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2.0 SITE AND ENVIRONMENT

Information presented in this section was used to develop criteria for storm, flood, and earthquake protection and to evaluate site characteristics affecting routine and accidental releases of radioactive liquids and gases to the environment. Field programs to investigate geology and seismology have been completed. A meteorological program on site commenced in April 1967 and continued until April 1969. Environmental radiological monitoring programs and ecological monitoring and research programs have been continued from prior to Unit 1 criticality until the present.

The site is in east central Wisconsin on the west shore of Lake Michigan approximately 30 miles SE of Green Bay and about 90 miles NNE of Milwaukee. Cooling water is drawn from an intake crib located 1750 feet offshore in Lake Michigan. Farming is the predominant activity in this sparsely populated area of the state. The plant is situated in a productive dairy farming and vegetable canning region; however, the area is heavily industrialized to the south in Two Rivers and Manitowoc, and to the west in the Fox River Valley.

Soil and subsurface layers have a high clay content which inhibits percolation and drainage to Lake Michigan. The site is well ventilated and not subject to severe persistent inversions. While tornadoes occur in the region, none have been reported to affect the lakeshore directly. High winds (on the order of 108 mph) can be expected once in 100 years from storms.

Upper glacial till or underlying lake deposits on the site provide a suitable foundation for plant structures other than reactor containment. To minimize differential settlement between adjacent structures, the reactor containments and spent fuel pool are supported on steel H piles driven to refusal in the underlying bedrock. A horizontal ground acceleration of 0.06 gravity combined with a vertical acceleration of 0.04 gravity is used for the earthquake design criteria at the site based on a report by John A. Blume and Associates. Site geological investigations were performed by Dames and Moore. Harza Engineering Company and Sargent and Lundy Engineers were consultants for hydrologic and hydraulic studies. Analysis of the environmental data was performed by NUS Corporation, Sargent and Lundy Engineers, and Murray and Trettel Inc.

2.1 SITE LOCATION AND BOUNDARIES

The site is in the Town of Two Creeks in the northeast corner of Manitowoc County, Wisconsin, on the west shore of Lake Michigan about 30 miles southeast of the center of the city of Green Bay, and 90 miles NNE of Milwaukee. It is located at longitude 87° 32.5′W and latitude 44° 17.0′N. Its location is shown in Figure 2.2-1. The international boundary between Canada and the United States is approximately 200 miles NE of the site.

The site comprises approximately 1260 acres, all of which is owned by NextEra Energy Point Beach.

Figure 2.2-2 shows the general topography of the region out to 50 miles. A site topographic map covering details out to a 5 mile radius is shown in Figure 2.2-2A. Figure 2.2-3 is a site plot depicting the site details, boundaries, and structures.

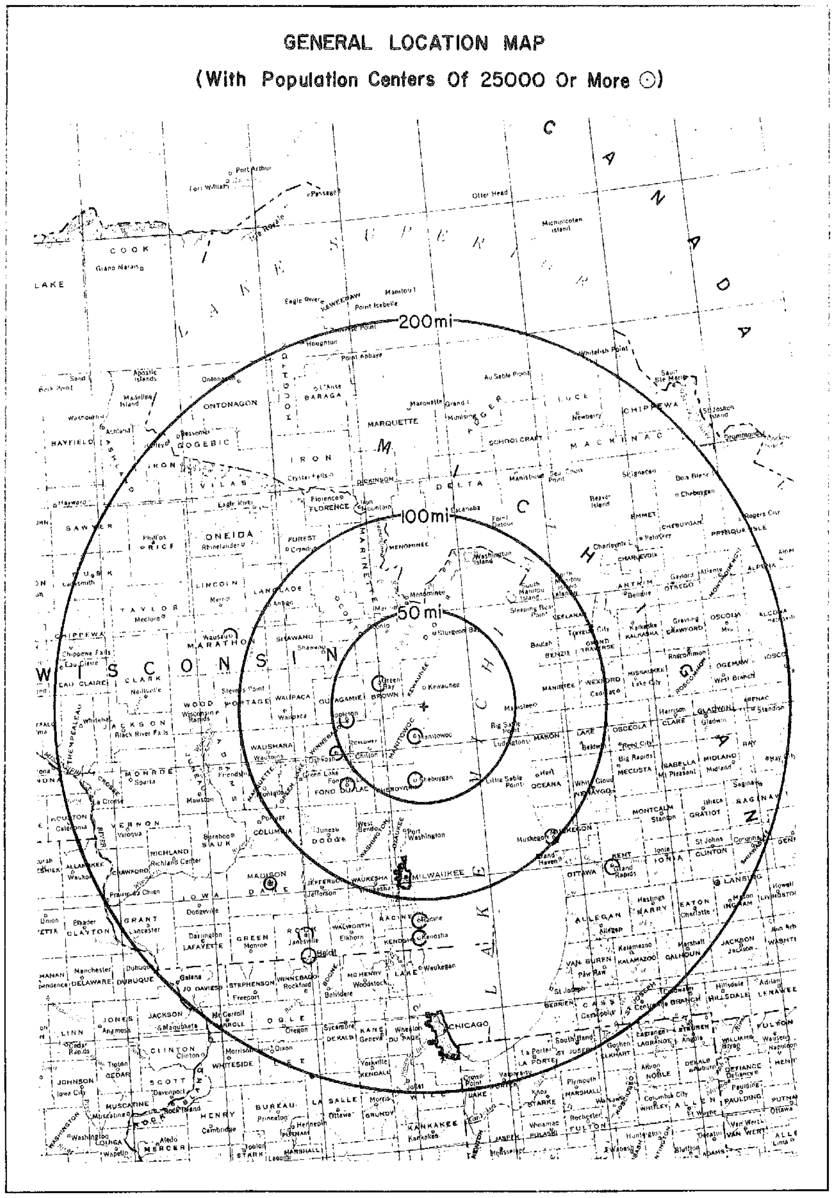
2.2 TOPOGRAPHY

Overall ground surface at the site of the Point Beach Nuclear Plant is gently rolling to flat with elevations varying from 3 to 58 feet above Plant Datum. Subdued knob and kettle topography is visible from aerial photographs. The land surface slopes gradually toward the lake from the higher glacial moraine areas west of the site. Higher ground adjacent to the lake, however, diverts the drainage to the north and south.

The major surface drainage features are two small creeks which drain to the north and south. One creek discharges into the lake about 1500 feet north of the northern corner of the site and the other near the center of the site. During the spring, ponds of water occupy many shallow depressions. Site drainage is poor due to the high clay content of the soil combined with the pock-marked surface.

Low bluffs face the Lake Michigan shore with evidence of marked erosion near the center of the site. At this point the beach is narrow (ranging in width from 20 to 50 feet) with bare mud slopes showing active erosion due to lake storms. In this area, shoreline recession ranges from 2 ½ (Reference 1) to 5 feet per year. Special protection is provided to control further recession of the shoreline at the site.

Figure 2.2-1 GENERAL LOCATION MAP



GENERAL LOCATION MAP
FIG. 2.2-1

Figure 2.2-2 GENERAL TOPOGRAPHY MAP

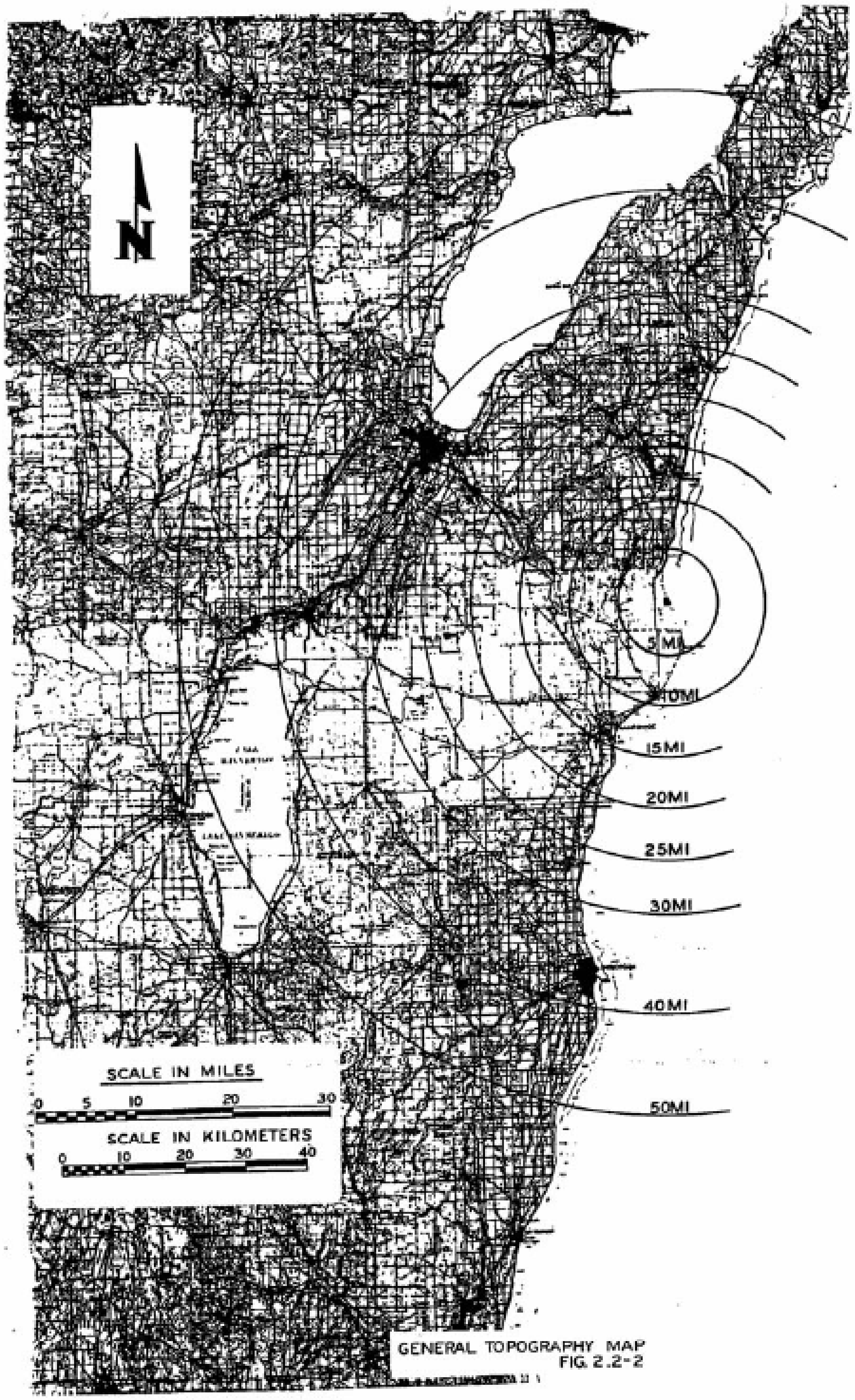


Figure 2.2-2A GENERAL TOPOGRAPHY MAP

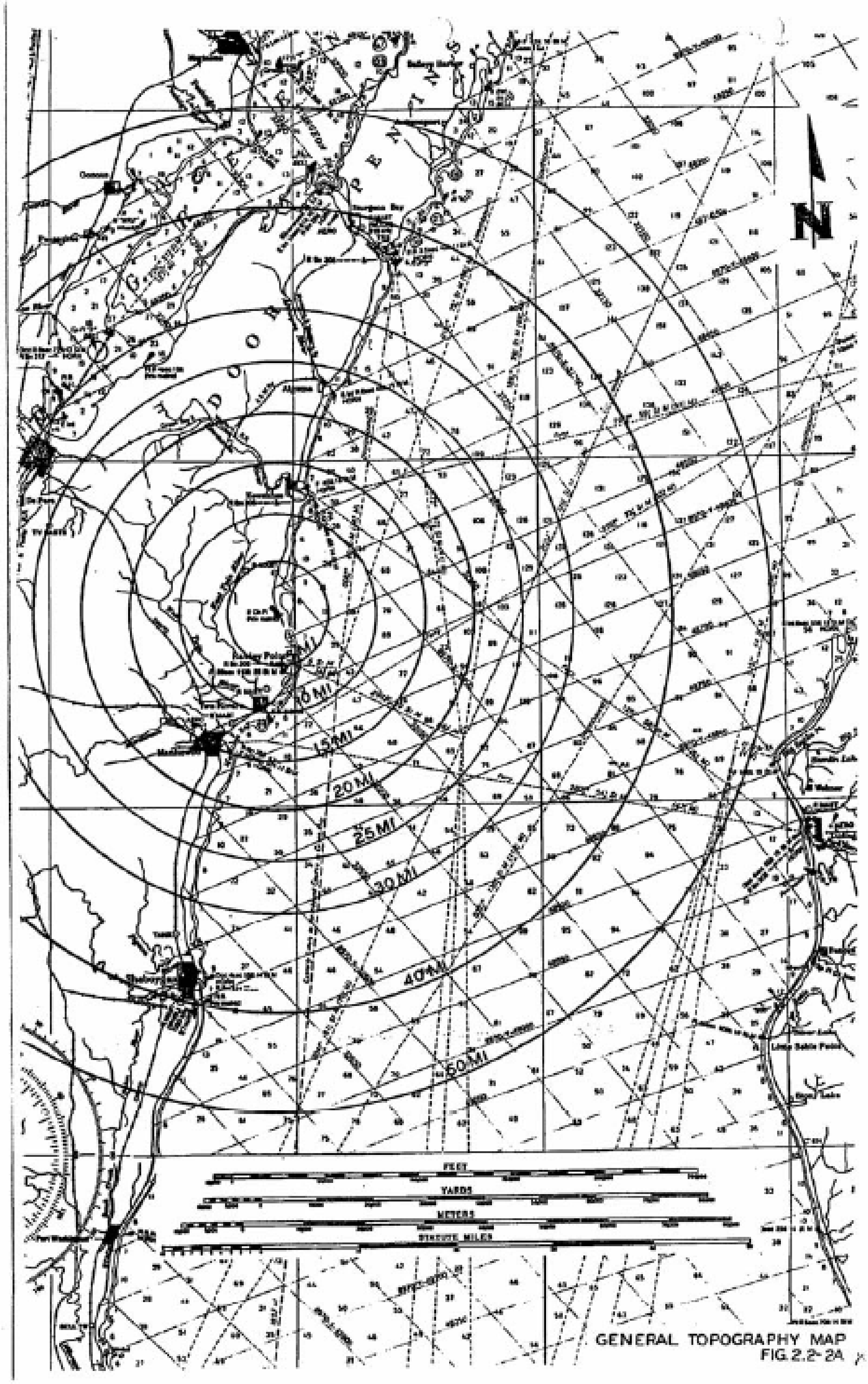


Figure 2.2-3 SITE TOPOGRAPHY MAP

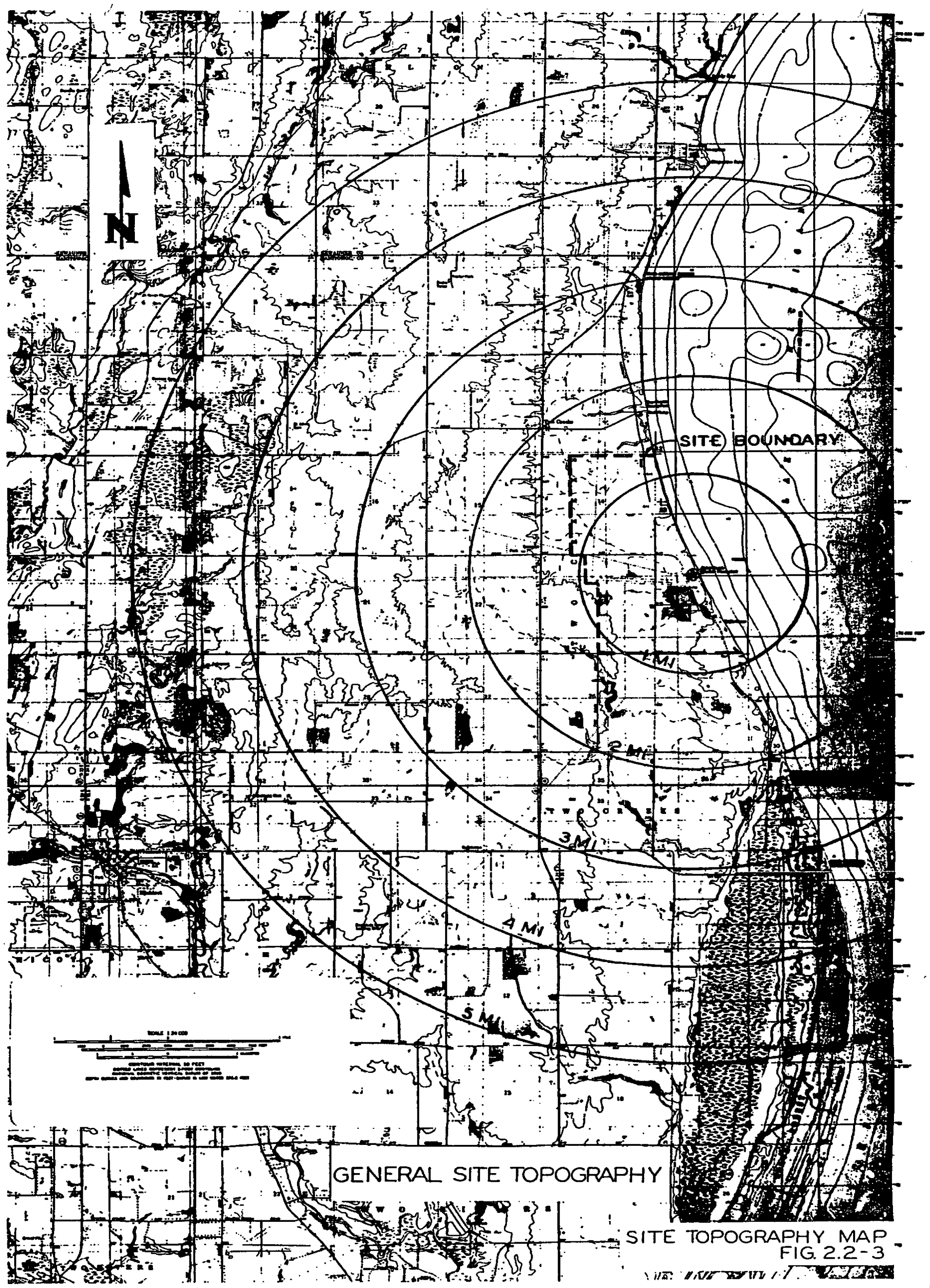


Figure 2.2-4 UNITS 1 & 2 SITE PLAN

2.3 POPULATION

Figure 2.2-1 depicts population centers of over 25,000 people within a radius of 100 miles of the site. The nearest population centers of 25,000 or more are Manitowoc (13 miles SSW of the site) with 32,547 people, Green Bay (27 miles NW of the site) with 87,899 people, Appleton (43 miles West of the site) with 53,531 people, and Sheboygan (36 miles SSW of the site) with 48,085 people. There are no other population centers greater than 25,000 people that lie within 50 miles of the site. Milwaukee, with a population of 636,210 lies 90 miles SSW of the site. All population figures are according to the 1980 Census.

Figure 2.3-1 shows the 1980 and projected (1990, 2000, 2010, 2020) population distribution in 16 directional sectors centered on the site and within 1, 2, 3, 4, and 5 mile radii. Figure 2.3-2 shows similar information for 5, 10, 20, 30, and 40 miles.

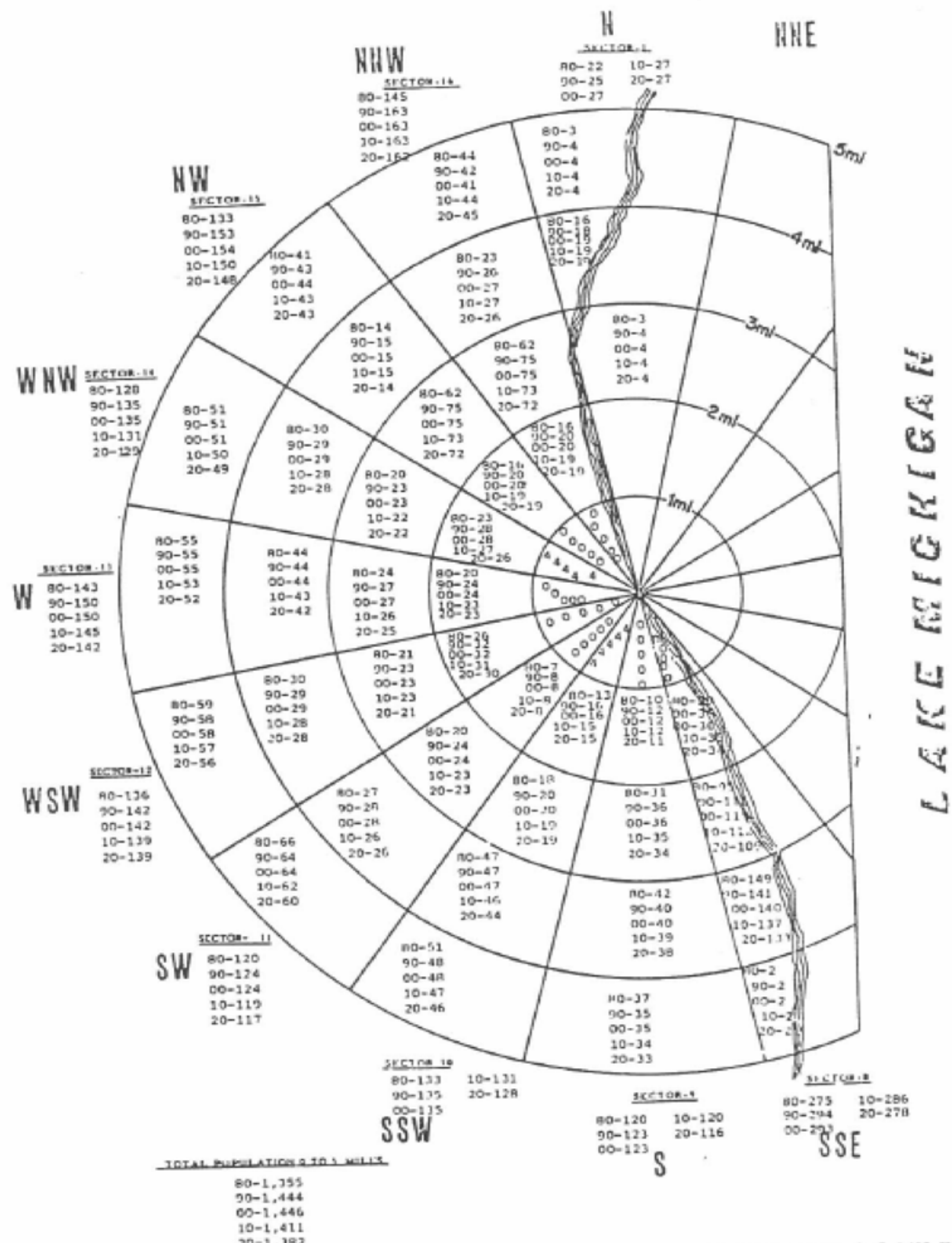
The population estimates in Figure 2.3-1 are based on population figures obtained in the 1980 U.S. Census. This information was applied to a series of 7.5 minute topographic maps of the area. These maps were developed by the United States Geological Survey in cooperation with the Wisconsin Division of Highways and Wisconsin Geological and Natural History Survey, and are based on aerial photographs.

