TABLE OF CONTENTS

CHAPTER 3.0

DESIGN OF STRUCTURES, COMPONENTS, EQUIPMENT AND SYSTEMS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES (Continued)

LIST OF FIGURES (Continued)

3.3 WIND AND TORNADO LOADINGS

3.3.1 WIND LOADINGS

3.3.1.1 Design Wind Velocity

The design wind velocity for all site-related Category I structures is 85 mph at 30 feet above ground for a 100 year recurrence interval. The bases for the wind velocity selection and supporting data and wind histories are contained in Section 2.3 and in Section 2.0 of BC-TOP-3-A.

As referenced in BC-TOP-3-A, ANSI-A58.1 (Ref. 1) is used as the basis for determining the vertical velocity distribution and gust factors. The wind pressure values listed in Section 6 of ANSI-A58.1 are the highest for exposure "C" which is flat, open country. Therefore, this exposure is adopted as a basis for determining the wind pressure values. Table 5 of ANSI-A58.1 for exposure "C" is used to determine effective velocity pressures on parts and portions of buildings and structures. The basic design wind velocity of 85 mph is used, and the tables take into account the effects of vertical velocity distribution and gust factors.

3.3.1.2 Determination of Applied Forces

Refer to Standard Plant FSAR Section 3.3.1.2.

3.3.2 TORNADO LOADINGS

Refer to Standard Plant FSAR Section 3.3.2.

3.3.2.1 Applicable Design Parameters

Refer to Standard Plant FSAR Section 3.3.2.1.

3.3.2.2 Determination of Forces on Structures

The methods employed to convert tornado loadings into forces and the distribution across the structures are outlined in Section 3.5 of BC-TOP-3-A. Load components of tornado effects are combined in accordance with Section 3.4 of BC-TOP-3-A. Load combinations involving tornado effects are stated in FSAR Section 3.8. A load factor of 1.0 for tornado effects is used and is based on the low probability of a tornado striking a specific geographical point and the degree of conservatism in the selection of the wind velocity for the design basis tornado.

All site-related, Category I structures, except the ultimate heat sink (UHS) cooling tower, are designed to prevent venting. The UHS cooling tower is fully vented because it is open throughout from the air inlets to the air outlets. The methods employed to determine the nominal venting pressures in the UHS cooling tower are

found in Section 3.5 of BC-TOP-3-A.

3.3.3 REFERENCES

1. American National Standards Institute (ANSI), Building Code Requirements for Minimum Design Loads in Buildings and Other Structures, A58.1-1972.

3.4 WATER LEVEL (FLOOD) DESIGN

3.4.1 FLOOD PROTECTION

3.4.1.1 Flood Elevations

The derivation and basis for flood elevations at the Callaway site are discussed in Section 2.4. The grade elevation of the plant structures is Elevation 840.0 feet MSL (Standard Plant Elevation 1999.5 feet), which is well above the probable maximum flood (PMF) elevation of 548.0 feet MSL on the Missouri River.

The only site-related structures required for the safe shutdown of the plant which are designed for dynamic water forces caused by flooding are the sides of the Category I ultimate heat sink (UHS) retention pond and the essential service water system (ESWS) pumphouse. These structures are subject to the forces resulting from the 48-hour local probable maximum precipitation (PMP) coincident with wave activity in the UHS retention pond. The resulting design flood elevation in the pond under this condition is Elevation 1997.2 feet. The maximum wave runup on the riprapped slopes caused by the 40 mph wind coincident with the PMF water level reaches Elevation 1997.8 which is below the top of the minimum surrounding plant grade elevation of 1999.5 feet. (Refer to Section 2.4.8.2). Both the UHS cooling tower and the ESWS pumphouse have penetrations below the design flood elevation in the UHS retention pond.

The UHS cooling tower is connected to the UHS retention pond by 36-inch-diameter ESWS discharge pipes from the cooling tower basin (Figure 3.8-4). The only safety-related components in the basin are ESWS pipes that are capable of normal function while surrounded by the design flood and any other additional water when the UHS cooling tower is operating.

The ESWS pumphouse extends into the UHS retention pond and takes suction from it through penetrations below both the design normal pond elevation and flood elevation (Figure 3.8-2). The only safety-related components in the pumphouse in contact with the design flood are the casings, shafts, and impellers of the ESWS pumps which are capable of normal function while surrounded by the design flood.

3.4.1.2 Ground Water Elevations

The design basis ground water for buoyancy and subsurface hydrostatic loadings on all site-related Category I structures is full hydrostatic pressure at all depths below Elevation 1999.5 feet. (Refer to Section 2.4.13.5). All Category I structures are protected below grade by waterstops at construction joints and electrical duct bank penetrations and flexible material at pipe penetrations, where necessary. Table 3.4-1 describes the site-related Category I structures that house safety-related equipment and identifies exterior penetrations that are below the design basis ground water elevation.

3.4.2 ANALYSIS PROCEDURES

3.4.2.1 Design Basis Flood in the UHS Retention Pond

The design of the sides of the Category I UHS retention pond for the static and dynamic effects of the postulated wind-wave activity shown in Table 3.4-2 is described in Sections 2.4.3.6 and 2.4.3.5.

The design of the walls of the ESWS pumphouse for the static and dynamic effects of the postulated wind-wave activity shown in Table 3.4-2 is in accordance with the load factors and loading combinations stated in Section 3.8 for live loads not coincident with earthquake or tornado loads. The load from the maximum postulated static water elevation in the pond is applied as a hydrostatic force, and the dynamic effect of the nonbreaking waves in the pond is converted to an equivalent hydrostatic force to the elevation shown in Table 3.4-2 and Figures 3.4-1 and 3.4-2. The wave forces from the nonbreaking waves on the face of the ESWS pumphouse are determined based on the procedure presented in the Shore Protection Manual (Ref. 1). Flooding of the ESWS pumphouse is precluded because there are no openings on the front face of the pumphouse above the floor slab elevation at 2000 feet. Refer to Section 2.4 for a description of the bases for the data in Table 3.4-2.

3.4.2.2 Design Basis Ground Water

Structures as a whole and component parts are designed for the hydrostatic forces from the maximum ground water level in accordance with the load factors and loading combinations stated in Section 3.8.

3.4.3 REFERENCES

1. U. S. Army Coastal Engineering Research Center, "Shore Protection Manual," Department of the Army, Corps of Engineers, 1973.

TABLE 3.4-1 SITE-RELATED CATEGORY I STRUCTURES WITH PENETRATIONS BELOW THE GROUND WATER ELEVATION

Structure and Figure References	Areas Below Ground Water Level and Their Penetrations	Safety-Related Components in Areas Below Ground Water Level	Inleakage Protection	Discussion
ESWS Pumphouse (Figures 3.8-1, 3.8-2, 3.8-3 and 3.8-8)	1. Sumps for ESWS pumps and 7.5 feet x 8 feet penetrations for water entry from UHS retention pond.	1. Casings, shafts and impellers of the ESWS pumps	1. None	1. Sumps are normally full of water
	2. Pipe chases for ESWS pipes and their sleeved penetration through the walls of the chase	2. ESWS pipes	2. Bootseal installed between the ESWS pipes and sleeves in the walls	
ESWS Electrical Manholes (Figures 3.8-10 and 3.8-11)	All manholes which have numerous penetrations for electrical duct banks	Electrical cable	Waterstops at construction joints and penetrations	
UHS Cooling Tower (Figures 3.8-8, 3.8-9 and 3.8-10)	Basins and chases in electrical rooms for pipes and electrical duct banks which penetrate chase walls	ESWS pipes and electrical cable	Waterstops at construction joints (except at basin) and electrical duct bank penetrations. Bootseal installed between pipe and pipe sleeves in walls	

TABLE 3.4-1 (Continued) (Sheet 2 of 2)

Structure and Figure References	Areas Below Ground Water Level and Their Penetrations	Safety-Related Components in Areas Below Ground Water Level	Inleakage Protection	Discussion
ESW Supply Lines Yard Vault	Pipe chase for ESW pipes and their sleeved penetration through the wall	ESWS pipes	Bootseal between the ESWS pipes and sleeves in walls	

TABLE 3.4-2 WIND-GENERATED WAVE DATA FOR UHS RETENTION POND AND ESWS PUMPHOUSE

	Case 1	Case 2
Wind Speed	40 mph (normal)	118 mph (extreme)
Significant Wave Height, H	0.7 ft	2.4 ft
Maximum Wave Height, H	1.2 ft	4.0 ft
Static Water Surface Elevation	1997.2 ft (probable max. water level)	1995.5 ft
Dynamic (Equivalent Static) Water Surface Elevation at the Face of the ESWS Pumphouse for period of Wave Motion	1998.8 ft 1.5 sec	2001 ft 2.5 sec
Wave Runup of Riprapped Slopes of the UHS Retention Pond for Period of Wave Motion	1997.8 ft 2.25 sec	1997.6 ft 3.75 sec

(a) For Case 1, the normal wind is coincident with the PMP on the pond.

(b) For Case 2, the extreme wind occurs over the normal pond water level.

(c) This level includes 0.6 ft. calculated wave runup. Wind setup is negligible for this case.

(d) This level includes 0.1 ft. calculated wind setup and 2.0 ft. calculated wave runup.

3.5 MISSILE PROTECTION

3.5.1 MISSILE SELECTION AND DESCRIPTION

3.5.1.1 Missiles Generated by Events Near the Site

Refer to Site Addendum Section 2.2.3.

