Herrmann's (1978) Equation (7) to a New Madrid-type event (0.18g at 175 miles) suggests that the recommended application only to m_b 6.0 or less should be adhered to.

Nuttli (1973c) has observed that velocity may be the best characteristic to directly describe ground motion and seems more correlatable with the Modified Mercalli Intensity (damage) scale. Nuttli further believes that surface waves may have the greatest damaging effect on a location in the far field such as the site's relationship to the New Madrid epicentral zone.

Intensity-velocity relationships may be derived by first obtaining surface wave attenuation in terms of particle velocity and then converting this value to Mercalli Intensity by comparing known particle velocities at specified intensities.

Using Nuttli's (1973a) bedrock formula,

$$m_b = 3.75 + 0.9 \log^{10} \frac{(KM)}{111.195} + \log^{10}(A/T)\text{microns/sec}, \qquad (2.5\text{-}4)$$

a New Madrid event of m_b = 7.5 (Intensity XI-XII) will yield a horizontal vector velocity of 3.06 cm/sec at 175 miles (282 km) (after multiplying by a factor of 2 to convert vertical velocity to a horizontal vector of velocity) (Nuttli, 1973; Street, 1978). Relating this velocity to Intensity using the relationship of Trifunac and Brady (1975),

$$\log V^h = 0.25\ I - 0.63, \qquad (2.5\text{-}5)$$

an intensity of IV to V is calculated for the ground motion generated at the site by a New Madrid-type event at 175 miles. This intensity can then be correlated with an acceleration value of a little over 0.02g using appropriate correlations (Figure 2.5-99).

In summary, the attenuation functions of Gupta (1976), Gupta and Nuttli (1976) and Nuttli and Herrmann (1978), as discussed in Section 2.4.2.4.1, would suggest a site intensity of VIII-IX and an acceleration level at the site of 0.18g (respectively) from a recurrence of a New Madrid event 175 miles from the site. However, it is suggested that the ground motion levels thus derived are not realistic on the basis of the following:

a. Nuttli and Herrmann (1978) state that their equation for site acceleration (not verified for body-wave magnitudes greater than 6.0) appears to overestimate site effects from large New Madrid-type events.

b. The attenuation variable in the relationship above is based on essentially similar formulas developed by Gupta (1970) and Gupta and Nuttli (1976), thus suggesting that a similar extrapolation to large, rare events (beyond the maximum intensity of VIII used for the attenuation data) is not verifiable.

c. Gupta (1976) and Gupta and Nuttli (1976) use average isoseismal radius to develop central U.S. attenuation relationships. As a result, the elongation of recorded isoseismals to the northeast from the New Madrid events would distort the calculated attenuation relationships when applied to the northwest (the site direction). Thus, the asymmetry shown by actual historical experience from the design event suggests that a lower intensity would prevail in the northwest (site) direction.

d. Appropriately referenced conclusions by the Nuclear Regulatory Commission (1977) concerning the Marble Hill Nuclear Generating Station, located 110 miles from the "New Madrid"-type event, cite the following:

   1. Accelerations exceeding 0.20g are unlikely at epicentral distances beyond 60 miles.

   2. Studies in the mid-continent region indicate that lower acceleration levels are appropriate (at the distances of concern herein).

   3. Much of the damage produced by the New Madrid events may have resulted from soil failure; long duration ground motions with relatively low acceleration can produce such failure.

Nuttli's magnitude formula converts the attenuated New Madrid event to a site intensity of IV to V, with an attendent acceleration level a little over 0.02g at the 175 mile distance. On the basis of the wide disparity between calculated levels of acceleration at the site (0.03 to 0.18g), a recommended SSE level of 0.20g is considered appropriately conservative for the above-average foundation conditions at the site as an anchor for the response spectra presented in Section 2.5.2.8, below.

2.5.2.7 Operating Basis Earthquake

The Operating Basis Earthquake (OBE) is defined as a recurrence of the New Madrid earthquake near its historic epicenter. Such an event produced site intensities a little over VI (Figure 2.5-56). As in the approach for the analysis of the Safe Shutdown Earthquake in Section 2.5.2.6, the Operating Basis Earthquake of MMI XI-XII will be attenuated to an MMI VI-VII. Using the most conservative correlation shown on Figure 2.5-99; the calculated peak horizontal acceleration at foundation level would be about 0.09g as indicated by Nuttli for the New Madrid event at 175 miles as previously discussed. However, the OBE is herein raised to a value of 0.12g, as a conservative measure.

A statistical analysis has been performed by Algermissen and Perkins (1976) for the contiguous United States. The authors' study considered structure and historical seismicity in contouring expected levels of acceleration. In the site area, they show an interpolated acceleration level of about 6 percent of gravity, with a 90 percent probability of not being exceeded (on hard rock) over a 50-year period. The return period for these parameters is 475 years. This converts to only an 8 percent probability of 0.06g being exceeded on the site bedrock during the 40-year operating life of the facility.

An additional study has been accomplished by the Applied Technology Council (1976) under contract to the National Bureau of Standards. Their "effective" acceleration for the site area is also about 0.06g with an 80 to 95 percent chance of not being exceeded at any one location in a 50-year period.

Therefore, existing studies concerning site specific risk are compatible, and show the value of 12 percent of gravity to be conservative, demonstrating a low order of probability for the selected OBE.

2.5.2.8 Response Spectra

Design response spectra are presented on Figures 2.5-100 and 2.5-101. The response spectra are scaled or normalized to the design horizontal ground acceleration for the Safe Shutdown Earthquake of 0.20g and for the Operating Basis Earthquake of 0.12g. These spectra are based on recommended criteria by Newmark, Blume, and Kapur (1973), and published as Regulatory Guide 1.60, as revised. The spectra represent the maximum amplitude of motion over the natural frequency range of various structural elements with typical degrees of damping.

The effects of low frequency, long duration ground motion resulting from an occurrence of the Safe Shutdown Earthquake as defined in Section 2.5.2.6 have been evaluated in order to determine the conservatism of the design response spectra. The analysis was performed using the following approach:

a. The accelerograms of two historical earthquakes having long time histories and with predominant energy in the frequency range between 0.33 and 1.0 Hertz were selected for evaluation. The accelerograms were scaled to a conservative maximum historical acceleration level of sustained motion (estimated for the site from the New Madrid event) and were used to compute model response spectra;

b. The model response spectra of the scaled accelerograms were compared to the design response spectra from Regulatory Guide 1.60, anchored at 0.20g; and

c. The design response spectra from Regulatory Guide 1.60, anchored at 0.20g were compared with the aseismic design recommendations for the central United States proposed by Nuttli (1973c).

The accelerograms that were selected for evaluating were those from the 1949 Olympia, Washington, earthquake and the 1968 Tokachioki, Japan, earthquake. These two historical earthquakes are considered to possess seismic characteristics closely approximating the low frequency, long duration ground motion that would be generated by a seismic event of Modified Mercalli Intensity XI-XII postulated to occur at the western boundary of the New Madrid Seismotectonic Region (Mississippi Embayment Seismic Zone).

Nuttli (1975) suggested the Seattle, Washington, record of the 1949 Olympia, Washington, earthquake. The time history (Murphy and Ulrich, 1951) and response spectra of this seismic event are well known. The Olympia earthquake had an Intensity of VIII (a Gutenberg-Richter magnitude of 7.1) and its epicenter was located about 40 miles from the recording station in Seattle. However, its duration was about 68 seconds. When scaled to the sustained acceleration level of 0.08g, the computed model response spectra for the Olympia event falls well within the entire design response spectra from Regulatory Guide 1.60, anchored at 0.20g.

The Tokachioki, Japan, earthquake of 1968 is considered to be even more representative of the postulated New Madrid earthquake because of its size and long duration. This earthquake has a (Gutenberg-Richter) magnitude of 7.9, and its epicenter was located about 120 miles from the recording station at Hachinohe Harbor. The accelerogram has a duration of 120 seconds, and the predominant energy was in the frequency range of 0.33 to 1.0 Hertz.

The actual time history of this earthquake is presented on Figure 2.5-102. When scaled to a sustained site acceleration of 0.08g, the computed model response spectra for this event also fall within the design response spectra from Regulatory Guide 1.60, anchored at 0.20g as shown on Figure 2.5-103.

Based on the evaluation of these two historical earthquakes, it is concluded that the effect of earthquake duration has been adequately incorporated into the design response spectra from Regulatory Guide 1.60. Comparison of the model response spectra computed from historical accelerograms with the Regulatory Guide spectra indicates that the Callaway plant design response spectra anchored at 0.20g are conservative, even in the frequency range from 0.33 to 1.0 Hertz.

Furthermore, the design response spectra anchored at 0.20g envelope the ground motion spectra proposed by Nuttli (1973a) in the period range of 1 to 3 seconds. Nuttli (1975) has suggested that, in view of the more recent results of Trifunac and Brady (1975), it would be better on the average to double his earlier values of ground motion. A ground motion spectra curve developed using Nuttli's approach would, therefore, consist of the following three points (at an epicentral distance of 175 miles):

a. At period T = 3.3 seconds, resultant displacement = 2 x 5.6 = 11.2 centimeters;

b. At period T = 1.0 second, resultant velocity = 2 x 6.0 = 12 centimeters per second;

c. At period T = 0.33 second, resultant acceleration = 2 x 0.016 = 0.032g.

These resultant values can be broken down into vertical and horizontal components as shown by Mohraz, Hall and, Newmark (1972). Since the vertical component is very small, the horizontal component values and the resultant values are nearly identical, with the resultants being the more conservative.

2.5.3 SURFACE FAULTING

There are no surface faults at the site. All tectonic features within 50 miles of the site have been discussed in Section 2.5.1.1.5, Regional Tectonic Features.

2.5.3.1 Geologic Conditions of the Site

The lithologic, stratigraphic, and structural geologic conditions of the site and surrounding region, including geologic history, have been discussed in Sections 2.5.1.1 and 2.1.1.2, Regional Geology and Site Geology respectively.

2.5.3.2 Evidence of Fault Offset

While the literature reveals no faults within 18 miles of the site (McCracken, 1971), recent field investigations indicate the existence of a fault approximately 12 miles from the site near Kingdom City (see Section 2.5.1.1.5.2.18). Field investigations for this project have not revealed any faults, active or inactive, within 5 miles of the site, with the exception of minor, inactive displacements associated with slump features (see Section 2.5.1.2.3.2).

2.5.3.3 Earthquakes Associated with Capable Faults

There have been no historically reported earthquakes within 40 miles of the site.

2.5.3.4 Investigation of Capable Faults

No faults have been identified any parts of which lie within 5 miles of the site.

2.5.3.5 Correlation of Epicenters with Capable Faults

No faulting is known to exist within 12 miles of the site, and no historic epicenters within 40 miles.

2.5.3.6 Description of Capable Faults

No capable or noncapable faults are known to exist within five miles of the site.

2.5.3.7 Zone Requiring Detailed Faulting Investigation

Preliminary geologic investigations of the site have not revealed any evidence of faulting; therefore, no basis to warrant detailed fault investigation exists.

2.5.3.8 Results of Faulting Investigations

A study of surface faulting is not required at the site. Reconnaissance and detailed boring data, subsurface correlations, geologic mapping, detailed excavation mapping, and aerial photograph interpretations have revealed no surface faulting within the site vicinity.

2.5.4 STABILITY OF SUBSURFACE MATERIALS

Several subsurface exploration programs were conducted to evaluate the overall geologic and subsurface conditions within the site proper and in the surrounding areas. The location of the plant with respect to the surrounding area is shown on Figure 2.5-104; the plant facility locations and their relationships to the test borings are shown on Figure 2.5-105.

In addition to the plant borings, additional exploratory borings were drilled to determine the most suitable source or sources of concrete aggregate and crushed rock structural fill and backfill. These quarry borings are located on Figures 2.5-107 through 2.5-111. To aid in visualizing the subsurface conditions at the site, selected subsurface profiles were prepared and are shown on Figures 2.5-112 through 2.5-118.

The field exploration programs revealed that the subsurface materials at the site consist of glacial and postglacial soils overlying older sediments consisting of the Graydon chert conglomerate and lithified formations of limestone, sandstone, shale, and dolomite. No evidence of any actual or potential surface or subsurface subsidence, uplift, or collapse resulting from tectonic or solution activity was observed during the field exploration programs.

Site preparation and earthwork for Unit 1 consisted of stripping, excavating, dewatering, and backfilling operations to attain a nominal plant grade of 840 feet mean sea level (MSL). All glacial and postglacial soils were overexcavated beneath the Seismic Category I structures and other major structures within the power block area. The glacial and postglacial soils were also overexcavated beneath the ultimate heat sink (UHS) cooling towers and the essential service water system (ESWS) pumphouse. These soils were excavated to the top of the Graydon chert conglomerate (approximate elevation 812) and replaced with compacted granular fill to attain the site and/or foundation grades. The ESWS pipelines and electrical duct banks are supported by in-situ soils except in the backfill area surrounding the power plant structures. An excavation plan is shown on Figure 2.5-119, and excavation profiles showing the Category I excavations, structures, and backfill geometry as they relate to the site stratigraphy are presented on Figures 2.5-120 through 2.5-123. Selected photographs of the Unit 1 power block

excavation and a partially completed excavation slope in the UHS retention pond are presented on Figures 2.5-124 and 2.5-125. Excavation and backfill activities are essentially completed at the present time in the Unit 1 power block, UHS cooling towers, and ESWS pumphouse areas. The excavation plan and profiles present the projected completed conditions.

The field and laboratory testing programs indicated that the crushed rock structural fill and backfill and the underlying chert conglomerate have static and dynamic characteristics favorable for support of the plant, and that the in-situ soils exhibit favorable static and dynamic characteristics for support of the ESWS pipelines and electrical duct banks. No adverse ground-water effects are expected, and the site is considered suitable for the plant.

2.5.4.1 Geologic Features

Geology of the site is discussed in Section 2.5.1.2.

2.5.4.2 Properties of Subsurface Materials

Representative undisturbed and reconstituted samples of the soil and rock obtained during the field programs were subjected to static and dynamic laboratory testing in order to determine the engineering properties of those materials. Field testing was also performed with emphasis on the Graydon chert conglomerate and compacted granular fill material. Summaries of the index, static, and dynamic properties of the in-situ subsurface materials based on both the laboratory and field tests are presented in Tables 2.5-14, 2.5-15, and 2.5-16. Summaries of the static properties of recompacted on-site cohesive materials are presented in Table 2.5-17. Summaries of the static and dynamic properties of the compacted granular fill material are presented in Tables 2.5-14 and 2.5-18.

The modified loess, accretion-gley and till soils were removed beneath the power block structures, UHS cooling towers, and the ESWS pumphouse. These structures are supported on mat or spread-footing foundations bearing directly on the Graydon chert conglomerate or compacted granular structural fill. The UHS retention pond is constructed as an excavated reservoir with the side slopes and bottom of the reservoir within the natural soils.

The granular structural fill used during plant construction was crushed limestone and dolomite (Callaway Formation) from approved sources. Preliminary laboratory studies were performed on samples of crushed limestone obtained from three commercial sources. In the spring and summer of 1975, a crushed stone structural fill test pad was constructed using material that was obtained from an on-site mine quarry that is an approved source of the structural fill. Extensive field and laboratory testing programs were carried out on the crushed stone in order to verify the structural fill properties obtained from initial testing and to develop compaction criteria and quality control procedures. The results of these investigations were summarized and presented in the

Dames & Moore "Report, Field and Laboratory Investigations of the Crushed Stone Structural Fill, Callaway Plant, Units 1 and 2, for Union Electric Company," dated August 8, 1975 (hereinafter referred to as the Structural Fill Report).

The crushed stone structural fill was placed and compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM Test Designation D 1557-70. It was found during the detailed evaluation of the crushed stone properties that this placement density is equivalent to 98 percent of the relative density as determined by ASTM Test Designation D 2049-69. Based on the results of extensive laboratory (static and dynamic strength and compressibility) and field (plate load and geophysical) tests, the crushed stone as compacted provides satisfactory engineering properties as structural fill for the Category I structures.

The surface soil at the site is a modified loess that varies from 3 to 12 feet in thickness under the plant and UHS area, with an average thickness of 7 feet. This soil was originally deposited as a windblown silt forming a loess deposit that has been altered by weathering to a mottled brown and gray, low to moderately plastic silty clay. Occasional lenses of clayey silt or silt are at the bottom of the deposit.

The modified loess is underlain by a deposit of moderately to highly plastic gray silty clay, which is discussed by Howe and Heim (1968) and identified as an accretion-gley deposit postulated to be the result of a very slow accumulation of weathered colloidal size materials (discussed in Section 2.5.1.2.2.1.2). The clay has an average thickness of about 14 feet and is encountered throughout the site area where its thickness varies from 5 to 24 feet under the plant and UHS areas. The plasticity of this clay is a feature significant to construction operations, as it becomes sticky and soft on exposure to water. In addition, the accretion-gley will swell, which results in volume change and strength reduction upon saturation.

A 3- to 18-foot thick layer of glacial till underlies the accretion-gley deposit. The till consists of brown or mottled brown and gray silty clay containing some mixed sand and gravel. Occasional lenses of silty or clayey sand are contained within the till. These lenses are more frequently encountered near the base of the deposit and vary from loose to very dense.

The Graydon chert conglomerate, as discussed in Section 2.5.1.2.2.2, consists of hard clay containing 5 to 90 percent by volume of irregular chert fragments and local deposits of indurated sandstone and sandy chert conglomerate. Observations of the Graydon within plant site excavations showed approximately 80 percent of the material to be the chert-clay conglomerate. Random pockets of hard silty clay containing no chert comprised approximately 10 percent of the material, and the remainder consisted of random pockets of claystone containing no chert. Beneath the power block areas, the chert fragments average approximately 30 percent by volume of the stratum. The chert fragments vary from pebble size to boulders nearly 2 feet in diameter. No open spaces or voids have been detected between rock fragments in the test borings, nor were any observed in exposures of the deposit. Within the plant site area, the Graydon unit is

between 12 and 49 feet thick, with the top of the stratum generally at about elevation 812 feet.

Borehole pressuremeter tests, plate load tests, and laboratory consolidation tests indicate that the clay matrix has a hard consistency. Considerable reliance was placed on the results of the field testing in the determination of the engineering properties of the Graydon unit due to the difficulty in obtaining undisturbed samples of the material.

The chert conglomerate is underlain by the Burlington Formation of Middle Mississippian age, at a depth of about 50 to 60 feet below existing grade. The Burlington Formation is a medium- to thick-bedded, coarse-grained, cherty, fossiliferous limestone, the upper surface of which shows some effects of solution and weathering (Section 2.5.1.2.5.3) but is predominantly very competent and indurated. In the test borings, the underlying Snyder Creek, Callaway and Cotter/Jefferson City formations were found to be competent to the maximum depth of borings, 402 feet.

2.5.4.2.1 Laboratory Tests

Laboratory tests were performed on representative undisturbed and remolded samples of the subsurface materials to aid in the evaluation of engineering properties and design parameters. The laboratory testing was primarily conducted in the Dames & Moore laboratory at Park Ridge, Illinois. Laboratory testing was also performed by Dr. T. C. Buschbach, Urbana, Illinois; Geo-Testing, Inc., San Rafael, California; Walter H. Flood & Co., Inc., Hillside, Illinois; Professor Kamran Majidzadeh, Columbus, Ohio; Richard C. Mielenz, P.E., Gates Mills, Ohio; Professor Marshall L. Silver, Chicago, Illinois; and the Dames & Moore laboratory at San Francisco, California.

During plant operations, testing will be performed to the latest revision of the applicable ASTM, provided this testing is not less conservative than the original testing, as reviewed and approved by Union Electric.

2.5.4.2.1.1 Static Strength Tests on Soil and Graydon Chert Conglomerate and Fill and Backfill Materials

2.5.4.2.1.1.1 Unconsolidated-Undrained Triaxial Compression Tests

Unconsolidated-undrained triaxial compression tests were performed on selected undisturbed samples under confining pressures representative of their in-situ condition in order to determine their undrained strength characteristics. A load-deflection curve was drawn for each test, and the strength of the soils was defined as either peak shear strength or shear strength at 10 percent strain, whichever occurred first. The tests were performed in accordance with ASTM Test Designation D 2850-70. The test results are presented on the plant site boring logs, Figures 2.5-129 through 2.5-293.

Consolidated-Undrained Triaxial Compression Tests

Consolidated-undrained triaxial compression tests were performed on selected undisturbed samples in order to determine their undrained strength characteristics. The samples were consolidated and tested under confining pressures approximating their in-situ conditions. The strength of the soil was defined as either peak shear strength or shear strength at 10 percent strain, whichever occurred first. The tests were performed in accordance with the procedures recommended in the U.S. Army Engineer Manual EM 1110-2-1906 (Department of the Army, 1970) and The Measurement of Soil Properties in the Triaxial Test (Bishop and Henkel, 1962). The test results are presented on the boring logs.

2.5.4.2.1.1.2 Consolidated-Undrained Triaxial Compression Tests with Pore Water Pressure Measurements

Consolidated-undrained triaxial compression tests with pore water pressure measurements were performed on selected undisturbed and compacted samples in order to determine their effective strength characteristics. The test procedures were similar to the consolidated-undrained triaxial compression tests except that pore water pressures were recorded to determine effective stress. The tests were performed in accordance with the recommended procedures given in Department of the Army (1970) and Bishop and Henkel (1962). The strength of the materials was defined as either peak shear strength or shear strength at 10 percent strain, whichever occurred first. The test results for the in-situ soils and Graydon chert conglomerate are presented in Table 2.5-19 and on the boring logs opposite the depths from which the samples were obtained.

Two samples of accretion-gley were consolidated before saturation. After consolidation at the field moisture content, the samples were saturated using very low backpressure increments and allowed to swell freely. This procedure was used to determine strength loss due to swelling. The results of these tests are presented in Table 2.5-20.

Consolidated-undrained triaxial compression tests with pore pressure measurements were also performed on remolded samples of modified loess and accretion-gley. Remolded samples of the modified loess were compacted at moisture contents close to optimum and to approximately 90 percent of the maximum dry density determined by the ASTM D 1557-70 method of compaction. The required density was obtained by compacting the soil into a 4-inch diameter compaction mold in three layers with 18 blows of a 5.5-pound hammer falling 12 inches per layer. After compaction, the soil was extruded intact from the mold and a 2-inch diameter test specimen was cored from the compacted soil. Remolded samples of the accretion-gley were compacted to two different specimen sizes. The samples consolidated at 2,400 and 3,500 pounds per square foot were compacted by kneading compaction in the Harvard miniature device to a specimen size 1.3 inches in diameter and 2.8 inches high. The sample consolidated at 1,500 pounds per square foot was compacted by static compaction to a specimen size 2.4 inches in diameter and 5.9 inches high. The samples were molded at moisture contents above optimum to densities ranging from 92 to 97 percent of the ASTM D

1557-70 maximum dry density. The results of the tests on remolded samples are presented in Table 2.5-21.

Consolidated-undrained triaxial compression tests with pore water pressure measurements were performed on compacted samples of limestone and dolomite during the detailed laboratory investigation for the crushed stone fill. The samples were compacted to selected densities using limestone and dolomite obtained from the proposed location of the on-site mine quarry. Samples were tested with three selected gradations. Tables 2.5-22 and 2.5-23 present summaries of the test results at the maximum effective stress ratio and maximum stress difference. Complete results of the tests are presented in the Structural Fill Report. Stress-strain curves are presented on Figures 4.1 through 4.12, and Mohr circles are presented on Figures 5.1 through 5.10 of that report.

2.5.4.2.1.1.3 Consolidated-Drained Triaxial Compression Tests

During preliminary investigations, consolidated-drained triaxial compression tests were performed on compacted samples of dredged sand and commercially obtained crushed limestone to determine their effective strength characteristics. The samples were prepared at predetermined moistures and dry densities. The tests were performed in accordance with the recommended procedures as given in the references cited for consolidated-undrained triaxial compression tests. The strength of the materials was taken at the peak shear strength. Results of the tests are given in Table 2.5-24.

2.5.4.2.1.2 Strength Tests on Rock

2.5.4.2.1.2.1 Unconfined Compression Tests

The compressive strength of representative rock core samples from the plant site borings was determined by unconfined compression tests. These tests were performed by Geo-Testing, Inc., San Rafael, California. Small surface irregularities on the cut ends were smoothed by casting a very thin plaster cap. The samples were subjected to vertical axial loads; both vertical and horizontal strain measurements were made with SR-4 strain gauges. Stress and Poisson's ratio versus strain diagrams were obtained along with the unit weight and moisture content of the test specimens. Modulus values were determined from the slope of the stress-strain curve. The unconfined strength results from the tests are presented in Table 2.5-25 along with the values of dry density, moisture content, modulus of elasticity and Poisson's ratio. The unconfined strengths are also presented on the logs for Borings P-1, P-2, P-16, P-18, and P-19.

The unconfined compressive strength and modulus of elasticity were determined for representative rock core samples obtained from the area selected for the on-site mine. The tests were performed by Walter H. Flood & Co., Inc., in accordance with recommended ASTM procedures. The results of the tests are presented in Table 2.5-26.

2.5.4.2.1.2.2 Modulus of Rupture Tests

Modulus of rupture was determined for representative rock core samples obtained from the area selected for the on-site mine. The tests were performed by Walter H. Flood & Co., Inc. The results of the tests are presented in Table 2.5-26.

2.5.4.2.1.3 Static Properties Tests

2.5.4.2.1.3.1 Compaction Tests

Representative bulk samples were used to determine the compaction characteristics of the modified loess and accretion-gley for possible use as fill materials. Compaction tests were performed in accordance with ASTM Designation D 1557-70. The test results are presented on Figures 2.5-394 through 2.5-398.

Compaction tests in accordance with ASTM Designation D 1557-70 were performed on samples of crushed limestone and dolomite during the comprehensive investigation for the granular structural fill. Results of the tests are presented on Figures 3.1 through 3.3 in the Structural Fill Report. Compaction tests were also performed using a 12-inch diameter mold and a compaction energy unit per unit volume equivalent to ASTM Designation D 1557-70. These tests were performed to include larger particle sizes than allowed in ASTM Designation D 15577-70, method D. The results of the tests are presented on Figure 3.4 in the Structural Fill Report. The results of all the compaction tests on the crushed stone are summarized in Table 2.5-27.

2.5.4.2.1.3.2 Relative Density Tests

Relative density tests were performed on three commercially obtained samples of crushed limestone during the preliminary studies for the granular structural fill. The tests were performed in accordance with ASTM Designation D 2049-69. The results of the tests are presented in Table 2.5-28. Relative density tests (ASTM D 2049-69) were also performed on graded samples of crushed limestone and dolomite from the on-site mine quarry location during the detailed laboratory investigation. The results of the tests are given in Table 2.5-27.

2.5.4.2.1.3.3 Consolidation Tests and One-Dimensional Compression Tests

Consolidation tests were performed on representative undisturbed samples to determine their compressibility characteristics. The tests were performed in accordance with ASTM Designation D 2435-70 except that each succeeding load was applied after time-settlement plots indicated that 90 percent of the primary settlement had occurred under a given load increments. Shelby tube samples and 4-inch diameter chert conglomerate samples were not trimmed to a smaller diameter for testing. Classification tests were performed for the majority of the samples tested. The results of the tests performed on undisturbed samples are presented on Figures 2.5-399 through 2.5-435.

Consolidation tests were also performed on one remolded sample each of modified loess and accretion-gley. The samples were compacted at moisture contents of 7 percent above optimum for modified loess and 9 percent above optimum for accretion-gley; both were compacted to approximately 87 percent of the maximum dry density determined by the ASTM D 1557-70 method of compaction. The samples tested were 2.4 inches in diameter and 1.0 inch in thickness and were trimmed from soil that had been compacted into a 4-inch diameter compaction mold. Test results are shown on Figures 2.5-436 and 2.5-437.

One-dimensional compression tests were performed on compacted samples of limestone and doloite during the detailed laboratory investigation for the granular structural fill to determine the compressibility characteristics of the materials. Samples were molded to selected densities from material of different trial gradations. The tests were performed in accordance with ASTM Designation D 2435-70 with the following variations. The specimens were 4 inches in diameter and 1.5 inches in thickness with 1/2 inch maximum stone size. Material greater than 1/2 inch in the trial gradations was replaced prior to compacting the test specimens to different densities, by an equal amount of material larger than the No. 4 sieve and less than or equal to 1/2 inch. The test results are summarized in Table 2.5-29. The test data are shown on Figures 6.1 through 6.9 in the Structural Fill Report.

2.5.4.2.1.3.4 Expansion (Swelling) Tests

Swelling tests were performed on selected samples of modified loess and accretion-gley in order to determine the potential expansive characteristics of the different strata upon saturation. Using the consolidometer apparatus, the specimens were laterally confined in a ring and consolidated under a wide range of pressures.

Each sample under a given consolidation pressure was then saturated and the vertical expansion measured. After swelling, the samples were unloaded in increments to a vertical pressure of 100 pounds per square foot. The volumetric expansion was calculated based on the volume after consolidation under the given consolidation pressure. Moisture content and dry density determinations were made on each sample before and after the test; values at intermediate points were calculated. The test results are presented in ; the results are also shown graphically for the accretion-gley on Figure 2.5-438.

2.5.4.2.1.3.5 Permeability Tests

Falling head permeability tests, performed in accordance with the recommended procedures given in Department of the Army Engineer Manual EM 1110-2-1906 (1970), were conducted on representative undisturbed samples of the soils and the Graydon chert conglomerate to evaluate their permeability characteristics. Remolded samples of modified loess and accretion-gley were also tested. The remolded samples were compacted both at optimum moisture content and at moisture contents above the optimum to between 86 and 91 percent of the maximum dry density determined by the

ASTM D 1557-70 method of compaction. The 2.4-inch diameter test samples were obtained from soil compacted into a 4-inch diameter compaction mold. Grain size and Atterberg limit tests were performed on many of the samples tested. The results of all tests performed on undisturbed samples are given in Table 2.5-31, and the results of tests performed on remolded samples are given in Table 2.5-32.

During the detailed laboratory testing of the structural fill, the permeability characteristics of a compacted sample of limestone and dolomite were investigated by means of a permeability test based on falling head permeability test principles. The test was performed in a triaxial compression test cell. The specimen was 6 inches in diameter by 13 inches in height and enclosed in a rubber membrane. After the specimen was saturated under backpressure, a hydraulic head differential was applied between the bottom and top of the specimen. The changes in head difference with time were recorded and the coefficient of permeability was calculated. For the sample with a gradation similar to that specified for Category I Granular Structural Fill, and compacted to 95 percent of the maximum dry density as determined by ASTM Test Designation D 1557-70, the coefficient of permeability was determined to be $7x10^{-4}$ centimeters per second.

2.5.4.2.1.4 Classification Tests

2.5.4.2.1.4.1 Grain-Size Analyses

Grain-size analyses were performed on selected samples from the borings and representative hand samples of Graydon chert conglomerate obtained in conjunction with large-scale plate load tests. The analyses of the gradation curves were primarily used for correlation purposes. These tests were performed according to ASTM Standard D 422-63. The results of the particle size analyses are presented on Figures 2.5-439 through 2.5-450.

Grain-size analyses were performed for correlation purposes on samples of granular fill material. The analyses performed on the three commercial samples of crushed limestone and one sample of dredged sand during preliminary studies for the granular structural fill were performed in accordance with ASTM Designation D 422-63 and are presented on Figure 2.5-440. Grain size determinations performed during the comprehensive field and laboratory investigations of the granular structural fill were performed in accordance with ASTM Designations C 117-69 and C 136-71. The results are presented on Figures 2.1 through 2.3 in the Structural Fill Report.

2.5.4.2.1.4.2 Atterberg Limit Tests

Atterberg limit tests were performed on the overburden soils in conjunction with the triaxial compression and consolidation tests. The liquid limit and plastic limit determinations were made in accordance with ASTM Standards D 423-66 and D 424-59. The results of the Atterberg limit determinations were used for classification and

correlation and are shown on the boring logs. Summaries of the results are presented in Table 2.5-15.

During the comprehensive laboratory investigation for the crushed stone structural fill, the fraction passing the No. 40 sieve (0.42 mm) of material with a gradation similar to Category I Granular Structural Fill was tested for liquid limit and plastic limit in accordance with ASTM Designations D 423-66 and D424-59 (1971), respectively. The material was found to be nonplastic.

2.5.4.2.1.5 Moisture and Density Determinations

2.5.4.2.1.5.1 Soil Deposits and Graydon Chert Conglomerate

Moisture content and density determinations were made on samples from the borings in accordance with ASTM Designation D 2216-71. The results are shown on the boring logs. Moisture content was also determined on hand samples of Graydon chert conglomerate in conjunction with large-scale plate load tests. These results are given with the plate load test results.

2.5.4.2.1.5.2 Rock Samples

Moisture and density determinations on rock core samples were performed by Geo-Testing, Inc., in conjunction with unconfined compression tests and resonant column tests and are listed with the results of these tests in Tables 2.5-25 and 2.5-33.

2.5.4.2.1.6 X-Ray Diffraction Analyses

X-ray diffraction analyses were performed on selected samples by Dr. T. C. Buschbach of the Illinois Geological Survey, Urbana, Illinois, in order to determine the clay mineralogy of the specimens. Each sample was analyzed three times using the following procedure:

a. A powder diffraction pattern of the whole sample was obtained; this pattern indicated the relative amount of clay minerals present, and also showed the major nonclay constituents present in the material;

b. A sedimented slide of the less than 2-micron particle size clay fraction was x-rayed to indicate the type and approximate quantity of those clay minerals comprising the clay fraction of the sample; and

c. The same sedimented slide was then reexamined after treatment with ethylene glycol. This permitted the swelling of any montmorillonitic clay minerals that were present. This swelling is indicated by shifts in the basal diffraction peaks on the x-ray pattern.

The results of the clay mineralogy studies are presented in Table 2.5-34.

2.5.4.2.1.7 Petrographic Analysis

Petrographic examination of selected rock core and hand samples taken from the Callaway Formation was performed by Richard C. Mielenz, P.E. The examination was performed in accordance with ASTM Designation C 295-65 on samples obtained from the area selected for the on-site mine. The results of the examination are summarized in Table 2.5-35 for the core samples and Table 2.5-36 for the hand samples.

2.5.4.2.1.8 Dynamic Tests

2.5.4.2.1.8.1 Resonant Column Tests

2.5.4.2.1.8.1.1 Soil Samples

Resonant column soil sample tests were performed to evaluate the dynamic modulus of rigidity and damping characteristics of selected undisturbed soil samples. The tests were conducted over a range of confining pressures at natural moisture content. The tests were performed in accordance with the recommended procedures given in "Suggested Method of Test for Shear Modulus and Damping for Soils by the Resonant Column" (Hardin) in ASTM STP-479. The test results are presented in Table 2.5-37.

2.5.4.2.1.8.1.2 Rock Samples

Resonant column tests were performed on rock core specimens in a manner similar to the tests performed on soil samples. The tests were conducted over a range of confining pressures. The test results are presented in Table 2.5-33.

2.5.4.2.1.8.2 Shockscope Tests

Compressional wave velocity (shockscope) tests were performed on representative rock samples. The velocity observed in the laboratory was used to compare with field velocity measurements obtained during the geophysical survey.

The samples were tested in accordance with ASTM Designation D 2845-69, with the variation that the samples were tested under various confining pressures. The test results are presented in Table 2.5-33.

2.5.4.2.1.8.3 Dynamic Triaxial Tests

2.5.4.2.1.8.3.1 Strain-Controlled Dynamic Triaxial Tests

The dynamic stress-strain properties of representative undisturbed soil and Graydon chert conglomerate samples were determined hy performing strain-controlled dynamic triaxial tests. The dynamic moduli and damping ratio were determined at the 10th cycle of each oscillating strain level. The tests were performed in a manner similar to that recommended in the April 1978 NRC Regulatory Guide 1.138. The test results are

presented in Table 2.5-38. Plots of single amplitude shear strain versus shear modulus for the soils and graydon chert conglomerate are shown on Figures 2.5-451 through 2.5-454; plots of single amplitude shear strain versus damping ratio are shown on Figures 2.5-455 through 2.5-458.

Strain-controlled dynamic triaxial tests were also performed to determine the dynamic stress-strain properties of the crushed stone fill. The tests were performed in the same manner as the tests on natural samples. During preliminary studies, compacted samples of crushed limestone from three commercial quarries were tested at varying relative densities. The results of the tests are presented in Table 2.5-39. During the detailed laboratory study, samples compacted to 90 and 95 percent of the maximum dry density determined by ASTM Designation D 1557-70 were tested. The results of the tests performed for the detailed investigation are presented in Table 2.5-40. The results are plotted in terms of single amplitude shear strain versus shear modulus and damping ratio on Figures 2.5-459 and 2.5-460, respectively.

2.5.4.2.1.8.3.2 Stress-Controlled Dynamic Triaxial Tests

Dynamic strength of a soil is usually expressed in terms of the number of cycles of a given stress required to produce a specified strain. This property for accretion-gley was evaluated by stress-controlled dynamic triaxial tests. the specimens were saturated and consolidated under isotropic conditions; then most samples were anisotropically consolidated under a specified principal stress ratio (K_c). The tests were performed in a manner similar to the currently recommended procedures given in the April 1978 NRC Regulatory Guide 1.138. The test results are shown in Table 2.5-41. The results for K_c = 1.5 are shown on Figure 2.5-461.

Stress-controlled dynamic triaxial tests were performed on compacted samples of crushed limestone and dolomite during the detailed laboratory investigation for the granular structural fill to determine the number of cycles of a given stress required to produce a specified strain. The tests were performed in the same manner as the tests on natural samples. All samples were isotropically consolidated (K_c = 1.0). The results of the tests are given in Table 2.5-42 and are shown on Figure 2.5-462.

2.5.4.2.2 Field Tests

2.5.4.2.2.1 Plate Load Tests

A total of 18 plate load tests were conducted on-site between September 1973 and September 1976:

a. Four tests on the Graydon chert conglomerate during September 1973;

b. Seven large-scale tests on the Graydon chert conglomerate: five in the Unit 1 power block excavation during April and May 1976 (Tests I through V)

and two in the Unit 2 power block excavation during September 1976 (Tests VI and VII); and

c. Seven tests on the surface of the granular structural fill test pad during the spring and summer of 1975.

The procedures and results of these tests are discussed in the following sections.

2.5.4.2.2.1.1 Plate Load Tests on Graydon Chert Conglomerate

2.5.4.2.2.1.1.1 Small-Scale Tests

During September 1973, Dames & Moore performed four plate load tests on the Graydon chert conglomerate in test pits to determine the stress-strain relationship of the material. At each test pit location (Figure 2.5-104), a trench was dug to the appropriate depth, and the bottom was hand cleaned and leveled. A 1-inch thick plate, 18 inches in diameter, was placed over approximately 1 inch of Ottawa sand and leveled.

Two 10-foot reference beams were placed parallel across the plate, and three dial gauges, reading in increments of 0.001 inch, were used to measure the settlement of the plate. A 75-ton hydraulic jack acting against a 14.8-ton Allis Chalmers dozer, Model HD-11, was used to apply the load to the plate. Three of the tests were performed for two cycles of incremental loading and unloading to zero. The fourth test consisted of one cycle of loading only. The deflection of the plate was measured for each increment of load. The test results are shown on Figure 2.5-463 as plots of load versus deflection. In-situ determinations of wet density and moisture content were obtained adjacent to each plate load test. The density and moisture content, subgrade modulus and modulus of elasticity are shown on the figure.

2.5.4.2.2.1.1.2 Large-Scale Tests

Five large-scale plate load tests were performed on the exposed Graydon chert conglomerate in the Unit 1 power block excavation during April and May 1976 (Tests I through V), and two large-scale tests were performed in the Unit 2 power block excavation during September 1976 (Tests VI and VII). The tests in the Unit 1 power block area were performed prior to any construction activities in the area other than excavation to design grades. The locations of the seven tests are shown on Figure 2.5-105.

Five of the plate load tests (I, II, III, VI, and VII) were performed with a 24-inch diameter plate and two tests (IV and V) were performed with a 30-inch diameter plate. To minimize bending of the plate, a stack of plates was used with each succeeding plate 6 inches smaller in diameter than the plate below, to a top plate 12 inches in diameter. A ball and socket was used above the jack to reduce any effects of eccentricity. Bedding of the load plates was accomplished with thin layers of plaster of paris and/or silica sand. The load was applied to the 24-inch diameter plate with a 50-ton capacity hydraulic jack reacting against a specially reinforced flat-bed semi-trailer bearing 50 tons of weights. The load

was applied to the 30-inch plate with a 100-ton capacity hydraulic jack reacting against the trailer bearing 80 tons of weights. Load was measured by calibrated pressure gauges attached to the jacks.

Three independent methods were used to measure the deflection of the plate during the tests. The primary method used three dial gauges reading in increments of 0.001 inch spaced at 120-degree intervals around the test plate. These were attached to two 20-foot long reference beams independently supported at distances of at least 8 feet from the edges of the test plate and oriented perpendicular to the axis of the reaction trailer. The second method used a scale reading to 1/64 inch which was mounted with a mirror on the loading jack. The scale was read by aligning a wire stretched across the reference beams with the image of the wire in the mirror. This measured the deflection of the jack and should approximate the deflection of the plate. The third method used a scale reading to 1/64 inch attached to the jack and read by a survey level.

The survey level was also used to read scales mounted on the reference beam supports to determine whether any movement occurred during the tests. No movement of the supports was measured in any of the tests.

Tests I, II, III, VI, and VII were performed after an initial seating load of 0.5 ton per square foot (TSF) was applied and released. No seating loads were applied for Tests IV and V since the smallest readable increment on the loading gauge of the 100-ton capacity jack was equivalent to about 2 TSF. The basic loading sequence was 1, 2, 4, 8, 12, and 15 TSF for all tests except when failure of the Graydon chert conglomerate occurred before reaching the last load increment. Loading and unloading cycles were also performed on some of the tests. Each pressure increment or decrement was maintained until the rate of deflection or rebound of the plate was less than 0.001 inch per minute for three consecutive minutes.

Observations of the Graydon chert conglomerate during testing indicated that approximately 80 percent of the unit consisted of chert-clay conglomerate. Approximately 10 percent of the Graydon consisted of random pockets of hard silty clay containing no chert, and the remainder consisted of random pockets of claystone containing no chert. Each of the materials was tested.

The results of the large-scale plate load tests are shown on Figures 2.5-464 through 2.5-470 and are summarized in Table 2.5-43. The moisture content of the Graydon below each test location was determined and is also presented in the table. Laboratory grain-size determinations were performed on hand samples of the Graydon from below several test locations, and the grain-size distributions are shown on Figures 2.5-449 and 2.5-450.

More detailed descriptions of the large-scale plate load tests and analyses of the results are given in the two Dames & Moore reports listed below:

a. "Report, Results of Plate Load Tests on Graydon Chert Conglomerate, Unit 1 Power Block Excavation, for Union Electric Company," dated June 24, 1976.

b. "Report, Results of Plate Load Tests on Graydon Chert Conglomerate, Unit 2 Power Block Excavation, for Union Electric Company," dated October 27, 1976.

2.5.4.2.2.1.2 Plate Load Test on Granular Structural Fill

In the spring and summer of 1975, a granular structural fill test pad was constructed using crushed Callaway Formation limestone and dolomite obtained from the location selected for the on-site mine quarry. The crushed stone was produced to a gradation very similar to that specified for Category I Granular Structural Fill. The granular fill in the test pad was compacted to from 95 to 100 percent of the maximum density determined by ASTM Designation D 1557-70 for the material. Details of test pad construction are presented in the Structural Fill Report. The location of the test pad is shown on Figure 2.5-104.

Seven plate load tests were performed on the surface of the completed crushed stone test pad to evaluate the in-situ properties of the granular structural fill. Four tests were performed with an 18-inch diameter plate, two tests with a 12-inch diameter plate and one test with a 24-inch diameter plate. To minimize bending, a stack of plates with diameters decreasing in 6-inch increments was used; no plate would thus be more than 6 inches larger in diameter than the plate above it. A 50-ton capacity hydraulic jack was used with the 18 and 24-inch plates, while a 30-ton hydraulic jack was used with the 12-inch plate. Reaction load was supplied by a specially reinforced flat-bed semi-trailer loaded with approximately 50 tons of lead ingots.

Settlement of the plates was measured by three dial gauges reading in increments of 0.001 inch and by a wire-scale-mirror system. The dial gauges and wire were attached to two 20-foot reference I-beams placed perpendicular to the axis of the trailer. The supports for the reference beams were at least 8 feet away from the edge of the plate. A surveyor's level was also used to monitor settlement of the plates and any possible movement of the reference beam supports.

The maximum pressure applied during the tests was 38 tons per square foot using the 12-inch diameter plate. Three tests were given two or more cycles of loading at partial or full load. Each pressure increment was maintained for a fixed interval of 10 minutes and, in all instances, the rate of deflection was less than 0.001 inch per minute for 3 minutes consecutively before the next increment of pressure was applied. No failure was reached in any of the tests; the maximum deflection observed was about 0.3 inch. The results of the tests shown as load deflection curves are presented on Figures 2.5-471 through 2.5-477.

2.5.4.2.2.2 Menard Pressuremeter Tests

A total of 32 Menard pressuremeter tests was performed in Borings P-1, P-6, P-76 and P-104 and in boreholes near Borings P-31 and P-48, by Soil Exploration Company, St. Paul, Minnesota, at depths selected by Dames & Moore in order to determine the in-situ modulus of elasticity and undrained shear strength of the Graydon chert conglomerate and overburden soils. Table 2.5-44 presents the results of the tests and the location and depth of each test.

2.5.4.2.3 Summary and Discussion of Properties of Subsurface Materials

2.5.4.2.3.1 Physical and Index Properties

A summary of the unit weights and Poisson's ratios of the granular structural fill, the soil units, the Graydon chert conglomerate, and the Burlington Limestone are given in Table 2.5-14. The unit weights for the soil units and Graydon along with the average moisture ocntents are also given in Table 2.5-15. The Atterberg limit data for the soils and Graydon are summarized in Table 2.5-15. Average coefficients of permeability for the in-situ soils and Graydon are given in Table 2.5-15. The laboratory permeabilities can be considered to represent the vertical permeability of the materials while the field permeabilities represent the horizontal permeabilities (see Section 2.5.4.3.3.2 for a description of the field permeability testing). Coefficients of permeability determined by laboratory tests for remolded modified loess and accretion-gley are given in Table 2.5-17. The permeabilities for granular fill and backfill materials are presented in Table 2.5-18. The permeabilities given for granular fill and backfill probably represent the upper-bound values for those materials.

2.5.4.2.3.2 Static Properties

2.5.4.2.3.2.1 <u>Drained and Undrained Strength Parameters</u>

A summary of the static undrained shear strengths of the soil units and Graydon chert conglomerate is given in Table 2.5-15. The recommended values for the soil units were based on laboratory tests while the value for the graydon was based on the large-scale plate load tests. The strength of the graydon was back-calculated from the tests where failure was reached by using Terzaghi's bearing capacity theory. The laboratory tests significantly underestimated the strength of the Graydon due mainly to sample disturbance. Also, the laboratory tests were performed only on the clay matrix portion of the clay-chert conglomerate rather than the composite, undisturbed material. Menard pressuremeter test results substantiate that the undrained shear strengths presented for the soils and Graydon are conservative.

A summary of the drained shear strength parameters (effective stress parameters) for the soils and Graydon chert conglomerate is given in Table 2.5-15. The results were obtained from laboratory, consolidated-undrained triaxial compression tests with pore

pressure measurements. The parameters for the Graydon are believed to underestimate the in-situ strength of the material due mainly to the effects of sample disturbance.

The drained shear strength parameters for accretion-gley that had been allowed to swell are presented in Table 2.5-15. The values were determined by consolidated-undrained triaxial tests with pore pressure measurements.

The drained shear strength parameters determined for remolded modified loess and accretion-gley are presented in Table 2.5-17. The values were determined by laboratory consolidated-undrained triaxial compression tests with pore pressure measurements.

The recommended effective strength parameters for the compacted granular fill and backfill materials are presented in Table 2.5-18. The values were determined by laboratory consolidated-undrained triaxial compression tests with pore water pressure measurements. The angle of internal friction for the granular structural fill was checked by values backcalculated from the results of the plate load tests on the test pad using Terzaghi's bearing capacity theory and assuming incipient failure at the highest loads achieved. The plate load tests indicate that the values given in Table 2.5-18 are conservative.

2.5.4.2.3.2.2 Compressibility, Stress-Strain, and Swelling Characteristics

Table 2.5-16 presents the compressibility parameters determined for the soil units based on the laboratory consolidation tests. No Category I structures are founded on the soils other than the ESWS pipelines.

The compressibility parameter determined for the Graydon chert conglomerate and utilized by Dames & Moore to calculate settlements of the power block structures, UHS cooling towers, and ESWS pumphouse is given in Table 2.5-16. The value presented is the constrained modulus based on the tangent modulus concept (Janbu, 1967). This parameter and method of analysis were chosen to best represent the behavior of the material. A constant constrained modulus was determined for the overconsolidated chert conglomerate up to the maximum preconsolidation pressure. Foundation loadings at the plant site do not load the Graydon to or beyond the preconsolidation pressure. The constrained modulus presented was determined from the large-scale plate load tests on the Graydon. Load deflection data were converted to modulus of elasticity and constrained modulus using elastic theory (Timoshenko and Goodier, 1951; Lamb and Whitman, 1969). The plate load test data were utilized because it was felt that the consolidation tests overestimated the compressibility of the material due to sample disturbance. The shape of the consolidation curves indicate sample disturbance.

The maximum preconsolidation pressures and overconsolidation ratios for the soils and Graydon chert conglomerate are presented in Table 2.5-16. The preconsolidation pressures were evaluated by both Casagrande's (1936) and Janbu's (1967) procedures and were checked by utilizing liquidity index (Naval Facilities Engineering Command, 1971) and c/p ratio (Peck, 1974). Determination of the preconsolidation pressure for the

Graydon was difficult due to sample distrubance and more reliance was placed on the values determined using liquidity index and c/p ratio.

In calculating the overconsolidation ratios, the lower values of preconsolidation pressures were generally used.

Although the modified loess shows some effects of overconsolidation, this is limited to samples taken from shallow depths. The material is predominantly normally consolidated.

The compressibility parameters determined from consolidation tests for remolded modified loess and accretion-gley are presented in Table 2.5-17. The remolded materials behave as normally consolidated.

The recommended compressibility parameter for the granular structural fill in terms of constrained modulus is presented in Table 2.5-18. The value was calculated from the results of the plate load tests on the test pad using elastic theory as described for the Graydon chert conglomerate. The plate load test results indicate that the consolidation tests overestimate the compressibility of the granular structural fill. The constrained modulus presented was found to be conservative when compared to constrained moduli calculated from geophysical results and strain-controlled dynamic triaxial compression tests with corrections for strain level.

Summaries of static modulus of elasticity and static modulus of rigidity for the granular structural fill, the in-situ soils, the Graydon chert conglomerate, and the Burlington Limeston are given in Table 2.5-14. The static modulus of elasticity values for the modified loess, accretion-gley, and till were calculated based on the Menard pressuremeter tests and laboratory consolidated-undrained triaxial tests at 0.5 percent vertical strain. The static modulus of elasticity values for the Graydon chert conglomerate was calculated from plate load tests, Menard pressuremeter tests, and laboratory triaxial compression tests. The static modulus of elasticity for the Burlington Limestone was determined from unconfined compression tests. The static modulus of elasticity for the granular structural fill was determined based on the results of the plate load tests and laboratory triaxial compression tests. Static moduli of rigidity were calculated from the static moduli of elasticity and Poisson's ratio.

Static moduli of elasticity for remolded modified loess and accretion-gley are given in Table 2.5-17. These were determined from laboratory consolidated-undrained triaxial compression tests using the 0.5 percent strain secant modulus. The percent compaction for which the values were determined are given in the table.

The swelling potential of the accretion-gley is shown on Figure 2.5-438 and is considered to be moderate. The modified loess has a low swelling potential. The glacial till was not tested for swelling potential. It is expected to have a moderate swelling potential although lower than the accretion-gley because the till has a slightly lower percentage of clay-size particles and has a lower liquid limit and plasticity index than the accretion-gley.

2.5.4.2.3.3 Dynamic Properties

2.5.4.2.3.3.1 Dynamic Stress-Strain Properties

Recommended dynamic modulus of elasticity, dynamic modulus of rigidity, and damping values for the granular structural fill, the in-situ soils, the Graydon chert conglomerate, and the Burlington Limestone are given in Table 2.5-14. Recommended design curves of dynamic modulus of rigidity and damping ratio versus single amplitude shear straiin are presented on Figures 2.5-459 and 2.5-460 for the granular structural fill and backfill. The modulus of rigidity was normalized in terms of confining pressure. The recommended curve for the structural fill is based primarily on the average results of the laboratory dynamic triaxial compression tests.

Recommended design curves of dynamic shear modulus and damping ratio versus single amplitude shear strain are presented on Figures 2.5-451 through 2.5-454 and 2.5-455 through 2.5-458, respectively, for the soils and Graydon chert conglomerate.

The measured dynamic moduli and damping values for the overburden soils were compared with the results of geophysical measurements and published data on similar soils and are believed to be representative of dynamic properties of the in-situ soil properties.

The dynamic stress-strain properties for the Graydon chert conglomerate were determined entirely on the clayey portion of the chert-clay matrix. Because of the highly heterogeneous and overly consolidated nature of the in-situ material, there was a high degree of distrubance involved in sampling and testing of the chert conglomerate, as indicated in Table 2.5-15, which presents static strength results. Therefore, the laboratory dynamic test results are considered low and not representative of the in-situ dynamic stress-strain behavior of the chert conglomerate. Based on a disturbance factor of 3 to 5 for the Graydon chert conglomerate (determined from static triaxial compression tests and Menard pressuremeter tests, Table 2.5-15), the upper-bound and lower-bound dynamic test results by the range of disturbance factor. At a shear strain of 10^{-4} percent, the recommended curves fit very naturally with the upper-bound and lower-bound modulus values obtained from data of the field geophysical surveys performed at the plant site. At the high shear strain level of approximately 1 percent, the recommended curves substantiate the values obtained from the results of the field Menard pressuremeter tests.

The recommended upper-bound and lower-bound curves as shown on Figure 2.5-454 are believed to be representative of the in-situ dynamic stress-strain behavior of the Graydon chert conglomerate at the plant site, where a thick soil overburden cover of over 30 feet is generally available. In other areas, such as around Borings R-1 and R-2, where the overburden soils are only about 10 feet in thickness, the Graydon chert conglomerate has been more severely weathered and geophysical data indicate a shear wave velocity of 1,200 feet per second, in contrast to the values of 1,700 to 2,500 feet per second at the plant site. At such locations the design curve for the dynamic properties of the chert

conglomerate should be lowered to correspond to the shear wave velocity of 1,200 feet per second; the resulting curve would be essentially the median of the laboratory dynamic test results.

2.5.4.2.3.3.2 Dynamic Strength Properties

Table 2.5-41 presents the results of stress-controlled dynamic triaxial tests for the accretion-gley. Recommended design curves of cyclic shear stress versus the number of cycles to attain indicated total mean axial strains are shown on Figure 2.5-461. The principal consolidation stress ratio (K_c) for the design curves are 1.5 and the shear stress values are the cumulative average cyclic shear stress measured over the indicated number of loading cycles. Limited tests performed with K_c = 1.0 and K_c = 2.0 conditions are shown in Table 2.5-41.

Table 2.5-42 presents the results of the stress-controlled dynamic triaxial tests performed on the granular structural fill and backfill materials. The recommended design curves of cyclic stress ratio versus the number of cycles to develop 5 percent double amplitude shear strain are presented on Figure 2.5-462. The test results for samples compacted to approximately 95 percent of the maximum density determined by ASTM Designation D 1557-70 show considerable dispersion. The major reason for the dispersion of the data is believed to be the use of different specimen sizes and the inclusion of varied maximum particle sizes in the specimens. Despite these variables in the laboratory testing, the crushed stone structural fill nevertheless demonstrates high resistance to liquefaction under cyclic loading conditions. The recommended design curve is based on the most conservative results obtained from the test specimen, which contained 3/4 inch maximum particle size.

2.5.4.3 Exploration

2.5.4.3.1 Borings and Test Pits

The purpose of the borings and test pits was to determine the details of lithology, stratigraphy, structure, physical properties and ground-water characteristics of the subsurface strata. All borings were drilled using truck-mounted drilling equipment; both flight auger and rotary wash techniques were used. The soils and older sediments encountered during the drilling operations were described on the boring logs by field engineers who constantly supervised all drilling operations.

2.5.4.3.1.1 Borings in the Plant Vicinity

Figures 2.5-104 and 2.5-105 show the locations of the borings in the plant vicinity. Nine widely spaced geologic borings (C5 Series) were drilled in the site area during March 1972 by Test Drilling Services, Inc., under the technical direction of Dames & Moore. The borings ranged in depth from 18 to 209 feet below the ground surface. The boring logs are shown on Figures 2.5-129 through 2.5-137. Keys to the symbols and descriptions used on the boring logs are given on Figures 2.5-126 and 2.5-127.

Eight additional borings (R Series) were drilled by Raymond International, Inc., under the technical direction of Dames & Moore, in the area of a proposed reservoir that was later deleted. These borings were drilled during July and August 1973 and ranged in depth from 95 to 208 feet below the ground surface. Logs of the R borings are shown on Figures 2.5-138 through 2.5-145.

One hundred forty-eight borings (P Series), ranging in depth from 28 to 402 feet below the ground surface, were drilled in the general area of the plant site and UHS. These borings were drilled during the period from November 1972 to February 1975 by Raymond International, Inc., under the technical direction of Dames & Moore. The boring logs are shown on Figures 2.5-146 through 2.5-293. The data for the C5-, R-, and P-Series borings are presented in Table 2.5-45.