Population projections for the years 1990, 2000, 2010, and 2020 were derived from the document "Wisconsin Population Projections 1980-2020," Fifth Edition, June 1988. This document was prepared by the Demographic Services Center of the Wisconsin Department of Administration in cooperation with the Applied Population Laboratory of the University of Wisconsin - Madison.

Population increase due to summertime cottage occupants in the vicinity of the site is minimal. These cottages are limited to the SSE and N sectors along the lake shore. There are 24 cottages between 1 to 4 miles SSE of the site and one cottage 4 to 5 miles north of the site. Projection of these summertime residents to 2020 is difficult, but a conservative increase by 100% would result in a total of 200 people. Additionally, in Point Beach State Forest, 127 individual campsites and two group campsites are located 3 to 7 miles S and SSE from the site.

The closest approach of the plant site boundary is about 1200 meters (3900 feet) from either reactor. This is defined as the exclusion radius for this site. The nearest population center having a population in excess of 25,000 is the Two Rivers-Manitowoc area which has an outer boundary approximately 12,000 meters (7 1/2 miles) from the plant. As defined in 10 CFR 100, the population center distance shall be not closer than 1 1/3 times the low population zone distance. Because of the relatively small number of people between the site boundary and the population center of Two Rivers-Manitowoc, the outer boundary of the low population zone for this site is defined as 9000 meters (5.6 miles). Analysis of predicted population and existing roads shows that the total number and density of the residents within the low population zone is such that there is a reasonable probability that appropriate protective measures could be taken in their behalf in the event of a serious accident.

Figure 2.3-1 POPULATION DISTRIBUTION 0-5 MILES



POPULATION DISTRIBUTION, 0-5 MILES
FIG. 2.3-1

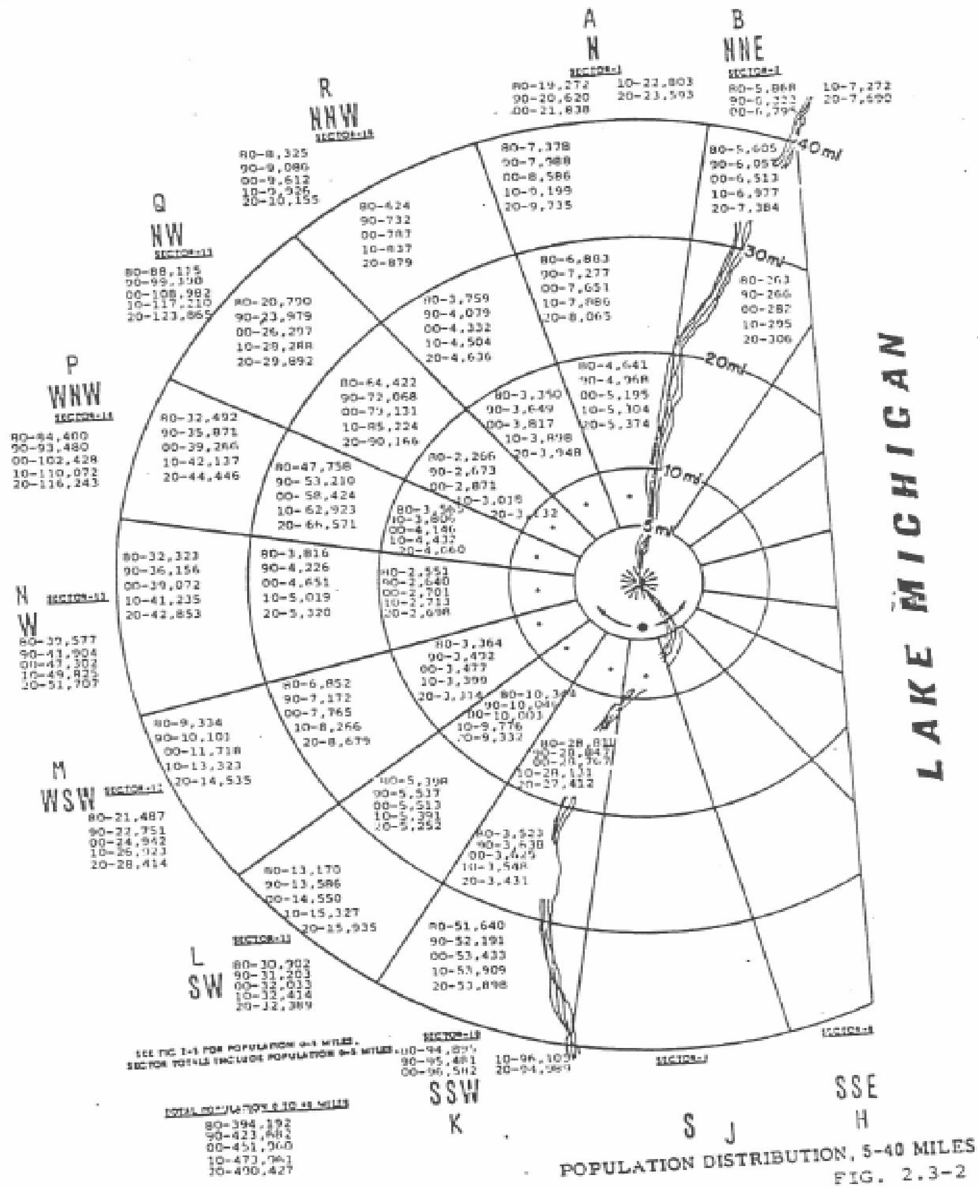
Revision 1

1988

Figure 2.3-2 POPULATION DISTRIBUTION 5-40 MILES

* 5-10 Miles

	1980	1990	2000	2010	2020
S-9	4,013	3,969	3,951	3,863	3,766
S-10	10,788	10,670	10,622	10,386	10,120
S-11	1,870	1,850	1,843	1,801	1,753
S-12	1,801	1,844	1,840	1,796	1,751
S-13	744	732	728	713	694
S-14	461	458	457	449	437
S-15	504	517	529	530	527
S-16	447	493	513	524	530
S-1	340	362	379	387	392



POPULATION DISTRIBUTION, 5-40 MILES
FIG. 2.3-2

Revision 1 1988

2.4 LAND USE

Regional Land Use

Manitowoc County, in which the site is located, and adjacent counties of Kewaunee, Brown, Calumet, and Sheboygan are predominantly rural. Agricultural pursuits account for approximately 90% of the total county acreage with individual farms ranging in average size from 110-124 acres. Dairy products and livestock account for 85% of the counties farm production with field crops and vegetables accounting for most of the remainder. The principal crops are grain corn, silage corn, oats, barley, hay, potatoes, green peas, lima beans, snap beans, beets, cabbage, sweet corn, cucumbers, sunflowers, and cranberries. Agricultural receipts in the five county area amounted to about $77,000,000 in 1963 according to the Wisconsin Department of Natural Resources and the Wisconsin Department of Agriculture. Within a 20 mile radius of the site there are approximately 11 dairy plants in Manitowoc County and approximately 4 in Kewaunee County.

More than one-third of the workers residing in the five county area were engaged in manufacturing operation; one-eighth were occupied in agriculture; about two-fifths in service industries. The remainder are in all other occupations according to 1960 statistics of the Wisconsin Department of Natural Resources.

Brown County, northwest of Manitowoc County and Outagamie County farther west are the centers of a large paper making industry on the Fox River. Heavy manufacturing is found in Manitowoc, Two Rivers, and Sheboygan. Representative industries at the time of license application in a 20 mile radius of the site are listed in Table 2.4-1.

Local Land Use

The region within a radius of 5 miles of the site is presently devoted exclusively to agriculture. During 1965, approximately 1390 acres of cash crops (peas and snap beans) were produced and sold to Lakeside Cannery in Manitowoc. Within the township of Two Creeks surrounding the site (15 sq. miles) there are about 800 producing cows on about 40 dairy farms. Some beef cattle are raised 2.5 miles north of the site. Cows are on pasture from the first of June to late September or early October. During the winter, cows are fed on locally produced hay and silage. Of the milk produced in this area, about 25% is consumed as fluid milk and 50% is converted to cheese, with the remainder being used in butter making and other by-products. In accordance with the Environmental Manual (EM), a visual verification of grazing animal population in the vicinity of the site boundary is conducted annually. This verification provides assurance that the selection of sampling locations remain as conservative as practicable.

The Kewaunee Nuclear Power Plant is located 4.5 miles N of the Point Beach site.

At the time of plant construction, the buildings within the exclusion area were farm complexes consisting of a residence, a major barn or barns for livestock, and miscellaneous out-buildings. Buildings in poor condition and not worthy of continued maintenance were razed. Existing residences in one or two cases were repurchased by the original owner and removed from the exclusion area. The remaining residences in good condition were to have been offered for rent to

employees of the Licensee. Those employees who take up residence within the exclusion area will do so under an immediate evacuation agreement.

Existing buildings may be offered for rent to local area farmers for use only for crop and machinery storage. Livestock will not be housed in the buildings.

The above policy is compatible with the Licensee’s plans for continued crop land and pasture and use of all areas within the exclusion boundary except the inner operating area inside the chain link fence.

As indicated earlier, the closest occupied residence off-site is at least 3/4 miles from the plant.

Table 2.4-1 TYPICAL INDUSTRIES IN REGION AT THE TIME OF LICENSE APPLICATION

Sheet 1 of 2

Company	Product	City and Location Manitowoc County
Aluminum Specialty Co.	Aluminum Cookware	Manitowoc, 15 miles SW
Anheuser-Busch, Inc.	Barley Malt	Manitowoc, 15 miles SW
Burger Boat Co., Inc.	Aluminum and Steel Boats	Manitowoc, 15 miles SW
Canada Dry Bottling Co.	Carbonated Beverages	Manitowoc, 15 miles SW
Cher-make Sausage Co.	Sausages	Manitowoc, 15 miles SW
Consumers Steel and Dock Co.	Alum. and Steel Fabrication	Manitowoc, 15 miles SW
Dick Bros. Bakery Co.	Bakery Products	Manitowoc, 15 miles SW
Fischl Ice Cream and Dairy Co.	Ice Cream and Dairy Products	Manitowoc, 15 miles SW
Great Atlantic and Pacific Tea Co.	Evaporated Milk, Ice Cream (White House Milk Division)	Manitowoc, 15 miles SW
Heresite and Chemical Co.	Phenolic Resins	Manitowoc, 15 miles SW
Imperial-Eastman Corp. (Eastman Division)	Brass and Steel Fittings	Manitowoc, 15 miles SW
Invincible Metal Furniture Co.	Steel Office Furniture	Manitowoc, 15 miles SW
Kornely Guernsey Farm Dairy	Milk	Manitowoc, 15 miles SW
Lake to Lake Dairy	Dairy Products	Manitowoc, 15 miles SW
Lakeside Packing Co.	Vegetable Canning	Manitowoc, 15 miles SW
Manitowoc Bottling Works	Soda Water	Manitowoc, 15 miles SW
Manitowoc Engineering Co.	Lift Cranes and Shovels	Manitowoc, 15 miles SW
Manitowoc Shipbuilding, Inc.	Ship Construction	Manitowoc, 15 miles SW
Manitowoc Portland Cement	Cement	Manitowoc, 15 miles SW
Mirro Aluminum Co.	Cooking Utensils, Giftware	Manitowoc, 15 miles SW
Northern Laboratories	Toiletries	Manitowoc, 15 miles SW
A. M. Richter Sons, Co.	Vinegars	Manitowoc, 15 miles SW

Table 2.4-1 TYPICAL INDUSTRIES IN REGION AT THE TIME OF LICENSE APPLICATION

Sheet 2 of 2

Company	Product	City and Location
		Manitowoc County
Sorge Ice Cream and Dairy Co.	Cottage Cheese, Ice Cream, Grade A Milk	Manitowoc, 15 miles SW
Weyerhauser Co.	Fiber Shipping Containers	Manitowoc, 15 miles SW
Yindra's Home Bakery	Bakery Products	Manitowoc, 15 miles SW
Eggers Plywood Co.	Plywood Manufacturing	Two Rivers, 9 miles SW
Formrite Tube Co.	Formed Tube Assemblies	Two Rivers, 9 miles SW
Hamilton Mfg. Co.	Automatic Washers and Driers	Two Rivers, 9 miles SW
Kahlenberg Bros. Co.	Marine Engines and Parts	Two Rivers, 9 miles SW
Paragon Electric Co., Inc.	Electric Timers	Two Rivers, 9 miles SW
Schwartz Mfg. Co.	Food Filter Bags	Two Rivers, 9 miles SW
Two Rivers Beverage Co.,	Inc. Beer and Soda Water	Two Rivers, 9 miles SW
Foremost Dairies, Inc.	Concentrated Whey	Mishicot, 7 miles WSW
Mishicot Modern	Dairy American Cheese	Mishicot, 6 miles WSW
Two Creeks Dairy	American Cheese	Two Creeks, 2 miles NW
		Kewaunee County
Frank Hamachek Machine Co.	Special Machinery and Castings	Kewaunee, 11 miles N
Kewaunee Engineering Corp.	Steel Fabrications	Kewaunee, 11 miles N
Kewaunee Orange Crush Bottling	Soft Drinks	Kewaunee, 11 miles N
Leyse Aluminum Co.	Aluminum Products	Kewaunee, 11 miles N
		Brown County
Lake to Lake Dairy Corp.	Milk Receiving Station, Butter, Powdered Milk	Denmark, 15 miles WNW

2.5 HYDROLOGY

Lake Michigan is the source of cooling water to the Point Beach Nuclear Plant. All radioactive liquid wastes generated at the plant are collected and monitored before discharge from the site in accordance with 10 CFR 20. Radioactivity levels do not exceed permissible concentrations at the cooling water outlets. Additional dilution is available due to the large volume of water in Lake Michigan and a minimum distance of 12 miles to the nearest potable water intake. Protection of the plant is provided against flooding, waves, and storms as well as ice build-up along the shore.

2.5.1 GENERAL LAKE HYDROLOGY

Lake Michigan is the third largest of the Great Lakes. It is 307 miles long from north to south and has an average width of 70 miles. It has a maximum depth of 923 feet, an average depth of 325 feet, and covers an area of 22,400 square miles. The total volume of water in Lake Michigan is approximately 1,400 cubic miles. The water level in Lake Michigan depends primarily on the runoff from the drainage basin.

In the general vicinity of the site, the 30-foot depth contour of the lake is between 1.0 and 1.5 miles, and the 60-foot depth contour is 3.0 to 3.5 miles from the shore.

Plant Datum

Plant Datum (plant elevation zero) is defined as 580.2 feet above the International Great Lakes Datum of 1955 (IGLD 1955), and is equal to 580.9 feet IGLD 1985, the datum currently used by the U.S. Army Corps of Engineers to report Lake Michigan water level. IGLD 1985 replaced IGLD 1955 in January 1992; the IGLD year refers to the central year of the data set used to determine the datum, not the year in which it was adopted. Elevations in the FSAR are relative to the Plant Datum unless otherwise noted. (Reference 19)

Thermal Stratification

The temperature stratification and circulation patterns of water in Lake Michigan have very distinct characteristics, as follows:

At the beginning of March, a warming trend starts in the lake water and at the end of May all of the water in the lake has reached approximately 40°F, which is the temperature of maximum water density. Until the temperature reaches this point, the surface water is colder than the deeper water in the lake; the colder surface water, which remains at approximately 34°F, is lighter than the 40°F deeper water. This layer of colder water circulates on the surface of the warmer deep water, reaching depths of 25 to 30 feet from the surface.

When all the water in the lake reaches approximately 40°F, the thermocline layer disappears and complete mixing of all the water in the lake takes place. However, when the ambient air temperature warms up the surface water, a thermocline layer is formed again at depths of 30 to 50 feet from the surface. This occurs from May to July and at this time parts of the water in the lake reach 65°F to 70°F. Consequently, the warmer and lighter surface water circulates above the denser and relatively stagnant 40°F water at the bottom of the lake. This condition continues until a cooling trend starts in September, reaching a peak about the last part of January, at which time the water in the lake again reaches an overall temperature of 40°F. At this time, complete mixing of the waters in the lake takes place until a colder and lighter layer of surface water starts to build up.

Currents (Reference 2)

Surface currents in Lake Michigan are generated primarily by wind stress on the water surface. The lake surface wind-driven currents have speeds averaging 1 to 2% of the wind speeds. Thus, an average wind speed of 15 mph over the lake would generate an average surface current of about 0.15 to 0.3 mph. Such currents may persist for several days after the wind has died down. On large water surfaces, the wind-driven current is theoretically 45° to the right of the wind vector, due to the rotation of the earth. On the west side of Lake Michigan, the current is largely parallel to the shore and more nearly 22° to the right of the prevailing wind. The predominant current direction near the western shore during the period of greatest stratification is in the northerly direction. However, temporary reversals of the general trend may take place. (Reference 3)

Current velocity was measured (Reference 4) at 20-minute intervals from August to October, 2 miles off the coast of Sheboygan. The measurements were taken from the surface of the lake down to the 30-foot depth. The following persistence patterns for different current velocities were observed:.

Current Velocity (ft/sec)	Persistence (% of the time)
0 - 0.5	68
0.6 - 0.7	10
0.8 - 0.9	12
1.0 or higher	10

It is fairly certain that this pattern does not differ greatly during the other months of the year.

Littoral Drift

Waves are responsible for most of the littoral drift on Lake Michigan. In this specific area, the predominant drift appears to be to the north. Under unfavorable conditions, littoral drift may have a pronounced effect on the advance or retreat of certain shore lines.

Ground Water

The subsurface water table at the site has a definite slope eastward toward the lake. The gradient indicated by test drilling on the site is approximately 30 feet per mile. It is, therefore, extremely unlikely that any accidental release of radioactivity on the site could spread inland. Furthermore, the rate of subsurface flow is small due to the relative impervious nature of the soil and will not promote the spread of accidental releases (Reference 24).

In addition to the ground water table, an upper aquifer composed of glacial drifts and recent deposits exists at depths ranging from +31 to -33 feet in respect to the plant elevation zero. A lower (bedrock) aquifer can be found at -81 to -38 feet. The bedrock aquifer in the general site region is known to produce saline water, hence that aquifer is usually not used for potable water supplies. Such supplies are taken from the upper aquifer or from the lake.

Potable Water Sources

Lake Michigan is used as the source of potable water supplies in the vicinity of the site for the cities of Two Rivers (12 miles south), Manitowoc (13 miles SSW), Sheboygan (40 miles south), Green Bay (intake at Rostok 1 mile north of Kewaunee, 13 miles north) and the Central Brown County Water Authority (supplied from Manitowoc). No other potable water uses are recorded within 50 miles of the site along the lake shore. All public water supplies drawn from Lake Michigan are treated in purification plants. The nearest surface waters used for drinking other than Lake Michigan are the Fox River 30 miles NW and Lake Winnebago 40 miles W of the site.

Ground water provides the remaining population with potable supplies. Public ground water supplies within a 20-mile radius of the site are listed in Table 2.5-3. Additional wells for private use are in existence throughout the region. The potable water for use at the Point Beach Nuclear Plant is drawn from a 257 feet deep well located at the southwest corner of the plant yard. The well pump has a capacity of 65 gpm. Water from this well is sampled as part of the environmental studies described in Section 2.7.

Fishing (Reference 5) (Reference 6)

Commercial fishing in Lake Michigan decreased in the fifteen years prior to license application due to the proliferation of the sea lamprey, causing a reduction in lake trout and an increase in less desirable rougher species of fish. A secondary cause for the decline was the botulism scare in 1963 which focused nationwide attention on the potential contamination of smoked whitefish and chubs. Alewives, chubs, and yellow perch accounted for 84% of the 1963 production from Lake Michigan. Total landings in Wisconsin from Lake Michigan accounted for 14.4 million pounds valued at $1.1 million in 1963. Manufactured fishery products accounted for nearly $3 million in Wisconsin in 1963.

Fishing is practiced generally throughout the lake with fishermen tending to operate within easy reach of their home ports. These ports are generally far enough apart to minimize any overlap in fishermen's routes. Fishing depths are in excess of 12 fathoms (72 feet) by law for trawlers and generally greater than 20 fathoms (120 feet). These depth restrictions place the fishing grounds at least 5 miles offshore. Inshore fishing is licensed occasionally when alewives (a shad-like food fish) are schooling in along the shore. This fish is used mostly for fertilizer and fish meal manufacture.