3.5.1.2 Aircraft Hazards

Sections 2.2.1.3.1 and 2.2.1.3.2 describe the locations of airports and air routes in the vicinity of the Callaway plant site. Aircraft movements at these airports and on the air routes do not pose any undue risk to the safe operation of the Plant. The location of the Plant with respect to airports and air routes meets the criteria set forth in the Standard Format Guide (R.G. 1.70), section 3.5.1.6 as explained in the following:

a. There are no airports within 10 miles of the plant site.

b. The nearest commercial airport, Fulton Memorial, and two private airstrips are located 12 miles beyond the site. The annual number of operations at these airports is less than 1,000 d^2, where d is the distance from the airport to the site in miles.

c. There are four low-altitude airways passing 5 miles beyond the plant and their annual movements are less than 1,000 d^2.

d. No military routes pass within 20 miles of the plant site.

Since aircraft movements at airports and on air routes do not pose any undue risk to the safe operation of Callaway Plant, no design-basis aircraft impact is postulated.

3.5.2 STRUCTURES, SYSTEMS, AND COMPONENTS TO BE PROTECTED FROM EXTERNALLY GENERATED MISSILES

The turbine and tornado missiles which, if generated, could affect the safety of the plant are discussed in Standard Plant FSAR Section 3.5.1.

The probability of significant damage (P_4) to critical components in the plant due to turbine failure has been assessed by first determining the separate probabilities of turbine failure and missile ejection (P_1, Refer to Standard Plant FSAR Section 3.5.1.3.4), such a missile striking a critical component or entire structure of safety significance (P_2), and significant damage occurring to the component (P_3, Refer to Standard Plant FSAR Section 3.5.1.3.4). Then the overall annual probability $P_4 = P_1 \times P_2 \times P_3$.

The probability P_1 of a missile ejection must be less than 10^{-5} per year. For an operating period of 100,000 hours, the probability P_1 is 6 x 10^{-9} for the entire period (refer to Standard Plant FSAR Section 3.5.1.3.4). This value is sufficiently low that no specific protective measures are required for turbine missiles.

Figures 3.5-1 through 3.5-5 identify the safety-related structures, including those outside the Power Block, within the turbine missile trajectory.

Protective measures are provided to minimize the effect of potential tornado-generated missiles. The protective structures, shields, and barriers are designed utilizing the procedures given in Standard Plant FSAR Section 3.5.3.

The portions of the Essential Service Water System (ESWS) located outside the Power Block, the ultimate heat sink (UHS), and their associated protective structures, shields and barriers are discussed below.

3.5.2.1 Essential Service Water System (ESWS) Pumphouse

The ESWS pumphouse is a tornado-resistant, reinforced concrete structure on a common foundation having redundant operating floors at Elevation 2000'-0". The separation of trains of the ESWS is provided by interior barrier walls. A tornado-resistant skimmer wall at the UHS retention pond interface provides protection for the ESWS pumps, whose suction ends are located 25 feet below the normal surface of the pond. Tornado-resistant shields protect the inlets and outlets of the ventilation system at the roof elevation and protect the personnel doors at grade level. Tornado-resistant covers protect the roof openings.

Figures 3.8-1 through 3.8-3 show the tornado missile protection for the safety-related penetrations in the ESWS pumphouse.

3.5.2.2 ESWS Pipes, Electrical Duct Banks, Manholes, and ESWS Supply Lines Yard Vault

When not protected by concrete, all ESWS pipes are buried a minimum depth of 4.5 feet to resist the effects of tornado-generated missiles and frost penetration. All ESWS electrical duct banks are reinforced concrete structures which are buried a minimum depth of 3.5 feet to resist the effects of tornado-generated missiles.

The buried ESWS electrical manholes and ESWS supply lines yard vault are tornado-resistant, reinforced concrete structures with missile-resistant manway covers and roofs. Figure 3.8-11 shows the tornado missile protection for the ESWS electrical manholes.

3.5.2.3 Ultimate Heat Sink (UHS) Cooling Tower

The UHS cooling tower is a tornado-resistant, reinforced concrete structure located as shown in Figure 3.5-1. A perimeter missile shield protects the tower shear walls from tornado missiles and prevents tornado missiles from entering the fill areas of the cooling tower. Exterior and interior walls divide the tower into four cells, providing horizontal tornado missile protection and support for the vertical tornado missile protection above the fan blades. The personnel door at elevation 2035 feet is a tornado-resistant, missile door.

Attached to the UHS cooling tower are two tornado-resistant, reinforced concrete electrical rooms which contain pipes, valves, and electrical equipment. Tornado-resistant missile shields protect the inlets and outlets of the ventilation system at the roof elevation. Tornado-resistant covers protect the roof openings. The personnel door at grade is a tornado-resistant, missile door.

Figures 3.8-12 through 3.8-14 show the tornado missile protection for the safety-related penetrations in the UHS cooling tower and electrical rooms.

3.5.2.4 Ultimate Heat Sink (UHS) Retention Pond and Auxiliary Structures

The UHS retention pond, which contains emergency makeup water for the UHS cooling towers, is an excavation in existing and fill soils. The design depth of the pond water is 18 feet. The ESWS intakes are located 25 feet below the design level of the pond in protected pumpwells. The ESWS discharge piping is buried below grade from the UHS cooling towers to the pond, where it terminates at discharge structures. The reinforced concrete discharge structures are positioned at the bottom of the pond and are sufficiently protected from tornado-missile damage by being submerged.

The reinforced concrete outlet structure is a slab on grade. This structure and non-Category I headwall structure for the pond makeup water are not required to be tornado missile-resistant because they serve no safety-related function in accordance with the requirements of 10CFR50, Appendix A, General Design Criteria 4.

TABLE 3.5-1 DELETED

3.7 SEISMIC DESIGN

The following material applies to the site-related, Category I structures, systems, and components.

3.7.1 SEISMIC INPUT

3.7.1.1 Design Response Spectra

The site design response spectra in compliance with Regulatory Guide 1.60 are illustrated in Figures 3.7-1 and 3.7-2, in both the horizontal and vertical directions for the 0.20 g safe shutdown earthquake (SSE). For the operating basis earthquake (OBE), the design response spectra values are taken as 60 percent of the SSE. Section 2.5.2 and BC-TOP-4A, Section 2.5, discuss the effects of focal and epicentral distances from the site, depths between the focus of the seismic disturbances and the site, existing earthquake records, and the associated amplification of the response spectra.

A 20.48-second duration is considered to be adequate for the time-history type of analysis used for the structures and equipment.

The design response spectra and earthquake time-histories are applied in the free field at finish grade.

For analysis of piping, Code Case N-411-1, "Alternate Damping Values for Response Spectra Analysis of Classes 1, 2, and 3 Piping, Section III, Division I," may be applied subject to the conditions imposed by the NRC staff in Regulatory Guide 1.84.

3.7.1.1.1 Bases for Site Dependent Analysis

Section 2.5.2 and BC-TOP-4A, Sections 2.4 and 2.5, describe the bases for specifying the vibratory ground motion for design use.

3.7.1.2 Design Time-History

Synthetic earthquake time-histories were generated because the response spectra of recorded earthquake motions do not necessarily envelop the site's design spectra. Standard Plant FSAR Figures 3.7(B)-3 and 3.7(B)-4 show the synthetic earthquake time-history motions for the SSE in the horizontal and vertical directions, respectively. Figures 3.7-3 through 3.7-8 show that the 10-percent, 7-percent, and 5-percent damping response spectra of the site synthetic time-history in the horizontal and vertical directions envelop the corresponding design spectra. Section 2.5.1 and BC-TOP-4A describes the generation of a typical synthetic earthquake time-history.

A typical foundation-level, free-field acceleration response spectrum for the ESWS Pumphouse is presented in Figure 3.7-9. The curve overlies the 60-percent design response spectrum and reflects raising of the ground spectrum at affected frequencies.

A typical foundation-level, free-field acceleration response spectrum for the UHS Cooling Tower is presented in Figure 3.7-10. Since the ground spectrum quite significantly exceeds the 60-percent design response spectrum in the regime of the fundamental mode frequency (5.5 Hz), no adjustments were made to the ground spectrum.

Conservative design seismic loads and floor response spectra are obtained by use of the computed foundation free-field response spectra and by broadening the floor response spectra by ± 10 percent.

3.7.1.3 Supporting Media for Seismic Category I Structures

A description of the supporting media for site-related Category I structures is provided in Section 2.5.4. Figure 3.7-11 provides the free-field soil profile.

Table 3.7-1 presents all site-related Category I structures and respective depths of soil or backfill deposits over bedrock.

3.7.2 SEISMIC SYSTEM ANALYSIS

3.7.2.1 Seismic Analysis Methods

Refer to Standard Plant FSAR Section 3.7(B).2.1 and the following table and figures:

1. Table 3.7-2 which lists the method of analysis for the site-related Category I structures.

2. Figure 3.7-12 which shows the typical mathematical model for the ESWS pumphouse.

3. Figure 3.7-13 which shows the typical mathematical model for the UHS cooling tower.

3.7.2.2 Natural Frequencies and Response Loads

The SSE and OBE fundamental mode frequencies in each global direction are presented in Table 3.7-3 for the ESWS pumphouse and in Table 3.7-4 for the UHS cooling tower.

Summary of response parameters determined by seismic analysis is provided in Table 3.7-5 for the ESWS pumphouse and in Table 3.7-6 for the UHS cooling tower which respectively identify their characteristic responses.

Typical floor response spectra are presented in Figure 3.7-14 for the ESWS pumphouse (SSE and OBE) and if Figure 3.7-15 for the UHS cooling tower (SSE and OBE).

