Appendix 3A. Tables

Table 3-1. System Piping Classification

Piping Class	Design Criteria	Designed For Seismic Loading
A	Class I, USAS B31.7[2]	Yes
B	Class II, USAS B31.7	Yes
C	Class III, USAS B31.7	Yes
D	USAS B31.1.0	Yes
E	USAS B31.1.0[1]	No
F	USAS B31.1.0	Yes
G	USAS B31.1.0	No
H	Good Industry Practice	No

Note:

1. Portions are considered a Class III system in accordance with FSAR Section 3.2.2.1.
2. Class I RCS piping was re-analyzed to the 1983 ASME Code (No Addenda) during the replacement steam generator analysis.

Table 3-2. System Component Classification

	Design Code	Designed For Seismic Loading (D=Dynamic Analysis) (S=Static Analysis)
Reactor Coolant System		
Reactor Vessel	ASME III, Class A	Yes – D
Reactor Vessel Head	ASME III, Class I, 1989 Edition, No Addenda	Yes – D
Pressurizer	ASME III, Class A	Yes - D
Reactor Coolant Pump Casing	ASME III, Class A (not code stamped)	Yes - D
Steam Generator	ASME III, Class A	Yes - D
High Pressure Injection System		
HP Injection Pump	See Table 6-3	Yes - Note 1
Letdown Cooler	ASME III-C & VIII	Yes - D
Seal Return Cooler	ASME III-C & VIII	Yes - Note 2
Letdown Storage Tank	ASME III-C	Yes - Note 2
Purification Demineralizer	ASME III-C	Yes - Note 2
Letdown Filter	ASME III-C	Yes - Note 2
RC Pump Seal Filter	USAS B31.7, Paragraph 2-724, Class II	Yes - Note 3
Chemical Addition and Sampling System		
Boric Acid Mix Tank	USAS B96.1	No
Lithium Hydroxide Mix Tank	-	No
Caustic Mix Tank	-	No
TSP Baskets	AISC	Yes -D
Boric Acid Pump	-	No
Lithium Hydroxide Pump	-	No
Hydrazine Pump	-	No
Caustic Pump	-	No
Pressurizer Sample Cooler	ASME III-C & VIII	No
Steam Generator Sample Cooler	ASME VIII	No
Component Cooling System		

	Design Code	Designed For Seismic Loading (D=Dynamic Analysis) (S=Static Analysis)
Component Cooling Pump	-	Yes - Note 1
Component Cooler	ASME VIII	Yes - Note 2
Component Cooling Surge Tank	AWWA D-100	Yes - S
CRD Cooling Coil Filter	ASME VIII	Yes - S
Reactor Fuel Cooling System		
Spent Fuel Cooler	ASME III-C & VIII	Yes - Note 2
Spent Fuel Pump	-	Yes - Note 1
Spent Fuel Filter	ASME III-C	Yes - S
Borated Water Recirculation Pump	-	Yes - Note 1
Spent Fuel Demineralizer	ASME III-C	Yes - Note 2
Fuel Transfer Tube	ASME III-B	Yes - D
Incore Instrument Handling Tank	AWWA D-100	Yes - D
Low Pressure Injection System		
LP Injection Pump	See Table 6-3	Yes - Note 1
LP Injection Cooler	ASME III-C & VIII	Yes - Note 2
Borated Water Storage Tank	AWWA D-100	Yes - S
Core Flooding Tank	ASME III-C	Yes - D
Reactor Building Spray System		
Reactor Building Spray Pump	See Table 6-3	Yes - Note 1
Reactor Building Penetration Room Ventilation System		
Penetration Room Filter	See Section 6.5.1	Yes - S
Penetration Room Fan	See Section 6.5.1	Yes - Note 4
LP Service Water System		
LP Service Water Pump	-	Yes - Note 1
SSF Systems and Components	See Section 9.6.4.5	Note 9
Reactor Building Cooling System		
Reactor Building Coolers	See Section 6.2.2	Yes - D
Recirculated Cooling Water System		