At the time of license application, active fish boats on the Wisconsin shore of Lake Michigan were as follows: Milwaukee (6 full-time and 12 part-time), Sheboygan (2), Manitowoc (1), Two Rivers (2), Kewaunee (2), and Algoma (5). Fishing in Lake Winnebago (40 miles to the west of the site) is confined primarily to rough species, most of which go to mink ranchers in the area for use as animal food.

Sport fishing is one of Wisconsin's prime tourist attractions. It may be considered as existing throughout the state and along all shoreline areas of the lake.

2.5.2 LAKE LEVELS AND FLOODING

This section provides the hydrological review of the potential external flooding sources at the Point Beach site. A detailed discussion of plant flooding protection methods and design is provided in Appendix A.7 “Plant Flooding.”

Lake Level

The nominal water level in Lake Michigan at the time of the original license submittal was -2 feet relative to the Plant Datum. A maximum water level was recorded in 1886 at +1.7 feet and minimum recorded to date occurred in 1964 at -4.8 feet. The site is, on average, about 20 or more feet above plant elevation zero and there is no record that it has been flooded by the lake.

The maximum analyzed value for high lake level is +1.7 feet. Operators will take actions to commence the orderly shutdown of any operating reactor per Abnormal Operating Procedure direction prior to reaching the analyzed limit.

Flood Level

The license basis level for protection of critical equipment from lake flooding is +9.0 feet (Reference 25). This is an acceptable and bounding value as each lake flooding source when evaluated individually, or in the combined effects review, provides resultant flood levels conservatively below this threshold thereby satisfying the General Design Criteria 2 requirement to include "an appropriate margin for withstanding forces greater than recorded to reflect uncertainties about the historical data and their suitability as a basis for design."

The limiting design basis lake flood event is a combination of the maximum lake level, the maximum wave run-up and a conservative value for the wind setup effect. Details are provided in the following section entitled "Combined Effects." The calculated level reaches +7.25 feet on the riprap shoreline and +8.42 feet on the vertical surfaces of the intake structure (Reference 28). All critical plant components are therefore protected by the strategies outlined in Appendix A.7 "Plant Flooding,"(Reference 30) .

Tides

Tides on Lake Michigan created by the attraction of the moon and sun are insignificant. The total range of oscillation does not exceed 2 inches.

Surges

Using the method delineated in "The Prediction of Surges in the Southern Basin of Lake Michigan, Part I, The Dynamical Basis for Prediction" by G. W. Paltzman (Reference 31), the storm surge that could occur at the site will be 4.14 feet due to the passage of a squall line with a pressure jump of 8 millibars and a simultaneous speed of movement of 65 knots with a shoaling factor of 3.5. Adding this surge of 4.14 feet to the maximum recorded water level in Lake Michigan of +1.7 feet results in a maximum elevation of 5.84 feet, which is bounded by the license basis flood level and is considerably lower than the turbine building grade floor elevation of +8.0 feet or the pumphouse operating floor elevation of +7.0 feet.

The value of 4.14 feet was developed using Platzman's contours of amplitude for pressure. There are no contours for the lake in the area of the site so a conservative approach was taken using the reflected surge values for Waukegan at 90° with a speed of movement of 65 knots, giving a pressure rise of 0.05 feet. Using 8 millibars or 0.236", the maximum surge due to pressure with a 3.5 shoaling factor will, therefore, be

$$0.05 \times \frac{0.236}{0.01} \times 3.5 = 4.14 feet$$

Using the above method, the computed amplitudes were adjusted using Reference 32 for wind velocities equal to or greater than 70 knots. The resultant amplitude for wind velocities equal to or greater than 70 knots is one foot over the computed value. If this 1'0" increase is added to the maximum surge elevation of 5.84 feet, the maximum elevation will be 6.84 feet, still below the plant floors and bounded by the license basis flood level.

Seiches

Seiches are caused by a frontal line defining an abrupt change in atmospheric pressure in the range of 0.1 inch, moving across the lake at a high velocity. An average of 20 seiches per year occur in the vicinity of Chicago, but the rise in the lake level due to most of these is insignificant.

Conditions at Point Beach with its open shoreline will not be subject to reflection and should not produce any amplification of the seiche height. It appears logical to consider that the rise in water level due to a seiche would be a maximum of 1 to 2 feet.

Historical records show that the peak rise in water level associated with a seiche can be achieved very quickly. The record seiche in Chicago on June 26, 1954 lasted about ½ hour. The historical records do not support a coincident occurrence of a major seiche with a major high wave condition. Winds of high velocity have been recorded before or after seiches for relatively short periods of time, but there is no basis to superimpose the conditions of maximum wave upon the maximum seiche. Thus, a maximum seiche is not combined with the maximum lake level, maximum wind setup and maximum wave run-up in the combined effects analysis (Reference 28).

Wave Height

The predicted magnitude of deep water wave heights is shown in Table 2.5-1.

The calculation of deep water wave heights is based upon the data given in Technical Memorandum No. 36 of the Beach Erosion Board, Office of the Chief of Engineers, Department of the Army. The data for Baileys Harbor, Wisconsin, and Milwaukee, Wisconsin, were extrapolated to include the period up to 500 years. The height at Point Beach was calculated by applying the results on the basis of an interpolation recognizing the relationship of Point Beach to these two sites.

The calculated wave height shown in Table 2.5-1 refers entirely to deep water waves. In the vicinity of Point Beach, the extremely flat slopes of the beach extend so far out into the water (approximately 1 on 100 for the first 1000 feet into the lake and 1 on 200 for the next 4000 feet) that the deep water waves break offshore. In this case, only waves of lesser height actually need to be considered in the run-up of the beach.

In the calculation of wave run-up, two methods of analysis were followed. In one case, the wave was treated as impinging upon a breakwater with very flat slopes, with the toe of the slope located in 12 foot deep water (the depth 1000 feet offshore). The computed vertical height above plant elevation zero for this case was 1.4 feet.

In the other case, an estimate of the probable maximum secondary wave was prepared from the average depth conditions prevailing after the deeper water wave has broken and reformed and the run-up on the beach above the water level was computed for a period equal to 8 seconds as:

Type of Surface	Vertical Height of Run-up
1 to 1 1/2 Smooth Slope	7.72 ft.
1 to 1 1/2 Riprap Slope	5.38 ft.
Vertical Structure	6.55 ft.

The arrangement for shore protection is based upon riprapping of the slope of the bank as shown in Figure 2.5-1. The wave run-up will, therefore, encounter this slope or the vertical faces formed by the intake structure walls.

The forebay portion of the intake structure as shown in Figure 2.5-1 extends 65 feet from the shoreline back to the pumphouse and has vertical walls extending to elevation +15.4 feet parallel to the shoreline (front) and to elevation +12.0 feet perpendicular to the shoreline. These walls protect the pumphouse portion of the intake structure from the run-up due to a wave impinging on a vertical structure. The bank adjacent to the intake structure has rip-rap placed on a 1 to 3.0 (vertical to horizontal) slope on the north side and 1 to 4.5 (vertical to horizontal) on the south side of the CWPH. A shoreline rip-rap analysis using these slopes demonstrates that the vertical wave run-up height on this portion of the shoreline, North and South of the CWPH, is less than the maximum vertical wave run-up height attained on the intake structure vertical walls.

Since prolonged winds of high velocity tend to form a wind tide setup, the additional level change has been calculated to be 0.17 feet based on a conservative value of sustained easterly wind velocity of 40 mph over a fetch length of 70 miles and average depth of 465 feet (Reference 27).

Precipitation

Lakes Michigan and Huron are considered as a unity from the standpoint of drainage and water level since these two lakes are connected. The drainage basin for these two lakes comprises 115,700 square miles and has an average annual rainfall of about 31 inches. The average and maximum precipitations recorded at various locations on the Wisconsin shore of Lake Michigan are listed in Table 2.5-2.

The maximum amount of precipitation at Point Beach is calculated from a combination of snowmelt and sustained heavy rains. The license basis precipitation values are developed from the once in 50 year water content value for snow in the latter half of March combined with the once in 50 year six hour rainfall (Reference 4) (Reference 22) (Reference 23) (Reference 29).

Drainage

There are no rivers or large streams on or near the site. The surface water on the site flows directly to Lake Michigan either through the storm sewer system or through two small creeks which drain the site. Natural drainage and site topography have proven adequate to remove water from precipitation flooding sources.

The bank at Point Beach is graded so that it slopes down on a 6% slope from elevation +23.5 feet at points approximately 300 feet north and south of the intake structure to elevation +7.0 feet (the lowest elevation) at the intake structure.

The topography of the site results in adequate natural drainage to remove the maximum amount of precipitation and snowmelt and limit ponding depth to prevent adversely affecting safety related equipment (Reference 22) and (Reference 23).

Combined Effects

Adding the secondary wave run up, wind tide setup and maximum lake water level results in the maximum resultant wave height of +8.42 feet on vertical structures and +7.25 feet on a riprap slope.

Type of Surface	Vertical Height of Run-up	Wind Setup	Maximum Lake Level	Total Wave Height
1 to 1 1/2 Riprap Slope	5.38 ft.	0.17 ft.	1.7 ft.	7.25 ft.
Vertical Structure	6.55 ft.	0.17 ft.	1.7 ft.	8.42 ft.

These values are bounded by the license basis flood level of +9.0 feet which is used for determining protection requirements for essential plant equipment (see Appendix A.7 "Plant Flooding").

With the exception of the tabulated combinations above, the Point Beach License Basis does not require consideration of the simultaneous combined effects of more than one extraordinary natural phenomenon (Reference 25).

Ice Formation

The U. S. Coast Guard reported pile up of ice in the form of frozen spray and ice floes to a height of 30 to 40 feet at the shore and extending about 100 feet into the lake. These observations were made at Rawley Point Lighthouse 5 miles south of the site. Similar conditions have been experienced at many power stations along the lake.

The primary reason for build-up seems to be the formation of ice which is driven out to deep water by offshore winds and collected until a change in wind drives these ice floes toward the shore. As they approach shallow water, they ground and the offshore floes are driven up and over the grounded floes. The peak point in height of this buildup does not occur at the shoreline on extremely flat beaches, but some distance offshore. This action has given rise to reports of "ice shoves" which have damaged fish shanties on a beach or light wharf structures projecting out into the water.

Beach structures for power stations represent a massive installation and the history of such structures has shown no major damage from ice shoves even where these have been located next

to the shoreline on shallow beaches. The outer wall of the intake forebay, the only structure on the beach, is designed with a 3 ft. minimum thickness of reinforced concrete. It is considered that this is adequate to withstand any pressure from the ice. The water intake is located 1750 feet offshore in a water depth of 18 feet (measured from the lowest recorded level of -4.8 feet plant elevation). Water is drawn from the intake crib through two 14 ft. diameter pipes buried below the lake bed and will not be affected by the ice. The cooling water is discharged through two flumes consisting of well braced steel sheet piling driven 40 feet into the lake bed and protected by riprap. It is considered that this also is adequate to withstand any pressure from the ice. Other structures are located approximately 190 feet from the beach line and are further protected by the low bluff along the shoreline.

There are no rivers or large streams on or near the site. Thus, ice dam induced flooding is not a potential source of external flooding at Point Beach.

2.5.3 DILUTION AND DIFFUSION IN LAKE MICHIGAN

Water from Lake Michigan is extensively used for municipal and domestic water supplies. Radioactive contamination of the lake can only occur in two modes. The first is by a continuous release of small amounts of activated corrosion products and fission products into the cooling water stream. The second mode of radioactivity release into the cooling water is conceivable only as a result of an operating error and equipment failure. This type of contamination may be regarded as a batch release (a release over a relatively short period of time) before the waste release is shut off.

As described in Chapter 11, all radioactive liquid wastes generated at the plant will be collected and monitored before discharge from the site. Release rates are manually controlled so that all liquid waste discharged will be much less than $(MPC)_w$ in the outfalling cooling water. Also, automatic radiation monitoring equipment prohibits releases that exceed permissible values. Thus, any radioactive release from the site into the lake will be diluted well below $(MPC)_w$ before it reaches the nearest water supply intake. It has already been indicated that the nearest municipal and domestic water intakes are located at Two Rivers and Rostok (1 mile N of Kewaunee), approximately 12 miles south and 13 miles north of the site, respectively.

Thermal stratification has insignificant effect on the dilution of released fission products by lake water currents. Discharge velocity of the circulating water is less than 4 ft/sec. It is expected that this jet action will promote mixing with colder water in the immediate vicinity of the discharge flume and a rapid reduction in pronounced differential temperatures. In addition to this, observations at power station discharges in Lake Michigan at Gary, Indiana, and Waukegan, Illinois, have shown that the wave action and shore currents are very effective in breaking up any tendency to pronounced stratification and isolation of the warm water. It is expected that this action, together with the jet momentum entrainment of colder water, will cause all temperature effects to be indiscernible within less than one mile from the point of discharge. The same conditions will prevent the establishment of a distinct pronounced plume of heated water which would transport released fission products directly to any potable water intake structure.

For completeness, computational models for evaluating the dilution of both types of radioactive release are discussed below.

Continuous Release

For continuing releases at a uniform discharge rate, the maximum concentration as a function of distance along the direction of the mean flow can be predicted by several methods. One of the more frequently used relationships for instantaneous releases is that derived by Okubo and Pritchard (Reference 7):

$$S(x, y, t) = \frac{nM}{2\sqrt{\pi}PDx} \exp\angle\left[\frac{y^2}{(Pt)^2}\right]$$

where:

S(x,y,t) = Concentration as a function of time and distance, $\mu Ci/cm^3$

M = Rate of release, μCi/sec

D = Depth of mixing layer, cm

P = Diffusion velocity, cm/sec

y = Cross plume point at which S is determined, cm

t = Time after start of release, sec

n = Degree of constraint for diffusing material (2 for 180° release)

x = The distance downstream from release point at which S is determined, cm

At a given distance, x, the concentration, S, equals zero initially (t = 0), but eventually a saturation condition is reached, corresponding to a maximum condition S_{max}, which will exist as long as the radioactive material is released at a constant rate. Under these conditions, S_{max} is a function of distance only and:

$$S_{max} = \frac{nM}{2\sqrt{\pi}PDx}$$

It has been indicated previously that the mixing depth during stratification of the lake is 25 to 50 feet, depending on the time of the year. It is conservatively assumed here that D = 10 m; P = 10^{-2} m/sec; and n = 2 to compensate for the effect of the shore. Thus, the peak concentration in $\mu Ci/cm^3$ per μCi/sec released is given by:

$$S_{max}/M = \frac{5.64\times10^{\angle 6}}{x}$$

Assuming various distances for x (in meters), the maximum concentration per unit release rate as a function of distance (in miles) is as follows:

Distance from Site (Miles)	Maximum Concentration per-unit Release S_{max}/M, $\mu Ci/cm^3$ Per $\mu Ci/sec$
1	3.5×10^{-9}
5	7×10^{-10}
10	3.5×10^{-10}
12	2.9×10^{-10}
15	2.3×10^{-10}
20	1.75×10^{-10}
25	1.4×10^{-10}

For a mixture of unidentified fission products with an $(MPC)_w$ 3×10^{-8} µCi/ml, approximately 8 curies per day may be released at the site without exceeding $(MPC)_w$ at the nearest potable water intake.

Batch Releases

The Okubo and Pritchard (Reference 7) diffusion model for a release over a relatively short period of time (batch release) is:

$$S(r,t) = \frac{nM}{\pi D(Pt)^2} \exp \angle \left[\frac{r^2}{(Pt)^2} \right]$$

where now:

M = Total radioactivity released, µCi

r = Distance, cm

If a volume of radioactive material is released into the offshore current, the radioactive volume will be carried along by the current. Although the overall concentration of radioactivity in this volume will decrease with passing time due to the mixing and outward diffusion from this volume, the peak concentration at any given time can be assumed to exist at the center (origin) of the drifting volume. Since r is the distance from the origin, r = 0 at the center of the radioactive volume and the peak concentration is a function of time only:

$$S_{peak} = \frac{nM}{\pi D(Pt)^2}$$

Assuming D = 10 m, P = 10^{-2} m/sec, and n = 2 the expression for peak concentration in µCi/cm^3 per µCi released at time t (in seconds) is:

$$s_{peak}/M = \frac{6.37\times10^{\angle 4}}{t^2}$$

The velocity of the current and its persistence at various speeds has been discussed previously. An average velocity calculated from these values is approximately 0.35 ft/sec. The peak concentration as a function of distance from the site, assuming this average current velocity, is indicated below:

Distance, Miles	Peak Concentration per Unit Release S_{peak}/M, µCi/cc per µCi
1 (4.2 hours)	2.8×10^{-12}
5 (21 hours)	1.1×10^{-13}
10 (42 hours)	2.8×10^{-14}
12 (50 hours)	2.0×10^{-14}
15 (63 hours)	1.25×10^{-14}
20 (84 hours)	7.0×10^{-15}
25 (105 hours)	4.5×10^{-15}

According to 10 CFR 20, the annual average concentration of an unknown mixture of fission products in unrestricted areas should not exceed 3×10^{-8} µCi/ml. Thus, it may be seen that a batch release of 1.5 curies at the site will be diluted to 3×10^{-8} µCi/ml at the nearest municipal water intake (12 miles). With one circulating water pump in operation at 214,000 gallons per minute flow, a release of 1.5 curies over a period of one hour results in a discharge flume concentration of approximately 3×10^{-5} µCi/ml or approximately 1×10^{3} MPC. Maximum short term releases for Point Beach Nuclear Plant are limited to less than 100 times MPC over a period not greater than one hour. Furthermore, it should be noted that the above concentration will be an instantaneous peak concentration and not the average concentration which could enter the water intake.

Table 2.5-1 FREQUENCY AND WAVE HEIGHT FOR DEEP WATER CONDITIONS

	Wave Height in Feet	
Frequency	Full Year	Ice-Free Period
Once each month	6	6
Once each 6 months	9.5	7
Once each year	11	8
Once each 2 years	12.5	9
Once each 5 years	15	11
Once each 10 years	17	12
Once each 25 years	17.7	13.6
Once each 500 years	23.5	18.0

Table 2.5-2 AVERAGE AND MAXIMUM PRECIPITATION

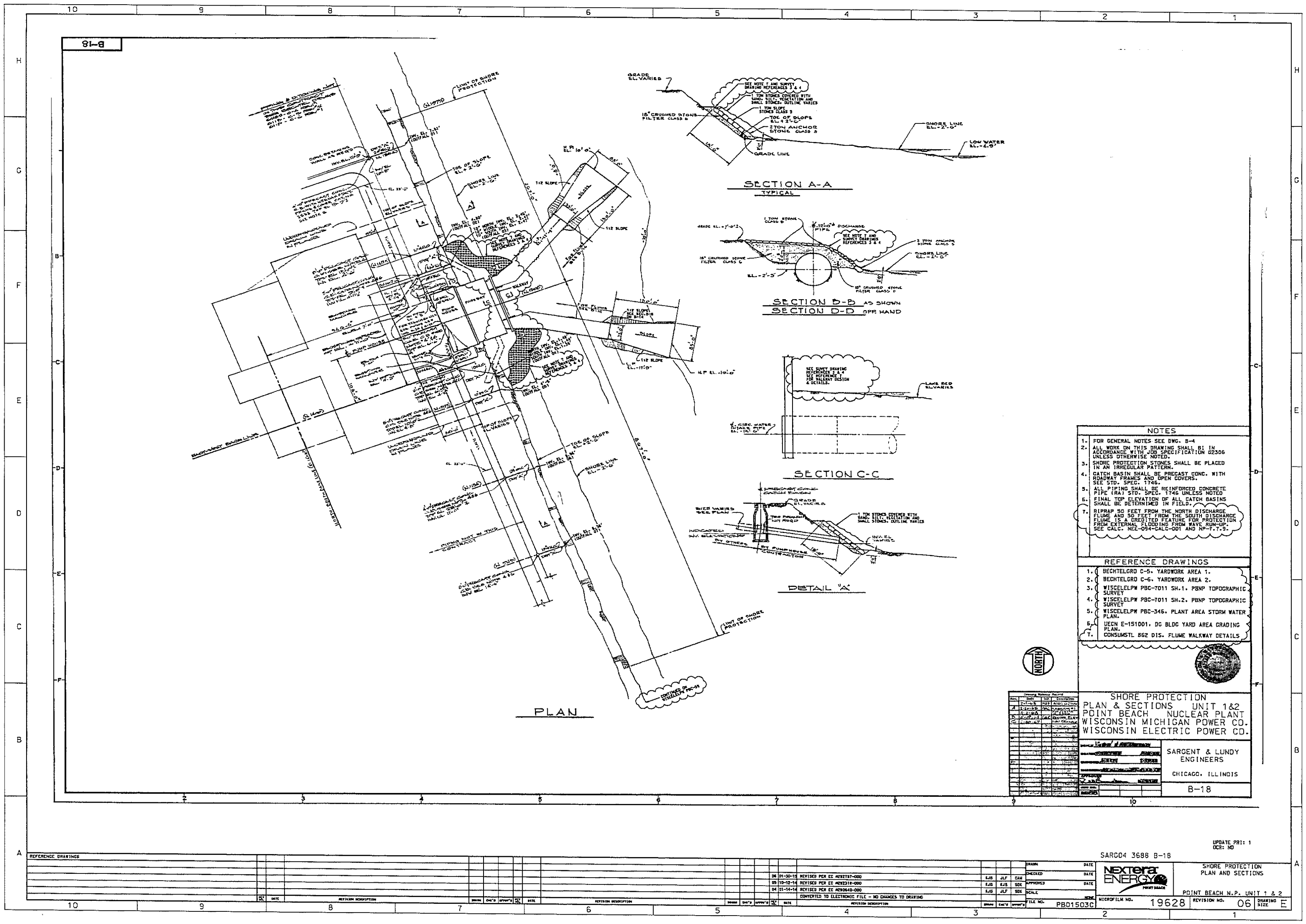
Location	Average Annual Precip., Inches	Maximum Annual Precip., Inches	Maximum 24-hr. Rainfall, Inches
Kenosha	29.86	41.84	3.55
Racine	31.90	48.33	4.00
Milwaukee	27.62	41.86	5.28
Shorewood	31.64	42.46	--
Port Washington	27.96	38.39	--
Sheboygan	29.27	40.14	4.55
Manitowoc	28.39	46.43	6.39
Two Rivers	28.65	41.17	--
Kewaunee	26.53	34.99	4.92
Sturgeon Bay	27.20	39.65	4.57
Green Bay	26.56	38.03	3.68
Washington Island	28.11	37.25	--

Table 2.5-3 MUNICIPAL GROUND WATER SUPPLIES AT THE TIME OF LICENSE APPLICATION

Place	1960 Population	Well Depth, ft.	Treatment[a]
Denmark, Brown County	1106	309-456	a, b, d, f
Kewaunee, Kewaunee County	2772	187-700	a, b, d, f
Luxemburg, Kewaunee County	730	431-495	d, h, z
Mishicot, Manitowoc County	762	80	d
Whitelaw, Manitowoc County	420	495	--

a. Type of treatment:
a. aeration
b. iron or manganese removal
d. disinfection
f. filtration
h. hardness removal
z. zeolite softening

Figure 2.5-1 SHORE PROTECTION



2.6 METEOROLOGY

Historical climatology in the region of the site and data collected at the site over the period April 1967 through April 1968 has been evaluated to provide a basis for determination of annual average waste gas release limits, estimates of exposure from potential accidents, and design criteria for storm protection. Information is provided in this section to show the adequacy of the design criteria and the estimates of site capabilities for diluting routine and accidental releases of radioactive gases.