3.7.2.3 Soil/Structure Interaction

Refer to Standard Plant FSAR Section 3.7(B).2.4 and Table 3.7-2 where foundation embedment depth below grade, minimum base dimension, and method of analysis are given. Refer to Standard Plant FSAR Section 3.7(B).2.4 for a description of the FLUSH finite element method of analysis. Structures completely buried below grade (ESWS electrical manholes, ESWS Supply Lines Yard Vault, and UHS discharge structures) move with the ground motion as a single, lumped mass. To account for the inertial effects of the walls and slabs due to the ground motion, the mass of the walls and slabs are multiplied by the site SSE and OBE. To account for the effects of soil pressures on the walls due to the ground motion, additional soil pressures as a function of the site SSE and OBE are applied to the walls (refer to Table 2.5-51). This procedure is conservative in the design of buried structures. Since response spectra are not needed for equipment qualification, finite element analysis is not performed.

TABLE 3.7-1 DEPTH OF SOIL AND GRAYDON CHERT CONGLOMERATE DEPOSITED OVER BEDROCK SITE-RELATED CATEGORY I STRUCTURES

Structure	Approximate Elev. of Bottom of Base Mat	Average Elev. of Top of Rock	Average Depth of Soil Over Rock (feet)
ESWS Pumphouse	1966'-4"	1946'-6"	19'-10"
ESWS Electrical Manholes	1973'-5"	1938'-6"	34'-11"
UHS Cooling Tower	1993'-0"	1939'-6"	53'-6"
UHS Discharge Structures	1977'-0"	1934'-6"	42'-6"

TABLE 3.7-2 FOUNDATION DEPTH BELOW GRADE, MINIMUM BASE DIMENSION AND METHOD OF ANALYSIS FOR SITE-RELATED CATEGORY I STRUCTURES

Structure	Approximate Foundation Embedment Depth Below Grade (feet)	Approximate Minimum Base Dimension (feet)	Ratio of Embedment Depth to Minimum Base Dimension	Method of Analysis
ESWS Pumphouse	33	86	0.384	1
ESWS Electrical Manholes	26	11	2.364	2
ESWS Supply Lines Yard Vault	13	17	0.765	2
UHS Cooling Tower	7	117	0.060	1
UHS Discharge Structures	23	6	3.833	2

1. Finite-element method, FLUSH computer program.

2. Single lumped mass-spring method - structures are buried below grade.

TABLE 3.7-3 SUMMARY FUNDAMENTAL MODE FREQUENCIES (HZ)
ESWS PUMPHOUSE

Item/Direction	SSE	OBE
^{f}North-South	8.5	8.7
^{f}East-West	8.0	8.0
^{f}Vertical	8.0	9.5

TABLE 3.7-4 SUMMARY FUNDAMENTAL MODE FREQUENCIES (HZ)
UHS COOLING TOWER

Item/Direction	SSE	OBE
^{f}North-South	5.5	5.7
^{f}East-West	5.2	5.3
^{f}Vertical	8.1	9.7

TABLE 3.7-5A SPECTRAL RESPONSE SUMMARY - ESWS PUMPHOUSE - 0.20G SSE

REF. Figure 3.7-12

			NORTH-SOUTH DIRECTION						EAST-WEST DIRECTION						VERTICAL DIRECTION				
Mass Point No.	Elevation	Lumped Weight (kips)	Flush Model Node Point No.	Max. Accel's. (g's)	Inertia Forces (kips)	Shear Forces (kips)	Bending Moments (kip-ft)	Displace-ments (inches)	Flush Model Node Point No.	Max. Accel's. (g's)	Inertia Forces (kips)	Shear Forces (kips)	Bending Moments (kip-ft)	Displace-ments (inches)	Flush Model Node Point No.	Max. Accel's. (g's)	Inertia Forces (kips)	Axial Forces (kips)	Displace-ments (inches)
(4)	2038'-6"	979	101	.288	282		0	.094	185	.500	489		0	.096	185	.378	370		.060
						282						489						370	
(3)	2025'-0"	3,218	103	.250	806		3,800	.085	187	.397	1,278		6,600	.088	187	.376	1,211		.060
						1,088						1,767						1,581	
(2)	2000'-0"	5,349	105	.216	1,153		31,000	.067	189	.244	1,304		50,800	.075	189	.361	1,930		.055
						2,241						3,071						3,511	
(1)	1969'-6"	3,019	-	.179	539		99,400	.035	-	.189	570		144,400	.037	-	.242	731		.018
						2,780						3,641						4,242	
-	1966'-6"	-	175	.179	-		107,700		273	.189	-		155,400		287	.242	-		

TABLE 3.7-5B SPECTRAL RESPONSE SUMMARY - ESWS PUMPHOUSE - 0.12G OBE

REF. Figure 3.7-12

Mass Point No.	Elevation	Lumped Weight (kips)	NORTH-SOUTH DIRECTION						EAST-WEST DIRECTION						VERTICAL DIRECTION				
			Flush Model Node Point No.	Max. Accel's. (g's)	Inertia Forces (kips)	Shear Forces (kips)	Bending Moments (kip-ft)	Displace-ments (inches)	Flush Model Node Point No.	Max. Accel's. (g's)	Inertia Forces (kips)	Shear Forces (kips)	Bending Moments (kip-ft	Displace-ments (inches)	Flush Model Node Point No.	Max. Accel's. (g's)	Inertia Forces (kips)	Axial Forces (kips)	Displace-ments (inches)
④	2038'-6"	979	101	.175	171		0	.036	185	.278	272		0	.058	185	.190	186		.028
						171						272						186	
③	2025'-0"	3,218	103	.153	493		2,300	.032	187	.227	731		3,700	.051	187	.189	609		.028
						664						1,003						795	
②	2000'-0"	5,349	105	.112	598		18,900	.025	189	.148	790		28,700	.039	189	.177	948		.026
						1,262						1,793						1,743	
①	1969'-6"	3,019	-	.093	281		57,400	.014	-	.088	265		83,400	.014	-	.116	349		.006
						1,543						2,058						2,092	
-	1966'-6"	-	111	.093	-		62,000		273	.088	-		89,600		273	.116	-		

TABLE 3.7-6A SPECTRAL RESPONSE SUMMARY - UHS COOLING TOWER (SHELL) - 0.20G SSE

REF. Figure 3.7-13B

			NORTH-SOUTH DIRECTION						EAST-WEST DIRECTION						VERTICAL DIRECTION				
Mass Point No.	Elevation	Lumped Weight (kips)	Flush Model Node Point No.	Max. Accel's. (g's)	Inertia Forces (kips)	Shear Forces (kips)	Bending Moments (kip-ft)	Displace-ments (inches)	Flush Model Node Point No.	Max. Accel's. (g's)	Inertia Forces (kips)	Shear Forces (kips)	Bending Moments (kip-ft)	Displace-ments (inches)	Flush Model Node Point No.	Max. Accel's. (g's)	Inertia Forces (kips)	Axial Forces (kips)	Displace-ments (inches)
(4)	2080'-6"	2,279	140	.514	1,180		7,800	.197	140	.523	1,207		7,300	.201	140	.232	526		.024
						1,180						1,207						526	
(5)	2067'-6"	4,364	142	.447	1,951		40,900	.177	142	.450	1,964		39,700	.179	142	.230	1,004		.023
						3,143						3,196						1,526	
(3)	2035'-0"	4,424	144	.267	1,181		160,000	.119	144	.249	1,102		159,700	.117	144	.222	982		.022
						4,316						4,318						2,512	
(2)	2020'-6"	3,316	146	.215	713		233,100	.100	146	.196	650		232,000	.100	146	.220	730		.021
						3,449						3,305						3,152	
(1)	2008'-6"	2,680	148	.181	485		283,500	.088	148	.163	437		280,300	.089	148	.219	587		.020
						1,616						1,442						3,149	
(0)	1997'-6"	1,840	150	.161	298		301,200	.073	150	.157	289		296,200	.073	150	.215	396		.017

TABLE 3.7-6B SPECTRAL RESPONSE SUMMARY - UHS COOLING TOWER (SHELL) - 0.12G OBE

REF. Figure 3.7-13B

			NORTH-SOUTH DIRECTION						EAST-WEST DIRECTION						VERTICAL DIRECTION				
Mass Point No.	Elevation	Lumped Weight (kips)	Flush Model Node Point No.	Max. Accel's. (g's)	Inertia Forces (kips)	Shear Forces (kips)	Bending Moments (kip-ft)	Displace-ments (inches)	Flush Model Node Point No.	Max. Accel's. (g's)	Inertia Forces (kips)	Shear Forces (kips)	Bending Moments (kip-ft)	Displace-ments (inches)	Flush Model Node Point No.	Max. Accel's. (g's)	Inertia Forces (kips)	Axial Forces (kips)	Displace-ments (inches)
(4)	2080'-6"	2,279	140	.330	767		5,200	.112	140	.336	776		4,900	.120	140	.161	366		.014
						767						776						366	
(5)	2067'-6"	4,364	142	.286	1,248		26,700	.100	142	.286	766		26,300	.107	142	.160	698		.014
						2,036						2,043						1,062	
(3)	2035'-0"	4,424	144	.163	721		104,000	.067	144	.151	668		103,400	.068	144	.153	677		.013
						2,764						2,719						1,736	
(2)	2020'-6"	3,316	146	.121	401		150,800	.052	146	.114	378		149,300	.050	146	.149	494		.012
						2,183						2,056						2,168	
(1)	2008'-6"	2,680	148	.104	279		182,900	.042	148	.098	263		179,700	.043	148	.144	386		.012
						1,006						880						2,153	
(0)	1997'-6"	1,840	150	.091	167		194,000	.034	150	.088	162		189,300	.035	150	.132	243		.009

3.8 DESIGN OF CATEGORY I STRUCTURES

3.8.4 OTHER SEISMIC CATEGORY I STRUCTURES

The essential service water system (ESWS) pumphouse, the ESWS pipes, the ESWS electrical duct banks and manholes, ESWS supply lines yard vault, the ultimate heat sink (UHS) cooling tower, and the UHS retention pond are the other Category I structures located at the Callaway site which are not defined in the Standard Plant FSAR Section 3.8.4.1.