	Design Code	Designed For Seismic Loading (D=Dynamic Analysis) (S=Static Analysis)
RCW Pump	-	No
RCW Heat Exchanger U1/U2	ASME VIII	Yes - Note 8
RCW Heat Exchanger U3	-	No
RCW Surge Tank	ASME VIII (not code stamped)	No
Coolant Storage System		
Quench Tank	ASME III-C	Yes - Note 2
Quench Tank Cooler	ASME III-C & VIII	Yes - Note 2
Component Drain Pump	-	Yes - Note 1
Coolant Bleed Holdup Tank	ASME VIII (not code stamped)	Yes - S
Bleed Transfer Pump	-	Yes - Note 1
Deborating Demineralizer	ASME III-C	Yes - Note 2
Concentrated Boric Acid Storage Tank	USAS B96.1	Yes - S
Concentrated Boric Acid Storage Tank Pump	-	No
Coolant Treatment System		
Coolant Bleed Evaporator Demineralizer	ASME III-C	Yes - Note 2
Coolant Bleed Evaporator Feed Tank	AWWA D-100	Yes - S
Coolant Bleed Evaporator	ASME VIII (lethal)	Yes - S
Recirculating Pump	-	Yes - S
Concentrate Cooler	ASME VIII (lethal)	Yes - S
Separator	ASME VIII (lethal)	Yes - S
Vapor Condenser	ASME VIII (lethal)	Yes - S
Distillate Pump	-	Yes - S
Distillate Cooler	ASME VIII (lethal)	Yes - S
Condensate Test Tank	USAS B96.1	Yes - S
Condensate Test Tank Pump	-	Yes - Note 1
Condensate Demineralizer	ASME III-C	Yes - S
Coolant Bleed Evaporator Feed Pump	-	Yes - S

	Design Code	Designed For Seismic Loading (D=Dynamic Analysis) (S=Static Analysis)
Steam & Power Conversion System (Pertinent Components Only)		
Condenser	-	Yes - S
Upper Surge Tank	ASME VIII	Yes - S
Emergency Feedwater Pump	-	Yes - Note 1
Emergency Feedwater Pump Turbine	-	Yes - Note 1
Liquid Waste Disposal System		
High Activity Waste Tank	Note 7	Yes - Note 5
High Activity Waste Tank Pump	-	No
Low Activity Waste Tank	Note 7	Yes - Note 5
Low Activity Waste Tank Pump	-	No
Waste Holdup Tank	AWWA D-100	Yes - S
Waste Holdup Transfer Pump	-	Yes - Note 1
Spent Resin Storage Tank	AWWA D-100	Yes - S
Spent Resin Transfer Pump	-	Yes - Note 1
Spent Resin Sluicing Pump	-	Yes - Note 1
Waste Evaporator Feed Tank	AWWA D-100	Yes - S
Waste Evaporator	ASME VIII (lethal)	Yes – S
Recirculating Pump	-	Yes – S
Concentrate Cooler	ASME VIII (lethal)	Yes – S
Separator	ASME VIII (lethal)	Yes – S
Vapor Condenser	ASME VIII (lethal)	Yes – S
Distillate Pump	-	Yes – S
Distillate Cooler	ASME VIII (lethal)	Yes - S
Reactor Building Sump Pump	-	Yes - Note 1
Waste Evaporator Feed Pump	-	Yes - S
Gaseous Waste Disposal System		

	Design Code	Designed For Seismic Loading (D=Dynamic Analysis) (S=Static Analysis)
Waste Gas Compressor	-	Yes - S
Waste Gas Separator	ASME VIII	Yes - S
Seal Water Cooler	-	Yes - S
Waste Gas Tank	ASME VIII-C	Yes - S
Waste Gas Filter	-	Yes - S
Waste Gas Exhauster	-	No
Condenser Cooling Water System		
Intake Structure	-	Yes - S
CCW Pumps	-	Yes - S
CCW Intake Pipe	-	Yes - S
CCW Discharge Pipe	-	Yes - S
ECCW Piping (Structural Portion)	-	Yes - S
Condenser	-	Yes - S
Essential Siphon Vacuum (ESV) System		
ESV Pumps	-	Yes - Note 6
ESV Tanks	ASME Secton VIII	Yes - S

Design Code	Designed For Seismic Loading (D=Dynamic Analysis) (S=Static Analysis)

Notes:

1. Vendor certification that component will meet seismic loading requirement.
2. Static and Dynamic Analyses performed.
3. Shock tested in lieu of analysis.
4. Vendor certification that component will meet seismic loading requirement will be furnished.
5. Tank meets loading requirement by its location in Auxiliary Building basement floor.
6. Seismic Adequacy evaluated using experience based criteria and procedures.
7. Stainless Steel Lining for Concrete Sump
8. Dynamic analysis performed. Static and/or dynamic analyses can be performed for future changes that affect the U 1/2 RCW Heat Exchanger. Seismic loads are applied to this U 1/2 Heat Exchanger since the attached CCW piping is Class D-seismic.
9. The SSF systems and components needed for safe shutdown are designed to withstand the safe shutdown Earthquake. See Sections 9.6.4.1 and 9.6.4.3
10. A separate PSW structure is provided for major electrical equipment. The PSW structure is designed to withstand the Maximum Hypothetical Earthquake (MHE) and tornado missiles, wind and differential pressure in accordance with Regulatory Guide 1.76 (Revision 1). Other components that receive backup power from the PSW System retain their existing seismic and quality classifications. See Section 9.7.

Table 3-3. Summary of Missile Equations

Missile Category	Principle	Symbolic Form of Equation	Solution
I	Stored strain energy equals kinetic energy	$\frac{\sigma \varepsilon v}{2} = \frac{mV_o^2}{2}$ $\frac{\sigma^2 v}{2E} = \frac{mV_o^2}{2}$	$V_o = \sigma \phi \sqrt{\frac{g}{E\rho}}$ **Note:** The above equation was revised in 2004 update.
II	Work done is Converted to kinetic energy	$F\ell = \frac{m V_o^2}{2}$ $= PA_o \ell$	$V_o = \sqrt{\frac{2PA_o \ell}{m}}$ **Note:** The above equation was revised in 2004 update.
III	Newton's second law	$F = ma$ $a = \dot{V} = \ddot{X} = \frac{F}{m}$ $\dot{V} = \left[\frac{\rho_f A_o V_f}{M}\right] \frac{A_m}{A_j} \left(V_f - V\right)$ **Note:** The above equation was revised in 1999 update.	$(1 - \frac{V}{V_f}) - 1n(1 - \frac{V}{V_f}) = K_1 - \frac{K_2}{r_o + X \tan\beta}$ **Note:** The above equation was revised in 1995 update. $K_1 = (1 - \frac{V_o}{V_f}) - 1n(1 - \frac{V_o}{V_f}) + \frac{K_2}{r_o}$ **Note:** The above equation was revised in 1999 update.
			$K_2 = \frac{\rho_f A_o A_m}{m\pi \tan\beta}$

Note:

1. Either graphical techniques or numerical methods must be used to obtain the solution to category III.

Table 3-4. List of Symbols

σ	=	ultimate tensile stress, (lb/ft^2)
ρ	=	density of missile, (#/ft^3)
ε	=	strain = σ/E, (in./in.)
E	=	modulus of elasticity, (lb/ft^2)
v	=	volume of missile, (ft^3)
m	=	mass of the missile, (lb-sec^2/ft)
V	=	velocity of missile, (ft/sec)
g	=	gravity constant, (ft/sec^2)
F	=	force on the missile, (lb)
ℓ	=	stroke length, (ft)
P	=	system pressure, (lb/ft^2)
A_o	=	missile area under pressure, throat area, (ft^2)
ρ_f	=	density of fluid, (#/ft^3)
V_f	=	jet velocity, (ft/sec)
A_m	=	projected area of missile, (ft^2)
A_j	=	jet area, (ft^2)
β	=	angle of jet expansion, (°from normal)
X	=	distance missile travels, (ft)
V_o	=	initial velocity of missile, (ft/sec)
r_o	=	radius of throat (ft)
K_2	=	constant

Table 3-5. Properties of Missiles - Reactor Vessel & Control Rod Drive

Missile Class	Description	Weight (lbs.)	Impact Area (in^2)	Velocity (ft/sec)	Kinetic Energy (Ft-lbs)
I	1. Closure head nut [Note 1]	80	38	97	11,680
	2. Closure stud w/nut [Note 1]	660	71	97	96,400
	3. 1" Valve bonnet stud	0.5	0.6	73.5	42
	4. C. R. nozzle flange bolt & nut	3.0	3.1	97	438
II	1. CRD closure cap	8.0	7.0	215	5,742
III	1. C. R. drive assembly	1000	64.0	90	125,777
Deleted row(s) per 2004 update					

Note:

1. These values are from the NSSS and Bechtel vendor calculations. HydraNuts have been established as acceptable alternate closure head nuts. Each HydraNut weighs approximately 108 lbs. This increase in weight and associated parameters in the table due to the use of the HydraNuts remains bounded by those of the control rod drive described in Section 3.5.1.1.