The climate of the region is primarily continental in character, greatly influenced by the easterly flow of storms along the northern portion of the country and from the southwest to the Great Lakes. Lake Michigan acts as a moderating influence in spring, summer, and fall. The site is well ventilated with infrequent calms. Prevailing winds during spring and summer are lake breezes from the NNE. Beginning in the summer, a flow from the SSW appears which is reinforced in the fall by overland flows from WSW and WNW. During winter the flow is from the sector NW through SSW. During the first year of site data collection, maximum persistence of extremely stable conditions occurred for 41 hours under an average wind speed of 6.7 meters/sec.

Extreme winds are not expected to exceed 108 mph more than once in 100 years. Tornadoes occur in the state but only one has been reported causing major property damage and injury to people in this region. This one occurred in Green Bay in 1959, 30 miles NW of the site.

Measurement of on-site meteorological parameters of wind speed and direction began in April 1967 and continued for a period of two years. A wind speed and direction recorder was placed on a 150-foot tower erected for this purpose on the site. These data are used to establish routine release limits of radioactive gases and to assess consequences of potential accidental releases of radioactive materials.

Data and analyses in this section are based on one year of hourly 15-minute average observations at the site supplemented by 5 years of hourly surface observations at Milwaukee, Wisconsin; summaries of data from Green Bay, Wisconsin and Escanaba, Michigan; plus 3 years of observations at Coast Guard Stations at Two Rivers and Kewaunee, Wisconsin; and Weather Bureau records of a more specialized nature referred to in the text.

METEOROLOGICAL PROGRAM

Site data collection began in April 1967 and continued for 2 years. A set of Belfort Type M wind transmitters was installed on top of a 150-foot tower approximately 2000 feet south of the nearest reactor containment structure.

Wind data were collected on the strip-chart recorder and reduced for computer input by Murray and Trettel, Inc. by manual (visual) methods. These data were extracted from the analog charts, keypunched on cards, and processed by a CDC-3600 computer using a computer code, WINDVANE, developed by NUS Corporation for this purpose. The code operates on the input data to provide seasonal and annual distributions of wind speed, wind direction, wind direction variance, and wind direction persistence. The variance of wind direction is a direct measure of the ability of the atmosphere to accept and disperse injected materials. Variance is computed (in the WINDVANE code) by measuring the range of wind fluctuations during the sampling period and dividing by six, according to methods used by Holland (Reference 8) and Slade (Reference 9), etc.

Currently three meteorological monitoring towers with instrumentation are provided for collecting weather data. This data may be used as input to an atmospheric diffusion model to provide radiation dose estimates from routine or emergency radioactive releases from the plant site. Refer to Emergency Plan Appendix L for detailed description of Meteorological System (Reference 17).

DESCRIPTIVE METEOROLOGY

Climate (Reference 10)

Climatic characteristics are illustrated in Figure 2.6-1 which shows average and extreme temperatures, precipitation, and extreme winds for 30 years of record at Kewaunee and Manitowoc, Wisconsin.

The climate of the site region is influenced by the general storms which move eastward along the northern tier of the United States and by those which move northeastward from the southwestern part of the country to the Great Lakes. This continental type of climate is modified by Lake Michigan. During spring, summer, and fall months the lake temperature differs greatly from the air temperature. Wind shifts from westerly to easterly directions produce marked cooling of daytime temperatures in spring and summer. In autumn the relatively warm water of the lake prevents nighttime temperatures from falling as low as they do a few miles inland from the shoreline. Summer time temperatures exceed 90°F for 6 days on the average. Freezing temperatures occur 147 days and below zero on 14 days of the winter on the average. Rainfall averages about 28 inches per year with 55% falling in the months of May through September. Maximum rainfall during 24 hours was 6.17 inches in September,1931. Snowfall averages about 45 inches per year with maximum of 15 inches in 24 hours in January, 1947.

Extreme winds for design purposes are also plotted in Figure 2.6-1. Results are from a special study by the Weather Bureau in conjunction with the Bureau of Public Roads for winds at 30 feet elevation (Reference 11). Extreme-mile winds are: 54 mph with a probability of 0.50 and a recurrence interval of once in 2 years; a 50-year recurrence interval is associated with a 100-mph wind with a probability of 0.02; and a 100-year recurrence interval is associated with a 108mph with a probability of 0.01. (The extreme-mile wind speed is defined as the 1-mile passage of wind with the highest speed for a day.)

Tornadoes (Reference 12)

Wisconsin lies to the northeast of the principal tornado belt in the United States. During the period 1916 through 1967, 359 tornadoes were experienced in the state. Of these, only six occurred in Manitowoc County, one in Kewaunee County, and nine in Brown County. Only one tornado of this latter group caused injury to people or major property damage. This one occurred in Green Bay, 30 miles WNW of the site with three people injured and property damage in the range of $500,000 to $5,000,000 on May 10,1959 at 8:50p.m. The tornado path was 6 miles long and 600 yards wide. The region north of Sheboygan along the Lake Michigan coast appears to be relatively free of tornadoes. Tornadoes appear to advance from the west with most of the tracks from the southwest. Maximum occurrence during the year is in June with 90% reported in May through September.

Tornado frequency was analyzed using the recorded tornadoes within increasing radii of the site for the period 1953 through 1967. The cumulative number of tornadoes within radii out to 75 miles are listed in Table 2.6-1.

These values were used in the statistical method proposed by Thom (Reference 13) by which the probability of a tornado striking a point within a given area may be estimated. This probability is given as:

$$P = \frac{\overline{zt}}{A}$$

where P is the mean probability, $\bar{z}$ is the mean tornado path area, $\dot{t}$ is the mean number of tornadoes per year, and A is the area of concern.

At a 95% confidence level, Thom's formula becomes:

$$P' = P\left[1 \pm \frac{1.96}{(N)^{1/2}}\right]$$

where N is the total number of tornadoes in the area of concern in the years of record, 1953 to 1967.

In order to maximize the point probability of striking the site, the probability and the confidence limits were calculated at increasing radii from the site. The maximum point probability occurs at 30miles:

$$P' = 1.6 \text{ x } 10^{-3} \text{ per year}$$

and the 95% confidence limits are 7.65 x 10^{-4} to 2.50 x 10^{-3} per year. The mean recurrence interval, R=1/P′, is 625 years and at the 95% confidence limit the recurrence interval range becomes 400 to 1310 years.

Ice Storms

Ice storms are infrequent in this region of Wisconsin. Wisconsin Public Service Corporation, which has transmission lines in this area, reports only a single line extending from Green Bay to Kewaunee to Sturgeon Bay has experienced outages due to ice storms since 1940. Six such outages occurred ranging in duration from 22 minutes to 2.5 hours. Since rebuilding the lines with improved conductors in 1956, only one outage has occurred.

Wind Speed and Direction

Average annual and seasonal wind rose patterns are shown in Figure 2.6-2 based on one year of records on-site from April 1967 through April 1968. On an annual basis, the winds blow onshore (from Lake Michigan toward the land) an average of 33.8% of the time. Onshore winds are defined as those which blow from the north through the south-southeast. Annually, winds blow from the shore towards the lake 63.5% of the time. Seasonal distributions of onshore and offshore flows are shown below in Table 2.6-2.

During the spring season, the predominant wind directions during the period of record were northeasterly and south-southwesterly. Wind speeds tended to be above 10 mph from all directions but east. Calm conditions were recorded 3.5% of the spring time.

A very predominating south-southwest wind was noted over the summer. Again, wind speeds tended to average near 10 mph, with the exception of southeasterly quadrant winds. The lowest average wind speed was 4.4 mph from the east. Calm conditions occurred 2.2% of the summer time.

During autumn, average wind speeds from the western semicircle of the compass ranged from 10 to over 14 mph. There were relatively frequent occurrences of winds approximately parallel to the shoreline in both the northerly and southerly directions. The lowest wind speeds were again from the east, the calm winds were observed 2.3% of the season. The onset of cold weather is evidenced by the increased frequencies of winds from the northwesterly quadrant.

The winter season is characterized by a preponderance of winds from the northwest quadrant. Winds from this quadrant were observed to occur over 60% of the time. During the winter months, no average wind speed from any direction was below 10 mph, but calm conditions occurred 3.1% of the winter time. It is noteworthy that the average wind speed from the north-northeast was over 20 mph.

On an annual basis, the winds at the Point Beach site show predominating spikes of higher frequency winds from the west-northwest and the south-southwest. Average wind speeds are generally quite high from all directions from south-southeast clockwise through northeast. These average values are all in excess of 10 mph. Significantly lower frequencies and lower wind speeds are observed with easterly winds, partially reflecting the Lake Michigan influence on winds which travel against the normal gradient flow.

Wind Directional Persistence

Wind persistence is defined as the duration of time that winds blow without interruption from any given direction. The annual summary of one-sector wind persistences is shown in Figure 2.6-3.

The distribution of long period persistences agrees well with the predominating directions, as may be expected, since higher percentage occurrences of direction produce a greater possibility of persistent winds from that direction. The most surprising feature of the persistence evaluation is the episode (on April 14-16, 1968) of 41 hours of Pasquill Type "G," or highly non-turbulent conditions. The ameliorating circumstance is an average wind speed of 13.1 mph for the duration of the persistence. This effect of an air trajectory over a long fetch of open water has been investigated and discussed by several researchers (Reference 14, Reference 15). Briefly, when air passes over long fetches of relatively frictionless open water, there is a net loss of turbulent energy and a corresponding increase in wind speed.

The longest persistence of calm winds was for 25 hours, during which 9 hours were unstable and 16 hours were stable.

Atmospheric Stability

An assessment of atmospheric stability at the site was made based on one year of data. These data were analyzed according to methods described by Holland and Slade, and formulated into a computer code, WINDVANE, by NUS Corporation. Hourly observations from both stations were analyzed for seasonal stability, dispersion (χ/Q) calculations, and persistence.

A portion of the output of the WINDVANE run made from site data, is shown in Table 2.6-3 and Table 2.6-4 with the results of the annual average calculations excluding the building wake effect correction.

On annual and seasonal bases, atmospheric stabilities at the Point Beach site occurred during the period of record as shown in Table 2.6-5 according to the WINDVANE breakdown of the site data.

ATMOSPHERIC DISPERSION

The directional variability of atmospheric stability on an annual basis may be best illustrated by Figure 2.6-4, which shows plots of stability by wind direction in percent of direction total. Figure 2.6-4 (the annual average) shows two peaks of unstable and neutral conditions with winds blowing roughly parallel to the shoreline or in a slightly offshore direction. This pattern is repeated in the seasonal plots with a great deal of uniformity, although with some slight seasonal variations. It is evident that atmospheric stability at the Point Beach site is, to a large degree, a function of seasonal variation. That is, atmospheric stability shows good correlation with direction and a fair correlation with season.

As described in Section 11, routine releases of radioactive gases will be made intermittently from the vent discharge pipe near the top of the containment structure.

Atmospheric dispersion of these gases may be described by various analytical expressions such as the Gaussian Formulation described by Gifford (Reference 16). This is modified for the building wake effect by using a virtual source distance correction. The basic expression for diffusion is as follows.

$$\chi / Q = \frac{1}{\pi \sigma_y \sigma_z \bar{\mu}} \exp(\angle 1/2)\left[\left(\frac{h^2}{\sigma_z^2} + \frac{y^2}{\sigma_y^2}\right)\right]$$

where:

χ	=	Concentration (units/m^3)
Q	=	Release rate (units/sec)
$\bar{\mu}$	=	Mean wind speed (m/sec)
σ_y and σ_z	=	Respectively, the lateral and vertical dispersion coefficients (m)
y	=	Lateral distance from plume centerline (m)
h	=	Height of release point (m)

Virtual source corrections may be made by setting half the area of the containment equal to an ellipse with semi-diameters of σ_y and σ_z and solving for source distance based on neutral stability conditions (the predominant case). For distances out to the exclusion boundary, the predominant dispersion mechanism is that due to aerodynamic turbulence in the wake of the containment structure as contrasted with release from a tall stack with no local interferences. The above expression integrated with respect to y from $+\infty$ to $-\infty$ can yield a long term average based on wind speed, direction, and atmospheric stability frequency. This technique is particularly appropriate to an evaluation of annual average stack release rates. Similarly, short term releases may be evaluated with the appropriate short period averages and information on wind and stability persistence.

Average Atmospheric Dilution

In making initial estimates of site annual average dilution factors in order to establish maximum permissible waste gas release rates for use in the PSAR document, meteorological data from General Mitchell Field in Milwaukee, Wisconsin, were reduced by a computer code, WINDIF, the output of which is exactly the same as the WINDVANE program previously described. The data used in that analysis encompassed December 1958 through November 1963. Based on the Milwaukee data, an overlay of annual average dilution factors, (χ/Q), in units of seconds per cubic meter, was superimposed on an aerial photograph of the Point Beach site. These data were corrected for building wake using a virtual source distance of 225 m. The results indicated that the nearest residence to the site, over 3900 feet (1200 meters) to the southwest, would have an annual average dilution factor of approximately 5×10^{-7} seconds per cubic meter, and the highest value at the site boundary would also be 5×10^{-7} seconds per cubic meter. The overlay of χ/Q isopleths from the Milwaukee data is shown in Figure 2.6-5.

The results of the WINDVANE output based on site data and using a 300 meter virtual source distance are shown in Figure 2.6-5. In most respects, there is good agreement between both sets of χ/Q values, with good correspondence of the isopleths. The exception is the southerly direction where, because of a higher incidence of north winds at the site than was recorded at Milwaukee, the highest annual average value of χ/Q at the site boundary is about 1.5×10^{-6} seconds per cubic meter, a factor of three higher than originally estimated. However, at the nearest residence 3900 feet southwest of the reactor, the revised value of χ/Q based on site data indicates only a 50% increase to about 7.5×10^{-7} seconds per cubic meter.

Using an unrestricted MPCa of 3×10^{-7} curies per cubic meter (χ), and the maximum annual average χ/Q value of 1.5×10^{-6} seconds per cubic meter, the resulting permissible release rate for a decayed noble gas mixture is 0.2 curies per second averaged over a year.

HYPOTHETICAL ACCIDENT METEOROLOGY

One year of continuous on-site meteorological data has provided some information to permit re-evaluation of the conditions which could realistically be expected to persist during a hypothetical accident situation.

Since offshore winds would blow any released waste gases away from nearby populations and would have no effect on people for a distance in excess of 50 miles across Lake Michigan (more for northwesterly or southwesterly winds), conditions under these winds were omitted from consideration although they were examined in detail for other facets of site meteorology. Based on one year of on-site data, a close examination of onshore winds which would blow released gases toward nearby segments of the local population indicates that the season of poorest diffusion is summer. This season has the highest percentage of stable conditions and the concomitant lowest wind speeds, which yields the poorest downwind dispersion of effluents. Accordingly, a revised meteorological model for application to hypothetical accident has been derived from site data and is presented in Table 2.6-6.

Model Comparison

In the original meteorological model as presented in the PSAR document, the calculations of χ/Q were made using the virtual source method. For the invariant wind condition, the basic form:

$$\frac{\chi}{Q} = \frac{1}{\pi \bar{u} \sigma_y \sigma_z}$$

was used for centerline values at various downwind distances. Where the average concentration over a 22 1/2 degree sector was indicated, the form:

$$\frac{\chi}{Q} = \left[\frac{2}{\pi}\right]^{1/2} \Sigma \frac{8 F_i f_i}{\pi \bar{u} \sigma_z \sigma_y x}$$

was used, where:

χ	=	Concentration, units per cubic meter
Q	=	Source term, units per second
$\bar{u}$	=	Mean wind speed, meters per second
σ_y and σ_z	=	Lateral and vertical dispersion parameters, meters
F_i	=	Fraction of time condition “i” exists
f_i	=	Fraction of time winds associated with condition “i” are in the sector of interest

Under a virtual source configuration, values of χ/Q at distance x are corrected for initial dilution in the turbulent wake of the containment by adding the virtual source distance x which, in this case, was 680 meters associated with Pasquill “F.”

In the revised model, downwind values of χ/Q were obtained by use of the building wake model which is of the form:

$$\frac{\chi}{Q} = \frac{1}{(\pi \sigma_y \sigma_z + cA)\bar{u}}$$

for centerline values, and of the form:

$$\frac{\chi}{Q_{ave}} = \left[\frac{2}{\pi}\right]^{1/2} \frac{8}{\pi} \Sigma_i \frac{F_i f_i}{(\sigma_{zi} + (cA)/(\pi\sigma_{yi}))\bar{u}x}$$

for 22 1/2 degree sector average values, where:

c = Building shape factor, dimensionless

A = Smallest cross sectional area of the containment structure, square meters

For the rectangular oblong containment at Point Beach, c was taken to be 1 and A is 1640 square meters.

The major differences in the resulting values is in the second time period, where an invariant wind was assumed for the original calculations and a sector-averaged condition was assumed for the revised model. All other calculated values are in close agreement, with minor differences in the 0 to 2 hour period entirely attributed to the difference between virtual source and building wake calculational methods. The calculated results from the two sets of model conditions are shown in Figure 2.6-7 and Figure 2.6-8.

Alternate Source Term

On April 14, 2011, the NRC approved a License Amendment Request (LAR) regarding the use of Alternate Source Term (AST). To support this LAR five years of hourly onsite meteorological data collected between September 2000 and September 2005 were used to generate new control room air intake atmospheric dispersion factors (χ/Q values) (Reference 18).

Table 2.6-1 CUMULATIVE NUMBER OF TORNADOES WITHIN VARYING RADII OF POINT BEACH

(Site: 1953 - 1967)

Radius From Site Miles	Cumulative Number Of Tornadoes
10	0
25	3
30	12
35	14
50	22
60	28
75	42

Table 2.6-2 WIND DISTRIBUTION (%)

	Onshore (N-SSE)	Offshore (S-NNW)	Calm
Spring	44.5	52.0	3.5
Summer	36.4	61.4	2.2
Autumn	30.8	67.0	2.3
Winter	22.9	74.0	3.1
Annual	33.8	63.5	2.7

Table 2.6-3 SITE ATMOSPHERIC STABILITY ANALYSIS ANNUAL AVERAGE - POINT BEACH, WISCONSIN THIRTEEN MONTH DATA - 4/67-4/68

(Sheet 1 of 3)

Hourly Stability Index Distribution - Total No. of Obs. - 7999

	Percent Total Obs.							In Percent of Hourly Obs						
Hour Index	1	2	3	4	5	6	7	1	2	3	4	5	6	7
1	0.09	0.03	0.28	1.19	1.49	0.84	0.26	2.10	0.60	6.61	28.53	35.74	20.12	6.31
2	0.09	0.03	0.21	1.30	1.53	0.84	0.15	2.11	0.60	5.14	31.42	36.86	20.24	3.63
3	0.10	0.04	0.19	1.26	1.55	0.89	0.13	2.41	0.90	4.52	30.42	37.35	21.39	3.01
4	0.04	0.01	0.15	1.33	1.54	0.91	0.16	0.91	0.30	3.63	32.02	37.16	22.05	3.93
5	0.08	0.04	0.16	1.39	1.55	0.74	0.18	1.82	0.91	3.94	33.64	37.58	17.88	4.24
6	0.08	0.03	0.25	1.26	1.83	0.51	0.15	1.83	0.61	6.10	30.79	44.51	12.50	3.66
7	0.06	0.03	0.44	1.54	1.55	0.46	0.06	1.51	0.60	10.57	37.16	37.46	11.18	1.51
8	0.09	0.01	0.50	1.76	1.39	0.35	0.03	2.12	0.30	12.12	42.73	33.64	8.48	0.61
9	0.11	0.25	0.63	1.74	1.10	0.30	0.04	2.70	6.01	15.02	41.74	26.43	7.21	0.90
10	0.10	0.21	0.64	1.75	1.11	0.31	0.04	2.40	5.11	15.32	42.04	26.73	7.51	0.90
11	0.06	0.31	0.63	1.78	0.96	0.43	0.04	1.49	7.44	14.88	42.26	22.92	10.12	0.89
12	0.11	0.25	0.61	1.69	1.09	0.40	0.04	2.69	5.97	14.63	40.30	25.97	9.55	0.90
13	0.11	0.15	0.59	1.85	0.99	0.41	0.08	2.69	3.59	14.07	44.31	23.65	9.88	1.80
14	0.14	0.11	0.68	1.85	0.90	0.38	0.11	3.30	2.70	16.22	44.44	21.62	9.01	2.70
15	0.10	0.18	0.53	1.73	1.19	0.40	0.05	2.40	4.20	12.61	41.44	28.53	9.61	1.20
16	0.15	0.16	0.43	1.79	1.21	0.35	0.06	3.61	3.92	10.24	43.07	29.22	8.43	1.51
17	0.08	0.15	0.33	1.64	1.39	0.48	0.09	1.81	3.63	7.85	39.58	33.53	11.48	2.11
18	0.06	0.03	0.31	1.36	1.76	0.54	0.13	1.49	0.60	7.46	32.54	42.09	12.84	2.99
19	0.08	0.03	0.18	1.33	1.73	0.73	0.15	1.79	0.60	4.17	31.55	41.07	17.26	3.57
20	0.04	0.01	0.28	1.20	1.68	0.78	0.23	0.89	0.30	6.55	28.57	39.88	18.45	5.36
21	0.10	0.00	0.24	1.16	1.59	0.88	0.25	2.37	0.00	5.64	27.60	37.69	20.77	5.93
22	0.10	0.01	0.25	1.25	1.44	0.95	0.21	2.37	0.30	5.93	29.67	34.12	22.55	5.04
23	0.06	0.03	0.25	1.20	1.41	0.99	0.28	1.48	0.59	5.93	28.49	33.53	23.44	6.53
24	0.06	0.00	0.25	1.26	1.60	0.85	0.16	1.49	0.00	5.97	30.15	38.21	20.30	3.88

Table 2.6-3 (Sheet 2 of 3)

Average Wind Speed For Each Stability Index and Direction (In MPH), Average Inverse Speed

Index	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
1	0.16	0.35	0.28	0.70	0.33	0.29	0.25	0.16	0.15	0.31	0.30	0.23	0.31	0.17	0.17	0.43
2	0.00	0.38	0.44	0.33	0.33	0.44	0.34	0.13	0.30	0.20	0.17	0.22	0.14	0.12	0.22	0.80
3	0.31	0.42	0.53	0.42	0.35	0.32	0.15	0.16	0.12	0.15	0.15	0.15	0.10	0.11	0.15	0.32
4	0.16	0.18	0.25	0.26	0.27	0.25	0.13	0.10	0.09	0.14	0.12	0.12	0.11	0.12	0.11	0.13
5	0.09	0.12	0.15	0.26	0.19	0.15	0.15	0.18	0.11	0.13	0.13	0.12	0.14	0.17	0.15	0.11
6	0.09	0.13	0.17	0.23	0.25	0.19	0.19	0.24	0.21	0.14	0.13	0.15	0.16	0.17	0.22	0.12
7	0.07	0.07	0.00	0.13	0.18	0.19	0.12	0.21	0.17	0.15	0.12	0.10	0.11	0.12	0.11	0.13

Stability Index Distribution In Percent of Total Obs.