During the drilling of the C5-, R-, and P-Series borings, particular attention was paid to recording losses of drilling fluids. Also, any sudden drops of the drill rods or sudden changes in bit penetration rates during drilling would be immediately detected and recorded.

Each completed C5-, R-, and P-Series boring not programmed for piezometer installation was grouted within 3 feet of the surface upon completion. The grout, which consisted of a slurry of portland cement, bentonite, and clean water, was pumped into the boring from the bottom upward using the drill rods or plastic pipe. Borings with piezometers were grouted from the upper piezometer seal to the surface.

2.5.4.3.1.1.1 Soil Sampling

Soil samples of the glacial and postglacial materials were obtained using the Dames & Moore Type U Sampler, the standard split-spoon sampler, the Pitcher rotary sampler, and the Shelby tube sampler. The location of each sample and the sampler type is noted at the appropriate depth on each boring log. Soil samples were obtained at a variety of sampling intervals with a maximum of approximately 5 feet between sampling attempts.

The Dames & Moore Type U Sampler (Figure 2.5-128) 3-1/4 inches in outside diameter and approximately 2-1/2 inches in inside diameter. The sampler was advanced by driving with a drop hammer using the weight and height of fall as noted on the boring logs. Some samples were aso obtained by driving the Dames & Moore Sampler fitted with a thinwall extension on the end of the bit.

Samples from the Dames & Moore Type U Sampler were placed in plastic bags inside rigid containers, stored upright in the same vertical position as withdrawn form the ground, and were protected from freezing.

The Pitcher sampler consists of a stationary thin inner barrel and a rotating outer barrel with a cutting bit, which is drilled into the soil. The stationary inner barrel has an outside diameter of 3.0 inches and an inside diameter of approximately 2.9 inches. When the sampler was withdrawn from the borehole, the inner barrel was removed from the

sampler and both ends of the tube were sealed with paraffin to preserve the natural moisture content. The samples remained sealed until laboratory testing was initiated.

Soil samples were also obtained using the 3.0-inch outside diameter and 2.9-inch inside diameter Shelby tubes that were hydraulically pushed into the soil. The ends of the tubes were sealed with paraffin until laboratory testing was initiated.

Disturbed soil samples were obtained with the standard split-spoon sampler (2.00-inch O.D., 1.38-inch I.D.) in accordance with ASTM Designation D 1586-67. The sampler was driven with a weight of approximately 140 pounds falling 30 inches. The exact weight of the hammer is noted on the boring logs. Standard split-spoon samples were taken for identification purposes and to compare blow counts with those obtained with the Dames & Moore Type U Sampler.

Soil samples extracted from the borings were examined and classified in the field in accordance with the Unified Soil Classification System as described on Figure 2.5-126. Field classifications were checked during further inspection in the laboratory, and the results of laboratory tests were used to confirm these classifications.

2.5.4.3.1.1.2 Graydon Chert Conglomerate Sampling

The Graydon chert conglomerate was continuously cored in most of the borings using NX wireline core barrels or NX double tube core barrels, both with split inner barrels, to visually classify and examine the material. The core runs and percent recovery are shown on the boring logs. NX core samples of the Graydon chert conglomerate were placed in core boxes and stored at the site.

The Graydon unit consists of a hard clay matrix with generally 5 to 90 percent by volume of chert fragments up to 2 feet in diameter. Sampling the Graydon chert conglomerate for laboratory testing was difficult, and several different types of samplers were used to obtain representative, relatively undisturbed samples.

Sampling attempts in the Graydon chert unit using the driven Dames & Moore and the rotary Pitcher samplers were not usually successful because of the interference caused by chert fragments jamming the bit or obstructing the sampler. In the fall of 1973, a 4-inch inside diameter, diamond bit core barrel was used to sample continuously in the Graydon chert conglomerate in Borings P-27, P-58 and P-63 in an attempt to get large-diameter, relatively undisturbed samples for laboratory testing. This method of sampling was somewhat more successful, and about 5 samples of 6 inches or more in length were retrieved from the boreholes and used for the dynamic and static laboratory testing. The samples were placed in plastic bags inside rigid containers, stored upright in the vertical position as withdrawn from the ground, and protected from freezing.

In the fall of 1974, the 4-inch diameter, diamond bit core barrel was again used to sample the Graydon chert conglomerate in Borings P-78, P-79, P-81, P-82, P-84, P-86, P-89 to P-91, P-93 to P-99, P101 to P-103, P-105 and P-106. A removable thin metal liner was

placed inside the inner core barrel during drilling. The metal liner then became the sample container during shipping and storage. The sample remained sealed within the liner until examined for laboratory testing. Several relatively good quality core samples of the clayey material in the conglomerate were obtained for static and dynamic laboratory testing.

2.5.4.3.1.1.3 Rock Sampling

The lithified formations were continuously cored with NX wireline core barrels and NX double tube core barrels 5 to 10 feet in length, with either split inner barrels or onepiece innner barrels. Rock cores were approximately 2-1/8 inches in diameter. The core run, percent recovery, and Rock Quality Designation (RQD) are shown on the boring logs. The lithology and physical characteristics of the core were logged in the field; stratigraphic correlation of rock units was completed in the field office. Rock core samples were placed in core boxes and stored at the site.

2.5.4.3.1.2 Quarry Borings

In addition to the borings drilled within and surrounding the plant site for geologic and engineering investigations, additional borings were drilled during investigations of existing and potential quarry sites for sources of coarse aggregate. These borings were drilled to determine the stratigraphy, structure, physical properties, and ground-water characteristics of the bedrock strata in the existing or proposed quarry or mine site areas. The overburden soils were not investigated during the aggregate source studies. Sixty-six borings (Q Series) were drilled within the plant site area, but away from the power block and UHS areas, for an on-site mine quarry source of limestone coarse aggregate. The locations of the borings are shown on Figure 2.5-107 and 2.5-108, and the boring logs are shown on Figures 2.5-294 through 2.5-359. Borings Q-1 through Q-26 were drilled during October through December, 1974 for the on-site mine quarry site selection study. Borings Q-27 through Q-48 were drilled during the period January through March, 1975, to provide recommentations for development of the on-site mine quarry. Borings Q-49 through Q-66 were drilled during March 1977 to further investigate the mine quarry area after roof stability problems developed in the production limestone mine. Table 2.5-46 presents a tabulation of the on-site quarry boring data.

Six borings (A Series) were drilled at the Auxvasse Quarry located approximately 17 miles north-northeast of the site near the town of Auxvasse. The location of the quarry with respect to the plant site is shown on Figure 2.5-109, the locations of the borings within the quarry are shown on Figure 2.5-110, and the boring logs are presented on Figures 2.5-360 through 2.5-365. The borings were drilled during April 1976 to investigate the quarry as a source of concrete aggregate.

Twenty-seven borings (H Series) were drilled at a limestone quarry site (Mertens Quarry, formerly known as MoCon of Fulton, Inc., Quarry) approximately 4.5 miles north of th plant site. The location of the quarry with respect to the plant site is shown on Figure 2.5-109. The locations of the borings are shown on Figure 2.5-111, and the boring logs

are shown on Figures 2.5-366 through 2.5-392. Borings H-1 through H-16 were drilled during April and May 1977 to investigate the area as a source of granular fill material. Borings H-17 through H-27 were drilled during May and June 1979 to investigate another part of the quarry area as a source of granular fill material and concrete aggregate.

All quarry investigation borings (G, H, and A Series) were performed by Wabash Drilling Company under the direction of Dames & Moore. The bedrock was cored with NX wireline core barrels and NX double tube core barrels. Dames & Moore engineers or geologists continuously monitored the drilling activities. Rock core samples were placed in core boxes and stored at the site.

2.5.4.3.1.3 Test Pits

During July and August 1973, concurrent with the R Borings, four test pits were dug in the area of a proposed reservoir (later deleted) to obtain bulk samples of the various soils and to perform plate load tests on the Graydon chert conglomerate. The logs of test pits are shown on Figure 2.5-393.

2.5.4.3.2 Geologic Mapping

Geologic mapping was performed in the power block excavations, ESWS pipeline trenches, and UHS area excavations. The Unit 1 power block, ESWS pumphouse and UHS cooling tower excavations have been completed. The UHS retention pond is partially completed. Minor portions of the ESWS pipe trenches have yet to be completed. Category I excavations completed to date have been mapped. The mapping data for the Unit 1 Power Block excavation, ESWS trenches, and UHS area excavations will be combined and presented when all work in these areas has been completed. Two interim mapping reports have been prepared by Dames & Moore and submitted to the NRC covering the Units 1 and 2 power block excavations, UHS cooling towers 1 and 2 excavations, ESWS pumphouse excavation, and a portion of the UHS retention pond excavation. The two Dames & Moore reports are:

a. "Report, Results of Detailed Excavation Mapping, Callaway Plant, Units 1 and 2, for Union Electric Company," dated August 24, 1976; and

b. "Interim Report, Results of Detailed Excavation Mapping, Ultimate Heat Sink Excavations, Callaway Plant, Units 1 and 2, for Union Electric Company," dated April 25, 1979.

The geologic mapping of the Category I excavations has not revealed either any unexpected feature or features that would adversely affect the safety of the plant. While sandy or silty lenses have been encountered in the power block excavations, ESWS trenches, UHS cooling tower excavations, and ESWS pumphouse excavation, they have not hindered construction and will not affect plant safety. Mapping of the UHS retention pond slopes completed to date revealed no zones that posed a seepage threat. Photographs of the Unit 1 power block excavation are presented on Figure 2.5-125. A

photograph of a partially completed slope in the UHS retention pond is presented on Figure 2.5-125.

2.5.4.3.3 Ground-Water Explorations

2.5.4.3.3.1 Piezometers

To determine the variations in ground-water levels between separate water-bearing formations, 49 piezometers were installed in selected boreholes between July and December 1974 under the supervision of Dames & Moore. The piezometers consisted of 0.75-inch and 2.0-inch I.D. polyvinyl chloride (PVC) pipe perforated throughout the length of the zone being monitored. The monitored zones were gravel-packed. The remainder of the borehole was sealed with bentonite pellets or cement grout to prevent leakage of water from another saturated zone. This procedure was repeated for each piezometer where more than one piezometer was installed in a boring. A summary of the depths at which piezometers were installed, the zones monitored and the water levels recorded are presented in Table 2.4-19. The location of the piezometers is show on Figures 2.4-26, 2.5-104, and 2.5-105. Monitoring of the 49 piezometers was discontinued prior to the start of construction at the plant site, and the piezometers were pressure grouted to the surface.

Eleven permanent piezometers were installed during May through July 1979 to monitor the level and quality of water in the various strata from the Graydon chert conglomerate to the middle Cotter-Jefferson City Formation. The piezometers consisted of 2-inch PVC pipe and PVC screens. Details of the piezometer installations are given in Section 2.4.13.2.3.2.2. The piezometer locations are given on Figure 2.4-27.

2.5.4.3.3.2 Falling Head Permeameter Tests

Falling head permeameter tests were conducted by Dames & Moore personnel in selected piezometers during investigations for the FSAR. The method of testing was as follows:

a. Initial static water levels of all piezometers within the same borehole were recorded before testing;

b. The piezometer to be tested was rapidly filled to the top with water; the volume of water and the time required were recorded;

c. The rate of fall of the water level in the piezometer was monitored for a period of 30 minutes to an hour by recording both the water level and the time (at intervals of about a minute);

d. Water levels in other piezometers within the same borehole were rechecked to determine if the piezometer tested was effectively revealed; and

e. The field data permitted calculation of the transmissivity of the zones monitored by each piezometer; the permeability in gallons per day per square foot of the zone is equal to the transmissivity divided by the thickness in feet of the slotted interval. The results of the permeameter tests are shown in Table 2.4-18.

2.5.4.3.3.3 Pumping Test

A pumping test was conducted in a well 400 feet deep located half the distance between piezometers P-1 and P-2. The results of the tests showed:

a. That there is poor hydraulic connection from the Graydon chert conglomerate to the Cotter-Jefferson City Formation;

b. That the yield in the 6-inch well from 149 to 400 feet was about 8 gallons per minute; and

c. That the upper Cotter-Jefferson City serves as a confining zone above the more permeable lower Cotter-Jefferson City, where ground water is under artesian pressure with about 65 feet of hydrostatic head.

A more detailed discussion of the pumping test is presented in Section 2.4.13.2.3.2.4.

2.5.4.3.3.4 Borehole Pressure Testing

Double-packer pressure tests were conducted to assess the permeability of the bedrock formations in the vicinity of paleokarst features encountered at the site.

Double-packer pressure testing was conducted in the following manner:

a. After completion of the hole, pressure testing equipment was lowered into the hole and 20-foot increments of hole were isolated by means of inflatable rubber packers;

b. Water was injected into the section of borehole between the packer seals; and

c. The injection pressure and flow rate were recorded in the field during testing.

After completion of the testing, the results were reduced, analyzed and permeability values were calculated based on the equation (U.S. Bureau of Reclamation, 1973):

$$K = \frac{Q}{2\pi LH} \log_e \frac{L}{r} \text{ for } L \geq 10r \qquad (2.5\text{-}6)$$

where:

K	=	Permeability;
Q	=	Constant rate of flow into the isolated interval;
L	=	Length of borehole between packers;
H	=	Differential head of water;
r	=	Radius of hole tested; and
$\log_e$	=	Natural logarithm

The permeability determined from pressure testing represents values for the intervals tested. The permeability results from fractures and joints in addition to the porosity of the rock.

All equipment was calibrated both before and after the pressure testing. During testing, it was determined that the barrel flow meter being used was not accurately recording the very low flows. The use of the meter system was discontinued at that point and testing resumed using a calibrated bottle system.

Results of the pressure testing are presented in Table 2.4-17. Discussion of the results is presented in Section 2.4.13.2.3.2.1 in conjunction with results from other groundwater investigations.

2.5.4.3.4 Geophysical Surveys

The following geophysical surveys were conducted at the site:

a. A seismic refraction survey to establish the compressional wave velocities of bedrock and the materials overlying bedrock. The results of this survey were used to determine the depths to the various velocity units under the site;

b. A surface wave survey to determine surface wave types, characteristics, and velocity;

c. Uphole and surface velocity surveys to further establish compressional wave velocities;

d. Uphole and surface shear wave surveys to establish shear wave velocities in the near-surface materials and in the underlying bedrock;

e. A crosshole shear wave survey to establish shear wave velocities in bedrock;

f. Ambient vibration studies to determine the characteristics of ground motion generated by background noise;

g. Geophysical borehole logging surveys to supplement the refraction, uphole, and shear wave surveys; and

h. A surface shear wave survey on the crushed stone structural fill test pad to determine compressional and shear wave velocities and Poisson's ratio of the compacted granular structural fill.

The locations of the above studies are shown on Figure 2.5-478 and partially on Figure 2.5-104. The results of the geophysical studies are presented in Section 2.5.4.4. The details of the survey locations and techniques are presented in this section.

2.5.4.3.4.1 Seismic Refraction Survey

A seismic refraction survey was conducted within the site area along four seismic profiles (Profiles 1 through 4) for a total of 10,850 linear feet.

Profiles 1 and 2 are located in the vicinity of the proposed power plant area, and Profiles 3 and 4 are located in the northeastern portion of the site. Profiles 1 and 2 trend approximately southeast-northwest and southwest-northeast respectively, intersecting at Boring P-1. Profiles 3 and 4 trend approximately east-west and southeast-northwest, respectively, intersecting at a point 200 feet east of Boring R-2, along seismic Profile 3. The locations of these profiles are shown on Figure 2.5-478.

Seismic energy used in the survey was produced by explosive charges placed in drilled holes. The holes ranged in depth from 4 to 11 feet. DuPont Nitramon-S was the explosive used; the charges ranged in size from 1 to 6 pounds.

The energy released by the explosives was detected by vertically-oriented geophones spaced at either 25- or 50-foot intervals along the profiles. The geophones, manufactured by Electro-Tech Labs, have a natural frequency of 14 Hz. Each geophone was fitted with a spike to assure proper coupling with the site materials. The energy pulses detected by the geophones were transmitted to an Electro-Tech Labs ER 75-12 seismograph to produce permanent seismic records.

2.5.4.3.4.2 Uphole Compressional Wave Velocity Surveys

Standard uphole velocity surveys were conducted at Borings P-1, P-31, P-48, P-62, and R-2. Small explosive charges were detonated in shallow drilled holes ranging in depth from 6 to 10 feet. The holes were located around the boring at distances of from 10 to 25 feet. The energy released by the explosives was detected in each boring by using a special cable, with geophones molded to it at 25-foot intervals. The cable was lowered into the borings, and after each shot, the cable was raised to provide times at intervals of 2.5 to 5 feet from the bottom of each boring to the ground surface. Recordings were

made of the seismic energy on Borings P-1 and R-2 with the Electro-Tech Labs ER 75-12. Recordings for Borings P-31, P-48 and P-62 were made utilizing an SIE Dresser Industries RS-44 amplifier coupled with an R-4 recording oscillograph.

2.5.4.3.4.3 Crosshole Shear Wave Survey

Crosshole shear wave surveys were performed at two locations within the site. Near the proposed power plant site, the survey used Borings P-1 and P-2, 300 feet apart. A second survey was performed in the northeastern portion of the site that used Borings R-1 and R-2, approximately 250 feet apart. At the proposed plant site, explosive charges (1 to 2 pounds of Nitramon-S) were detonated in drilled holes 500 feet from Boring P-2, and in line with Borings P-1 and P-2. At the location of the second survey, explosive charges (1 to 3 1/2 pounds of Nitramon-S) were detonated in drilled holes 500 feet from Boring R-1 and in line with Borings R-1 and R-2.

The energy released by the explosive charges was detected by a geophone placed at the same elevation in each boring. The geophones used were three-component, low frequency, Mark Products L1-3DS, which were coupled with the seismograph recording system. The geophones were raised in 10- and 20-foot intervals after each recording.

Shear wave arrivals are often masked by the relatively large amplitude motions caused by repeatedly reflected and refracted compressional wave arrivals and surface (body) wave arrivals. To help overcome this difficulty, both high and low gain recordings were made at each depth in the borings.

2.5.4.3.4.4 Uphole and Surface Shear Wave Surveys

In addition to the crosshole shear wave survey, an uphole shear wave survey and a surface shear wave survey were performed in and adjacent to Borings P-2 and R-2. The uphole shear wave survey consisted of placing a single three-component geophone in the borings, and recording the seismic energy resulting from the impact of an 8-pound sledge hammer against a heavy wooden plank. The plank was positioned in a shallow excavation located at the top of each boring. Both horizontal and vertical impacts were recorded at 10-foot intervals in each boring.

At Boring R-2, a secondary method was used to provide recordings at 10-foot intervals in the boring. This method consisted of detonating primacord in shallow trenches located around the boring. Two trenches were used simultaneously, such that the detonation of the primacord produced a horizontal twisting motion around the boring.

The surface shear wave surveys were performed to provide shear wave velocities of the near surface materials. This survey was performed by placing three-component geophones on the ground surface at 10- and 20-foot intervals. The geophones were buried in shallow holes to assure proper coupling with the ground. Recordings of the impact of an 8-pound sledge hammer against a heavy wooden plank, placed in a shallow excavation, were taken. Recordings were taken of both horizontal and vertical impacts.

2.5.4.3.4.5 Surface Wave Studies

Surface wave studies were conducted at two locations within the site. At the proposed plant site, a surface wave survey was conducted along seismic refraction Profile 1 for a distance of 2,820 feet. At the other location, in the northeastern portion of the site, a surface wave survey was conducted along seismic refraction Profile 4, for a distance of 2,385 feet. The locations of these studies are shown on Figure 2.5-478.

Seismic energy was produced by explosive charges of from 1/2 to 5 pounds of Nitramon-S placed in holes drilled to depths of 4 to 10 feet. These drilled holes were arranged in a pattern at the southeast end of each survey line.

Four Sprengnether Engineering S-6000, three-component geophones were placed on the ground at intervals of 100 feet. The energy pulses detected by the geophones were transmitted to a Sprengnether VS-1200-4 amplifier coupled with an Electro-Tech SDW 100 recording oscillograph.

Each surface wave study was completed in 300-foot segments with four geophones placed 100 feet apart. After completing a high gain and low gain recording at each segment, the setup was moved and the last geophone location on the completed segment was tied to the first geophone location on the next segment.

2.5.4.3.4.6 Ambient Vibration Studies

Measurements of the level of ground motion due to background (ambient) vibrations were taken at Borings P-1 and R-2. These measurements were taken when activity at the site area was at a minimum. An oriented, 3-component S-6000 Sprengnether Engineering geophone coupled with the VS-1200-4 system was utilized to record the ambient ground motion. The seismograph recorded ground motion in three modes: velocity, acceleration and displacement. In each mode, ground motion in three components (radial, transverse, and vertical) was recorded. The seismograph had gain characteristics in the velocity mode of 2,000 inches per inch per second, in the acceleration mode of 200 inches per inch per second, and in the displacement mode of 20,000 inches per inch.

2.5.4.3.4.7 Geophysical Borehole Logging

A suite of geophysical borehole logs was run in Borings P-1, P-31, P-48 and P-62, below the Graydon chert conglomerate. The logging services were provided by the Birdwell Division of Seismograph Service Corporation. In each boring, caliper, density and acoustic logs were run. In addition, electric logs were run in Borings P-1 and P-48.

2.5.4.3.4.8 Surface Shear Wave Survey on Granular Structural Fill Test Pad

Surface compressional and shear wave velocities were measured on the completed crushed stone test pad. Direct measurements of the wave arrival times were monitored

by four, 3-component Sprengnether V-6000 geophones in a line at 5-foot intervals from the source of the seismic energy. The source of energy was a sledgehammer blow to the surface. Geophone output was amplified by a Sprengnether VS-1200-4 (MSS) seismic amplifier and recorded on an Electro-Tech Lab SDW-100 oscillograph.

2.5.4.4 Geophysical Surveys

The procedures used for the geophysical surveys were presented in Section 2.5.4.3.4. The results of the surveys are presented in this section.

The compressional wave velocities and the corresponding depths to different velocity units under the site were evaluated by plotting the first arrival times of the seismic energy at each geophone against the distance of each geophone from the source of the seismic energy. The time distance data from each profile and the corresponding subsurface cross section of the profiles are shown on Figures 2.5-479 through 2.5-482.

The refraction data generally show four different compressional wave velocities. The depths to the different velocity units have been interpreted from the field data; however, the accuracy of these depths is considered to be ± 15 percent. This accuracy figure is a result of the small velocity contrasts of the deeper materials. The small velocity contrast suggests that there may be increase in velocity with depth within the Graydon chert conglomerate. The increase in velocity with depth is a function of the degree of previous weathering of this unit. The lower part of the unit was less desiccated and less weathered than the upper part and consequently has a higher average compressional wave velocity. The increase in velocity with depth is not linear. Lateral variations in compressional wave velocity within the different subsurface units were detected by the refraction survey. The combination of both lateral velocity changes and velocity increases with depth has made the interpretation of the refraction data difficult.

The first velocity unit on the site indicates compressional wave velocities that range from 1,000 to 2,300 feet per second. This unit correlates with the modified loess throughout the site but does include part of the underlying accretion-gley in some parts of the site. This suggests that the water table in these areas is below the top of the accretion-gley. The second velocity unit indicated by the refraction data has a compressional wave velocity that ranges from 3,200 to 5,100 feet per second. This unit corresponds to the accretion-gley, glacial till, and part of the Graydon chert conglomerate. On Seismic Profile 3, at Borings R-1 and R-2, the accretion-gley and the glacial till are missing due to weathering and erosion that has removed both of the units. The seismic contact between velocity units 1 and 2, therefore, falls at the top of the Graydon chert conglomerate.

The third velocity unit has a range of compressional wave velocities from 8,100 to 11,400 feet per second. This unit includes a part of the Graydon chert conglomerate and the Burlington, Bushberg, Snyder Creek and Callaway formations. The seismic control for this unit is very poor, as explained above in the discussion of seismic velocity functions. The observed anomalous arrival times on the time-distance plots are due primarily to variations in thickness and variations in the lateral and vertical velocities of the

uppermost layers at the site. As a result of the velocity variations, no definitive statements can be made concerning the character of the bedrock, such as the presence or absence of solution fillings within the bedrock.

The deepest seismic velocity unit (fourth velocity unit) encountered in the refraction survey corresponds to the Cotter-Jefferson City Formation. This unit has a velocity range of 12,500 to 14,600 feet per second.

The results of the uphole surveys and the geophysical borehole logging are shown on Figures 2.5-483 through 2.5-495. The surveys in the P-series borings show five basic velocity units. The modified loess is indicated by a fairly constant velocity of 2,000 feet per second. The underlying accretion-gley and glacial till, extending to the top of the Graydon chert conglomerate, is indicated by a velocity range of 3,400 to 4,200 feet per second. The Graydon chert conglomerate is indicated by a fairly constant velocity of 6,000 feet per second. Another velocity unit, with a range of velocities from 8,200 to 9,000 feet per second, extends from the top of the Burlington Formation to the top of the Cotter-Jefferson City Formation. The velocity of the Cotter-Jefferson City Formation as determined by the uphole surveys, 14,000 feet per second, was uniform over the site.

The uphole surveys indicate a velocity change at the top of the Graydon chert conglomerate. This velocity change is not evident on the refraction profiles, due to the small velocity contrast between the overburden and the chert conglomerate.

The compressional wave velocities obtained from the acoustic borehole logs run in rock were integrated and plotted on the uphole compressional wave survey figures. These integrated velocities show excellent agreement with the uphole velocities.

Both the uphole surveys and the acoustic logs show that compressional wave velocity distribution in the power plant area is uniform. The shear wave velocity distribution is also considered to be uniform, based on the uniformity of the compressional wave velocity distribution and the uniformity of geology from the borings. The shear wave velocities, as shown on Figures 2.5-496 and 2.5-497, were determined from the data obtained from the crosshole method and uphole shear wave survey. The uphole shear wave survey consisted of two separate parts, explained in Section 2.5.4.3.4.4.

The best quality data for shear waves was produced by the secondary part of the uphole shear wave survey, the primacord method. The crosshole method provided a good check on the shear wave values. The deepest shear wave velocity was measured by the crosshole method only; however, the surface wave survey confirms the value shown. Figures 2.5-496 and 2.5-497 show time-depth plots for the uphole shear wave surveys. Figures 2.5-498 and 2.5-499 show the results of the surface shear wave surveys conducted at Borings P-2 and R-2. The results of the crosshole survey are not shown, as the interpretation consisted of using a geologic cross-section model. Once this model was constructed, compressional wave velocities were added, and a ray-path analysis was performed to each geophone to compute compressional wave arrival times. These computed times were checked against the field records. The model was adjusted for

agreement between calculated and true arrival times. The same ray-path analysis was performed for shear wave arrivals by use of shear wave velocities obtained from the uphole shear wave surveys and the surface shear wave surveys.

In Boring P-1, the modified loess has a shear wave velocity of 500 feet per second. The underlying accretion-gley and glacial till show a shear wave velocity ranging from 950 to 1,150 feet per second. The underlying zone, the Graydon chert conglomerate, extending to the top of the Burlington Formation, shows a shear wave velocity of 2,500 feet per second. From the top of the Burlington Formation to the top of the Cotter-Jefferson City Formation, the shear wave velocity ranges from 3,350 to 4,000 feet per second. The Cotter-Jefferson City Formation shows a shear wave velocity of 7,500 feet per second.

In Boring, R-2 the soil has a shear wave velocity of 500 feet per second. The underlying Graydon chert conglomerate has a shear wave velocity of 1,200 feet per second. The shear wave velocity from the top of the Burlington Formation to the top of the Cotter-Jefferson City Formation is 4,000 feet per second. The Cotter-Jefferson City Formation shows a shear wave velocity of 7,600 feet per second.

The properties of the soil, Graydon chert conglomerate, and bedrock strata at the site based on geophysical methods are summarized on typical geologic columns at Borings P-1 and R-2 on Figures 2.5-500 and 2.5-501.

Two distinct surface waves were observed at the site; their characteristics are presented in Table 2.5-47, Surface Wave Characteristics. The surface waves were generated at this site by small explosive charges placed at shallow depths. Wave 1 is probably a coupled surface wave system. The maximum amplitude ration between the surface waves and the body wave trains from the same shot is 5:1. The surface waves observed during this study all have predominant motion in the radial and radial-transverse directions, with lesser motion in the vertical direction. The observed surface waves at the site exhibited a characteristic frequency range of 7 to 16 Hz.

The ambient ground motion measurements obtained from the investigations are summarized in Table 2.5-48.

The results of the surface shear wave survey on the granular structural fill test pad, presented as time-distance plots, are shown on Figures 2.5-502 through 2.5-504. The computed wave velocities were in the range of 2,600 to 3,000 feet per second (fps) for the compressional waves and 1,300 to 1,400 fps for the shear waves. The lower-bound values were obtained from a part of the pad where the compacted density was about 95 percent of the maximum density determined by ASTM Test Designation D 1557-70, slightly lower than the density in the other two areas tested. The Poisson's ratios, calculated based on the relationship of shear and compressional wave velocities, were in the range of 0.33 to 0.36.

2.5.4.5 Excavation and Backfill

The topography in the plant area slopes toward the east with the ground surface varying from about elevation 850 to 830 feet. Existing drainage is toward the east, along a shallow swale. The power plant area lies at the top of a plateau (see Section 2.5.1.2.1). Surface water flows radially away from the plateau in all directions; however, the plant site area proper lies on the northeastern flanks of a very broad and gently sloping ridge trending northwest-southeast as shown by the contours on Figure 2.5-104.

Site preparation and earthwork for Unit 1 consist of stripping, excavating, dewatering and backfilling operations to attain a nominal plant grade of 840 feet. A plan showing the extent of Category I excavations is presented on Figure 2.5-119. Typical excavation profiles showing the relationship of the structures to the glacial and postglacial soil deposits, older sediments, lithified formations and compacted fill and backfill are presented on Figures 2.5-120 to 2.5-123. Typical photographs of the Unit 1 power block excavation and a partially completed excavation slope in the UHS retention pond are presented on Figures 2.5-124 and 2.5-125.

2.5.4.5.1 Excavation

Trees, brush, crops, grass, roots, and other deleterious materials were stripped from areas occupied by structures and from all areas filled. All topsoil was removed prior to general excavation operations. All glacial and postglacial soils were removed beneath the Category I and other major structures within the power block area. The glacial and postglacial soils were also removed below the UHS cooling towers and the ESWS pumphouse. The maximum depth of cut in the overburden soils was about 30 feet for the plant area. On the basis of the slope stability analyses (Section 2.5.5.2.2), construction slopes were cut on slopes of 1 horizontal to 1 vertical or flatter. Excavation was accomplished by conventional earthmoving equipment, both in the overburden soils and in the deeper excavations into the Graydon chert conglomerate.

The UHS retention pond is constructed as a dug reservoir in the natural soils. The location of the pond and Category I UHS cooling towers is shown on Figures 2.5-104 and 2.5-105. The pond is 684 feet by 334 feet in plan dimensions with the bottom at elevation 818 feet, and side slopes of 3 horizontal to 1 vertical. The top of the slopes is at approximately elevation 840 feet. The Category I ESWS pumphouse is located along the northwestern slope of the pond between the Category I UHS cooling towers. Maximum pool elevation is 836 feet. A subsurface profile showing the relationship of the cooling towers and UHS retention pond to the natural soil and rock and compacted fill is presented on Figure 2.5-121. The slope stability analyses for static and earthquake conditions, as discussed in Section 2.5.5.2.1, indicate a factor of safety greater than 2.0 for the side slopes of 3:1. Excavation was accomplished by conventional earthmoving equipment.

2.5.4.5.2 Dewatering

Measurement of the ground-water conditions at the site prior to the start of construction indicated that the lower portions of the site excavations would be below the ground-water level. The low permeabilities of the soils and Graydon chert conglomerate prevented any significant seepage into the excavations. Seepage water was not observed from the cohesive materials in the slopes, probably because the seepage rate was less than the rate of evaporation. Dewatering was handled by a system of shallow trenches connected to sumps from which the water was pumped. This dewatering system was used to collect and remove surface water runoff from precipitation. All earthwork was performed under dry conditions.

2.5.4.5.3 Protection of Foundation Materials

The base of the excavation was protected from deterioration and softening caused by frost, ponded water, and construction activities. All loose or disturbed materials were removed prior to the placement of fill or backfill materials, and the prepared subgrades were inspected by quality control personnel immediately before placement of the fill and backfill was initiated. The Graydon chert conglomerate was protected by compacted granular fill or by stabilized backfill.

2.5.4.5.4 Fill and Backfill Materials

Five major types of Category I fill and backfill materials were placed at the site: Category I Granular Structural Fill, Category I Granular Structural Backfill, Category I Cohesive Fill, Stabilized Backfill, and Category I Bedding Material.

2.5.4.5.4.1 Material Specifications and Placement

2.5.4.5.4.1.1 Material Specifications

2.5.4.5.4.1.1.1 Category I Granular Structural Fill

Category I Granular Structural Fill consisted of well-graded crushed limestone and dolomite from approved sources. The material was required to meet the following gradation requirements specified in Revision 12 of Construction Specification 4645-4A(Q), Technical Specification for Power Block Fill and Backfill:

SIEVE SIZE	ALLOWABLE RANGE (PERCENTAGE PASSING)
2 in. (50 mm)	100
1-1/2 in. (37.5 mm)	90 - 100
1 in. (25.0 mm)	80 - 100

SIEVE SIZE	ALLOWABLE RANGE (PERCENTAGE PASSING)
3/4 in. (19.0 mm)	70 - 90
3/8 in. (9.5 mm)	52 - 70
No. 4 (4.75 mm)	37 - 53
No. 10 (2.0 mm)	22 - 37
No. 30 (600 micron)	10 - 23
No. 40 (425 micron)	7 - 20
No. 200 (75 micron)	0 - 10*

* The portion passing the No. 200 sieve shall not exceed 60 percent of the portion passing the No. 30 sieve.

2.5.4.5.4.1.1.2 Category I Granular Structural Backfill

Category I Granular Structural Backfill consists of wellgraded crushed limestone and dolomite from approved sources. The specified gradation limits for the material in Revision 12 to the Technical Specification for Power Block Fill and Backfill was similar to that for Category I Granular Structural Fill but with an allowance of up to 15 percent passing the No. 200 (75 micron) sieve size.

2.5.4.5.4.1.1.3 Category I Cohesive Fill

Category I Cohesive Fill consisted of modified loess obtained from on-site excavations. Revisions 0 through 12 to the Technical Specification for Power Block Fill and Backfill required that the Category I Cohesive Fill consist of modified loess.

2.5.4.5.4.1.1.4 Stabilized Backfill

Stabilized Backfill consisted of granular material stabilized with portland cement in order to achieve a minimum 28-day compressive strength of 1000 psi.

2.5.4.5.4.1.1.5 Category I Bedding Material

The project specifications allowed two types of material to be used as Category I Bedding Material. The Category I Bedding Material used at the site consisted of aggregate fines of limestone and dolomite from approved sources and meeting specified gradation requirements.

A second material type was allowed by the specifications for Category I Bedding Material but not used during construction. The material was to consist of clean sand from approved sources and meeting specified gradation requirements. The material was specified to be placed in horizontal lifts of 12 inches or less in thickness and compacted to a minimum of 70 percent relative density based on a procedure modified from ASTM Test Designation D 2049-69.

2.5.4.5.4.1.2 Material Placement

2.5.4.5.4.1.2.1 Category I Granular Structural Fill

Category I Granular Structural Fill was placed in horizontal loose lifts of 12 inches or less and compacted to a minimum of 95 percent of the maximum dry density determined by the ASTM D 1557-70 method of compaction. Detailed evaluations of the crushed stone structural fill have shown that 95 percent compaction is equivalent to 98 percent relative density as determined by ASTM Test Designation D 2049-69. The first 2 feet of the material immediately overlying the Graydon chert conglomerate was compacted to a minimum of 92 percent of the maximum dry density determined by the ASTM D 1557-70 method of compaction in order to prevent disturbance to the Graydon by the high degree of compactive effort necessary to achieve 95 percent compaction of the granular structural fill. The material was placed below the foundations of Category I structures down to the level of the Graydon chert conglomerate. Typical placement geometry of the Category I Structural Fill is shown on the excavation profiles, Figures 2.5-120 through 2.5-122.

2.5.4.5.4.1.2.2 Category I Granular Structural Backfill

Category I Granular Structural Backfill was placed in horizontal lifts 12 inches or less in thickness and compacted to a minimum of 90 percent of the maximum dry density determined by the ASTM D 1557-70 method of compaction. The material was placed adjacent to the foundation mats and foundation walls as shown on the typical excavation profiles, Figures 2.5-120 through 2.5-123.

2.5.4.5.4.1.2.3 Category I Cohesive Fill

Category I Cohesive Fill was placed in horizontal lifts 6 inches or less in thickness and compacted to a minimum of 90 percent of the maximum dry density determined by the ASTM D 1557-70 method of compaction. The material was compacted at a moisture content no more than 5 percent over the optimum moisture content determined by the compaction tests. The Category I Cohesive Fill was used in the following locations:

a. Outside the zones of Category I Granular Structural Fill and Backfill;

b. Beside the ESWS pumphouse to block water flow from the UHS retention pond to the Category I Granular Structural Fill;

c. As bedding material for the ESWS pipes and backfill in the pipe trenches where water seepage along the pipes or pipe trenches was to be prevented; and

d. On the northwest side and around the northeast end of the UHS retention pond to raise the grade to 840 feet (MSL).

Typical placement geometries of the Category I Cohesive Fill are shown on the excavation profiles, Figures 2.5-120 through 2.5-123.

2.5.4.5.4.1.2.4 Stabilized Backfill

Stabilized Backfill was used for protection of the Graydon chert conglomerate and protection of granular structural fill and backfill. It was used as a replacement for other fill and backfill materials, except where prohibited, in areas where placement and compaction of those materials would have been difficult.

2.5.4.5.4.1.2.5 Category I Bedding Material

Category I Bedding Material was used under, around, and over ESWS piping and ductbanks. Typical placement geometries are shown on the excavation profiles presented on Figure 2.5-123.

The material was placed in horizontal lifts 12 inches or less in thickness and compacted to a minimum of 90 percent of the maximum dry density determined by ASTM Test Designation D 1557-70.

2.5.4.5.4.1.2.6 Substitutions

Stabilized Backfill was occasionally substituted for Category I Granular Structural Fill and Backfill, Category I Cohesive Fill, and Category I Bedding Material, except where the cohesive fill was needed as a flexible, impermeable barrier. Category I Granular Structural Fill and Backfill were often used as a substitute for Category I Cohesive Fill except where an impermeable barrier was required.

Category I Granular Structural Fill and Backfill were substituted for all Category I Cohesive Fill in the Unit 1 power block, UHS cooling tower, and ESWS pumphouse excavations with the following two exceptions:

1. No substitution was performed on the north and south sides of the ESWS pumphouse wing walls to maintain the low permeability block between the UHS retention pond and the granular fill supporting the eastern part of the pumphouse.

No granular structural fill or backfill was substituted for Category I Cohesive Fill in the ESWS pipe or duct bank trench excavations.

Originally, Category I Cohesive Fill was to be placed outside the Category I Granular Structural Fill required for support of Category I structures and outside the Category I Granular Structural Backfill required adjacent to the subsurface walls of the structures. The cohesive fill had no specific design criteria other than to provide a stable backfill material. It was to be compacted to a minimum of 90 percent of the maximum dry density determined by the ASTM D 1557-70 compaction test. Granular structural fill and backfill were substituted for the cohesive fill for construction expendiency. The substitute materials were compacted to higher densities and have higher bearing strengths than the cohesive fill and, therefore, exceed the design requirements for the cohesive fill.

2.5.4.5.4.1.2.7 Quality Control and Quality Assurance

Quality control and quality assurance organizations at the site performed the inspection and monitoring functions necessary to insure compliance with the project specifications and provided documentation to support that compliance. Quality control personnel continuously monitored the fill and backfill operations. The prepared subgrade was inspected immediately before placement of fill and backfill materials was initiated and the surface of each lift was inspected for contamination before succeeding lifts were placed. In-place moisture content and density determinations were performed in accordance with rigid frequency requirements given in the project specifications. The in-place moisture and density tests were performed to assure compliance with the density and compaction moisture content criteria given in the specifications.

Progress reports detailing the subgrade preparation work and the Category I fill, backfill, and pipe bedding placement work have been prepared. Details of the earthwork construction progress are available in these reports.

2.5.4.5.4.2 Exploration

All borrow material used in the production of granular structural fill and backfill was Callaway Formation limestone and dolomite that was quarried or mined from approved sources. All borrow material used for Category I Cohesive Fill was modified loess obtained from on-site excavations.

Detailed investigations were performed for an on-site mine quarry source of Callaway Formation limestone and dolomite used for granular structural fill and backfill. A total of 6 borings (Q Series) were drilled for site selection studies and detailed investigations. The boring locations and mine quarry site are shown on Figures 2.5-107 and 2.5-108; boring data are summarized in Table 2.5-46. The investigations showed that the Callaway Formation limestone and dolomite obtained from the on site mine quarry were suitable for use as Category I Granular Structural Fill and Backfill. The detailed investigations performed for the on-site mine quarry were presented in complete detail in the following Dames & Moore reports and report addendum:

a. "Report, On-Site Rock Quarry Site Selection and Feasibility Study, Source of Coarse Aggregate, Callaway Plant, Units 1 and 2, for Union Electric Company", dated April 11, 1975;

b. "Report, Engineering Geology Investigation, Proposed On-Site Production Mine Quarry, Source of Coarse Aggregate, Callaway Plant, Units 1 and 2, for Union Electric Company," dated July 31, 1975; and

c. "Report Addendum, Engineering Geology Investigation, Proposed On-Site Production Mine Quarry, Source of Coarse Aggregate, Callaway Plant, Units 1 and 2, for Union Electric Company," dated June 2, 1977.

Six borings (A Series) were drilled at the Auxvasse Quarry located approximately 17 miles northwest of the site. Figure 2.5-109 shows the location of the quarry with respect to the plant site, and Figure 2.5-110 shows the boring locations with respect to the quarry layout at the time of the investigation. The investigation at the Auxvasse quarry showed that a portion of the Callaway Formation was suitable for concrete aggregate. The same material is approved for use as Category I Granular Structural Fill and Backfill.

Two investigations were performed at an off-site quarry (Mertens Quarry, formerly known as MoCon of Fulton, Inc. Quarry) located approximately 4.5 miles north of the site. The location of the quarry with respect to the plant site is shown on Figure 2.5-109. Twenty-seven borings (H Series) were drilled to investigate the quarry site. The locations of the borings are shown on Figure 2.5-111. The investigations showed that the Callaway Formation limestone and dolomite was suitable for Category I Granular Structural Fill and Backfill.

2.5.4.5.4.3 Field and Laboratory Testing

The field and laboratory testing performed to determine the engineering properties of the fill and backfill materials and the results of the testing were presented in Section 2.5.4.2. Summaries of the properties of the materials are presented in Tables 2.5-14, 2.5-17, and 2.5-18.

2.5.4.5.5 Non-Category I Backfill Material

A 2-foot thick clay blanket was placed over the Category I Granular Structural backfill in order to limit seepage into the backfill from surface water.

2.5.4.5.5.1 Substitutions

A minimum of 6" of concrete or asphalt has been substituted for the clay blanket in various locations which acts as a low permeability barrier. No granular fill or backfill was substituted for the clay blanket where the purpose of the blanket was to provide a low permeability fill material.

2.5.4.6 Ground Water Conditions

Regional and site groundwater conditions are discussed in detail in Section 2.4. Regional and local groundwater systems are discussed in Sections 2.4.13.1.1.1 and 2.4.13.1.1.2, respectively. Regional and local groundwater conditions are discussed in Sections 2.4.13.2.3.1 and 2.4.13.2.3.2, respectively. The design bases for subsurface hydrostatic loadings are presented in Section 2.4.13.5. Details of the permanent ground-water monitoring system are given in Section 2.4.13.2.3.2.2.

Records of groundwater fluctuations from piezometer observations indicate that fluctuations are on the order of a few feet under normal conditions. Larger fluctuations are caused by periods of prolonged drought or heavy rainfall.

The low permeability of the glacial and postglacial soil deposits and older sediments allowed minimal seepage into excavations during construction. The maximum depth of excavations for the facility is below the base of glacial till, extending approximately 15 feet into the Graydon chert conglomerate. Even though the highest water table in the site area was about 10 to 15 feet above the top of the chert conglomerate, neither the postglacial and glacial soils nor the chert conglomerate layer required dewatering. Observations of the ground-water conditions during construction did not reveal any seepage into the excavations through the cohesive materials, probably because the rate of seepage was lower than the rate of evaporation. Isolated saturated silt lenses at the bottom of the modified loess and sand lenses in the glacial till did yield seepage when exposed by excavations, but the small seepage did not hinder construction or affect construction quality. Sump pumps located in the excavations were adequate to remove seepage and any runoff occurring after periods of rainfall.

Although the ground-water table (top of saturated zone) is raised locally in the vicinity of the completed UHS Retention Pond, permeabilities are low (Section 2.4.13.2.3.2.4) so that there is no significant influence on the ground-water table in the plant area. The pond itself is contained above the Graydon chert layer (Figure 2.5-121). The low permeabilities of the glacial and postglacial materials preclude any significant seepage loss from the pond, and it was therefore considered unnecessary to seal the pond side slopes and bottom with an impervious blanket. The following justification for this conclusion was presented in our response to NRC Question 241.2C. The pond side slopes and bottom are being inspected during construction. Any previous sand or silt lenses encountered will be removed and replaced with Category I Cohesive Fill.

(i) The construction of the UHS retention pond has been completed, and filling was completed on April 10, 1980. During the period May 5 through September 26, 1980, a test was performed to determine the rate of seepage from the pond (Reference 1). The change in water level of the retention pond was recorded during the test, and a meteorology station was established adjacent to the pond to record precipitation and evaporation. These data were used in a water budget analysis to evaluate the rate of seepage from the retention pond. No water was pumped into or

out of the pond during the test, and the site grading around the retention pond prevented surface water runoff into the pond.

The amount of seepage from the retention pond was evaluated by the following water budget:

Seepage = Net Volume Loss-Evaporation+Precipitation

Net volume loss and precipitation were determined by direct measurements. Retention pond evaporation could not be measured directly but was evaluated by applying an appropriate pan coefficient to the evaporation measured by a U.S. Weather Bureau, Class A evaporation pan.

Another, independent estimate of the seepage rate was obtained by using the results of field permeability tests performed in February, 1980. These new data were used to reevaluate the estimate of seepage loss using flow nets described in Response (ii) below, which was performed in 1977. The February, 1980 field permeability of the soils surrounding the UHS retention pond was less than 4 x 10^{-6} cm/sec, whereas a value of 2 x 10^{-5}cm/sec had been used in 1977.

The seepage rate from the UHS retention pond was found to be very small by both the water budget analysis and by reevaluation of the 1977 flow net seepage analysis. The average seepage rate was found to be less than 0.5 acre-foot for a 30-day period and probably on the order of 0.3 acre-foot. A seepage loss of 0.5 acre-foot would result in approximately a 1.5-inch drop in the retention pond water surface at the normal operating level. If the maximum weekly seepage rate calculated from the seepage test data was projected to 30 days, the seepage loss would be slightly less than 1.0 acre-foot.

2.5.4.7 <u>Response of Soil and Rock to Dynamic Loading</u>

A generalized summary of dynamic moduli and damping values for the granular fill, natural soils, Graydon chert conglomerate and lithified formations is presented in Table 2.5-14. Recommended design curves for the soils, Graydon chert conglomerate, and granular fill and backfill are presented on Figures 2.5-451 through 2.5-460. The dynamic moduli of elasticity and rigidity were evaluated from geophysical measurements and/or laboratory tests. The values for the Graydon chert conglomerate were adjusted based on the results of Menard pressuremeter tests as described in Section 2.5.4.2.2.2. The testing performed to determine these dynamic values is described in Sections 2.5.4.2 and 2.5.4.3.

Soil-structure interaction analyses are described in Section 3.7.2.4. Dynamic analysis of buried metallic pipelines and duct banks is described in Section 6.0 of BC-TOP-4A. Dynamic analysis of buried polyethlene ESW replacement piping is described in Callaway specification M-2017, “Design Specification for Replacement ASME Section III Buried Essential Service Water System Piping.”

Figures 2.5 118b and 2.5 118a were submitted as Figures 1 and 2 with the original response to Item 241.7C, which was transmitted by ULNRC-506 dated September 10, 1981.

(a) (i) The location and routing of the original ESWS pipelines and electrical duct banks is shown on Figure 2.5 118a. The location and routing of the replacement ESWS pipline is shown in Figure 3.8-4.

(ii) The locations and identification of the borings along or nearest the route of the pipelines and duct banks are shown on Fig. 2.5 118b attached. The boring spacing can be clearly seen from the scale of Figure 2.5 118a.

(b) (i) Figures 2.5 118b and 2.5 118a indicate the borings used to prepare the pipeline and duct bank soil profiles. The complete logs of these borings can be found in the boring log section of the figures for Section 2.5 of the FSAR. Figure 2.5-123 of the FSAR shows typical configurations of the fill above the pipelines and duct banks. Also see Figures 3 and 4 of the "Progress Report V. Results of Field Observation of Geotechnically-Related Construction Activities, Callaway Plant, Units 1 and 2, "Volume I, for typical configurations of the pipeline and duct bank fill. Figure 5 of that report shows areas where stabilized Backfill was substituted, as permitted, for Category I Bedding Material.

The soil classification and SPT blowcount information is shown on the pertinent boring logs and also on Figure 2.5 118a.

(ii) The soil stratification and the top of the Graydon chert conglomerate are shown on Figure 2.5 118a. As stated in FSAR Section 2.4.13.5, the design water table is Elevation 840' MSL which is equivalent to plant elevation 1999.5.'

(iii) The invert of the original ESWS pipelines is shown on Figure 2.5-118a. The top of the pipelines is approximately 30 inches above the invert elevation. Typically in the main run, the invert (of bottom) of the duct bank is approximately 1 foot below the pipeline invert.

(c) Static soil parameters used in designing the ESWS pipelines and ductbanks.

Unit weight = 150 pcf

Maximum Groundwater Elevation = 1999'-6"

Maximum Groundwater Elevation = (below pipe)

(d) Dynamic soil parameters used in designing the ESWS pipelines and ductbanks.

Unit weight = 150 pcf

Coefficient of Subgrade Reaction, K = 1000 pci

Coefficient of Friction Between the soil and surface of structure = 0

Compressive Wave Velocity, C_p = 2100 fps

Shear Wave Velocity, C_s = 860 fps

(e) Refer to Standard Plant FSAR Section 3.7(B).3.12 for this information. The site specific soils related information is provided in FSAR Site Addendum Section 2.5.4 and in the above responses.

2.5.4.8 Liquefaction Potential

The liquefaction potential of the structural fill beneath the Category I structures was evaluated on the basis of the simplified procedure described by Seed and Idriss (1971). The procedure is based on both theoretical considerations and descriptions of subsurface conditions where liquefaction was known to have occurred or not to have occurred under earthquakes of known or estimated magnitudes. The liquefaction potential of a granular soil deposit is related to:

a. The grain-size characteristics of the granular soil;

b. The relative density;

c. The position of the ground-water table;

d. The intensity and duration of ground shaking; and

e. The number of significant stress cycles produced by the earthquake.

The evaluation was based on a maximum horizontal ground surface acceleration of 0.20g during the Safe Shutdown Earthquake postulated for the site. The structural fill was assumed to be compacted to a relative density of at least 85 percent. Actually, the structural fill is compacted to greater than 98 percent relative density, which is equivalent

to 95 percent of the maximum dry density as determined by ASTM Test Designation D 1557-70.

The maximum shear stresses were computed assuming that the soil behaves as a rigid body. The rigid body stresses were corrected using a stress reduction coefficient (Seed and Idriss, 1971) to account for the fact that the soil actually behaves as a deformable body. The average equivalent uniform shear stress during the earthquake was estimated to be 65 percent of the computed maximum shear stress. The cyclic shear stresses required to produce liquefaction in 30 cycles were determined assuming that for the same relative density, the stresses causing liquefaction of gravels are at least 20 percent higher than those for sands (Wong, 1971), and that they were proportional to relative density, as assumed by Seed and Idriss.

The factor of safety is defined as the ratio of the cyclic shear stress required to produce liquefaction to the average equivalent uniform cyclic shear stress induced by the earthquake. the results of the analysis indicated that compaction of the structural fill to 85 percent relative density will preclude the possibility of liquefaction.

No other liquefaction analyses were necessary for the plant. All Category I structures not founded on structural fill are founded on the Graydon chert conglomerate, and the Category I UHS retention pond is excavated into the in-situ cohesive soils and Category I cohesive fill. The Graydon chert conglomerate and the cohesive materials are not susceptible to liquefaction when subjected to earthquake loading.

2.5.4.9 Earthquake Design Basis

The earthquake design basis is discussed in Section 3.7. The Safe Shutdown Earthquake corresponds to Modified Mercalli Intensity VII ground motion with a peak horizontal acceleration of 0.20g as described in Section 2.5.2.6. The Operating Basis Earthquake corresponds to Modified Mercalli Intensity VI to VII with a peak horizontal acceleration of 0.12g as described in Section 2.5.2.7.

2.5.4.10 Static Stability

The Category I structures are supported on reinforced concrete mat foundations. The Category I UHS Retention Pond is constructed within the natural soils at the site.

2.5.4.10.1 Bearing Capacity

Ultimate bearing capacities and factors of safety under both static and dynamic conditions were computed for the Category I structures using conventional, single and double layer theories and by slip-circle and sliding-wedge analyses. The Category I Granular Structural Fill was analyzed using an angle of internal friction of 45 degrees and a wet density of 150 pounds per cubic foot. The Graydon chert conglomerate was analyzed using a conservative undrained shear strength of 4,500 pounds per square foot based on the results of the plate load tests. The analyses were performed assuming the

water table was at elevation 820 or 811 feet (MSL), whichever was more conservative. Each building was analyzed separately, neglecting the stabilizing surcharge effect of loads from adjacent structures. The results of these analyses are presented in Table 2.5-49.

2.5.4.10.2 Settlement

2.5.4.10.2.1 Calculated Settlements

The overburden soils were removed beneath the power block, UHS cooling tower and ESWS pumphouse areas down to the top of the Graydon chert conglomerate at about elevation 812 feet. The soils are replaced with Category I Granular Structural Fill from the chert conglomerate up to the bottom of the foundations. The foundations of the auxiliary and control building lie within the chert conglomerate, and portions of the reactor building and ESWS pumphouse foundations lie within the chert conglomerate. The turbine building has both mat and spread footing foundations; all other Category I structures are on mat foundations. A plan view of the power block area showing the elevations of all foundations as modeled for the settlement analysis and showing the foundation pressures used in the analysis is presented on Figure 2.5-505. The loads shown for all buildings except the fuel building are the maximum edge pressures of the foundations. These loads were used in the analysis as conservative average foundation loads. The loads shown for the fuel building were averaged from the pressure distribution for the highest loading condition. Use of the maximum edge pressure was considered overly conservative for the fuel building.

The settlements were computed using computer program EP-10 developed by Dames & Moore. The program computes stresses using the Boussinesq theory of stress distribution and assumes all loaded areas are flexible. The settlements were calculated using the tangent modulus concept described by Janbu (1967). The settlement parameters used for the Graydon chert conglomerate and Category I Granular Structural Fill are given in Tables 2.5-16 and 2.5-18. These parameters were selected based mainly on the results of the plate load tests performed on those materials. The ground-water level was assumed to be at elevation 820 feet.

The results of the settlement analyses are shown on Figure 2.5-505 for the power block structures and are given in Table 2.5-50 for the power block structures, UHS cooling tower, and ESWS pumphouse. The calculated settlement values shown on the figure are not accurate to the number of significant figures shown but have been reported to that figure to indicate the order of magnitude of differential settlement within and between structures. Table 2.5-55 shows values for foundation loads and estimated settlement that supersede values presented in Table 2.5-50.

The calculated settlements represent the total settlement that can be expected for each foundation from first application of the structural load. It was assumed that any rebound of the Graydon chert conglomerate due to excavation of the overburden soils was rapid and was completed when excavation was completed. Recompression of the chert

conglomerate due to placement of Category I Granular Structural Fill was assumed to be rapid and completed at the completion of the filling operations. Compression of the Category I Granular Structural Fill by its own weight was assumed to have occurred at the completion of the filling operations. These rebounds and compressions were not included in the total settlements because they were assumed to have occurred before the application of any structural load. The gross foundation loads were used in the analysis without any reduction for buoyant effect for foundations below the ground-water level.

The actual settlements are expected to be slightly less than shown by the computer analysis because maximum edge pressures were used as uniform average pressures. The actual average pressures would be lower. The settlements of foundations below the ground-water level may also be slightly less than those calculated because the buoyant effect will reduce the foundation load. The actual settlements of the outside edges of structures surrounded by structural fill or backfill are expected to be slightly greater than the calculated settlements because the structural fill and backfill load outside the foundations was not included in the analysis.

The magnitudes of differential settlements that are anticipated between structures and within structures can be obtained by comparing the total settlements presented on Figure 2.5-505. The actual differential settlements within structures are expected to be less than indicated due to the effect of foundation rigidity. The computer program assumes a flexible loaded area; however, the foundations are quite rigid. The differential settlement within structures surrounded by structural fill or backfill is also expected to be slightly less than indicated by comparing edge settlements with interior settlements on Figure 2.5-505 because the edge settlements are expected to be slightly larger than shown on the figure. The total differential settlement within a structure or between adjacent structures is not expected to exceed 1/2 inch.

The Category I granular structural fill and the overconsolidated Graydon chert conglomerate behave elastically within the range of applied loads; therefore, nearly all of the settlement will occur concurrent with application of the structural loads. Significant differential settlements are generally those that occur after the connections between structures and important utilities are made.