3.8.4.1 Description of the Structures

3.8.4.1.1 Essential Service Water System (ESWS) Pumphouse

The ESWS pumphouse was designed for two units. It is a tornado-resistant, rectangular (76 x 57 feet), conventionally reinforced concrete structure on a common foundation. The Unit 1 portion of the pumphouse contains two 100-percent-capacity ESWS pumps, valves, two self-cleaning strainers, two pump motors, two transformers, two motor control centers, redundant HVAC, and piping. The Unit 2 portion of the pumphouse is presently being used as temporary office facilities. No permanent use of this facility is planned at this time. The operating floor is at Elevation 2000.0 feet. The roof slab elevation is 2025.0 feet. A 59 x 72-foot apron slab is attached to the pumphouse and extends into the UHS retention pond. The pumphouse is of heavy shear wall construction with concrete slabs. Tornado-resistant missile shields protect the entrances and exits of the ventilation system at the roof elevation and protect the doors at grade. Removable hatch covers are bolted down to prevent their movement in the horizontal and vertical directions. Typical plans and sections are shown on Figures 3.8-1, 3.8-2, and 3.8-3.

3.8.4.1.2 Essential Service Water System (ESWS) Pipes

Redundant below-grade, 36-inch-diameter pipes carry cooling water from the ESWS pumphouse to the Standard Power Block; redundant below-grade, 36-inch-diameter pipes return cooling water from the Standard Power Block to the ultimate heat sink (UHS) cooling tower; and redundant, below-grade, 36-inch-diameter pipes return cooling water from the UHS cooling tower to the UHS retention pond. In addition, below-grade, 4-inch-diameter pipes carry ESWS self-cleaning strainer backflush water from the ESWS pumphouse to the ESWS 36-inch-diameter pipes. When not protected by concrete, they are buried a minimum depth of 4.5 feet to resist the effects of tornado missiles and frost penetration. Typical plans and sections are shown on Figures 3.8-4 through 3.8-7.

Piping is carbon steel, polyethylene, or stainless steel. Carbon steel and stainless steel piping have welded joints except at interface with dissimilar piping materials, where flanges are used. Polyethylene piping has fused joints, except at interfaces with stainless steel piping, where flanges are used. Interfaces between buried stainless steel and indoor carbon steel piping require the use of insulating flanges to isolate cathodic

protection current and use of non-conducting gaskets to avoid galvanic corrosion. All buried carbon steel and stainless steel pipe exteriors are coated and are cathodically protected.

At points where the ESWS pipes enter structures, provision is made for flexible, waterproof sleeves between the pipes and the structures (See Figure 3.8-8).

The 36-inch-diameter and 4-inch-diameter pipes are rigidly attached by embedment to the UHS cooling tower and ESWS pumphouse, respectively, thereby not requiring waterproof sleeves between the pipes and the structures (See Figure 3.8-9).

3.8.4.1.3 Essential Service Water System (ESWS) Electrical Duct Banks and Manholes

Redundant, below-grade, reinforced concrete electrical duct banks housing electrical cables which transmit the required power to the ESWS pumphouse and UHS cooling tower from the Standard Power Block are provided. They are buried a minimum depth of 3.5 feet to resist the effects of tornado missiles and frost penetration. Typical plans and sections are shown on Figures 3.8-4 through 3.8-7.

At points where the electrical duct banks enter structures, provisions are made for flexible filler and waterstops (where required) between the duct banks and the structures (See Figure 3.8-10).

Redundant, reinforced concrete, tornado-resistant electrical manholes are provided to permit the pulling of electrical cables through the duct banks. Removable manhole covers are bolted down to prevent their movement in the horizontal and vertical directions. Typical plans and sections are shown on Figure 3.8-11.

3.8.4.1.4 Ultimate Heat Sink (UHS) Cooling Tower

The UHS cooling tower is a tornado-resistant, reinforced concrete structure. The structure consists of a 110 x 117-foot reinforced concrete base slab with top-of-slab Elevation 1997 feet which forms the collecting basin for the tower and supports the shear walls and perimeter missile shield. The perimeter missile shield protects the shear walls from tornado missiles and prevents tornado missiles from entering the fill areas of the cooling tower. Exterior and interior reinforced concrete walls supported on the shear walls extend to Elevation 2080.25 feet. These walls divide the cooling tower into four cells and support the interior reinforced concrete fill-support beams and the drift eliminator beams. These walls also provide support for the reinforced concrete fan decks (which support the fans, fan motors and gears, and fan stacks), and the tornado missile protection for the fan blades. The vertical tornado missile protection for the fan blades consists of horizontal concrete missile shields at Elevation 2080.25 feet and steel beam supported gratings and circular concrete slabs at Elevation 2069.5 feet over the fan blades. The circular, reinforced concrete slabs over the fan blades are 28 feet in diameter and prevent vertical tornado missiles from entering the fan area. Gratings (2 1/

2 inches deep with 2 1/8 inches clear openings) cover the remaining area between these slabs and the vertical walls (which protect the fan blades from horizontal tornado missiles) and protect the air outlets of the tower from tornado-generated debris. Plans and sections are shown on Figures 3.8-12, 3.8-13, and 3.8-14.

Attached to the UHS cooling tower are two tornado-resistant, reinforced concrete electrical rooms which contain pipes, valves, and electrical equipment. Tornado-resistant missile shields protect the entrances and exits of the ventilation system at the roof elevation.

3.8.4.1.5 Ultimate Heat Sink (UHS) Retention Pond and Auxiliary Structures

The UHS retention pond which contains water for the UHS cooling tower is an excavation in existing and fill soils. The approximate dimensions of the pond at grade Elevation 1999.5 feet are 330 by 680 feet. The bottom of the pond Elevation is 1977.5 feet, and the side slopes are 3 horizontal to 1 vertical. The side slopes are protected by riprap from the surrounding grade elevation to Elevation 1987.5 feet. The target (nominal) UHS retention pond level is maintained between levels corresponding to the low and high UHS water level alarms. Two submerged, reinforced concrete discharge structures discharge water into the pond from the UHS cooling tower. A reinforced concrete outlet structure is provided for outflow from the pond. A 14-inch-diameter, non-Category I make-up pipe provides normal make-up water manually for the pond. Typical plans and sections are shown on Figures 3.8-15, 3.8-16, and 3.8-17. Additional information is provided in Section 9.2.5.

3.8.4.1.6 ESWS Supply Lines Yard Vault

A redundant, below-grade, reinforced concrete ESWS supply lines yard vault houses the transition of ESWS stainless steel piping to polyethylene piping. The ESWS supply lines yard vault consists of two compartments, one for each train separated by reinforced concrete. Watertight boot seals are installed in each penetration sleeve, and the gap between the piping and the penetration sleeve is filled with RTV foam to seal the yard vault.

Redundant, reinforced concrete, tornado resistant manholes are provided to permit inspection and maintenance of the piping. Removable manhole covers are bolted down to prevent their movement in the horizontal and vertical directions. ESWS supply lines yard vault plans and sections are shown on Figure 3.8-19.

3.8.4.2 Applicable Codes, Standards, and Specifications

All nonstandard Category I structures at the site are designed in accordance with the codes, standards, and specifications listed in Standard Plant FSAR Section 3.8.3.2, with the exception of NRC Regulatory Guide 1.46 and BN-TOP-2, which are not applicable.

In addition to those documents listed in Standard Plant FSAR Section 3.8.3.2, the following documents are also used. Compliance with the NRC Regulatory Guides listed is discussed in Appendix 3A.

a. NRC Regulatory Guide 1.27 - Ultimate Heat Sink for Nuclear Power Plants.

b. NRC Regulatory Guide 1.76 - Design Basis Tornado for Nuclear Power Plants.

c. NRC Regulatory Guide 1.59 - Design Basis Floods for Nuclear Power Plants.

d. Bechtel Power Corporation Topical Report, BC-TOP-3-A Tornado and Extreme Wind Design Criteria for Nuclear Power Plants, Revision 3, August 1974.

3.8.4.3 Loads and Load Combinations

The loads and load combinations used in the design of all nonstandard

Category I structures at the site other than the ESWS pipe are provided in the sections below. The loads and load combinations used in the design of the ESWS pipe are provided in Standard Plant Section 3.9.3.

3.8.4.3.1 Definitions

The following nomenclature and definition of terms apply to the design of the nonstandard Category I structures. All the major loads to be encountered and/or to be postulated are listed. All the loads listed, however, are not necessarily applicable to all structures and their elements. Loads and the applicable load combinations for which each structure is designed are dependent upon the conditions to which that particular structure is subjected. A full description of the loads and the analysis performed, for each structure, is given in Section 3.8.4.4.

Normal Loads

Normal loads are those loads to be encountered during normal plant operation and shutdown. They include the following:

D = Dead loads or their related internal moments and forces, including any permanent equipment loads and hydrostatic loads.