Index	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	CALM
1	0.15	0.19	0.10	0.09	0.04	0.10	0.11	0.19	0.31	0.16	0.14	0.09	0.10	0.15	0.06	0.10	0.00
2	0.00	0.03	0.04	0.01	0.01	0.04	0.13	0.04	0.08	0.04	0.04	0.08	0.16	0.24	0.08	0.05	1.04
3	0.05	0.16	0.08	0.19	0.13	0.11	0.14	0.59	0.33	0.24	0.16	0.50	2.80	2.95	0.41	0.14	0.00
4	0.93	1.05	0.51	0.55	0.48	0.78	1.43	6.00	4.65	1.60	1.66	3.31	4.71	2.94	3.78	1.23	0.00
5	4.23	3.06	0.96	0.68	0.76	1.06	1.06	1.23	4.71	3.06	1.69	2.46	0.83	0.54	0.93	4.60	1.70
6	1.33	0.75	0.43	0.39	0.35	0.76	0.53	0.48	1.36	2.84	0.78	1.00	0.64	0.44	0.14	2.50	0.00
7	0.13	0.09	0.00	0.01	0.03	0.13	0.10	0.06	0.39	0.54	0.20	0.40	0.18	0.06	0.01	0.74	0.00

Average Wind Speed For Each Stability Index and Direction (In MPH)

Index	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N
1	8.7	5.1	6.1	2.3	3.3	4.1	6.7	10.3	9.3	10.2	6.1	6.1	10.6	10.4	7.4	5.5
2	0.0	3.0	2.3	3.0	3.0	2.3	4.1	7.7	6.3	6.7	6.7	5.3	8.2	9.3	6.8	2.0
3	6.5	4.8	3.2	3.7	4.2	7.1	7.9	9.2	9.8	9.1	9.7	11.4	14.1	12.3	10.6	7.5
4	11.8	8.9	7.5	5.7	5.8	9.0	12.3	14.8	14.4	11.8	12.2	15.5	13.2	11.3	12.0	12.7
5	15.3	12.2	11.3	6.3	10.9	11.6	9.8	8.2	13.6	11.3	10.8	11.9	9.6	8.2	9.4	14.2
6	14.1	11.8	10.3	8.5	6.5	6.7	8.4	6.3	8.2	9.6	10.0	10.2	8.7	9.1	7.4	12.6
7	14.6	15.6	0.0	8.0	5.5	6.9	9.1	5.0	7.9	8.6	10.1	11.3	10.6	9.8	9.0	11.2

Table 2.6-3 (Sheet 3 of 3)

Wind Rose For Each Stability Index (In Percent of Each Index Total)

Index	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	M	CALM
1	7.23	9.04	4.82	4.22	1.81	4.82	5.42	9.04	15.06	7.83	6.63	4.22	4.82	7.23	3.01	4.82	0.00
2	0.00	1.20	1.81	0.60	0.60	1.81	6.02	1.81	3.61	1.81	1.81	3.61	7.83	11.45	3.61	2.41	50.00
3	0.56	1.81	0.84	2.09	1.39	1.26	1.53	6.56	3.63	2.65	1.81	5.58	31.24	32.91	4.60	1.53	0.00
4	2.60	2.95	1.44	1.55	1.33	2.18	4.00	16.86	13.07	4.50	4.67	9.31	13.24	8.25	10.61	3.44	0.00
5	12.59	9.13	2.87	2.01	2.27	3.17	3.17	3.65	14.05	9.13	5.03	7.34	2.46	1.60	2.76	13.71	5.07
6	9.02	5.11	2.89	2.64	2.38	5.19	3.57	3.23	9.28	19.32	5.28	6.81	4.34	2.98	0.94	17.02	0.00
7	4.10	2.87	0.00	0.41	0.82	4.10	3.28	2.05	12.70	17.62	6.56	13.11	5.74	2.05	0.41	24.18	0.00

Gross Wind Rose (In Percent of Total Obs.)

	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	CALM
	6.80	5.33	2.11	1.91	1.79	2.98	3.49	8.58	11.83	8.48	4.66	7.84	9.41	7.31	5.40	9.35	2.74
Speed	14.4	11.1	9.5	6.1	7.9	8.9	10.2	12.8	12.8	10.5	10.9	13.0	12.7	11.3	11.2	13.1	0.0

Stability Index Distribution For Each Wind Direction (In Percent of Direction Total)

Index	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	N	CALM
1	2.21	3.52	4.73	4.58	2.10	3.36	3.23	2.19	2.64	1.92	2.95	1.12	1.06	2.05	1.16	1.07	0.00
2	0.00	0.47	1.78	0.65	0.70	1.26	3.58	0.44	0.63	0.44	0.80	0.96	1.73	3.25	1.39	0.53	37.90
3	0.74	3.05	3.55	9.80	6.99	3.78	3.94	6.85	2.75	2.80	3.49	6.38	29.75	40.34	7.64	1.47	0.00
4	13.60	19.72	24.26	28.76	26.57	26.05	40.86	69.97	39.32	18.88	35.66	42.26	50.07	40.17	69.91	13.10	0.00
5	62.13	57.51	45.56	35.29	42.66	35.71	30.47	14.29	39.85	36.14	36.19	31.42	8.76	7.35	17.13	49.20	62.10
6	19.49	14.08	20.12	20.26	19.58	25.63	15.05	5.54	11.52	33.48	16.62	12.76	6.77	5.98	2.55	26.74	0.00
7	1.84	1.64	0.00	0.65	1.40	4.20	2.87	0.73	3.28	6.34	4.29	5.10	1.86	0.85	0.23	7.89	0.00

Stability Index Distribution (In Percent of Total Obs.)

Index	1	2	3	4	5	6	7
	2.08	2.08	8.96	35.59	33.55	14.69	3.05

Average Wind Speed For Each Stability Index (In MPH)

	1	2	3	4	5	6	7
Average Speed	7.6	3.2	11.6	12.8	11.6	10.1	10.0
Inverse Speed	0.26	0.13	0.14	0.12	0.12	0.15	0.13

Table 2.6-4 SITE ATMOSPHERIC STABILITY ANALYSIS ANNUAL AVERAGE - POINT BEACH, WISCONSIN, THIRTEEN MONTH DATA - 4/67-4/68

(Sheet 1 of 2)

CHI/Q For Release Height of 0.000+000 Meters (In Sec. Per CU Meter)

Dist, M	NNE	NE	ENE	E	ESE	SE	SSE	S
2.0000+002	2.7258-005	2.6373-005	1.3928-005	1.7493-005	1.5479-005	2.2919-005	1.8666-005	3.3966-005
4.0000+002	7.3458-006	7.0720-006	3.7420-006	4.6845-006	4.1776-006	6.1963-006	5.0298-006	9.1893-006
6.0000+002	3.5278-006	3.3798-006	1.7923-006	2.2384-006	2.0097-006	2.9897-006	2.4172-006	4.4214-006
8.0000+002	2.1472-006	2.0482-006	1.0886-006	1.3574-006	1.2255-006	1.8296-006	1.4732-006	2.6939-006
1.2000+003	1.1111-006	1.0521-006	5.6038-007	6.9743-007	6.3460-007	9.5317-007	7.6230-007	1.3877-006
1.6000+003	7.0122-007	6.6081-007	3.5179-007	4.3752-007	3.9978-007	6.0245-007	4.7984-007	8.6942-007
2.4000+003	3.6739-007	3.4418-007	1.8307-007	2.2761-007	2.0895-007	3.1643-007	2.5064-007	4.5083-007
3.2000+003	2.3271-007	2.1718-007	1.1545-007	1.4354-007	1.3214-007	2.0085-007	2.5849-007	2.8347-007
4.0000+003	1.6353-007	1.5219-007	8.0861-008	1.0055-007	9.2747-008	1.4139-007	1.1125-007	1.9805-007
4.8000+003	1.2272-007	1.1395-007	6.0521-008	7.5260-008	6.9532-008	1.0626-007	8.3428-008	1.4791-007
5.6000+003	9.6354-008	8.9307-008	4.7416-008	5.8966-008	5.4551-008	8.3549-008	6.5475-008	1.1566-007
6.4000+003	7.8204-008	7.2370-008	3.8413-008	4.7770-008	4.4245-008	6.7895-008	5.3126-008	9.3533-008
7.2000+003	6.5100-008	6.0159-008	3.1924-008	3.9701-008	3.6809-008	5.6583-008	4.4215-008	7.7607-008
8.0000+003	5.5285-008	5.1025-008	2.7071-008	3.3665-008	3.1242-008	4.8102-008	3.7543-008	6.5710-008
8.8000+003	4.7713-008	4.3988-008	2.3332-008	2.9015-008	2.6950-008	4.1555-008	3.2398-008	5.6556-008
9.6000+003	4.1732-008	3.8434-008	2.0382-008	2.5346-008	2.3560-008	3.6378-008	2.8335-008	4.9340-008
1.0400+004	3.6911-008	3.3962-008	1.8006-008	2.2392-008	2.0829-008	3.2203-008	2.5061-008	4.3536-008
1.1200+004	3.2959-008	3.0300-008	1.6062-008	1.9973-008	1.8591-008	2.8779-008	2.2378-008	3.8788-008
1.2000+004	2.9674-008	2.7257-008	1.4446-008	1.7964-008	1.6731-008	2.5930-008	2.0147-008	3.4847-008
1.2800+004	2.6908-008	2.4698-008	1.3086-008	1.6273-008	1.5166-008	2.3530-008	1.8269-008	3.1535-008
1.4400+004	2.2530-008	2.0650-008	1.0937-008	1.3601-008	1.2689-008	1.9728-008	1.5297-008	2.6304-008
1.5200+004	2.0777-008	1.9031-008	1.0077-008	1.2531-008	1.1697-008	1.8204-008	1.4106-008	2.4212-008
1.6000+004	1.9245-008	1.7617-008	9.3265-009	1.1598-008	1.0831-008	1.6872-008	1.3067-008	2.2389-008
1.6800+004	1.7898-008	1.6374-008	8.6667-009	1.0778-008	1.0070-008	1.5700-008	1.2152-008	2.0787-008
1.7600+004	1.6706-008	1.5275-008	8.0832-009	1.0052-008	9.3958-009	1.4663-008	1.1343-008	1.9371-008
1.8400+004	1.5646-008	1.4297-008	7.5641-009	9.4067-009	8.7965-009	1.3739-008	1.0639-008	1.8112-008
1.9200+004	1.4697-008	1.3423-008	7.1001-009	8.8297-009	8.2605-009	1.2913-008	9.9786-009	1.6988-008
2.0000+004	1.3844-008	1.2638-008	6.6832-009	8.3115-009	7.7788-009	1.2170-008	9.3997-009	1.5978-008
2.0800+004	1.3075-008	1.1930-008	6.3171-009	7.8440-009	7.3441-009	1.1499-008	8.8771-009	1.5068-008
2.1600+004	1.2377-008	1.1288-008	5.9664-009	7.4205-009	6.9502-009	1.0891-008	8.4036-009	1.4244-008
2.2400+004	1.1743-008	1.0705-008	5.6567-009	7.0354-009	6.5920-009	1.0338-008	7.9728-009	1.3495-008
2.3200+004	1.1164-008	1.0172-008	5.3740-009	6.6841-009	6.2651-009	9.8323-009	7.5797-009	1.2812-008
2.4000+004	2.0634-008	9.6850-009	5.1153-009	6.3626-009	5.9658-009	9.3696-009	7.2196-009	1.2187-008
5.0000+004	3.9511-009	3.5604-009	1.8638-009	2.3221-009	2.1967-009	3.5197-009	2.6798-009	4.3709-009
1.0000+005	1.8701-009	1.6632-009	8.5352-010	1.0683-009	1.0237-009	1.6948-009	1.2671-009	1.9710-009

Table 2.6-4 CHI/Q For Release Height of 0.000+000 Meters (InSec.PerCUMeter)

(Sheet 2 of 2)

Dist, M	SSW	SW	WSW	W	WNW	NW	NNW	N
2.0000+002	5.5353-005	5.2632-005	2.2391-005	3.5416-005	2.9993-005	2.2692-005	1.9474-005	5.1034-005
4.0000+002	1.4973-005	1.4258-005	6.0414-006	9.5820-006	8.0820-006	6.0870-006	5.2637-006	1.3799-005
6.0000+002	7.2223-006	6.9014-006	2.9066-006	4.6191-006	3.8743-006	2.9043-006	2.5257-006	6.6625-006
8.0000+002	4.4165-006	4.2383-006	1.7733-006	2.8214-006	2.3526-006	1.7554-006	1.5334-006	4.0808-006
1.2000+003	2.2991-006	2.2242-006	9.1973-007	1.4637-006	1.2042-006	8.9145-007	7.8408-007	2.1341-006
1.6000+003	1.4540-006	1.4135-006	5.8036-007	9.2277-007	7.5047-007	5.5269-007	4.8862-007	1.3548-006
2.4000+003	7.6409-007	7.4805-007	3.0416-007	4.8283-007	3.8656-007	2.8268-007	2.5141-007	7.1596-007
3.2000+003	4.8509-007	4.7728-007	1.9276-007	3.0559-007	2.4202-007	1.7613-007	1.5718-007	4.5643-007
4.0000+003	3.4153-007	3.3734-007	1.3553-007	2.1464-007	1.6858-007	1.2224-007	1.0932-007	3.2242-007
4.8000+003	2.5671-007	2.5436-007	1.0176-007	1.6102-007	1.2561-007	9.0819-008	8.1339-008	2.4303-007
5.6000+003	2.0185-007	2.0054-007	7.9939-008	1.2640-007	9.8044-008	7.0716-008	6.3400-008	1.9157-007
6.4000+003	1.6404-007	1.6336-007	6.4912-008	1.0258-007	7.9170-008	5.6985-008	5.1127-008	1.5603-007
7.2000+003	1.3672-007	1.3643-007	5.4059-008	8.5387-008	6.5609-008	4.7139-008	4.2315-008	1.3030-007
8.0000+003	1.1623-007	1.1621-007	4.5928-008	7.2511-008	5.5493-008	3.9807-008	3.5747-008	1.1098-007
8.8000+003	1.0042-007	1.0056-007	3.9654-008	6.2580-008	4.7719-008	3.4181-008	3.0703-008	9.6048-008
9.6000+003	8.7915-008	8.8180-008	3.4696-008	5.4736-008	4.1597-008	2.9758-008	2.6733-008	8.4223-008
1.0400+004	7.7830-008	7.8177-008	3.0700-008	4.8414-008	3.6678-008	2.6207-008	2.3546-008	7.4675-008
1.1200+004	6.9559-008	6.9963-008	2.7423-008	4.3234-008	3.2658-008	2.3309-008	2.0942-008	6.6835-008
1.2000+004	6.2677-008	6.3121-008	2.4698-008	3.8927-008	2.9323-008	2.0907-008	1.8784-008	6.0305-008
1.2800+004	5.6880-008	5.7351-008	2.2404-008	3.5300-008	2.6523-008	1.8892-008	1.6972-008	5.4799-008
1.4400+004	4.7698-008	4.8199-008	1.8771-008	2.9562-008	2.2104-008	1.5716-008	1.4116-008	4.6066-008
1.5200+004	4.4016-008	4.4524-008	1.7316-008	2.7263-008	2.0339-008	1.4449-008	1.2976-008	4.2560-008
1.6000+004	4.0799-008	4.1311-008	1.6044-008	2.5256-008	1.8800-008	1.3345-008	1.1983-008	3.9494-008
1.6800+004	3.7969-008	3.8481-008	1.4926-008	2.3490-008	1.7449-008	1.2377-008	1.1111-008	3.6794-008
1.7600+004	3.5464-008	3.5974-008	1.3936-008	2.1928-008	1.6256-008	1.1522-008	1.0342-008	3.4403-008
1.8400+004	3.3233-008	3.3741-008	1.3055-008	2.0538-008	1.5195-008	1.0763-008	9.6582-009	3.2273-008
1.9200+004	3.1238-008	3.1742-008	1.2267-008	1.9295-008	1.4248-008	1.0085-008	9.0481-009	3.0365-008
2.0000+004	2.9443-008	2.9943-008	1.1559-008	1.8177-008	1.3398-008	9.4774-009	8.5007-009	2.8649-008
2.0800+004	2.7823-008	2.8317-008	1.0919-008	1.7169-008	1.2632-008	8.9298-009	8.0075-009	2.7098-008
2.1600+004	2.6354-008	2.6843-008	1.0340-008	1.6255-008	1.1939-008	8.4344-009	7.5614-009	2.5692-008
2.2400+004	2.5018-008	2.5501-008	9.8127-009	1.5424-008	1.1309-008	7.9845-009	7.1562-009	2.4411-008
2.3200+004	2.3798-008	2.4274-008	9.3315-009	1.4665-008	1.0734-008	7.5746-009	6.7870-009	2.3242-008
2.4000+004	2.2680-008	2.3151-008	8.8908-009	1.3970-008	1.0209-008	7.1998-009	6.4495-009	2.2170-008
5.0000+004	8.5562-009	8.8830-009	3.3310-009	5.2156-009	3.6537-009	2.5396-009	2.2513-009	8.5620-009
1.0000+005	4.1604-009	4.4097-009	1.6052-009	2.5050-009	1.6535-009	1.1243-009	9.7402-010	4.3089-009

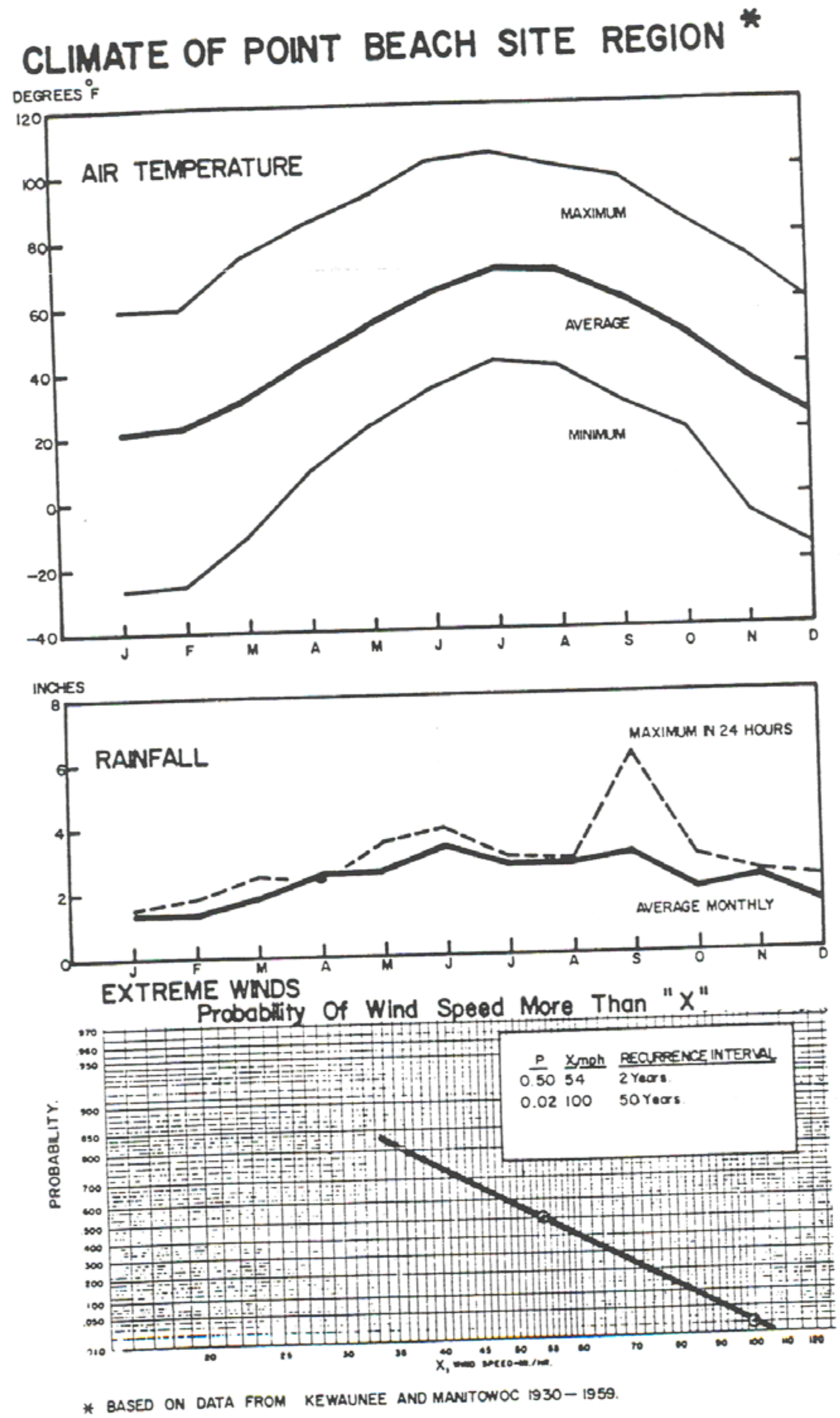
Table 2.6-5 ATMOSPHERIC STABILITY (%)