Building settlements are being monitored at regular intervals. Measured settlements are compared with the predicted settlements in Table 2.5-55. Since differential settlements, and not the total settlements of structures are of prime interest in evaluating the impact on utility connections, the differential settlement quantities are also evaluated.

2.5.4.10.2.2 Measured Settlements

A settlement monitoring program was established to monitor settlements of the structures during plant construction and thereafter. Embedded plates were established in the walls and slabs, and survey circuits are regularly performed to monitor settlement.

Figure 2.5-507 shows the location of the settlement monitoring plates for the Category I structures at the Callaway Plant. Table 2.5-55 presents a summary of the predicted, measured, and allowable settlements for the structures. A differential settlement of 0.5 inch is allowed within and between structures. The allowable settlements do not necessarily represent the maximum recorded settlements that can be accepted. Rather, they represent values that, when exceeded, should be reviewed by the designers.

Building settlement primarily occurred during the construction phase and application of full dead loads. Periodic survey data has shown that the settlements that have occurred, have been acceptable, and that the structures have stabilized. Some measurements have exceeded the original estimated settlement range, but have not exceeded the allowable settlement.

The 1981 measured survey data show that the differential settlement within the Containment Building was approximately 0.7 inch on January 31, 1981 and, therefore, exceeded 0.5 inch. It appears that the structure is settling as a rigid body with the most settlement on the southeast side. Approximately 0.7 inch of differential settlement is not significant to the Containment Building and will not affect its operation or safety.

The differential settlement between structures has not exceeded 0.5 inch. Comparing the total settlements measured to date would give the false impression that there may be more than 0.5 inch of differential settlement between the Containment Building and the adjacent structures, but this is due to the different periods of settlement measurements. A significant amount of the Containment Building settlement occurred before settlement readings were started for the adjacent structures.

In summary, the measured settlement is less than predicted for all structures except for one monitoring point of the Fuel Building and Containment Building. Following full application of the structural loads, settlements of all structures except these have been less than predicted. The average settlement of these Buildings has been very close to the maximum predicted. No measured settlements should approach the allowable values. There will be no detrimental impact from any difference between the predicted and measured settlements for any of the Category I structures and appurtenances.

2.5.4.10.3 Lateral Earth Pressures

All subsurface building walls were designed to resist static and dynamic lateral earth pressures exerted by the compacted granular backfill. Walls located partly or fully below the site design ground-water level are designed to resist the combined soil and hydrostatic pressures. In addition, subsurface walls are designed to resist lateral pressures from adjacent foundations. Conservative lateral pressures, expressed as equivalent fluid pressures for various conditions of loading are presented in Table 2.5-51, where the minimum surcharge is taken as 250 psf.

The granular structural backfill was compacted to a minimum of 90 percent of the maximum dry density as determined by the ASTM test Designation D 1557-70. The rigid

subsurface walls were designed to resist static at rest and dynamic lateral earth pressures. Cantilever walls, those walls free to rotate, were designed to resist static and dynamic active earth pressures.

The computation of dynamic lateral pressures was based on the theory developed by Mononabe-Okabe as simplified by Seed and Whitman (1970). A horizontal acceleration of 0.20g (equal to the Safe Shutdown Earthquake) was used in the analysis.

The following discussion of earth pressure computations was given in the response to NRC Question 241.5C:

In the design of the Standardized Plant's subsurface walls, the at-rest lateral earth pressure coefficients and the lateral earth pressure distributions shown in Standard Plant FSAR Figure 2.5-7 were used. This figure gives the coefficients for the different backfill materials at the various sites which were used to compute the lateral earth pressures at the top and the bottom of each wall at each site. The maximum earth pressures computed for all sites were taken to be the enveloping pressure and were used in the design of that wall of the Standardized Plant.

For the Callaway ESWS pumphouse (a site-unique structure) the Callaway site lateral earth pressures shown in Standard Plant FSAR Figure 2.5-7 were used in design.

The coefficient of earth pressure at rest used for design of the ESWS pumphouse subsurface walls was 0.33, which corresponds to an angle of internal friction of 42 degrees for the material. Engineering studies of the Category I Granular Structural Backfill showed the material to have an angle of internal friction of 43 to 46 degrees. The material placed against the pumphouse walls up to elevations approximately 1996 to 1998 feet was Category I Structural Fill for support of the eastern part of the pumphouse. Structural fill has an angle of internal friction of 45 to 50 degrees.

For the design of the pumphouse wing walls and other site facilities (i.e., barrier walls, manholes, etc.) cohesive fill was used. For the cohesive fill, the pressure diagrams shown on Standard Plant FSAR Figure 2.5-7 were utilized, with an arrest coefficient of lateral earth pressure of 0.49 and saturated and buoyant unit weights of 127 pcf and 65 pcf, respectively.

2.5.4.11 Design Criteria

The design criteria and methods of analysis for static stability were based on established soil mechanics procedures as discussed in the references cited and explained in Section 2.5.4.10. The computed factors of safety were presented and discussed in Section 2.5.4.10. The minimum factor of safety for bearing capacity was required to be 3.0 for static conditions and 2.0 for combined static and dynamic conditions.

2.5.4.12 Techniques to Improve Subsurface Conditions

The glacial and postglacial soils at the location of the plant were excavated and removed down to the Graydon chert conglomerate. The excavation was made by conventional earthwork equipment.

The clayey soils removed were placed beneath the structures and around perimeter walls with competent compacted fill and backfill. The fill and backfill are placed in thin lifts and compacted, respectively, to a minimum of 95 and 90 percent of the maximum density as determined by ASTM Test Designation D 1557-70. The placement and compaction of fill and backfill were continuously supervised by a qualified engineer, and in-situ density tests were performed to insure that the required densities were obtained.

2.5.4.13 Subsurface Instrumentation

The settlement monitoring program is described in Section 2.5.4.10.

2.5.4.14 Construction Notes

No construction problems affecting safety of the Category I structures were experienced.

A problem did develop when placement of Category I Bedding Material was initiated. Originally, clean sand of a specified gradation was the only material allowed at Category I Bedding Material. Compaction of the sand bedding material to 70 percent relative density based on ASTM D 2049-69 could not be achieved. All sand bedding was removed, and al alternate Category I Bedding Material consisting of limestone aggregate fines was allowed. The aggregate fines were compacted to a minimum of 90 percent of the maximum dry density determined by ASTM Test Designation D 1557-70. The compaction specification of the sand bedding material was later reduced to 70 percent relative density based on a modified ASTM D 2049-69 procedure when tests showed the reduced density was adequate for support of the pipes. Placement of aggregate fines for Category I Bedding Material continued, and no sand was placed as Category I Bedding Material.

2.5.5 STABILITY OF SLOPES

The cut slopes of the UHS retention pond are the only permanent slopes, either natural or man-made, within the plant area. The pond is constructed as a dug reservoir contained within the natural soils at the site.

Temporary excavation slopes were cut during excavation for the Category I structures and pipelines.

2.5.5.1 Slope Characteristics

2.5.5.1.1 Permanent Slopes

The UHS retention pond, shown on Figure 2.5-106, is 334 feet by 684 feet in plan dimensions (at top), with 3:1 (horizontal to vertical) side slopes. Prior to excavation, the existing natural ground sloped from elevations 848 feet in the south (plant northwest) corner of the pond to 834 feet in the north (plant southeast) corner, as shown on Figure 2.5-106.1. The finished grade elevation around the pond is generally 840 feet, rising to 845 feet in the south (plant northwest) corner, as illustrated on Figure 2.5-106. A maximum of 6 feet of fill was placed on the northeast (plant south) portion of the pond perimeter to bring the grade to the required elevation. The extent of this fill is shown on Figure 2.5-106.1. The bottom of the pond is at elevation 818 feet, with design water level at 836 feet and the crest of the outlet structure at 836.5 feet. After 30 days of operational use of water from the pond, the water level will decrease to elevation 821.0 feet, assuming that there is no pond replenishment during that time.

Typical pond slopes are shown on Figure 2.5-106. Riprap (Section 2.4.8.2.2.2) extends from the top of the slope to an 8-foot horizontal bench at elevation 828 feet. The pond has several structures built into and adjacent to the slope (see Figure 2.5-106). These are the ESWS pumphouse and apron slab, the pond outlet structure, the makeup water line, and the ESWS discharge pipes. The cooling tower for Unit 1 is approximately 75 feet east of the top of the pond slope. the location of the cooling tower excavation relative to the pond excavation is shown on Figure 2.5-121.

Details of the field boring program at the pond site are provided in Section 2.5.4.3.1; boring locations are shown on Figure 2.5-106. Menard pressuremeter tests performed in a boring within the pond area are described in Section 2.5.4.2.2.2. Geologic features at the site are described in Section 2.5.1.2. As noted in Section 2.5.4.3.2, geologic mapping of the pond excavation is continuing as excavation progresses. Mapping of the pond slopes completed to date has revealed no zones that pose a seepage threat.

Ground-water conditions existing at the site prior to pond excavation are described and discussed in Sections 2.4.13 and 2.5.4.6. Water level conditions assumed for analyses varied with the slope stability cases considered and are described in Section 2.5.5.2.1. As noted in Section 2.5.4.6, although the ground-water table (top of saturated zone) is raised locally in the vicinity of the completed UHS retention pond, permeabilities are low (Section 2.5.4.2.3.1), so that there is no significant influence on the ground-water table in the plant area. The pond itself is contained above the Graydon chert conglomerate layer (Figure 2.5-121). The low permeabilities of the glacial and postglacial materials (see Table 2.5-15) preclude any significant seepage loss from the pond (Section 2.5.4.6). Therefore, it was considered unnecessary to seal the pond side slopes and bottom with an impervious blanket. The following justification for this conclusion was presented in our response to NRC Question 241.2C.

(ii) Seepage loss from the UHS retention pond was estimated by the construction of flow nets (Reference 2) based on the following: (See Figure 2.5-106 of the Callaway Site FSAR Addendum)

1. A pond slope of 3(H): 1(V) and no liner at the bottom or the sides of the pond.

2. Design pond water level at El. 836.

3. Pond top of slope at El. 845, bottom of pond at El. 818.

4. Impervious (horizontal) layer below the pond bottom at El. 789.

5. Permeability of the soil k = $2x10^{-5}$cm/sec. This permeability for the Graydon chert conglomerate was selected for the assumed homogenous isotropic soil since it was the highest field permeability for all soil materials present in the pond area. This was done to provide the needed conservatism in sizing the pond against seepage.

6. Ground water away from the pond at Case (1) El. 825 (0.8 acre-feet seepage loss), Case (2) El. 812 (1.3 acre-feet seepage loss).

The conservatively high estimates of the seepage analyses resulted in a total seepage loss of 0.8 to 1.3 acre-feet in 30 days. For sizing the pond, among other factors, a seepage loss of 1.3 acre-feet was assumed for 30 days. In addition, the pond is sized to provide a 12% margin above the total water requirements for 30 days following a LOCA. The conservatism of the data base for permeability of soils can be seen in the table below:

Summary Of
Coefficients of Permeability, k, (cm/sec)

Material	Field Tests	Laboratory Tests
Modified Loess	3×10^{-6}	5×10^{-7}
Accretion-Gley	2×10^{-7}	2×10^{-8}
Glacial Till	5×10^{-6}	5×10^{-8} to 5×10^{-5}
Graydon chert conglomerate	2×10^{-5}	3×10^{-8}

k Used in seepage analysis = 2×10^{-5} cm/sec.

The actual seepage loss was expected to be less than the above estimate as it has been proven in a full scale seepage test conducted after the filling of the pond (see Section 2.5.4.6).

(iii) One permeable silt lens and two permeable sand lenses were encountered in the retention pond excavation. The silt body was encountered in the pond slope near the top of the accretion-gley soil stratum near the southeast corner of the pond. The material was removed and replaced with Category I Cohesive Fill. Due to miscommunication at the site, the extent of the body was not mapped at the time the material was removed, and it could not be mapped later because the riprap and filter material had been placed over the area. Figure 2.5-125a was extracted from the detailed mapping report covering the UHS area (Reference 3). The location of the silt lens is not indicated on this figure, but it was located near survey station M4 northeast of the southern pair of discharge pipes.

Two permeable sand bodies were encountered in the bottom of the retention pond. The extent of the materials was mapped as they were excavated and is shown on Figure 2.5-125a. One body was located approximately 80 feet north of the ESWS pumphouse and the other body was located approximately 50 feet southwest of the pumphouse. The sandy material was removed from both areas and replaced with Category I Cohesive Fill.

Three other zones of questionable permeability were located by visual inspection of the retention pond excavation. One zone consisted of a thin layer of somewhat organic material that was found in the slope above the bench near the southwest corner of the pond. This material was topsoil that had not been completely stripped before Category I Cohesive Fill was placed to raise the grade in that area. A second zone of questionable permeability consisted of a lens of modified loess that appeared more silty than normal, which was also found in the upper slope in the southwest corner of the pond. The extent of these areas is shown on Figure 2.5-125a. Thin wall tube samples were obtained of the topsoil and apparent silty modified loess, and laboratory permeability tests were performed on the materials. The coefficients of permeability determined by the tests were less than 10^{-7}cm/sec. These values were less than the value of 2×10^{-5} cm/sec assumed during initial analyses to check the sizing of the pond; therefore, the areas were judged to pose no seepage threat.

The third zone of questionable permeability consisted of several small areas in the bottom of the retention pond where fragments of Graydon chert conglomerate (Gcc) were encountered. The fragments were first thought to be outcrops of the Gcc when encountered during excavation; however, further examination indicated that they were fragments of the Gcc that had been picked up by the glacier and deposited as part of the basal

till soil. The areas where Gcc fragments were exposed are shown on Figure 2.5-125a. Field permeability tests were performed in two of the exposures in October, 1979. The tests showed that the coefficient of permeability was at most 3 x 10^{-6} cm/sec in one area and 6 x 10^{-7} cm/sec in the other area. These values were less than the value of 2 x 10^{-5} cm/sec used during initial analyses to check sizing of the pond, and the exposures were small, scattered, and probably discontinuous; therefore, the exposures were judged to pose no seepage threat.

The seepage test results presented in Section 2.5.4.6 indicate that no significant areas, that would allow a large amount of seepage from the pond, were overlooked during inspection of the slopes and bottom of the retention pond.

(iv) Field permeability tests were performed in six piezometers in the UHS area during preconstruction investigations at the Callaway Plant site. The results of the tests are presented in Table 2.4-22 of the FSAR Site Addendum. Piezometers P104M, P104AG, P104T, and R-1-20 listed in Table 2.4-22 are not in the UHS area. Field permeability tests were performed in five observation wells installed around the completed retention pond in February 1980. The effective interval of all five observation wells included both the accretion-gley and glacial till soil strata. The locations of the observation wells are shown on Figure 2.5-125b, and the results of the tests are given in Table 2.5-18a. The field permeability tests performed in the piezometers and observation wells were falling head tests. The standpipes were filled with water, and the rate of drop with time was recorded. These data were used to calculate the reported coefficients of permeability.

In October, 1979 field permeability tests were performed in two of the small, scattered areas where Graydon chert conglomerate fragments were incorporated in the glacial till exposed on the bottom of the retention pond. The results of the tests showed that the coefficient of permeability was at most 3 x 10^{-6}cm/sec in one area and 6 x 10^{-7}cm/sec in the other area. These tests were constant head tests and were performed in accordance with "Field Permeability Test (Well Permeameter Method) Designation E-19" as described in the Earth Manual (Reference 4).

Subsurface conditions at the site are described in detail in Section 2.5.4.2. At the UHS retention pond, the subsurface materials and their contact elevations established for the two sections considered in the stability analyses are shown on Figure 2.5-115; Table 2.5-52 indicates the range of material thickness existing at the pond site. On parts of the northeast (plant south) portion of the pond slope, fill was required to bring the slope elevation to 840 feet (see Figure 2.5-106.1).

The fill consisted of modified loess soil, obtained on site and compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM Designation D 1557. The pond was excavated through this thin fill layer and into the in-situ soils. The properties of the subsurface materials at the pond site are discussed in Section 2.5.4.2. The in-situ strength properties used in the stability analyses of the pond materials are shown in Table 2.5-15. For the modified loess fill, the strengths are remolded strengths shown in Tables 2.5-17 and 2.5-21. The strength values for the soil units were based on laboratory tests, while the value for the Graydon chert conglomerate was based on the largescale plate load tests.

The values provided in Table 2.5-15 are for static properties. The dynamic properties of the subsurface materials are described in Section 2.5.4.2.3.3. Section 2.5.4.8 indicates that the pond materials are not susceptible to liquefaction due to earthquake loading. Consequently, a pseudo-static analysis of earthquake effects on slope stability was employed, as described in Section 2.5.5.2.1, using the static engineering properties of the soil and rock material.

2.5.5.1.2 Temporary Slopes

The temporary excavations for the plant structures were constructed with side slopes of 1:1 (horizontal to vertical), extending from the ground surface to the top of Graydon chert conglomerate with a maximum depth of slope of about 30 feet. Excavation profiles showing the relationship of the temporary excavations to the natural soil, rock, and compacted fill and backfill are presented on Figures 2.5-120 through 2.5-123. The extent of the Category I excavations showing the temporary cut slopes is presented on Figure 2.5-119.

2.5.5.2 Design Criteria and Analyses

2.5.5.2.1 Permanent Slopes

2.5.5.2.1.1 Design Criteria

The slope stability of the UHS retention pond was verified for both static and earthquake cases, assuming various water levels in the pond and pond walls. The design SSE for the pond is 0.25 g. Minimum acceptable factors of safety against slope failure are the following (U.S. Army Corps of Engineers, 1970):

	Condition	Minimum Factor of Safety
1.	End of Excavation	1.4
2.	Maximum Pond Level	1.5
3.	Partial Pond Level	1.5

4.	Earthquake, Maximum Pond, 0.25 g Acceleration	1.1
5.	Earthquake, Partial Pond, 0.25 g Acceleration	1.1

The partial pond level used above is the level equivalent to an elevation of 823 feet, 5 feet above the UHS pond bottom. In this condition, the pond level is drawn down from the design level of elevation 836 feet to elevation 823 feet. This partial pond condition approximates the conventional rapid drawdown situation for the dug pond.

In addition to the above conditions, the slopes were verified for end of construction and maximum pond conditions for a representative live load case that could occur during construction or during future operations; this load comprised a uniform surcharge of 250 pounds per square foot. Furthermore, the slopes were verified, under seismic conditions, for construction of plant support buildings with footings 65 feet from the top edge of the pond berm with a 15 kip per foot load.

Two sections (Figure 2.5-115) were selected for analysis. The locations of these sections, shown on Figure 2.5-106, are representative of extreme conditions in the pond area. At all locations, the pond slopes are 3:1 (horizontal to vertical). Section X-X' is representative of conditions at the southwest (plant north) end of the pond where the maximum amount of cut is located. Section Y-Y' is representative of conditions at the northeast (plant south) end of the pond where the maximum amount of fill was placed. These sections are based on the boring data and subsurface profiles presented in Section 2.5.4.3. The ground-water and pond level combinations used for the stability analyses represent conditions that will result in conservative estimates of factor of safety. These levels are illustrated on Figures 2.5-115.1 through 2.5-115.6 and summarized in Table 2.5-53.

The in-situ soil strength parameters assumed in the slope stability analyses were discussed in Section 2.5.5.1.1 and are presented in Table 2.5-15. The fill properties are based on the remolded strengths of the modified loess described in Section 2.5.4.2 and shown in Tables 2.5-17 and 2.5-21. The accretion-gley material is moderately susceptible to swelling. For the end of excavation condition, soil strength parameters based on tests without swelling are used. For the other conditions, assumed strengths are reduced to account for anticipated swelling. As indicated in Section 2.5.4.2.3.2.1, results from in-situ Menard pressuremeter tests indicate that the undrained strength parameters used in the stability analysis are conservative. Also, the drained strength parameters of the Graydon chert conglomerate underestimate the in-situ strength of the material due mainly to the effects of sample disturbance.

2.5.5.2.1.2 Method of Analysis

The stability of the pond slopes was evaluated using the simplified Bishop Method. In this method, the soil mass within an assumed circular failure surface is divided into vertical

slices. From consideration of the limit equilibrium of the slices, the forces acting on each slice are evaluated. The equilibrium of the entire mass is determined by summation of the forces on all the slices. The analysis is simplified for circular arcs (with little resulting loss of accuracy) by assuming that the resultant of the vertical forces on the side of each slice is equal to zero. The factor of safety of the slope against sliding failure along the assumed circular slip surface is the ratio of the resisting forces along the slip surface (due to the shear strength of the soils) to the driving forces of the soil mass. Earthquake effects are included in the analyses by a pseudo-static method in which inertia force equal to a horizontal force applied at the center of gravity of each slice of soil is added to the driving forces. This inertia force is equal to the total slice weight times 0.25, which is the SSE coefficient for the UHS retention pond.

The simplified Bishop Method of analysis was performed using the McDonnell Douglas computer program ICES SLOPE (1974). PC-SLOPE was used to compute effects of support building loads on slope stability with program results verified with the ICES SLOPE program results. This method is suited to computer analysis for three reasons. First, for each slope condition a large number of slip circle centers, each with a large number of assumed radii, can be generated and analyzed; second, an iterative process is used for each circle analyzed; and third, a large number of slices can be assumed for each circle analyzed, increasing the accuracy of the results. An abstract of the ICES SLOPE (1974) program is provided in Appendix 3.8A.

2.5.5.2.1.3 Total and Effective Stress Analyses

Each of the two sections on Figure 2.5-115 was analyzed for the seven different conditions indicated on Table 2.5-53. Except for the earthquake conditions discussed below, each condition was analyzed using both total stress and effective stress parameters. Total stress analysis has conventionally been applied to nonfissured clay soils in situations in which the shear strength of the soil may be assumed to be the same before and after a stress change that might lead to failure; it is assumed that the stress producing failure occurs so rapidly that no opportunity for drainage is afforded whereby the soil can increase in shear strength by consolidation. Effective stress analysis can, in theory, be applied to all conditions, although it is often used for stiff fissured clays or for long-term conditions where excess pore pressures have dissipated and the soil is in a drained condition. For the UHS retention pond, each of the conditions considered (except the earthquake conditions) was analyzed using both total and effective stress parameters to envelope all situations.

Earthquakes generally produce cyclic loadings which are rapid enough that pore pressures in the soil build up and the soil conditions can be considered essentially undrained; the earthquake condition is, therefore, limited to a stability evaluation by total stress analysis. The materials comprising the pond slopes are not susceptible to liquefaction (Section 2.5.4.8). Analysis is confined to simulating the earthquake forces with a horizontal force equal to the SSE coefficient for the pond times the slice weight. In the earthquake analysis, slice weight is considered as the total weight of the soil in the slice, regardless of the assumed water level within the slice.

2.5.5.2.1.4 Results of Slope Stability Analyses

The critical circles for the slope stability analyses are presented in Figures 2.5-115.1 through 2.5-115.6. A summary of the minimum factors of safety are presented in Table 2.5-54. In all cases, the factors of safety are substantially greater than the minimum requirements.

2.5.5.2.2 Temporary Slopes

The stability of temporary slopes was analyzed using the modified Bishop method. Only the static case was analyzed using both effective stress and total stress parameters, based on a maximum height of slope of 40 feet. In the total stress analysis, the calculated value of factor of safety exceeded 3.5 for the temporary side slopes of 1:1, while in the effective stress analysis, the calculated factor of safety was 1.0.

It is not expected that a totally drained condition in the slopes will develop during the excavation operations. Therefore, a temporary slope of 1:1 during excavation was considered adequate.

2.5.5.3 Logs of Borings

The locations of the test borings at the site with respect to the structures are shown on Figures 2.5-104 and 2.5-105. The logs of borings are presented on Figures 2.5-146 through 2.5-293. The details of the field investigations were presented in Section 2.5.4.3.

2.5.5.4 Compacted Fill

Category I Cohesive Fill as described in Section 2.5.4.5.4 was placed around the northeast (plant south) end of the UHS retention pond to raise the grade to elevation 840 feet. All topsoil was stripped before placement of the cohesive fill was initiated. The material was compacted to a minimum of 90 percent of the maximum dry density determined by the ASTM Designation D 1557-70 method of compaction. The material was compacted at moisture contents less than 5 percent above the optimum moisture content for the material determined by the ASTM D 1557-70 compaction test. Sufficient in-place density tests were performed to verify that the material was placed and compacted in accordance with the specifications.

The area of Category I Cohesive Fill placement around the northeast end of the UHS retention pond is shown on Figures 2.5-106.1.

REFERENCES: SECTION 2.5

Published References

REFERENCES: SECTION 2.5 (Continued)

Aggarwal, Y., 1977, Study of earthquake hazards in New York and adjacent states. Lamont-Doherty Geological Observatory, Annual Technical Report, Phase IV (September 30).

Algermissen, S.T., and Perkins, D.M., 1976, A probabilistic estimate of maximum acceleration in rock in the contiguous United States. U.S. Geological Survey Open File Report 76-416, Department of Interior, 45 p.

Allen, W.H., 1973, First-look analysis of geologic ground patterns on ERTS-1 imagery of Missouri. ERTS Symposium 2.

American Association of Petroleum Geologists, 1971, Future petroleum provinces of the United States - their geology and potential. American Association of Petroleum Geologists, Tulsa, Oklahoma, Memoir, Vol. II, no. 15, p. 1214-1217.

Applied Technology Council, 1976, Working draft of recommended comprehensive seismic design provisions for building. Prepared by Applied Technology Council, San Francisco, California, sponsored by National Science Foundation Research Applied to National Needs Program and National Business Standards (January 31).

Army, Department of, 1970, U.S. Army Engineer Manual 1110-2-1906. Washington, D.C.

Atherton, E.T., 1971, Tectonic development of the eastern interior region of the United States, in Background materials for symposium on future petroleum potential of NCP region 9 (Illinois Basin, Cincinnati Arch, and northern part of Mississippi Embayment). Illinois State Geological Survey, Urbana, Illinois, Illinois Petroleum 96, p. 29-43.

Barosh, P.J., 1969, Use of seismic intensity data to predict effects of earthquakes. U.S. Geological Survey, Washington, D.C., Bulletin No. 1279.

Baxter, J.W., and Desborough, G.A., 1965, Areal geology of the Illinois fluorspar district, Part 2. Illinois State Geological Survey, Urbana, Illinois, Circular No. 385.

Baxter, J.W., Potter, P.E., and Doyle, F.L., 1963, Areal geology of the Illinois fluorspar district, Part 1. Illinois State Geological Survey, Urbana, Illinois, Circular No. 343.

Baxter, J.W., Desborough, G.A., and Shaw, C.N., 1967, Areal geology of the Illinois fluorspar district, part 3. Illinois State Geological Survey, Urbana, Illinois, Circular No. 413.

Baxter, J.W., Bradbury, J.C., and Hester, N.C., 1973, A geologic excursion to fluorspar mines in Hardin and Pope counties, Illinois. Illinois State Geological Survey, Urbana, Illinois, guidebook, series 11.

REFERENCES: SECTION 2.5 (Continued)

Bell, A.H., 1929, The Dupo oil field. Illinois State Geological Survey, Urbana, Illinois, Illinois Petroleum, no. 17.

_____, 1943, Subsurface structure on the base on the Kinderhook-New Albany Shale in central and southern Illinois. Illinois State Geological Survey, Urbana, Illinois, Report of Investigation No. 92.

Bell, A.H., et al., 1964, Deep oil possibilities of the Illinois Basin. Illinois State Geological Survey, Urbana, Illinois, Circular No. 38, 38 p.

Ben-Menahem, A., and Singh, S.J., 1972, Computation of models of elastic dislocations in the earth, in Methods of computational physics, seismology--body waves and sources. Academic Press, New York, Bruce A. Bolt, editor, vol. 12.

Bieber, C.L., 1946, Structures and structural trends in southwest Missouri. Missouri Geological Survey and Water Resources, Rolla, Missouri, unpublished manuscript.

_____, 1955, The structural geology of southwestern Missouri. Missouri Geological Survey and Water Resources, Rolla, Missouri, unpublished manuscript.

Billings, M.P., 1972, Structural geology, 3rd ed. Prentice Hall, Englewood, New Jersey.

Bishop, A.W., and Henkel, D.J., 1962, The measurement of soil properties in the triaxial test. Edward Arnold Ltd. (Publishers), London, England, 228 p.

Bollinger, C.A., 1977, Reinterpretation of the intensity data for the 1886 Charleston, South Carolina, earthquake, in Preliminary Studies of the 1886 Charleston, South Carolina earthquake, U.S. Geological Survey Professional Paper 1028.

Bond, D.C., et al., 1971, Possible future petroleum potential of region 9 - Illinois Basin, Cincinnati Arch, and northern Mississippi Embayment, in Cram, I.H., Future petroleum provinces of the United States--their geology and potential. American Association of Petroleum Geologists, Memoir, vol. II, no. 15.

Brackenridge, H.M., 1814, View of Louisiana.

Bradbury, J.C., and Atherton, D., 1965, The Precambrian basement of Illinois. Illinois State Geological Survey, Urbana, Illinois, Circular No. 382, p. 9.

Bradford's Illustrated Atlas of the United States, 1854.

Braile, L.W., et al., 1978, An integrated geophysical and geological study of the tectonic framework of the 38th Parallel Lineament in the vicinity of its intersection with the extension of the New Madrid fault zone, in New Madrid seismotectonic study - activities during fiscal year 1978, T.C. Buschbach, editor, NRC, NUREG/CR-0450, p. 16-44.

REFERENCES: SECTION 2.5 (Continued)

Braile, L.W., and Hinze, W.J., 1979, What is the northeastern extent of the New Madrid Fault Zone? Geological Society of America, Abstracts with Programs, vol. II, no. 2, p. 145.

Branson, E.B., 1944, The geology of Missouri. University of Missouri, Columbia, Missouri, Studies no. 3, vol. XIX, p. 274-275.

Brazee, R.J., 1969, Attenuation of modified Mercalli intensities with distance for the United States east of latitude 109. Seismological Society of America, Bulletin.

Brill, K.G., et al., 1960, Middle Mississippian and Pennsylvanian stratigraphy of St. Louis and St. Louis County, Missouri. Association of Missouri geologists, 7th Annual field trip guidebook, 14 p.

Bristol, H.M., 1967, Structure of the base of the Mississippian Beech Creek (Barlow) Limestone in Illinois. Illinois State Geological Survey, Urbana, Illinois, Illinois Petroleum, no. 88, plate 1.

Bristol, H.M. and Treworgy, J.D., 1978, The Wabash Valley Fault System in southeastern Illinois, in New Madrid seismotectonic study - activities during fiscal year 1978. T.C. Buschbach, editor, NRC, NUREG/CR-0450, p. 105-111.

Broadhead, G.C., 1889, The geological history of the Ozark Uplift. American Geology, vol. 3, p. 6-13.

Brownfield, R.L., 1954, Structural history of the Centralia area. Illinois State Geological Survey, Urbana, Illinois, Report of Investigation No. 172.

Buschbach, T.C., 1973, Illinois State Geological Survey, unpublished report.

_____, 1978, Geologic setting of the New Madrid area, Abs. of 3rd Ann. A.G.U. Midwest Meeting, Sept. 26-28, 1977, in New Madrid seismotectonic study-activities during fiscal year 1978. NRC, NUREG/CR-0450, p. 123.

Buschbach, T.C., and Ryan, R., 1963, Ordovician explosive structure at Glasford, Illinois. American Association of Petroleum Geologists, vol. 47, no. 12, p. 2015-2022 (December).

Byerly, P., 1926, The Montana earthquake of June 28, 1925. Seismological Society of America, Bulletin No. 16, p. 209-263.

_____, 1928, Nature of first motion in the Chilean earthquake of November 11, 1922. American Journal of Science, no. 16, p. 232-236.

_____, 1930, Love waves and the nature of the motion at the origin of the Chilean earthquake of November 11, 1922. American Journal of Science, no. 19, p. 274-282.

REFERENCES: SECTION 2.5 (Continued)

Casagrande, A., 1936, The determination of the preconsolidation load and its practical significance, in Proceedings International Conference on Soil Mechanics and Foundation Engineering, vol. III, p. 60-64.

Cedergren, H.R., 1968, Seepage, drainage, and flow nets: John Wiley & Sons, New York.

Charles, H.H., 1927, Oil and gas resources of Anderson County, Kansas. Kansas State Geological Survey, Lawrence, Kansas, Bulletin No. 6.

Clair, J.R., 1943, Oil and gas resources of Cass and Jackson counties, Missouri. Missouri Geological Survey and Water Resources, Rolla, Missouri, vol. 27, 2nd series, p. 208.

Clark, E.L., 1941, Geology of the Cassville Quadrangle, Parry County, Missouri. University of Missouri, Columbia, Missouri, unpublished Ph.D. dissertation.

Clegg, K.E., 1965, The LaSalle anticlinal belt and adjacent structures in east-central Illinois. Illinois State Geological Survey, Urbana, Illinois, reprint 1965-H, p. 13.

Clegg, K.E., and Bradbury, J.C., 1956, Igneous intrusive rocks in Illinois and their economic significance. Illinois State Geological Survey, Urbana, Illinois, Report of Investigation 197, 19 p.

Coffman, J.L., and von Hake, C.A., 1973, Earthquake history of the United States. U.S. Government Printing Office, Washington, D.C., 200 p.

Cohee, G. V., 1940, Recent developments in oil and gas in Illinois. Illinois State Geological Survey, Urbana, Illinois, Circular No. 97, p. 6.

Cole, V.B., 1961, The Cap au Gres Fault, in Guidebook of 26th annual field conference of the Kansas Geological Society. Missouri geological Survey and Water Resources, Rolla, Missouri, Report of Investigation No. 27, p. 86-88.

_____, 1962, Configuration of top of Precambrian basement rocks in Kansas. Kansas Geological Survey, Lawrence, Kansas, Oil & Gas Investigation No. 26, map.

_____, 1976, Configuration of top of Precambrian rocks in Kansas. Kansas Geological Survey, map M-7.

Cordell, R.J., 1950, Preliminary report on the geology of Grundy County. Missouri Geological Survey and Water Resources, Rolla, Missouri, unpublished manuscript.

Coulter, H.W., Waldron, H.H., and Devine, J.F., 1973, Seismic and design considerations for nuclear facilities. Proceedings of the 5th World conference on Earthquake Engineering, Rome, Italy, paper No. 302.

REFERENCES: SECTION 2.5 (Continued)

Cushing, E.M., Boswell, E.H., and Hosman, R.L., 1964, General Geology of the Mississippi Embayment. U.S. Geological Survey Professional Paper 448-B.

Dake, C.L., 1927, Early diastrophic events in the Ozarks. (Abstract) Geological Society of America Bulletin, vol. 38, p. 157-158.

_____, 1930, The geology of the Potosi and Edgehill quadrangles. Missouri Bureau of Geology and Mines, vol. 23, 2nd series, p. 233.

Dake, C.L., and Bridge, J., 1932, Buried and resurrected hills of central Ozarks. American Association of Petroleum Geologists, Bulletin, vol. 16, p. 629-652.

Dames & Moore, 1975, Report, on-site rock quarry site selection and feasibility study, source of coarse aggregate, Callaway Plant, Units 1 and 2, for Union Electric Company. Dames & Moore, Park Ridge, Illinois (April 11).

_____, 1975, Report, engineering geology investigation, on-site production mine quarry, source of coarse aggregate, Callaway Plant, Units 1 and 2, for Union Electric Company. Dames & Moore, Park Ridge, Illinois (July 31).

_____, 1975, Report, field and laboratory investigations of the crushed stone structural fill, Callaway Plant, Units 1 and 2, for Union Electric company. Dames & Moore, Park Ridge, Illinois (August 8).

_____, 1976, Report, results of plate load tests on graydon chert conglomerate, unit 1 power block excavation, for Union Electric Company. Dames & Moore, Park Ridge, Illinois (June 24).

_____, 1976, Report, results of plate load tests on graydon chert conglomerate, unit 2 power block excavation, for Union Electric Company. Dames & Moore, Park Ridge, Illinois (October 27).

_____, 1976, Report, results of detailed excavation mapping, Callaway Plant, Units 1 and 2, for Union Electric Company. Dames & Moore, Park Ridge, Illinois (August 24).

_____, 1977, Report addendum, engineering geology investigation, proposed on-site production mine quarry, source of coarse aggregate, Callaway Plant Units 1 and 2, for Union Electric Company. Dames & Moore, Park Ridge, Illinois (June 2).

_____, 1979, Interim report, results of detailed excavation mapping, ultimate heat sink excavation, Callaway Plant, Units 1 and 2, for Union Electric Company. Dames & Moore, Park Ridge, Illinois (April 25).

Dames & Moore, 1981, Results of seepage test, ultimate heat sink retention pond, Callaway Plant, Units 1 and 2: Dames & Moore, Park Ridge, Illinois (February 25).

REFERENCES: SECTION 2.5 (Continued)

Dames & Moore, 1980, Results of detailed excavation mapping, ultimate heat sink area, essential service water system, and unit 1 power block subgrade, Callaway Plant, Units 1 and 2: Dames & Moore, Park Ridge, Illinois (July 29).

Darby's Universal Gazetteer, 1827.

Docekal, J., 1970, Earthquakes of the stable interior with emphasis on the midcontinent. University of Nebraska, unpublished Ph.D. dissertation.

DuBois, E.P., 1951, Geology and coal resources of a part of the Pennsylvanian System in Shelby, Moultrie, and portions of Effingham and Fayette countries. Illinois State Geological Survey, Urbana, Illinois, Report of Investigation No. 156.

DuBois, S.M., and Wilson, F.W., 1978, A revised and augmented list of earthquake intensities for Kansas, 1867-1977. Kansas Geological Survey, Lawrence, Kansas, Environmental Geology Series 2, 56 p.

Eardley, A.J., 1962, Structural geology of North America. Harper and Row, New York, 2nd edition, p. 37.

Ellis, J.F., 1929, The influence of the environment on the settlement of Missouri.

Eppley, R.A., 1965, Earthquake history of the United States, Part 1, stronger earthquakes of the United States (exclusive of California and western Nevada) through 1963. U.S. Coast and Geodetic Survey.

Farrar, W., and McManamy, L., 1937, The geology of Stoddard County, Missouri. Missouri Geological Survey and Water Resources, Rolla, Missouri, 59th Biennial report 1935-1936, Appendix 6, p. 92.

Fenneman, N.M., 1911, Geology and mineral resources of the St. Louis Quadrangle, Missouri-Illinois. U.S. Geological Survey, Washington, D.C., Bulletin No. 438, map, p. 73.

_____, 1931, Physiography of the Western United States. McGraw Hill, New York, p. 534.

_____, 1938, Physiography of the Western United States. McGraw Hill, New York, 714 p.

_____, 1946, Physical divisions of the United States. U.S. Geological Survey, Washington, D.C., map.

Finch, W.I., 1971, Geologic map of part of the Bondurant quadrangle, Fulton County, Kentucky and New Madrid and Mississippi counties, Missouri. U.S. Geological Survey, Washington, D.C., map GQ-944.

REFERENCES: SECTION 2.5 (Continued)

Fischer, J.A., et al., 1970, Seismotectonic relationships of the New Madrid, Missouri, region. Geological Society of America, vol. 2, no. 7, abstracts, p. 551.

Fisk, H.N., 1944, Geological investigation of the Alluvial Valley of the lower Mississippi River. U.S. Army Corps of Engineers, Mississippi River Commission, Vicksburg, Mississippi, 1 vol. of text, 78 p., 1 vol. of maps.

Flint, R.F., 1918, The geology of parts of Perry and Cape Girardeau Counties, Missouri. University of Chicago, Chicago, Illinois, unpublished Master's thesis.

_____, 1926, Thrust faults in southeastern Missouri. American Journal of Science, vol. 12, p. 37-40.

Foster, W.H., 1929, Coffeyville oil field, Montgomery County, Kansas. American Association of Petroleum Geologists, Structure of Typical American Oil Fields, vol. 1.

Fox J.H., 1954, Cryptovolcanic force field, St. Louis University, St. Louis, Missouri, unpublished Ph.D. dissertation.

Frank, A.J., 1945, The earthquake of March 27, 1945, on the Moselle (Missouri) Fault. American Geophysical Union, trans., vol. 26, no. 3, p. 347-351.

_____, 1948, Faulting on the northeastern flank of the Ozarks, Missouri. Geological Society of America, Bulletin, vol. 12, no. 59, Part 2, 1322 p.

Franks, P.C., 1966, Ozark Pre-Cambrian-Paleozoic relations. American Association of Petroleum Geologists, Bulletin, vol. 50, no. 5, 1035 p.

Friedman, M., 1964, Petrofabric techniques for the determination of principal stress directions in rocks, in State of stress of the earth's crust. William R. Judd, ed., Proceedings of the International Conference, June 13-14, 1963, Santa Monica, California, p. 451-552.

Frye, J.C., et al., 1960, Accretion-gley and the gumbotil dilemna. American Journal of Science, vol. 258, no. 3.

_____, 1960, Accretion-gley, and the weathering profile. Illinois Geological Survey, Urbana, Illinois, Circular No. 295.

Fuller, D.L., et al., 1967, Ground water in Mineral and water resources of Missouri. U.S. Geological Survey, Missouri Division of Geological Survey and Water Resources, Rolla, Missouri, Document, vol. XLII, no. 19, 2nd series, p. 281-313.

Fuller, M.L., 1905, The New Madrid earthquake, by Shepard, Edward M., in American geologist, vol. 35. Journal of Geology, vol. 13, p. 45-62.

REFERENCES: SECTION 2.5 (Continued)

_____, 1912, The New Madrid earthquake. U.S. Geological Survey, Bulletin, no. 494, pp. 119, and abstracts from Brooks, A.H., Washington Academy of Science, Journal, vol. 2, p. 350-351.

Gealy, J.R., 1955, Geology of the Cape Girardeau and Jonesboro quadrangles, southeastern Missouri. Yale University, New Haven Connecticut, unpublished Ph.D. dissertation.

Gentile, R.J., 1965, Stratigraphy, sedimentation, and structure of the Upper Cherokee and Lower Marmaton (Pennsylvanian) rocks of Bates County and portions of Henry and Vernon counties, Missouri. University of Missouri, Rolla, Missouri, unpublished Ph.D. dissertation.

_____, 1976, The geology of Bates County, Missouri. Missouri Geological Survey and Water Resources, Rolla, Missouri, Report of Investigation No. 59, 89 p.

Gibbons, J.F., 1972, Tectonics of the eastern Ozarks area, southeastern Missouri. Syracuse University, Syracuse, New York, unpublished Ph.D. dissertation, 70 p.

Gordon, D.W., et al., 1970, The south-central Illinois earthquake of November 9, 1968 - macroseismic studies. Seismological Society of America, Bulletin, vol. 60, p. 221-250.

Graves, H.B., 1938, The Precambrian Structure of Missouri. Transactions of the St. Louis Academy of Science, vol. 29, p. 111-161.

Gregory, B.W., 1954, Geology of the Coloma quadrangle, Missouri. University of Missouri, Columbia, Missouri, unpublished Master's thesis.

Grogan, R.M., and Bradbury, J.C., 1968, Fluorite-zinc-lead deposits of the Illinois mining district, in Ore deposits in the United States 1933/1967, V.I. American Institute of Mining Engineers, New York, p. 370-399.

Grohskopf, J.G., 1955, Subsurface geology of the Mississippi Embayment of southeast Missouri. Missouri Geological Survey and Water Resources, Rolla, Missouri, vol. 37, 2nd series.

Grohskopf, J.G., Hinchey, N.S., and Greene, F.C., 1939, Subsurface geology of northeastern Missouri. Missouri Geological Survey and Water Resources, Rolla, Missouri, 60th Biennial report, appendix 1, p. 1-60.

Gross, R.E., 1949, The geology of the southwestern quarter of the Elsberry quadrangle, Missouri. University of Iowa, Iowa City, Iowa, unpublished Master's thesis.

Gubin, I.E., 1967, Earthquakes and seismic zoning. International Institute of Seismology, Bulletin, vol. 4, p. 107-126.

REFERENCES: SECTION 2.5 (Continued)

Gupta, I.N., 1976, Attenuation of intensities based on isoseismals of earthquakes in central United States. Earthquake Notes, vol. 47, no. 3, p. 13-20.

Gupta, I.N., and Nuttli, O.W., 1976, Spatial attenuation of intensities for central United States earthquakes. Bulletin Seismological Society of America, vol. 66, p. 743-752.

Gutenberg, B., and Richter, C.F., 1942, Earthquake magnitude, intensity, energy, and acceleration. Seismological Society of America, Bulletin, vol. 32, p. 163-191.

Harlan, J.L., 1951, The geology of the east-central portion of the Jefferson City quadrangle, Missouri. University of Missouri, Columbia, Missouri, unpublished Master's thesis.

Harris, S.E., and Parker, M.C., 1964, Stratigraphy of the Osage Series in southeastern Iowa. Iowa Geological Survey, Iowa City, Iowa, Report of Investigation No. 1, p. 52.

Harrison, J.A., 1951, Subsurface geology and coal resources of the Pennsylvanian System in White County, Illinois. Illinois State Geological Survey, Urbana, Illinois, Report of Investigation No. 153.

Hayes, W.C., Jr., 1960, Reconnaissance mapping in Christian, Douglas, Stone, and Reynolds counties, Missouri. Missouri Geological Survey and Water Resources, Rolla, Missouri, unpublished maps.

Hayes, W.C., 1962, Precambrian lineament map of Missouri. Missouri geological Survey, Rolla, Missouri, open file.

Heflin, L.H., 1961, The geology of the southern half of Warrenton quadrangle. University of Missouri, Columbia, Missouri, unpublished Master's thesis.

Heigold, P.C., 1968, Notes on the earthquake of November 9, 1968, in southern Illinois. Illinois Geological Survey, Environmental Geology Notes No. 24, 16 p.

Heinrich, R.R., 1941, A contribution to the seismic history of Missouri. Seismological Society of America, bulletin, vol. 31, no. 3, p. 187-204 (July), and Master's thesis, 1938, St. Louis University, St. Louis, Missouri, unpublished.

Hendricks, H.E., 1942, Geology of the Macks Creek quadrangle, Missouri. University of Iowa, Iowa City, Iowa, unpublished master's thesis.

_____, 1954, Geology of the Steelville quadrangle, Missouri. Missouri Geological Survey and Water Resources, Rolla, Missouri, vol. 36, 2nd series, p. 52-72.

Herrmann, R.B., 1978, A seismological study of the northern extent of the New Madrid seismic zone, in New Madrid seismotectonic study - activities during fiscal year 1978, T.C. Buschbach, editor. NRC, NUREG/CR-0450, p. 94-104.

REFERENCES: SECTION 2.5 (Continued)

_____, 1979, Surface wave focal mechanisms for eastern North American earthquakes with tectonic implications, in Journal Geophysical Research, vol. 84 (in press).

Hershberger, J., 1956, A comparison of earthquake accelerations with intensity ratings. Seismological Society of America, Bulletin, vol. 46, no. 4, p. 317-320.

Heyl, A.V. et al., 1965, Regional structure of the southeast Missouri and Illinois Kentucky mineral districts. U.S. Geological Survey, Bulletin No. 1202-B, p. 20.

_____, 1972, The 38th parallel lineament and its relationship to ore deposits. Economic Geology, vol. 67, p. 885-887, and abstracts, p. 879-894.

_____, 1977, Some major lineaments in the central United States. Geological Society of America, Abstracts with Programs, vol. 9, no. 5, p. 605 (March).

Hildenbrand, T.G., et al., 1977, Magnetic and gravity anomalies in the northern Mississippi Embayment and their spatial relation to seismicity, miscellaneous field studies map, MF-914. U.S. Geological Survey, Ecological Survey.

Hinds, H., 1912, Coal deposits of Missouri. Missouri Bureau of Geology and Mines, vol. 11, 2nd series, 503 p.

Hinds, H., and Greene, P.C., 1915, The stratigraphy of the Pennsylvanian Series in Missouri. Missouri Bureau of Geology and Mines, vol. 13, 2nd series, p. 407.

Hinze, W.J., et al., 1977, A tetonic overview of the central midcontinent. U.S. NRC publication NUREG-0382, R6A, p. 106.

History of Callaway County, Missouri, 1884.

Hopper, M.G., and Algermissen, S.T., 1980, An evaluation of the effects of the October 31, 1985, Charleston, Missouri, earthquakes: U.S. Geological Survey, Open-File Report 80-778, 43 p.

Howe, W.B., et al., 1961, The stratigraphic succession in Missouri. Missouri Geological Survey and Water Resources, Rolla, Missouri, Report, no. 40, 2nd series, p. 10-136.

Howe, W.B., and Fellows, L.D., 1977, The resources of St. Charles County, Missouri, land, water and minerals. Missouri Geological Survey and Water Resources, Rolla, Missouri, 233 p.

Howe, W.B., and Heim, G.E., Jr., 1968, The Ferrelview Formation of Missouri. Missouri Geological Survey and Water Resources, Rolla, Missouri, Report of Investigations, no. 42, p. 17.

Howell, B.F., Jr., 1959, Introduction of geophysics, isoseismal map of Charleston, South Carolina, 1886. McGraw-Hill Book Company, New York.

REFERENCES: SECTION 2.5 (Continued)

Illinois State Geological Survey, 1971, Background materials for symposium on future petroleum potential of NPC region 9. Illinois State Geological Survey, Urbana, Illinois, Illinois Petroleum 96, 63 p.

Indiana Geological Survey, 19774, Earthquake list. Department of Natural Resources, Geological Survey, Bloomington, Indiana, 18 p.

James, J.A., 1951, The relationship of regional structural geology to the ore deposits in the southeastern Missouri mining district. University of Missouri, Columbia, Missouri, unpublished Ph.D. dissertation.

Janbu, N., 1967, Settlement calculations based on the tangent modulus concept, in Soil mechanics and foundation engineering. The Technical University of Norway, Trondheim, Norway.

Jewett, J.M., 1951, Geologic structures in Kansas. Kansas State Geological Survey, Lawrence, Kansas, Bulletin no. 90.

Jewett, J.M., and Abernathy, G.E., 1945, Oil and gas in eastern Kansas. Kansas State Geological Survey, Lawrence, Kansas, Bulletin No. 57, p. 244.

Jewett, J.M., and Merriam, D.F., 1959, Geological framework of Kansas -- a review of geophysicists, in Symposium on geophysics in Kansas. Kansas State Geological Survey, Lawrence, Kansas, Bulletin No. 21.

Jewett, J.M., and Newell, N.O., 1935, The geology of Wyandotte County, Kansas. Kansas State Geological Survey, Lawrence, Kansas, Bulletin No. 21.

Johnston, A.C., in press, On the use of the frequency-magnitude relation in earthquake risk assessment: Submitted for presentation for the conference on Earthquakes and Earthquake Engineering: The Eastern U.S. - Knoxville, Tennessee, September 14 - 16, 1981.

Kane, M.F., 1977, Correlation of major eastern earthquake epicenters with mafic/ ultramafic basement masses. U.S. Geological survey, Professional Paper 1028, p. 199-204.

Keller, G.R., and Austin, C.B., 1977, Gravity studies of features along the 38th Parallel lineament. Geological Society of America, Abstracts with Programs, vol. 9, no. 5, 1977, p. 614, (March).

Keyes, C.R., 1894, Crustal adjustment in the Upper Mississippi Valley. Geological society of America, Bulletin, vol. 5, p. 231-242.

Kiilsgaard, T.H., et al., 1963, The Crooked Creek disturbance, southeast Missouri. U.S. Geological Survey, Professional Paper 450-E, p. 14-19.

REFERENCES: SECTION 2.5 (Continued)

King, P.B., 1959, Evolution of North America. Princeton University Press, Princeton, New Jersey, p. 10.

Kisslinger, C., and Nuttli, O.W., 1965, The earthquake of October 20, 1965, and Precambrian structure in Missouri. Earthquake Note No. 36, p. 32-36.

Kisvarsanyi, E.B., 1974a, Operation basement-buried Precambrian rocks of Missouri - their petrography and structure. American Association of Petroleum Geologists, vol. 58, no. 4, p. 674-684.

_____, 1974b, Ortho-polygonal tectonic patterns in the exposed and buried Precambrian basement of southeast Missouri, in Proceedings of the First International Conference on the new basement tectonics, Salt Lake City, Utah (June 3-7). Utah Geological Association Public, no. 5, p. 169-182.

Koenig, J.W., 1960 Reconnaissance mapping in Stone and Taney counties for state geologic map. Missouri Geological Survey and Water Resources, Rolla, Missouri, unpublished quadrangle maps.

Kolata, D.P., 1978, Structural framework of the Mississippi Embayment of southern Illinois, in New Madrid seismotectonic study - activities during fiscal year 1978, T.C. Buschbach, editor, NRC, NUREG/CR-0450, p. 75-90.

Kolata, D.R., Treworgy, J.D., and Masters, J.M., 1979, Structural Framework of the Mississippi Embayment in southernmost Illinois. Geological Society of America, Abstracts with Programs, vol. II, no. 2, p. 150-151.

Kolata, D.R., Treworgy, J.D., and Masters, J.M., 1981, Structural Framework of the Mississippi Embayment of southern Illinois: Illinois State Geological Survey, Circular 516, 38 p.

Knight, R.D., 1962, Map of the groundwater areas of Missouri. Missouri Geological Survey and Water Resources, Rolla, Missouri.

Krey, F., 1924, Structural reconnaissance of the Mississippi Valley area from Old Monroe, Missouri, to Nauvoo, Illinois. Illinois State Geological Survey, Urbana, Illinois, Bulletin, no. 45, pp. 38-39. Missouri Bureau of Geology and Mines, vol. 18, 2nd Series, map, p. 86.

Kukla, G.J., and Opdyke, N.D., 1973, Paleomagnetic correlation of Early Pleistocene in the glaciated American midwest. Unpublished discussion paper presented at 7th Annual Meeting, North Central Division, Geological Society of America.

Kulp, J.L., 1961, Geologic timescale in Science, vol. 133, p. 1105-1114.

Laclede Gas company, no date, Hallsville underground storage, Browns Station Anticline, contour map on base of Chouteau Limestone.

REFERENCES: SECTION 2.5 (Continued)

Lamb, T.W., and Whitman, R.V., 1969, Soil mechanics. John Wiley & Sons, Inc., New York, 553 p.

Lee, W., 1914, The geology of the Rolla quadrangle. Missouri Bureau of Geology and Mines, 2nd ser., vol. 12, 111 p.

_____, 1943, The stratigraphy and structural development of the Forest City basin in Kansas. Kansas State Geological Survey, Lawrence, Kansas, Bulletin No. 51, p. 13.

Lidiak, E.G., and Zietz, I., 1976, Interpretation of aeromagnetic anomalies between latitudes 37°N and 38°N in the eastern and central United States. Geological Society of America, Spec. Paper 167, 37 p.

_____, 1977, Aeromagnetic lineaments along the 38th Parallel lineament in the eastern and central United States. Geol. Soc. of America, Abstracts with Programs, vol. 9, no. 5, p. 622 (March).

Lobeck, A.K., 1950, Physiographic diagram of North America. The Geographical Press, Columbia University, New York.

Lyell, C., 1849, A second visit to the United States of North America. London, vol. 2, 2nd and 3rd editions, p. 228-239.

Marbut, C.F., 1907, The geology of Morgan County. Missouri bureau of Geology and Mines, Rolla, Missouri, vol. 7, 2nd series, 97 p.

Mateker, E.J., Jr., 1956, Gravity survey of the Cap au Gres structure in the Hardin Brussels quadrangle, Illinois. St. Louis University, St. Louis, Missouri, unpublished Bachelor's thesis.

McCracken, E., 1938, Structure map - base of Roubidoux Formation. Missouri Geological Survey and Water Resources, Rolla, Missouri, unpublished map.

_____, 1956, Northeast Missouri oil possibilities improve. Missouri Geological Survey and Water Resources, Rolla, Missouri, reprint from Oil and Gas Journal, Report of Investigation No. 21, p. 3.

McCracken, E. and McCracken, M.H., 1965, Subsurface maps of the Lower Ordovician (Canadian series) of Missouri. Missouri Geological Survey and Water Resources, maps, scale 1:1,000,000.

McCracken, M.H., 1961, Geologic map of the state of Missouri. Missouri Geological Survey and Water Resources, Rolla, Missouri.

_____, 1964, The Cambro-Ordovician rocks of northeastern Oklahoma and adjacent areas. Tulsa Geological Society, Digest, vol. 32, p. 49-75.

REFERENCES: SECTION 2.5 (Continued)

_____, 1967, Structure, in Mineral and water resources of Missouri. Missouri Geological Survey and Water Resources, Rolla, Missouri, Bulletin No. 43, 2nd series, p. 20-21.

_____, 1971, Structural features of Missouri. Missouri Geological Survey and Water Resources, Rolla, Missouri, Report of Investigations No. 49, 99 p.

McGinnis, L.D., 1970, Tectonics and the gravity field in the continental interior. Journal of Geophysical Research, vol. 75, no. 2.

McGinnis, L.D., and Ervin, C.P., 1975, Earthquakes and block tectonics in the Illinois basin. Geology, vol. 2, no. 10, p. 517-519.

McMillan, N.J., 1956, Petrology of the Nodaway Underclay (Pennsylvanian), Kansas. Kansas State Geological Survey, Lawrence, Kansas, Bulleting No. 119.

McQueen, H.S., 1943, Geology of the fire clay districts of east central Missouri. Missouri Geological Survey and Water Resources, Rolla, Missouri, vol. XXVIII, 2nd series, pp. 250.

McQueen, H.S. and Aid, K., 1940, Map of top of Bethany Falls Limestone in vicinity of Blackburn School, Livingston County. Missouri Geological Survey and Water Resources, Rolla, Missouri, unpublished map.

McQueen, H.S., and Greene, F.C., 1938, The geology of northwestern Missouri. Missouri Geological Survey and Water Resources, Rolla, Missouri, vol. 25, 2nd series, 217 p.