Table 3-6. Properties of Missiles - Steam Generator

Missile Class	Description	Weight (lbs.)	Impact Area (in^2)	Velocity (ft/sec)	Kinetic Energy (Ft-lbs)
	Original Steam Generator				
I	1. 1½" Vent valve bonnet stud	2.0	.8	73.5	167
	2. Feedwater inlet flange bolt	0.3	.6	67.5	21
	3. 16" I.D. manway stud, tube side	8.0	2.1	67.5	566
	4. 5" Inspection opening cover stud	1.5	1.2	73.5	125
	5. 1" Valve bonnet stud	0.5	.6	73.5	42
II	1. 1½" Vent valve stem & wheel	5.0	.45	44.5	154
	2. Sample line 1" valve stem & wheel	4.0	.3	35.8	80
	3. Sample line 1" EMO valve stem and wheel	4.0	.3	35.8	80
III	1. 16" I.D. manway cover, tube side	955	615	515	1,950,000
	2. 16" I.D. manway cover, shell side	478	615	777	2,230,000
	3. 5" I.D. inspection cover, tube side	80	150	515	160,000
	4. 5" I.D. inspection cover, shell side	40	150	852	220,000
	5. 1½" Vent valve bonnet and assembly	24	38	371	51,180
	6. Sample line 1" valve bonnet & assy.	30	27	243	27,460
	7. Sample line 1" EMO bonnet & assy.	115	27	138	34,250

Missile Class	Description	Weight (lbs.)	Impact Area (in^2)	Velocity (ft/sec)	Kinetic Energy (Ft-lbs)
	Replacement Steam Generator				
I	1. 1½" Vent valve bonnet stud	2.0	.8	73.5	167
	2. Feedwater inlet flange bolt	0.3	.6	67.5	21
	3. 16" I.D. manway stud, tube side	8.0	2.1	67.5	566
	4. 6" Handhole opening cover stud	1.5	1.2	73.5	125
	5. 1" Valve bonnet stud	0.5	.6	73.5	42
II	1. 1½" Vent valve stem & wheel	5.0	.45	44.5	154
	2. Sample line 1" valve stem & wheel	4.0	.3	35.8	80
	3. Sample line 1" EMO valve stem and wheel	4.0	.3	35.8	80
III	1. 16" I.D. manway cover, tube side	955	615	515	1,950,000
	2. 16" I.D. manway cover, shell side	478	615	777	2,230,000
	3. 6" Handhole opening cover, tube side	80	150	515	160,000
	4. 6" Handhole opening cover, shell side	40	150	852	220,000
	5. 1½" Vent valve bonnet and assembly	24	38	371	51,180
	6. Sample line 1" valve bonnet & assy.	30	27	243	27,460
	7. Sample line 1" EMO bonnet & assy.	115	27	138	34,250

Table 3-7. Properties of Missiles - Pressurizer

Missile Class	Description	Weight (lbs.)	Impact Area (in^2)	Velocity (ft/sec)	Kinetic Energy (Ft-lbs)
I	1. 4" Valve bonnet stud	3.0	1.8	73.5	250
	2. 5" Valve bonnet stud	3.0	2.4	73.5	250
	3. 16" Manway cover stud	7.5	3.1	67.5	530
	4. Heater bundle stud	25.0	7.0	73.5	2100
	5. 3/4" Valve stem stud	0.8	.45	73.5	67
II	1. Spray line 4" EMO valve stem	9	1.0	135.0	2560
	2. Sample line 3/4" valve stem	4	.3	72.7	330
	3. Sample line 3/4" EMO valve stem	4	.3	72.7	330
III	1. 16" I.D. manway cover	250	615	375	546,000
	2. Heater bundle assembly	2500	850	375	5,400,000
	3. Spray line 4" EMO valve bonnet and assembly	325	150	521	1,370,000
	4. 2½" x 6 Relief valve bonnet and assembly	175	65	232	146,000
	5. Sample line 3/4" valve bonnet and assembly	20	21	364	41,150
	6. Sample line 3/4" EMO valve bonnet and assembly	115	21	258	118,400