	Unstable	**Neutral**	**Stable**
Spring	11.21	31.90	56.89
Summer	14.16	25.97	59.87
Autumn	12.23	40.68	47.10
Winter	14.91	44.81	40.27
Annual	13.12	35.59	51.29

Table 2.6-6 HYPOTHETICAL ACCIDENT METEOROLOGICAL MODEL BASIC ON SITE DATA, 1967 - 1968

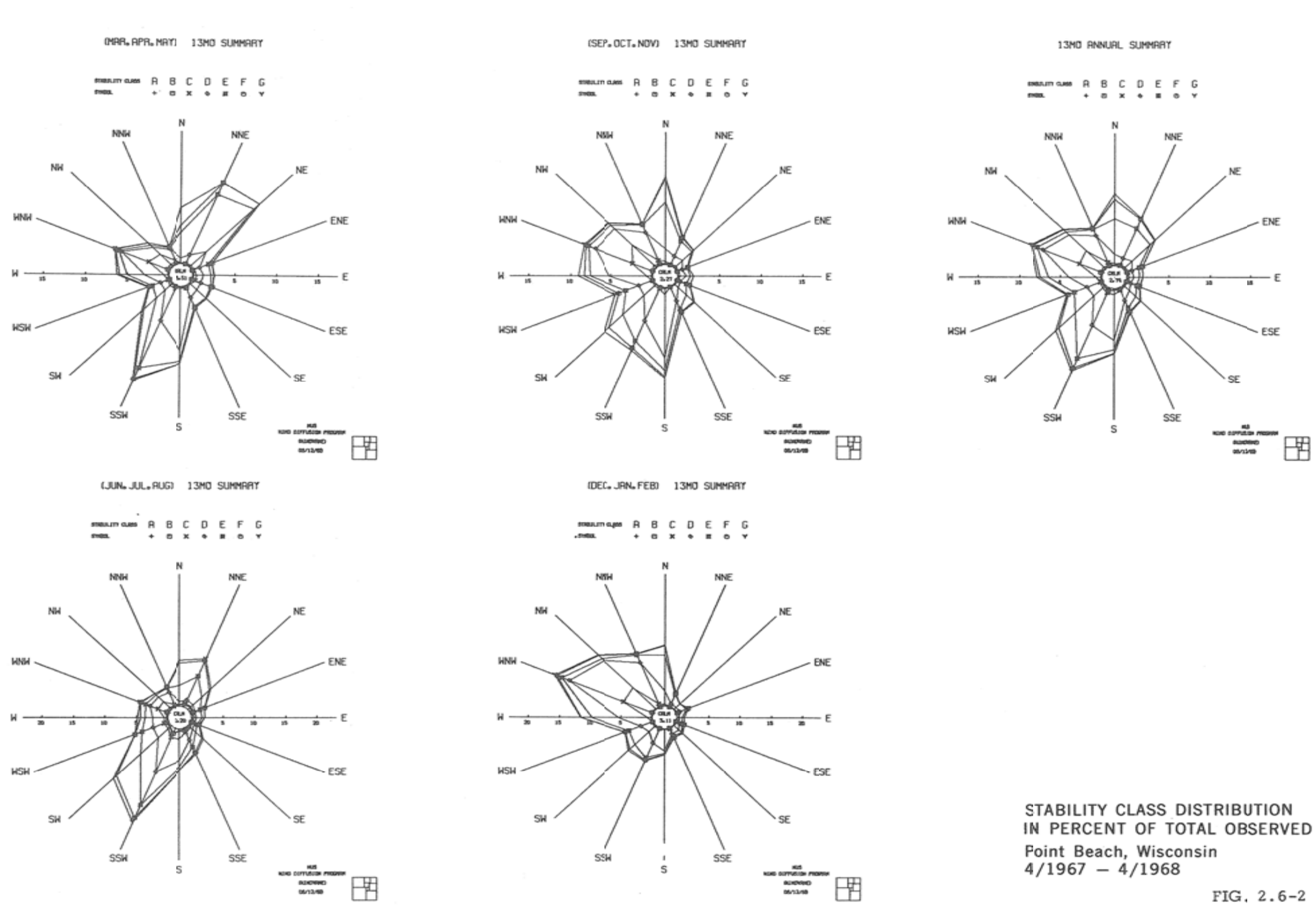
Time Period	Pasquill Stability	Wind Speed (Meters/Sec)	Fi	fi	Wind Condition
0 - 2 Hours	F	1.0	1.00	1.00	Invariant
2 - 48 Hours	F	2.5	1.00	1.00	Sector Avg.
2 - 30 Days	B	3.5	0.75	0.75	Sector Avg.
	D	4.0	0.15	0.20	Sector Avg.
	F	2.0	0.10	0.15	Sector Avg.

Figure 2.6-1 CLIMATE OF POINT BEACH SITE REGION



CLIMATE OF POINT BEACH SITE REGION
FIGURE 2.6-1

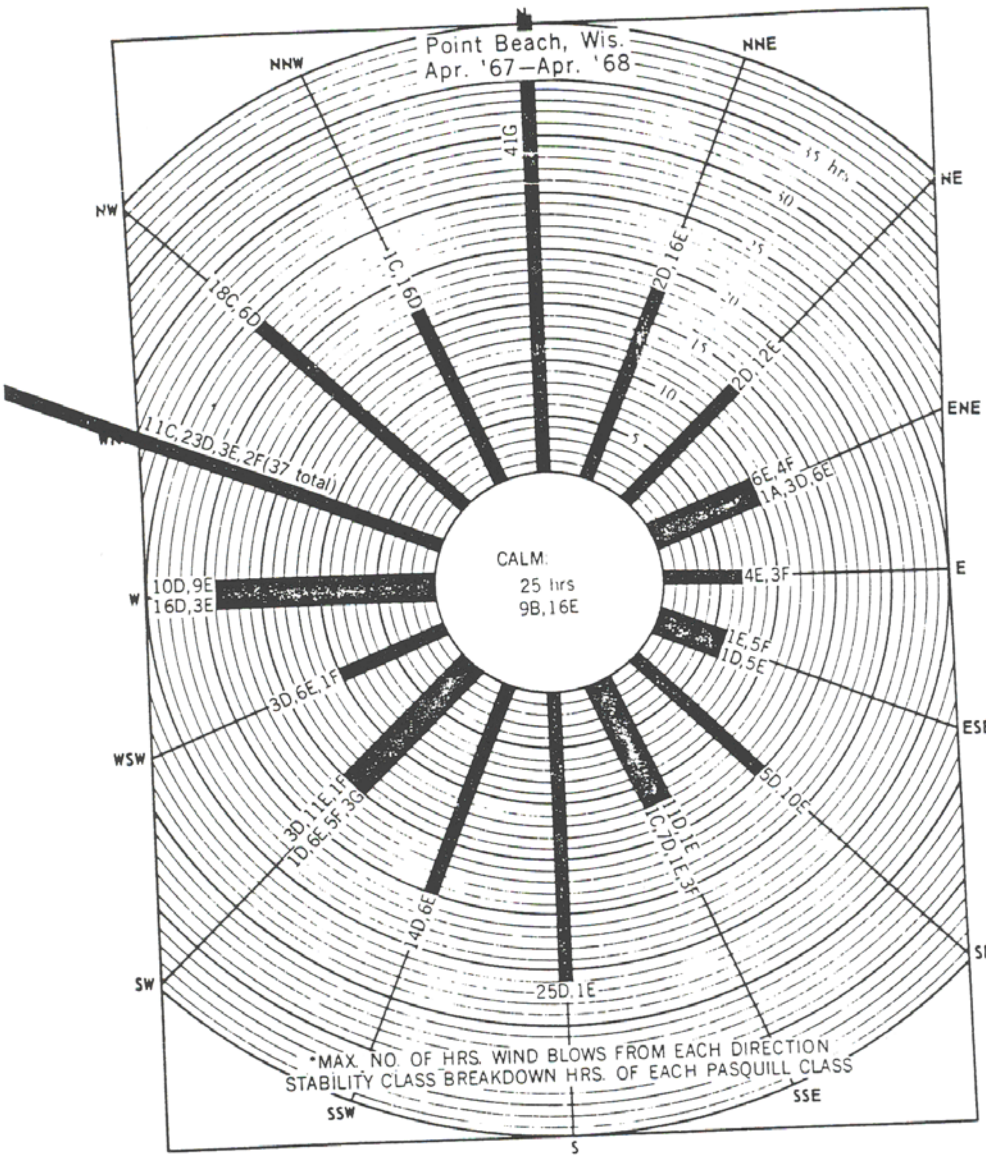
Figure 2.6-2 STABILITY CLASS DISTRIBUTION IN PERCENT OF TOTAL OBSERVED



STABILITY CLASS DISTRIBUTION
IN PERCENT OF TOTAL OBSERVED
Point Beach, Wisconsin
4/1967 – 4/1968

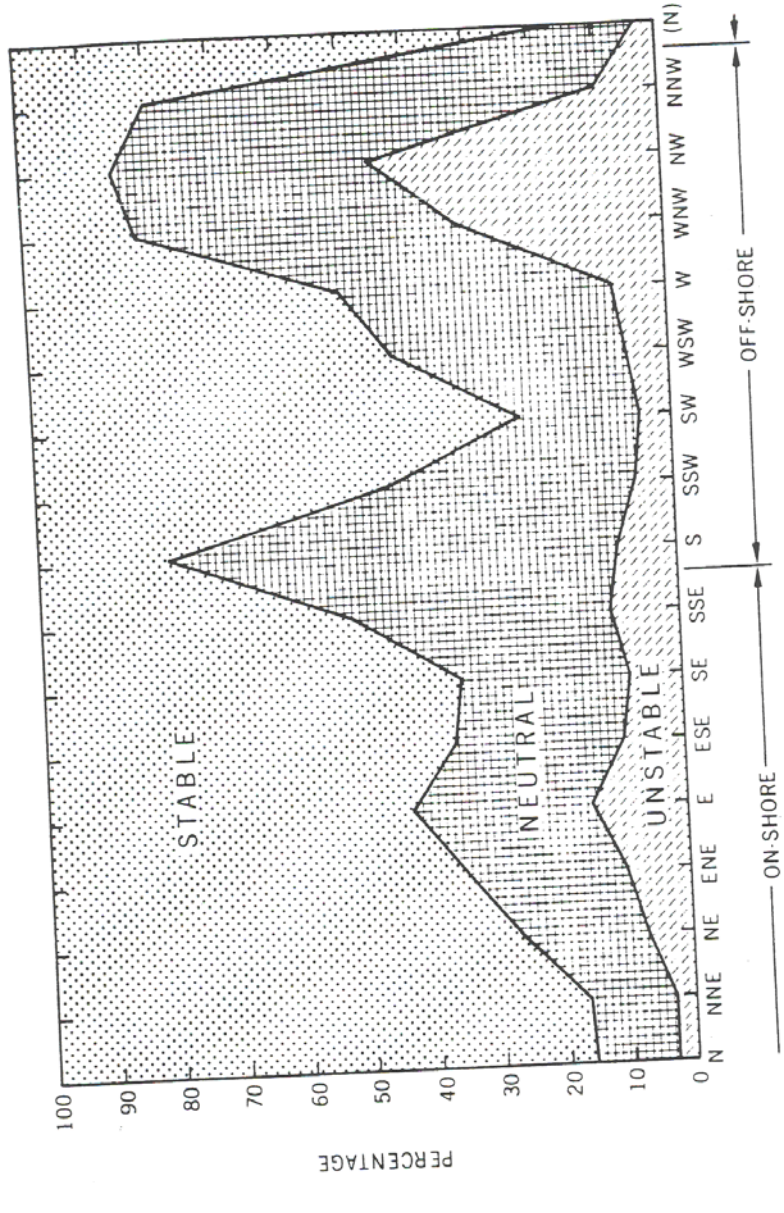
FIG. 2.6-2

Figure 2.6-3 PERSISTENCE WIND ROSE



PERSISTENCE WIND ROSE*
FIGURE 2.6-3

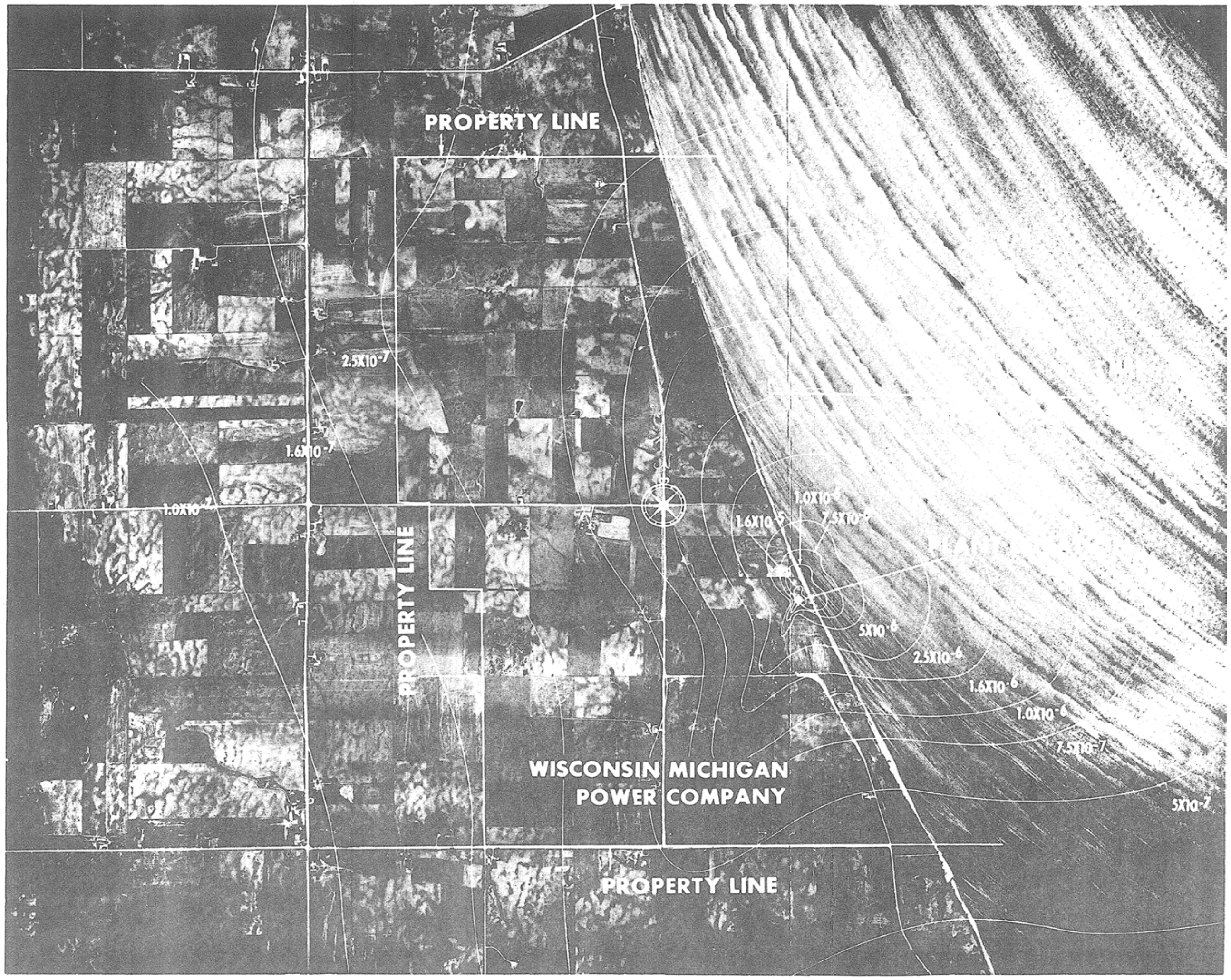
Figure 2.6-4 DISTRIBUTION OF STABILTY BY DIRECTION - POINT BEACH ANNUAL AVERAGE - 4/67-4/68



DISTRIBUTION OF STABILITY BY DIRECTION - POINT BEACH ANNUAL AVERAGE - 4/67-4/68

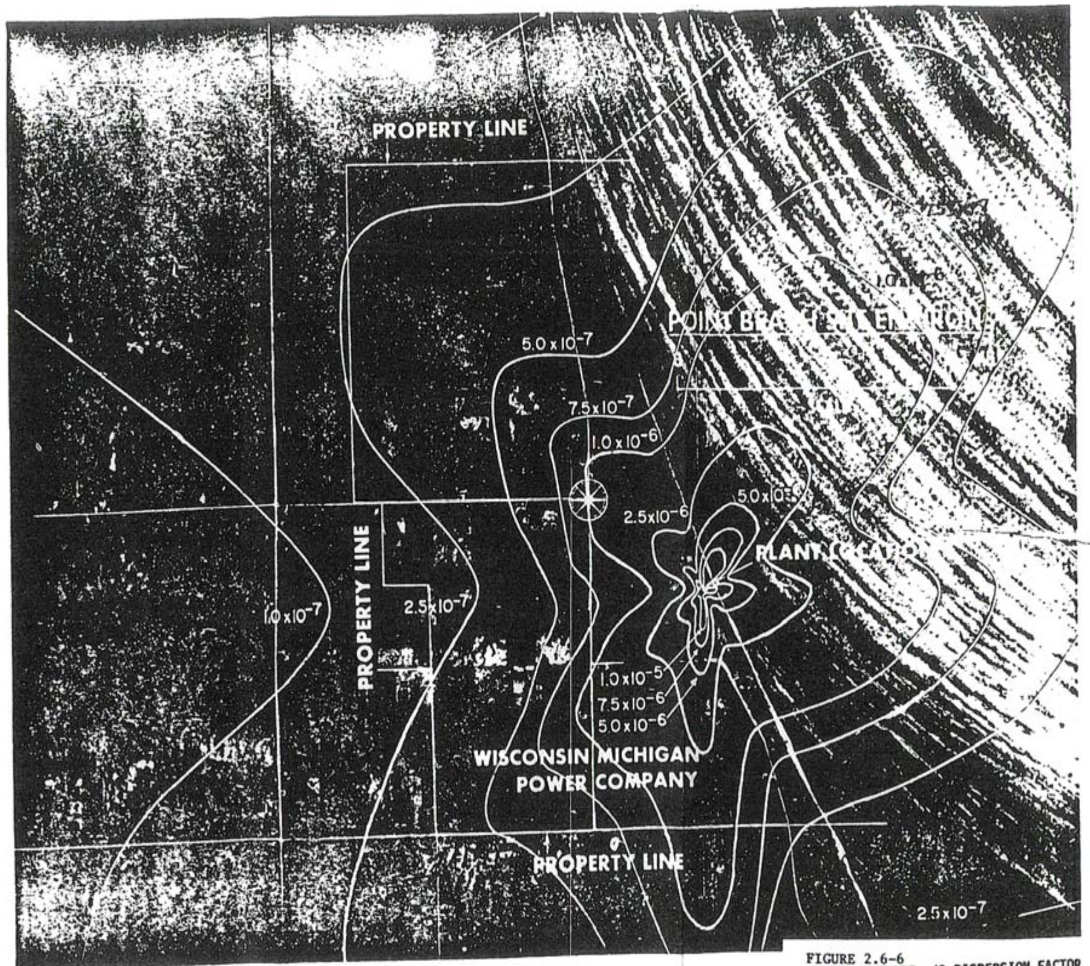
FIGURE 2.6-4

Figure 2.6-5 ANNUAL χ/Q DISPERSION FACTOR MILWAUKEE DATA



ANNUAL AVERAGE χ/Q DISPERSION FACTOR
MILWAUKEE DATA FIGURE 2.6-5

Figure 2.6-6 ANNUAL AVERAGE χ/Q DISPERSION FACTOR SITE DATA (4/67-4/68)



ANNUAL AVERAGE χ/Q DISPERSION FACTOR
SITE DATA (4/67–4/68)

FIGURE 2.6-6
ANNUAL AVERAGE χ/Q DISPERSION FACTOR
Site Data (4/67-4/68)
Point Beach Nuclear Plant