L = Live loads or their related internal moments and forces, including any moveable equipment loads and other loads which vary with intensity and occurrence such as: floor area loads, moveable equipment loads, lateral earth pressure (Table 3.8-1 and Section 2.5.4.10), 100-year recurrence snowpack load (24 psf as defined in Section 2.4.2.3), wind-generated wave loads (Table 3.4-2 and Sections 2.4.3.6 and 2.4.5.3), loads from forces due to ice expansion (2.4 psf for 24 inches of ice with 5°F temperature rise per hour), loads for wind drag on the ice surface (24 psf at wind speeds of 40 mph), and all other live loads during plant operation (Table 3.8-1). Justification of the 100-year recurrence interval and the assumed temperature rise of 5°F per hour is discussed in the response to NRC Item 240.4C. The basis for wind speeds used in the computation of drag forces on the ice surface in the UHS pond is discussed in the response to NRC Item 240.5C. Determination of probable maximum wind is discussed in response to NRC Item 240.6C.

T = Thermal effects and loads during normal operating and shutdown conditions, based on the most critical transient or steady state condition.

R = Pipe reactions during normal operating or shutdown conditions, based on the most critical transient or steady state condition.

Severe Environmental Loads

Severe environmental loads are those that could infrequently be encountered during the plant life. They include the following:

E = Loads generated by the Operating Basis Earthquake (OBE) as specified in section 2.5.2.11.

W = Loads generated by the design wind as specified in Section 3.3.1.

Extreme Environmental Loads

Extreme environmental loads are those loads which are credible but are highly improbable. They include the following:

E'= Loads generated by the Safe Shutdown Earthquake (SSE) as specified in Section 2.5.2.10.

W = Loads generated by the Design Basis Tornado as specified in Standard Plant FSAR Section 3.3.2. They include loads due to tornado wind pressure, loads due to tornado-created differential pressures, and loads due to tornado-generated missiles.

N = Probable Maximum Winter Precipitation (PMWP) in the form of snow, 108 psf applied to the roofs of safety-related structures as specified in Section 2.4.2.3.

Other Definitions

S = For concrete structures, S is the required section strength based on the Working Stress Design method and the allowable stresses defined in Section 8.10 of ACI 318-71.

For structural steel, S is the required section strength based on the elastic design method and the allowable stresses defined in Part 1 of the AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings," February 12, 1969.

U = For concrete structures, U is the section strength required to resist design loads and based on methods described in ACI 318-71.

Y = For structural steel, Y is the section strength required to resist design loads and based on the plastic design method described in Part 2 of AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings", February 12, 1969.

3.8.4.3.2 Load Combinations

The nonstandard Category I structures and components at the Callaway site, except for the ESWS pipe, are designed to resist the load combinations given below. The ESWS pipes are designed to resist the load combinations given in Standard Plant Section 3.9.3.

Concrete Structures

The load combinations, load factors, and required section strength, using both the working stress design method and the ultimate strength design method, are given in Table 3.8-2.

Steel Structures

The load combinations, load factors, and required section strength, using both the elastic working stress design method and the plastic design method, are given in Table 3.8-3.

3.8.4.3.3 Explanation of Load Combination Cases

a. Loading cases (1), (1a), and (1b)

These cases include all loads which are expected to be applied during the normal plant operation including the loads from thermal effects and pipe reactions.

b. Loading cases (2), (2a), (2b), (2b'), (3), (3a), (3b), (3b')

These cases include all loads which are expected to be applied during the normal plant operation, including the loads from thermal effects and pipe reactions, plus the loads from the design wind and OBE.

c. Loading cases (4) to (6)

These cases include events and the resulting loads which are highly improbable, such as the design tornado, the SSE, and the probable maximum winter precipitation in the form of snow.

Loads resulting from postulated loss-of-coolant accident or the rupture of high energy pipes, including jet impingement and missile impact loads resulting from such incidents are not applicable in the design of the nonstandard Category I structures.

3.8.4.3.4 Specific Considerations

a. The mass considered in developing earthquake loading shall be only the mass contributing to dead loads and identifiable live loads.

b. In all loading cases, the live load is considered to vary from zero to the maximum specified value in determining the most critical loading condition.

c. For load cases including either earthquake or tornado loads, the live load (L) shall be limited to only that live load expected to be present when the plant is operating.

3.8.4.3.5 Design Allowables

The applicable design allowables for the nonstandard Category I structures are the same as those discussed in Standard Plant FSAR Section 3.8.3.3.

3.8.4.4 Design and Analysis Procedures

The design and analysis procedures for the nonstandard Category I structures are similar to those discussed in Standard Plant FSAR Section 3.8.4.4.

The following sections discuss, in greater detail, the procedures used for analyzing and designing the nonstandard Category I structures.

3.8.4.4.1 Essential Service Water System (ESWS) Pumphouse

The ESWS pumphouse is supported on a concrete floor slab with integral footings at grade and a forebay and apron slab 33 feet below grade and in the ultimate heat sink (UHS) retention pond. All vertical loads are transferred to the floor, forebay, and apron slabs through exterior walls, interior walls, and columns. All lateral loads are transferred to the floor, forebay, and apron slabs by diaphragm action of the roof and floor slabs which transfer loads to shear walls, and by beam action for walls not acting as shear walls. All lateral loads are transferred to the subgrade by friction. Typical connection details between the walls and the slabs are shown in Figures 3.8-2 and 3.8-3. The reinforced concrete roof and floor slabs are analyzed and designed for vertical loads as one-way or two-way slabs supported by bearing walls, concrete columns, and concrete beams.

The reinforced concrete interior and exterior walls are analyzed and designed for lateral loads as cantilevered, one-way or two-way slabs supported by the floor, forebay, apron, and roof slabs. The forebay compartments within the UHS retention pond are analyzed and designed to resist the effects of hydrostatic and hydrodynamic loads. The reinforced concrete floor, forebay and apron slabs are analyzed and designed as rigid slabs resting on an elastic foundation.

3.8.4.4.2 Essential Service Water System Pipes

Refer to Standard Plant Section 3.9.3.

3.8.4.4.3 Essential Service Water System (ESWS) Electrical Duct Banks and Manholes

The reinforced concrete ESWS electrical duct banks are buried below grade. They are analyzed and designed as beams on elastic foundations for vertical loads. Differential movement between the duct banks and other Category I structures is considered in the analysis and design. Refer to Figure 3.8-10 for details.

The ESWS electrical manholes are supported on base slabs. All vertical loads are transferred to the base slabs through exterior and interior walls. Since the manholes are horizontally continuous frames below grade, all lateral loads on the walls are balanced through the walls as reactions from adjacent walls. The roof slab is bolted to the walls and transfers lateral load to the walls through the bolts. Refer to Figure 3.8-11 for details.

3.8.4.4.4 Ultimate Heat Sink (UHS) Cooling Tower

The UHS cooling tower is supported on a concrete base slab. All vertical loads are transferred to the base slab through exterior and interior walls. Part of the lateral load is transferred to the base slab through shear walls by diaphragm action of the roof slab for the electrical rooms attached to the perimeter of the tower and the fan deck slab for the cooling tower. The remaining part of the lateral load is transferred to the base slab

through shear walls by beam action of the attached walls and beams. All lateral loads are transferred to the subgrade by friction. Typical connection details between the exterior and interior walls and the base slab are shown in Figures 3.8-13 and 3.8-14.

The reinforced concrete missile protection at Elevation 2080.25 feet and 2069.5 feet for the UHS cooling tower fans, the fan deck slabs at Elevation 2035.5 feet, the electrical room roof slabs, and other horizontally projecting slabs for missile protection are all analyzed and designed for vertical loads as cantilevered, one-way, or two-way slabs supported by bearing walls and structural steel beams. The reinforced concrete interior and exterior walls are analyzed and designed for lateral loads as cantilevered, one-way, or two-way slabs supported by intersecting walls and beams and by the fan deck slabs and base slabs. The structural steel beams supporting the reinforced concrete slabs at Elevation 2069.5 feet are analyzed and designed as composite sections.

The interior reinforced concrete beams are analyzed and designed for lateral, vertical, and axial loads. The reinforced concrete base slab is analyzed and designed as a rigid slab resting on an elastic foundation. See Figures 3.8-12, 3.8-13, and 3.8-14 for details.

3.8.4.4.5 Ultimate Heat Sink (UHS) Retention Pond and Ancillary Structures

Refer to Section 9.2.5 for the procedures used for analyzing and designing the UHS retention pond and ancillary structures.

The two submerged, reinforced concrete discharge structures are supported on base slabs. All vertical loads are transferred to the base slabs through the exterior walls. All lateral loads are transferred to the base slabs by beam and shear wall action. All lateral loads are transferred to the subgrade by friction. The reinforced concrete wing and head walls are analyzed and designed for lateral loads as one-way or two-way slabs supported by the base slabs and intersecting walls. The reinforced concrete base slabs are analyzed and designed as rigid slabs resting on elastic foundations. Refer to Figure 3.8-18 for details.

The reinforced concrete outlet structure is a slab on grade. All vertical loads are transferred from the slabs to the subgrade. All lateral loads from the slab are transferred to the subgrade by friction. The base slab is analyzed and designed as a rigid slab resting on an elastic foundation. Typical details are shown in Figures 3.8-16, and 3.8-17.

3.8.4.5 <u>Structural Acceptance Criteria</u>

All nonstandard Category I structures are designed for the structural acceptance criteria defined in Sections 3.8.4.2 and 3.8.4.3. The Category I essential service water pipes are designed to the criteria defined in Section 3.9.3.

3.8.4.6 Materials, Quality Control, and Special Construction Techniques

Materials, quality control, and special construction techniques are discussed in Standard Plant FSAR Section 3.8.4.6.