McQueen, H.S., et al., 1939, Notes on Paleozoic, Mesozoic, and Cenozoic stratigraphy of southeastern Missouri. Kansas Geological Society, 13th annual field conference guidebook, p. 59-76.

McQueen, H.S., et al., 1941, The Lincoln fold in Lincoln, Pike, and Ralls counties, northeastern Missouri. Kansas Geological Society, 15th annual field conference guidebook, p. 99-110 (reprinted in 26th annual field conference guidebook, 1961, p. 81-85).

Medvedev, S.V., Sponheuser, W., and Karnik, V.T., 1963, Seimicheskala. Proceedings of the 3rd World Conference on Earthquake Engineering.

Meents, W.F., and Swann, D.H., 1965, Grand Tower Limestone (Devonian) of southern Illinois. Illinois State Geological Survey, Urbana, Illinois, Circular No. 389.

Merriam, D.F., 1963, The geologic history of Kansas. Kansas State Geological Survey, Lawrence, Kansas, Bulletin No. 162, p. 160, 179, 180, 182, 223, 253.

Miller, J.C., 1967, Geology and groundwater resources of Saline County, Missouri. University of Missouri, Columbia, Missouri, unpublished Master's thesis.

REFERENCES: SECTION 2.5 (Continued)

Missouri Geological Survey and Water Resources, 1961, The stratigraphic succession in Missouri. Rolla, Missouri, vol. XL, 2nd series, John W. Koenig, editor.

Mitchell, B.J., 1973, Radiation and attenuation of Rayleigh waves from the southeastern Missouri earthquake of October 21, 1965. Journal Geophysical Research, vol. 78, no. 5, p. 886-899.

Mohraz, B., Hall, W.J., and Newmark, N.M., 1972, A study of vertical and horizontal earthquake spectra. Nathan M. Newmark, Consulting Engineering Service, Urbana, Illinois, U.S. AEC Contract No. AT (49-5)-2667.

Monette, J., 1846, The influence of the environment on the settlement of Missouri.

Moore, R.C., and Landes, K.K., 1937, Geologic map of Kansas. Kansas State Geological Survey, Lawrence, Kansas.

Muehlberger, W.R., 1966, Ozark Pre-Cambrian-Paleozoic relations; A discussion. American Association of Petroleum Geologists, Bulletin, vol. 50, no. 5, p. 1043.

Murphy, L.M., and Ulrich, F.P., 1951, United States earthquakes, 1949. U.S. Coast and Geodetic Survey, Washington, D.C.

Nakano, H., 1923, Notes on the nature of the forces which give rise to the earthquake motions. Central Meteorological Observatory, Japan, Seismological Bulletin No. 1, p. 92-130.

_____, 1930, Some problems concerning the propagation of the disturbances in and on a semi-infinite elastic solid. Geophysical Magazine, no. 2, p. 189-348.

National Oceanic and Atmospheric Administration, 1973, Earthquake history of the United States, Coffman, J.L., and von Hake, C.A. (eds.). NOAA, 1977 reprint, 208 p.

Naval Facilities Engineering Command, 1971, Design manual soil mechanics, foundations, and earth structures. Department of the Navy, Washington, D.C., DM-7 (March).

Newmark, N.M., Blume, J.A., and Kapur, K.K., 1973, Design response spectra for nuclear power plants. American Society of Civil Engineers, annual meeting, San Francisco, California.

Nuclear Regulatory Commission, 1977, Safety evaluation report (section 2.5.2.1) for the Marble Hill nuclear generating station. Dockets 50-546 and 50-547 (June).

Nuttli, O.W., 1973a, The Mississippi Valley earthquakes of 1811 and 1812, intensities, ground motion and magnitudes. Seismological Society of America, Bulletin, vol. 63, no. 1, p. 227-248.

REFERENCES: SECTION 2.5 (Continued)

_____, 1973c, State of the art for assessing earthquake hazards in the United States, report 1, design earthquakes for the central United States. U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

_____. 1974, On the recurrence rate of lower Mississippi Valley earthquakes. Seismological Society of America, annual meeting (May).

_____, 1978, Working draft of earthquake list of midcontinent region.

Nuttli, O.W., Bollinger, S.A., and Griffith, D.W., 1979, On the relation between modified Mercalli intensity and body-wave magnitude, in Bulletin, Seismological Society of America, vol. 69 (in press).

Nuttli, O.W., and Herrmann, R.B., 1978, State of the art for assessing earthquake hazards in the United States, report 12, credible earthquakes for the central United States. U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Mississippi, Misc. Paper 5-73-1, 99 p.

Nuttli, O.W., 1981, Catalog of central United States earthquakes since 1800 $m_b \geq 3.0$ in Barstow, N. L., Brill, K.G., Nuttli, O.W. and Pomeroy, P.W., An approach to seismic zonation for siting nuclear electric power generating facilities in the eastern United States: U.S. Nuclear Regulatory Commission, NUREG/CR-1577, Appendix B, pp. B-2-1 to B2-31.

O'Brien, L.J., Murphy, J.R., and LaHoud, J.A., 1977, The correlation of peak ground acceleration amplitude with seismic intensity and other physical parameters. Prepared by Computer Sciences Corp. for the U.S. Nuclear Regulatory Commission, Office of Standards Development, Contract No. AT (49-245)-0148, NUREG-0143.

O'Connor, H.G., 1960, Geology and groundwater resources of Douglas County, Kansas. Kansas State Geological Survey, Lawrence, Kansas, Bulletin No. 148, p. 200.

O'Leary, D.W., and Hildenbrand, T.G., 1979, Structural significance of lineament and aeromagnetic patterns in the Mississippi embayment. Proceedings, 3rd International conference on Basement Tectonics, 1980 (in press).

Olive, W.W., 1969, Geologic map of parts of the Bandana and (Olmsted quadrangles, McCracken and Ballard counties, Kentucky, in Geologic quadrangle maps of the United States. U.S. Geological Survey, Department of the Interior, Washington, D.C., map GQ-799.

_____, 1972, Geology of the Jackson Purchase region, Kentucky. Geological Society of Kentucky, Spring Field Conference (April 6-8), 11 p.

REFERENCES: SECTION 2.5 (Continued)

Parizek, E.J., 1949, Geology of the Vineland and Tiff quadrangles of southeast Missouri. University of Iowa, Iowa City, Iowa, unpublished Ph.D. dissertation.

Peck, R.B., 1974, The selection of soil parameters for the design of foundations. Second Nabor Carillo Lecture, Mexican Society for Soil Mechanics, Mexico City, Mexico.

Peterschmidtt, E., 1952, Sur la variation de l'intensite microseismique avec la distance epicentral. Bureau Central Seismologique Internationale, publication series A, no. E, p. 183-208.

Phelan, M.J., 1968, Crystal structure in the central Mississippi valley earthquake zone form geophysical measurement. Washington University, St. Louis, Missouri, unpublished Ph.D. dissertation.

Pike, R.W., 1929, The geology of the Crystal City Quadrangle. University of Chicago, unpublished Master's thesis.

Prucha, J.J., Graham, J.A., and Nickelsen, R.P., 1965, Basement controlled deformation in the Wyoming province of the Rocky Mountain front range. American Association of Petroleum Geologists, Bulletin, vol. 49, p. 966-992.

Robertson, F.S., 1940, Flow sequence in the felsite rocks in the eastern Ironton Quadrangle. Washington University, St. Louis, Missouri, unpublished Ph.D. dissertation.

Ross, C.A., 1963, Structural framework of southernmost Illinois. Illinois State Geological Survey, Urbana, Illinois, Circular, no. 351.

Rubey, W.W., 1952, Geology and mineral resources of the Hardin and Brussels quadrangles (Illinois). U.S. Geological Survey, Professional Paper, no. 218, p. 179.

Russ, D.P., 1978, Recent surface faulting and earthquake recurrence in the Reelfoot Lake area, northwestern Tennessee. Abstracts, Midwest Annual American Geophysical Union Meeting, St. Louis, Missouri (September).

_____, 1979, Late Holocene faulting and earthquake recurrence in the Reelfoot Lake area, northwestern Tennessee. Bulletin, Geological Society of America, in press.

Russ, D.P. and Crone, A.J., 1979, New stratigraphic information from a deep test well in New Madrid County, Missouri. Geological Society of America, Abstracts with programs, vol. 11, no. 2, p. 165.

Rutledge, R.B., 1924, McDonald County map with geologic reconnaissance. Missouri Bureau of Geology and Mines, Rolla, Missouri, unpublished map.

REFERENCES: SECTION 2.5 (Continued)

_____, 1929, Geologic map of Lawrence County, Missouri. Missouri Bureau of Geology and Mines.

Satterfield, I.R., and Ward, R.A., 1978, Structural geologic study of southeastern Missouri, in New Madrid seismotectonic study - activities during fiscal year 1978m, Buschbach, T.C. (editor). NRC, NUREG/CR-0450, p. 53-63.

Schroeder, E.R., 1950, The geology of a portion of the Hermitage quadrangle, Missouri. University of Iowa, Iowa City, Iowa, unpublished Master's thesis.

Schuchert, C., 1910, Paleogeography of North America. Geological Society of America, Bulletin, vol. 20, p. 427-606.

Schwalb, H.R., 1978, Geology of the Reelfoot Basin; abstract of 3rd annual A.G.U. midwest meeting, September 26-28, 1977, in New Madrid seismotectonic study - activities during fiscal year 1978, Buschbach, T.C. (editor). NRC, NUREG/CR-0450, p. 123.

Searight, T.K., 1954, The geology of the Humansville Quadrangle, Missouri: Missouri Geological Survey and Water Resources, Rolla, Missouri, Report of Investigation No. 15, p. 50.

Searight, T.K, and Searight, W.V., 1961, Pennsylvanian geology of the Lincoln Fold, in Guidebook of 26th regional field conference of the Kansas Geological Society: Missouri Geological Survey and Water Resources, Rolla, Missouri, Report of Investigation No. 27, p. 168.

Searight, W.V., et al., 1953, Classification of Desmoinesian (Pennsylvanian) of the northern midcontinent. American Association of Petroleum Geologists, Bulletin, vol. 37, no. 12, p. 2747-2749.

Seed, H.B., and Idriss, I.M., 1971, Simplified procedure for evaluating soil liquifaction potential, in Journal of soil mechanics and foundations division. American Society of Civil Engineers, vol. 97, no. SM9 (September).

Seed, H.B., and Whitman, V.R., 1970, Design of earth retaining structures for dynamic loads. Cornell University, 1970 specialty conference on lateral stresses in the ground and design of earth-retaining structures (June).

Shepard, E.M., 1898, A report on Greene County, Missouri. Missouri Geological Survey, vol. 12, 1st series, part 1, p. 147, 160.

Sinclair, V.R., 1956, Geologic map of the Mineola area Montgomery County, Missouri. Missouri Geological Survey and Water Resources, Rolla, Missouri, unpublished map.

REFERENCES: SECTION 2.5 (Continued)

Skillman, M.W., 1948, Pre-upper Cambrian sediments of Vernon County, Missouri. Missouri Geological Survey and Water Resources, Rolla, Missouri, Report of Investigation 7, 18 p.

Smart, B., 1957, Geologic study and mapping of Pennsylvanian rocks in western Missouri. University of Iowa, Iowa City, Iowa, unpublished Master's thesis.

Snyder, F.G., 1968, Tectonic history of midcontinental United States. University of Missouri at Rolla Journal, no. 1, p. 70-72.

Snyder, F.G., and Gerdemann, P.E., 1965, Explosive igneous activity along an Illinois-Missouri-Kansas axis. American Journal of Science, vol. 263, p. 465-493.

Soderberg, R.K., and Keller, G.R., 1981, Geophysical evidence for deep basin in western Kentucky: American Association Petroleum Geologists Bulletin, Volume 65-2, pp. 226-234.

Stauder, W., 1973, Seismicity study of the site of Meramec Lake, Missouri. U.S. Geological Survey, St. Louis University contract 14-08-0001-12860.

_____, 1977, Microearthquake-array studies of the seismicity in southeast Missouri. Earthquake Information Bulletin, vol. 9, no. 1, p. 8-13 (January-February).

Stauder, W., et al., 1975, Relation of microearthquakes in southeast Missouri to structural features (abstract). EOS Transactions of the American Geophysical Union, vol. 56, no. 6, p. 398.

Stauder, W., et al., 19776, Seismic characteristics of southeast Missouri as indicated by a regional telemetered microearthquake array. Bulletin of the Seismological Society of America, vol. 66, no. 6, p. 1953-1964.

Stearns, R.G., 1958, Cretaceous, Paleocene, and lower Eocene geologic history of the northern Mississippi Embayment. Tennessee Division of Geology, Report of Investigations No. 6.

_____. 1973, Geology and seismic hazard in and east of the New Madrid fault zone. Geological Society of America meeting.

Stearns, R.G., and Marcher, M.V., 1962, Late Cretaceous and subsequent structural development of the northern Mississippi Embayment area. Tennessee Division of Geology, Report of Investigations 18 (reprinted from Geological Society of America Bulletin, vol. 75, p. 1387-1394.)

Stearns, R.G., and Wilson, C.W., 1972, Relationship of earthquakes and geology in west Tennessee and adjacent areas. Tennessee Valley Authority.

Stearns, R.G., and Zurawski, A., 1976, Post-Cretaceous faulting in the head of the Mississippi Embayment. southeastern Geology, vol. 17, no. 4, p. 207-229.

REFERENCES: SECTION 2.5 (Continued)

Stearns, R.G., 1980, Monoclinical structure and shallow faulting of the reelfoot Scharp as estimated from drill holes with variable spacings: U.S. Nuclear Regulatory Commission, NUREG/CR-1501, 37 pp.

Steward, D.R., 1942, Mesozoic and Cenozoic geology of southeastern Missouri. Missouri Geological Survey and Water Resources, Rolla, Missouri, unpublished Master's thesis.

Stonehouse, H.B., and Wilson, G.M., 1955, Faults and other structures in southern Illinois - a compilation. Illinois State Geological Survey, Urbana, Illinois, Circular 195, 4 p.

Street, R.L., 1978, A note on the horizontal to vertical Lg wave-amplitude ratio. Earthquake Notes, vol. 49, p. 15-20.

Street, R.L., and Herrmann, R.C., 1974, Map showing fault plane solutions for seismic events in the region of interest for the period 1962 to 1973. Refuge Site PSAR manuscript, figure 25-21.

Street, R.L., Herrmann, R.B., and Nuttli, O.W., 1974, Earthquake mechanics in the central United States. Science, vol, 184, no. 4143, p. 1285-1287.

Street, R.L., 1980, The southern Illinois earthquake of September 27, 1981: Bulletin seismological Society America, Volume 70, No. 3, pp. 915-920.

Stryker, W.L., 1925, Subsurface geology of Wilson County, Kansas. American Association of Petroleum Geologists, Bulletin, vol. 9, p. 1207-1214.

Sutton, P.G., 1953, A geological review of the Rough Creek fault system. Kentucky Geological Survey, Special Paper 3, Series 9, p. 17-20.

Swann, D.H., 1951, Waltersburg Sandstone oil pods of lower Wabash area, Illinois and Indiana. American Association of Petroleum Geologists, Bulletin vol. 35, no. 2.

Tarr, A.C., 1977, Recent seismicity near Charleston, South Carolina, and its relationship to the August 31, 1886 earthquake, in Studies related to the Charleston, South Carolina earthquake of 1886 - a preliminary report. U.S. Geological Survey Professional Paper 1028.

Terzaghi, K., and Peck, R.B., 1967, Soil mechanics in engineering practice. John Wiley and Sons, Inc., New York, 2nd ed., 729 p.

Theil, J.M., 1924, Lawrence County exposure and outcrop maps (includes written description of area). Missouri Bureau of Geology and Mines, unpublished manuscript.

Thornbury, W.D., 1965, Regional geomorphology of the United States. Wiley and Sons, New York, p. 251, 268, 269.

REFERENCES: SECTION 2.5 (Continued)

Tikrity, S.S., 1968, Tectonic genesis of the Ozark Uplift. Washington University, St. Louis, Missouri, unpublished Ph.D. dissertation.

Timoshenko, S., and Goodier, J.N., 1951, Theory of elasticity. McGraw-Hill, New York, 506 p.

Trifunac, M.D., and Brady, A.G., 1975, On the correlation of seismic intensity scales with the peaks of recorded strong ground motion. Seismological Society of America, Bulletin, abstract in Earthquake Notes, vol. 46, nos. 1-2, p. 46.

Twenhofel, W.H., 1926, Intrusive granite of the Rose Dome, Woodson City, Kansas. Geological Society of America, Bulletin, vol. 37, p. 403-412.

Unklesbay, A.G., 1952, Geology of Boone County, Missouri. Missouri Geological Survey and Water Resources, Rolla, Missouri, vol. 33, 2nd series, p. 159.

_____, 1955, The geology of the Fulton quadrangle, Missouri. Missouri Geological Survey and Water Resources, Rolla, Missouri, Report of Investigations No. 19, p. 7, 10.

U.S. Army Corps of Engineers, 1970, Engineering and design stability of earth and rock-fill dams, Washington, D.C., EM 110-2-1902.

U.S. Bureau of Reclamation, 1973, Design of small dams. United States Department of the Interior, Washington, D.C., 2nd ed., 816 p.

U.S. Department of the Interior, 1974, Earth Manual U.S. GPO, Washington, D.C., Bureau of Reclamation.

U.S. Geological Survey and Missouri Division of Geological Survey and Water Resources, 1967, Mineral and water resources of Missouri. U.S. Geological Survey and Missouri Division of Geological Survey and Water Resources, Rolla, Missouri, Document, vol. XLIII, no. 19, p. 13-20.

Wagner, R.E., and Kisvarsanyi, E.B., 1969, Lapilli tufts and associated pyroclastic sediments in Upper Cambrian strata along Dent Branch, Washington County, Missouri. Missouri Geological Survey and Water Resources, Rolla, Missouri, Report of Investigation No. 43, p. 80.

Wagner, R.J., 1961, Geology of the barite deposits in Washington County, Missouri. St. Louis University, St. Louis, Missouri, unpublished Master's thesis.

Wanless, H.R., undated Pennsylvanian correlations in the eastern interior and Appalachian coal fields. Geological Society of America, Special Paper No. 17, p. 130.

REFERENCES: SECTION 2.5 (Continued)

Ward, J.R., 1968, A study of the joint patterns in gently dipping sedimentary rocks of south-central Kansas. Kansas State Geological Survey, Lawrence, Kansas, Bulletin No. 191, Part 2.

Warfield, R.G., 1953, Stratigraphy and structure of the northeast quarter of the Richwoods quadrangle, Missouri. University of Iowa, Iowa City, Iowa, unpublished Master's thesis.

Wayman, N.L., 1968, A pictorial history of St. Louis.

Weller, J.M., Grogan, R.M., and Tippie, F.E., 1952, Geology of the fluorospar deposits of Illinois. Illinois State Geological Survey, Urbana, Illinois, Bulletin No. 76, 147 p.

Weller, S., and St. Clair, S., 1928, Geology of Ste. Genevieve County, Missouri. Missouri Bureau of Geology and Mines, 2nd Ser., vol. 22.

Wheeler, H.E., 1965, Ozark Precambrian-Paleozoic relationships. American Association of Petroleum Geologists, Bulletin, vol. 49, p. 1647-1666.

Whiting, L.L., and Stevenson, D.L., 1965, The Sangamon Arch. Illinois State Geological Survey, Urbana, Illinois, Circular No. 383, p. 20.

Williams, J.H., 1966, Reconnaissance mapping in the Doniphan Quadrangle, Missouri. Missouri Geological Survey and Water Resources, Rolla, Missouri, unpublished map.

Williams, J.H., and Vineyard, J., 1969, Perennial groundwater level map. Federal Water Pollution Control Administration, Springfield, Missouri, James River-Wilson Creek Study, vol. 2, appendix D.

Willman, H.B., and Payne, J.N., 1942, Geology and Mineral resources of Marseilles, Ottawa, and Streator quadrangles. Illinois State Geological Survey, Urbana, Illinois, Bulletin No. 66, p. 195, 197, 203.

Willman, H.B., et al., 1967, Geologic map of Illinois. Illinois State Geological Survey, Urbana, Illinois.

Wilson, M.E., 1922, The occurrence of oil and gas in Missouri. Missouri Bureau of Geology and Mines, vol. 16, 2nd series, p. 294.

Wong, R.T., 1971, Deformation characteristics of gravel and gravelly soils under cyclic loading conditions. University of California, Berkeley, California, Ph.D. dissertation.

Zartman, R.E., et al., 1967, K-Ar and Rb-Sr ages of some alkalic intrusive rocks from central and eastern United States. American Journal of Science, vol. 265, p. 848-870.

REFERENCES: SECTION 2.5 (Continued)

Zoback, M.D., 1979, Reactivation of late Cretaceous faulting in the vicinity of Reelfoot Lake, northwestern Tennessee. Geological Society of America, Bulletin, in press.

Zoback, M.D., et al., 1979, Seismic reflection profiling to delineate tectonic features of the New Madrid seismic region. Unpublished paper delivered at SSA annual meeting, Golden, Colorado, Abstract. Earthquake Notes, vol. 49, no. 4, p. 27-28.

Zollweg, J., et al., 1974, Some preliminary results from a seismograph network in the New Madrid, Missouri region. Paper presented at the 46th annual meeting of the Eastern Section of the Seismological Society of America, abstract in Earthquake Notes, vol. 46, nos. 1-2, p. 46.

Zollweg, J.E., and Johnston, A.C., 1980, Memphis Area Regional Seismic Network, annual progress report - fiscal year 1979 in Buschbach, T.C., ed., New Madrid Seismotectonic Study; Activities during fiscal year 1979: U.S. Nuclear Regulatory Commission, NUREG/CR-0977, pp. 117-125.

Personal Communications

Allen, W.H., 1973, Missouri Geological Survey, Rolla, Missouri, personal communication.

Andreas, 1973, Present owner of Daniel Boone's home, personal communication.

Atherton, E.T., 1973, Illinois Geological Survey, Urbana, Illinois, personal communication.

Baxter, J.W., 1973, Illinois Geological Survey, Urbana, Illinois, personal communication.

Bechtel Power Corporation, 1976, personal communication (April 19).

_____, 1979a, personal communication (April 3).

_____, 1979b, personal communication (April 19).

_____, 1979c, personal communication (April 20).

_____, 1979d, personal communication (April 24).

_____, 1979e, personal communication (September 10).

Beveridge, T.C., 1973, Former state geologist of Missouri, University of Missouri, Rolla, Missouri, personal communication.

Buschbach, T.C., 1973, Illinois Geological Survey, Urbana, personal communication.

_____, 1974, personal communication.

_____, 1975, personal communication.

REFERENCES: SECTION 2.5 (Continued)

Cloud, W.F., 1973, University of California, Berkeley, California, personal communication.

Dean, T., Missouri Geological Survey, Rolla, Missouri, personal communication.

Herrmann, R.C., 1973, St. Louis University, St. Louis, Missouri, personal communication.

Heyl, A.V., 1973, U.S. Geological Survey, Denver, Colorado, personal communication.

Illinois State Geological Survey, 1973, Urbana, Illinois, Staff members, personal communication.

Kisvarsanyi, E., 1973, Missouri Geological Survey, Rolla, personal communication.

Kukla, G.J., Lamont-Doherty Geological Observatory, Palisades, New York, personal communication.

Laclede Gas Company, 1974, St. Louis, Missouri, Thomas Farrell provided structure contour maps of Florissant dome (1969) and Browns Station Anticline.

Mateker, E.J., 1974, personal communication.

McGinnis, L.C., 1973, Professor at Northern Illinois University, DeKalb, Illinois, personal communication.

_____, 1974, personal communication.

Missouri Division of Geological Survey and Water Resources, 1973, 1974, Rolla, Missouri, Staff members, personal communication.

National Oceanic and Atmospheric Administration, 1978, Earthquake data file, area 35-42 N, 87-103 W, personal communication.

_____, 1981, Earthquake data file, area 35-42N., 87-96W., personal communication.

Nuttli, O.W., 1973, St. Louis University, St. Louis, Missouri, personal communication.

Oliver, 1973, Great-great-granddaughter of Daniel Boone, St. Charles, Missouri, personal communication.

Olson, E.M., 1968, 1973, Historian, St. Charles County, Missouri, personal communication.

Raymond International, Inc., 1974, Matt Lowes, supervisor, Chicago, Illinois, personal communication.

REFERENCES: SECTION 2.5 (Continued)

Robertson, C.E., 1974, Geologist, Mineral Resources Data and Research, Missouri Geological Survey and Water Resources, Rolla, Missouri, personal communication.

Rupert, G., 1973, University of Missouri, Rolla, Missouri, geophysical observatory, personal communication.

St. Louis University Geophysical Observatory, 1981 Earthquake data file computer printout June 19, 1974 to December 30, 1980, personal communication.

Stauder, W., 1973, St. Louis University, St. Louis, Missouri, personal communication.

Stearns, R.G., 1973, Vanderbilt University, Nashville, Tennessee, personal communication.

_____, 1974, personal communication.

Yelton, C., 1973, University of Missouri, Rolla, Missouri, Geophysical Observatory, personal communication.

Zoback, M., 1979, U.S. Geological Survey, Menlo Park, California, personal communication.

Zollweg, J., Tennessee Earthquake Information Center, Memphis State University, Memphis, Tennessee, personal communication.

TABLE 2.5-1 GEOLOGIC TIME SCALE

	GEOLOGIC TIME UNITS	BEGINNING OF PERIOD (IN MILLIONS OF YEARS)	TIME-STRATIGRAPHIC UNITS
CENOZOIC ERA	Quaternary Period	1	Quaternary System
	Tertiary Period	63	Tertiary System
MESOZOIC ERA	Cretaceous Period	135	Cretaceous System
	Jurassic Period	181	Jurassic System
	Triassic Period	230	Triassic System
PALEOZOIC ERA	Permian Period	280	Permian System
	Pennsylvania Period	320	Pennsylvanian System
	Mississippian Period	345	Mississippian Period
	Devonian Period	405	Devonian System
	Silurian Period	425	Silurian System
	Ordovician Period	500	Ordovician Period
	Cambrian Period	600 (approx.)	Cambrian System
PRECAMBRIAN			

Note: Time-scale in millions of years after Kulp 1961.

TABLE 2.5-2 SUMMARY OF FOLIDS

MAP NO.[a]	NAME AND STATE	IDENTIFICATION[b]	LAST MOVEMENT
	Illinois:		
1	Clay City Anticline	B	Post-Pennsylvanian (Bell, 1943)
2	Downs Anticline	B	Late Paleozoic (Cohee, 1940)
3	Dupo-Waterloo Anticline	S, B	Post-Pennsylvanian, pre-Pleistocene (Bell, 1929)
4	DuQuoin Monocline	B	Pennsylvanian (Brownfield, 1954)
5	Fishook Anticline	B	Post-Pennsylvanian (Buschbach, 1973)
6	Glasford Disturbance	S, B	Late Ordovician (Buschbach and Ryan, 1963)
7	Hicks Dome	S, B	Late Paleozoic (Heyl, 1972)
	Illinois Basin	S, B, G	Early to Late Paleozoic (Eardley, 1962)
	LaSalle Anticlinal Belt	S, B, G	Late Pennsylvanian or Permian (Eardley, 1962)
8	Marshall Syncline	B	Late or post-Pennsylvanian (Clegg, 1965)
9	Mattoon Anticline	B	Late Paleozoic (Cohee, 1940)

a Features are numbered sequentially by state on Figure 2.5-12; unnumbered features are labeled on Figure 2.5-5.

b S = Surface, B = Borehole, G = Geophysical.

TABLE 2.5-2 (Continued) (Sheet 2 of 7)

MAP NO.[a]	NAME AND STATE	IDENTIFICATION[b]	LAST MOVEMENT
	Mississippi River Arch	S, B, G	Late Mississippian (Illinois State Geological Survey, 1971)
10	Moorman Syncline	S, B	Post-Pennsylvanian (Bell, 1964)
11	Murdock Syncline	B	Late or post-Pennsylvanian (Clegg, 1965)
12	Pittsfield-Hadley Anticline	S, B	Post-Mississippian pre-Pennsylvanian (Krey, 1924)
13	Salem-Louden Anticlinal Belt	B	Post-Pennsylvanian (DuBois, 1951)
	Sangamon Arch	B, G	Late Silurian to Early Mississippian (Whiting and Stevenson, 1965)
14	Tuscola Anticline	B	Pennsylvanian and later (Clegg, 1965)
	Iowa:		
1	Bentonsport Anticline	B	Pre-Late Mississipian (Harris and Parker, 1964)
2	Burlington Anticline	B	Pre-Late Mississippian (Harris and Parker, 1964)
3	Oquawka Anticline	B	Pre-Late Mississippian (Harris and Parker, 1964)
4	Skunk River Anticline	B	Pre-Late Mississippian (Harris and Parker, 1964)
5	Sperry Anticline	B	Pre-Late Mississippian (Harris and Parker, 1964)
	Kansas:		
	Bourbon Arch	B, G	Late Pennsylvanian (McMillan, 1956)
1	Brownville Syncline	B	Post-Mississippian (Jewett and Abernathy, 1945)
	Cherokee Basin	S, B, G	Pennsylvanian (Merriam, 1963)
2	Coffeyville Dome	B	Late or post-Paleozoic (Foster, 1929)

TABLE 2.5-2 (Continued) (Sheet 3 of 7)

MAP NO.[a]	NAME AND STATE	IDENTIFICATION[b]	LAST MOVEMENT
3	Fredonia Dome	S, B	Late or post-Pennsylvanian (Stryker, 1925)
4	McLouth Dome	S, B	Post-Pennsylvanian (Lee, 1943)
5	Mildred Dome	S, B	Post-Middle Pennsylvanian (Charles, 1927)
6	Morris Anticline	S	Post-Pennsylvanian (Jewett and Newell, 1935)
7	Mound City Dome	S, B	Post-Middle Pennsylvanian (Jewett, 1951)
	Nemaha Uplift	S, B, G	Pre-Middle Pennsylvanian post-Mississippian (Merriam, 1963)
8	Rose Dome	S, B	Post-Mississippian, pre-Late Pennsylvanian (Moore and Landes, 1937)
9	Straham Anticline	S, B	Post-Early Pennsylvanian (Jewett and Merriam, 1959)
	<u>Missouri</u>:		
1	Adams County Terrace	B	Pennsylvanian (Missouri Geological Survey, 1973)
2	Auxvasse Creek Anticline	S, B	Post-Pennsylvanian (Unklesbay, 1955)
3	Benton County Anticline	S	Paleozoic (McCracken, 1971)
4	Big Spring Anticline	S	Post-Ordovician (McCracken, 1971)
5	Blackburn School Anticline	S	Late or post-Pennsylvanian (McQueen and Aid, 1940)
6	Blue Lick Anticline	S	Post-Devonian (McCracken, 1971)
7	Blue Ridge School Anticline	S, B	Late or post-Paleozoic (Clair, 1943)

TABLE 2.5-2 (Continued) (Sheet 4 of 7)

MAP NO.[a]	NAME AND STATE	IDENTIFICATION[b]	LAST MOVEMENT
8	Bolivar-Mansfield Anticline	S, B	Late or post-Paleozoic (Shepard, 1898)
9	Browns Station Anticline	S, B	Late Mississippian or Pennsylvanian (Unklesbay, 1952)
10	Cameron-Union Star Syncline	B	Post-Pennsylvanian (Wilson, 1922)
11	Cassville Anticline	S	Post-Mississippian (Clark, 1941)
12	Centerview-Kansas City Anticline	S	Post-Pennsylvanian (Clair, 1943)
13	Cheltenham Syncline	S	Late or post-Pennsylvanian (Fenneman, 1911)
14	College Mound-Bucklin Anticline	S, B	Late or post-Pennsylvanian (Hinds and Greene, 1915)
15	Coloma Anticline	S	Late Paleozoic
16	Cow Creek Anticline	S	Post-Mississippian (McCracken, 1971)
17	Crystal City Anticline	S	Post-Mississippian (Missouri Geological Survey, 1973)
18	Cuivre Anticline	S	Post-Mississippian (Missouri Geological Survey, 1973)
19	Davis Creek Anticline	S, B	Post-Mississippian (McQueen, 1943)
20	Dupo Anticline	S, B	Late or post-Paleozoic (Fenneman, 1911)
21	Eureka-House Springs Anticline	S, B	Post-Early Ordovician (McCracken, 1971)
22	Farmington Anticline	S, B	Devonian (Zartman, Brock, Heyl, and Thomas, 1967)
23	Fish Creek Anticline	S, B	Post-Early Mississippian (Miller, 1967)
24	Florissant Dome	B	Post-Ordovician (McCracken, 1956)

TABLE 2.5-2 (Continued) (Sheet 5 of 7)

MAP NO.[a]	NAME AND STATE	IDENTIFICATION[b]	LAST MOVEMENT
	Forest City Basin	S, B, G	Pennsylvanian (Lee, 1943)
25	Galesburg-Pittsburg	S, B	Post-Middle Mississippian (Bieber, 1955)
26	Golden City-Miller	B	Post-Middle Mississippian (Bieber, 1955)
28	Gradon-Northview Anticline	S	Paleozoic (Shepard, 1898)
29	Hamilton-King City-Quitman Axis Anticline	B, G	Post-Pennsylvanian (McQueen and Green, 1938)
30	Horse Creek Anticline	S	Post-Ordovician (Bieber, 1955)
31	Howard County Syncline	B	Late or post-Pennsylvanian (Grohskopf et al., 1939)
32	Humansville Anticline	S	Pre-Pennsylvanian (Snyder and Gerdemann, 1965)
33	Jasper Anticline	S	Post-Middle Mississippian (Bieber, 1946, 1955)
34	Joplin Anticline	B	Paleozoic (Bieber, 1955)
35	Kirksville-Mendota Anticline	S, B	Late Paleozoic (Gentile, 1965)
36	Kruegers Ford Anticline	S, B	Post-Ordovician (McQueen, 1943)
37	LaDue-Freeman Anticline (Central Anticline-Clair, 1943)	S	Late or post-Pennsylvanian (Hinds and Green, 1915)
38	Lamar Syncline	S, B	Pre-Pennsylvanian (Bieber, 1955)
39	Lawton Trough	?	Late or post-Paleozoic (?) (McCracken, 1971)
40	Leon-Powersville	S, B	Late or post-Pennsylvanian (Cordell, 1950)
41	Lewis	S, B	Late or post-Pennsylvanian (Smart, 1957)

TABLE 2.5-2 (Continued) (Sheet 6 of 7)

MAP NO.[a]	NAME AND STATE	IDENTIFICATION[b]	LAST MOVEMENT
42	Lincoln Fold	S	Late Paleozoic (McCracken, 1971)
43	Little Weaubleau Anticline	S	Paleozoic (Schroeder, 1950)
44	Macon-Sullivan	S	Post-Ordovician (McCracken, 1938)
45	Mexico Anticline	S, B	Late or post-Pennsylvanian (McQueen, 1943)
46	Mineola Dome	S, B	Early Ordovician (Sinclair, 1956)
	Mississippi Embayment	S, B, G	Pre-Late Cretaceous (McCracken, 1971)
47	Morrisville-Brighton Fold	S	Paleozoic (Shepard, 1898)
48	Nashville-Carthage Sag	B	Post-Warsaw (Mississippian) (Bieber, 1955)
49	Newport Basin	B	Post-Mississippian (Bieber, 1955)
50	North Dry Sac Syncline	S	Paleozoic (?) (Shepard, 1898)
51	Osage-Verona Anticline	S	Paleozoic (Theil, 1924)
	Ozark Uplift	S, B, G	Early to Late Paleozoic (Early Pennsylvanian)
52	Pascola Arch	S, B, G	Post-Early Devonian (McCracken and McCracken, 1965)
54	Pittsfield-Hadley Anticline		Post-Pennsylvanian (Krey, 1924)
55	Plattin Creek Anticline	S	Post-Mississippian (Missouri Geological Survey, 1973)
56	Proctor Anticline	S	Late Paleozoic (Marbut, 1907)
57	Richmond-St. Joseph Anticline	B, G	Late Paleozoic (McQueen and Greene, 1938)
58	Sac River Anticline	S	Post-Mississippian (Theil, 1924)

TABLE 2.5-2 (Continued) (Sheet 7 of 7)

MAP NO.[a]	NAME AND STATE	IDENTIFICATION[b]	LAST MOVEMENT
	Saline County Arch	S	Late Paleozoic (Searight and Searight, 1961)
59	Salsbury-Quitman Anticline	S	Post-Pennsylvanian (McCracken, 1971)
60	Schell City-Rich Hill Anticline	S	Pre-Pennsylvanian (Gentile, 1965)
61	South Sac-Ash Grove Syncline	S	Paleozoic (Shepard, 1898)
62	Springfield Anticline	questionable feature	Paleozoic (?) (McCracken, 1971)
63	Stinton Anticline	S	Paleozoic (Rutledge, 1929)
64	Trenton Anticline	B, G	Late Paleozoic (McQueen and Greene, 1938)
65	Troy-Brussels Syncline	S	Late Mississippian to post-Pennsylvanian (Rubey, 1952)
66	Warren County Anticline	S	Post-Mississippian (Heflin, 1961)
67	Washburn Syncline	S	Post-Mississippian (Clark, 1941)
68	Cuba Anticline	B	Post-Pennsylvanian (Missouri Geological Survey and Water Resources, 1974)

TABLE 2.5-3 SUMMARY OF FAULTS

MAP. NO.[a]	NAME AND STATE	IDENTIFICATION[b]	DISPLACEMENT	LAST MOVEMENT
	ILLINOIS:			
1.	Centralia Fault	S, B	Down 200' to the west	Post-Pennsylvanian (Bristol, 1967)
2.	Fluorspar Area Complex	S, B	2,000' maximum on NE trending faults	Post-Pennsylvanian pre-Late Cretaceous (Baxter et al., 1967)
3.	Rough Creek Lineament	G	Down 400' or more to the north	Post-Pennsylvanian pre-Cretaceous (Wanless, 1939; Heyl, 1972; Willman et al., 1967)
4.	St. Genevieve	S	1,000' to 2,000'	Post-Pennsylvanian (Ross, 1963; Meents & Swan, 1965)
5.	Wabash Valley	S, B	200' to 480'	Post-Pennsylvanian pre-Pleistocene (Harrison, 1951; Swann, 1951; Bristol and Treworgy, 1978)

a Features are numbered sequentially by state on Figure 2.5-13.

b S = Surface, B = Borehole, G = Geophysics.

TABLE 2.5-3 (Continued) (Sheet 2 of 7)

MAP. NO.[a]	NAME AND STATE	IDENTIFICATION[b]	DISPLACEMENT	LAST MOVEMENT
	MISSOURI:			
1.	Aptus Fault	S	Unknown	Paleozoic (Wagner, 1961)
2.	Aquilla Fault	S, B	30' down to SW	Post-Paleocene (Farrar and McManamy 1937)
3.	Big River Fault System	S	120' down to NW	Post-Roubidoux (Ordovician) (James, 1951)
4.	Black Fault	S, B	300'	Post-Cambrian (James, 1951)
5.	Bolivar-Mansfield	S	Up to 300'	Post-Middle Pennsylvanian (Gentile, 1965, 1976)
6.	Cabanne Fault	S	Down to the north	(McCracken, 1971)
7.	Cap au Gres Faulted Flexure	S, B	Few hundred feet	Post-Pennsylvanian pre-Pleistocene (Rubey, 1952)
8.	Chesapeake Fault	S, B	100' down to NE	Late Mississippian (Cole, 1976; Rutledge, 1924)
9.	Crooked Creek Structure	S, B	1,300'	Post-Mississippian (Hendricks, 1954)
10.	Cuba Fault	S, B, G	125' - 150' down to NE	Post-Ordovician (McQueen, 1943)
11.	Cuba Graben	S, B, G	125' - 300'	Post-Pennsylvanian (Fox, 1951)

TABLE 2.5-3 (Continued) (Sheet 3 of 7)

MAP. NO.[a]	NAME AND STATE	IDENTIFICATION[b]	DISPLACEMENT	LAST MOVEMENT
12.	Ditch Creek Fault System	S	20' - 180'; down to NE	Post-Pennsylvanian (Warfield, 1953)
13.	Doniphan Fault	S	Down to S	Post-Ordovician (Williams, 1966)
14.	Ellington Fault	S, B	Down to NE	Paleozoic (McCracken, 1971)
15.	English Hill Fault	S	30'	Pleistocene (Grohskopf, 1955)
16.	Fox Hollow Fault	S	120'	Post-Mississippian (Unklesbay, 1952)
17.	Greasy Creek Fault	S	250' down to E	Post-Mississippian (Rutledge, 1924)
18.	Greenville Fault	B	Unknown	Paleozoic (McCracken, 1971)
19.	Highlandville Fault	S	Down to SW	Paleozoic (Hayes, 1960)
20.	Idalia Fault	S	50' - 100' down to N	Tertiary (Grohskopf, 1955)
21.	Jackson Fault	B	200'	Paleozoic (Gealy, 1955)
22.	Jeffriesburg Fault	S, B	100' down to NE	Post-Pennsylvanian (McCracken, 1971; Missouri Geological Survey and Water Resources, 1974)

TABLE 2.5-3 (Continued) (Sheet 4 of 7)

MAP. NO.[a]	NAME AND STATE	IDENTIFICATION[b]	DISPLACEMENT	LAST MOVEMENT
23.	Lampe Fault	S, B	100' down to SE	Post-Mississippian (McCracken, 1964)
24.	Leasburg Fault	S, B	300' maximum down to W	Late or post-Pennsylvanian (McQueen 1943)
25.	Moselle Fault	S, B	50' - 100' down to W	Post-Early Ordovician (Frank, 1945)
25.	Newburg Fault	S	60' to S	Post-Ordovician (Lee, 1911)
27.	Palmer Fault System	S	200' - 1,200' down to S&SW	Post-Ordovician (James, 1951)
28.	Ponce de Leon Fault	S	50' - 60' down to SW	Paleozoic (Hayes, 1960)
29.	Pineville Fault	S, B	50' - 100' down to W	Post-Mississippian (McCracken, 1971)
30.	Red Arrow Fault	S, G	100' down to SW	Paleozoic (Hendricks, 1942)
31.	Ritchey Fault	S, G	150' down to S	Post-Mississippian pre-Pennsylvanian (McCracken, 1971)
32.	Sac River Fault	S	50' - 80' down E and NE	Post-Mississippian pre-Pennsylvanian (Williams & Vineyard, 1969)
33.	Saline City Fault	S	100'+	Post-Early Mississippian (Miller, 1967)

TABLE 2.5-3 (Continued) (Sheet 5 of 7)

MAP. NO.[a]	NAME AND STATE	IDENTIFICATION[b]	DISPLACEMENT	LAST MOVEMENT
34.	Salt Fork Fault	B	200' - 250' down to SE	Post-Mississippian (Miller, 1967)
35.	Seneca Fault	B	370'	Post-Mississippian (Bieber, 1955)
36.	Shell Knob-Eagle River Structure	S	100' down to SE	Post-Ordovician (Clark, 1941)
37.	Simms Mountain	S, B	400' - 600' down to NE	Post-Ordovician (McCracken, 1971)
38.	Ste. Genevieve Fault System	S, B	550' to over 1,000'	Post-Pennsylvanian (McCracken, 1971)
39.	St. Louis Fault	S, G	10'	Paleozoic (Frank, 1948)
40.	Ten O'Clock Run Fault	S, B	Down to SW	Paleozoic (Koenig, 1960)
41.	Wardsville Fault	S, B	100' down to NE	Post-Early Mississippian (McCracken, 1971)
42.	Mississippi Valley	B	700' - 4000'	Post-Cretaceous to recent (AAPG, 1971; Heyl, 1972)
43.	Avon Diatremes (dikes)	S	Unknown	Middle Devonian (Zartman et al., 1967)
44.	Decaturville Structure	S, B	Unknown	Post-Early Silurian (Snyder and Gerdemann, 1965; McCracken, 1971)

TABLE 2.5-3 (Continued) (Sheet 6 of 7)

MAP. NO.[a]	NAME AND STATE	IDENTIFICATION[b]	DISPLACEMENT	LAST MOVEMENT
45.	Dent Branch Structure	S	Unknown	Post-Late Cambrian (Wagner and Kisvarsanyi, 1969)
46.	Furnace Creek Structure	B	Unknown	Late Cambrian (Snyder and Gerdemann, 1965)
47.	Weaubleau Creek Structure		Associated faults - 80' down to NE	Post-Mississippian pre-Pennsylvanian (Snyder and Gerdemann, 1965)
48.	Kingdom City Fault	B	300' down to SE	Post-Ordovician (Missouri Geological Survey and Water Resources, 1974; Anderson 1974)
49.	Anthonies Mill Fault	S, B	150' - 200'	Post-Early Ordovician (McCracken, 1971)
50.	Catawissa Fault	B	150' down to NW	Post-Early Ordovician
51.	Browns Station Fault	B	300' down to SW	Late Mississippian or Pennsylvanian (Laclede Gas Co., 1974)
52.	Mineola Fault	B	200' down to SW	Post-Early Ordovician
53.	Ste. Mary's Fault	S, B, G	200' - 400' down to SE	(Tikrity, 1968)
54.	Unnamed Fault (Jefferson County)	S	Unknown	(Missouri Geological Survey, 1979)

TABLE 2.5-3 (Continued) (Sheet 7 of 7)

MAP. NO.[a]	NAME AND STATE	IDENTIFICATION[b]	DISPLACEMENT	LAST MOVEMENT
55.	Unnamed Fault (St. Charles County)	S	Unknown	(Howe and Fellows, 1977)
56.	Unnamed Fault (Lake of the Ozarks Region)	S	Unknown	(Missouri Geological Survey, 1979)
	KANSAS:			
1.	Chesapeake fault	B	1000'	Pre-Pennsylvanian (Merriam, 1963)
2.	Worden Fault	S	5' to 40' down to the south and east	Pre-Early Pennsylvanian (O'Connor, 1960)
	KENTUCKY:			
1.	Reelfoot Lake Fault	S, B	70' to 265' down to NW	Recent (Finch, 1971; Zoback et al., 1979)

TABLE 2.5-4 FOLDS WITHIN 50 MILES OF SITE

MAP. NO.[a]	NAME	IDENTIFICATION[b]	MAJOR MOVEMENT
2	Auxvasse Creek Anticline	S	Post-Pennsylvanian (Unklesbay, 1955)
4	Big Springs Anticline	S	Post-Ordovician (McCracken, 1971)
9	Browns Station Anticline	S, B	Late Mississippian or Pennsylvanian (Unklesbay, 1952)
18	Cuivre Anticline	S	Post-Mississippian (Missouri Geological Survey, 1973)
19	Davis Creek Anticline	S, B	Post-Mississippian (McQueen, 1943)
21	Eureka-House Springs Anticline	S, B	Post-Early Ordovician (McCracken, 1971)
23	Fish Creek Anticline	S, B	Post-Early Mississippian (Miller, 1967)
36	Kruegers Ford Anticline	S, B	Post-Ordovician (McQueen, 1943)

TABLE 2.5-4 (Continued) (Sheet 2 of 2)

MAP. NO.[a]	NAME	IDENTIFICATION[b]	MAJOR MOVEMENT
45	Mexico Anticline	S, B	Late or post-Pennsylvanian (McQueen, 1943)
46	Mineola Dome	S	Lower Ordovician (Sinclair, 1956)
66	Warren County Anticline	S	Post-Mississippian (Heflin, 1961)
68	Cuba Anticline	B	Post-Pennsylvanian (Missouri Geological Survey, 1974)

a Features are numbered on Figure 2.5-12.

b S = Surface, B = Borehole.

(Sheet 1 of 1)

TABLE 2.5-5 FAULTS WITHIN 50 MILES OF SITE

MAP. NO.[a]	NAME	IDENTIFICATION[b]	DISPLACEMENT	LAST MOVEMENT
7	Cap au Gres Fault	S, B	Few hundred feet	Post-Pennsylvanian pre-Pleistocene (Rubey, 1952)
10	Cuba Fault	S, B	125' - 150' down to NE	Post-Ordovician (McQueen, 1943)
11	Cuba Graben	S, B	125' - 150'	Post-Pennsylvanian (Fox, 1954)
16	Fox Hollow Fault	S	120' down to W	Post-Mississippian (Unklesbay, 1952)
22	Jeffriesburg Fault	S, B	30' - 50' down to NE	Post-Pennsylvanian (McCracken, 1971)
24	Leasburg Fault	S, B	300' maximum down to NW	Late or post-Pennsylvanian (McQueen, 1943)
41	Wardsville Fault	S, B	100' down to NE	Post-Early Mississippian (McCracken, 1971)
48	Kingdom City Fault	B	300' down to SE	Post-Ordovician (Missouri Geological Survey Well Log Files, 1974)
51	Browns Station Fault	B	300' down to SW	Late Paleozoic
52	Mineola Fault	B	200' down to SW	Paleozoic

a Features are numbered sequentially on Figure 2.5-13.

b S = Surface, B = Borehole.

TABLE 2.5-6 MODIFIED MERCALLI INTENSITY SCALE OF 1931 (ABRIDGED)

I. Not felt except by a very few under especially favorable circumstances. (I Rossi-Forel Scale)

II. Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing. (I to II Rossi-Forel Scale)

III. Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibration like passing of truck. Duration estimated. (III Rossi-Forel Scale)

IV. During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, doors disturbed; walls make creaking sound. Sensation like heavy truck striking building. Standing motorcars rocked noticeably. (IV to V Rossi-Forel Scale)

V. Felt by nearly everyone; many windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbance of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop. (V to VI Rossi-Forel Scale)

VI. Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight. (VI to VII Rossi-Forel Scale)

VII. Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motorcars. (VIII Rossi-Forel Scale)

VIII. Damage slight in specially designed structures; considerable in ordinary substantial buildings with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving motorcars disturbed. (VIII+ to IX Rossi-Forel Scale)

IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. (IX+ Rossi-Forel Scale)

X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from riverbanks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks. (X Rossi-Forel Scale)

XI. Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.

XII. Damage total. Waves seen on ground surfaces. Lines of sight and level distorted. Objects thrown upward into air.

TABLE 2.5-7 EARTHQUAKE EPICENTERS*

1795 to 1980

35° - 42° N LATITUDE
87° - 96° W LONGITUDE

	DATE	MODIFIED MERCALLI INTENSITY	LOCATION	NORTH LATITUDE	WEST LONGITUDE	FELT AREA (SQ MI)	REFERENCE
1.	1795 Jan 8	IV-V	Kaskaskia, IL	39.0	89.9	4,500	1, 2
2.	1804 Aug 20, 24	V-VI	Fort Dearborn, IL	42.0	87.8	30,000	1, 2, 3
3.	1811 Dec 16	X-XI	New Madrid, MO	36.0	90.0	2,000,000	1, 4
4.	1812 Jan 23	X-XI	New Madrid, MO	36.3	89.6	2,000,000	1, 4
5.	1812 Feb 7	XI-XII	New Madrid, MO	36.5	89.6	2,000,000	1, 4
6.	1820 Nov 9	IV-V	Cape Girardeau, MO	37.3	89.5	2,000,000	1
7.	1838 Jun 9	VI	St. Louis, MO	38.6	90.2	300	1
8.	1841 Dec 27	V	Nr. Hickman, KY	36.5	89.2	5,000	1, 2
9.	1843 Jan 4	VIII	Western, TN	35.2	90.0	800,000	1
10.	1848 Jan 24	V	Hickman, KY	36.6	89.2	----	2

* Earthquakes of Intensity V and greater only are tabulated beyond a distance of 60 miles from the site up to the limits of the study. All known epicenters located within 60 miles of the site are listed.

REFERENCES:
1) NOAA, 1973.
2) Docekal, 1970.
3) Indiana Geological Survey, 1974.
4) Nuttli and Herrmann, 1978.
5) NOAA, 1978.
6) Nuttli, 1978.
7) DuBois and Wilson, 1978.
8) NOAA, 1981.
9) St. Louis Univ. Geophys. Obs., 1981.
10) Nuttli and Brill, 1981.
11) Street, 1980.
12) Hopper and Algermissen, 1980.