Figure 2.6-7 FSAR ACCIDENT MODEL

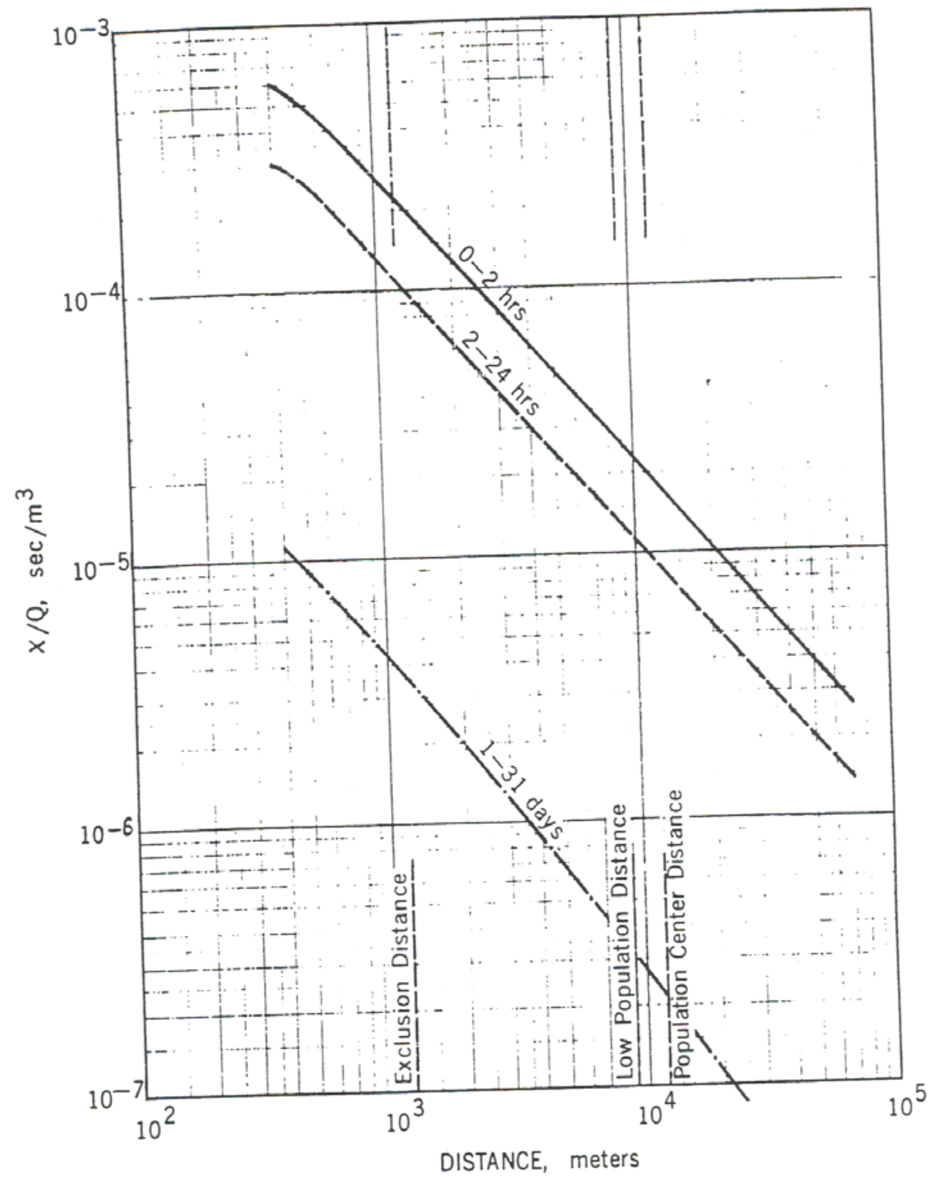


FIGURE 2.6-7
PSAR ACCIDENT MODEL
Virtual Source Distance = 680 meters
Point Beach Nuclear Plant

Figure 2.6-8 REVISED ACCIDENT MODEL

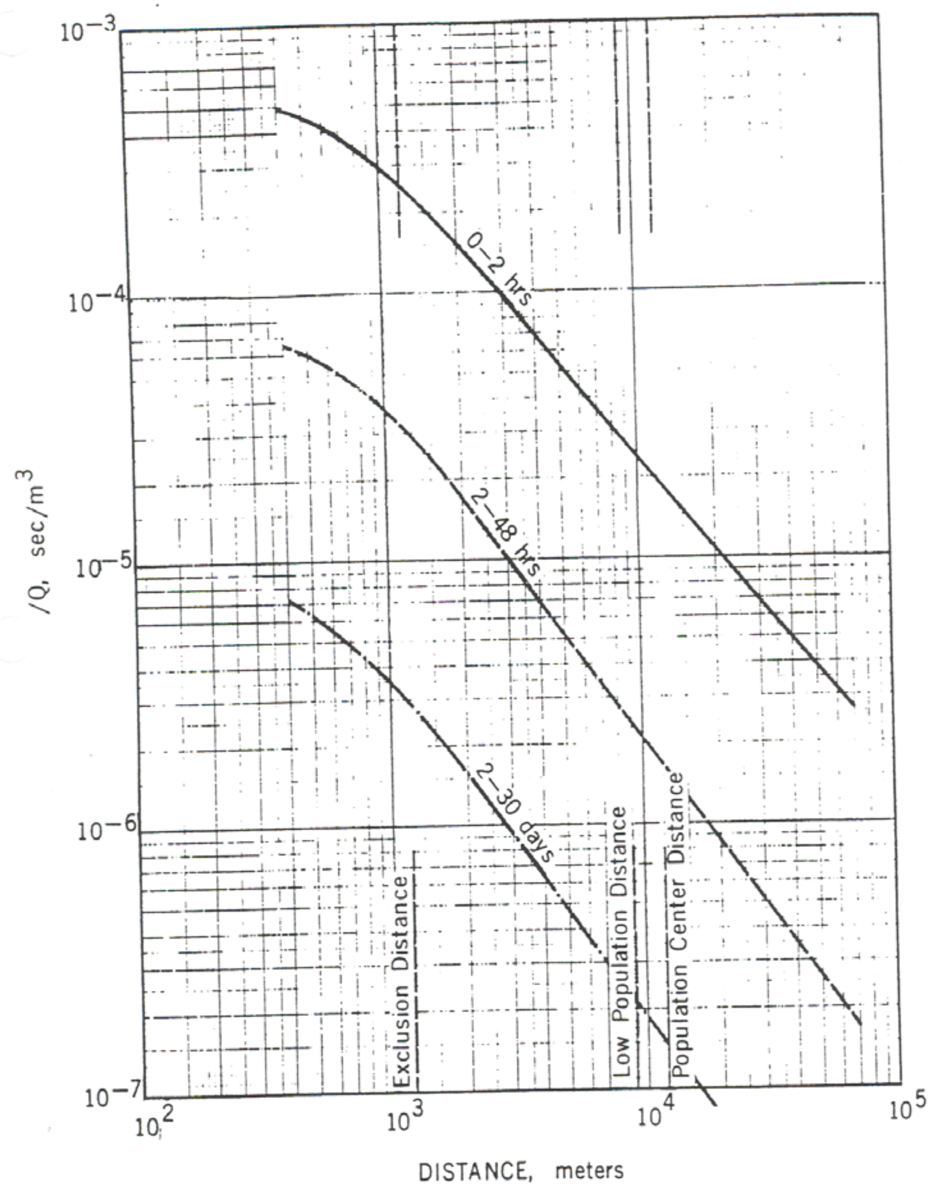


FIG. 2.6-8
REVISED ACCIDENT MODEL
Building Wake Factor = (1x1640)m^2
Point Beach Nuclear Plant

2.7 ENVIRONMENTAL RADIOACTIVITY STUDIES

PRE-OPERATIONAL

A pre-operational environmental radiological monitoring program was started in November, 1967. Monitored variables included air, water, shoreline sediment, soil vegetation, milk and algae samples as listed in Table 2.7-1. Figure 2.7-1 shows the locations of the sampling stations used.

The purpose of the pre-operational environmental program was to test equipment, sampling and analytical procedures, to investigate the suitability of the selected sampling points, and to provide a radiological background base line from which possible changes in radiation levels during and following plant operations could be detected and evaluated.

The milk samples were collected monthly from a local dairy and processed by the Radiation Protection Section of the Wisconsin Department of Health and Social Services. The Radiation Protection Section also agreed to gamma scan lake water samples and perform confirmatory checks on selected Point Beach Nuclear Plant environmental samples.

Soil and vegetation samples were taken at the sample stations listed in Table 2.7-1. All the exclusion area stations were under control of the Licensee, and the off-site stations were chosen with consideration of minimum disturbance by the public and continuing availability for the lifetime of the plant. Soil, air, and vegetation analyses were performed by an outside environmental analysis contractor.

Lake water, shoreline sediment, and algae samples were taken at points along the Lake Michigan shoreline as shown in Table 2.7-1. These samples were also analyzed by an outside environmental contractor.

Since the subsurface water table at the site has a definite lakeward slope, only the plant well was sampled. Pre-operational samples of the plant well were taken and analysis was handled by an outside environmental contractor. Air particulate samples, film badges, and stray radiation chambers were employed for pre-operational studies. These were also analyzed by an outside environmental contractor.

Lake Michigan fish life is undergoing a rapid state of evolution caused by the various programs to introduce salmon and trout species and control the alewife and sea lamprey populations. For this reason and because of the migratory habits of lake fish, an environmental monitoring program concerning lake fish would have had questionable value and was not performed directly by the Licensee. Others in the vicinity of Point Beach Nuclear Plant included fish in their environmental monitoring programs. These included samples taken by the Wisconsin Department of Natural Resources for the Radiation Protection Section of the Wisconsin Department of Health and Social Services and samples from monitoring activities at the Kewaunee Nuclear Plant site approximately 4.5 miles north of the Point Beach site. These studies were considered to provide an adequate baseline for sampling fish in the vicinity of the Point Beach Nuclear Plant.

The lake bottom in the vicinity of Point Beach Nuclear Plant is primarily either solid clay and rock or hard-packed sand. There is very little solid organic material in the bottom sediments due, in part, to the grinding action of suspended sediments. Because of these conditions, there are very few benthic (bottom dwelling) organisms present in the area. Snails were not found in any samples at this time. A few crustaceans, e.g., Pontopareia, had been found, but their populations were not large enough to be practical as an indicator organism.

OPERATIONAL

The operational radiological environmental monitoring program is based on the pre-operational program, and is carried out in accordance with the schedule presented in the Environmental Manual (EM). The program provides sufficient sample types and locations to detect and evaluate changes (if any) in environmental radioactivity due to releases from the plant.

Since plant radioactivity releases are continuously monitored and recorded, the need for environmental monitoring is limited.

Because land in the area is primarily used for farming and dairy operations, sampling of environmental components such as soil or vegetation is implemented to detect changes in radiological conditions at the base of the terrestrial food chain for animals. Since dairy farming is a major industry in the area, area-produced milk is also sampled.

Air particulate samples and thermoluminescent dosimeters at various locations provide means of detecting significant changes in environmental radioactivity as a result of plant releases to the atmosphere.

Locations for terrestrial radiological sampling emphasize monitoring around the site boundary and at various other points out to a distance of 5miles. A single sampling location well beyond a distance of 10 miles in a low χ/Q sector is provided for many sample types to provide an estimate of background levels. The locations are listed and depicted in the EM.

In the aquatic environment, sample types such as lakewater, algae, or shoreline sediment are selected both north and south of the discharge point.

NONRADIOLOGICAL ENVIRONMENTAL STUDIES

A non-radiological environmental program is also implemented at Point Beach Nuclear Plant. Ambient, intake, and condenser cooling water discharge temperatures are monitored. Chemicals and dissolved and suspended solids in liquid plant effluents are also monitored.

In addition to the routine thermal and chemical monitoring of plant effluent, an intensive non-radiological monitoring program was conducted during the first several years of plant operation as required by Technical Specifications. This program includes measurements of physical, chemical, and biological characteristics with a sufficient frequency and at a sufficient number of locations to establish the need and bases for longer term monitoring activities. Additionally, the experimental field was selected such that the short and long term plume effects could be isolated and the relative strength of variables could be established. Measurement of the vertical profiles of the lake water physical and chemical characteristics provide a determination of the physical and chemical spatial effects resulting from natural occurrences and from plant operations. Each

biological measurement was associated, as far as practicable, with a simultaneous set of chemical and physical measurements to enable the observation of potential correlations with plume characteristics, meteorology, or plant operation.

In the early 1990s, zebra mussels were discovered in the vicinity of Point Beach Nuclear Plant. These mussels have been known to cause macroscopic biological fouling in fresh water cooling systems. In response to the potential infestation, routine inspections for zebra mussels are conducted in the cooling water discharge flumes, the outside of the intake crib, the forebay, and service water pump house. In addition, a chlorination / dechlorination system has been installed to control microscopic fouling if zebra mussels or mussel viligers (larvae) are found.

Table 2.7-1 PRE-OPERATIONAL ENVIRONMENTAL RADIOLOGICAL SURVEY FOR THE POINT BEACH NUCLEAR PLANT

Sheet 1 of 2

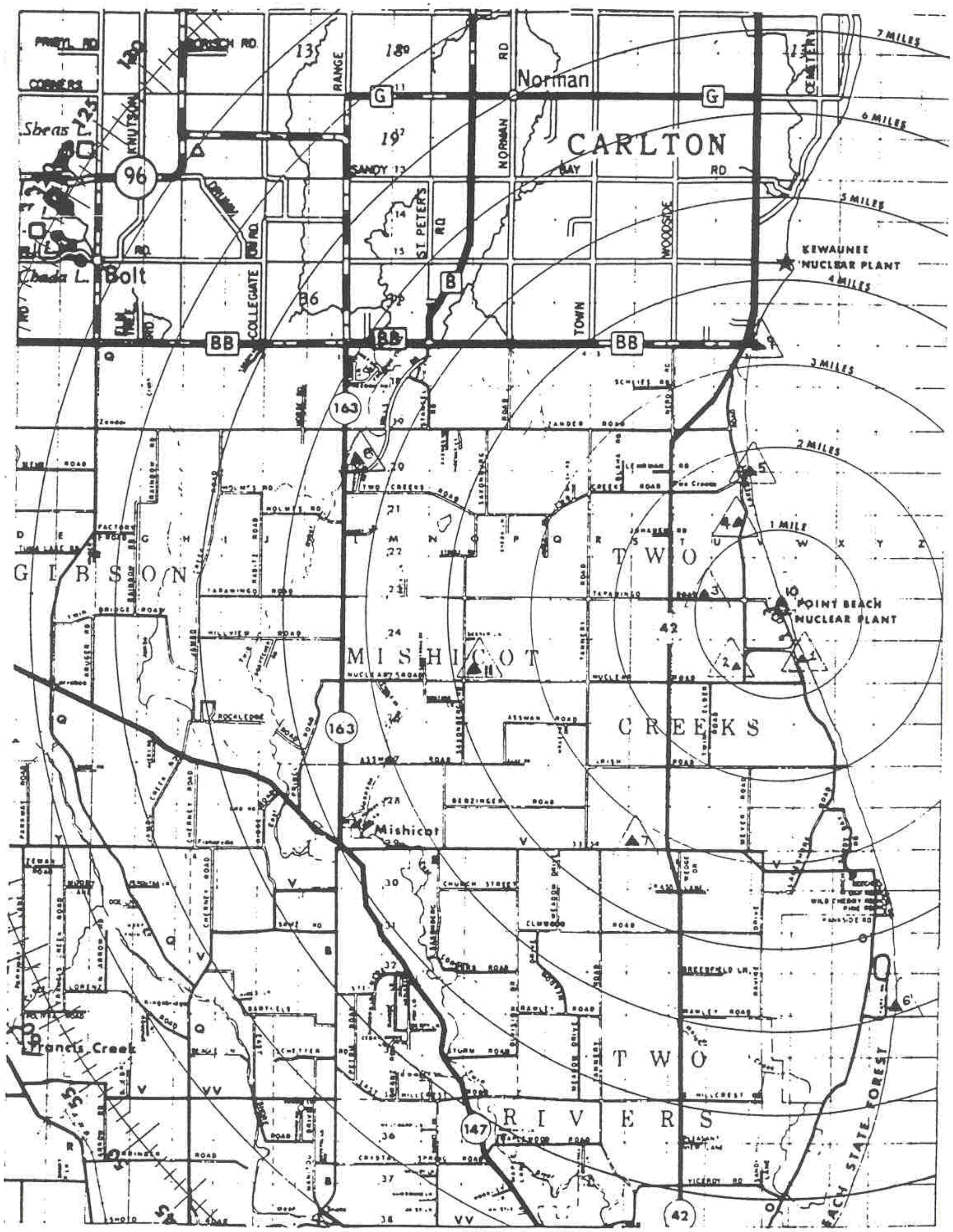
Station Number	Location	Type of Sample	Analysis	Frequency
1	Meteorological tower, south of the plant	Soil Vegetation Film badge Shoreline sediment Lake water Suspended solids Dissolved solids	Gross Beta Gross Beta Integrated Dose Gross Beta Gamma Scan Gross Beta Gross Beta	Annual Biannual Monthly Biannual Biannual Biannual Biannual
2	Southwest boundary of exclusion area	Soil Vegetation	Gross Beta Gross Beta	Annual Biannual
3	West boundary of exclusion area	Soil Vegetation	Gross Beta Gross Beta	Annual Biannual
4	Northern boundary of exclusion area	Soil Vegetation Air particulate Film badge	Gross Beta Gross Beta Gross Beta Integrated Dose	Annual Biannual Weekly Monthly
5	Two Creeks County Park	Shoreline sediment Lake water Suspended solids Dissolved solids Aquatic biota algae	Gross Beta Gamma Scan Gross Beta Gross Beta Gross Beta	Annual Biannual Biannual Biannual Biannual
6	Point Beach State Park	Soil Vegetation Shoreline sediment Lake water Suspended solids Dissolved solids	Gross Beta Gross Beta Gross Beta Gamma Scan Gross Beta Gross Beta	Annual Biannual Biannual Biannual Biannual Biannual
7	Wisconsin Public Service Corporation Substation on County Highway V SW of site	Soil Vegetation	Gross Beta Gross Beta	Annual Biannual
8	Farm just off State Highway 163 NW of site	Soil Vegetation	Gross Beta Gross Beta	Annual Biannual

Table 2.7-1 PRE-OPERATIONAL ENVIRONMENTAL RADIOLOGICAL SURVEY FOR THE POINT BEACH NUCLEAR PLANT

Sheet 2 of 2

Station Number	Location	Type of Sample	Analysis	Frequency
9	Nature Conservancy Buried Forest Site at Manitowoc-Kewaunee County line on the shore of Lake Michigan	Soil Vegetation Shoreline sediment Lake water Suspended solids Dissolved solids	Gross Beta Gross Beta Gross Beta Gamma Scan Gross Beta Gross Beta	Annual Biannual Biannual Biannual Biannual Biannual
10	Well at plant site	Water	Gross Alpha and Beta	Biannual
11	Local milk pool Kornely Dairy, Mishicot	Milk	Gamma Scan Strontium-90	Monthly

Figure 2.7-1 PRE-OPERATIONAL ENVIRONMENTAL RADIOACTIVITY SAMPLING SITES



2.8 GEOLOGY

A geological program involving a regional geological survey, borings, and other tests at the site was completed to provide preliminary information needed to assess foundation conditions, seismic activity, and ground water conditions. A comprehensive foundation investigation was performed (Final Dames and Moore Soils Report), the results of which were filed with the Atomic Energy Commission on January 5, 1967 as a part of the APPLICATION FOR EXEMPTION UNDER SECTION 50.12 OF THE REGULATIONS OF THE AEC (Docket No. 50-266). This investigation disclosed that a pile foundation would be required under the reactor containment and spent fuel pool to minimize differential settlements. The soil is adequate to support other structures at bearing pressures of three to five tons per square foot. Findings concerning ground water and seismology are described in Subsections 2.5 and 2.9, respectively.

GEOLOGICAL PROGRAM

An evaluation of the geological characteristics of the Point Beach site was made as follows:

1. A description of geological structure in the site region was developed, including estimates of the character and thickness of underlying strata. This was based on existing geological data and discussions with geologists working in the area.
2. On-site subsurface conditions were explored with 4-inch diameter test holes up to 132 feet deep and a seismic refraction survey to develop bedrock profiles.
3. Samples of the soils and rock underlying the site were subjected to a variety of laboratory tests to evaluate the physical and chemical properties of the soil and rock.

DESCRIPTIVE GEOLOGY

Regional Geology

The geologic structure of the region is essentially very simple. Gently dipping sedimentary rock strata of Paleozoic age outcrop in a horseshoe pattern around a shield of Precambrian crystalline rock which occupies the western part of the region. The site is located on the western flank of the Michigan Basin, which is a broad downwarp ringed by discontinuous outcrops of more resistant formations. The bedrock formations are principally limestones, dolomites, and sandstones with subordinate shale layers. The Maquoketa shale is the only formation in which shale predominates. The rocks form a succession of extensive layers that are relatively uniform in thickness. The bedrock strata dip very gently towards Lake Michigan at from 15 to 35 feet per mile. A geologic column listing the bedrock units encountered in the area is presented in Table 2.8-1.

Local Geology

The uppermost bedrock under the site is Niagara Dolomite. Bedrock does not outcrop on the site, but is covered by glacial till and lake deposits.

The thickness, texture, and type of deposits are extremely variable from place to place. The soils contain expansive clay minerals and have moderately high base exchange capacity.

In the area of the site, the overburden soils are approximately 70 to 100 feet in thickness. Although the character of the glacial deposits may vary greatly within relatively short distances, a generalized section through the overburden soils adjacent to Lake Michigan at the site consists of the following sequence which is depicted in Figure 2.8-1 and Figure 2.8-2.

1. An upper layer of brown clay silt topsoil underlain with several feet of brown silty clay with layers of silty sand.
2. A layer of 20 feet of reddish-brown silty clay with some sand and gravel and occasional lenses of silt.
3. A layer of 25 feet of reddish-brown silty clay with layers of silty sand and lenses of silt.
4. A layer of 50 feet of reddish-brown silty clay with some sand and gravel, the lower poron of which contains gravels, cobbles, and boulders resting on a glacial eroded surface of Niagara dolomite bedrock.