3.8.4.7 Testing and Inservice Inspection Requirements

The nonstandard Category I structures are not directly related to the function of the containment concept; hence, no testing or inservice surveillance is required.

The essential service water system is tested and inspected in accordance with the codes described in Standard Plant FSAR Section 9.2.1.2.5.

3.8.5 FOUNDATIONS

3.8.5.1 Description of the Foundations

The foundations of all nonstandard Category I structures at the site consist of reinforced concrete base slabs resting on Category I, granular structural fill, or undisturbed soil and rock The arrangement of the structures and foundations is shown in Figures 3.8-1 through 3.8-4 and 3.8-11 through 3.8-18.

The following sections provide descriptions of the foundations of the nonstandard Category I structures.

3.8.5.1.1 Essential Service Water System (ESWS) Pumphouse

At grade, the ESWS pumphouse foundation consists of a 1-foot-6-inch thick reinforced concrete floor slab spanning between 4-foot-thick and 3-foot-6-inch thick footings made integral with the floor slab and extending 3 feet 6 inches and 3 feet respectively, below grade. The floor slab and integral footings are attached to the forebay walls which extend to the below-grade portion of the foundation. Below grade, the ESWS pumphouse foundation consists of a 3-foot-thick reinforced concrete forebay slab located 33 feet below grade and an apron slab which varies in thickness. The apron slab provides a transition from the forebay slab to the bottom of the ultimate heat sink retention pond. In plan, the combined area of the foundations forms a rectangular-shaped foundation approximately 86 feet wide and 124 feet long. The general arrangement and details of the ESWS pumphouse foundation are shown in Figures 3.8-1, 3.8-2, and 3.8-3.

Horizontal shears, such as those that are seismically induced, are transferred to the subgrade foundation media by friction along the bottom of the floor slab in areas that are not waterproofed and through the soil below the shear keys attached to the forebay and apron slabs.

Equipment such as the ESWS pumps and strainers is anchored to the floor slab by means of anchor bolts which transmit the equipment loads, including seismic forces, to the foundation. Other equipment and piping are anchored to walls, roofs, or to platforms anchored to the floor slab. Refer to Section 3.8.4.4.1 for a description of the anchorage of internal structures to the foundation.

3.8.5.1.2 Essential Service Water System (ESWS) Electrical Manholes

The ESWS electrical manhole foundations consist of 2-foot-6-inch thick reinforced concrete slabs below grade. The slabs are rectangular in shape and have varying dimensions. Typical general arrangements and details of the ESWS electrical manholes are shown in Figure 3.8-11.

Transfer of horizontal shears, such as those that are seismically induced, is by the walls of the ESWS electrical manholes bearing against the soil which completely surrounds the manholes. Electrical conduit within the manholes is anchored to the walls.

3.8.5.1.3 Ultimate Heat Sink (UHS) Cooling Tower

The UHS cooling tower foundation consists of a 3-foot-6-inch thick reinforced concrete base slab 6 feet 6 inches below grade which is locally thickened to 6 feet near the perimeter of the slab. In addition, 4-foot-thick reinforced concrete base slabs for the two electrical rooms are attached integrally to opposite edges of the tower base slab. The cooling tower base slab is rectangular in shape and is approximately 117 feet long and 110 feet wide. The electrical room base slabs are rectangular in shape and are approximately 37 feet long and 15 feet wide. The long edges of the electrical rooms are attached to the short edges of the tower base slab. The general arrangement and details of the UHS cooling tower foundation is shown in Figures 3.8-12, 3.8-13, and 3.8-14.

Horizontal shears, such as those that are seismically induced, are transferred to the Category I, granular structural fill by friction along the bottom of the foundation. There is no waterproofing membrane provided on the horizontal surfaces between the foundation and fill.

The UHS cooling tower fill is anchored and supported by the cooling tower walls and beams. Equipment is rigidly attached to base slab and the fan deck slabs by means of anchor bolts which transmit the equipment loads, including seismic lateral forces, to the foundation. Refer to Section 3.8.4.4.4 for a description of the anchorage of internal structures to the foundation.

3.8.5.1.4 Ancillary Structures for the Ultimate Heat Sink (UHS)

The discharge structure foundations consist of 1-foot-6-inch thick reinforced concrete slabs 1 foot 6 inches below the bottom of the UHS retention pond. The slabs are trapezoidal in shape, are 11 feet long, and have 12 foot and 6 foot parallel sides. The

general arrangement and details of the discharge structure foundations are shown in Figure 3.8-18.

Horizontal shears, such as those that are seismically induced, are transferred to the subgrade foundation media by friction along the bottom of the foundations.

The outlet structure foundation consists of a 7-1/2-inch thick reinforced concrete slab on grade with shear keys at each end. The slab is rectangular in shape and is 34 feet long and 18 feet wide. The general arrangement and details of the outlet structure foundation are shown in Figures 3.8-16 and 3.8-17.

Horizontal shears, such as those that are seismically induced, are transferred to the subgrade foundation media by friction through the soil wedge behind the shear keys attached to the foundation.

3.8.5.2 Applicable Codes, Standards, and Specifications

Applicable codes, standards, and specifications are discussed in Section 3.8.4.2.

3.8.5.3 Loads and Load Combinations

Foundation loads and loading combinations are discussed in Section 3.8.4.3.

3.8.5.4 Design and Analysis Procedures

The foundations of these structures are analyzed, using well established methods based on the general principles of engineering mechanics. Codes, standards, and specifications prescribed in Section 3.8.4.2 are used in the design and analysis of structures and systems.

3.8.5.5 Structural Acceptance Criteria

The foundations of these structures are designed to meet the structural acceptance criteria described in Sections 3.8.4.2 and 3.8.4.3. The limiting conditions for the foundation medium, together with a comparison between actual capacity and estimated structural loads, are found in Sections 2.5.4.10 and 2.5.4.11.

All structures meet or exceed the factors of safety shown in Table 3.8-4 for the load combinations for overturning, sliding, and flotation given in Table 3.8-4. Definitions of D, E, W, E' and W are found in Section 3.8.4.3.1. H is the lateral soil pressure, and F' is the buoyant force of the ground water which is assumed at grade. No live loads are included in these combinations to help resist overturning, sliding, and flotation.

3.8.5.6 Materials, Quality Control, and Special Construction Techniques

Materials, quality control, and special construction techniques are discussed in Standard Plant FSAR Section 3.8.5.6.

3.8.5.7 Testing and Inservice Inspection Requirements

Testing and inservice inspection are not required for the foundations of these structures.

APPENDIX 3.8A - COMPUTER PROGRAMS USED FOR ANALYSIS OF CATEGORY I STRUCTURES

TABLE OF CONTENTS

BECHTEL MAP 152 GENERAL FULLY MIXED COOLING POND MODEL (GFULMIX)

1. Description

GFULMIX was developed to provide estimates of the temperature response of cooling ponds to imposed heat loads. The program assumes that the pond is fully mixed for the entire period of computation, therefore knowledge of the hydrodynamics of the pond is not required. Meteorologic data are input at specified time points. Heat loads are input either as heat load per unit time or as flow rate with time varying temperature. The pond is assumed to have a constant surface area while its volume is reduced by the amount of pond evaporation during each time step. Net inflows and outflows to the pond input at specified time points are accounted for in the pond volume computation. Pond temperature, evaporation rate and volume, net inflow or outflow and imposed heat load rates are output at specified time points.

2. Validation

The program was verified by a detailed check of the equations and assumptions used and of the computer source code. Additionally, mechanical computations of simple problems were checked against program output. Program user's manual, verification report, and theoretical manual are on file with Bechtel Data Processing.

3. Extent of Application

The program was used to determine the outlet temperature, natural and forced evaporation, and water volume for the ultimate heat sink retention pond under the assumed condition of a LOCA.

4. Reference

1. Ryan, P.J., and Harleman, D.R.F., "An Analytical and Experimental Study of Transient Cooling Pond Behavior", Ralph M. Parsons Laboratory for Water Resources and Hydrodynamics, Report No. 161, January, 1973.

2. Edinger, J.E. and Geyer, J.E., "Heat Exchange in the Environment", The Johns Hopkins University, Cooling Water Studies for the Edison Electric Institute, Project No. 49, June 1, 1965.

3. Goff, J.A., and Gratch, S., "Low Pressure Properties of Water From - 160°F to 212°F". Trans. American Soc. Heating Ventilating Engrs., 52, 1946.

4. Thom, H. C. S., "New Distribution of Extreme Winds in the United States", Journal of the Structural Division, ASCE, July 1968.

5. "Effect of Geographical Location on Cooling Pond Requirements and Performance", Vanderbilt University for the Water Quality Office, EPA, March 1971.

6. Jirka, G. H., et al, "Mathematical Predictive Models for Cooling Lake Design", Part A-Model Development and Design Considerations, MIT Report No. 238, December 1978.

7. Jirka, G. H., "Thermal Structure of Cooling Ponds", presented at Waste Heat Management and Utilization Conf., Miami, December 4-6, 1978.

SLOPE STABILITY ANALYSIS - ICES SLOPE

(by McDonnell Douglas Automation Company)

1. Description

SLOPE utilizes the theory of equilibrium forces to determine the factor of safety against sliding of any embankment. SLOPE contains the following methods of stability analysis: A) Bishop method, B) Fellenius method and C) Morgenstern and Price method. The program will locate the radius having minimum factor of safety at each of a specific set of trial centers. Alternatively, a search routine is provided that can be useful in locating the center of radius of the critical trial failure surface. SLOPE also has the capability to introduce an earthquake loading.