TABLE 2.5-7 (Continued) (Sheet 2 of 7)

	DATE	MODIFIED MERCALLI INTENSITY	LOCATION	NORTH LATITUDE	WEST LONGITUDE	FELT AREA (SQ MI)	REFERENCE
11.	1853 Dec 18	IV-V	Hickman, KY	36.6	89.2	40,000	2
12.	1857 Oct 8	VI	St. Louis, MO	38.5	90.3	35,000	1
13.	1858 Sep 21	VI	Line Shore, KY	36.5	89.2	----	2
14.	1860 Aug 7	V	Henderson, KY	37.8	87.6	30,000	2
15.	1865 Aug 17	VII	Southeast MO.	36.5	89.5	24,000	1
16.	1867 Apr 24	VII	Manhattan (Wamego), KS felt in MO	39.5	96.7	300,000	1, 2, 7
17.	1875 Nov 8	V	Topeka, KS	39.3	95.5	9,000	1, 2
18.	1876 Sep 25	VI	Evansville, IN	38.5	87.7	60,000	1
19.	1878 Mar 12	V	Columbus, KY	36.8	89.2	local	1
20.	1878 Nov 18	VI	Southeastern MO	36.7	90.4	150,000	1
21.	1882 Jul 20	V	Charleston, MO	38.0	90.0	3,000	1
22.	1882 Sep 27	VI	Southern IL	39.0	90.0	40,000	1
23.	1882 Oct 15	V	Southern IL	39.0	90.0	40,000	1
24.	1882 Oct 22	VI-VII	AR	35.0	94.0	135,000	1
25.	1883 Jan 11	VI	Cairo, IL	37.0	89.2	80,000	1
26.	1883 Apr 12	VI-VII	Cairo, IL	37.0	89.2	----	1
27.	1883 Dec 5	V	Izard County, AR	36.3	91.8	local	1, 2
28.	1886 Aug 31	X	Charleston, SC felt in MO	32.9	80.0	2,000,000	1
29.	1887 Feb 6	V-VI	Vincennes, IN	38.7	87.5	75,000	1
30.	1887 Aug 2	V	Cairo, IL	37.0	89.0	----	1
31.	1889 Jul 19	VI	Memphis, TN	35.2	90.0	local	1, 2
32.	1891 Jul 26	VI	Evansville, IN	37.9	87.5		1
33.	1891 Sep 27	VII	Mt. Vernon, IL	38.3	88.5	200,000	2, 10, 11
34.	1895 Oct 31	VIII	Charleston, MO	37.0	89.4	1,000,000	1, 8, 10, 12
35.	1899 Apr 29	VI-VII	IN/IL	38.5	87.0	40,000	1
36.	1901 Jan 3	V	Eldorado Springs, MO	37.5	94.0	2,000	2
37.	1902 Jan 24	VI	MO	38.6	90.3	40,000	1
38.	1903 Feb 8	VI	Murphysboro, IL	38.5	90.3	65,000	1, 2

TABLE 2.5-7 (Continued)

	DATE	MODIFIED MERCALLI INTENSITY	LOCATION	NORTH LATITUDE	WEST LONGITUDE	FELT AREA (SQ MI)	REFERENCE
39.	1903 Oct 4	V-VI	St. Louis, MO	38.5	90.3	45,000	2
40.	1903 Nov 4	VI-VII	Charleston, MO	36.9	89.3	135,000	1, 2
41.	1903 Nov 27	V	New Madrid, MO	36.5	89.5	70,000	1
42.	1905 Apr 13	V	Keokuk, IA	40.4	91.4	5,000	1
43.	1905 Aug 21	VI-VII	Sikeston, MO	36.8	89.5	125,000	1, 2
44.	1906 May11	V	Petersburg, IN	38.5	87.2	800	1
45.	1906 May 21	V	Flora, IL	37.5	88.5	----	1
46.	1907 Jan 30	V	Greenville, IL	38.9	89.5	1,200	2
47.	1907 Jul 4	IV-V	Farmington, MO	37.7	90.4	400	1
48.	1908 Sep 28	IV-V	New Madrid, MO	36.6	89.6	5,000	1
49.	1908 Oct 27	V	Cairo, IL	37.0	89.2	5,000	1
50.	1909 May 26	VII	Aurora, IL	41.8	89.3	500,000	1
51.	1909 Jul 18	VII	IL	40.2	90.0	40,000	1
52.	1909 Aug 16	----	Southwest IL	----	----	not plotted	
53.	1909 Sep 27	VII	IN	39.0	87.7	30,000	1
54.	1909 Oct 23	V	Robinson, IL	39.0	87.7	8.000	1
55.	1909 Oct 23	V	Southeastern MO	37.0	89.5	40,000	1
56.	1912 Jan 2	VI-V	IL	41.5	88.5	40,000	1
57.	1915 Apr 28	IV-V	New Madrid, MO	36.5	89.5	200	1
58.	1915 Oct 26	V	Mayfield, KY	36.7	88.6	local	1, 2
59.	1915 Dec 7	V-VI	Ohio River	36.7	89.1	60,000	1
60.	1916 Dec 18	VI-VII	Hickman, KY	36.6	89.2	local	1, 2
61.	1917 Apr 9	VI	Eastern MO	38.1	90.6	210,000	1, 2
62.	1918 Oct 13	V	Noxie, AR	36.1	91.0	1,800	1, 2
63.	1918 Oct 15	V	Western TN	35.2	89.2	40,000	1, 2
64.	1919 May 25	V	Princeton, IN	38.4	87.5	25,000	1, 2
65.	1919 Nov 3	IV-V	AR	36.2	90.9	local	1, 2
66.	1920 May 1	V	MO	38.5	90.5	10,000	1

TABLE 2.5-7 (Continued) (Sheet 4 of 7)

	DATE	MODIFIED MERCALLI INTENSITY	LOCATION	NORTH LATITUDE	WEST LONGITUDE	FELT AREA (SQ MI)	REFERENCE
67.	1922 Jan 10	IV-V	Mt. Vernon, IN	37.9	87.8	9,500	2
68.	1922 Mar 22	V	Southern IL	37.3	88.6	60,000 (2 shocks)	2
69.	1922 Mar 30	IV-V	Memphis, TN	36.0	89.6	15,000	2
70.	1922 Nov 27	VI-VII	El Dorado, IL	37.8	88.5	50,000	2, 8
71.	1923 Oct 28	VII	AR	35.5	90.4	40,000	1
72.	1923 Nov 9	V	Cass County, IL	40.0	90.5	600	1, 2
73.	1923 Dec 31	V	AR	35.4	90.3	60,000	1, 2
74.	1924 Mar 2	V	KY	36.9	89.1	30,000	2
75.	1925 Apr 26	VI	Princeton, IN	38.3	87.6	100,000	1
76.	1925 May 13	V	KY	36.7	88.6	3,000	1
77.	1925 Jul 13	V	Edwardsville, IL	38.8	90.0	----	2
78.	1925 Sep 2	V-VI	KY	37.8	87.5	75,000	1
79.	1927 Mar 18	VI	White Cloud, KS	40.0	95.3	300	1, 7
80.	1927 May 7	VII	Mississippi Valley	35.7	90.6	130,000	1
81.	1927 Aug 13	V	Tiptonville, TN	36.4	89.5	25,000	2
82.	1930 Sep 1	V	Marston, MO	36.6	89.4	4,000	2
83.	1931 Jan 5	V	Elliston, IN	39.0	87.0	500	1
84.	1931 Aug 9	VI	Turner, KS	39.1	94.7	300	2, 7
85.	1933 Dec 9	V	Manila, AR	35.8	90.2	100	2
86.	1934 Aug 19	VI	Rodney, MO	36.9	89.2	33,000	2
87.	1934 Nov 12	VI	Rock Island, IL	41.5	90.5	----	1
88.	1937 May 16	IV-V	Northeastern AR	35.9	90.4	25,000	1
89.	1937 Nov 17	V	Centralia, IL	38.6	89.1	20,000	1, 2
90.	1938 Feb 12	V	Lake Michigan	41.6	87.0	6,500	2
91.	1938 Sep 16	IV-V	Northeastern AR	35.5	90.3	90,000	1
92.	1939 Nov 23	V	Griggs, IL	38.2	90.1	150,000	1
93.	1940 Nov 23	VI	Griggs, IL	38.2	90.1	150,000	2
94.	1941 Nov 16	VI	Covington, TN	35.5	89.7	20,000	2

TABLE 2.5-7 (Continued) (Sheet 5 of 7)

DATE	MODIFIED MERCALLI INTENSITY	LOCATION	NORTH LATITUDE	WEST LONGITUDE	FELT AREA (SQ MI)	REFERENCE
95. 1943 July 25	IV-V	East central MO	38.1	91.3	----	2
96. 1945 Mar 27	III	Moselle, MO	38.4	90.9	3,000	2
97. 1946 Oct 7	IV-V	Chloride, MO	37.5	90.6	32,000	2
98. 1947 June 29	VI	St. Louis, MO	38.4	90.2	15,000	1
99. 1947 Dec 15	V	Lepanto, AR	35.6	90.1	6,000	2
100. 1949 Jan 13	V	TN-AR-MO Border	36.3	89.7	15,000	2
101. 1949 Aug 26	III	Defiance, MO	38.6	90.8	----	2
102. 1950 Feb 8	V	Lebanon, MO	37.7	92.7	5,500	1, 2
103. 1952 Feb 20	V	TN-MO Border	36.4	89.5	13,000	2
104. 1952 Jul 16	VI	Dyersburg, TN	36.2	89.6	----	1
105. 1953 Sep 11	VI	Southwestern, IL	38.6	90.1	----	1
106. 1954 Feb 2	VI	Poplar Bluff, MO	36.7	90.3	32,000	1, 2
107. 1954 Apr 26	V	Memphis, TN	35.1	90.1	16,000	1, 2
108. 1955 Mar 29	VI	Finley, TN	36.0	89.5	10,000	1, 10
109. 1955 Apr 9	VI	Sparta, IL	38.1	89.9	20,000	1
110. 1955 Sep 5	V	Finley, TN	36.0	89.5	----	1
111. 1955 Dec 13	V	Dyer County, TN	36.0	89.5	----	1
112. 1956 Jan 28	VI	TN-AR Border	35.6	89.6	5,000	1, 2
113. 1956 Oct 29	V	Caruthersville, MO	36.1	89.7	----	1
114. 1956 Oct 30	VII	Northeastern OK	36.2	95.9	10,000	2, 10
115. 1956 Nov 25	VI	Wayne County, MO	37.1	90.6	27,000	2
116. 1957 Mar 26	V	Paducah, KY	37.0	88.6	300	1, 2
117. 1958 Jan 26	V	Caruthersville, MO	35.2	90.0	6.500	2
118. 1958 Jan 27	V	IL-KY-MO Border	37.0	89.0	15,000	2
119. 1958 Apr 8	V	Obion County, TN	36.2	89.1	800	2
120. 1958 Apr 26	V	Lake County, TN	36.4	89.5	700	2
121. 1958 Nov 7	VI	IL-IN Border	38.4	87.9	33,000	2
122. 1959 Feb 13	V	Bogota, TN	36.2	89.5	170	2

TABLE 2.5-7 (Continued) (Sheet 6 of 7)

DATE	MODIFIED MERCALLI INTENSITY	LOCATION	NORTH LATITUDE	WEST LONGITUDE	FELT AREA (SQ MI)	REFERENCE
123. 1959 Dec 21	V	Finley, TN	36.0	89.5	400	2
124. 1960 Jan 28	V	Dyer County, TN	36.0	89.5	300	2
125. 1960 Apr 21	V	Lake County, TN	36.3	89.5	local	2
126. 1961 Apr 27	V	Southeastern OK	34.5	95.2	8,000	2
127. 1961 Dec 25	V	Excelsior Springs, MO	39.1	94.6	16,000	2
128. 1962 Feb 2	VI	New Madrid, MO	36.5	89.6	45,000	2
129. 1962 Jun 26	V	Southern IL	37.7	88.5	17,500	2
130. 1962 Jul 23	VI	TN	36.1	89.8	4,000	2
131. 1963 Mar 3	VI	Southeast MO	36.7	90.1	125,000	2
132. 1963 Aug 2	V	IL-KY Border	37.0	88.8	2,600	2
133. 1965 Mar 6	VI	Eastern MO	37.8	91.2	----	3
134. 1965 Aug 13	VI	Southwestern IL	36.3	89.5	----	3
135. 1965 Aug 14	VII	Tamms, IL	37.1	89.2	400	2
136. 1965 Aug 15	V	Southwestern IL	37.4	89.5	2 shocks not plotted	1
137. 1965 Oct 20	VI	Eastern MO	37.8	91.1	245,000	2
138. 1967 Jul 21	VI	MO	37.5	90.4	----	1, 2
139. 1968 Nov 9	VII	Southcentral IL	38.0	88.5	580,000	1
140. 1970 Nov 16	VI	North AR	35.9	89.9	30,000	1
141. 1971 Oct 1	V	Sedgwick, AR	35.8	90.4	----	3
142. 1972 Feb 1	V	AR-MO Border	36.4	90.8	10,200	3
143. 1972 Mar 29	V	New Madrid, MO	36.1	89.9	felt in 6 states	3
144. 1972 Apr 4	II	Washington, MO	38.5	91.1	----	
145. 1972 Sep 15	VI	Northern IL	41.6	89.4	----	3
146. 1974 Jan 8	V	MO-TN Border	36.2	89.4	----	5
147. 1974 Apr 3	VI	Olney, IL	38.6	88.1	252,800	5, 10
148. 1974 May 13	VI	Charleston, MO	36.7	89.4	----	5
149. 1974 Jun 5	V	Belleville, IL	38.6	89.9	----	5

TABLE 2.5-7 (Continued) (Sheet 7 of 7)

DATE	MODIFIED MERCALLI INTENSITY	LOCATION	NORTH LATITUDE	WEST LONGITUDE	FELT AREA (SQ MI)	REFERENCE
150. 1974 Aug 11	V	Fremont, MO	36.9	91.2	----	5
151. 1975 Feb 13	V	New Madrid, MO	36.5	89.6	----	5
152. 1975 Jun 13	V-VI	New Madrid, MO	36.5	89.7	----	5, 8, 9, 10
153. 1975 Dec 3	V	New Madrid, MO	36.5	89.6	----	5
154. 1976 Mar 25	VI	Marked Tree, AR	35.6	90.5	112,000	5, 10
155. 1976 Apr 15	V	Greenville, KY	37.4	87.3	----	5
156. 1976 May 22	V	Dunklin, MO	36.0	89.8	----	5
157. 1976 Sep 25	V	Marked Tree, AR	35.6	90.4	----	5
158. 1976 Dec 13	V	Farmington, MO	37.8	90.2	----	5
159. 1977 Jan 3	VI	Jackson, MO	37.5	89.8	----	5
160. 1978 Jun 2	V	Fairfield, IL	38.4	88.5	----	8, 9
161. 1978 Aug 31	V	Dyersburg, TN	36.1	89.4	----	8, 9
162. 1978 Sep 20	V	Webster Groves, MO	38.6	90.3	----	8, 9
163. 1978 Dec 5	V	Flora, IL	38.6	88.4	----	8, 9
164. 1979 Feb 27	VI	Strawberry, AR	35.9	91.2	----	8, 9
165. 1979 Jun 11	V	Caruthersville, MO	36.2	89.7	----	8, 9
166. 1979 Jun 25	V	Marked Tree, AR	35.5	90.4	----	8, 9
167. 1979 Jul 8	V	Charleston, MO	36.9	89.3	----	8, 9
168. 1979 Jul 13	V	Hayti, MO	36.1	89.8	----	8, 9
169. 1979 Nov 5	V	Warm Springs, AR	36.4	91.0	----	8, 9
170. 1980 Dec 2	V	Miston, TN	36.2	89.4	----	8, 9

(Sheet 1 of 2)

TABLE 2.5-8 HISTORIC EARTHQUAKES SIGNIFICANT TO THE SITE

DATE	LOCATION	MAXIMUM MMI	MMI AT SITE
1811-1812	New Madrid, MO	XI-XII	VI-VII
1843 Jan. 4	Western TN	VIII	Unknown (Probably II)
1867 Apr. 24	Manhattan (Wamego), KS	VII	IV-V
1878 Nov. 18	Southeastern MO	VI	I-III
1886 Aug. 31	Charleston, SC	X	II-III
1891 Sep. 27	Mt. Vernon, IL	VIII	Unknown (No Reports)
1895 Oct. 31	Charleston, MO	VIII	V-VI, VI[a]
1902 Jan. 24	MO	VI	II-III
1903 Feb. 8	Murphysboro, IL	VI	I
1903 Nov. 4	Charleston, MO	VII	II-III
1905 Aug. 21	Sikeston, MO	VI-VII	I
1917 Apr. 9	Eastern MO-St. Louis	VI	IV
1920 May 1	MO	V	III-IV
1939 Nov. 23	Griggs, IL	V	I-III
1946 Oct. 7	Chloride, MO	V	I-III
1955 Apr. 9	Sparta, IL	VI	I
1956 Nov. 25	Wayne Co., MO	VI	I-III
1963 Mar. 3	Southeastern MO	VI	II-III
1965 Oct. 20	Eastern MO-St. Louis	VI	IV-V
1968 Nov. 9	Southcentral IL	VII	IV

TABLE 2.5-8 (Continued) (Sheet 2 of 2)

DATE	LOCATION	MAXIMUM MMI	MMI AT SITE
1971 Oct. 1	Sedgwick, AR	V	I-III
1974 Apr. 3	Olney, IL	VI	IV
1974 June 5	Belleville, IL	V	III[b]
1976 Mar. 25	Marked Tree, AR	VI	I-III
1976 Dec. 13	Farmington, MO	V	II[b]
1977 Jan. 3	Jackson, MO	VI	IV[b]
1978 June 2	Fairfield, IL	V	II[b]
1978 Sep. 20	Webster Groves, MO	V	III[b]
1979 Feb. 27	Strawberry, AR	VI	II-III[b]

a MMI VI according to Hopper and Algermissen, 1980, Plate 1.

b Estimated attenuation obtained using equation from Gupta and Nuttli (1976). No felt reports from site area.

(Sheet 1 of 2)

TABLE 2.5-9 SEISMOTECTONIC REGIONS

REGION	MAXIMUM HISTORICAL EARTHQUAKE	LEVEL OF SEISMICITY	FAULT PLANE CHARACTER	GEOLOGY
New Madrid Region	XI-XII	High	1. Northeast-Reverse Oblique Slip. 2. North-South-Normal, Reverse and Oblique Slip. 3. Northwest-Normal and Strike Slip.	New Madrid Fault Zone trending Northeast and Northerly and Northwesterly trending faults center of Mississippi Embayment.
Reelfoot Region	VII	Moderate	1. Northeast-Strike slip. 2. North-South-Reverse.	Related to the Reelfoot Region, Center of Mississippi Embayment, some evidence for recent faulting.
West Embayment Region	VI	Low-Moderate	1. Northeast-Normal. 2. North-South-Reverse. 3. North-South-Oblique. 4. Northwest-Strike Slip.	West Side of Mississippi Embayment, little or no faulting since Cretaceous border marked by presence of Tertiary sediments.
East Embayment Region	<V	Low		East side of Mississippi Embayment, no faulting since Cretaceous.
Nashville Dome	<V	Very low		Structural Dome, Paleozoic rocks, stable area.
Fluorspar Fault Complex and Western Kentucky Faulted Belt	V	Low		Densely faulted and mineralized areas, no major faulting since Cretaceous. Various orientations and ages of faulting.
Wabash Valley Region	VII	Moderate	Northeast-Reverse and Normal	Wabash Valley faults trending Northeast.
Border Region	<V	Very low		Margin of Ozark Uplift stable area.
Illinois Basin Random Region	VII	Low		Mostly Illinois Basin, earthquakes not related to known structures.
Missouri Random Region	V	Low		Western Ozark Uplift and part of interior plains, stable area.

TABLE 2.5-9 (Continued)

REGION	MAXIMUM HISTORICAL EARTHQUAKE	LEVEL OF SEISMICITY	FAULT PLANE CHARACTER	GEOLOGY
Chester-Dupo Region	VII	Moderate		North-South axis related to Chester-Dupo and related folds, St. Louis area.
Ste. Genevieve Region	VI	Moderate	Northwest-Reverse and Normal.	Northwest trending axis, related to Ste. Genevieve and associated faults.
St. Francois Region	VI	Low-Moderate	Northwest-Normal and Strike Slip.	Faults around margin of pre-Cambrian core of St. Francois Mts.

TABLE 2.5-10 SEISMIC EVENTS IN AREA SURROUNDING NEW MADIRD BY YEAR, MODIFIED MERCALLI INTENSITY, LATITUDE AND LONGITUDE

YEAR	MODIFIED MERCALLI INTENSITY	LATITUDE	LONGITUDE
1811	XI	36.6	89.6
1811	X-XI	36.6	89.6
1812	XI-XII	36.6	89.6
1841	V	36.6	89.2
1842	IV	36.6	89.2
1842	V	36.6	89.2
1846	III	36.6	89.6
1848	III-IV	36.6	89.2
1853	III	36.6	89.2
1853	IV-V	36.6	89.2
1855	IV	37.0	89.2
1855	III	37.0	89.2
1856	IV	36.6	89.5
1857	IV	36.6	89.5
1858	VI	36.5	89.2
1865	VII	36.0	89.5
1865	III-IV	36.6	89.5
1868	III	36.6	89.2
1870	III-IV	36.6	89.2
1871	III	37.0	89.2
1872	II-III	35.1	90.0
1872	III	35.1	90.0
1872	III-IV	37.0	89.2
1873	IV	36.0	89.6
1873	II-III	35.1	90.0
1874	III-IV	37.0	89.2
1875	IV	35.1	90.0
1875	III-IV	36.1	89.6
1877	III-IV	35.1	90.0
1877	III-IV	37.0	89.2
1877	III-IV	36.5	89.7
1878	III-IV	37.0	89.2
1878	III	37.0	89.2
1878	V	36.8	89.1
1878	VI	36.7	89.3

TABLE 2.5-10 (Sheet 2)

YEAR	MODIFIED MERCALLI INTENSITY	LATITUDE	LONGITUDE
1879	II-III	37.0	89.2
1879	III-IV	35.1	90.0
1880	IV	35.1	90.0
1881	IV	35.1	90.0
1882	V	36.9	89.2
1883	VI	35.1	90.0
1883	III	37.4	89.3
1883	VI-VII	37.0	89.2
1883	V-VI	37.0	89.2
1883	IV-V	37.0	89.2
1883	III	37.0	89.2
1884	IV	35.5	89.7
1886	III-IV	37.0	89.2
1887	V	37.0	89.2
1888	IV	35.1	90.0
1888	III	35.1	90.0
1889	IV	35.1	90.0
1891	V	37.0	89.2
1891	III-IV	35.1	90.0
1892	III	35.1	90.0
1894	III	35.1	90.0
1895	VIII	37.0	89.4
1895	IV	37.0	89.4
1895	III-IV	37.0	89.4
1895	III	36.6	89.5
1895	III	35.2	90.0
1897	IV	37.0	89.0
1897	IV-V	35.8	89.6
1898	IV	36.0	89.4
1901	IV	36.0	90.0
1901	III	35.1	90.0
1903	V	36.5	89.5
1903	II-III	36.6	89.5
1903	III	36.6	89.5
1903	V-VI	37.0	90.0

TABLE 2.5-10 (Sheet 3)

YEAR	MODIFIED MERCALLI INTENSITY	LATITUDE	LONGITUDE
1903	VII	36.9	89.3
1903	VI	36.9	89.3
1905	VI-VII	36.8	89.6
1908	IV	37.0	89.0
1908	IV-V	37.0	89.0
1908	IV	36.1	89.6
1909	V-VI	37.0	89.5
1915	IV-V	36.5	89.5
1915	V-VI	36.7	89.1
1915	IV	37.1	89.2
1916	IV	36.1	89.5
1916	V-VI	36.6	89.2
1916	IV	37.0	89.2
1917	IV	36.8	89.4
1917	IV	36.9	90.0
1917	III	36.9	90.0
1918	III	37.0	89.2
1918	V	35.2	89.2
1919	III	36.8	89.4
1919	III	36.6	89.2
1919	III	36.4	89.5
1921	IV	36.4	89.5
1921	III	37.0	89.2
1922	III	36.7	90.4
1922	IV-V	36.1	89.6
1923	IV	35.5	90.4
1923	VII	35.5	90.4
1923	III-IV	37.0	89.2
1923	IV	37.0	89.2
1923	V	35.4	90.3
1924	IV-V	36.4	89.5
1924	V	37.0	89.1
1926	IV	36.2	89.0
1926	IV	36.4	89.5
1926	III	36.7	89.4

TABLE 2.5-10 (Sheet 4)

YEAR	MODIFIED MERCALLI INTENSITY	LATITUDE	LONGITUDE
1927	IV	37.4	89.7
1927	IV	36.9	90.0
1927	V	36.4	89.5
1927	IV	36.3	89.5
1928	IV	37.4	89.5
1928	IV	36.6	89.5
1928	IV	36.5	89.2
1929	III	36.4	89.5
1930	II	36.1	89.5
1930	III-IV	37.0	90.2
1930	IV	37.0	89.1
1930	V	36.6	89.4
1930	IV	36.1	89.7
1930	III	35.5	90.4
1930	IV	35.1	90.1
1930	II-III	35.1	89.9
1930	II	35.7	89.5
1931	IV	35.9	89.8
1931	IV	36.8	89.0
1931	IV	36.6	89.5
1932	III	36.0	90.2
1933	IV	36.7	90.4
1933	V	35.8	90.2
1934	II-III	37.0	89.2
1934	VI	36.9	89.2
1934	IV	35.2	90.0
1935	IV	36.4	89.5
1936	II	37.4	89.5
1936	III	37.4	89.5
1936	III	36.7	89.0
1936	II	36.6	89.6
1936	IV	36.2	89.7
1936	III	36.0	89.8
1937	IV	36.1	89.7
1937	III	36.6	89.5

TABLE 2.5-10 (Sheet 5)

YEAR	MODIFIED MERCALLI INTENSITY	LATITUDE	LONGITUDE
1937	III	36.4	89.5
1938	II	36.6	89.6
1938	III	36.5	89.9
1938	III	35.8	89.9
1938	IV-V	35.5	90.3
1938	II-III	35.5	90.3
1939	III	36.8	89.4
1939	III	36.4	89.5
1940	III	37.3	89.5
1940	II-III	36.8	89.2
1940	II-III	36.5	89.6
1940	III	35.9	89.8
1941	IV-V	36.2	89.7
1941	III	36.7	89.7
1941	IV	37.0	89.1
1941	II-III	37.4	89.5
1941	VI	35.5	89.7
1941	IV	35.1	90.0
1942	IV	37.0	89.2
1942	III	36.8	89.7
1944	IV	37.5	89.7
1944	IV	36.2	89.7
1945	III	36.1	89.7
1945	IV	37.0	89.2
1945	IV	36.5	89.7
1945	III	36.5	89.5
1945	III	36.4	89.1
1947	V	35.1	90.1
1947	II-III	37.0	89.2
1949	V	35.4	89.7
1949	III	36.1	89.7
1950	II-III	36.5	89.9
1950	III-IV	35.7	89.9
1951	III	35.6	90.3
1951	II-III	35.6	90.3

TABLE 2.5-10 (Sheet 6)

YEAR	MODIFIED MERCALLI INTENSITY	LATITUDE	LONGITUDE
1952	II	35.9	89.8
1952	IV	35.9	89.8
1952	II-III	36.0	89.4
1952	IV	36.0	89.4
1952	VI	36.1	89.6
1952	V	36.4	89.5
1952	IV	36.6	89.7
1952	III	36.7	89.6
1952	IV	36.2	89.6
1952	IV	36.1	89.6
1953	III	37.0	89.2
1953	IV	36.5	89.5
1953	III	36.5	89.5
1953	IV	36.0	89.5
1953	II	36.0	89.5
1953	III	36.0	89.5
1954	IV	36.7	90.3
1954	IV	36.0	89.4
1954	V	35.1	90.0
1955	IV	36.4	89.5
1955	VI	36.0	89.5
1955	V	36.0	89.5
1955	III	36.0	89.5
1956	VI	35.6	89.6
1956	II-III	36.1	89.7
1956	V	36.1	89.7
1957	IV	36.0	89.5
1958	V	36.3	89.2
1958	V	36.4	89.5
1958	V	37.1	89.2
1958	V	36.1	89.7
1958	IV	35.5	90.4
1959	IV	36.3	89.5
1959	V	36.1	89.5
1959	V	36.0	89.5

TABLE 2.5-10 (Sheet 7)

YEAR	MODIFIED MERCALLI INTENSITY	LATITUDE	LONGITUDE
1959	III	35.9	89.8
1960	V	36.3	89.5
1960	V	36.0	89.5
1962	II-III	35.0	90.2
1962	V	36.1	89.7
1962	VI	36.5	89.6
1962	II-III	36.9	90.0
1962	VI	36.8	89.2
1963	VI	36.7	90.0
1964	IV-V	36.5	89.9
1964	III	36.5	89.9
1964	IV	36.2	89.6
1965	V	37.4	89.5
1965	IV	37.4	89.5
1965	VII	37.1	89.2
1965	III	36.4	89.5
1966	IV	35.9	90.0
1967	VI	37.5	90.4
1968	III	36.8	89.2
1968	III	36.5	89.6
1970	IV	36.7	89.5
1970	III	36.5	89.7
1970	III-IV	36.3	89.5
1970	V	35.9	90.1
1971	V-VI	35.8	90.4
1972	III	37.0	89.1
1972	V	36.2	89.7
1972	IV	35.9	90.0
1973	IV	35.9	90.0
1973	IV	36.5	89.6
1973	IV	36.5	89.6
1974	V	36.2	89.4
1974	V	36.2	89.4
1974	VI	38.6	88.1
1974	VI	36.7	89.4

TABLE 2.5-10 (Sheet 8)

YEAR	MODIFIED MERCALLI INTENSITY	LATITUDE	LONGITUDE
1975	V	36.5	89.6
1975	VI	36.5	89.7
1975	V	36.5	89.6
1976	IV	35.9	92.1
1976	VI	35.6	90.5
1976	V	36.1	89.8
1976	V	35.6	90.5
1977	IV	36.2	89.6

TABLE 2.5-11 COLUMNAR SECTION SOUTHEASTERN MISSOURI, MISSISSIPPI EMBAYMENT AREA

ERA	SYSTEM		FORMATION	MAXIMUM THICKNESS (in feet)	LITHOLOGIC CHARACTER
CENOZOIC	QUATERNARY		Alluvium	275	Sand and gravel, some clay, lignite.
			Loess	80	Silt, yellow-brown.
	TERTIARY	CLAIBORNE GROUP	"Lafayette"	60	Gravel, sand, clay.
		WILCOX GROUP	Holly Springs ? Ackerman ?	1300	Sand, several well-developed clay zones, thick basal sand.
		MIDWAY GROUP	Porters Creek	650	Clay, blue-gray, conchoidal fracture, siderite and silt in upper portion. Glauconitic and calcareous in lower portion.
			Clayton	15	Limestone and calcareous clay, fossiliferous, glauconitic.
MESOZOIC	CRETACEOUS		Owl Creek	70	Clay, brown, sandy, glauconitic. Very fossiliferous.
			Mc Nairy (Ripley)	250	Sand, sandy clay, glauconitic, fossiliferous.
			Ozan ? Marlbrook-Saratoga ?	250	Sand, calcareous sand and clay.
PALEOZOIC	DEVONIAN	LOWER	Bailey	50	Limestone, very cherty.
		MIDDLE	Bainbridge	400	Limestone, red, argillaceous.
	SILURIAN	LOWER	Brassfield		Limestone, gray, glauconitic at top.
			Girardeau		Limestone, dark gray, dense, cherty.
	ORDOVICIAN		Thebes Maquoketa	25	Sandstone, brown. Shale, gray.
			Fernvale	10	Limestone, white, crystalline.
			Kimmswick	125	Limestone, white, crystalline.
			Decorah	25	Limestone, gray, dense, shaly.
			Plattin	420	Limestone, dark gray, dense, dolomoldic chert in upper portion, oölitic and conglomeratic limestone at base.
			Rock Levee	270	Limestone, dark gray, dense. Dolomite, buff, finely granular to crystalline.
			Joachim	175	Dolomite, buff, fine grained. Thin chert zones at top, sandy in lower portion.

TABLE 2.5-11 (Continued) (Sheet 2 of 2)

ERA	SYSTEM		FORMATION	MAXIMUM THICKNESS (in feet)	LITHOLOGIC CHARACTER
PALEOZOIC	ORDOVICIAN		Dutchtown	160	Limestone, dark gray, dense. Shaly in middle portion. Sandy in lower portion.
PALEOZOIC	ORDOVICIAN		St. Peter-Everton	135	Sandstone, white, friable, coarse to fine-grained.
PALEOZOIC	ORDOVICIAN		Everton	420	Dolomite, dark gray to brown, finely crystalline, sandy. Some green and brown shale and sandy chert. Thin beds of sandstone. Dense, dark gray limestone in uppermost portion.
PALEOZOIC	ORDOVICIAN	CANADIAN SYSTEM (E.O. ULRICH)	Smithville ?	255	Dolomite, buff, gray, finely crystalline, argillaceous.
PALEOZOIC	ORDOVICIAN	CANADIAN SYSTEM (E.O. ULRICH)	Powell ?		Dolomite, buff, fine- to medium-crystalline, sandy. Quartz, green shale, brown quartzose chert.
PALEOZOIC	ORDOVICIAN	CANADIAN SYSTEM (E.O. ULRICH)	Cotter Jefferson City	540	Dolomite, gray to buff, medium to coarse crystalline, oölitic and dolomoldic chert, thin shale partings and thin sandstones.
PALEOZOIC	ORDOVICIAN	CANADIAN SYSTEM (E.O. ULRICH)	Roubidoux	400	Dolomite, gray to brown, crystalline. Sand, sandy chert, and brown quartzose oölitic chert.
PALEOZOIC	ORDOVICIAN	OZARKIAN (E. O. ULRICH)	Gasconade Van Buren Gunter	600	Dolomite, gray, coarsely crystalline, slightly sandy and noncherty in upper portion, middle portion cherty. White and blue opaque to translucent chert, oölitic and dolomoldic. Sandy dolomite and thin sandstones in lower portion.
PALEOZOIC	CAMBRIAN (UPPER)	OZARKIAN (E. O. ULRICH)	Eminence	325	Dolomite, gray to cream, crystalline, slightly siliceous. Gray quartzose chert, white lace-like dolomoldic silica. Some quartz and green shale.
PALEOZOIC	CAMBRIAN (UPPER)	OZARKIAN (E. O. ULRICH)	Potosi	400	Dolomite, brown, coarsely crystalline, vuggy. Vugs lined with drusy quartz which is banded.
PALEOZOIC	CAMBRIAN (UPPER)	RESTRICTED CAMBRIAN	ELVINS GROUP: Doerun Derby Davis	615	Dolomite, buff, finely crystalline to granular, argillaceous, glauconitic, shale in lower portion.
PALEOZOIC	CAMBRIAN (UPPER)	RESTRICTED CAMBRIAN	Bonneterre	1580	Dolomite, crystalline, argillaceous. Shale, black, dolomitic, glauconitic. Limestone in lower portion is white, crystalline, glauconitic, sandy, fossiliferous.
PALEOZOIC	CAMBRIAN (UPPER)	RESTRICTED CAMBRIAN	Lamotte ?	90	Quartzite, buff, very fine-grained, well-cemented and hard, somewhat dolomitic.
PRE-CAMBRIAN				?	Granite and porphyry at outcrop in extreme northwest portion of area.

REFERENCES:

1. GROHSKOPF, 1955
2. RUSS AND CRONE, 1979

TABLE 2.5-12 INFORMATION FROM WELLS NEAR NEW MADRID

WELL NUMBER	OWNER	DRILLER	DATE	COUNTY	LOCATION	ELEVATION MSL	TOTAL DEPTH (FEET)	MISSOURI SURVEY WELL NO.	TOP OF PORTERS CREEK CLAY ELEVATION MSL	TOP OF PALEOZOIC ELEVATION MSL
1	J. P. Pearson No. 1	Coastal Development Co.	1939	Butler	SW NE NW Sec. 27 T22N R6E	292	753	6614	--	-218
2	Eder Oil Co. No. 1	Parkin & Truman	1955	Butler	NE NE SE Sec. 3 T23N R5E	399	160	14428	--	+ 329 or above
3	Neelyville School	Earl Parkin	1964	Butler	C SE SE Sec. 5 T23N R5E	381	310	22525	--	+ 281 or above
4	Boste Station, Miss.	W. Parkin & Sons	1941	Butler	SW SW Sec. 9 T23N R5E	380	290	7288	--	+ 280 or above
5	Miss. River Fuel Co.	Earl Parkin	1957	Butler	SW NW SE Sec. 9 T23N R5E	300	300	16817	--	+ 322 or above
6	City of Qulin	Layne-Arkansas	1965	Butler	NW Cor NW SW Sec. 31 T23N R82	317	324	23187	+ 242 or above	--
7	City of Cardwell No. 1	Weldon Well Co.	1949	Dunklin	CNW SW SE Sec. 3 T16N R7E	248	1770	10902	-669	--
8	City of Arbyrd	Layne-Arkansas	1962	Dunklin	CNW SE Sec. 6 T16N R8E	247	1667	20814	-1103	--
9	City of Hornersville No. 2	Weldon Well Co.	1946	Dunklin	SE SW NE Sec. 8 T16N R9E	246	1846	9110	-1084	--

Source:

Base Map Compiled from Portions of the following U.S. Geological Survey Topographic Maps at a scale of 1:250,000

Rolla, Missouri	1954
Paducah, Kentucky	1948
Poplar Bluff, Missouri	1957
Dyersburg, Tennessee	1956-64

Deep well locations obtained from

1 Grohskopf, 1955.

2 Stearns, 1958.

3 Missouri Geological Survey and Water Resources, 1974.

TABLE 2.5-12 (Continued)

WELL NUMBER	OWNER	DRILLER	DATE	COUNTY	LOCATION	ELEVATION MSL	TOTAL DEPTH (FEET)	MISSOURI SURVEY WELL NO.	TOP OF PORTERS CREEK CLAY ELEVATION MSL	TOP OF PALEOZOIC ELEVATION MSL
10	City of Sennath No. 3	Weldon Well Co.	1945	Dunklin	SE SW SE Sec. 2 T17N R8E	259	1717	8948	-891	--
11	Hellor No. 1	J & L Oil Co.	1957	Dunklin	NE NW NW Sec. 25 T18N R8E	258	N.A.	15957	-842 or above	--
12	City of Kennett No. 3	Carloss Well Co.	1939	Dunklin	SE NE NE Sec. 2 T18NR9E	265	1600	5293	-915 -925*	--
13	City of Kennett No. 2	Weldon Well Co.	1949	Dunklin	C NW NE SW Sec. 35 T19N R9E	267	1630	11147	-828	--
14	City of Holcomb	Layne-Arkansas	1960	Dunklin	C SE NW Sec. 6 T20N R10E	276	1245	18905	-499 est.	--
15	Campbell Lumber Co. No. 1	Johnson & Fleming	1902	Dunklin	SW SW NE Sec. 3 T21N R9E	304	960	Grohskopf p.65	--	--
16	City of Campbell No. 3	Layne-Arkansas	1955	Dunklin	C NW SE Sec. 3 T21N R9E	301	935	13823	- 39	--
17	City of Clarkston	Carloss Well Supply Co.	1949	Dunklin	SE NE NW Sec. 22 T21N R10E	285	1320	10570	-494	--
18	John Stewart No. 1	Allen Brothers	1959	Dunklin	Sec. 14 T22N R9E	415	865	17846	-55 -185*	--
19	U.S. Army Basic Flying School No. 1	C. M. Journey Co.	1942	Dunklin	SE NE NW Sec. 28 T23N R10E	292	N.A.	8024	-158	-683 est.
20	U.S. Army Basic Flying School No. 1	C. M. Journey Co.	1942	Dunklin	SW SW SE Sec. 28 T23N R10E	292	860	7937	-68 -273*	--
21	Big Oak Tree No. 1	Monarch Producing Co.	1965	Missis-sippi	SW NE Sec. 7 T24N R17E	293	4909	24204	-667	-1132
22	City of Charleston No. 3	Cart Contracting Co.	1925	Missis-sippi	C SW NE SW Sec. 5 T26N R16E	325	800	2661	-150	-460
23	City of Charleston (test hole)	Layne-Arkansas	1960	Missis-sippi	SW SE NW Sec. 8 T26N R16E	328	810	18685	-207	--
24	City of Charleston No. 1	Layne-Arkansas	1959	Missis-sippi	C N1/2 NE NE Sec. 8 T26N R16E	328	870	18268	-187	--

TABLE 2.5-12 (Continued)

WELL NUMBER	OWNER	DRILLER	DATE	COUNTY	LOCATION	ELEVATION MSL	TOTAL DEPTH (FEET)	MISSOURI SURVEY WELL NO.	TOP OF PORTERS CREEK CLAY ELEVATION MSL	TOP OF PALEOZOIC ELEVATION MSL
25	R. G. Delaney No. 1	Little Egypt Oil Co.	1961	Missis-sippi	NW NE NW Sec. 6 T26N R17E	314	1050	19911	--	-506
26	City of Gideon No. 4	Weldon Well Co.	1949	New Madrid	NE SW SE Sec. 13 T21N R10E	268	1330	10903	-537	--
27	City of Gideon No. 5	Layne-Arkansas	1955	New Madrid	NW NW NW Sec. 19 T21N R11E	265	1308	13427	-595	--
28	City of Risco	Layne-Arkansas	1956	New Madrid	NW NE NW Sec. 13 T22N R11E	276	1160	14280	-389	--
29	R. B. Oliver Jr. No. 1	Pioneer Drilling Co.	1945	New Madrid	C SW SW Sec. 29 T22N R11E	269	3728	8882	-482	-1018
30	City of Marston	Layne-Arkansas	1961	New Madrid	NW NW SW Sec. 25 T22N R13E	288	1658	20369	-847	--
31	City of Lilbourn	Weldon Well Co.	1947	New Madrid	NE NE SW Sec. 35 T23N R13E	285	1335	9502	-590 -740*	--
32	Mrs. S. L. Hunter No. 1	Lilbourn Oil Co.	1941	New Madrid	SW SW SW Sec. 18 T23N r14E	288	1455	7309	-522 -587*	-1132
33	Mrs. Eddye Phillips No. 1	Cordova-Union Oil Co.	1941	New Madrid	SW SW NW Sec. 33 T23N R14E	302	2503	6809	-983 -703*	-1258
34	City of Matthews No. 1	Layne-Arkansas	1959	New Madrid	NE SW SW Sec. 31 T25N R14E	309	955	18003	-131	--
35	Himmelberger-Harrison Lumber Co.	Wm. B. Johnson	1902	New Madrid	C W 1/2 SW SE Sec. 31 T26n R13E	301	780	270	+15	-389
36	City of Steele No. 1	--	--	Pemiscot	Sec. 26 T17N R11E	N.A.	2350	--	--	--
37	City of Steele No. 2	Layne-Arkansas	1947	Pemiscot	C S 1/2 NW NE Sec. 26 T17N R11W	260	2337	9460	-1338	--
38	City of Deering No. 2	Carloss Well Co.	1941	Pemiscot	SE Cor SW Se Sec. 17 T18N R11E	257	2025	6910	-1013	--
39	City of Caruther-sville No. 5	Layne-Arkansas	1957	Pemiscot	SE NE SW Sec. 16 T18N R13E	276	1394	16268	-274 est.	--
40	City of Caruther-sville No. 6	Layne-Arkansas	1960	Pemiscot	NE SE SW Sec. 16 T18N R13E	271	1396	19689	-277 est.	--

TABLE 2.5-12 (Continued)

WELL NUMBER	OWNER	DRILLER	DATE	COUNTY	LOCATION	ELEVATION MSL	TOTAL DEPTH (FEET)	MISSOURI SURVEY WELL NO.	TOP OF PORTERS CREEK CLAY ELEVATION MSL	TOP OF PALEOZOIC ELEVATION MSL
41	Kenneth Pattinson,l O. W. Killam, T. J. Conway	--	1941	Pemiscot	SE SW Sec. 33 T18N R13E	263	3345	73247	-1267	-2449
42	Pemiscot Water Supply District No. 2 Test Hole No. 1	Layne-Arkansas	1967	Pemiscot	C S 1/2 NW SE Sec. 23 T19N R11E	264	1970	25003	-886 est.	--
43	T. P. Russell No. 1	Strake Petroleum Co.	1941	Pemiscot	NW SW SE Sec. 24 T19N R11E	266	4740	7222	-929 -1114*	-1789
44	City of Hayti No. 4	Weldon Wll Co.	1947	Pemiscot	NE SW SW Sec. 34 T19N R12E	270	2153	9422	-1265	--
45	City of Wardell	Layne-Arkansas	1962	Pemiscot	SE SE SW Sec. 24 T20N R11E	250	1725	20619	-915	--
46	Farrer No. 1	Glen Bull	--	Ripley	SW SW NW Sec. 1 T22N R4E	304	1090	24168	--Truncated at ground level	
47	Doug Woodward	Kennon Gas & Electric Co.	1962	Ripley	NE NE NW Sec. 3 T22N R4E	305	66	21533	--	+280 or above
48	Paul Porter	Kennon Gas & Electric Co.	--	Ripley	C N 1/2 NE NW Sec. 18 331 T22N R4E	331	65	22401	--	+306 or above
49	B. Stickler	W. Parkin & Son	1943	Ripley	NW NW Sec. 4 T23N R4E	500	110	8268	--	+435 or above
50	J. M. Nichols No. 1	Weldon Well Co.	1955	Ripley	NE NW NE Sec. 7 T23N R4E	487	110	13410	--	+472 or above
51	Ron Yacks	E. Parkin	1964	Ripley	NE SW SW Sec. 11 T23N R4E	420	75	22536	--	+375 or above
52	Earl Clayton	Kennon Gas & Electric Co.	1963	Ripley	SW SE SW Sec. 31 T23N R4E	365	53	22400	--Truncated at ground level +365	
53	Sherman Cress No. 1	Weldon Well Co.	--	Ripley	SW SW SE Sec. 34 T23N R4E	349	80	13408	--	+319 or above
54	City of Sikeston No. 2	H. T. Kilmer	1925	Scott	C SW SE Sec. 19 T26N R14E	327	505	2122	-85	-523 est.

TABLE 2.5-12 (Continued)

WELL NUMBER	OWNER	DRILLER	DATE	COUNTY	LOCATION	ELEVATION MSL	TOTAL DEPTH (FEET)	MISSOURI SURVEY WELL NO.	TOP OF PORTERS CREEK CLAY ELEVATION MSL	TOP OF PALEOZOIC ELEVATION MSL
55	City of Sikeston No. 3	Carloss Well Co.	1932	Scott	SW SW SE Sec. 19 T26N R14E	327	405	Grohskopf p 101	-78	--
56	City of Sikeston No. 5	Layne-Arkansas	1951	Scott	C SE SW Sec. 19 T26N R14E	330	422	11630	-80	--
57	City of Sikeston No. 6	Layne-Arkansas	1960	Scott	SE SE SW Sec. 19 T26N R14E	330	409	19120	-85 est.	--
58	Sikeston Water Works	Layne-Arkansas	1969	Scott	C W 1/2 Sec. 19 T26N R14E	327	410	26235	-73	--
59	Gypsy No. 1	Sherman McNew, et al.	1964	Scott	C SW NE SE Sec. 1 T27N R14E	338	2702	23365	118 or above	-407
60	OSCAR Deinberger Fee No. 1	Schneider and Gwin	1941	Scott	C N 1/2 NW NW Sec. 10 T28N R13E	383	340	7407	--	+323
61	OSCAR Deinberger No. 1	Schneider and Gwin	1941	Scott	NE NE NE Sec. 9 T28N R13E	380	340	--	--	+320
62	Stephan A. Barton	Schneider and Gwin	1942	Scott	C NE SE Sec. 11 T28N R13E	490	135	7834	+445	--
63	Scott County Jail at Benton	Chas. Wise	1905	Scott	C N 1/2 NE NW Sec. 13 T28N R13E	435	1500	200	--	+275
64	Tom Scott No. 1	E. M. Gould	1935	Scott	NW SW SW Sec. 13 T28N R13E	400	208	Grohskopf p.100	--	+245
65	City of Oran (test)	Schneider Drilling Co.	1944	Scott	NE SE SW Sec. 17 T28N R13E	370	140	9214	--	+233
66	City of Oran No. 1	E. M. Gould	1936	Scott	C SE SE Sec. 18 T28N	335	149	3561	--	+193
67	C. E. Faulkner No. 1 No. 1	Schneider and Gwin	1942	Scott	S 1/2 NW NW Sec. 23 T28N R13E	461	70	7774	+406	--
68	Charles Butler No. 1	E. M. Gould	1937	Scott	SW NW SE Sec. 29 T28N R13E	380	186	--	+370 or above	--
69	Kay Ranch No. 1	J. W. Hill	1943	Scott	NW SE NE Sec. 5 T28N R14E	370	215	8757	--	+160

TABLE 2.5-12 (Continued)

WELL NUMBER	OWNER	DRILLER	DATE	COUNTY	LOCATION	ELEVATION MSL	TOTAL DEPTH (FEET)	MISSOURI SURVEY WELL NO.	TOP OF PORTERS CREEK CLAY ELEVATION MSL	TOP OF PALEOZOIC ELEVATION MSL
70	Clarence LeGrand No. 1	Schneider Drilling Co.	1946	Scott	C NW NW Sec. 6 T28N R14E	439	215	9274	--	+269
71	Jim Norrid No. 1	Ray Lucas, E M. Gould	1934	Scott	C W 1/2 W 1/2 Sec. 6 T28N R14E	390	163	3119	--	+340
72	W. C. Pattongill Fee No. 1	E. M. Gould	1934	Scott	C NE SW SE Sec.6 T28N R14E	445	168	3137	--	+285
73	W. C. Pattongill No. 1	E. M. Gould	1934	Scott	NW SE SE Sec. 6 T28N R14E	445	168	Grohskopf p.97-98	--	+285
74	Benton Pulbic School No. 1	Farmington Drilling Co.	1937	Scott	SE NW NW Sec. 18 T28N R14E	440	183	4279	--	+310
75	City of Chaffee	F. M Luth	--	Scott	C E 1/2 NW NE Sec. 18 T29N R13E	337	2175	2147	--	+247 or above
76	St. Lawrence Catholic Catholic Church (At New Hamburg) No. 1	A. J. Patterson	1914	Scott	SW SW SW Sec. 35 T29N R13E	459	245	Grohskopf p.96-97	--	+340
77	St. Lawrence Catholic Church No. 2	E.E. Schneider	1949	Scott	SW SW SW Sec. 35 T29N R13E	455	475	11114	--	+375
78	Illmo - Commerce "Dade" Bollinger	Schneider Drilling Co.	1946	Scott	SE SW SW Sec. 3 T29N R14E	410	238	9279	--	+230
79	Herman Blattel	Schneider and Gwin	1941	Scott	C NW SW NW Sec. 16 T29N R14E	425	318	7202	--	+360
80	H. V. Ashley	Schneider Drilling Co.	1944	Scott	C N 1/2 SW SE Sec. 21 T29N R14E	434	235	8594	--	+339
81	John Davis	Missouri Geological Survey	1938	Scott	Sec. 24 T29N R14E	477	55	5314	+442	--
82	Tenant Keller No. T291424-16	Missouri Geological Survey	1937	Scott	C SW NE Sec. 24 T29N R14E	450	72	4691	Truncated at ground level	--
83	Joe Ellis No. T291425-28	Missouri Geological Survey	1938	Scott	Sec. 25 T29N R14E	472	133	5034	+437 or above	--
84	H. W. Dodge No. T291425-18	Missouri Geological Survey	1937	Scott	C NW NE NE Sec. 25 T29N R14E	425	117	5308	+380	--

TABLE 2.5-12 (Continued)

WELL NUMBER	OWNER	DRILLER	DATE	COUNTY	LOCATION	ELEVATION MSL	TOTAL DEPTH (FEET)	MISSOURI SURVEY WELL NO.	TOP OF PORTERS CREEK CLAY ELEVATION MSL	TOP OF PALEOZOIC ELEVATION MSL
85	Joe Ellis No. T291425-30	Missouri Geological Survey	1938	Scott	C NW NW Sec. 25 t29N R14E	469	37	5315	+443	--
86	WPA Project No. T291426-1	Missouri Geological Survey	1937	Scott	NW SE Sec. 26 T29N R14E	481	78	4803	Truncated at ground level	--
87	Joe Ellis	Missouri Geological Survey	1938	Scott	C NW NW Sec. 25 T29N R14E	478	57	5313	+446	--
88	Carol Anderson No. 1	Brown Well Drilling	1961	Scott	C N 1/2 SE NW Sec. 26 T29N R14E	573	272	20650	--	+308
89	H. V. Ashley	Schneider Drilling Co.	1944	Scott	NE NE NW Sec. 28 T29N R14E	440	235	Grohskopf p.96	--	+345
90	R. W. Schwitz No. 1	G. W. Fowler	1939	Scott	Sec. 34 T29N R14E	458	205	5331	--	+228 est.
91	City of Bernio	Carloss Well Co.	1940	Stoddard	C NW SE NW Sec. 3 T23N R10E	303	690	5946	-32	-537 est.
92	D. L. Garner	W. Parkins & Son	1941	Stoddard	C SW SW Sec. 1 T24N R9E	352	224	6975	+272	--
93	Snider	Brown Well Drilling	1961	Stoddard	C W 1/2 SE NE Sec. 11 T24N R92	330	86	20783	+250	--
94	Asa Dowdy	Brown Well Drilling	1960	Stoddard	C N 1/2 SW SE Sec. 14 T24N R9E	336	185	19096	+256	--
95	Guerthe Bros.	Brown Well Drilling	1962	Stoddard	NW SE NE Sec. 2 T24N R10E	294	375	20740	*244 or above	--
96	Higgins No. 1	Stoddard County Exploration Co.	--	Stoddard	C SW SE Sec. 6 T25N R9E	345	1860	--	--	+110 or above
97	R. Pixley	Brown Well Drilling	1962	Stoddard	C NW SE Sec. 5 T25N R10E	489	280	20738	+434	--
98	Sam Garner No. 1	Dexter Oil & Gas Co.	1915	Stoddard	SE SE SE Sec. 7 T25N R10E	432	2330	1675	+397 or above	-108
99	County Court	Missouri Geological Survey	1941	Stoddard	NW SE NW Sec. 7 T25N R10E	370	125	12421	+371 or	--

TABLE 2.5-12 (Continued)

WELL NUMBER	OWNER	DRILLER	DATE	COUNTY	LOCATION	ELEVATION MSL	TOTAL DEPTH (FEET)	MISSOURI SURVEY WELL NO.	TOP OF PORTERS CREEK CLAY ELEVATION MSL	TOP OF PALEOZOIC ELEVATION MSL
100	Jack Jones	Briggs Well Drilling Co.	1953	Stoddard	SW SE Sec. 7 T25N R10E	391	125	12421	+371 or above	--
101	Missouri Highway Department	Brown Well Drilling	1960	Stoddard	C SW SE Sec. 16 T25N R10E	380	260	19746	+320	--
102	Elmer Hoffman	Brown Well Drilling	1962	Stoddard	SW NW NE Sec. 17 T25N R10E	378	240	20735	+358 or above	--
103	Missouri Pacific Railroad	Layne-Arkansas	1943	Stoddard	SW NW SE Sec. 21 T25N R10E	370	540	8363	+280	--
104	Coffey Coal Company	Layne-Arkansas	1960	Stoddard	SE NW SW Sec. 23 T25 R10E	323	337	19538	+283 or above	--
105	City of Dexter Fee #1	Dexter Ice & Fuel Co.	1924	Stoddard	C N 1/2 SW SW Sec. 23 T25N R10E	320	420	3081	+280 or above	-365
106	City of Dexter (test hole)	Lingen Layne	--	Stoddard	C NW SE SW Sec. 23 T25N R10E	321	500	26636	+266 or above	--
107	City of Dexter No. 11	Layne-Arkansas	1962	Stoddard	NW SE SW Sec. 23 T25N R10E	317	373	21023	+247 or above	--
108	City of Dexter No. 4	Layne-Arkansas	1943	Stoddard	C SW NE SW Sec.23 T25N R10E	320	518	8423	+266 or above	--
109	City of Dexter No. 12	Layne-Arkansas	1968	Stoddard	C N 1/2 NE NW Sec. 26 T25N R10E	308	430	25752	+238 or above	--
110	City of Dexter	P & W Water Service	1954	Stoddard	NE NE NW Sec. 26 T25N R10E	316	355	12929	+256	--
111	Knollwood Association	P & W Water Service	1955	Stoddard	NW SE SW Sec. 27 T25N R10E	429	420	14162	+314	--
112	Public Water Supply District No. 1	Layne-Arkansas	1965	Stoddard	NE SE NE Sec. 31 T25N R10E	418	537	23728	+288	-142 est.
113	Barnett No. 1	M. H. Marr et. al.	1945	Stoddard	C SW SW Sec. 3 T25N R11E	311	4580	8742	+261	-157
114	W. Crutcher No. 4	M. H. Marr	1944	Stoddard	SW SW SW Sec. 10 T25N R11E	300	522	8573	+236 or above	--

TABLE 2.5-12 (Continued)

WELL NUMBER	OWNER	DRILLER	DATE	COUNTY	LOCATION	ELEVATION MSL	TOTAL DEPTH (FEET)	MISSOURI SURVEY WELL NO.	TOP OF PORTERS CREEK CLAY ELEVATION MSL	TOP OF PALEOZOIC ELEVATION MSL
115	W. J. Crutcher No. 4	M. H. Marr	1944	Stoddard	SW SW SW Sec. 10 T25N R11E	300	522	8573	+236 or	--
115	City of Essex	--	1956	Stoddard	SW NW NW Sec. 15 T25N R11E	301	475	15073	+226 or above	--
116	Miss Lorena L. Thomason	National Geophysics Co.	1944	Stoddard	NE NE NE Sec. 36 T25N R11E	294	610	8570	+91	-411 est.
117	Public Water Supply District No. 3	Layne-Arkansas	1968	Stoddard	NE SE NW Sec. 8 T25N R12E	297	480	25751	+167 or above	--
118	B. B. Zarecore No. 1	National Geophysics Co.	1944	Stoddard	NW NW NW Sec. 18 T25N R12E	297	601	8569	+188 or above	--
119	Doyle Case	Earl Parkin	1963	Stoddard	--	435	151	22051	--	315 or above
120	Helen Smith	Daniel Fowler	1962	Stoddard	NW Cor NW SW Sec. 14 T26N R8E	426	177	21227	--	+298
121	John Richards	Earl Parkin	1963	Stoddard	CN 1/2 NE SW Sec. 15 T26N RT8E	436	148	22052	--	+356
122	Charles V. Kush	Myrl Fowler	1964	Stoddard	C NE NW SE Sec. 16 T26N R8E	403	150	22873	--	+338
123	Carl Limbaugh	Earl Parkin	1964	Stoddard	SE NE NE Sec. 26 T26N R8E	380	243	22531	--	+230 or above
124	Charles O. Stephens	Farrar	1936	Stoddard	C E 1/2 NE NE SE Sec. 26 T26N R9E	390	41	B26926-3	--	--
125	J. E. Freshoune	Brigs Well Co.	1955	Stoddard	SW SE SW Sec. 12 T26N R10E	429	110	13524	+394 or above	--
126	Jess Bennett	Brown Well Drilling	--	Stoddard	Sec. 13 T26N R10E	403	360	19781	+363	--
127	City of Bloomfield	--	--	Stoddard	C N 1/2 SE NE Sec. 23 T26N R10E	445	40	19232	+410	--

TABLE 2.5-12 (Continued)

WELL NUMBER	OWNER	DRILLER	DATE	COUNTY	LOCATION	ELEVATION MSL	TOTAL DEPTH (FEET)	MISSOURI SURVEY WELL NO.	TOP OF PORTERS CREEK CLAY ELEVATION MSL	TOP OF PALEOZOIC ELEVATION MSL
128	City of Bloomfield No. 4 (test)	H. G. Gentry	1952	Stoddard	C N 1/2 SE NE Sec. 23 T26N R10E	466	290	11833	+414	--
129	City of Bloomfield No. 1	Sewell Well Company	1925	Stoddard	C E 1/2 SE NE Sec. 23 T26N R10E	458	918	2123	+418	+28
130	City of Bloomfield No. 2	Weldon Well Company	1943	Stoddard	C SE NE Sec. 23 T26N R10E	458	288	8443	+413	+33 est.
131	City of Bloomfield No. 6	Weldon Well Company	1943	Stoddard	C SW NE NE Sec. 23 T26N R10E	443	270	26259	+398	--
132	City of Bloomfield No. 4	Layne-Arkansas	1965	Stoddard	SE NE NE Sec. 23 T26N R10E	457	273	23551	+415	--
133	Monte White	Earl Parkin	1958	Stoddard	C E 1/2 NE SE Sec 26 T26N R10E	564	170	17610	+399	--
134	Will Shipman	Brown Well Drilling	1963	Stoddard	C NW SE Sec. 35 T26N R10E	575	160	22272	+425	--
135	Godwin No. 2	Brown Well Drilling	1961	Stoddard	Sec. 3 T26N R11E	336	215	20736	+301	--
136	Jess Bennett No. 1	Tyree Brown	1959	Stoddard	C E 1/2 NW SE T26N R11E	390	150	18547	+355	--
137	Harry Pullum	Brown Well Drilling	1963	Stoddard	C SE SE Sec. 14 T26N R11E	335	305	22279	+323 or above	--
138	Will Reed No. 6	M. H. Marr	1944	Stoddard	SW SE NW Sec. 23 T26N R11E	334	408	8571	+299	--
139	Carl Needham No. 12-M-3	National Geophysics Co.	1944	Stoddard	SE SE SE Sec. 25 T26N R11E	301	475	8574	+200 or above	-174
140	M. H. Marr	--	1944	Stoddard	NW SW NW Sec. 27 T26N R11E	370	460	8572	+330	-89
141	James Swan No. 7	M. H. Marr	1944	Stoddard	NE Cor NW NE Sec. 33 T26N R11E	302	371	8575	+277	--

TABLE 2.5-12 (Continued)

WELL NUMBER	OWNER	DRILLER	DATE	COUNTY	LOCATION	ELEVATION MSL	TOTAL DEPTH (FEET)	MISSOURI SURVEY WELL NO.	TOP OF PORTERS CREEK CLAY ELEVATION MSL	TOP OF PALEOZOIC ELEVATION MSL
142	Edward Dunivan	Myrl Fowler	1964	Stoddard	C NW N NW Sec. 25 T27N R8E	395	104	22980	--	+321 or above
143	Johney R. Jones	Ralph Fowler	1964	Stoddard	C SE SE NE Sec. 26 T27N R8E	400	115	22951	--	+375 or above
144	Mingo Wildlife Refuge	Clark & Clark	1969	Stoddard	SE NW SW Sec. 33 T27N R8E	400	500	26539	--	+365
145	Mingo Fish-Wildlife No. 1	Earl Parkin	1965	Stoddard	SW NW SW Sec. 33 T27N R8E	415	200	23546	--	+385
146	Phillips	Joe Trankle	1963	Stoddard	C E 1/2 SE NE Sec. 1 T27N R10E	415	285	22275	--	+215
147	Daniel Byrd	Cae Drilling Co.	1955	Stoddard	NE SE NE Sec. 9 T27N R11E	568	315	13756	+493	--
148	Himmelberger No. 1	Semo Drilling Co.	--	Stoddard	NE NE NW Sec. 28 T27N R12E	304	2910	2204	--	-11
149	Ringer Hall No. A (D. B. Perkins)	Fowler	1935	Stoddard	C SW NW Sec. 23 T28N R11E	450	190	6386	--	+362
150	D. B. Perkins No. B	Fowler	1935	Stoddard	Sec. 23	450	290	6387	--	+330

TABLE 2.5-13 FAULT PLANE SOLUTION PARAMETERS FOR CENTRAL UNITED STATES EARTHQUAKES

EVENT	DATE	OT(UT)	LAT (°N)	LON (°W)	P AXIS (COMPRESSION) TREND	P AXIS (COMPRESSION) PLUNGE	T AXIS (TENSION) TREND	T AXIS (TENSION) PLUNGE
1*	02 Feb 62	06 43 34.0	36.5	89.6	43	19	301	28
2	01 Jun 62	11 23 40.5	35.0	90.2	336	80	252	0
3	14 Jul 62	02 23 49.0	36.8	89.9	92	2	356	82
4	23 Jul 62	06 05 17.0	36.1	89.4	131	75	233	5
5*	03 Mar 63	17 30 11.4	36.7	90.1	174	11	77	31
6	31 Mar 63	13 31 03.7	36.9	89.0	161	83	104	0
7	06 Apr 63	08 12 22.4	36.5	89.6	85	7	346	56
8	03 Aug 63	02 37 47.8	37.0	88.7	92	3	191	83
9	16 Jan 64	05 09 57.1	36.8	89.5	220	15	95	60
10	17 Mar 64	02 15 29.0	36.2	89.6	304	32	168	48
11	23 May 64	15 00 33.7	36.6	90.0	223	68	83	12
12	11 Feb 65	03 40 24.0	36.4	89.7	268	10	33	67
13	06 Mar 65	21 08 50.5	37.5	91.1	260	67	165	0
14*	14 Aug 65	13 13 56.6	37.2	89.3	239	28	148	1
15*	21 Oct 65	02 04 38.4	37.5	91.1	273	76	156	7
16	04 Nov 65	07 43 33.6	37.1	91.0	156	5	289	83
17	12 Feb 66	04 32 14.7	35.9	90.0	140	83	271	5

Source: Street et al., 1974.