Elevations shown in Figure 2.8-1 refer to the Plant Datum. Detailed geological data are given in the Dames and Moore Final Foundation Report included in Appendix B to the APPLICATION FOR EXEMPTION UNDER SECTION 50.12 OF REGULATIONS OF THE AEC, Wisconsin Michigan Power Company, Point Beach Unit No.1, (Docket No.50-266).

Table 2.8-1 BEDROCK FORMATIONS IN EASTERN WISCONSIN

Geologic Age	Geologic Name	Description
Quaternary	Recent deposits	Sand, silt, peat, and gravel.
	Pleistocene deposits	Glacial drift, mostly till, clay silt, sand, gravel, and boulders.
Silurian	Niagara Dolomite	Dominate, thin-bedded to massive, some coral reefs. Some chert.
Ordovician	Maquoketa Shale	Shale and dolomitic shale.
	Galena Dolomite Decorah formation Platteville formation	Dolomite. Some shale. Sandy at base.
	St. Peter Sandstone	Sandstone, fine to medium grained dolomitic in places.
	Prairie du Chien Group	Dolomite. Sandy and shaly zones in places.
Cambrian	Trempealean Formation Franconia Sandstone Dresbach Group	Sandstone, fine to coarse grained, dolomitic. Some shale and dolomite beds.
Precambrian	Undifferentiated	Granite and quarzite.

Figure 2.8-1 POINT BEACH BORING LOCATIONS

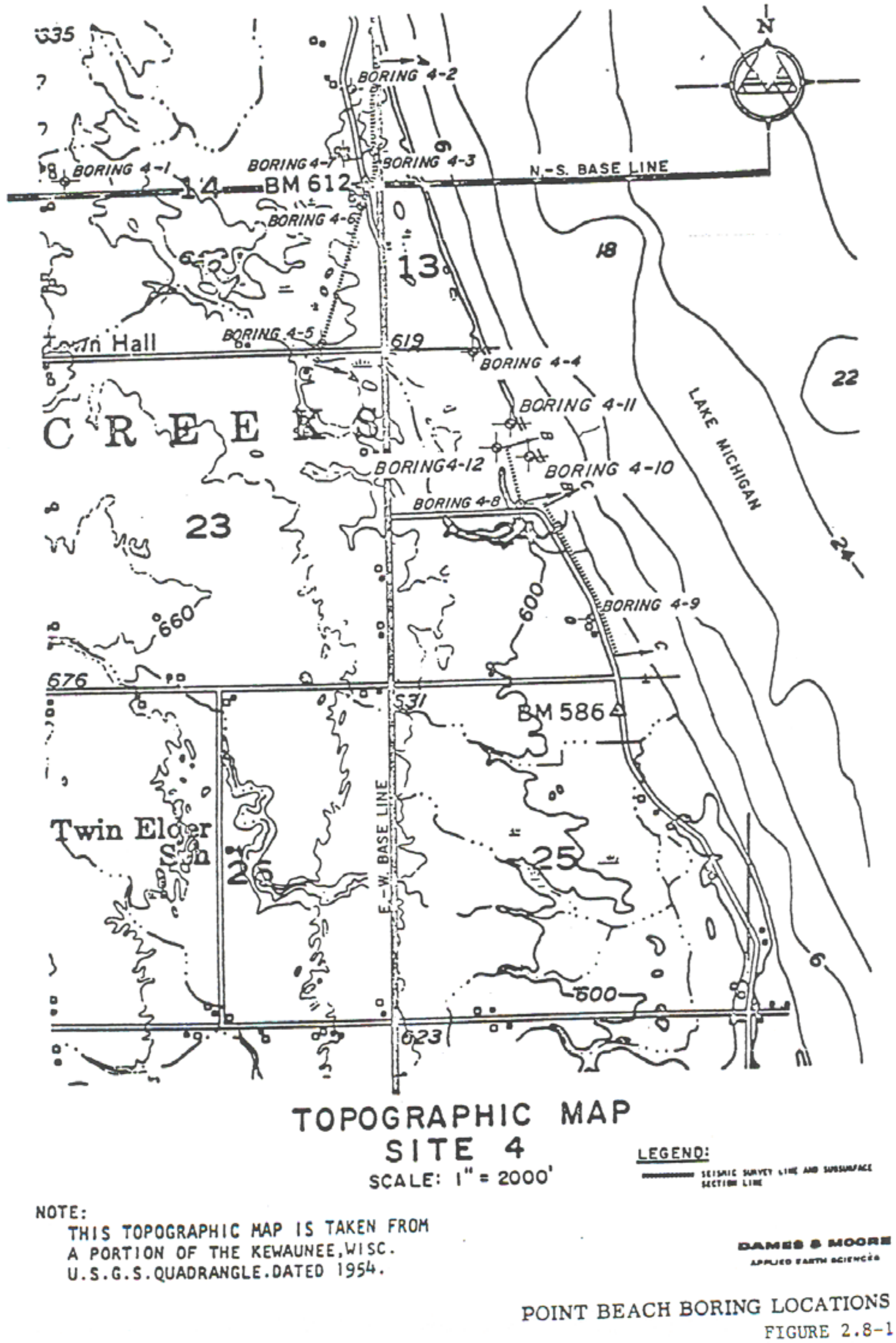


Figure 2.8-2 POINT BEACH BORING LOG

(Sheet 1 of 2)

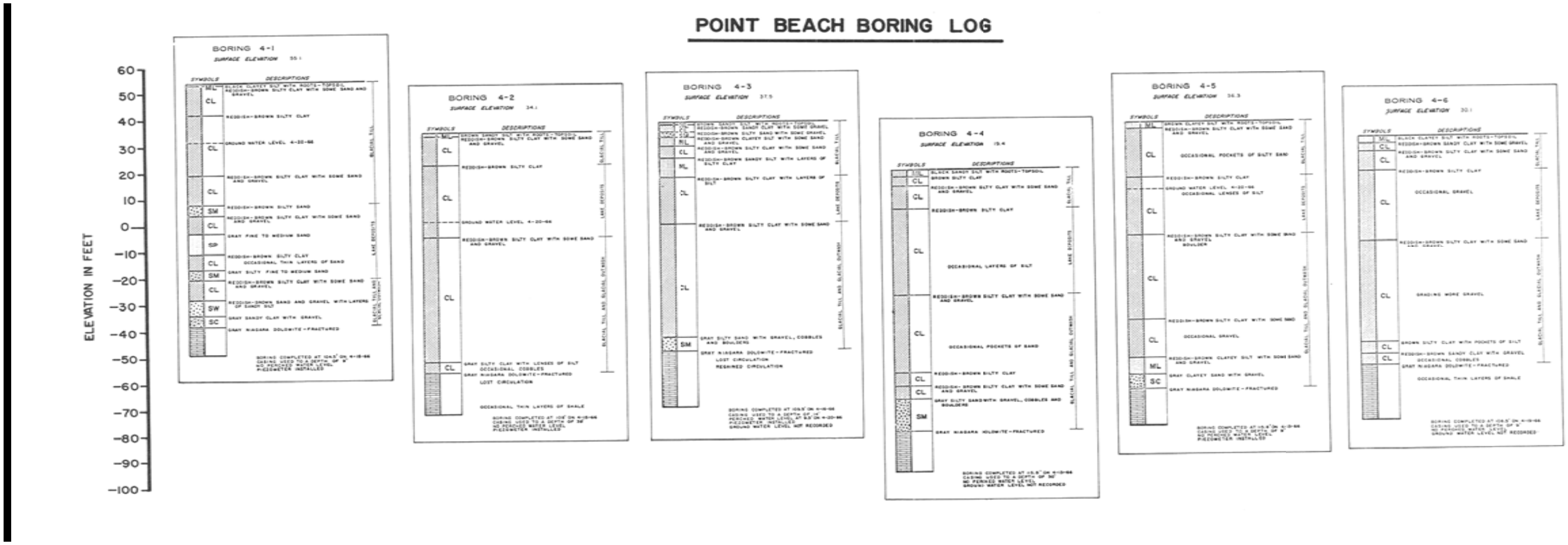
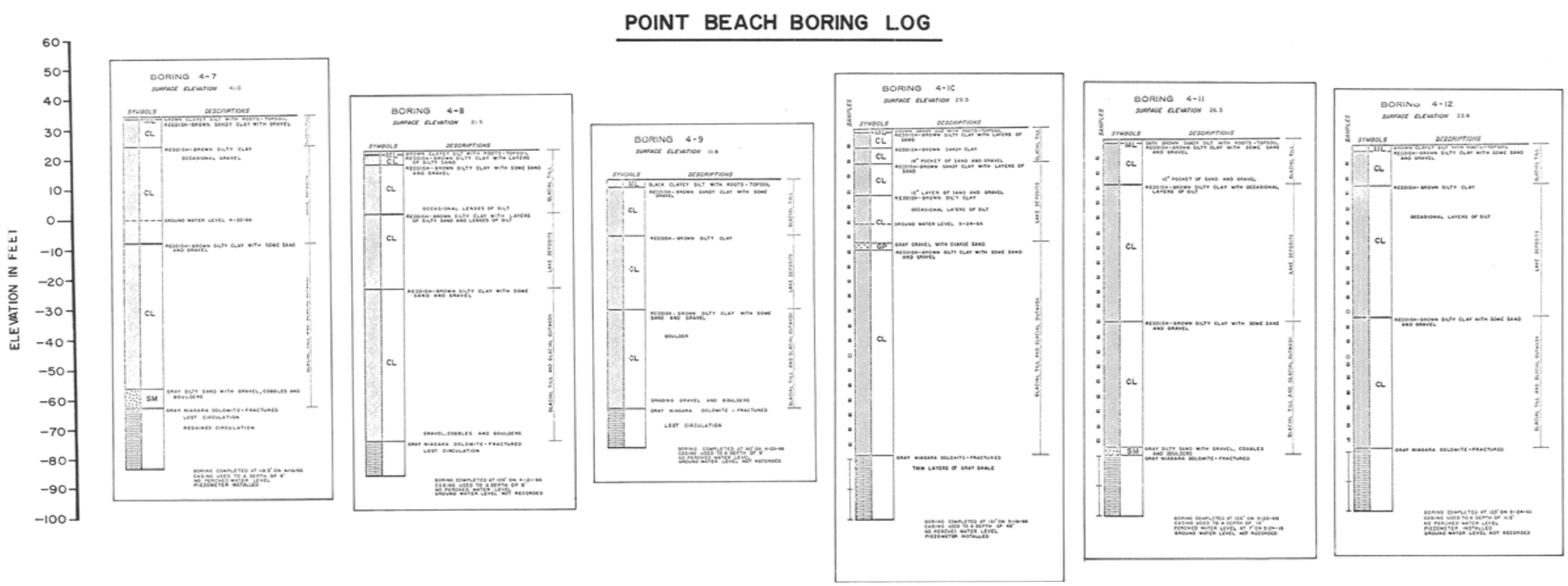


Figure 2.8-2 POINT BEACH BORING LOG

(Sheet 2 of 2)



2.9 SEISMOLOGY

A seismological program has been carried out to provide information for predicting possible seismic effects at the site. Estimates of such effects are described in this section as a basis for judging the seismic design criteria set forth in Chapter 5 and Appendix A. Field investigations have been made by Dames and Moore and are described in Appendix A of the Preliminary Safety Analysis Report for Point Beach Nuclear Plant, Unit 1, Docket No.50-266. Assessments of seismicity by John A. Blume and Associates are set forth in Appendix D of that report.

The seismic history of the region and of this area in particular is young, but a review of these data and the field investigations of Dames and Moore by John A. Blume and Associates permits the opinion that the possibility of damaging earthquakes is relatively minor. It is estimated that the maximum earthshock would produce a horizontal acceleration at the site of less than 0.06 gravity.

SEISMOLOGY PROGRAM

The following explorations were made to evaluate the seismological characteristics of the Point Beach site.

1. An investigation of the earthquake history of northcentral United States was used to develop estimates of the maximum earthquake which could affect the site. All recorded earthquakes in this region with Modified Mercalli (MM) intensity of V or greater were plotted and considered.

   Two local quakes of MM intensity IV and one of MM intensity III are also plotted. They are shown on Figure 2.9-1.

2. Investigations were made of the local and regional geology. This involved examination of drilling logs and the development of a bedrock surface profile from on-site borings, probings, and refraction survey.

DESCRIPTIVE SEISMOLOGY

The northcentral United States is a relatively inactive earthquake area. The Coast and Geodetic Survey, Seismic Probability Map of the United States assigns the area to Zone 0 - no damage. There is no instrumental or verifiable record of large intensity shocks (above MM VII) within 200 miles of the site, and there is no record of damaging earthquakes with epicenters within 100 miles of the site. Appendix D of the Unit 1 Preliminary Safety Analysis Report, Docket No. 50-266 contains a listing of the seismic history of the regions.

None of the maps presently available, including the Tectonic Map of the United States, shows the presence of faults on which the earthquakes of eastern Wisconsin may have originated. It seems highly unlikely that a regional zone of fracture of any magnitude is present but as yet unmapped. There is a strong possibility that local earthquakes are manifestations of the release of residual stresses remaining in the rock since the glacial periods. The Wisconsin drift sheet is the youngest of these, having occurred only a few thousands of years ago.

Neither the seismic history of the site nor the regional tectonics indicates that a large intensity earthquake is to be expected near the proposed site, and the large earthquakes which have occurred at great distances have had but little effect at the site.

Because the constantly operating stress-relieving mechanism suggested above may produce a small shock anywhere in the affected region, a small intensity earthquake very close to the proposed site is postulated.

A horizontal ground acceleration at the site of 0.06g combined with a vertical acceleration of 0.04g are used for the earthquake design criteria. These accelerations are considered as acting simultaneously.

The hypothetical earthquake is twice the magnitude of the design earthquake; the horizontal and vertical accelerations are considered as acting simultaneously. Components that are essential to safety are designed such that there is no loss of function due to seismic effects.

Figure 2.9-1 MAP SHOWING EPICENTERS OF PRINCIPAL EARTHQUAKES IN THE WISCONSIN REGION

MAP SHOWING EPICENTERS OF
PRINCIPAL EARTHQUAKES IN
THE WISCONSIN REGION

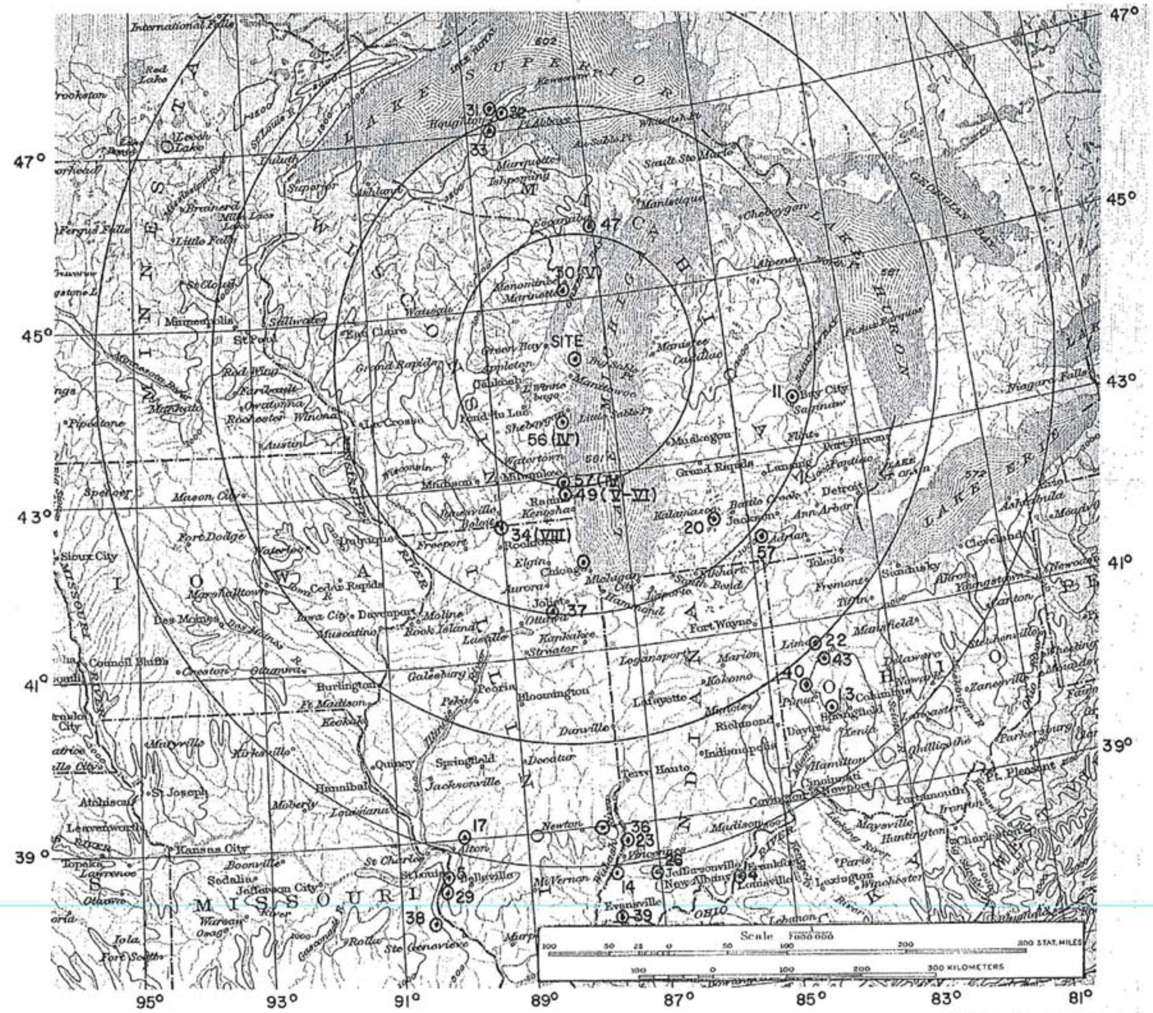


FIG 2.9-1

2.10 ENVIRONMENTAL CONCLUSIONS

POPULATION

One factor influencing the selection of the Point Beach site was the relatively low population density around the site. Analysis of predicted population and existing roads shows that the total number and density of the residents within 5.6 miles of the site (the low population zone as defined in Section 2) is such that there is a reasonable probability that appropriate protective measures could be taken in their behalf in the event of a serious accident. The accident analysis described in Section 14 demonstrates that the offsite dose due to the maximum hypothetical accident for this low population zone is well below the 10 CFR 50.67 limit for the low population zone.

LAND USE

The land use information shows that the surrounding area is devoted to agriculture, the main products being milk or vegetables. Since these products are for human consumption, the environmental monitoring program includes milk and vegetation samples (see Section 2.7). The disposition of the residences with respect to the site at the time of application is indicated in Section 2.

HYDROLOGY

Lake Michigan is the source of plant service and cooling water. Low level liquid wastes is discharged to the lake through the condenser circulating water discharge under carefully controlled and monitored conditions. The maximum allowable concentration at the circulating water outlet does not exceed the limits of 10 CFR 20. Based on operating experience, discharges are less than about 0.03 MPC of 10 CFR 20 per year for all isotopes (Section 11). Additional dilution of any releases from the plant occurs before the water reaches the nearest public water supply intake 12 miles away. This dilution factor is 2.9×10^{-10} μCi/cm^3 per mCi/sec for continuous release and 2.0×10^{-14} for μCi/cm^3 per μCi for batch releases. Since it is estimated that the peak concentration at the nearest intake will occur 50 hours after a batch release, there is ample time after an accidental release to take appropriate action for the public water supplies. Sources of other nearby public water supplies are wells which lie north, south, or west of the site. Since the ground water table has a definite eastward slope (towards the lake) and the soils are relatively impervious, the possibility of contaminating any water supply by an accidental release of radioactivity on the site or nearby is remote. Furthermore, the surface waters on the site flows directly to Lake Michigan either through the storm sewer system or through the two small creeks which drain the site. The plant potable water well is periodically sampled for radioactivity as a check.

The water level in Lake Michigan is dependent on rainfall and does not vary greatly. Other than the Circulating Water Pump House (CWPH), the lowest plant elevation having drain connections to the lake is at Elevation +8.0' which is 6.3 feet above the highest level recorded to date. The CWPH has floor relief dampers at Elevation +7.0'. The existing natural drainage system now draining the site is adequate to prevent flooding of the site due to rainfall and snowmelt. Thus, there is no danger of inundating equipment due to rainfall, snow melting, or longtime variation in

lake levels. Possible inundation of plant equipment due to waves or seiches is discussed in Section 2.5. Protection of the plant from ice in Lake Michigan is discussed in Section 2.5. No safety problem is expected to occur from fishing. Radioactivity in Lake Michigan is monitored as described in Section 2.7.

GEOLOGY

The Final Dames and Moore Soils Report filed with the Atomic Energy Commission on January 5,1967 as Appendix B to the APPLICATION FOR EXEMPTION UNDER SECTION 50.12 OF THE REGULATIONS OF THE AEC, indicated that the containment structure would undergo settlements of up to 2 inches relative to adjacent structures if it were placed on a mat foundation. In addition, the report indicates an ultimate soil bearing value of 15,000 lb/sq ft and recommends a safety factor of 3 for dead and permanent live loads, and a factor of safety of 2 1/ 2 for dead, live, and seismic loads in combination; the recommended design values are, therefore, 5000 and 6000 lb/sq ft, respectively.

The soil bearing loads under a containment mat and the fuel pool would have exceeded the above recommendations with no opportunity to spread the foundation to reduce bearing loads to tolerable values. Therefore, the decision was made to put the containment structure and fuel pool on piles. The differential settlements are in the order of 1/4 inch with the fuel pool and containment structure on piles. The soil bearing loads of all other structures in the plant are held to approximately 4000 lb/sq ft for dead and live loads and 5300 lb/sq ft for dead and live loads in combination with seismic or wind loads.

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