2. Validation

The solutions to the problem have been verified to be substantially identical to the results obtained by manual calculations. Document traceability is available at Bechtel International Corporation.

3. Extent of Application

The program was used to analyze all earth slopes for the Ultimate Heat Sink retention pond.

INTEGRATED SOFTWARE FOR STRUCTURAL ANALYSIS AND DESIGN (SAP2000)

(by Computers and Structures, Inc.)

1. Description

SAP2000 is a general purpose finite element program which performs the static or dynamic, linear or nonlinear analysis of structural systems. It is a widely used program for design of structures following AASHTO specifications, ACI and AISC building codes.

2. Validation

The solutions to example problems have been verified to be substantially identical to the results obtained by manual calculations. The validation documentation is maintained by Sargent & Lundy, LLC.

3. Extent of Application

For the replacement of existing buried ESW carbon steel pipe with polyethylene and stainless steel pipe, SAP2000 was used to calculate forces and moments for design of the replacement polyethylene piping sections.

ATTACHMENT PLATE ANALYSIS (APLAN)

(Sargent & Lundy Program Number 03.7.282-2.0 Rev. 4)

1. Description

Attachment Plate Analysis Program is a specialized Finite Element Analysis (FEA) routine that performs nonlinear analysis on anchor plates.

2. Validation

The solutions to example problems have been verified to be substantially identical to the results obtained by use of the ADINA computer code. The validation documentation is maintained by Sargent & Lundy, LLC.

3. Extent of Application

For evaluation of pipe support anchorage on the ESW piping replacement, APLAN was used to determine anchor forces and plate bending stresses for use in qualifying heavily loaded and/or complex base plate configurations.

TABLE 3.8-1 GENERAL DESIGN LIVE LOADS

Stairs and walkways	100 psf
Grating, floors, and platforms	100 psf (except in areas of heavier loads, which will govern)
Surcharge outside and adjacent to subsurface walls	250 psf vertical load or 8,000-pound wheel load converted to lateral equivalent load, whichever is governing; or railroad surcharge per AREA specification, where applicable.
Railings	25 psf or 200 pounds applied in any direction at top of railing.
Concentrated load on slabs (to be considered with dead load only)	5 kips to be so applied as to maximize moment or shear. This load is not carried to columns.
Concentrated load on beams and girders (in addition to all other loads)	5 kips to be so applied as to maximize moment or shear. This load is not carried to columns.
Ground floor	250 psf

TABLE 3.8-2 LOAD COMBINATIONS AND LOAD FACTORS FOR CATEGORY I CONCRETE STRUCTURES

Working Stress Design Method

(1) S = D + L
(2) S = D + L + E
(3) S = D + L + W
(1a) 1.3S = D + L + T + R
(2a) 1.3S = D + L + T + R + E
(3a) 1.3S = D + L + T + R + W

Both cases of "L" having its full value or being completely absent should be checked.

Strength Design Method

(1) U = 1.4D + 1.7L
(2) U = 1.4D + 1.7L + 1.9E
(3) U = 1.4D + 1.7L + 1.7W
(1b) U = 0.75 (1.4D + 1.7L + 1.7T + 1.7R)
(2b) U = 0.75 (1.4D + 1.7L + 1.7T + 1.7R + 1.9E)
(3b) U = 0.75 (1.4D + 1.7L + 1.7T + 1.7R + 1.7W)

Both cases of "L" having its full value or being completely absent should be checked with the following combinations:

(2b') U = 1.2D + 1.9E
(3b') U = 1.2D + 1.7W

Where soil and/or hydrostatic pressures are present, in addition to all the above combinations where they have been included in L and D, respectively, the requirements of Section 9.3.4 and 9.3.5 of ACI 318-71 should also be satisfied.

For the following combinations, which represent extreme environmental conditions, the strength design method should be used and the following load combinations should be satisfied:

(4) U = D + L + T + R + E'
(5) U = D + L + T + R + W
(6) U = D + L + T + R + N

TABLE 3.8-3 LOAD COMBINATIONS AND LOAD FACTORS FOR CATEGORY I STEEL STRUCTURES

Elastic Working Stress Design Method

(1) S = D + L
(2) S = D + L + E
(3) S = D + L + W
(1a) 1.5S = D + L + T + R
(2a) 1.5S = D + L + T + R + E
(3a) 1.5S = D + L + T + R + W

Both cases of "L" having its full value or being completely absent should be checked in the above combinations.

(4) 1.6S = D + L + T + R + E'
(5) 1.6S = D + L + T + R + W
(6) 1.6S = D + L + T + R + N

Plastic Design Method

(1) Y = 1.7D + 1.7L
(2) Y = 1.7D + 1.7L + 1.7E
(3) Y = 1.7D + 1.7L + 1.7W
(1b) Y = 1.3 (D + L + T + R)
(2b) Y = 1.3 (D + L + E + T + R)
(3b) Y = 1.3 (D + L + W + T + R)

Both cases of "L" having its full value or being completely absent should be checked in the above combinations.

(4) .90Y = D + L + T + R + E'
(5) .90Y = D + L + T + R + W
(6) .90Y = D + L + T + R + N

TABLE 3.8-4 ADDITIONAL LOAD COMBINATIONS FOR SLIDING, OVERTURNING, AND FLOTATION

Loading Combination	Minimum Factor of Safety		
	Overturning	Sliding	Flotation
a. D + H + E	1.50	1.10	---
b. D + H + W	1.50	1.10	---
c. D + H + E'	1.50	1.10	---
d. D + H + W	1.50	1.10	---
e. D + F'	---	---	1.25

APPENDIX 3.A - CONFORMANCE TO NRC REGULATORY GUIDES

This appendix briefly discusses the extent to which Union Electric conforms to NRC published regulatory guides for the site related portions of Callaway Plant. The Standard Plant FSAR Appendix 3A may refer to the Addendum Appendix 3A or the Union Electric Operational Quality Assurance Manual (OQAM) for the specific regulatory commitment for certain regulatory guides. However in cases where a reference is not made to the Addendum Appendix 3A or the OQAM, the commitment is as stated in the Standard Plant Appendix 3A and the same regulatory position is not repeated in the Addendum Appendix 3A or in the OQAM. The statement of specific regulatory commitment for the following regulatory guides is located as indicated:

Callaway FSAR, Standard Plant - Regulatory Guides 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.9, 1.10, 1.11, 1.12, 1.13, 1.14, 1.15, 1.18, 1.20, 1.22, 1.24, 1.25, 1.26, 1.29, 1.31, 1.32, 1.34, 1.35, 1.36, 1.40, 1.41, 1.42, 1.43, 1.44, 1.45, 1.46, 1.47, 1.48, 1.49, 1.50, 1.51, 1.52, 1.53, 1.54, 1.55, 1.56, 1.57, 1.59, 1.60, 1.61, 1.62, 1.63, 1.65, 1.66, 1.67, 1.68, 1.68.1, 1.68.2, 1.69, 1.70, 1.71, 1.72, 1.73, 1.75, 1.76, 1.77, 1.78, 1.79, 1.80, 1.81, 1.82, 1.83, 1.84, 1.85, 1.87, 1.89, 1.90, 1.92, 1.93, 1.95, 1.96, 1.97, 1.98, 1.99, 1.100, 1.101, 1.102*, 1.103, 1.104, 1.105, 1.106, 1.107, 1.108, 1.110, 1.112, 1.115, 1.117, 1.118, 1.119, 1.120, 1.121, 1.122, 1.124, 1.126, 1.128, 1.129, 1.130, 1.131, 1.133, 1.136, 1.137, 1.139, 1.140, 1.141, 1.142, 1.143, 1.147, 1.150, 1.152, 1.155, 1.158, 1.160, 1.163, 1.181, 1.182, 1.187, and 1.195.

Callaway FSAR, Site Addendum - Regulatory Guides 1.17, 1.21, 1.23, 1.27, 1.59, 1.86, 1.91, 1.102*, 1.109, 1.111, 1.113, 1.114, 1.125, 1.127, 1.132, 1.134, 1.138, and 1.145.

Union Electric Operational Quality Assurance Manual - Regulatory Guides 1.8, 1.28, 1.30, 1.33, 1.37, 1.38, 1.39, 1.58, 1.64, 1.74, 1.88, 1.94, 1.116, 1.123, 1.144, and 1.146.

Clarifications, alternatives, and exceptions to these guides are identified and justification is presented or referenced. In the discussion of each guide, the sections or tables of the FSAR where more detailed information is presented are referenced. The referenced tables provide a comparison of Union Electric's position to each regulatory position of section C of the regulatory guides. All statements within the Regulatory Position Section (C) of the Regulatory Guides are considered requirements unless a specific exception or clarification has been committed to by Union Electric. This is true regardless of the qualifier (i.e., "shall" or "should") which prefaces the statement. As regards to standards endorsed by the Regulatory Guide, unless further qualified within the Regulatory Guide, "shall" statements denote requirements while "should" statements denote recommendations. A glossary of definitions is provided in the Quality Assurance Procedures Manual.

---

* Refer to both the Standard Plant and the Site Addendum for the Complete statement of regulatory commitment.

In each of the ANSI standards referenced by one of the listed regulatory guides, other documents (i.e. other standards, codes, regulations or appendices) required to be included as a part of the standard are either identified at the point of reference or are described in a special section of the standard. The specific applicability or acceptability of these listed standards, codes regulations or appendices is either covered in other specific areas in the FSAR or UE Operating QA Program (OQAP), including tables, or such documents are not considered as req.uirements, although they may be used as guidance. When sections are referenced within a standard, it is understood that UE will comply with the referenced section as clarified.