Table 3-8. Properties of Missiles - Quench Tank and Instruments

Missile Class	Description	Weight (lbs.)	Impact Area (in^2)	Velocity (ft/sec)	Kinetic Energy (Ft-lbs)
	QUENCH TANKS				
I	1. 1½" Drain valve bonnet stud	0.6	.2	73.5	50
	2. 4" Valve bonnet stud	2.0	.3	73.5	167
II	1. 1½" EMO drain valve stem	5.0	.45	11.0	9
	2. 4" EMO valve stem	9.0	1.0	21.5	65
III	1. 1½" EMO drain valve & op.assy.	220	20	73.5	18,450
	2. 1½" Drain valve bonnet & assy.	20	20	73.5	1,670
	3. 4" EMO valve bonnet & op. assy.	355	65	73.5	29,780
	INSTRUMENTS				
III	1. RTE	1.0	.2	208	670
	2. RTE & Plug	2.0	4.0	448	6230

Table 3-9. Properties of Missiles - System Piping

Missile Class	Description	Weight (lbs.)	Impact Area (in^2)	Velocity (ft/sec)	Kinetic Energy (Ft-lbs)
Core Flooding Line					
I	14" C.V. bonnet stud	2.0	1.7	73.5	167
I	14" Valve bonnet stud	3.5	4.0	67.5	248
II	14" C.V. check pivot stud	10.0	1.75	249	9650
II	14" P.O. valve stem	98.0	5.0	143	31,100
III	14" C.V. bonnet & assembly	525.0	125	448	1,640,000
III	14" P.O. valve bonnet and assembly	1900.0	650	558	9,180,000
L.P. Injection Line					
I	12" C.V. bonnet stud	2.0	1.7	73.5	167
II	12" C.V. check pivot stud	10	1.75	249	9,650
III	12" C.V. bonnet and assy.	450	95	558	2,170,000
R.V. Outlet Line to L.P. System					
I	10" Valve bonnet stud	2.5	1.7	73.5	177
I	Relief valve bonnet stud	0.5	.3	73.5	42
I	Relief valve stem assy.	40	12.5	35.3	768
II	10" EMO valve stem	50	3.1	130	13,200
III	10" EMO valve bonnet & assy.	1270	415	558	6,140,000
R.V. Inlet Line from H.P. System					
I	4" C.V. bonnet stud	1.0	.8	73.5	83.5
II	4" C.V. check pivot stud	3.0	.8	158	1170
III	4" C.V. bonnet and assy.	30	19	558	145,000
S.G. Outlet Line to Pump Inlet					
I	1" Drain valve bonnet stud	0.8	.6	73.5	67
II	1" Drain valve stem assy.	4.0	.3	84	438
III	1" Drain valve & bonnet assy.	30.0	27	448	84,380
Pressurizer to C.A. System Line					
I	3/4" Valve bonnet stud	1.0	.45	73.5	83
II	3/4" Valve stem	4	.3	73	330
II	3/4" EMO valve stem	4	.3	73	330
III	3/4" Valve bonnet and assy.	20	21	425	56,250

Missile Class	Description	Weight (lbs.)	Impact Area (in^2)	Velocity (ft/sec)	Kinetic Energy (Ft-lbs)
III	3/4" EMO valve bonnet and assy.	115	21	280	140,000
Primary Pump Seal Water Return to H.P. System Line					
I	3" EMO valve bonnet stud	1.0	1.0	73.5	83.5
II	3" EMO valve stem	25.0	.3	125.7	6150
III	3" EMO valve bonnet and assy.	285.0	85	507	1,137,000
Letdown Cooler Inlet & Outlet Lines					
I	1½" EMO valve bonnet stud	2.0	.8	73.5	167
II	1½" EMO valve stem	1.0	1.0	153.2	1830
III	1½" EMO valve bonnet and assy.	250.0	38	320	397,000
Primary Pump Seal Water Inlet and Outlet Lines					
I	3" Inlet C.V. bonnet stud	1.0	.8	73.5	83.5
I	3" Outlet valve bonnet stud	2.0	1.0	73.5	167
II	3" C.V. check pivot stud	3.0	.8	158.4	1170
II	3" Outlet valve stem	25.0	2.4	125.7	6150
III	3" Inlet C.V. bonnet and assy.	25.0	85	558	120,800
III	3" Outlet valve bonnet and assy.	65.0	85	523	276,000
Primary Pump Vent & Drain Lines					
I	1½" Vent & drain valve bonnet stud	2.0	.8	73.5	167
II	1½" Vent & drain valve stem	5.0	1.0	153.2	1830
III	1½" Vent & drain valve bonnet and assy.	55.0	38	435.0	161,600