* Herrmann, 1978.

** Herrmann, 1979b.

TABLE 2.5-13 (Sheet 2)

EVENT	DATE	OT(UT)	LAT (°N)	LON (°W)	P AXIS (COMPRESSION) TREND	P AXIS (COMPRESSION) PLUNGE	T AXIS (TENSION) TREND	T AXIS (TENSION) PLUNGE
18	13 Feb 66	23 19 36.9	37.0	91.0	292	68	183	7
19	26 Feb 66	08 10 19.4	37.1	91.0	292	68	183	7
20	06 Dec 66	08 00 47.0	38.9	92.8	277	2	10	58
21*	04 Jun 67	16 14 13.6	33.6	90.9	248	7	155	21
22	21 Jul 67	09 14 48.9	37.5	90.6	314	52	50	5
23*	09 Nov 68	17 01 42.0	38.0	88.5	97	1	192	82
24*	01 Jan 69	23 35 36.2	34.8	92.6	329	6	227	65
25	28 Feb 69	13 10 13.1	37.9	88.6	282	2	192	78
26	27 Mar 70	03 44 29.5	36.5	89.7	264	75	15	8
27*	17 Nov 70	02 13 54.5	35.9	90.2	272	91	176	32
28	12 Feb 71	12 44 27.2	38.5	87.9	78	50	344	3
29	13 Apr 71	14 00 50.0	35.8	90.1	54	72	263	15
30	18 Oct 71	06 39 30.7	36.7	89.6	108	8	12	53
31	01 Feb 72	05 42 10.0	36.4	90.8	227	60	128	10
32	29 Mar 72	20 38 31.9	36.2	89.6	180	86	270	10
33	07 May 72	02 12 08.5	35.9	90.0	52	72	265	15
34	09 Jun 72	19 15 19.1	37.7	90.4	269	49	15	14
35	19 Jun 72	05 46 14.7	37.0	89.1	138	22	268	60
36	12 Jan 73	11 56 56.0	37.9	90.5	70	25	278	63
37	03 Oct 73	03 50 14.0	35.8	90.1	251	13	114	72
38	09 Oct 73	20 18 26.8	36.5	89.6	36	15	263	67

TABLE 2.5-13 (Sheet 3)

EVENT	DATE	OT(UT)	LAT (°N)	LON (°W)	P AXIS (COMPRESSION) TREND	P AXIS (COMPRESSION) PLUNGE	T AXIS (TENSION) TREND	T AXIS (TENSION) PLUNGE
39*	03 Apr 74	23 05 02.5	38.6	88.1	267	14	173	14
40*	13 Jun 75	22 40 27.0	36.5	89.7	49	34	313	8
41*	25 Mar 76	00 41 20.5	35.6	90.5	272	1	181	38
42*	25 Mar 76	01 00 11.9	35.6	90.5	271	28	174	13
43**	02 Jun 78	02 07 28.5	38.5	88.5	267	14	173	14
44**	19 Jun 78	08 54 15.9	38.2	88.4	267	14	173	14

(Sheet 1 of 2)

TABLE 2.5-14 PARAMETERS FOR ANALYSIS OF ROCK-FILL-SOIL STRUCTURE INTERACTION

		CATEGORY I GRANULAR STRUCTURAL FILL	MODIFIED LOESS	ACCRETION-GLEY	TILL	GRAYDON CHERT CONGLOMERATE	BURLINGTON FORMATION
Density (pcf)							
Dry Density		139	102	105	113	122	165
Wet Density		150	125	128	133	138	166
Poisson's Ratio		0.35	0.45	0.45	0.45	0.40	0.26
Static Modules of Elasticity (Es)							
In-situ Modules (psf)		20.0 to 30.0 x 10^{5}[a]	1.5 x 10^5	2.5 x 10^5	3.5 x 10^5	16.0 x 10^5	11.2 to 17.5 x 10^{8}[b]
Dynamic Modulus of Elastisity (psf)							
Single amplitude Shear Strain	= 1.0%	29,700 $\sigma(_m')$	2.0 x 10^5	2.6 x 10^5	4.1 x 10^5	20 x 10^5	
	= 0.1%	97,200 $\sigma(_m')$	7.8 x 10^5	8.7 x 10^5	13.3 x 10^5	84 x 10^5	
	= 0.01%	221,000 $\sigma(_m')$	15.7 x 10^5	20.3 x 10^5	31.9 x 10^5	218 x 10^5	1.5 to 14.6 x 10^{8}[b]
	= 0.001%	324,000 $\sigma(_m')$	22.3 x 10^5	36.3 x 10^5	58.0 x 10^5	412 x 10^5	
Static Modulus of Rigidity (Gs)							
In-situ Modulus (psf)		20.0 to 30.0 x 10^{5}[a]	0.5 x 10^5	0.9 x 10^5	1.2 x 10^5		4.4 to 6.9 x 10^{8}[b]

TABLE 2.5-14 (Continued) (Sheet 2 of 2)

		CATEGORY I GRANULAR STRUCTURAL FILL	MODIFIED LOESS	ACCRETION-GLEY	TILL	GRAYDON CHERT CONGLOMERATE	BURLINGTON FORMATION
Dynamic Modulus of Rigidity (psf)							
Single amplitude Shear Strain	= 1.0%	$11,000\ \sigma(m')^{1/2}$	0.7×10^5	0.9×10^5	1.4×10^5	7×10^5	
	= 0.1%	$36,000\ \sigma(m')^{1/2}$	2.7×10^5	3.0×10^5	4.6×10^5	30×10^5	
	= 0.01%	$82,000\ \sigma(m')^{1/2}$	5.4×10^5	7.0×10^5	11.0×10^5	78×10^5	0.6 to 5.8×10^{8}[b]
	= 0.001%	$120,000\ \sigma(m')^{1/2}$	7.7×10^5	12.5×10^5	20.0×10^5	147×10^5	
Damping							
Percent of Critical Dampling: Single amplitude Shear Strain	= 1.0%	12	19	16	18	20	
	= 0.1%	8	8	6	9	9	
	= 0.01%	4	3	4	4	5	1 to 2[b]
	= 0.001%	2	2	3	3	3	

a These values are valid for foundation pressures of 3,000 to 8,000 ksf.

b These values are valid for strain levels on the order of 10^{-4} to 10^{-5} percent.

$\sigma(m')$ = Mean effective stress (psf).

TABLE 2.5-15 SUMMARY OF SOIL PROPERTIES INDEX AND SHEAR STRENGTH PROPERTIES

									EFFECTIVE STRENGTH PARAMETERS[a]		COEFFICIENT OF PERMEABILITY (cm/sec)	
GEOLOGIC UNIT	IN-SITU DRY DENSITY (lb/ft^3)	IN-SITU MOISTURE CONTENT (percent)	LIQUID LIMIT (percent)	PLASTICITY INDEX (percent)	LABORATORY UNDRAINED SHEAR STRENGTH (psf)[b,c]	MENARD PRESSUREMETER UNDRAINED SHEAR STRENGTH (psf)[c]	SHEAR STRENGTH DISTURBANCE FACTOR[d]	RECOMMENDED UNDRAINED SHEAR STREGTH (psf)	COHESION (psf)	ANGLE OF INTERNAL FRICTION (degrees)	FIELD TESTS	LABORATORY TESTS
Modified loess	102	23	42	23	1,900 (±200)	3,200	1.5 - 2	1,900	0	29 (±2)	$3x10^{-6}$	$5x10^{-7}$
Accretion-gley	105	22	50	33	2,900 (±200)	5,200	1.5 - 2	2,900	500 (±125)	20 (±2)	$2x10^{-7}$	$2x10^{-8}$
Accretion-gley (after swelling)	-	-	-	-	-	-	--	-	500	17	-	-
Glacial till	113	18	38	22	3,500 (±200)	5,800	1.5 - 2	3,500	600 (±125)	22 (±4)	$5x10^{-6}$	$5x10^{-8}$ to $6x10^{-5}$
Graydon chert conglomerate	122	13	22	14	3,000	14,000 (±2,000)	3 - 5	4,500[e]	1,250	10	$2x10^{-5}$	$3x10^{-8}$

a The values in parentheses represent estimated variations in the properties.

b The laboratory undrained shear strength was obtained from uncosolidated-undrained triaxial tests for the soil units. For the Graydon unit, the undrained shear strength was determined from consolidated-undrained triaxial tests at a net confining pressure equal to the lower-bound of the preconsolidation pressure measured in consolidation tests (σ_3 = 10,000 psf).

c The values in parentheses represent statistical variations from the mean based on 90 percent confidence intervals.

d Ratio of undrained shear strengths as determined from the Menard pressuremeter tests and the laboratory triaxial tests.

e Based on the results of large-scale plate load tests. See Section 2.5.4.2.3.2.1.

(Sheet 1 of 1)

TABLE 2.5-16 SUMMARY OF SOIL PROPERTIES COMPRESSIBILITY PROPERTIES AND STRESS-STRAIN RELATIONSHIPS

GEOLOGIC UNIT	VOID RATIO	SLOPE OF CONSOLIDATION CURVE[a] RELOADING	SLOPE OF CONSOLIDATION CURVE[a] VIRGIN	RECOMPRESSION INDEX[a,b]	COMPRESSION INDEX[a]	CONSTRAINED MODULUS (ksf)	PRECONSOLIDATION PRESSURE (psf)	OVERCONSOLIDATION RATIO
Modified loess	0.62	0.02	0.12	0.03	0.20	---	500 - 2,000	1 - 4
Accretion-gley	0.57	0.03	0.14	0.04	0.22	----	10,000 - 13,000	3 - 7
Glacial till	0.46	0.03	0.12	0.04	0.17	----	10,000 - 13,000	2 - 4
Graydon chert conglomerate	0.36	----	----	----	----	3,600	> 15,000	> 2

a The compression index and the recompression index are the conventional compressibility parameters used in the Terzaghi method of settlement analysis. The slope of the consolidation curve is defined as the slope of the curve on a plot of vertical strain versus log of vertical consolidation stress as presented in this report. The compression index is equal to the virgin slope of the consolidation curve multiplied by one plus the initial void ratio. The recompression index is equal to the reloading slope of the consolidation curve multiplied by one plus the initial void ratio.

b Determined from the slope of the unloading portion of the consolidation curve.

c Janbu, 1967. Constant constrained modulus applicable for both loading and unloading below the preconsolidation pressure for the Graydon chert conglomerate.

TABLE 2.5-17 SUMMARY OF SOIL PROPERTIES (REMOLDED SAMPLES)

PROPERTY	UNIT OF MEASURE	GEOLOGIC UNIT		
		MODIFIED LOESS (CH)[a]	MODIFIED LOESS (CL)[a]	ACCRETION-GLEY (CH)[b]
Optimum Moisture Content[c]	percent	14.0	11.0	13.0
Maximum Dry Density[c]	pcf	117	118	120
<u>Effective Strength Parameters</u>				
Cohesion	psf	---	200	1,300
Angle of Internal Friction	degrees	---	31	21
Coefficient of Permeability	cm/sec	2.2×10^{-8}	3.0 x 10	2.8×10^{-8}
Static Modulus of Elasticity[d]	psf	---	1.4×10^{5}	5.0×10^{5}
<u>Slope of Consolidation Curve</u>[e]				
Reloading	---	0.03	0.01	0.04
Virgin	---	0.12	0.07	0.20
Recompression Index[e]	---	0.05	0.02	0.06
Compression Index[e]	---	0.19	0.11	0.32

a The strength and modulus of elasticity represent the properties of specimens molded to 90 percent of the maximum dry density at the optimum moisture content; the permeability and compressibility represent 90 percent compaction molded wet of the optimum.

b The properties represent specimens molded to 95 percent of the maximum dry density at moisture contents wet of optimum.

c Obtained in accordance with ASTM Test Designation D 1557-70 method of compaction.

d The static modulus of elasticity was determined from the laboratory consolidated-undrained triaxial tests using the 0.5 percent strain secant modulus.

e The compression index and the recompression index are the conventional compressibility parameters used in the Terzaghi method of settlement analysis. This slope of the consolidation curve is defined as the slope of the curve on a plot of vertical strain versus log of vertical consolidation stress as presented in this report. The compression index is equal to the virgin slope of the consolidation curve multiplied by one plus the initial void ratio. The recompression index is equal to the reloading slope of the consolidation curve multiplied by one plus the initial void ratio.

TABLE 2.5-18 ENGINEERING PROPERTIES FOR CRUSHED STONE STRUCTURAL FILL AND BACKFILL

PROPERTY	UNIT OF MEASURE	STRUCTURAL BACKFILL	STRUCTURAL BACKFILL
Dry density	pcf	131.4 (min.)	138.7 (min.)
Degree of Compaction[a]	percent	90.0 (min.)	95.0 (min.)
Relative Density[b]	percent	82 (min.)	98 (min.)
Saturated Density	pcf	145.8	150.5
Effective Strength Parameters			
Cohesion	psf	0	0
Angle of Internal Friction σ_1'/σ_3' maximum	degrees	46	50
Angle of Internal Friction σ_1'/σ_3' peak	degrees	43	45
Coefficient of Permeability	cm/sec	1×10^{-2}	1×10^{-3}
Compressibility Parameters			
Constrained Modulus	ksf	---	5,000

a ASTM Test Designation D 1557-70.

b ASTM Test Designation D 2049-69.

TABLE 2.5-18A FIELD PERMEABILITY TEST RESULTS

OBSERVATION WELL NUMBER	COEFFICIENT OF PERMEABILITY (centimeters/second)
OW1	4.0×10^{-6}
OW2	3.0×10^{-7}
OW3	2.9×10^{-6}
OW4	1.7×10^{-7}
OW5	9.6×10^{-6}
Numerical Average	3.4×10^{-6}

Tests performed in February 1980.

(Sheet 1 of 2)

TABLE 2.5-19 CONSOLIDATED-UNDRAINED TRIAXIAL TEST RESULTS WITH PORE PRESSURE MEASUREMENTS (UNDISTURBED SAMPLES)

BORING NUMBER	DEPTH/ ELEVATION (ft/MSL)	CONSOLIDATION PRESSURE σ_c'/σ_3' (lbs/sq ft)	APPLIED BACK PRESSURE[a] (lbs/sq ft)	SHEAR STRENGTH[b] (lbs/sq ft)	STRESSES AT FAILURE[c] (lbs/sq ft)		
					Δu	σ_1'	σ_3'
			Modified loess				
P-75	5.0/831.5	1,010	8,210	1,800	-400	5,020	1,410
P-77	4.5/843.8	2,020	23,620	2,040	-730	6,830	2,750
P-88	1.5/838.2	4,030	6,480	2,365	1,830	6,930	2,200
P-78	5.0/832.5	6,050	8,350	4,175	2,150	12,250	3,900
			Accretion-gley				
P-17	19.0/817.3	2,490	6,910	2,180	650	6,210	1,840
P-19	19.0/829.9	2,950	11,230	1,950	2,060	4,800	890
P-27	5.0/833.4	580	12,670	660	350	1,540	230
P-29	15.5/822.0	2,450	11,950	1,720	1,770	4,120	680
P-32	14.5/825.2	2,000	9,790	1,560	190	4,940	1,810
P-37	13.5/826.8	1,790	8,350	1,660	260	4,840	1,530
P-44	15.5/827.0	1,990	11,230	1,180	270	4,070	1,710
P-75	15.5/821.0	2,020	10,660	1,070	650	3,510	1,370
P-77	15.0/821.0	4,030	6,770	1,900	1,150	6,690	2,880
P-88	12.0/827.7	6,050	7,780	3,190	1,300	11,130	4,750
P-92	12.0/823.4	6,620	7,780	3,230	1,570	11,510	5,050
P-116	13,0/833.5	7,990	16,850	3,440	2,790	12,090	5,200
P-123	15.0/826.3	5,040	6,770	2,890	850	9,970	4,190
P-129	18.0/829.9	10,080	22,320	3,515	3,200	13,910	6,880
			Glacial till				
P-8	34.0/822.5	4,610	9,790	4,050	980	11,720	3,630
P-27	19.0/819.4	2,390	9,790	1,940	560	5,710	1,830

TABLE 2.5-19 (Continued) (Sheet 2 of 2)

BORING NUMBER	DEPTH/ ELEVATION (ft/MSL)	CONSOLIDATION PRESSURE σ_c'/σ_3' (lbs/sq ft)	APPLIED BACK PRESSURE[a] (lbs/sq ft)	SHEAR STRENGTH[b] (lbs/sq ft)	STRESSES AT FAILURE[c] (lbs/sq ft)		
					Δu	σ_1'	σ_3'
P-36	14.0/816.5	1,790	8,350	1,420	530	4,100	1,250
P-37	23.5/816.8	3,000	8,350	2,330	1,280	6,370	1,710
P-75	22.5/814.0	2,020	11,950	2,220	-760	7,220	2,780
P-77	25.5/822.8	4,030	6,490	2,100	460	7,775	3,570
P-88	19.0/820.7	6,050	7,920	3,550	660	12,480	5,390
P-92	19.0/816.4	7,920	6,490	2,910	2,430	11,310	5,490
P-116	28.0/818.5	7,060	18,000	3,410	2,480	11,410	4,580
P-129	33.0/814.9	10,080	24,050	4,080	3,820	14,440	6,260
			Graydon chert conglomerate				
P-18	43.5/806.4	5,000	8,350	2,320	1,210	8,440	3,790
P-54	35.2/811.5	4,320	10,080	2,170	1,350	7,310	2,970
P-89	33.0/806.7	10,220	4,180	2,980	3,540	12,650	6,680
P-101	29.0/812.3	6,050	8,210	3,090	1,770	10,450	4,280
P-105	31.0/805.8	7,920	6,480	2,480	2,920	9,960	5,000

a The applied back pressure was used to saturate the specimans, and it remained constant throughout the shearing process.

b Shear strength taken at peak deviator stress or at 10 percent axial strain, whichever occurred first.

c Δu, σ_1', and σ_3' are change in pore pressure, major principal effective stress, and minor principal stress, respectively, at peak deviator stress or 10 percent axial strain, whichever occured first.

TABLE 2.5-20 CONSOLIDATED-UNDRAINED TRIAXIAL TEST RESULTS WITH PORE PRESSURE MEASUREMENTS (ACCRETION-GLEY SAMPLES ALLOWED TO SWELL)

BORING NUMBER	DEPTH/ ELEVATION (ft/MSL)	CONSOLIDATION PRESSURE σ_c'/σ_3' (lbs/sq ft)	APPLIED BACK PRESSURE[a] (lbs/sq ft)	SHEAR STRENGTH[b] (lbs/sq ft)	STRESSES AT FAILURE[c] (lbs/sq ft)		
					Δu	σ_1'	σ_3'
P-80	12.5/827.5	1,510	6,910	1,340	-158	4,350	1,670
P-81	12.0/823.6	4,030	7,490	2,010	690	7,370	3,340

a The applied back pressure was used to saturate the specimans, and it remained constant throughout the shearing process.

b Shear strength taken at peak deviator stress or at 10 percent axial strain, whichever occurred first.

c Δu, σ_1', and σ_3' are change in pore pressure, major principal effective stress, and minor principal stress, respectively, at peak deviator stress or 10 percent axial strain, whichever occured first.

(Sheet 1 of 1)

TABLE 2.5-21 CONSOLIDATED-UNDRAINED TRIAXIAL TEST RESULTS WITH PORE PRESSURE MEASUREMENTS (REMOLDED SAMPLES)

TEST PIT LOCATION[a]	DEPTH/ ELEVATION (ft/MSL)	SOIL TYPE	MOLDED DRY DENSITY (lbs/sq ft^3)	DEGREE OF COMPACTIO[b] (percent)	MOLDING MOISTURE CONTENT (percent)	CONSOLIDATION PRESSURE σ_c'/σ_3' (psf)	APPLIED BACK PRESSURE[c] (psf)	SHEAR STRENGTH[d] (pfs)	STRESSES AT FAILURE[e] (lbs/sq ft)		
									Δu	σ_1'	σ_3'
P-1 and P-4	7.0/844.3 and 8.0/843.4	Accretion-gley (CH)	113	97	14.8	1,500	12,384	2,190	845	5,040	655
P-1 and P-4	7.0/844.3 and 8.0/843.4	Accretion-gley (CH)	114	97	16.6	2,420	11,476	3,650	1,320	8,400	1,100
P-1 and P-4	7.0/844.3 and 8.0/843.4	Accretion-gley (CH)	108	92	21.5	3,500	10,900	3,270	988	9,040	2,510
P-79	4.0/841.3	Modified loess (CL)	105	89	11.5	504	15,408	1,226	-144	3,099	648
P-79	4.0/841.3	Modified loess (CL)	105	89	11.5	1,008	12,528	1,238	72	3,412	936
P-79	4.0/841.3	Modified loess (CL)	106	90	11.6	2,016	11,808	2,137	374	5,915	1,642

a Test pits were located immediately adjacent to the indicated boring location.

b American Society for Testing and Materials (ASTM) Test Designation D 1557-70.

c The applied back pressure was used to saturate the specimans, and it remained constant throughout the shearing process.

d Shear strength taken at peak deviator stress or at 10 percent axial strain, whichever occurred first.

e Δu, σ_1', and σ_3' are change in pore pressure, major principal effective stress, and minor principal stress, respectively, at peak deviator stress or 10 percent axial strain, whichever occured first.

f Combined bulk sample from 7.0- to 12.0-foot depth at P-1 and 8.0- to 13.5-foot depth at P-4.

TABLE 2.5-22 RESULTS OF CONSOLIDATED - UNDRAINED TRIAXIAL TESTS WITH PORE PRESSURE MEASUREMENTS CRUSHED STONE FILL AND BACKFILL (AT MAXIMUM σ_1'/σ_3')

			Specimen - 6" Diameter					At Maximum σ_1'/σ_3' [c]						
				Molding Conditions										
Gradation[a]	Material Source[b]	Maximum Size (inches)	Maximum Particle Size in Specimen (inches)	Initial Dry Density (lb/ft^3)	Moisture Content (percent)	Degree of Compaction (percent)	Consolidation Pressure, σ_3' [c] (ksf)	ϵ_v (percent)	Δu (ksf)	σ_1' (ksf)	σ_3' (ksf)	$1/2(\sigma_1'-\sigma_3')$ (ksf)	C' (ksf)	ϕ' (degrees)
As-Crushed	Face I (Initial)	1.0	0.75	145.0	7.0	98.6	7.0	1.0	0.6	58.5	6.4	26.0	0	53.4
As-Crushed	Face III (Initial)	1.5	0.75	145.0	7.0	99.7	7.0	0.5	0.9	53.0	6.1	23.4	0	52.5
MSHC	Face I (Initial)	0.75	0.75	123.7	5.8	95.9	7.0	1.2	1.0	44.0	6.0	19.0	0	49.5
ASTM	Face I (Initial)	1.5	1.5	138.2	7.2	95.0	7.0	1.2	1.8	36.5	5.2	15.6	0	48.6
ASTM	Face III (Initial)	1.5	1.5	138.3	8.0	94.1	3.0	1.5	0.6	19.1	2.4	8.4	0	51.0
ASTM	Face III (Initial)	1.5	1.5	138.0	8.3	93.9	7.0	4.0	1.1	44.2	5.9	19.1	0	49.9
ASTM	Face III (Initial)	1.5	1.5	138.4	0.4	94.1	7.0	3.5	0.3	51.5	6.7	22.4	0	50.3
ASTM	Face III (Initial)	1.5	1.5	138.5	12.0	94.2	7.0	4.0	-0.9	63.1	7.9	27.6	0	51.0
ASTM	Face I (Test Pad)	1.5	1.5	133.2	7.5	91.2	3.0	1.0	-0.6	27.1	3.6	11.8	0	50.2
ASTM	Face I (Test Pad)	1.5	1.5	133.2	7.5	91.2	7.0	2.5	1.7	35.3	5.3	15.0	0	47.6
ASTM	Face I (Test Pad)	1.5	1.5	130.6	7.5	89.5	3.0	1.8	-0.4	23.5	3.4	10.0	0	48.3
ASTM	Face I (Test Pad)	1.5	1.5	130.2	7.5	89.2	7.0	2.5	0.9	36.1	6.1	15.0	0	45.3

[a] As-Crushed: Produced during trial crushing, similar to ASTM gradation.
MSHC: Missouri State Highway Commission Type 4 Aggregate.
ASTM: D 2940-71T gradation.

[b] Face I, Face III: On-site mine test faces, see Figure 2.5-104.
Initial: Sample obtained for laboratory testing prior to construction of the structural fill test pad.
Test Pad: Sample obtained during construction of the structural fill test pad.

[c] The symbols ϵ_v, Δu, σ_1', σ_3', C', and ϕ' indicate, respectively, the vertical strain, change in pore pressure, major principal effective stress, minor principal effective stress, effective cohesion, and effective angle of internal friction.

TABLE 2.5-23 RESULTS OF CONSOLIDATED-UNDRAINED TRIAXIAL TESTS WITH PORE PRESSURE MEASUREMENTS CRUSHED STONE FILL AND BACKFILL (AT PEAK σ_1'/σ_3')

			SPECIMEN - 6" DIAMETER					AT PEAK $\sigma_1'-\sigma_3'$ [c]							
				MOLDING CONDITIONS											
GRADATION[a]	MATERIAL SOURCE[b]	MAXIMUM SIZE (inches)	MAXIMUM PARTICLE SIZE IN SPECIMEN (inches)	INITIAL DRY DENSITY (lb/ft^3)	MOISTURE CONTENT (percent)	DEGREE OF COMPACTION (percent)	CONSOLIDATION PRESSURE, σ_3' [c] (ksf)	ϵ_v (percent)	Δu (ksf)	σ_1' (ksf)	σ_3' (ksf)	$(\sigma_1'-\sigma_3')/2$ (ksf)	c' (ksf)	ϕ' (degrees)	MODULUS OF ELASTICITY[d] (ksf)
As-crushed	Face I (Initial)	1.0	0.75	145.0	7.0	98.6	7.0	5.0	-9.7	107.7	16.7	45.5	0	47.0	5,090
As-crushed	Face III (Initial)	1.5	0.75	145.0	7.0	99.7	7.0	6.0	-10.8	115.7	17.8	49.0	0	47.2	9,380
MSHC	Face I (Initial)	0.75	0.75	123.7	5.8	95.9	7.0	8.0	-4.0	61.6	11.0	25.3	0	44.2	2,650
ASTM	Face I (Initial)	1.5	1.5	138.2	7.2	95.0	7.0	10.0	-5.4	69.4	12.4	28.5	0	44.2	2,890
ASTM	Face III (Initial)	1.5	1.5	138.3	8.0	94.1	3.0	14.0	-12.4	81.1	15.4	32.9	0	42.9	1,220
ASTM	Face III (Initial)	1.5	1.5	138.0	8.3	93.9	7.0	14.0	-7.7	86.2	14.7	35.8	0	45.1	2,400
ASTM	Face III (Initial)	1.5	1.5	138.4	0.4	94.1	7.0	15.0	-7.5	86.0	14.5	35.8	0	45.3	3,660
ASTM	Face III (Initial)	1.5	1.5	138.5	12.0	94.2	7.0	10.0	-8.9	101.6	15.9	42.8	0	46.8	3,640
ASTM	Face I (Test Pad)	1.5	1.5	133.2	7.5	91.2	3.0	5.0	-5.4	45.2	8.4	18.4	0	43.4	2,840
ASTM	Face I (Test Pad)	1.5	1.5	133.2	7.5	91.2	7.0	8.5	-3.2	53.9	10.2	21.9	0	43.0	3,260
ASTM	Face I (Test Pad)	1.5	1.5	130.6	7.5	89.5	3.0	5.5	-2.3	30.5	5.3	12.6	0	44.7	2,740
ASTM	Face I (Test Pad)	1.5	1.5	130.2	7.5	89.2	7.0	8.0	-0.1	41.1	7.1	17.0	0	44.9	5,010

[a] As-crushed: produced during trial crushing, similar to ASTM gradation.
MSHC: Missouri State High Commission Type 4 aggregate.
ASTM: D 2940-71T gradation.

[b] Face I, Face III: On-site mine test faces (see Figure 2.5-104).
Initial: Sample obtained for laboratory testing prior to construction of the structural fill test pad.
Test Pad: Sample obtained during construction of the structural fill test pad.

[c] The symbols ϵ_v, Δu, σ_1', σ_3', c' and ϕ' indicate, respectively, the vertical strain, change in pore pressure, major principal effective stress, minor principal effective stress, effective cohesion, and effective angle of internal friction.

[d] The modulus of elasticity was taken as the secant modulus at 0.5% strain.

(Sheet 1 of 1)

TABLE 2.5-24 CONSOLIDATED-DRAINED TRIAXIAL TEST RESULTS

SOURCE	SOIL TYPE	MOISTURE CONTENT (PERCENT)	DRY DENSITY[a] (lbs/cu ft)	CONSOLIDATION PRESSURE (lbs/cu ft)	SHEAR STRENGTH[b] (lbs/cu ft)
Mokane Sand and Gravel Pit	Brown Fine to Coarse Sand (SP)	17.0	109 (98)	1,930	3,720
		17.0	109 (98)	5,000	8,370
		17.0	109 (98)	10,000	15,700
Callaway Rock Quarry	Crushed Limestone[c]	1.8	98	2,016	3,000
		1.8	98	5,040	6,600
		1.8	98	10,080	15,500
Jeff Cole Quarry	Crushed Limestone[c]	10.7	98	1,008	1,100
		10.7	98	2,016	6,200
		10.7	98	5,040	6,900
		10.7	98	10,080	20,200

a The numbers in parentheses represent the percent compaction determined by ASTM D1557-70 method of compaction.

b At $(\sigma_1' / \sigma_3')/2$ max.

c Multiphase Test.

TABLE 2.5-25 UNCONFINED COMPRESSION TEST RESULTS ROCK SAMPLES FROM PLANT AREA

Boring Number	Depth/Elevation (ft/MSL)	Rock Unit	Dry Density (lbs/cu.ft.)	Moisture Content (percent)	Unconfined Compressive Strength (lbs/sq.in.)	Modulus of Elasticity (lbs/sq.in.)	Poisson's Ratio*
P-19	64.1/784.8	Burlington Formation Limestone	162	0.3	11,801	12.2×10^6	0.03 to 0.07
P-2	66.5/783.2	Burlington Formation Limestone	162	0.4	17,059	7.8×10^6	0.24 to 0.26
P-16	66.9/776.5	Burlington Formation Limestone	166	0.4	20,882	11.9×10^6	0.25 to 0.27
P-16	93.8/749.6	Snyder Creek Formation Siltstone	153	1.2	5,248	0.5×10^6	0.02 to 0.19
P-18	110.4/733.0	Snyder Creek Formation Siltstone	153	0.7	6,985	2.2×10^6	0.11 to 0.29
P-1	119.0/732.3	Callaway Formation Limestone	169	0.2	12,426	11.8×10^6	0.28 to 0.30
P-2	134.5/715.2	Callaway Formation Limestone	171	0.2	16,434	11.2×10^6	0.24 to 0.26
P-1	143.7/707.6	Callaway Formation Sandstone	164	0.5	19,665	11.4×10^6	0.31 to 0.26
P-1	152/699.3	Cotter-Jefferson City Formations - Dolomite	169	0.3	3,577	10.3×10^6	0.22 to 0.24
P-2	204/645.7	Cotter-Jefferson City Formations - Dolomite	156	0.8	6,544	5.0×10^6	0.18 to 0.22
P-1	269/582.3	Cotter-Jefferson City Formations - Dolomite	154	0.2	11,029	6.25×10^6	0.19 to 0.31

* Poisson's Ratio varies with stress.

TABLE 2.5-26 UNCONFINED COMPRESSION TEST RESULTS ROCK SAMPLES FROM ON-SITE MINE AREA

BORING NUMBER	SAMPLE DEPTH (feet)	LITHOLOGY	UNCONFINED COMPRESSIVE STRENGTH (psi)	MODULUS OF ELASTICITY (psi)	MODULUS OF RUPTURE (psi)
		SNYDER CREEK FORMATION			
Q-27	52.7-53.7	Shale: Gray, fine grained, fissile, blocky	5,170	467,000	---
Q-27	60.8-61.6	Siltstone: Gray-green, fine grained, medium bedded, blocky	10,920	4,243,000	---
Q-29	49.0-49.9	Shale: Gray, fine grained, fissile, silty	6,640	750,000	---
Q-29	52.8-53.9	Shale: Gray, fine grained, fissile, silty	5,900	404,000	---
Q-32	64.4-65.3	Shale: Gray very fine grained, fissile, blocky, fossiliferous	5,020	571,000	---
Q-45	57.0-58.0	Siltstone: Gray-green, fine grained, medium bedded blocky, calcareous, pyritic	5,330	3,111,000	---
AVERAGE, Snyder Creek Formation			6,496	1,591,000	
		CALLAWAY FORMATION			
Q-27	72.8-73.8	Upper Limestone: Gray, fine grained, medium bedded blocky	---	---	4,280
Q-27	72.8-73.8	Upper Limestone: Gray, fine grained, medium bedded, blocky	10,110	6,121,000	---

TABLE 2.5-26 (Continued)

BORING NUMBER	SAMPLE DEPTH (feet)	LITHOLOGY	UNCONFINED COMPRESSIVE STRENGTH (psi)	MODULUS OF ELASTICITY (psi)	MODULUS OF RUPTURE (psi)
Q-27	74.3-74.8	Upper Limestone: Gray, medium grained, medium bedded, stylolitic	7,820	---	---
Q-29	63.0-63.9	Upper Limestone: Gray, fine-grained, medium bedded, blocky	---	---	3,090
Q-29	63.0-63.9	Upper Limestone: Gray, fine grained, medium bedded, blocky	13,950	11,915,000	---
Q-29	69.6-70.3	Upper Limestone: Gray, fine grained, thin bedded, fossiliferous, stylolitic	12,550	8,264,000	---
Q-29	74.0-75.0	Upper Limestone: Gray fine grained, medium bedded, stylolitic	11,000	---	---
Q-32	75.2-76.1	Upper Limestone: Gray, fine grained, fossiliferous, stylolitic	9,740	10,263,000	---
Q-32	80.2-81.1	Upper Limestone: Gray, fine grained, medium bedded blocky	---	---	2,140
Q-45	63.4-64.2	Upper Limestone: Gray, medium grained, fossiliferous, stylolitic	---	---	2,140
Q-45	76.1-77.0	Upper Limestone, Gray, fine grained, medium bedded, fossiliferous	9,240	---	---
Q-45	76.1-77.0	Upper Limestone: Gray, fine grained, medium bedded, fossiliferous	9,750	12,580,000	---
AVERAGE,	Callaway Formation	Upper Limestone Unit	10,520	9,828,600	2,912

TABLE 2.5-26 (Continued)

BORING NUMBER	SAMPLE DEPTH (feet)	LITHOLOGY	UNCONFINED COMPRESSIVE STRENGTH (psi)	MODULUS OF ELASTICITY (psi)	MODULUS OF RUPTURE (psi)
Q-27	87.3-88.4	Upper Dolomite: Gray-brown, fine grained, medium bedded, blocky, calcareous	7,230	---	---
Q-27	87.3-88.4	Upper Dolomite: Gray-brown, fine grained, medium bedded, blocky, calcareous	7,560	8,871,000	---
Q-29	87.0-87.9	Upper Dolomite: Gray-brown, fine grained, medium bedded, stylolitic, calcareous	7,900	---	---
Q-29	87.0-87.9	Upper Dolomite: Gray-brown, fine grained, medium bedded, stylolitic, calcareous	8,120	10,667,000	---
Q-32	94.2-95.2	Upper Dolomite: Gray-brown, fine grained, medium bedded, 5% porosity	9,450	---	---
Q-32	94.2-95.2	Upper Dolomite: Gray-brown, fine grained, medium bedded, 5% porosity	8,780	10,000,000	---
Q-45	83.0-84.2	Upper Dolomite: Gray-brown, fine grained, calcareous, fossiliferous	5,100	---	---
AVERAGE,	Callaway Formation	Upper Dolomite Unit	7,734	9,846,000	---
Q-27	91.7-92.8	Lower Limestone: Gray, medium grained, thick bedded, fossiliferous	10,070	---	---
Q-29	97.0-97.7	Lower Limestone: Gray, coarse grained, medium bedded	6,050	---	---

TABLE 2.5-26 (Continued)

BORING NUMBER	SAMPLE DEPTH (feet)	LITHOLOGY	UNCONFINED COMPRESSIVE STRENGTH (psi)	MODULUS OF ELASTICITY (psi)	MODULUS OF RUPTURE (psi)
Q-45	91.3-92.5	Lower Limestone: Gray, medium grained, medium bedded, stylolitic	12,800	---	---
Q-45	91.3-92.5	Lower Limestone: Gray, medium grained, medium bedded, stylolitic	12,120	11,829,000	---
AVERAGE, Callaway Formation		Lower Limestone Unit	10,260	11,829,000	---
Q-27	99.2- 00.2	Lower Dolomite: Gray, fine grained, thin bedded, blocky, 10% porosity	6,720	---	---
Q-27	99.2-100.2	Lower Dolomite: Gray, fine grained, thin bedded, blocky, 10% porosity	6,270	5,814,000	---
Q-32	107.8-108.4	Lower Dolomite: Gray, fine grained, 5% porosity	15,240	---	---
Q-32	111.0-111.8	Lower Dolomite: Gray, fine grained, medium bedded	6,640	---	---
AVERAGE, Callaway Formation		Lower Dolomite Unit	8,717	5,814,000	---
AVERAGE, Callaway Formation		All Units	^,313	9,632,400	2,912
		<u>COTTER-JEFFERSON CITY FORMATION</u>			
Q-27	107.9-108.7	Dolomite: Gray, very fine grained, thin bedded, argillaceous	6,200	---	---

TABLE 2.5-26 (Continued)

BORING NUMBER	SAMPLE DEPTH (feet)	LITHOLOGY	UNCONFINED COMPRESSIVE STRENGTH (psi)	MODULUS OF ELASTICITY (psi)	MODULUS OF RUPTURE (psi)
Q-29	105.0-106.3	Dolomite: Light gray, very fine grained, thin bedded, argillaceous	12,320	---	---
Q-29	105.0-106.3	Dolomite: Light gray, very fine grained, thin bedded, argillaceous	12,770	10,263,000	---
Q-32	113.7-115.0	Dolomite: Light gray, very fine grained, argillaceous	6,570	---	---
Q-32	113.7-115.0	Dolomite: Light gray, very fine grained, argillaceous	6,940	7,778,000	---
Q-45	97.0-97.8	Dolomite, light gray very fine grained, thin bedded, argillaceous	4,960	---	---
AVERAGE,	Cotter-Jefferson City Formation		8,293	9,020,500	---

(Sheet 1 of 2)

TABLE 2.5-27 RESULTS OF COMPACTION AND RELATIVE DENSITY TESTS CRUSHED STONE FILL AND BACKFILL

			COMPACTION TEST			RELATIVE DENSITY TEST (ASTM D2049-69)		
						AVERAGE MINIMUM DRY DENSITY (pcf)	AVERAGE MAXIMUM DRY DENSITY (pcf)	
GRADATION[a,b]	MATERIAL SOURCE[c]	MAXIMUM SIZE (inches)	MAXIMUM PARTICLE SIZE IN SPECIMEN (inches)	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE CONTENT (percent)	DRY METHOD	DRY METHOD	WET METHOD
AS-Crushed	Face I (Initial)	1.0	0.75	140.0[d]	6.8	--	--	--
AS-Crushed	Face III (Initial)	1.5	0.75	140.0[d]	7.5	--	--	--
MSHC	Face I (Initial)	0.75	0.75	129.2[d]	12.9	--	--	--
ASTM	Face I (Initial)	1.5	1.5	145.5[d]	7.5	--	--	--
ASTM	Face III (Initial)	1.5	1.5	147.0	6.5	105.1[e]	--	139.2[e]
ASTM	Face I (Test Pad)	1.5	1.5	142.6[f]	7.2	105.3[g]	134.1[g]	131.9[g]
ASTM	Face I (Test Pad)	1.5	1.5	137.4[f]	9.0	--	--	--
ASTM	Face I (Test Pad)	1.5	1.5	141.4[f]	7.9	--	--	--

a Index Properties not listed in the table:
Face I, Natural Moisture Content = 2.4%
Face III, Natural Moisture Content = 1.9%
Atterberg Limit tests indicated non-plastic material
Specific Gravity = 2.74, based on laboratory test results (ASTM C128-68)

TABLE 2.5-27 (Continued)

b AS-Crushed: produced during trial crushing, similar to ASTM gradation
MSHC: Missouri State Highway Commission Type 4 Aggregate
ASTM: D2940-71T gradation

c Face I, Face III: on-site mine test faces see Figure 2.5-104
Initial: sample obtained for laboratory testing prior to construction of the structural fill test pad
Test Pad: sample obtained during construction of the structural fill test pad

d ASTM D1557-70, METHOD D

e Average of 2 tests

f 12” Mold, procedure and compaction energy per unit volume equivalent to ASTM D 1557-70

g Average of 3 tests

TABLE 2.5-28 RELATIVE DENSITY TEST RESULTS (PRELIMINARY STUDIES)

SOURCE	SAMPLE NUMBER	SOIL TYPE	MINIMUM DENSITY[a] (lbs/cu.ft.)	MAXIMUM DENSITY[a] (lbs/cu.ft.)
Callaway Rock Quarry	A	Crushed Limestone (GP)	86	103
Jeff Cole Rock Quarry	B	Crushed Limestone (GW)	92	113
Auxvasse Stone and Gravel Company	C	Crushed Limestone (GP)	84	101

a American Society for Testing and Materials Test Designation D2049-69.

TABLE 2.5-29 ONE-DIMENSONAL COMPRESSION TESTS CRUSHED STONE FILL AND BACKFILL

		SPECIMEN (4 in. diameter and 1.5 in. height)									
			MAXIMUM	MOLDING CONDITIONS				SLOPE OF CONSOLIDATION CURVE[a]			
GRADATION[b]	MATERIAL SOURCE[c]	MAXIMUM SIZE (inches)	PARTICLE SIZE IN SPECIMEN[d] (inches)	DRY DENSITY (lb/ft^3)	MOISTURE CONTENT (percent)	DEGREE OF COMPACTION (percent)	VOID RATIO	RELOADING[e]	VIRGIN	RECOMPRESSION INDEX[a,e]	COMPRESSION INDEX[a]
As-Crushed	Face I (Initial)	1.0	0.5	129.1	5.4	92.3	0.32	0.006	0.021	0.008	0.028
As-Crushed	Face III (Initial)	1.5	0.5	130.3	5.5	93.1	0.31	0.007	0.021	0.009	0.028
MSHC	Face I	0.75	0.5	130.3	4.7	100.9	0.31	0.005	0.022	0.007	0.029
ASTM	Face I (Initial)	1.5	0.5	140.1	5.0	95.3	0.22	0 004	0.019	0.005	0.023
ASTM	Face III (Initial)	1.5	0.5	143.6	2.5	97.7	0.19	0.005	0.023	0.006	0.027
ASTM	Face III (Initial)	1.5	0.5	137.2	2.3	93.3	0.24	0.004	0.020	0.005	0.024
ASTM	Face III (Initial)	1.5	0.5	142.5	6.2	96.9	0.20	0.006	0.017	0.007	0.020
ASTM	Face III (Initial)	1.5	0.5	143.5	6.9	97.6	0.19	0.004	0.013	0.005	0.016
ASTM	Face III (Initial)	1.5	0.5	132.7	6.5	90.3	0.29	0.003	0.018	0.004	0.023

[a]The compression index and the recompression index are the conventional compressibility parameters used in the Terzaghi method of settlement analysis. The slope of the consolidation curve is defined as the slope of the curve on a plot of vertical strain versus log of vertical consolidation stress as presented in this report. The compression index is equal to the virgin slope of the consolidation curve multiplied by one plus the initial void ratio. The recompression index is equal to the reloading of the consolidation curve multiplied by one plus the initial void ratio.

[b]As-Crushed: produced during trial crushing, similar to ASTM gradation
MSHC: Missouri State Highway Commission Type 4 Aggregate
ASTM: D 2940-71T gradation

[c]Face I, Face III: on-site mine test faces, see Figure 2.5-104
Initial: sample obtained for laboratory testing prior to construction of the structural fill test pad
Test Pad: sample obtained during construction of the structural fill test pad

[d]Modified Blend; Material greater than 1/2 in. replaced by material greater than No. 4 and less than or equal to 1/2 in. because of equipment limitation.

[e]Determined from the slope of the unloading portion of the consolidation curve.

TABLE 2.5-30 EXPANSION (SWELLING) TEST RESULTS

BORING NUMBER	DEPTH/ ELEVATION (ft/MSL)	GEOLOGIC UNIT	CONSOLIDATION PRESSURE (lbs/sq ft)	DRY DENSITY (lbs/cu ft) INITIAL	DRY DENSITY (lbs/cu ft) AFTER CONSOLIDATION	DRY DENSITY (lbs/cu ft) AFTER SWELLING	MOISTURE CONTENT (PERCENT) INITIAL	MOISTURE CONTENT (PERCENT) AFTER CONSOLIDATION	MOISTURE CONTENT (PERCENT) AFTER SWELLING	VOLUMETRIC EXPANSION* (PERCENT)
P-122	3.8/836.3	Modified loess	424	100.7	102.3	101.8	23.8	23.8	24.1	0.4
	3.9/836.2	Modified loess	847	98.7	99.6	99.5	26.5	26.5	26.5	0.1
	4.0/836.1	Modified loess	1,624	98.9	101.8	101.9	25.3	25.3	25.2	-0.1
	4.1/836.0	Modified loess	3,247	98.2	103.7	103.8	25.1	25.1	25.1	-0.1
P-2	23.5/826.2	Accretion-gley	3,000	106.4	108.3	107.3	21.0	21.0	21.9	1.0
P-15	23.5/830.3	Accretion-gley	3,000	103.3	104.6	103.7	22.8	22.8	23.5	0.8
P-122	13.1/827.0	Accretion-gley	141	101.9	102.8	96.3	21.6	21.6	26.9	6.7
	13.3/826.8	Accretion-gley	212	103.3	104.0	98.6	23.0	23.0	27.4	5.5
	13.5/826.6	Accretion-gley	847	102.1	103.3	101.7	23.1	23.1	25.8	1.5
	13.6/826.5	Accretion-gley	1,624	102.5	105.7	101.6	22.8	22.8	24.9	2.3
	13.8/826.3	Accretion-gley	3,248	102.2	107.9	98.8	22.6	22.6	24.1	2.0
	18.5/821.6	Accretion-gley	6,355	110.0	112.8	112.3	18.4	18.4	18.9	0.4
	18.7/821.4	Accretion-gley	12,708	111.0	114.9	114.9	18.2	18.2	18.3	-0.03
P-15	38.5/815.3	Glacial till	5,000	116.5	120.2	119.3	16.3	16.3	17.4	0.7

*The sample was saturated after consolidation and then allowed to swell under the consolidation pressure. Percent volume expansion referenced to soil volume after consolidation. Positive value means expansion and negative indicates net compression.

(Sheet 1 of 2)

TABLE 2.5-31 LABORATORY PERMEABILITY TEST RESULTS (UNDISTURBED SAMPLES)

BORING NUMBER	DEPTH/ELEVATION (ft/MSL)	TYPE OF TEST	MOISTURE CONTENT (percent)	DRY DENSITY (lbs/cu.ft)	COEFFICIENT OF PERMEABILITY AT 20°C (cm/sec)
		Modified Loess			
P-41	5.0/833.5	Falling Head	20.0	105	4.6×10^{-7}
P-90	2.0/835.7	Falling Head	34.0	88	1.6×10^{-8}
P-101	5.5/835.8	Falling Head	20.6	106	1.1×10^{-8}
		Accretion-Gley			
P-40	14.0/822.2	Falling Head	21.2	105	1.7×10^{-8}
P-62	14.5/830.0	Falling Head	22.1	103	7.3×10^{-9}
P-76	16.0/826.9	Falling Head	22.8	104	1.6×10^{-8}
P-90	9.0/828.7	Falling Head	21.7	106	2.3×10^{-8}
P-101	12.5/828.8	Falling Head	20.9	104	1.1×10^{-8}
		Glacial Till			
R-6	23.5/809.3	Falling Head	16.0	117	1.7×10^{-8}
P-41	24.5/814.0	Falling Head	17.2	115	4.5×10^{-8}
P-62	24.5/820.0	Falling Head	20.2	110	8.2×10^{-9}
P-64	31.0/814.2	Falling Head	16.0	118	5.5×10^{-9}

TABLE 2.5-31 (Continued) (Sheet 2 of 2)

BORING NUMBER	DEPTH/ELEVATION (ft/MSL)	TYPE OF TEST	MOISTURE CONTENT (percent)	DRY DENSITY (lbs/cu.ft)	COEFFICIENT OF PERMEABILITY AT 20°C (cm/sec)
P-72	27.0/813.0[a]	Falling Head	13.3	119	3.1×10^{-8}
P-76	25.5/817.4	Falling Head	20.5	106	2.4×10^{-8}
P-77	32.5/815.8[a]	Falling Head	17.2	113	1.3×10^{-7}
P-88	28.0/811.0[a]	Falling Head	14.0	114	5.6×10^{-5}
P-90	19.5/818.2	Falling Head	18.1	111	1.6×10^{-8}
P-101	26.0/815.3	Falling Head	18.6	111	1.1×10^{-8}
		Graydon Chert Conglomerate			
P-5	53.5/789.6	Falling Head	38.5	98	3.1×10^{-8}
P-38	24.5/810.6	Falling Head	16.3	119	1.6×10^{-8}
P-45	33.5/810.7	Falling Head	8.0	118	2.5×10^{-8}

a Test performed on clayey sand lens in the till.

(Sheet 1 of 1)

TABLE 2.5-32 LABORATORY PERMEABILITY TEST RESULTS (REMOLDED SAMPLES)[a]

TEST PIT LOCATION[b]	DEPTH/ELEVATION (ft/MSL)	MOLDED DRY DENSITY (lbs/cu ft)	DEGREE OF COMPACTION[c] (percent)	MOLDING MOISTURE CONTENT (percent)	OPTIMUM MOISTURE CONTENT[c] (percent)	COEFFICIENT OF PERMEABILITY at 20°C (cm/sec)
<u>Modified Loess</u>						
P-79	4.0/841.3	101	86	19.0	11.0	5.6×10^{-8}
P-79	4.0/841.3	102	87	19.0	11.0	1.8×10^{-7}
P-79	4.0/841.3	106	90	11.2	11.0	2.6×10^{-7}
P-79	4.0/841.3	107	91	11.3	11.0	3.8×10^{-7}
P-90	3.5/834.2	103	88	20.1	14.0	4.0×10^{-8}
P-90	3.5/834.2	105	90	19.9	14.0	1.8×10^{-8}
<u>Accretion-gley</u>						
P-1 and	7.0/844.3	112	97	19.8	12.5	2.3×10^{-8}
P-4	8.0/843.3					
P-79	10.5/834.8	104	87	20.8	13.0	2.2×10^{-8}
P-79	10.5/834.8	106	88	20.1	13.0	2.8×10^{-8}

a Falling head permeability tests.

b Test pits were located immediately adjacent to the listed boring location.

c Based on the ASTM Designation D1557-70, Method of Compaction.

d Combined bulk sample from 7 to 12-foot depth at Boring B-1 and 8 to 13.5-foot depth at Boring P-4.