REGULATORY GUIDE 1.8

*Revision 1 Dated 9/75 For the position of Radiation Protection Manager only, in accordance with the Callaway Plant Technical Specifications.

Personnel Selection and Training

DISCUSSION:

Refer to the Union Electric Company Operational Quality Assurance Manual.

REGULATORY GUIDE 1.17 REVISION 1 DATED 6/73

Protection of Nuclear Power Plants Against Industrial Sabotage

DISCUSSION:

Union Electric.s method of physical protection of its nuclear power plant against industrial sabotage is defined in the Callaway Plant Security Plan.

REGULATORY GUIDE 1.21 REVISION 1 DATED 6/74

Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants

DISCUSSION:

The Union Electric program for measuring, evaluating, and reporting radioactivity in solid wastes and releases of radioactive materials in liquid and gaseous effluents from light-water-cooled nuclear power plants is described in the Callaway Plant Technical Specifications, the Offsite Dose Calculation Manual, and the Process Control Program.

REGULATORY GUIDE 1.23 REVISION 1 DATED 3/07

Onsite Meteorological Monitoring Programs for Nuclear Power Plants

DISCUSSION:

UE complies with the recommendations of this regulatory guide, with the following exceptions:

(a) The meteorological tower is not sited at the same elevation as finished plant grade as recommended in section 3 of the regulatory guide. Refer to Site Addendum Section 2.3.3.1.2

(b) The inspection frequencies for the tower guyed wires and anchors will be per the tower vendor recommendations in lieu of the recommendations provided in section 5 of the regulatory guide.

Refer to Site Addendum Section 2.3.3.1.1 through 2.3.3.1.7, which contain elements of a graded quality assurance program for meteorological monitoring, and Sections 2.3.4 through 2.3.5, which describe the methods for analyzing meteorological data.

REGULATORY GUIDE 1.27 REVISION 2 DATED 1/76

Ultimate Heat Sink for Nuclear Power Plants

DISCUSSION:

Refer to Site Addendum Section 9.2.5 and Table 9.2-5.

REGULATORY GUIDE 1.28

Quality Assurance Program Requirements (Design and Construction)

DISCUSSION:

Refer to the Union Electric Company Operational Quality Assurance Manual.

REGULATORY GUIDE 1.30

Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electronic Equipment (Safety Guide 30)

DISCUSSION:

Refer to the Union Electric Company Operational Quality Assurance Manual.

REGULATORY GUIDE 1.33

Quality Assurance Program Requirements (Operation)

DISCUSSION:

Refer to the Union Electric Company Operational Quality Assurance Manual.

REGULATORY GUIDE 1.37

Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants

DISCUSSION:

Refer to the Union Electric Company Operational Quality Assurance Manual.

REGULATORY GUIDE 1.38

Quality Assurance Requirements for Packaging, Shipping, Receiving, Storage, and Handling of Items for Water-Cooled Nuclear Power Plants

DISCUSSION:

Refer to the Union Electric Company Operational Quality Assurance Manual.

REGULATORY GUIDE 1.39

Housekeeping Requirements for Water-Cooled Nuclear Power Plants

DISCUSSION:

Refer to the Union Electric Company Operational Quality Assurance Manual.

REGULATORY GUIDE 1.58

Qualification of Nuclear Power Plant Inspection, Examination, and Testing Personnel

DISCUSSION:

Refer to the Union Electric Company Operational Quality Assurance Manual.

REGULATORY GUIDE 1.59 REVISION 2 DATED 8/77

Design Basis Floods for Nuclear Power Plants

DISCUSSION:

Refer to Site Addendum Section 3.4.

REGULATORY GUIDE 1.64

Quality Assurance Requirements for the Design of Nuclear Power Plants

DISCUSSION:

Refer to the Union Electric Company Operational Quality Assurance Manual.

REGULATORY GUIDE 1.74

Quality Assurance Terms and Definitions

DISCUSSION:

Refer to the Union Electric Company Operational Quality Assurance Manual.

REGULATORY GUIDE 1.86 REVISION 0 DATED 6/74

Termination of Operating Licenses for Nuclear Reactors

DISCUSSION:

The termination of the operating license and subsequent decommissioning of Callaway Plant will be in accordance with regulations in effect at that time.

REGULATORY GUIDE 1.88

Collection, Storage, and Maintenance of Nuclear Power Plant Quality Assurance Records

DISCUSSION:

Refer to the Union Electric Company Operational Quality Assurance Manual.

REGULATORY GUIDE 1.91 REVISION 1 DATED 2/78

Evaluation of Explosions Postulated to Occur on Transportion Routes near Nuclear Power Plants

DISCUSSION:

Refer to Site Addendum Section 2.2.3.1 for a discussion of explosions near the plant site.

REGULATORY GUIDE 1.94

Quality Assurance requirements for installation, inspection and testing of structural concrete and structural steel during the construction phase of nuclear power plants.

DISCUSSION:

Refer to the Union Electric Company Operational Quality Assurance Manual.

REGULATORY GUIDE 1.101 REVISION NA DATED NA

Emergency Planning for Nuclear Power Plants

DISCUSSION:

This regulatory guide has been withdrawn.

REGULATORY GUIDE 1.102 REVISION 1 DATED 9/76

Flood Protection for Nuclear Power Plants

DISCUSSION:

Refer to Site Addendum Section 2.4.10 and 3.4 for a discussion offlood protection.

REGULATORY GUIDE 1.109 REVISION 1 DATED 10/77

Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I

DISCUSSION:

UE complied with the recommendations of this regulatory guide. Refer to Standard Plant Chapter 11 Historical data. Current methodology is maintained in the ODCM.

REGULATORY GUIDE 1.111 REVISION 1 DATED 7/77

Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors

DISCUSSION:

UE complies with the recommendations of this regulatory guide. Refer to Site Addendum Section 2.3.

REGULATORY GUIDE 1.113 REVISION 1 DATED 4/77

Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I

DISCUSSION:

UE complies with the recommendations of this regulatory guide. Refer to Site Addendum Section 2.4.

REGULATORY GUIDE 1.114 REVISION 2 DATED 5/89

Guidance on Being Operator at the Controls of a Nuclear Power Plant

DISCUSSION:

UE complies with the recommendations of this regulatory guide.

REGULATORY GUIDE 1.116

Quality Assurance Requirements for Installation, Inspection, and Testing of Mechanical Equipment and Systems

DISCUSSION:

Refer to the Union Electric Company Operational Quality Assurance Manual.

REGULATORY GUIDE 1.123

Quality Assurance Requirements for Control of Procurement of Items and Services for Nuclear Power Plants

DISCUSSION:

Refer to the Union Electric Company Operational Quality Assurance Manual.

REGULATORY GUIDE 1.125 REVISION 1 DATED 10/78

Physical Models for Design and Operation of Hydraulic Structures and Systems for Nuclear Power Plants

DISCUSSION:

No physical models were used to predict the action or interaction of surface waters with safety-related structures or components located outside of containment. This Regulatory Guide does not apply to the Callaway Plant.

REGULATORY GUIDE 1.127 REVISION 1 DATED 3/78

Inspection of Water-Control Structures Associated with Nuclear Power Plants

DISCUSSION:

Refer to Site Addendum Section 2.4.11.6 for a discussion of this regulatory guide.

REGULATORY GUIDE 1.132 REVISION 1 DATED 3/79

Site Investigations for Foundations of Nuclear Power Plants

DISCUSSION:

Refer to Site Addendum Section 2.5.4 for a discussion of stability of subsurface materials and foundations.

REGULATORY GUIDE 1.134 REVISION 2 DATED 4/87

Medical Certification and Monitoring of Personnel Requiring Operating Licenses

DISCUSSION:

UE complies with the recommendations of this Regulatory Guide with the following clarifications:

With regard to Section 5.4.2 of ANSI/ANS 3.4-1983 title Nose: UE shall instruct the medical consultant to ask the examinee whether they have the ability to detect common odors (such as coffee, pine oil, ammonia, peppermint, burning leaves/wood). If the examinee answers "no", further follow-up will be made to determine if this is a disqualifying condition.

With regard to Section 5.4.14 of ANSI/ANS 3.4-1983 titled Neurological: UE shall instruct the medical consultant to ask the examinee a series of questions which relate to his/her ability to effectively use their fingers, hands, arms, shoulders and upper back. If the examinee answers "yes" to any of these questions, further follow-up will be made to determine if he/she can operate controls as required.

REGULATORY GUIDE 1.138 REVISION 0 DATED 4/78

Laboratory Investigations of Soils for Engineering Analysis and Design of Nuclear Power Plants

DISCUSSION:

Refer to Site Addendum Section 2.5.4 for a discussion on engineering analysis of subsurface materials.

REGULATORY GUIDE 1.144

Auditing of Quality Assurance Programs for Nuclear Power Plants

DISCUSSION:

Refer to the Union Electric Company Operational Quality Assurance Manual.

REGULATORY GUIDE 1.145

Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants

DISCUSSION:

UE complies with the recommendations described in the Draft Regulatory Guide 1.XXX (1978). Refer to Site Addendum Section 2.3.4.2.1 for a discussion of short-term diffusion estimates.

REGULATORY GUIDE 1.146

Qualification of Quality Assurance Program Audit Personnel for Nuclear Power Plants

DISCUSSION:

Refer to the Union Electric Company Operational Quality Assurance Manual.

REGULATORY GUIDE 1.160 REVISION 2 DATED 3/97

Monitoring the Effectiveness of Maintenance at Nuclear Power Plants

DISCUSSION:

Refer to Appendix 3A of the Standard Plant FSAR.