Table 3-10. Missile Characteristics

Weight	**Impact Area**
5944 lbs	Side On - 8.368 sq ft End On - 3.657 sq ft
Velocity	**Kinetic Energy Ft-Lbs**
Initial - 710 fps Impact	Initial - 46.5×10^{6} Impact
Cylinder - 502 fps Dome - 431 fps	Cylinder - 23.25×10^{6} Dome - 18.0×10^{6}

Table 3-11. Depth of Penetration of Concrete

Case I		Case II		Case III	
Cylinder	**Dome**	**Cylinder**	**Dome**	**Cylinder**	**Dome**
6"	5½"	12 3/4"	12¼"	35½"	25"

Table 3-12. Containment Coatings

Surface	Coating Systems		Dry Film Thickness	Manufacturer	Remarks
1. Carbon Steel 0°F - 200°F	Original System				Note 1
	Prime Coat	Carbo Zinc 11	3.0 mils DFT	Carboline	
	Finish Coat	Phenoline 305 Finish	4.0 mils DFT	Carboline	
			7.0 mils DFT		
	Maintenance System				Note 2
	over Original System	DP-SP28 Power Tool Cleaning			
	Maintenance Coat	DP#78-1 Carboline 890	2.0 to 7.0 mils DFT	Carboline	
	New System	DP-SP5 White Metal Blast Cleaning	2.0 mils DFT	Carboline	Note 2
	Prime Coat	DP#12-1 Carbo Zinc 11 SG	5.0 mils DFT	Carboline	
	Finish Coat	DP#78-1 Carboline 890	7.0 mils DFT		
2. Carbon Steel 0°F - 200°F	Original System				Note 1
	Prime Coat	Carboline 191 Primer	2.0 mils DFT	Carboline	
	Finish Coat	Phenoline 305 Finish	5.0 mils DFT	Carboline	
			7.0 mils DFT		
	Maintenance System				Note 2
	over Original System	DP-SP28 Power Tool Cleaning			
	Maintenance Coat	DP#78-1 Carboline 890	2.0 to 7.0 mils DFT	Carboline	
	New System	DP-SP5 White Metal Blast Cleaning			Note 2
	Prime Coat	DP#78-1 Carboline 890	2.0 mils DFT	Carboline	
	Finish Coat	DP#78-1 Carboline 890	5.0 mils DFT	Carboline	
			7.0 mils DFT		

Surface	Coating Systems		Dry Film Thickness	Manufacturer	Remarks
3. Carbon Steel 0°F - 750°F	Original System				Note 1
	Prime Coat	Carbo Zinc 11	3.0 mils DFT	Carboline	
	New system	DP-SP5 White Metal Blast Cleaning			Note 2
	Prime Coat	DP#12-1 Carbo Zinc 11 SG	3.0-5.0 mils DFT	Carboline	
4. Carbon Steel 0°F-250°F Tank Lining	New System	DP-SP5 White Metal Blast Cleaning			Note 2
	Prime Coat	DP#71-1 7155HHB Plasite Phenolic	4.0 mils DFT	Wisconsin	
	Intermediate Coat	DP#71-1 7155HHB Plasite Phenolic	4.0 mils DFT	Wisconsin	
	Finish Coat	DP#71-1 7155HHB Plasite Phenolic	4.0 mils DFT	Wisconsin	
			12.0 mils DFT		
5. Concrete Floors	Original System				Note 1
	Prime Coat	195Epoxy Surfacer	8.0 mils DFT	Carboline	
	Finish Coat	Phenoline 305 Finish	4.0-8.0 mils DFT	Carboline	
			12.0-16.0 mils DFT		
	Maintenance System			Note 2	
	over Original System	DP-SP25			
	Maintenance Coat	DP#78-1 Carboline 890	Carboline		
	New System				Note 2
	Prime Coat	DP-SP25			
	Finish Coat	DP#36-1 Starglaze 2011S	Seal Concrete	Carboline	
		DP#78-1 Carboline 890	8.0 mils DFT	Carboline	
			8.0 mils DFT		