TABLE 2.5-33 RESONANT COLUMN AND SHOCKSCOPE TESTS

BORING NUMBER	DEPTH/ELEVATION (ft/MSL)	ROCK UNIT	DRY DENSITY (lbs/ft^3)	MOISTURE CONTENT (percent)	CONFINING PRESSURE (lbs/in)	Strain (in/in)	SHEAR MODULUS (lbs/in)	DAMPING RATIO	COMPRESSION WAVE VELOCITY (ft/sec)
P-19	64.1/784.8	Burlington Formation Limestone	166	0.1	6.9	7.5×10^{-8}	4.00×10^{5}	27.0×10^{-3}	17,200
						31.0×10^{-8}	3.94×10^{5}	29.8×10^{-3}	
						110.0×10^{-8}	3.71×10^{5}	35.7×10^{-3}	
					20.8	8.5×10^{-8}	4.19×10^{5}	22.6×10^{-3}	
						35.0×10^{-8}	4.17×10^{5}	24.0×10^{-3}	
						130.0×10^{-8}	3.93×10^{5}	28.4×10^{-3}	
					34.7	9.4×10^{-8}	4.89×10^{5}	18.7×10^{-3}	
						36.0×10^{-8}	4.78×10^{5}	21.3×10^{-3}	
						130.0×10^{-8}	4.60×10^{5}	25.9×10^{-3}	
P-2	66.5/783.2	Burlington Formation Limestone	¯65	0.3	6.9	3.7×10^{-8}	9.18×10^{5}	11.3×10^{-3}	13,600
						21.0×10^{-8}	9.14×10^{5}	13.6×10^{-3}	
						80.0×10^{-8}	9.10×10^{5}	14.7×10^{-3}	
					20.8	4.0×10^{-8}	9.37×10^{5}	10.9×10^{-3}	
						23.0×10^{-8}	9.27×10^{5}	12.0×10^{-3}	
						80.0×10^{-8}	9.22×10^{5}	14.0×10^{-3}	
					34.7	4.0×10^{-8}	9.42×10^{5}	10.8×10^{-3}	
						24.0×10^{-8}	9.39×10^{5}	11.6×10^{-3}	
						80.0×10^{-8}	9.32×10^{5}	13.2×10^{-3}	
P-16	66.9/776.5	Burlington Formation Limestone	166	0.2	13.9	2.6×10^{-8}	10.2×10^{5}	19.0×10^{-3}	13,800
						15.0×10^{-8}	10.1×10^{5}	17.5×10^{-3}	
						75.0×10^{-8}	9.96×10^{5}	18.5×10^{-3}	
					27.8	2.5×10^{-8}	10.2×10^{5}	17.0×10^{-3}	
						16.0×10^{-8}	10.2×10^{5}	17.4×10^{-3}	
						75.0×10^{-8}	9.96×10^{5}	18.9×10^{-3}	
					41.7	2.6×10^{-8}	10.2×10^{5}	18.2×10^{-3}	
						16.0×10^{-8}	10.1×10^{5}	15.9×10^{-3}	
						75.0×10^{-8}	9.96×10^{5}	16.5×10^{-3}	
P-16	93.8/749.6	Snyder Creek Formation Siltstone	155	1.1	13.9	44.0×10^{-8}	4.72×10^{5}	24.6×10^{-3}	5,800
						93.0×10^{-8}	4.68×10^{5}	25.0×10^{-3}	
						150.0×10^{-8}	4.63×10^{5}	24.7×10^{-3}	
					27.8	50.0×10^{-8}	4.91×10^{5}	23.5×10^{-3}	
						93.0×10^{-8}	4.91×10^{5}	24.9×10^{-3}	
						150.0×10^{-8}	4.90×10^{5}	24.9×10^{-3}	
					41.7	58.0×10^{-8}	5.10×10^{5}	18.5×10^{-3}	
						110.0×10^{-8}	5.10×10^{5}	19.5×10^{-3}	
						180.0×10^{-8}	5.00×10^{5}	20.0×10^{-3}	

TABLE 2.5-33 (Continued) (Sheet 2 of 3)

BORING NUMBER	DEPTH/ELEVATION (ft/MSL)	ROCK UNIT	DRY DENSITY (lbs/ft^3)	MOISTURE CONTENT (percent)	CONFINING PRESSURE (lbs/in)	Strain (in/in)	SHEAR MODULUS (lbs/in)	DAMPING RATIO	COMPRESSION WAVE VELOCITY (ft/sec)
P-18	110.4/733.0	Snyder Creek Formation Siltstone	152	0.7	17.4	21.0×10^{-8}	2.97×10^{5}	23.1×10^{-3}	10,100
						44.0×10^{-8}	2.77×10^{5}	23.2×10^{-3}	
						73.0×10^{-8}	2.70×10^{5}	25.6×10^{-3}	
					34.7	17.0×10^{-8}	3.41×10^{5}	18.9×10^{-3}	
						35.0×10^{-8}	3.47×10^{5}	20.1×10^{-3}	
						57.0×10^{-8}	3.37×10^{5}	19.5×10^{-3}	
					52.1	30.0×10^{-8}	3.85×10^{5}	17.5×10^{-3}	
						31.0×10^{-8}	3.78×10^{5}	17.9×10^{-3}	
						53.0×10^{-8}	3.75×10^{5}	17.5×10^{-3}	
P-1	119.0/732.3	Callaway Formation Limestone	165	0.2	6.9	21.0×10^{-8}	10.2×10^{5}	25.8×10^{-3}	18,700
						42.0×10^{-8}	10.0×10^{5}	26.3×10^{-3}	
						69.0×10^{-8}	10.0×10^{5}	26.5×10^{-3}	
					20.8	21.0×10^{-8}	10.2×10^{5}	25.4×10^{-3}	
						43.0×10^{-8}	10.0×10^{5}	25.3×10^{-3}	
						68.0×10^{-8}	10.0×10^{5}	26.8×10^{-3}	
					34.7	19.0×10^{-8}	10.3×10^{5}	24.2×10^{-3}	
						41.0×10^{-8}	10.1×10^{5}	25.3×10^{-3}	
						68.0×10^{-8}	10.0×10^{5}	26.6×10^{-3}	
P-2	134.5/715.2	Callaway Formation Limestone	168	0.2	13.9	8.0×10^{-8}	11.2×10^{5}	10.4×10^{-3}	15,500
						36.0×10^{-8}	11.1×10^{5}	11.7×10^{-3}	
						70.0×10^{-8}	10.9×10^{5}	12.5×10^{-3}	
					27.8	8.0×10^{-8}	11.2×10^{5}	10.1×10^{-3}	
						36.0×10^{-8}	11.1×10^{5}	11.1×10^{-3}	
						70.0×10^{-8}	10.9×10^{5}	12.8×10^{-3}	
					41.7	8.0×10^{-8}	11.1×10^{5}	10.0×10^{-3}	
						36.0×10^{-8}	11.1×10^{5}	11.6×10^{-3}	
						70.0×10^{-8}	10.9×10^{5}	11.9×10^{-3}	
P-1	143.7/707.6	Callaway Formation Sandstone	158	0.5	34.7	17.0×10^{-8}	10.3×10^{5}	21.4×10^{-3}	9,600
						140.0×10^{-8}	10.2×10^{5}	21.8×10^{-3}	
					48.6	30.0×10^{-8}	10.3×10^{5}	24.6×10^{-3}	
						140.0×10^{-8}	10.2×10^{5}	26.4×10^{-3}	
					69.4	37.0×10^{-8}	10.7×10^{5}	16.0×10^{-3}	
						120.0×10^{-8}	10.6×10^{5}	18.0×10^{-3}	
P-1	152.0/699.3	Cotter-Jefferson City Formations - Dolomite	167	0.3	13.9	3.4×10^{-8}	10.8×10^{5}	13.0×10^{-3}	18,400
						20.0×10^{-8}	10.7×10^{5}	13.7×10^{-3}	
						69.0×10^{-8}	10.5×10^{5}	15.8×10^{-3}	
					27.8	3.7×10^{-8}	10.8×10^{5}	12.0×10^{-3}	
						21.0×10^{-8}	10.8×10^{5}	11.8×10^{-3}	
						69.0×10^{-8}	10.7×10^{5}	12.7×10^{-3}	
					41.7	3.9×10^{-8}	10.9×10^{5}	10.9×10^{-3}	
						23.0×10^{-8}	10.8×10^{5}	11.0×10^{-3}	
						69.0×10^{-8}	10.7×10^{5}	10.8×10^{-3}	

TABLE 2.5-33 (Continued) (Sheet 3 of 3)

BORING NUMBER	DEPTH/ELEVATION (ft/MSL)	ROCK UNIT	DRY DENSITY (lbs/ft^3)	MOISTURE CONTENT (percent)	CONFINING PRESSURE (lbs/in)	Strain (in/in)	SHEAR MODULUS (lbs/in)	DAMPING RATIO	COMPRESSION WAVE VELOCITY (ft/sec)
P-2	204.0/645.7	Cotter-Jefferson City Formations - Dolomite	154	0.3	17.4	2.0×10^{-8}	6.33×10^{5}	21.5×10^{-3}	12,600
						12.0×10^{-8}	5.67×10^{5}	26.1×10^{-3}	
						51.0×10^{-8}	5.62×10^{5}	29.7×10^{-3}	
					34.7	3.7×10^{-8}	5.80×10^{5}	19.9×10^{-3}	
						12.0×10^{-8}	5.67×10^{5}	20.0×10^{-3}	
						47.0×10^{-8}	5.58×10^{5}	22.3×10^{-3}	
					52.1	7.1×10^{-8}	7.50×10^{5}	14.1×10^{-3}	
						28.0×10^{-8}	7.41×10^{5}	14.8×10^{-3}	
						100.0×10^{-8}	7.30×10^{5}	16.7×10^{-3}	
P-1	269.0/582.3	Cotter-Jefferson City Formations - Dolomite	151	0.2	27.8	15.0×10^{-8}	5.54×10^{5}	14.6×10^{-3}	13,100
						29.0×10^{-8}	5.45×10^{5}	14.8×10^{-3}	
						47.0×10^{-8}	5.37×10^{5}	14.8×10^{-3}	
					55.6	15.0×10^{-8}	6.16×10^{5}	13.6×10^{-3}	
						29.0×10^{-8}	6.16×10^{5}	14.5×10^{-3}	
						49.0×10^{-8}	6.16×10^{5}	14.5×10^{-3}	
					69.4	15.0×10^{-8}	6.89×10^{5}	14.8×10^{-3}	
						28.0×10^{-8}	6.89×10^{5}	16.0×10^{-3}	
						44.0×10^{-8}	6.89×10^{5}	17.2×10^{-3}	

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TABLE 2.5-34 CLAY MINERALOGY

BORING NUMBER	DEPTH/ELEVATION (ft/MSL)	SOIL UNIT	KAOLINITE (PERCENT)	MONTMORILLONITE (PERCENT)	ILLITE (PERCENT)
P-10	24/824.5	Glacial Till	8	85	7
P-10	34/814.5	Glacial Till	16	70	14
P-36	24.5/806.5	Graydon chert conglomerate	48	--	52
P-1	45.2/806.1	Graydon chert conglomerate	40	--	60
P-1	54.5/796.8	Graydon chert conglomerate	41	--	59
P-15	64.0/789.8	Graydon chert conglomerate	30	--	70
P-48	65.0/781.0	Graydon chert conglomerate	9	--	91
P-2	76.0/773.7	Cavity Filling (Burlington)	60	*	20
P-15	82.0/771.8	Cavity Filling (Burlington)	11	--	89
P-1	80.0/771.3	Cavity Filling (Burlington)	--	*	80
Bulk Sample Surface Outcrop	Approx. Elev.: 740 (5 feet above Burlington Formation)	Graydon chert conglomerate	9	--	91

* Plus 20 percent of mixed layer expansible clay.

TABLE 2.5-35 RESULTS OF TETROGRAPHIC ANALYSIS ROCK CORE SAMPLES FROM ON-SITE MINE AREA

BORING	DEPTH (ft)	CLASSIFICATION	INTERNAL FRACTURING	STYLOLITE SEAMS	CLAY CONTENT[a]	SUITABILITY[b] CONCRETE AGGREGATE	STRUCTURAL FILL AND BACKFILL F&T	NO F&T
Q-27	75.6-76.2	Limestone with lesser dolomitic limestone	No	Yes	Trace	S-F[c]	S-F	S
Q-27	85.6-86.2	Calcitic dolomite	No	No	Minor	F[c]	F	S
Q-27	91.0-91.7	Dolomitic limestone	No	Yes	Minor	S-F[c]	S-F	S
Q-27	98.3-98.9	Calcitic dolomite	Yes	Yes[d]	Very minor	S[c]	S	S
Q-29	75.6-76.2	Limestone	No	Yes	Trace	S-F	S-F	S
Q-29	85.5-86.0	Calcitic dolomite	No	Yes	Conspicuous	S-F[c]	S-F	S
Q-29	96.4-97.0	Limestone, dolomitic limestone and calcitic dolomite	No	Yes	Conspicuous	S-F[c]	S	S
Q-29	100.0-100.6	Dolomitic limestone and calcitic dolomite	No	Yes	Minor	F-S[c]	F-S	S
Q-30	79.6-80.4	Limestone	Yes	Yes	Trace	F-S	F-S	S
Q-30	90.4-91.0	Calcitic dolomite	No	Yes[d]	Minor	F[c]	F	F
Q-30	100.2-100.7	Dolomitic limestone and calcitic dolomite	Yes	Yes	Minor-Trace	F-S[c]	F	S
Q-31	80.0-80.8	Limestone	Yes	Yes	Trace	F	F	S

TABLE 2.5-35 (Continued)

BORING	DEPTH (ft)	CLASSIFICATION	INTERNAL FRACTURING	STYLOLITE SEAMS	CLAY CONTENT [a]	SUITABILITY[b] CONCRETE AGGREGATE	STRUCTURAL FILL AND BACKFILL F&T	NO F&T
Q-31	91.6-92.1	Calcitic dolomite	No	No	Minor	F[c]	F	S
Q-31	100.2-100.7	Limestone, dolomitic limestone and calcitic dolomite	No	Yes[d]	Very Minor	S[c]	S	S
Q-31	103.5-104.1	Dolomitic limestone	No	No	Very Minor	S[c]	S	S
Q-32	85.0-85.8	Limestone	No	Yes	Trace	S-F	S	S
Q-32	95.2-95.8	Dolomite	Yes	Yes	Minor	F[c]	F	S
Q-32	103.7-104.4	Limestone	No	Yes[d]	Trace	S	S	S
Q-32	109.7-110.4	Dolomite	Yes	Yes	Conspicuous	F[c]	F	S
Q-33	105.3-106.0	Dolomite	Yes	Yes[e]	Minor	S-F[c]	S-F	S
Q-34	79.9-80.7	Limestone	No	Yes	Trace	F	F	S
Q-34	90.0-90.7	Calcitic dolomite	No	Yes[d]	Conspicuous	F[c]	F	S
Q-34	108.4-109.1	Calcitic dolomite	No	Yes	Conspicuous	F-P[c]	F	S
Q-40	84.8-85.6	Limestone	No	Yes	Trace	S-F	F	S
Q-40	96.9-97.4	Calcitic dolomite	No	Yes	Conspicuous	S-F[c]	S	S
Q-40	100.0-100.8	Limestone	No	Yes	Trace	S-F	F	S
Q-40	105.5-106.0	Calcitic dolomite	Yes	Yes	Conspicuous	F[c]	F	F

[a] Estimated microscopically; maximum clay content of the matrix is on the order of 10%.

[b] Key: S= Satisfactory; F = Fair; P = Poor; F&T = Freeze and thaw.

[c] Susceptible to the alkali-carbonate rock reaction.

[d] Seams at one or both ends only.

[e] Thin clay laminae.

TABLE 2.5-36 RESULTS OF PETROGRAPHIC ANALYSIS HAND SAMPLES FROM ON-SITE MINE AREA

						SUITABLILITY[b]		
							STRUCTURAL BACKFILL	
SAMPLE	SOURCE	CLASSIFICATION	INTERNAL FRACTURING	STYLOLITE SEAMS	CLAY CONTENT[a]	CONCRETE AGGREGATE	F&T	NO F&T
I-1	Top 1 ft of Upper Dolomite	Calcitic dolomite	No	No	Conspicuous	P[c]	P	F
I-2	Bottom 2 ft of Upper Dolomite	Calcitic dolomite	No	No	Minor	F-P[c]	F	F
I-3	2 ft below top of Lower Limestone	Limestone and dolomitic limestone	No	Yes	Minor	S-F[c]	F	S
I-4	6 ft below top of Lower Limestone	Dolomitic limestone and limestone	Yes	Yes	Minor	S-F[c]	F-P	F

a Estimated microsopically; maximum clay content of the matrix is on the order of 10 percent.

b Key: S = Satifactory; F = Fair; P = Poor; F&T = Freeze and thaw.

c Susceptible to the alkali-carbonate rock reaction.

(Sheet 1 of 1)

TABLE 2.5-37 RESONANT COLUMN TEST RESULTS (SOIL)

BORING NUMBER	DEPTH/ELEVATION (ft/MSL)	SOIL CLASSIFICATION	MOISTURE CONTENT (percent)	DRY DENSITY (lb/ft)	CONFINING PRESSURE (psf)
P-6	18.0/828.8	Accretion-gley	22.2	103	1497.6
					2505.6
					3499.2
P-6	28.0/818.8	Till	16.5	116	2995.2
					4003.2
					4996.8

BORING NUMBER	SHEAR WAVE VELOCITY (fps)	SHEAR STRAIN (percent)	MODULUS OF RIGIDITY (psf)	DAMPING (percent)
P-6	554.84	1.10710×10^{-3}	1,208,000	4.9
	564.41	1.07599×10^{-3}	1,250,000	5.0
	580.65	1.02698×10^{-3}	1,323,000	4.7
P-6	786.76	5.88067×10^{-4}	2,593,000	5.7
	796.11	5.75578×10^{-4}	2,655,000	5.7
	802.39	5.6747×10^{-4}	2,697,000	6.0

TABLE 2.5-38 STRAIN-CONTROLLED DYNAMIC TRIAXIAL COMPRESSION TEST RESULTS UNDISTURBED SAMPLES

BORING NUMBER	DEPTH/ELEVATION (ft/MSL)	GEOLOGIC UNIT	MOISTURE CONTENT (percent)	CONSOLIDATED DRY DENSITY (lbs/ft^3)	CONSOLIDATION PRESSURE (psf)	CYCLIC DEVIATOR STRESS (psf)	SINGLE AMPLITUDE SHEAR STRAIN (percent)	MODULUS OF ELASTICITY (psf)	MODULUS OF RIGIDITY (psf)	DAMPING (percent)
P-76	4.0/838.9	Modified Loess	25.2	99	500	354.9	0.044490	1,157,000.	399,000.	6.1
			(Saturated)			571.2	0.087163	950,000.	328,000.	6.8
						842.9	0.172511	708,000.	244,000.	9.1
						1,109.1	0.342752	469,000.	162,000.	12.7
						1,308.7	0.708203	268,000.	92,000.	17.7
						1,486.2	1.305182	165,000.	57,000.	23.3
P-104	5.0/835.8	Modified Loess	21.2	108	625	293.9	0.046564	915,000.	316,000.	--
			(Saturated)			465.8	0.090800	744,000.	257,000.	10.5
						676.5	0.182763	537,000.	185,000.	11.6
						915.0	0.363198	365,000.	126,000.	13.2
						1,153.5	0.726397	230,000.	79,000.	16.4
						1,386.4	1.396917	144,000.	50,000.	19.5
P-5	13.5/829.6	Accretion-gley	24.5	106	1,800	229.1	0.021040	1,578,945.	544,000.	15.4
			(Saturated)			402.9	0.041194	1,418,286.	489,000.	12.4
						650.1	0.082135	1,147,695.	396,000.	8.5
						1,002.2	0.162456	895,740.	309,000.	7.3
						1,444.7	0.319414	655,826.	226,000.	8.6
						1,772.0	0.638826	402,206.	139,000.	11.9
						2,133.1	1.267513	244,029.	84,000.	17.0
						2,539.4	2.281524	161,395.	56,000.	22.6
						2,957.0	4.436296	96,652.	33,000.	32.1
						2,539.4	4.436296	83,003.	29,000.	33.9
P-5	17.5/825.6	Accretion-gley	23.7	110	2,500	106.5	0.011041	1,398,099.	482,000.	9.5
			(Saturated)			188.9	0.020733	1,320,903.	455,000.	7.6
						344.5	0.041593	1,201,139.	414,000.	6.5
						576.9	0.082678	1,011,793.	349,000.	6.8
						906.6	0.163828	802,387.	277,000.	7.0
						1,364.4	0.321806	614,795.	212,000.	8.1
						1,785.6	0.648699	399,144.	138,000.	10.5
						2,209.2	1.278321	250,591.	86,000.	17.7
						2,438.1	2.035137	173,714.	60,000.	20.6
						2,644.1	3.052705	125,596.	43,000.	26.8
						2,724.2	4.451862	88,733.	30,000.	35.6

TABLE 2.5-38 (Continued)

BORING NUMBER	DEPTH/ELEVATION (ft/MSL)	GEOLOGIC UNIT	MOISTURE CONTENT (percent)	CONSOLIDATED DRY DENSITY (lbs/ft^3)	CONSOLIDATION PRESSURE (psf)	CYCLIC DEVIATOR STRESS (psf)	SINGLE AMPLITUDE SHEAR STRAIN (percent)	MODULUS OF ELASTICITY (psf)	MODULUS OF RIGIDITY (psf)	DAMPING (percent)
P-76	14.0/828.9	Accretion-gley	24.7	101	1,500	282.8	0.041740	982,000.	339,000.	3.9
			(Saturated)			485.2	0.083481	843,000.	291,000.	4.4
						748.6	0.169102	642,000.	221,000.	5.7
						1,070.3	0.337135	460,000.	159,000.	8.5
						1,347.5	0.674269	290,000.	100,000.	13.2
						1,563.8	1.230809	184,000.	64,000.	19.4
P-104	17.5/823.3	Accretion-gley	21.1	105	1,700	349.4	0.042971	1,179,000.	407,000.	5.4
			(Saturated)			598.9	0.085942	1,010,000.	348,000.	5.1
						931.6	0.176292	766,000.	264,000.	6.4
						1,319.8	0.341565	560,000.	193,000.	8.6
						1,719.1	0.683131	365,000.	126,000.	12.5
						2,107.3	1.294643	236,000.	81,000.	17.1
P-5	23.5/819.6	Till	18.5	118	3,300	342.0	0.021377	2,319,669.	800,000.	10.5
			(Saturated)			600.4	0.042110	2,067,546.	713,000.	8.8
						957.1	0.082160	1,689,144.	582,000.	9.2
						1,410.8	0.161230	1,268,811.	437,000.	10.5
						1,963.8	0.323231	880,982.	304,000.	12.5
						2,573.3	0.646463	577,195.	199,000.	15.4
						3,397.2	1.249141	394,354.	136,000.	20.1
						3,792.2	2.524039	217,859.	75,000.	25.1
						4,221.1	4.024039	152,338.	52,000.	31.4
P-5	25.5/817.6	Till	17.4	118	3,500	363.4	0.019395	2,717,043.	937,000.	8.4
			(Saturated)			641.1	0.418523	2,221,052.	766,000.	7.2
						1,047.4	0.081663	1,859,740.	641,000.	7.5
						1,629.7	0.162306	1,456,010.	502,000.	9.2
						2,189.5	0.321549	987,382.	340,000.	12.5
						2,844.2	0.648203	636,240.	219,000.	16.6
						3,464.9	1.263230	397,729.	137,000.	19.5
						3,927.4	2.500940	227,723.	78,000.	24.9
						4,311.4	3.917289	159,591.	55,000.	26.1

TABLE 2.5-38 (Continued)

BORING NUMBER	DEPTH/ELEVATION (ft/MSL)	GEOLOGIC UNIT	MOISTURE CONTENT (percent)	CONSOLIDATED DRY DENSITY (lbs/ft^3)	CONSOLIDATION PRESSURE (psf)	CYCLIC DEVIATOR STRESS (psf)	SINGLE AMPLITUDE SHEAR STRAIN (percent)	MODULUS OF ELASTICITY (psf)	MODULUS OF RIGIDITY (psf)	DAMPING (percent)
P-76	23.0/819.9	Till	19.8	110	2,100	454.7	0.045031	1,464,000.	505,000.	5.2
			(Saturated)			776.4	0.087811	1,282,000.	442,000.	6.8
						1,262.5	0.177873	1,029,000.	355,000.	9.3
						1,541.6	0.348991	641,000.	221,000.	12.5
						1,985.3	0.702484	410,000.	141,000.	16.6
						2,218.2	1.322387	243,000.	84,000.	20.1
P-104	24.5/816.3	Till	19.3	110	2,200	490.8	0.042851	1,661,000.	573,000.	6.3
			(Saturated)			815.2	0.082888	1,426,000.	492,000.	7.0
						1,186.7	0.167224	1,026,000.	354,000.	8.5
						1,586.0	0.340858	675,000.	233,000.	12.8
						1,885.5	0.497761	549,000.	189,000.	13.5
						2,739.5	1.244403	319,000.	110,000.	18.0
P-27	34.5/803.9	Graydon Chert	6.0	141.3	4,500	229	0.002320	7,162,000.	2,468,000.	
		Conglomerate	(In-situ)	(In-situ)	(Confining	334	0.004257	5,860,000.	2,021,000.	
					pressure)	573	0.007539	5,509,000.	1,900,000.	
						802	0.011599	5,013,000.	1,729,000.	
						1031	0.016623	4,497,000.	1,551,000.	
						1261	0.021263	4,297,000.	1,482,000.	
						1490	0.026877	4,019,000.	1,396,000.	
						1719	0.042806	3,906,000.	1,347,000.	
						14,904	0.344373	3,138,000.	1,082,000.	
						19,483	0.489373	2,886,000.	995,000.	
						20,621	0.543747	2,749,000.	948,000.	
P-63	35.7/801.0	Graydon Chert	20.0	--	5,000	573	0.003427	12,121,000.	4,180,000.	2.2
		Conglomerate	(In-situ)		(Confining	802	0.024518	2,372,000.	818,000.	3.3
					pressure)	1,031	0.031899	2,344,000.	806,000.	4.2
						1,261	0.033283	2,746,000.	947,000.	4.8
						1,490	0.038227	2,825,000.	974,000.	4.9
						1.719	0.046136	2,701,000.	932,000.	5.6
						3.438	0.118539	2,096,000.	723,000.	7.8
						4,584	0.197717	1,679,000.	579,000.	
						5,157	0.382280	979,000.	337,000.	

TABLE 2.5-38 (Continued) (Sheet 4 of 4)

BORING NUMBER	DEPTH/ELEVATION (ft/MSL)	GEOLOGIC UNIT	MOISTURE CONTENT (percent)	CONSOLIDATED DRY DENSITY (lbs/ft^3)	CONSOLIDATION PRESSURE (psf)	CYCLIC DEVIATOR STRESS (psf)	SINGLE AMPLITUDE SHEAR STRAIN (percent)	MODULUS OF ELASTICITY (psf)	MODULUS OF RIGIDITY (psf)	DAMPING (percent)
P-63	40.0/796.7	Graydon Chert Conglomerate	18.0 (In-situ)	--	5,500 (Confining pressure)	229	0.005158	3,230,000.	1,114,000.	
						573	0.027674	1,501,000.	517,000.	3.4
						802	0.043769	1,329,000.	459,000.	4.5
						1,031	0.062619	1,194,000.	412,000.	4.4
						1,261	0.082380	1,109,000.	382,000.	6.2
						1,490	0.094912	1,138,000.	393,000.	6.8
						1,719	0.110075	1,132,000.	391,000.	6.6
						4,584	0.329563	1,008,000.	347,000.	
P-82	30.0/812.2	Graydon Chert Conglomerate	15.9 (Saturated)	124	3,750	1,787.3	0.304847	850,000.	293,000.	13.0
						2,540.2	0.622331	592,000.	204,000.	15.8
						3,458.4	1.224129	410,000.	141,000.	18.0
						4,774.4	2.464052	281,000.	97,000.	23.3
P-101	33.5/807.8	Graydon Chert Conglomerate	7.2 (Saturated)	146	4,400	838.6	0.030966	3,923,000.	1,353,000.	8.2
						1,322.1	0.061993	3,092,000.	1,066,000.	10.7
						1,836.3	0.122396	2,175,000.	750,000.	15.2
						3,121.7	0.246382	1,837,000.	634,000.	22.5
						2,907.5	0.492765	856,000.	295,000.	29.7
						3,565.5	0.933869	554,000.	191,000.	36.8

TABLE 2.5-39 STRAIN-CONTROLLED TRIAXIAL COMPRESSION TEST DATA CRUSHED LIMESTONE (PRELIMINARY STUDIES)

SOURCE	SAMPLE NUMBER	SOIL TYPE	REMOLDED DRY DENSITY (lb/ft^3)	MOISTURE CONTENT (percent)	CONFINING PRESSURE (psf)	SINGLE AMPLITUDE SHEAR STRAIN (percent)	MODULUS OF RIGIDITY (psf)	DAMPING (percent)
Callaway Rock Quarry	A	Crushed Limestone	100.9	0.0	5,000	0.0084	3.891×10^6	5
						0.0180	3.641×10^6	7
						0.0386	2.785×10^6	8
						0.0806	1.865×10^6	12
						0.1387	1.316×10^6	17
						0.2964	6.610×10^6	18
						0.6120	3.151×10^6	18
Callaway Rock Quarry	A	Crushed Limestone	100.9	0.0	3,000	0.0063	3.023×10^6	5
						0.0115	2.825×10^6	6
						0.0210	2.531×10^6	7
						0.0446	1.920×10^6	9
						0.0860	1.323×10^6	13
						0.1418	0.952×10^6	17
						0.2916	0.478×10^6	19
						0.5943	0.252×10^6	18
						1.2587	0.132×10^6	16
Jeff Cole Rock Quarry	B	Crushed Limestone	108.0	0.0	5,000	0.0041	3.544×10^6	7
						0.0098	3.323×10^6	7
						0.0198	2.947×10^6	8
						0.0405	2.362×10^6	8
						0.0759	1.735×10^6	12
						0.1345	1.170×10^6	14
						0.2911	0.554×10^6	18
						0.5822	0.274×10^6	17
						0.9303	0.191×10^6	16
Jeff Cole Rock Quarry	B	Crushed Limestone	107.5	0.0	3,000	0.0035	3.912×10^6	--
						0.0108	2.968×10^6	12
						0.0181	2.643×10^6	11
						0.0407	1.964×10^6	13
						0.0788	1.385×10^6	13
						0.1407	0.932×10^6	15
						0.2924	0.471×10^6	18
						0.5832	0.251×10^6	16
						1.2259	0.131×10^6	15
Auxvasse Stone and Gravel Co.	C	Crushed Limestone	97.8	0.0	5,000	0.0029	3.034×10^6	--
						0.0108	2.724×10^6	6
						0.0204	2.532×10^6	8
						0.0386	2.163×10^6	9
						0.0807	1.563×10^6	11
						0.1329	1.225×10^6	14
						0.2817	0.698×10^6	17
Auxvasse Stone and Gravel Co.	C	Crushed Limestone	98.7	0.0	3,000	0.0070	1.900×10^6	9
						0.0128	1.703×10^6	9
						0.0224	1.444×10^6	10
						0.0415	1.148×10^6	12
						0.0846	0.759×10^6	15
						0.1373	0.558×10^6	18
						0.2954	0.274×10^6	20

Note: Additional dynamic triaxial compression test data for the structural fill are presented in Tables 4 and 5 of the Dames & Moore "Report, Field and Laboratory Investigation of the Crushed Stone Fill, Callaway Plant Units 1 and 2, for Union Electric Company," dated August 8, 1975.

TABLE 2.5-40 STRAIN-CONTROLLED DYNAMIC TRIAXIAL COMPRESSION TEST RESULTS CRUSHED STONE FILL AND BACKFILL

SPECIMEN MATERIAL[a]	SPECIMEN DIAMETER (inches)	MAXIMUM PARTICLE SIZE IN SPECIMEN (inches)	MOISTURE CONTENT (percent)	DRY DENSITY (lb/ft^3)	DEGREE OF COMPACTION (percent)	CONSOLIDATION PRESSURE, (psf)	CYCLIC DEVIATOR STRESS, (psf)	SINGLE AMPLITUDE SHEAR STRAIN (percent)	MODULUS OF RIGIDITY, G (PSF) $X10^6$	$K=G/(1000\sqrt{\sigma'_c})$	DAMPING (percent)
Face III (Initial)	5	1.5	6.7	139.0	94.6	3,000.0	375.7	0.0037	5.12	93.4	--
							919.5	0.0102	4.50	82.2	5.3
							1,420.4	0.0188	3.77	68.8	7.1
							2,169.8	0.0404	2.69	49.0	8.6
							3,479.3	0.0878	1.98	36.2	8.1
							4,397.0	0.1405	1.57	28.6	8.3
							2,905.8	0.2842	0.51	9.3	8.5
Face III (Initial)	5	1.5	5.7	139.0	94.6	7,000.0	596.7	0.0048	6.18	73.9	--
							1,341.6	0.0121	5.53	66.1	6.7
							2,619.8	0.0279	4.69	56.0	5.3
							4,501.0	0.0603	3.73	44.6	4.6
							7,005.3	0.1187	2.95	35.3	6.3
							9,838.6	0.2146	2.29	27.4	8.0
Face I (Test Pad)	4	0.75	7.9	138.4	94.8	3,000.0	6,670.0	0.1000	1.71	31.2	10.1
							10,490.0	0.2300	1.13	20.6	11.7
							20,520.0	0.6200	0.82	15.0	11.7
Face I (Test Pad)	4	0.75	7.3	133.3	91.3	3,000.0	5,259.0	0.0900	1.46	26.7	11.0
							6,936.0	0.2800	0.63	11.4	13.1
							11,070.0	0.7400	0.38	6.9	12.8
Face I (Test Pad)	4	0.75	7.0	132.3	90.6	3,000.0	4,559.0	0.1000	1.17	21.3	15.6[b]
							7,790.0	0.2600	0.74	13.5	12.5[b]
							14,780.0	0.7100	0.52	9.5	11.6

[a] ASTM D 2940-71T Gradation, 1.5-inch maximum particle size.
Face I, Face III: on-site mine test faces, see Figure 2.5-104.
Initial: obtained for laboratory testing prior to construction of the structural fill test pad.
Test Pad: obtained during construction of the structural fill test pad.

[b] Due to piston friction.

(Sheet 1 of 1)

TABLE 2.5-41 STRESS-CONTROLLED DYNAMIC TRIAXIAL COMPRESSION TEST RESULTS (ACCRETION-GLEY SAMPLES)

		IN-SITU CONDITIONS		AFTER CONSOLIDATION		CONSOLIDATION PRESSURE	PRINCIPAL CONSOLIDATION	CYCLIC SHEAR STRESS	CYCLES TO INDICATED MEAN AXIL STRAIN			
BORING NUMBER	DEPTH/ ELEVATION (ft/MSL)	MOISTURE CONTENT (percent)	DRY DENSITY (lb/ft^3)	MOISTURE CONTENT (percent)	DRY DENSITY (lb/ft^3)	σ_c (ksf)	STRESS RATIO K_c	$\Delta\sigma_{1/2}$ (ksf)	1%	5%	10%	TOTAL TEST CYCLES
P-77	18.5/829.8	20.6	106	23.0	106	1.0	1.0	0.50	--	--	--	200
									(0.3% maximum)			
P-76	17.5/825.4	21.3	106	23.4	104	1.0	1.5	0.94	3	25	67	200
P-83	14.0/819.5	17.3	113	19.2	110	1.0	1.5	0.50	--	--	--	200
									(0.1% maximum)			
P-87	13.0/830.5	20.6	105	22.9	104	1.0	1.5	1.35	1	5	13	27
P-78	15.5/822.0	19.9	108	22.5	104	1.0	1.0	0.49	1	--	--	200
									(2.7% maximum)			

(Sheet 1 of 1)

TABLE 2.5-42 STRESS-CONTROLLED DYNAMIC TRIAXIAL COMPRESSION (LIQUEFACTION) TEST RESULTS
(CRUSHED STONE FILL AND BACKFILL)

SPECIMEN MATERIAL[a]	SPECIMENT DIAMETER (inches)	MAXIMUM PARTICLE SIZE IN SPECIMENT (inches)	MOISTURE CONTENT (percent)	DRY DENSITY (lb/ft^3)	DEGREE OF COMPACTION (PERCENT)	CONSOLIDATION PRESSURE, $\Delta\sigma;c$ (psf)	CYCLIC DEVIATOR STRESS, $\Delta\sigma;$ (psf)	STRESS RATIO, $R = \Delta\sigma_1 / (2\sigma;C)$	CYCLES TO INITIAL LIQUEFACTION[b]	CYCLES TO 5% DOUBLE AMPLITUDE STRAIN	CYCLES TO 10% DOUBLE AMPLITUDE STRAIN
FACE III (Initial)	5	1.5	5.7	139.1	94.6	3,400	3,500	0.51	13	300	>500
FACE III (Initial)	5	1.5	5.7	139.2	94.7	2,100	3,200	0.76	85	500	>1,000
FACE I (Test Pad)	4	0.75	7.0	139.8	95.8	6,000	6,000	0.49	60	78	>100
FACE I (Test Pad)	4	0.75	6.4	135.1	92.5	6,000	6,000	0.49	30	32	>44
FACE I (Test Pad)	4	0.75	15.0	131.7	90.2	6,000	6,000	0.48	30	20	>44

a ASTM, D2940-71T Gradation, 1.5-inch maximum particle size.
Face I, Face III: on-site mine test faces, see Figure 2.5-104.
Initial: obtained for laboratory testing prior to construction of the structural fill test pad.
Test Pad: obtained during construction o fthe structural fill test pad.

b Initial liquefaction is reached when the increase in pore pressure becomes equal to the lateral consolidation pressure.

TABLE 2.5-43 SUMMARY OF TEST CONDITIONS AND RESULTS PLATE LOAD TESTS ON GRAYDON CHERT CONGLOMERATE UNITS 1 AND 2 POWER BLOCK AREAS

TEST NUMBER	TEST ELEVATION (feet)	PLATE DIAMETER (feet)	SOIL CONDITIONS TYPE	SOIL CONDITIONS IN-PLACE MOISTURE CONTENT (percent)	MAXIMUM LOADING (TSF)	DEFORMATION AT MAXIMUM LOADING (inches)
I	801.2	2.0	Clay-chert mixture	10.8[a]	15.9	0.44
II	807.7	2.0	Claystone	--[b]	15.9	0.37
III	810.7	2.0	Clay-chert mixture	18.2[a]	12.1[c]	1.28
IV	807.0	2.5	Granulated silty clay	8.1 to 12.5	12.6[d]	>1.98
V	810.1	2.5	Clay-chert mixture	13.9	16.2[d]	>2.22
VI	812.1	2.0	Weathered claystone	8.3 to 12.6	15.9[d]	>0.97
VII	811.1	2.0	Clay-chert mixture	13.0 to 18.3[a]	15.9	0.63

a Determined based on the clayey portion of the material.

b Not determined because of the consolidated nature of the material.

c Impending failure.

d Failure.

TABLE 2.5-44 MENARD PRESSUREMETER TEST RESULTS

BORING NUMBER	DEPTH/ELEVATION (ft/MSL)	GEOLOGIC UNIT	UNDRAINED SHEAR STRENGTH (psf)	MODULUS OF ELASTICITY (psf)
P-6	38.0/808.8	Graydon chert conglomerate	---	720,000
P-1	42.5/808.8	Graydon chert conglomerate	---	802,000
P-1	49.5/801.8	Graydon chert conglomerate	---	1,930,000
P-1	52.0/799.3	Graydon chert conglomerate	---	2,936,000
P-1	61.5/789.8	Graydon chert conglomerate	---	2,182,000
P-104	30.0/810.8	Graydon chert conglomerate	---	794,000
P-104	39.1/801.7	Graydon chert conglomerate	17,600	1,058,000
P-104	42.2/798.6	Graydon chert conglomerate	12,300	1,146,000
P-104	45.5/795.3	Graydon chert conglomerate	10,400	645,000
P-104	57.0/783.8	Graydon chert conglomerate	34,600	1,400,000
P-104	60.0/780.8	Graydon chert conglomerate	51,000	3,153,000
P-76	42.4/800.5	Graydon chert conglomerate	19,300	651,000
P-76	36.4/806.5	Graydon chert conglomerate	---	6,078,000

a Boring PM-1 is located approximately 15 feet north and 10 feet west of Boring P-48.

b Boring PM-2 is located approximately 20 feet north and 10 feet west of Boring P-31

TABLE 2.5-44 (Continued) (Sheet 2 of 2)

BORING NUMBER	DEPTH/ELEVATION (ft/MSL)	GEOLOGIC UNIT	UNDRAINED SHEAR STRENGTH (psf)	MODULUS OF ELASTICITY (psf)
P-76	44.5/798.4	Graydon chert conglomerate	---	1,183,000
P-76	52.1/790.8	Graydon chert conglomerate	30,500	2,149,000
PM-1a	42.1/803.9	Graydon chert conglomerate	11,900	1,514,000
PM-1	47.4/798.6	Graydon chert conglomerate	11,500	1,312,000
PM-1	52.5/793.5	Graydon chert conglomerate	17,400	2,742,000
PM-1	57.5/788.5	Graydon chert conglomerate	---	5,484,000
PM-1	60.6/785.4	Graydon chert conglomerate	---	7,459,000
PM-1	67.1/778.9	Graydon chert conglomerate	---	13,015,000
PM-1	70.7/775.3	Graydon chert conglomerate	---	8,983,000
PM-1	75.6/770.4	Graydon chert conglomerate	---	14,038,000
PM-1	82.3/763.7	Graydon chert conglomerate	37,900	5,464,000
PM-2b	29.0/808.8	Graydon chert conglomerate	14,500	1,391,000
PM-2	34.0/803.8	Graydon chert conglomerate	13,500	1,003,000
PM-2	38.0/799.8	Graydon chert conglomerate	19,700	1,719,000
PM-2	43.0/794.8	Graydon chert conglomerate	10,700	2,128,000
PM-2	48.0/789.8	Graydon chert conglomerate	37,700	1,412,000
P-76	4.7/838.2	Modified loess	3,300	158,000
P-76	9.7/833.2	Accretion-gley	5,500	278,000
P-76	14.7/828.2	Accretion-gley	5,100	309,000
P-76	23.7/819.2	Glacial till	5,900	381,000

TABLE 2.5-45 TABULATION OF BORING DATA

Boring No.	Surface Elev. Datum Mean Sea Level	Accretion-Gley Depth	Accretion-Gley Eleva-tion	Accretion-Gley Thick-ness	Glacial Till Depth	Glacial Till Eleva-tion	Glacial Till Thick-ness	Graydon Chert Conglomerate Depth	Graydon Chert Conglomerate Eleva-tion	Graydon Chert Conglomerate Thick-ness	Top of Lithified Formations Depth	Top of Lithified Formations Eleva-tion	Top of Well-Indurated Rock Depth	Top of Well-Indurated Rock Eleva-tion	Burlington Formation Depth	Burlington Formation Eleva-tion	Burlington Formation Thick-ness
CS-1	843.5	12.5	831.0	4.1	16.6	826.9	16.9	33.5	810.0	26.5	60.0	783.5			60.0	783.5	9.1
CS-2	848.5	5.5	843.0	24.0	29.5	819.0	11.5	41.0	807.5	24.0	65.0	783.5			65.0	783.5	11.5
CS-3	844.3	8.7	835.6	12.3	21.0	823.3	17.0	38.0	806.3	21.5	59.5	784.8			--	--	--
CS-4	837.1	12.5	824.6	9.5	22.0	815.1	9.5	31.5	805.6	30.0	61.5	775.6			61.5	775.6	3.5
CS-5A	809.7	--	--	--	4.5	805.2	6.5	11.0	798.7	1.5*							
CS-5B	831.5	--	--	--	--	--	--	28.0	803.5	15.7	43.7	787.8			--	--	--
CS-6	804.2	--	--	--	--	--	--	7.0	797.2	30.0	37.0	767.2			37.0	767.2	4.5
CS-7	811.1	--	--	--	21.7	789.4	27.2	46.9	762.2	49.9*							
CS-8	821.0	8.6	812.4	4.4	13.0	808.0	4.0	17.0	804.0	1.5*							
R-1	791.9	--	--	--	--	--	--	2.7	789.2	19.3	22.0	769.9			22.0	769.9	17.9
R-2	802.1	--	--	--	4.5	797.6	4.5	9.0	793.1	19.0	28.0	774.1			28.0	774.1	21.4
R-3	821.7	7.0	814.7	10.5	17.5	804.2	7.2	24.7	797.0	29.5	54.2	767.5	56.2	765.5	--	--	--
R-4	818.7	7.5	811.2	11.2	18.7	800.0	2.8	21.5	797.2	24.5	46.0	772.7	53.3	765.4	46.0	772.7	2.2
R-5	824.0	7.8	816.2	13.4	21.2	802.8	11.4	32.6	791.4	61.2	69.3	754.7	71.9	752.1	--	--	--
R-6	832.8	10.0	822.8	12.2	22.2	810.6	4.2	26.4	806.4	35.9	62.3	770.5	89.5	743.3	62.3	770.5	41.7
R-7	834.2	7.5	826.7	15.6	23.1	811.1	8.3	31.4	802.8	19.9	51.3	782.9	64.8	769.4	51.3	782.9	10.5
R-8	838.9	8.0	830.9	18.5	26.5	812.4	11.8	38.3	800.6	25.3	63.6	775.3	63.6	775.3	--	--	--
P-1	851.3	8.0	843.3	26.0	34.0	817.3	7.5	41.5	809.8	36.5	78.0	773.3	82.0	769.3	78.0	773.3	7.7
P-2	849.7	8.6	841.1	18.4	27.0	822.7	14.0	41.0	808.7	20.5	59.0	788.2	76.5	773.2	61.5	788.2	17.2
P-3	853.1	8.0	845.1	19.5	27.5	825.6	14.0	41.5	811.6	40.8	82.3	770.8	82.3	770.8	--	--	--
P-4	851.4	7.5	843.9	23.5	31.0	820.4	8.0	39.0	812.4	41.0	80.0	771.4	81.5	769.9	80.0	771.4	9.7
P-5A	842.4	6.5	835.9	15.0	21.5	820.9	10.0	31.5	810.9	42.0	73.5	768.9	74.5	767.9	73.5	768.9	6.5
P-6A	847.0	6.5	840.5	15.5	22.0	825.0	12.7	34.7	812.3	37.8	72.5	774.5	85.2	764.5	72.5	774.5	11.1
P-7	851.5	10.0	841.5	20.5	30.5	821.0	11.5	42.0	809.5	33.7	75.7	775.8	77.7	763.7	75.7	775.8	1.5
P-8	856.5	17.0	839.5	10.5	27.5	829.0	19.5	47.0	809.5	40.4	87.4	769.1	91.5	765.0	--	--	--
P-9	848.3	10.5	837.8	17.5	28.0	820.3	9.0	37.0	811.3	34.4	71.4	776.9	79.8	768.5	71.4	776.9	8.4
P-10	848.3	6.5	841.8	16.0	22.5	825.8	15.9	38.4	809.9	49.7	88.1	760.2	89.5	758.8	--	--	--
P-11	851.0	7.5	843.5	28.1	35.6	815.4	4.4	40.0	811.0	39.0	79.0	772.0	80.3	770.7	--	--	--
P-12	850.1	10.5	839.6	23.5	34.0	816.1	7.0	41.0	809.1	40.0	81.0	769.1	85.3	764.8	--	--	--
P-13	848.0	12.0	836.0	20.0	32.0	816.0	5.0	37.0	811.0	26.5	63.5	784.5	63.5	784.5	--	--	--
P-14	840.7	8.0	832.7	9.4	17.4	823.3	11.8	29.2	811.5	48.8	78.0	762.7	78.0	762.7	--	--	--
P-15	853.8	12.0	841.8	21.7	33.7	820.1	8.3	42.0	811.8	36.4	78.4	775.4	89.1	764.7	78.4	775.4	9.0
P-16	843.4	12.0	831.4	9.0	21.0	822.4	11.0	32.0	811.4	28.3	60.3	783.1	64.3	779.1	60.3	783.1	15.5
P-17	836.3	7.5	828.8	12.5	20.0	816.3	8.0	28.0	808.3	33.5	61.5	774.8	65.0	771.3	--	--	--
P-18	849.9	7.5	842.4	28.0	35.5	814.4	5.5	41.0	808.9	30.5	71.5	778.4	80.0	769.9	71.5	778.4	17.9
P-19	848.9	12.0	836.9	22.3	34.3	814.6	8.3	42.6	806.3	4.2	46.8	802.1	68.4	780.5	46.8	802.1	27.2
P-20	840.9	7.5	833.4	14.0	21.5	819.4	7.5	29.0	811.9	30.5	59.5	781.4	67.0	773.9	--	--	--
P-21	848.5	7.0	841.5	24.0	31.0	817.5	7.5	38.5	810.0	17.8	56.3	792.2	71.8	776.7	56.3	792.2	15.1
P-22	843.6	4.9	838.7	18.1	23.0	820.6	10.5	33.5	810.1	39.0	66.5	771.1	70.7	772.9	66.5	777.1	7.0
P-23	848.5	8.0	840.5	19.5	27.5	821.0	11.2	38.7	809.8	31.5	70.2	778.3	70.2	778.3	--	--	--
P-24	840.1	7.5	832.6	16.0	23.5	816.6	5.9	29.4	810.7	21.3	50.7	789.4	53.3	786.8	50.7	789.4	2.8
P-25	827.8	8.0	819.8	6.0	14.0	813.8	9.0	23.0	804.8	20.0	43.0	784.8	46.5	781.3	43.0	784.8	22.1
P-26	839.9	3.4	836.4	14.6	18.0	821.9	9.0	27.0	812.9	28.5	55.5	784.4	65.5	774.3	55.5	784.4	16.0
P-27	838.4	5.5	832.9	13.5	19.0	819.4	6.0	25.0	813.4	36.5	61.5	776.9	64.8	773.6	61.5	776.9	1.3
P-28	836.3	9.0	827.3	9.5	18.5	817.8	8.0	26.5	809.8	41.8	68.3	768.0	70.5	765.8	--	--	--
P-29	837.5	7.0	830.5	14.0	21.0	816.5	4.5	25.5	812.0	27.0	52.5	785.0	57.5	780.0	52.7	784.8	18.2
P-30	837.1	8.0	829.1	11.5	19.5	817.6	6.0	25.5	811.6	33.0	58.5	778.6	62.5	774.6	58.3	778.9	6.1
P-31	837.7	3.0	834.7	10.8	13.8	823.9	11.2	25.0	812.7	27.2	52.2	785.5	53.7	784.0	52.2	785.5	12.5
P-32	839.7	8.0	831.7	9.0	17.0	822.7	10.5	27.5	812.2	25.0	52.5	787.2	59.4	780.3	52.5	787.2	7.4
P-33	841.8	6.0	835.8	15.0	21.0	820.8	8.5	29.5	812.3	26.0	55.5	786.3	74.4	767.3	55.5	786.3	18.7
P-34	843.0	7.2	835.8	13.6	20.8	822.2	11.2	32.0	811.0	24.2	56.2	786.8	72.8	770.2	56.2	786.8	17.4
P-35	836.5	9.5	827.0	11.5	21.0	815.5	3.5	24.5	812.0	38.5	63.0	773.5	63.0	773.5	63.0	773.5	3.6
P-36	830.5	5.7	824.8	6.3	12.0	818.5	9.5	21.5	809.0	27.8	49.3	781.2	58.7	771.8	49.3	781.2	8.1
P-37	840.3	7.0	833.3	13.0	20.0	820.3	9.0	29.0	811.3	24.8	53.8	786.5	67.2	773.1	53.8	786.5	15.2
P-38	835.1	4.0	831.1	15.0	19.0	816.1	4.0	23.0	812.1	21.5	44.5	790.6	46.6	788.5	44.5	790.6	11.7
P-39	834.9	9.2	825.7	8.8	18.0	816.9	5.5	23.5	811.4	33.5	57.0	777.9	59.0	775.9	57.0	777.9	2.0
P-40	836.2	7.5	828.7	9.0	16.5	819.7	7.0	23.5	812.7	28.5	52.0	784.2	60.8	775.4	52.0	784.2	15.2
P-41	838.5	6.5	832.0	11.5	18.0	820.5	11.0	29.0	809.5	26.5	55.5	783.0	59.5	779.0	55.5	783.0	7.7
P-42	845.4	3.5	841.9	28.5	32.0	813.4	4.5	36.5	808.9	14.0	50.5	794.9	66.2	779.2	50.5	794.9	15.7
P-43	848.0	8.0	840.0	19.0	27.0	821.0	12.0	39.0	809.0	31.5	70.5	777.5	70.5	777.5	70.5	777.5	2.3
P-44	842.5	3.5	839.0	21.5	25.0	817.5	4.5	29.5	813.0	28.3	57.8	784.7	57.8	784.7	--	--	--
P-45	844.2	5.7	838.5	16.3	22.0	822.2	10.0	32.0	812.2	42.6	74.6	769.6	81.7	762.5	--	--	--
P-46	844.8	6.2	838.6	16.8	23.0	821.8	7.2	30.2	814.6	28.2	62.5	780.6	69.6	775.2	62.5	782.3	7.7
P-47	845.9	7.5	838.4	16.0	23.5	822.4	9.0	32.5	813.4	27.4	59.7	786.0	63.6	782.3	59.7	786.2	15.6
P-48	846.0	7.5	838.5	19.7	27.2	818.8	10.3	37.5	808.5	49.2	86.7	759.3	88.5	757.5	--	--	--
P-49	846.4	8.0	838.4	16.5	24.5	821.9	10.0	34.5	811.9	26.5	61.0	785.4	77.0	769.4	61.0	785.4	10.0
P-50	847.3	10.5	836.8	12.5	23.0	824.3	13.0	36.0	811.3	31.6	67.6	779.7	69.8	777.5	67.6	779.7	3.7
P-51	847.8	7.5	840.3	14.5	22.0	825.8	14.0	36.0	811.8	38.3	74.3	773.5	74.3	773.5	--	--	--
P-52	843.4	5.7	837.7	19.0	24.7	818.7	5.0	29.7	813.7	32.5	62.2	781.2	63.7	779.7	--	--	--
P-53	843.9	6.7	837.2	15.3	22.0	821.9	10.0	32.0	811.9	30.0	60.7	781.9	72.7	771.2	60.7	783.2	13.3
P-54	846.7	7.0	839.7	18.0	25.0	821.7	10.0	35.0	811.7	31.8	66.8	779.9	72.2	774.5	60.8	779.9	9.7
P-55	841.7	8.0	833.7	14.0	22.0	819.7	7.0	29.0	812.7	30.2	59.2	782.5	62.6	779.1	59.2	782.5	10.1
P-56	842.0	7.4	834.6	13.6	21.0	821.0	8.0	29.0	813.0	48.6	77.6	764.4	80.0	762.0	77.6	764.4	10.0
P-57	846.4	7.0	839.4	12.3	19.3	827.1	10.7	30.0	816.4	44.0	74.0	772.4	74.0	772.4	--	--	--
P-58	842.5	9.0	833.5	14.5	23.5	819.0	11.5	35.0	807.5	24.5	59.5	783.0	65.5	777.0	59.5	783.0	6.0
P-59	848.0	8.7	839.3	18.3	27.0	821.0	11.8	38.8	809.2	33.5	72.3	776.0	72.9	775.1	72.3	775.7	0.6
P-60	845.3	7.0	838.3	16.5	23.5	821.8	11.0	34.5	810.8	25.2	59.7	785.6	68.9	776.4	59.7	785.6	17.5
P-61	837.7	5.0	832.7	12.0	17.0	820.7	7.2	24.2	813.5	23.3	47.5	790.2	49.3	788.4	47.5	790.2	14.1
P-62	844.5	6.0	838.5	18.5	24.5	820.0	7.5	32.0	812.5	34.6	66.6	777.9			66.6	777.9	6.0
P-63	836.7	4.0	832.7	15.5	19.5	817.2	7.0	26.5	810.2	30.5	57.0	779.7	63.5	773.2	57.0	779.7	7.0
P-64	845.2	10.0	835.2	14.0	24.0	821.2	11.0	35.0	810.2	21.3	56.3	788.8	70.9	774.3	56.3	788.8	14.6
P-65	833.5	7.0	826.5	12.0	19.0	814.5	3.5	22.5	811.0	25.7	48.0	785.5	55.0	778.5	48.0	785.5	12.1
P-66	833.9	7.5	826.4	9.5	17.0	816.9	7.5	24.5	809.4	38.4	62.9	771.0	62.9	771.0	62.9	771.0	1.8
P-67	835.5	6.0	829.5	11.5	17.5	818.0	9.5	27.0	808.5	45.8	72.8	763.0	72.8	762.7	--	--	--

Boring No.	Bushberg Formation Depth	Bushberg Formation Eleva-tion	Bushberg Formation Thick-ness	Snyder Creek Formation Depth	Snyder Creek Formation Eleva-tion	Snyder Creek Formation Thick-ness	Callaway Formation Depth	Callaway Formation Eleva-tion	Callaway Formation Thick-ness	Joachim Formation Depth	Joachim Formation Eleva-tion	Joachim Formation Thick-ness	St. Peter Formation Depth	St. Peter Formation Eleva-tion	St. Peter Formation Thick-ness	Cotter-Jefferson City Formations Depth	Cotter-Jefferson City Formations Eleva-tion	Cotter-Jefferson City Formations Thick-ness	Total Depth	Final Eleva-tion
CS-1	69.4	774.1	1.8	70.9	772.6	25.5	96.4	747.1	38.8	--	--	--	--	--	--	135.2	708.3	73.8*	209.0	634.5
CS-2	76.5	772.0	3.0	79.5	769.0	11.5*													91.0	757.5
CS-3	59.5	784.8	5.0	64.5	779.8	22.5*													88.0	756.3
CS-4	65.0	772.1	3.4	68.4	768.7	15.6*													84.0	753.1
CS-5A																			12.5	797.2
CS-5B	43.7	787.8	1.0	44.7	786.8	33.3*													78.0	753.5
CS-6	41.5	762.7	1.2	42.7	761.5	29.3*													72.0	732.2
CS-7																			98.8	712.3
CS-8																			18.5	802.5
R-1	39.9	752.0	2.6	42.5	749.4	47.5	90.0	701.9	11.0	101.0	690.9	10.2	--	--	--	111.2	680.7	41.1*	152.3	639.6
R-2	49.4	752.7	1.4	50.8	751.3	39.7	90.5	711.6	20.2	--	--	--	--	--	--	110.7	691.4	62.3*	173.0	629.1
R-3	54.2	767.5	2.8	57.0	764.7	38.0*													95.0	726.7
R-4	48.2	770.5	1.8	50.0	768.7	41.3	91.3	727.4	29.7	--	--	--	--	--	--	121.0	697.7	5.8*	126.8	691.9
R-5	69.3	754.7	2.6	71.9	752.1	33.0	104.9	719.1	3.6*										108.5	715.5
R-6	104.0	728.8	2.3	106.3	726.5	26.0	132.3	700.5	28.5	160.8	672.0	4.9	--	--	--	165.7	667.1	42.3*	208.0	624.8
R-7	61.8	772.4	3.0	64.8	769.4	28.0	92.8	741.4	27.9	--	--	--	--	--	--	120.7	713.5	14.1*	134.8	699.4
R-8	--	--	--	63.6	775.3	27.8	91.4	747.5	34.6	126.0	712.9	6.3	--	--	--	132.3	706.6	3.0*	135.2	703.6
P-1	85.7	765.6	1.0	86.7	764.6	29.5	116.2	735.1	34.1	--	--	--	--	--	--	150.3	701.0	154.7*	305.0	546.3
P-2	78.7	771.0	1.5	80.2	769.5	32.8	113.0	736.7	34.5	--	--	--	--	--	--	147.5	702.2	58.5*	206.0	643.7
P-3	82.3	770.8	1.5	83.8	769.3	28.6	112.4	740.7	38.6	--	--	--	--	--	--	151.0	702.1	3.8*	154.8	698.3
P-4	89.7	761.7	4.8	94.5	756.9	28.5	123.0	728.4	35.5*										158.5	692.9
P-5A	80.0	762.4	4.3	84.3	758.1	22.7	107.0	735.4	35.6	--	--	--	--	--	--	142.6	699.8	13.4*	156.0	686.4
P-6A	--	--	--	83.6	763.4	24.4	108.0	739.0	40.0	--	--	--	--	--	--	148.0	699.0	7.2*	155.2	691.8
P-7	77.2	774.3	1.8	79.0	772.5	26.8	105.8	745.7	3.7*										109.5	742.0
P-8	87.4	769.1	3.0	90.4	766.1	22.1	112.5	744.0	33.2	--	--	--	--	--	--	145.7	710.8	9.3*	155.0	701.5
P-9	79.8	768.5	1.2	81.0	767.3	33.0	114.0	734.3	1.0*										115.0	733.3
P-10	88.1	760.2	0.9	89.0	759.3	23.4	112.4	735.9	31.3	--	--	--	--	--	--	143.7	704.6	0.8*	144.5	703.8
P-11	79.0	772.0	1.2	80.2	770.8	34.9	115.1	735.9	35.0	--	--	--	--	--	--	150.1	700.9	3.9*	154.0	697.0
P-12	81.0	769.1	2.0	83.0	767.1	28.8	111.8	738.3	2.8*										114.6	735.5
P-13	63.5	784.5	3.8	67.3	780.7	33.7	101.0	747.0	36.5	--	--	--	--	--	--	137.5	710.5	7.1*	144.6	703.4
P-14	78.0	762.7	3.6	81.6	759.1	23.1	104.7	736.0	10.6*										115.3	725.4
P-15	87.4	766.4	1.7	89.1	764.7	23.5	112.6	741.2	6.8*										119.4	734.4
P-16	75.8	767.6	1.6	77.4	766.0	27.7	105.1	738.3	39.6	144.7	698.7	3.6	--	--	--	148.3	695.1	1.0*	149.3	694.1
P-17	--	--	--	61.5	774.8	34.5	96.0	740.3	31.4	--	--	--	--	--	--	127.4	708.9	7.6*	135.0	701.3
P-18	89.4	760.5	4.1	93.5	756.4	10.3	103.8	746.1	48.9	--	--	--	--	--	--	152.7	697.2	12.1*	164.8	685.1
P-19	74.0	774.9	1.0*																75.0	773.9
P-20	59.5	781.4	1.8	61.3	779.6	39.0	100.3	740.6	3.7*										104.0	736.9
P-21	71.4	777.1	2.8	74.2	774.3	31.8	106.0	742.5	3.0*										109.0	739.5
P-22	73.5	770.1	3.5	77.0	766.6	33.8	110.8	732.8	22.2	--	--	--	--	--	--	133.0	710.6	171.3*	304.3	539.3
P-23	--	--	--	70.2	778.3	29.6	99.8	748.7	3.3*										103.1	745.4
P-24	53.5	786.6	2.0	55.5	784.6	29.7	89.2	750.9	14.9*										104.1	736.0
P-25	65.1	762.7	1.3	66.4	761.4	27.3	93.7	734.1	6.8*										100.5	727.3
P-26	71.5	768.4	1.3	72.8	767.1	23.9	96.7	743.2	4.8*										101.5	738.3
P-27	62.8	775.6	2.7	65.5	772.9	27.0	92.5	745.9	10.0*										102.2	735.6
P-28	68.3	768.0	2.2	70.5	765.8	29.5	100.0	736.3	10.5*										110.5	725.8
P-29	64.9	772.6	0.2	65.1	772.4	30.9	96.0	741.5	5.6*										101.6	735.9
P-30	64.4	772.7	1.5	65.9	771.2	27.7	93.6	743.5	5.9*										99.5	737.7
P-31	64.7	773.0	1.0	65.7	772.0	29.7	95.4	742.3	31.5	--	--	--	--	--	--	126.9	710.8	78.1*	205.0	632.7
P-32	59.9	779.8	1.1	61.0	778.7	32.9	93.9	745.8	8.6*										102.5	737.2
P-33	74.2	767.6	2.3	76.5	765.3	33.7	110.2	731.6	12.8*										123.0	718.7
P-34	73.6	769.4	1.1	74.7	768.3	42.6	117.3	725.7	7.2*										124.5	718.5
P-35	66.6	769.9	2.2	68.8	767.7	26.2	95.0	741.5	10.3*										105.3	731.2
P-36	57.4	773.1	0.9	58.3	772.2	29.7	88.0	742.5	5.5*										93.5	737.0
P-37	69.0	771.3	2.8	71.8	768.5	40.2	112.0	728.3	2.0*										114.0	726.3
P-38	56.2	778.9	1.4	57.6	777.5	32.6	90.2	744.9	4.3*										94.5	740.6
P-39	59.0	775.9	1.0	60.0	774.9	40.8	100.8	734.1	10.0*										110.8	724.1
P-40	67.2	769.0	1.3	68.5	767.7	28.4	96.9	739.3	7.6*										104.5	731.7
P-41	63.2	775.3	3.7	66.9	771.6	32.1	99.0	739.5	3.5*										103.5	735.0
P-42	66.2	779.2	2.5	68.7	776.7	29.7	98.4	747.0	7.6*										106.0	739.4
P-43	72.8	775.2	1.9	74.7	773.3	33.3	108.0	740.0	12.0*										120.0	728.0
P-44	57.8	784.7	1.4	59.2	783.3	32.3	91.5	751.0	12.0*										103.5	739.0
P-45	74.6	769.6	2.4	77.0	767.2	26.5	103.5	740.7	7.5*										111.0	733.2
P-46	70.2	774.6	2.3	72.7	772.1	34.5	107.0	737.8	18.8*										125.8	719.0
P-47	75.3	770.6	4.0	79.3	766.6	32.0	111.3	734.6	2.7*										114.0	731.9
P-48	86.7	759.3	1.6	88.3	757.7	24.2	112.5	733.5	37.0	149.5	696.5	4.0	153.5	692.5	11.0	164.5	681.5	40.0*	204.5	641.5
P-49	71.6	774.8	5.2	76.8	769.6	28.4	105.2	741.2	6.6*										111.8	734.6
P-50	71.3	776.0	0.7	72.0	775.3	31.7	103.7	743.6	5.3*										109.0	738.3
P-51	74.3	773.5	1.2	75.5	772.3	28.5	104.0	743.8	6.3*										110.3	737.5
P-52	62.2	781.2	1.3	63.5	779.9	28.2	91.7	751.7	7.3*										101.0	742.4
P-53	74.0	769.9	6.0	80.0	763.9	33.6	113.6	730.3	4.9*										118.5	725.4
P-54	70.5	776.2	1.7	72.2	774.5	32.2	104.4	742.3	8.2*										112.6	734.1
P-55	69.3	772.4	1.7	71.0	770.7	30.7	101.7	740.0	8.3*										110.0	731.7
P-56	87.6	754.4	2.4	90.0	752.0	18.3	108.3	733.7	6.7*										115.0	727.0
P-57	74.0	772.4	5.9	79.9	766.5	32.1	112.0	734.4	8.0*										120.0	726.4
P-58	65.5	777.0	2.5	68.0	774.5	30.0	98.0	744.5	5.3*										103.3	739.2
P-59	72.9	775.1	3.6	76.5	771.5	38.5	115.0	733.0	6.1*										121.1	727.0
P-60	77.3	768.0	5.5	82.8	762.5	29.3	112.1	733.2	8.7*										120.8	724.5
P-61	61.6	776.1	3.1	64.7	773.0	33.3	98.0	739.7	7.0*										105.0	732.7
P-62	72.6	771.9	4.9	77.5	767.0	30.2	107.7	736.8	42.8	--	--	--	--	--	--	150.5	694.0	49.5*	200.0	644.5
P-63	64.0	772.7	2.3	66.3	770.4	33.7*													100.0	736.7
P-64	70.9	774.3	4.1	75.0	770.2	34.4	109.4	736.2	5.6*										115.0	730.2
P-65	60.1	773.4	2.2	62.3	771.2	34.2	96.5	738.8	8.5*										105.0	728.5
P-66	64.7	769.2	3.3	68.0	765.9	28.4	96.4	737.5	8.6*										105.0	728.9
P-67	72.8	762.7	2.5	75.3	760.2	30.0	105.3	730.2	6.0*										111.3	724.2

Notes: Depths indicate distance in feet below land surface to top of stratigraphic units.

Elevations indicate relative position of top of stratigraphic units with reference to mean sea level

* indicates stratigraphic unit not completely penetrated by test boring.

-- indicates stratigraphic unit absent.

TABLE 2.5-45 (Sheet 2 of 2)

Boring Number	Surface Elevation MSL Datum	Modified Loess			Accretion-Gley			Till			Graydon Chert Conglomerate			Top of Lithified Formations		Top of Well-Indurated Rock		Burlington Formation			Bushberg Formation			Snyder Creek Formation			Callaway Formation			Joachim Formation			St. Peter Formation			Paleokarst Rubble			Cotter-Jefferson City Formation			Total Depth	Final Elevation	Boring Number
		Depth	Elevation	Thickness	Depth	Elevation	Thickness	Depth	Elevation	Thickness	Depth	Elevation	Thickness	Depth	Elevation	Depth	Elevation	Depth	Elevation	Thickness	Depth	Elevation	Thickness	Depth	Elevation	Thickness	Depth	Elevation	Thickness	Depth	Elevation	Thickness	Depth	Elevation	Thickness	Depth	Elevation	Thickness	Depth	Elevation	Thickness			
P-68	841.3	0.8	840.5	5.7	6.5	834.8	17.5	24.0	817.3	6.2	30.2	811.1	29.6	59.8	781.5			59.8	781.5	2.0	61.8	779.5	2.1	63.9	777.4	28.5	92.4	748.9	44.2	--	--	--	--	--	--	--	--	--	136.6	704.7	66.9[a]	203.5	637.8	P-68
P-69	843.5	1.2	842.3	7.3	8.5	835.0	14.5	23.0	820.5	8.5	31.5	812.0	26.7	60.2	783.3			60.2	783.3	8.4	68.6	774.9	2.4	71.0	772.5	30.3	101.3	742.2	41.0	--	--	--	--	--	--	--	--	--	142.3	701.2	238.5[a]	380.8	462.7	P-69
P-70	843.7	1.1	842.6	7.9	9.0	834.7	13.0	22.0	821.7	10.0	32.0	811.7	31.0	63.0	780.7			63.0	780.7	11.7	74.7	769.0	7.8	82.5	761.2	35.3	117.8	725.9	38.7	156.5	687.2	8.4	164.9	678.8	100.3	265.2	578.5	28.9	294.1	549.6	107.6[a]	401.7	442.0	P-70
P-71	840.0	1.0	839.0	8.0	9.0	831.0	9.0	18.0	822.0	10.5	28.5	811.5	31.7	60.2	779.8			60.2	779.8	14.3[b]	74.5[b]	765.5	2.5[b]	77.0[b]	763.0	14.5[b]	91.5	748.5	42.5	--	--	--	--	--	--	--	--	--	134.0	706.0	66.0[a]	200.0	640.0	P-71
P-72	840.0	1.0	839.0	8.0	9.0	831.0	10.0	19.0	821.0	8.5	27.5	812.5	31.5	59.0	781.0	83.0	757.0	59.0	781.0	--	--	--	--	75.0[b]	765.0[b]	29.5[b]	104.5	735.5	36.5	141.0	699.0	3.0	144.0	696.0	13.0	157.0	683.0	5.0	162.0	678.0	38.0[a]	200.0	640.0	P-72
P-73	835.9	3.5	832.4	5.5	9.0	826.9	9.3	18.3	817.6	6.2	24.5	811.4	32.0	--	--																											58.0	777.9	P-73
P-74	837.5	0.8	836.7	7.0	7.8	829.7	10.2	18.0	819.5	6.5	24.5	813.0	25.5	50.0	787.5			50.0	787.5	9.7	59.7	777.8	1.8	61.5	776.0	23.4	84.9	752.6	41.3	--	--	--	--	--	--	--	--	--	126.2	711.3	273.8[a]	400.0	437.5	P-74
P-75	836.5	1.0	835.5	9.5	10.5	826.0	11.0	21.5	815.0	5.8	27.3	809.2	27.0	54.3	782.2	69.2	767.3	54.3	782.2	8.1	72.4	764.1	6.0	78.4	758.1	0.8[a]																79.2	757.3	P-75
P-76	842.9	1.0	841.9	6.0	7.0	835.9	15.0	22.0	820.9	10.5	32.5	810.4	21.5	54.0	788.9			54.0	788.9	14.2	68.2	774.7	2.2	70.4	772.5	2.9[a]																73.3	769.6	P-76
P-77	848.3	0.5	847.8	6.0	6.5	841.8	18.8	25.3	823.0	11.9	37.2	811.1	25.8	63.0	785.3	70.8	777.5	63.0	785.3	16.8	79.8	768.5	5.7	85.5	762.8	4.0[a]																89.5	758.8	P-77
P-78	837.5	1.0	836.5	8.8	9.8	827.7	10.2	20.0	817.5	8.0	28.0	809.5	6.0[a]																													34.0	803.5	P-78
P-79	845.3	0.6	844.7	7.9	8.5	836.8	16.0	24.5	820.8	8.0	33.5	811.8	4.5[a]																													38.0	807.3	P-79
P-80	840.0	1.5	838.5	8.0	9.5	830.5	10.5	20.0	820.0	8.5	28.5	811.5	10.0[a]																													38.5	801.5	P-80
P-81	835.6	1.5	834.1	8.0	9.5	826.1	8.2	17.7	817.9	7.3	25.0	810.6	6.0[a]																													31.0	804.6	P-81
P-82	842.2	1.0	841.2	10.0	11.0	831.2	8.0	19.0	823.2	10.7	29.7	812.5	5.3[a]																													35.0	807.2	P-82
P-83	833.5	1.0	832.5	6.0	7.0	826.5	12.2	19.2	814.3	5.0	24.2	809.3	27.8	52.0	781.5	61.6	771.9	52.0	781.5	14.5	66.5	767.0	2.5	69.0	764.5	5.0[a]																74.0	759.5	P-83
P-84	836.5	1.0	835.5	10.2	11.2	825.3	6.3	17.5	819.0	7.5	25.0	811.5	5.8[a]																													30.8	805.7	P-84
P-85	838.3	1.0	837.3	8.0	9.0	829.3	5.0	14.0	824.3	12.5	26.5	811.8	24.8	51.3	787.0	57.4	780.9	51.3	787.0	11.1	62.4	775.9	2.0	64.4	773.9	4.1[a]																68.5	769.8	P-85
P-86	839.3	1.1	838.2	7.9	9.0	830.3	7.5	16.5	822.8	10.5	27.0	812.3	5.3[a]																													32.3	807.0	P-86
P-87	843.5	0.7	842.8	8.8	9.5	834.0	10.7	20.2	823.3	12.1	32.3	811.2	23.7	56.0	787.5	59.3	784.2	56.0	787.5	25.8	81.8	761.7	5.5	87.3	756.2	12.0[a]																99.3	744.2	P-87
P-88	839.0	1.2	837.8	6.3	7.5	831.5	10.0	17.5	821.5	15.0	32.5	806.5	33.7	66.2	772.8	66.5	772.5				66.2	772.8	3.0	69.2	769.8	6.3[a]																75.5	763.5	P-88
P-89	839.7	0.8	838.9	8.7	9.5	830.2	7.0	16.5	823.2	10.2	26.7	813.0	9.9[a]																													36.6	803.1	P-89
P-90	837.7	0.8	836.9	8.2	9.0	828.7	7.1	16.1	821.6	9.4	25.5	812.2	3.0[a]																													28.5	809.2	P-90
P-91	836.9	0.8	836.1	8.2	9.0	827.9	9.2	18.2	818.7	6.3	24.5	812.4	4.7[a]																													29.2	807.7	P-91
P-92	835.4	1.0	834.4	8.0	9.0	826.4	10.5	19.5	815.9	3.2	22.7	812.7	28.1	50.8	784.6	51.9	783.5	50.8	784.6	15.6	66.4	769.0	2.1	68.5	766.9	1.5[a]																70.0	765.4	P-92
P-93	831.7	1.0	830.7	7.5	8.5	823.2	5.0	13.5	818.2	9.0	22.5	809.2	6.0[a]																													28.5	803.2	P-93
P-94	834.0	3.5	830.5	5.5	9.0	825.0	9.5	18.5	815.5	4.0	22.5	811.5	6.2[a]																													26.7	805.3	P-94
P-95	848.2	0.8	847.4	9.2	10.0	838.2	21.5	31.5	816.7	8.7	40.2	808.0	5.8[a]																													46.0	802.2	P-95
P-96	836.3	1.0	835.3	7.0	8.0	828.3	9.0	17.0	819.3	7.5	24.5	811.8	3.9[a]																													28.4	807.9	P-96
P-97	837.3	2.0	835.3	8.2	10.2	827.1	4.5	14.7	822.6	10.0	24.7	812.6	6.1[a]																													30.8	806.5	P-97
P-98	838.3	1.0	837.3	6.2	7.2	831.1	8.5	15.7	822.6	11.5	27.2	811.1	4.3[a]																													31.5	806.8	P-98
P-99	839.8	1.0	836.8	6.6	7.6	832.2	9.9	17.5	822.3	11.0	28.5	811.3	6.5[a]																													35.0	804.8	P-99
P-100	840.9	1.0	839.9	11.0	12.0	828.9	7.0	19.0	821.9	10.5	29.5	811.4	38.0	67.5	773.4			67.5	773.4	4.2	71.7	769.2	3.3	75.0	765.9	3.5[a]																78.5	762.4	P-100
P-101	841.3	1.0	840.3	9.0	10.0	831.3	8.5	18.5	822.8	10.5	29.0	812.3	6.5[a]																													35.5	805.8	P-101
P-102	839.1	1.0	838.1	8.2	9.2	829.9	10.8	20.0	819.1	7.5	27.5	811.6	6.5[a]																													34.0	805.1	P-102
P-103	840.3	1.1	839.2	5.9	7.0	833.3	8.5	15.5	824.8	13.5	29.0	811.3	4.2[a]																													33.2	807.1	P-103
P-104	840.8	1.2	839.6	7.3	8.5	832.3	13.2	21.7	819.1	6.8	28.5	812.3	30.8	59.3	781.5			59.3	781.5	11.9	71.2	769.6	0.4	71.6	769.2	2.7[a]																74.3	766.5	P-104
P-105	836.8	1.2	835.6	9.8	11.0	825.8	5.5	16.5	820.3	11.2	27.7	809.1	6.0[a]																													33.7	803.1	P-105
P-106	847.1	1.0	846.1	5.2	6.2	840.9	16.8	25.0	822.1	12.5	37.5	809.6	5.0[a]																													42.5	804.6	P-106
P-107	847.6	1.0	846.6	6.0	7.0	840.6	15.0	22.0	825.6	14.3	36.3	811.3	37.3	73.6	774.0	77.8	769.8				73.6	774.0	4.1	77.7	769.9	7.3[a]																85.0	762.6	P-107
P-108	842.8	1.0	841.8	5.5	6.5	836.3	17.0	23.5	819.3	14.5	38.0	804.8	11.9	49.9	792.8	59.9	782.9	49.9	792.9	14.7	64.6	778.2	2.4	67.0	775.8	21.0	98.0	744.8	33.5	--	--	--	--	--	--	--	--	--	131.5	711.3	13.0[a]	144.5	698.3	P-108
P-109	847.2	1.1	846.1	7.9	9.0	838.2	15.1	24.1	823.1	16.5	40.6	806.6	18.7	59.3	787.9	59.4	787.8	59.3	787.9	15.9	75.2	772.0	1.8	77.0	770.2	2.3[a]																79.3	767.9	P-109
P-110	850.1	1.0	849.1	5.6	6.6	843.5	17.4	24.0	826.1	16.2	40.2	809.9	23.2	63.4	786.7	65.9	784.2				63.4	786.7	3.8	67.2	782.9	7.8[a]																75.0	775.1	P-110
P-111	846.8	1.0	845.8	8.0	9.0	837.8	11.0	20.0	826.8	18.0	38.0	808.8	42.0	80.0	766.8	80.0	766.8							80.0	766.8	20.0[a]																100.0	746.8	P-111
P-112	849.3	0.8	848.5	6.4	7.2	842.1	19.4	26.6	822.7	13.4	40.0	809.3	29.5	69.5	779.8	74.5	774.8	69.5	779.8	4.7	74.2	775.1	0.6	74.8	774.5	4.7[a]																79.5	769.8	P-112
P-113	847.3	1.0	846.3	5.5	6.5	840.8	17.0	23.5	823.8	17.3	40.8	806.5	33.2	74.0	773.3	80.5	766.8	74.0	773.3	12.0	86.0	761.3	4.6	90.6	756.7	1.9[a]																92.5	754.8	P-113
P-114	839.3	1.5	837.8	10.0	11.5	827.8	8.5	20.0	819.3	7.7	27.7	811.6	36.9	64.6	774.7	58.7	780.6	64.6	774.7	9.4	74.0	765.3	5.0	79.0	760.3	10.0[a]																89.0	750.3	P-114
P-115	842.2	0.7	841.5	11.3	12.0	830.2	12.7	24.7	817.5	10.5	35.2	807.0	35.0	70.2	772.0	75.0	767.2				70.2	772.0	7.3	77.5	764.7	7.5[a]																85.0	757.2	P-115
P-116	846.5	0.7	845.8	9.1	9.8	836.7	16.7	26.5	820.0	10.7	37.2	809.3	27.7	64.9	781.6	79.5	767.0	64.9	781.6	15.6	80.5	766.0	8.0	88.5	758.0	24.6	113.1	733.4	32.2[a]	--	--	--	--	--	--	--	--	--	145.3	701.2	11.5[a]	156.5	690.0	P-116
P-117	848.5	1.0	847.5	5.5	6.5	842.0	16.5	23.0	825.3	14.4	37.4	811.1	31.7	69.1	779.4	72.5	776.0				69.1	779.4	3.1	72.2	776.3	41.2	113.4	735.1	5.1[a]													118.5	730.0	P-117
P-118	839.2	1.0	838.2	8.0	9.0	830.2	12.5	21.5	817.7	8.7	30.2	809.0	5.3[a]																													35.5	803.7	P-118
P-119	834.0	0.9	833.1	6.4	7.3	826.7	9.2	16.5	817.5	8.0	24.5	809.5	24.0	48.5	785.5			48.5	785.5	22.1	70.6	763.4	2.4	73.0	761.0	33.5	106.5	727.5	10.0[a]													116.5	717.5	P-119
P-120	842.4	0.8	841.6	6.5	7.3	835.1	16.7	24.0	818.4	10.5	34.5	807.9	6.5[a]																													41.0	801.4	P-120
P-121	847.5	1.0	846.5	5.8	6.8	840.7	19.5	26.3	821.2	11.7	38.0	809.5	5.0[a]																													43.0	804.5	P-121
P-122	840.1	0.9	839.2	8.1	9.0	831.1	14.5	23.5	816.6	5.5	29.0	811.1	5.5[a]																													34.5	805.6	P-122
P-123	841.3	0.8	840.5	8.7	9.5	831.8	12.0	21.5	819.8	9.7	31.2	810.1	30.1	61.3	780.0	63.5	777.8	61.3	780.0	7.3	68.6	772.7	1.1	69.7	771.6	8.8[a]																78.5	762.8	P-123
P-124	841.8	0.8	841.0	9.2	10.0	831.8	14.0	24.0	817.8	8.0	32.0	809.8	19.9	51.9	789.9	53.3	788.5	51.9	789.9	20.4	72.3	769.5	2.4	74.7	767.1	5.3[a]																80.0	761.8	P-124
P-125	842.6	1.0	841.6	8.0	9.0	833.6	15.0	24.0	818.6	7.8	31.8	810.8	6.2[a]																													38.0	804.6	P-125
P-126	845.0	0.9	844.1	12.1	13.0	832.0	11.0	24.0	821.0	10.9	34.9	810.1	5.6[a]																													40.5	804.5	P-126
P-127	848.3	0.7	847.6	6.6	7.3	841.0	19.2	26.5	821.8	12.0	38.5	809.8	5.5[a]																													44.0	804.3	P-127
P-128	847.9	0.9	847.0	5.6	6.5	841.4	18.5	25.0	822.9	12.4	37.4	810.5	5.6[a]																													43.0	804.9	P-128
P-129	847.9	1.0	846.9	7.0	8.0	839.9	23.5	31.5	816.4	6.2	37.7	810.2	5.3[a]																													43.0	804.9	P-129
P-130	845.0	1.0	844.0	6.3	7.3	837.7	17.7	25.0	820.0	6.8	31.8	813.2	5.0[a]																													36.8	808.2	P-130
P-131	848.0	1.1	846.9	6.9	8.0	840.0	19.3	27.3	820.7	9.7	37.0	811.0	34.3	71.4	776.6	--	--	71.4	776.6	12.7	84.1	763.9	3.9	88.0	760.0	35.9	123.7	724.3	21.6	--	--	--	--	--	--	--	--	--	145.5	702.5	56.3[a]	201.8	646.2	P-131
P-132	849.2	0.8	848.4	5.7	6.5	842.7	21.2	27.7	821.5	9.8	37.5	811.7	22.9	60.5	788.7	--	--	60.5	788.7	6.3	66.8	782.4	1.6	68.4	780.8	32.6	101.0	748.2	41.8	--	--	--	--	--	--	--	--	--	142.8	706.4	57.7[a]	200.5	648.7	P-132
P-133	849.6	0.8	848.8	8.2	9.0	840.6	15.0	24.0	825.6	11.5	35.5	814.1	5.5[a]																													41.0	808.6	P-133
P-134	850.4	0.6	849.8	8.9	9.5	840.9	19.0	28.5	821.9	10.5	39.0	811.4	7.0[a]																													46.0	804.4	P-134
P-135	850.5	0.7	849.8	8.3	9.0	841.5	19.5	28.5	822.0	12.0	40.5	810.0	5.5[a]																													46.0	804.5	P-135
P-136	844.7	0.9	843.8	8.1	9.0	835.7	15.5	24.5	820.2	7.5	32.0	812.7	5.4[a]																													37.4	807.3	P-136
P-137	842.8	1.0	841.8	8.0	9.0	833.8	17.5	26.5	816.3	6.5	33.0	809.8	5.5[a]																													38.5	804.3	P-137
P-138	844.8	1.2	843.6	7.8	9.0	835.8	11.0	20.0	824.8	16.5	36.5	808.3	5.5[a]																													42.0	802.8	P-138
P-139	850.1	0.8	849.3	7.9	8.7	841.4	20.8	29.5	820.6	10.5	40.0	810.1	5.5[a]																													45.5	804.6	P-139
P-140	845.4	1.0	844.4	8.2	9.2	836.2	18.0	27.2	818.2	8.8	36.0	809.4	5.0[a]																													41.0	804.4	P-140
P-141	844.2	1.0	843.2	8.2	9.2	835.0	12.5	21.7	822.5	9.3	31.0	813.2	33.0	64.0	780.2			64.0	780.2	3.0	67.0	777.2	3.6	70.6	773.6	27.9	98.5	745.7	40.6	--	--	--	--	--	--	--	--	--	139.1	705.1	10.9[a]	150.0	694.2	P-141
P-142	845.2	1.5	843.7	5.0	6.5	838.7	14.2	20.7	824.5	13.8	34.5	810.7	24.9	59.4	785.8	64.0	781.2	59.4	785.8	3.6	63.0	782.2	1.0	64.0	781.2	33.8	108.5	736.7	38.7	--	--	--	--	--	--	--	--	--	136.5	708.7	48.3[a]	183.8	661.4	P-142
P-143	842.7	1.1	841.6	6.2	7.3	835.4	12.9	20.2	822.5	9.7	29.9	812.8	39.1	69.0	773.7	77.0	781.2	69.0	773.7	6.2	75.2	767.5	6.4	81.6	761.1	27.9	109.5	733.2	47.5	157.0	685.7	3.1	160.1	682.6	20.4	180.2	662.5	60.8	241.0	601.7	44.0[a]	285.0	557.7	P-143
P-144	843.7	--	--	--	--	--	--	--	--	--	32.1	811.6	28.3	60.4	783.3	75.5	768.2	60.4	783.3	15.6	76.0	767.7	6.0	82.0	761.7	30.0	112.0	731.7	42.0	154.0	689.7	6.2	160.2	683.5	63.1	223.3	620.4	52.7	276.0	567.7	19.0[a]	295.0	548.7	P-144
P-145	845.3	1.0	844.3	--	--	--	--	--	--	--	30.5	814.8	28.5	59.0	786.3	71.0	774.3	59.0	786.3	11.4	70.4	774.9	3.4	73.8	771.5	34.2	108.0	737.3	33.2	--	--	--	--	--	--	--	--	--	141.2	704.1	51.0[a]	193.0	652.3	P-145
P-146	837.1	1.0	836.1	--	--	--	--	--	--	--	25.5	811.6	25.5	51.0	786.1	68.0	769.1	51.0	786.1	13.5	64.5	772.6	1.1	65.6	771.5	29.9	95.5	741.6	39.7	--	--	--	--	--	--	135.2	701.9	15.7	150.9	686.2	34.1[a]	185.0	652.1	P-146
P-147	838.4	1.0	837.4	--	--	--	--	--	--	--	28.0	810.4	27.1	55.1	783.3	64.5	773.9	55.1	783.3	12.7	67.8	770.6	3.0	70.8	767.6	39.0	109.8	728.6	28.2	--	--	--	--	--	--	139.5	698.9	14.0	153.5	684.9	38.6[a]	192.1	646.3	P-147
P-148	836.7	--	--	--	--	--	--	--	--	--	--	--	--	56.5	780.2	94.0	742.7	56.5	780.2	3.5	60.0	776.7	0.6	60.6	776.1	34.2	94.8	741.9	33.8	--	--	--	--	--	--	--	--	--	128.6	708.1	271.4[a]	400.0	436.7	P-148

Notes: Depths indicate distance in feet below land surface to top of stratigraphic units.
Elevations indicate relative position of top of stratigraphic units with reference to mean sea level.
-- indicates stratigraphic unit absent.

[a] Indicates stratigraphic unit not completely penetrated by test boring.

[b] Low core recovery between 70.0 and 75.0 feet due to mechanical malfunction prevented exact determination of Bushberg Formation contacts.

TABLE 2.5-46 TABULATION OF QUARRY BORING DATA

BORING NUMBER	SURFACE ELEVATION	SOIL THICKNESS	PENNSYLVANIAN AND MISSISSIPPIAN SEDIMENTS (UNDIFFERENTIATED) DEPTH	ELEVATION	THICKNESS	GRAYDON CHERT CONGLOMERATE DEPTH	ELEVATION	THICKNESS	BURLINGTON FORMATION DEPTH	ELEVATION	THICKNESS	BUSHBERG FORMATION DEPTH	ELEVATION	THICKNESS	SNYDER CREEK FORMATION DEPTH	ELEVATION	THICKNESS	CALLAWAY FORMATION DEPTH	ELEVATION	THICKNESS	JOACHIM FORMATION DEPTH	ELEVATION	THICKNESS	ST. PETER FORMATION DEPTH	ELEVATION	THICKNESS	COTTER-JEFFERSON CITY FORMATION DEPTH	ELEVATION	THICKNESS	TOTAL DEPTH	FINAL ELEV.	BORING NUMBER
Q-1	770.6	7.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.2	763.4	18.8	--	--	--	--	--	--	26.0	744.6	14.0*	40.0	730.6	Q-1
Q-2	782.6	8.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.5	774.1	16.0	--	--	--	--	--	--	24.5	758.1	30.5*	55.0	727.6	Q-2
Q-3	809.9	4.0	--	--	--	--	--	--	--	--	--	4.0	805.9	6.8	10.8	799.1	34.2	45.0	764.9	10.6	--	--	--	--	--	--	55.6	754.3	19.4*	75.0	734.9	Q-3
Q-4	817.0	22.0	--	--	--	--	--	--	--	--	--	22.0	795.0	2.5	24.5	792.5	25.5	50.0	767.0	31.6	--	--	--	--	--	--	81.6	735.4	8.4*	90.0	727.0	Q-4
Q-5	822.1	9.5	--	--	--	--	--	--	9.5	812.6	12.3	21.8	800.3	5.7	27.5	794.6	30.8	58.3	763.8	21.3	--	--	--	--	--	--	79.6	742.5	5.4*	85.0	737.1	Q-5
Q-6	807.1	0.5	--	--	--	--	--	--	--	--	--	0.5	806.6	7.2	7.7	799.4	30.8	38.5	768.6	15.6	--	--	--	--	--	--	54.1	753.0	14.6*	68.7	738.4	Q-6
Q-7	777.6	4.5	--	--	--	--	--	--	--	--	--	--	--	--	4.5	773.1	20.5	--	--	--	--	--	--	--	--	--	25.0	752.6	15.0*	40.0	737.6	Q-7
Q-8	806.0	10.0	--	--	--	--	--	--	--	--	--	10.0	796.0	2.3	12.3	793.7	31.7	44.0	762.0	34.0	78.0	728.0	4.1	82.1	723.9	17.9*	--	--	--	100.0	706.0	Q-8
Q-9	814.2	3.2	--	--	--	--	--	--	--	--	--	3.2	811.0	7.3	10.5	803.7	42.7	53.2	761.0	9.2	--	--	--	--	--	--	62.4	751.8	3.4*	65.8	748.4	Q-9
Q-10	810.2	2.0	--	--	--	--	--	--	--	--	--	2.0	808.2	6.3	8.3	801.9	27.2	35.5	774.7	20.6	--	--	--	--	--	--	56.1	754.1	2.8*	58.9	751.3	Q-10
Q-11	764.8	7.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.9	756.9	20.1*	28.0	736.8	Q-11
Q-12	782.7	13.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13.5	769.2	26.1	39.6	743.1	5.7	45/3	737.4	2.7*	--	--	--	48.0	734.7	Q-12
Q-13	793.5	3.0	--	--	--	--	--	--	--	--	--	--	--	--	3.0	790.5	22.6	25.6	767.9	35.6	61.2	732.3	5.3	66.5	727.0	2.2*	--	--	--	68.7	724.[illegible]	Q-13
Q-14	800.0	28.1	--	--	--	--	--	--	28.1	771.9	6.4	34.5	765.5	7.0	41.5	758.5	27.0	68.5	731.5	9.5*	--	--	--	--	--	--	--	--	--	78.0	722.0	Q-14
Q-15	764.8	14.4	--	--	--	--	--	--	14.4	750.4	16.4	30.8	734.0	2.4	33.2	731.6	47.5	80.7	684.1	12.8*	--	--	--	--	--	--	--	--	--	93.5	671.3	Q-15
Q-16	788.1	12.0	--	--	--	12.0	776.1	15.5	27.5	760.6	16.9	44.4	743.7	0.9	45.3	742.8	30.2	75.5	712.6	34.4	--	--	--	--	--	--	109.9	678.2	8.1*	118.0	670.1	Q-16
Q-17	781.3	10.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10.2	771.1	19.8*	30.0	751.3	Q-17
Q-18	805.2	10.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10.0	795.2	20.0	--	--	--	--	--	--	30.0	775.2	16.3*	46.3	758.9	Q-18
Q-19	837.5	10.5	--	--	--	--	--	--	--	--	--	10.5	827.0	5.2	15.7	821.8	33.0	48.7	788.8	14.8	--	--	--	--	--	--	63.5	774.0	5.8*	69.3	768.2	Q-19
Q-20	799.5	7.5	--	--	--	--	--	--	7.5	792.0	4.1	11.6	787.9	7.4	19.0	780.5	30.1	49.1	750.4	17.7	--	--	--	--	--	--	66.8	732.7	21.5*	88.3	711.2	Q-20
Q-21	808.5	12.0	--	--	--	--	--	--	--	--	--	12.0	796.5	8.2	20.2	788.3	25.9	46.1	762.4	19.9	--	--	--	--	--	--	66.0	762.4	9.5*	75.5	733.0	Q-21
Q-22	794.1	6.0	--	--	--	6.0	788.1	25.5	31.5	762.6	15.6	47.1	747.0	1.4	48.5	745.6	33.0	81.5	712.6	29.0	--	--	--	--	--	--	110.5	683.6	29.0*	139.5	654.6	Q-22
Q-23	793.2	8.8	--	--	--	8.8	784.4	25.2	34.0	759.2	9.0	43.0	750.2	1.4	44.4	748.8	42.6	87.0	706.2	22.1	--	--	--	--	--	--	109.1	684.1	17.4*	126.5	666.7	Q-23
Q-24	804.4	28.5	--	--	--	--	--	--	28.5	775.9	10.6	39.1	765.3	0.9	40.0	764.4	37.0	77.0	721.4	38.2	--	--	--	--	--	--	115.2	689.2	19.6*	134.8	669.6	Q-24
Q-25	796.0	30.4	--	--	--	30.4	765.6	9.5	39.9	756.1	10.1	50.0	746.0	0.9	50.9	745.1	34.1	85.0	711.0	23.0	--	--	--	--	--	--	108.0	688.0	22.0*	130.0	666.0	Q-25
Q-26	799.6	28.0	--	--	--	--	--	--	--	--	--	28.0	771.6	2.0	30.0	769.6	45.4	75.4	724.2	38.3	--	--	--	--	--	--	113.7	685.9	8.8*	122.5	677.1	Q-26
Q-27	789.6	3.5	--	--	--	3.5	786.1	13.5	17.0	772.6	8.0	25.0	764.6	1.1	26.1	763.5	36.4	62.5	727.1	40.4	--	--	--	--	--	--	102.9	686.7	20.4*	123.3	666.3	Q-27
Q-28	796.5	15.6	--	--	--	15.6	780.9	26.4	42.0	754.5	9.0	51.0	745.5	1.2	52.2	744.3	27.2	79.4	717.1	31.5	--	--	--	--	--	--	110.9	685.6	19.5*	130.4	666.1	Q-28
Q-29	782.1	3.0	--	--	--	3.0	779.1	17.5	20.5	761.6	13.0	33.5	748.6	0.5	34.0	748.1	28.7	62.7	719.4	40.9	--	--	--	--	--	--	103.6	678.5	19.9*	123.5	658.6	Q-29
Q-30	787.5	4.0	--	--	--	4.0	783.5	33.9	--	--	--	37.9	749.6	1.0	38.9	748.6	29.5	68.4	719.1	36.5	--	--	--	--	--	--	104.9	682.6	12.1*	117.0	670.5	Q-30
Q-31	791.9	8.3	--	--	--	8.3	783.6	27.2	--	--	--	--	--	--	35.5	756.4	27.5	63.0	728.9	44.7	--	--	--	--	--	--	107.7	684.2	20.0*	127.7	664.2	Q-31
Q-32	798.5	13.0	--	--	--	13.0	785.5	7.0	20.0	778.5	17.5	37.5	761.0	1.3	38.8	759.7	33.2	72.0	726.5	40.7	--	--	--	--	--	--	112.7	685.8	19.8*	132.5	666.0	Q-32
Q-33	801.9	15.5	--	--	--	15.5	786.4	8.5	24.0	777.9	17.4	41.4	760.5	1.0	42.4	759.5	37.6	80.0	721.9	31.2	--	--	--	--	--	--	111.2	690.7	20.8*	132.0	669.9	Q-33
Q-34	794.9	15.1	--	--	--	15.1	779.8	9.9	25.0	769.9	6.4	31.4	763.5	1.1	32.5	762.4	35.9	68.4	726.5	42.2	--	--	--	--	--	--	110.6	684.3	21.9*	132.5	662.4	Q-34
Q-35	799.6	11.5	--	--	--	11.5	788.1	19.5	31.0	768.6	19.5	50.5	749.1	1.7	52.2	747.4	42.8	95.0	704.6	35.4	--	--	--	--	--	--	130.4	669.2	27.6*	158.0	641.6	Q-35
Q-36	750.6	7.0	--	--	--	--	--	--	--	--	--	--	--	--	7.0	743.6	38.2	45.2	705.4	20.8	--	--	--	--	--	--	66.0	684.6	22.9*	88.9	661.7	Q-36
Q-37	796.5	10.3	--	--	--	10.3	786.2	27.7	--	--	--	38.0	758.5	6.1	44.1	752.4	29.8	73.9	722.6	34.9	--	--	--	--	--	--	108.8	687.7	20.2*	129.0	667.5	Q-37
Q-38	799.6	12.4	--	--	--	12.4	787.2	28.6	41.0	756.6	3.4	44.4	755.2	0.9	45.3	754.3	34.9	80.2	719.4	29.2	--	--	--	--	--	--	109.4	690.2	20.6*	130.0	669.6	Q-38
Q-39	794.2	8.0	--	--	--	8.0	786.2	17.5	25.5	768.7	7.7	33.2	761.0	1.0	34.2	760.0	36.5	70.7	723.5	40.6	--	--	--	--	--	--	111.3	682.9	16.2*	127.5	666.7	Q-39
Q-40	797.9	16.0	--	--	--	16.0	781.9	17.0	33.0	764.9	7.8	40.8	757.1	1.3	42.1	755.8	33.3	75.4	722.5	33.7	--	--	--	--	--	--	109.1	688.8	21.4*	130.5	667.4	Q-40
Q-41	781.4	8.0	--	--	--	8.0	773.4	29.7	37.7	743.7	3.3	41.0	740.4	2.3	43.3	738.1	35.0	78.3	703.1	23.7	--	--	--	--	--	--	102.0	679.4	20.5*	122.5	658.9	Q-41

* Indicates stratigraphic unit not completely penetrated by test boring.

-- Indicates data not obtained.

TABLE 2.5-46 (Sheet 2 of 2)

BORING NUMBER	SURFACE ELEVATION	SOIL THICKNESS	PENNSYLVANIAN AND MISSISSIPPIAN SEDIMENTS (UNDIFFERENTIATED) DEPTH	ELEVATION	THICKNESS	GRAYDON CHERT CONGLOMERATE DEPTH	ELEVATION	THICKNESS	BURLINGTON FORMATION DEPTH	ELEVATION	THICKNESS	BUSHBERG FORMATION DEPTH	ELEVATION	THICKNESS	SNYDER CREEK FORMATION DEPTH	ELEVATION	THICKNESS	CALLAWAY FORMATION DEPTH	ELEVATION	THICKNESS	JOACHIM FORMATION DEPTH	ELEVATION	THICKNESS	ST. PETER FORMATION DEPTH	ELEVATION	THICKNESS	COTTER-JEFFERSON CITY FORMATION DEPTH	ELEVATION	THICKNESS	TOTAL DEPTH	FINAL ELEV.	BORING NUMBER
Q-42	794.9	7.0	--	--	--	7.0	787.9	23.0	--	--	--	30.0	764.9	0.7	30.7	764.2	43.0	73.7	721.2	31.3	--	--	--	--	--	--	105.0	689.9	21.0*	126.0	668.9	Q-42
Q-43	791.7	4.0	--	--	--	4.0	787.7	27.0	31.0	760.7	16.9	47.9	743.8	1.6	49.5	742.2	35.6	85.1	706.6	20.1	--	--	--	--	--	--	105.2	686.5	21.3*	126.5	665.2	Q-43
Q-44	803.1	15.5	--	--	--	15.5	787.6	23.0	--	--	--	--	--	--	38.5	764.6	39.1	77.6	725.5	43.2	--	--	--	--	--	--	120.8	682.3	22.2*	143.0	660.1	Q-44
Q-45	781.8	3.9	--	--	--	3.9	777.9	23.1	--	--	--	27.0	754.8	1.4	28.4	753.4	33.1	61.5	720.3	33.1	--	--	--	--	--	--	94.6	687.2	20.0*	114.6	667.2	Q-45
Q-46	792.6	18.0	--	--	--	18.0	774.6	7.8	--	--	--	--	--	--	25.8	766.8	38.5	64.3	728.3	39.9	--	--	--	--	--	--	104.2	688.4	19.6*	123.8	668.8	Q-46
Q-47	800.0	6.0	--	--	--	6.0	794.0	36.3	42.3	757.7	1.1	43.4	756.6	3.6	47.0	753.0	28.3	75.3	724.7	36.0	--	--	--	--	--	--	111.3	688.7	19.4*	130.7	669.3	Q-47
Q-48	788.7	1.7	--	--	--	1.7	787.0	30.3	32.0	756.7	11.8	43.8	744.9	0.4	44.2	744.5	35.2	79.4	709.3	23.4	--	--	--	--	--	--	102.8	685.9	16.6*	119.4	669.3	Q-48
Q-49	728.8	0.0	removed from quarry area			--	--	--	--	--	--	--	--	--	0.0	728.8	8.2*	8.2	720.6	35.6	--	--	--	--	--	--	43.8	685.0	4.6*	48.4	680.4	Q-49
Q-50	728.8	0.0	removed from quarry area			--	--	--	--	--	--	--	--	--	0.0	728.8	14.8*	14.8	714.0	28.2	--	--	--	--	--	--	43.0	685.8	9.0*	52.0	676.8	Q-50
Q-51	794.6	--	--	--	--	--	--	--	--	--	--	--	--	--	46.7	747.9	31.2	77.9	716.7	30.5	--	--	--	--	--	--	108.4	686.2	6.2*	114.6	680.0	Q-51
Q-52	729.5	0.0	removed from quarry area			--	--	--	--	--	--	--	--	--	0.0	729.5	6.8*	6.8	722.7	37.7	--	--	--	--	--	--	44.5	685.0	3.0*	47.5	682.0	Q-52
Q-53	728.3	0.0	removed from quarry area			--	--	--	--	--	--	--	--	--	0.0	728.3	6.6*	6.6	721.7	36.7	--	--	--	--	--	--	43.3	685.0	3.7*	47.0	681.3	Q-53
Q-54	728.7	0.0	removed from quarry area			--	--	--	--	--	--	--	--	--	0.0	728.7	18.0*	18.0	710.7	25.5	--	--	--	--	--	--	43.5	685.2	10.0*	53.5	675.2	Q-54
Q-55	726.8	0.0	removed from quarry area			--	--	--	--	--	--	--	--	--	0.0	726.8	17.9*	17.9	708.9	21.5	--	--	--	--	--	--	39.4	687.4	3.6*	43.0	683.8	Q-55
Q-56	790.9	8.0	8.0	782.9	32.2	--	--	--	--	--	--	--	--	--	40.2	750.7	28.1	68.3	722.6	36.4	--	--	--	--	--	--	104.7	686.2	9.2*	113.9	677.0	Q-56
Q-57	793.0	7.5	7.5	785.5	27.7	--	--	--	--	--	--	--	--	--	35.2	757.8	32.4	67.6	725.4	39.1	--	--	--	--	--	--	106.7	686.3	7.3*	114.0	679.0	Q-57
Q-58	795.0	18.5	18.5	776.5	38.7	--	--	--	--	--	--	--	--	--	57.2	737.8	18.7	75.9	719.1	32.1	--	--	--	--	--	--	108.0	687.0	1.2*	109.9	66[illegible].8	Q-58
Q-59	794.6	21.0	21.0	773.6	24.0	--	--	--	--	--	--	--	--	--	45.0	749.6	31.5	76.5	718.1	32.7	--	--	--	--	--	--	109.2	685.4	5.5*	114.7	679.9	Q-59
Q-60	796.2	14.0	14.0	782.2	26.0	--	--	--	--	--	--	--	--	--	40.0	756.2	30.4	70.4	725.8	39.4	--	--	--	--	--	--	109.8	686.4	7.2*	117.0	679.2	Q-60
Q-61	797.1	--	--	--	--	--	--	--	--	--	--	--	--	--	39.5	757.6	31.4	70.9	726.2	39.7	--	--	--	--	--	--	110.6	686.5	8.4*	119.0	678.1	Q-61
Q-62	798.1	18.0	18.0	780.1	29.4	--	--	--	--	--	--	--	--	--	47.4	750.7	30.0	77.4	720.7	32.2	--	--	--	--	--	--	109.6	688.5	3.3*	112.9	685.2	Q-62
Q-63	795.6	19.0	19.0	776.6	24.8	--	--	--	--	--	--	--	--	--	43.8	751.8	29.0	72.8	722.8	35.9	--	--	--	--	--	--	108.7	686.9	2.3*	111.0	684.6	Q-63
Q-64	788.1	16.5	16.5	771.6	22.5	--	--	--	--	--	--	--	--	--	39.0	749.1	26.2	65.2	722.9	36.9	--	--	--	--	--	--	102.1	686.0	15.9*	118.0	670.1	Q-64
Q-65	726.5	0.0	removed from quarry area			--	--	--	--	--	--	--	--	--	0.0	726.5	11.2	11.2	715.3	29.6	--	--	--	--	--	--	40.8	685.7	3.5*	44.3	682.2	Q-65
Q-66	715.0	0.0	removed from quarry area			--	--	--	--	--	--	--	--	--	--	--	--	0.0	715.0	30.8	--	--	--	--	--	--	30.8	684.2	7.2*	38.0	677.0	Q-66

TABLE 2.5-47 SURFACE WAVE CHARACTERISTICS

LOCATION	OBSERVED WAVE	PROBABLE WAVE TYPE	PREDOMINANT WAVE MOTION	APPARENT VELOCITY (FT/SEC)	FREQUENCY (HERTZ)	OBSERVED LENGTH OF WAVE TRAIN (CYCLES)
Plant Site	1	Coupled with Rayleigh M_1 type motions	Radial	7800	13-16	6-8
Plant Site	2	Coupled with Rayleigh M_1 type motions	Radial	500-700	6-8	8-9
Dam Site	1	Coupled with Rayleigh M_1 type motions	Radial-Transverse	7600	10-13	10
Dam Site	2	Coupled with Rayleigh M_1 type motions	Radial-Transverse	500-700	7-9	8-10

TABLE 2.5-48 AMBIENT GROUND MOTION MEASUREMENTS

LOCATION	FREQUENCY (HERTZ)	GAIN*	GROUND MOTION IN INCHES x 10^{-3} RADIAL	VERTICAL	TRANSVERSE
Plant Site	3.2 to 4.8	Dx2000	.001	.001	.0018
(Boring P-1)	--	Ax2000	nil	nil	nil
	2.6, 3.6, 5.6	Vx2000	.2	nil	.25
Dam Site	--	Dx2000	nil	nil	nil
(Boring R-2)	--	Ax2000	nil	nil	nil
	2.8, 3.6, 5.4	Vx2000	.018	nil	.015

* D = Displacement (inches)
A = Acceleration (inches/second/second)
V = Velocity (inches/second)

TABLE 2.5-49 BEARING CAPACITY FACTOR OF SAFETY

BUILDING	ELEVATION (MSL)	MAXIMUM APPLIED STATIC PRESSURE (psf)	STATIC MINIMUM FACTOR OF SAFETY	MAXIMUM APPLIED STATIC PLUS DYNAMIC PRESSURE (psf)	MINIMUM STATIC AND DYNAMIC FACTOR OF SAFETY
Reactor Building	810	7,500[a]	4.5	20,000[c]	2.1
Auxiliary/Control Building	808.5	7,900[b]	4.0	13,800[b]	2.3
Fuel Building	834	10,600[a]	6.6	30,700[d]	3.7
Diesel Generator Building	830	5,300[a]	12.6	19,000[a]	3.2
UHS Cooling Towers and Electrical Rooms	832 to 836.5	2,500[b]	15.4	11,500[b]	4.5
ESWS Pumphouse	806.8 and 836.3	6,300[b]	4.3	16,900[b,e]	2.1

[a] Bechtel Power Corporation, 1979a.
[b] Bechtel Power Corporation, 1979d.
[c] Bechtel Power Corporation, 1976.
[d] Bechtel Power Corporation, 1979c.
[e] Bechtel Power Corporation, 1979e.

TABLE 2.5-50 ESTIMATED TOTAL SETTLEMENTS

	FOUNDATION DESIGN LOADS[a,b] (ksf)	ESTIMATED SETTLEMENT[b] (inches)
Fuel Building	10.6[c]	1/2 to 1
Diesel Generator Building	4.5[d]	1/2 to 3/4
Control Building	5.0[d]	1/2 to 3/4
Auxiliary Building	5.0[d]	1/2 to 3/4
Reactor Building	7.0[d]	1/2 to 1
ESWS Pumphouse	6.3[e]	1/2 to 3/4
UHS Cooling Towers	2.5[e]	1/4 to 1/2

a Values are maximum edge pressures. These values were used in the settlement analyses as uniform loads except for the fuel building, which utilized the pressure distribution for the highest loading condition averaged over the building area.

b See Table 2.5-55 for foundation loads or estimated settlement which supersede values shown in this Table.

c Bechtel Power Corporation, 1979b.

d Bechtel Power Corporation, 1979a.

e Bechtel Power Corporation, 1979d.

TABLE 2.5-51 LATERAL EARTH PRESSURES CATEGORY I GRANULAR STRUCTURAL BACKFILL

	EFFECTIVE LATERAL EARTH PRESSURE COEFFICIENT	TOTAL EQUIVALENT FLUID PRESSURE BELOW WATER TABLE (psf/ft depth)	INCREMENTAL DYNAMIC EQUIVALENT FLUID PRESSURE (psf/ft depth)	EFFECTS OF SURCHARGE,q
Static:				
At rest Pressure	0.33	92	--	0.33q[a]
Active Pressure	0.20	80	--	0.20q[a]
Dynamic (Incremental to static parameters) SSE=0.20g:				
At rest Pressure	0.17	--	30	0.30q[b]
Active Pressure	0.12	--	25	0.30q[b]
Dynamic (Incremental to static parameters) OBE=0.12g:				
At rest Pressure	0.10	--	18	0.18q[b]
Active Pressure	0.06	--	14	0.18q[b]

a Uniform earth pressure distribution.

b The maximum dynamic earth pressure along the wall should be placed at the top of the wall so that the dynamic earth pressure distribution is an inverted triangle.

c Based on a saturated unit weight of 150 pcf and an angle of internal friction of 42°.

TABLE 2.5-52 MINIMUM/MAXIMUM/AVERAGE THICKNESSES OF SOIL AND ROCK UNITS AT THE UHS RETENTION POND AS DETERMINED BY TEST BORINGS

STRATUM	MINIMUM (feet)	MAXIMUM (feet)	AVERAGE (feet)
Modified loess	3	10	8
Accretion-gley	5	19	12
Glacial till	5	13	9
Graydon chert	--	--	28
Lithified bedrock formations	--	--	51

TABLE 2.5-53 SUMMARY OF CONDITIONS STUDIED

CASE	CONDITION	POND LEVEL ELEVATION	GROUND WATER ELEVATION	STRENGTH PARAMETERS	COMMENTS
1	End of Construction	817	825	Total + Effective	In-situ Properties of Accretion-gley
2	End of Construction	817	825	Total + Effective	250 psf surcharge at crest
3	Maximum Pond	836	836	Total + Effective	
4	Maximum Pond	836	836	Total + Effective	250 psf surcharge at crest
5	Partial Pond	823	825	Total + Effective	
6	Earthquake Maximum Pond	836	836	Total	SSE = 0.25 g
7	Earthquake Partial Pond	823	825	Total	SSE = 0.25 g

TABLE 2.5-54 FACTORS OF SAFETY

		TOTAL STRESS ANALYSIS[ab]		EFFECTIVE STRESS ANALYSIS		
CASE	CONDITION	SECTION X-X'	SECTION Y-Y'	SECTION X-X'	SECTION Y-Y'	REQUIRED
1	End of excavation	5.4	6.3	2.5	2.2	1.4
2	Excavation, 250 psf surcharge	5.0	5.8	2.4	2.1	1.4
3	Maximum pond level	7.0	9.5	3.0	3.7	1.5
4	Maximum pond 250 psf surcharge	5.7	8.5	2.9	3.2	1.5
5	Partial pond level[c]	5.5	6.1	2.6	2.6	1.5
6	Earthquake, maximum pond	2.2	2.3	Not applicable		1.1
7	Earthquake, partial pond	2.0	2.1	Not applicable		1.1

a The total stress analysis was performed using a preliminary undrained shear strength value of 3,000 pounds per square foot for the Graydon chert conglomerate, as opposed to the final value of 4,500 pounds per square foot shown in Table 2.5-15. It was not felt necessary to repeat the analysis using the higher strength value since the results obtained would provide an equal or higher factor of safety.

b The total stress analysis for Cases 3 through 7 were performed using an undrained shear strength of 1,600 pounds per square foot for the accretion-gley as opposed to 2,900 pounds per square foot shown in Table 2.5-15. This strength reduction allows for anticipated swelling of the accretion-gley after construction.

c Additional partial pond level analyses were performed by effective stress analysis, assuming that ground-water level remained at elevation 836 feet while the water level in the pond was drawn down to elevation 819 feet. The resulting minimum factors of safety for Sections X-X' and Y-Y' were 2.2 and 2.3, respectively.

TABLE 2.5-55 ESTIMATED, MEASURED, AND ALLOWABLE SETTLEMENTS

STRUCTURES	FOUNDATION DESIGN LOAD (ksf)	ESTIMATED SETTLEMENT (inches)	SETTLEMENT MONITORING PROGRAM			
			PLATE NUMBER	DATE OF FIRST READING	MEASURED SETTLEMENT[a] (inches)	ALLOWABLE SETTLEMENT[b] (inches)
Containment	7.5[c]	0.5 to 1.0	AZ 50°	1/31/78	0.86	1.5
		0.5 to 1.0	AZ 135°	1/31/78	1.34	1.5
		0.5 to 1.0	AZ 225°	1/31/78	0.89[d]	1.5
		0.5 to 1.0	AZ 315°	1/31/78	0.47[d]	1.5
		0.5 to 1.0	AZ 270°	9/4/85	nil[e]	1.5
Auxiliary Building	7.9[c]	0.5 to 1.0[c]	A-1	10/25/78	0.53	1.0
		0.5 to 1.0[c]	A-2	10/25/78	0.37	1.0
		0.5 to 1.0[c]	A-3	8/28/79	0.25	1.0
Control Building	7.9[c]	0.5 to 1.0[c]	C-1	8/24/79	nil	1.0
Diesel Generator Building	5.3[c]	0.5 to 1.0[c]	D-1	8/24/79	0.13	1.0
		0.5 to 1.0[c]	D-2	8/24/79	0.17	1.0
		0.5 to 1.0[c]	D-3	8/24/79	0.23	1.0
Fuel Building	10.6[f]	0.5 to 1.0	F-1	8/24/79	0.86	1.75
		0.5 to 1.0	F-2	8/24/79	0.74	1.75
		0.5 to 1.0	F-3	8/24/79	0.83	1.75
		0.5 to 1.0	F-4	8/24/79	1.16	1.75
UHS Cooling Tower No. 1	2.5	0.25 to 0.5	UHS 11	10/25/78	0.31	1.0
		0.25 to 0.5	UHS 12	10/25/78	0.40	1.0
		0.25 to 0.5	UHS 13	10/25/78	0.61	1.0
		0.25 to 0.5	UHS 14	10/25/78	0.50	1.0
ESWS Pumphouse	6.3	0.5 to 0.75	E-1	6/23/79	0.31	1.0
		0.5 to 0.75	E-2	5/22/79	0.22	1.0
		0.5 to 0.75	E-3	4/21/79	0.14	1.0
		0.5 to 0.75	E-4	4/21/79	0.35	1.0

a Measured settlement as of August 1995.

b Settlements indicated do not necessarily represent the maximum recorded settlements that can be accepted. Rather, they represent values that, when exceeded, should be reviewed by the engineer.

c Foundation load or estimated settlement supersede values presented in Table 2.5-50 of the FSAR Site Addendum, Revision 0.

d Measured settlement as of 1/31/81. Settlement plate currently not used due to poor access.

e This settlement plate established to use in lieu of the plates at AZ 225° and AZ 315°, which have poor access.

f Maximum corner pressure; building was divided into parts with average loads for settlement analysis.