Surface	**Coating Systems**		**Dry Film Thickness**	**Manufacturer**	**Remarks**
6. Concrete Walls	Original System	DP-SP17			Note 1
	Prime Coat	DP#36-1 46-X-29-00 Epoxy Surfacer	8.0 mils DFT	Carboline	
	Finish Coat	DP#69-1 76 Series-00 High Build Epoxy	4.0-8.0 mils DFT	Carboline	
			12.0-16.0 mils DFT		
	Maintenance System				Note 2
	over Original System	DP-SP17			
	Maintenance Coat	DP#78-1 Carboline 890	2.0 to 5.0 mils DFT	Carboline	
	New System	DP-SP17	Seal Concrete	Carboline	Note 2
	Prime Coat	DP#36-1 Starglaze 2011S	5.0 mils DFT	Carboline	
	Finish Coat	DP#78-1 Carboline 890	8.0 mils DFT		

Notes:

"HISTORICAL INFORMATION NOT REQUIRED TO BE REVISED"

1. *Original coating systems have satisfactorily withstood the following autoclave tests designed to simulate LOCA conditions with no loss of adherence or erosion of material from surface:*

Carbon Steel

a. Test specimens: Coating system applied to sandblasted carbon steel coupons.

b. Water chemistry: 3000 ppm boron as boric acid in water; also 3% boric acid

Surface	Coating Systems	Dry Film Thickness	Manufacturer	Remarks
c.	*Temperature:*			
	For 3000 ppm boron			
	3 hours at 285°F-290°F			
	2 days at 200° F			
	6 days at 150°F			
	4 days at 130°F			
	For 3% Boric Acid			
	3 hours at 75°F-300°F			
	3 hours at 300°F			
	3 hours at 300°F-180° F			
	15 hours cooling to ambient			
	Total 24 hour cycle repeated ten times			
Concrete				
a.	*Test specimens: Prepared concrete coupons.*			
b.	*Water Chemistry: 3000 ppm boron as boric acid in water; also 3% boric acid .*			
c.	*Temperature:*			
	2 hours at 75°F - 300° F			
	14 hours at 300°F			
	2 hours at 75° F			
	4 hours cooling to ambient			

- *We understand testing performed by ANS Subcommittee for Protective Coatings for Reactor Containment Facilities and by Dr. C D Watson at Oak Ridge did not disclose any significant difference between results of static autoclave exposure and autoclave exposure using a spray of solution on panels. On this basis either static or dynamic exposure to spray solution is considered to be acceptable as basis for testing.*
- *We do not have available test results on jet impingement effects; however, it is felt that there is no coating system available which would*

withstand a high temperature, high velocity steam jet. We believe that the assumption of large scale, rapid LOCA by means of a double-ended pipe failure or otherwise, negates the possibility of concentrated local jet impinging on a coated steel area of substantial size. Therefore, we believe the autoclave tests in which specimens were subjected to steam and water at elevated temperatures more nearly approximate overall building environment under LOCA conditions than would a local steam jet application.

- *We understand ANS subcommittee found no system for coating steel or concrete for resisting steam jet impingement and therefore has established no standards for this condition of exposure .*
- *Decontamination factor for Phenoline 305 is 325. Test methods described in Oak Ridge National Laboratory Reports ORNL-3589, 3916 and others.*
- *Carbo Zinc 11 withstands in excess of 3 x 10^9 Roentgens when irradiated in water. There is no serious damage to Phenoline 305 at 6 x 10^9 Roentgens when irradiated in air. Phenoline 305 withstands in excess of 2 x 10^9 Roentgens irradiated in water .*

2. Maintenance coating over Original Coating Systems and New Coating Systems have satisfactorily withstood radiation and autoclave tests with no loss of adherence or erosion of material from surface.

- Coating Systems are qualified by Engineering in accordance with ANSI N101.2 and ANSI N101.4 for (A) LOCA Conditions and (B) Radiation Tolerance.
- Coating specifications for shop and field application include the following: Scope, Coating System, Approved Materials, Application Procedures, Touchup Procedures, Workmanship Guide, Inspection Requirements, Record Requirements, and Product Data Sheets.
- A Materials Certification of each batch of coating material procured is in accordance with ANSI N101.4 and is provided by the Manufacturer.
- Distribution of Containment Coating Specifications and Coating Schedules are transmitted by Document Control.

Table 3-13. Service Load Combinations for Reactor Building

1. $D + F + L + T_o$		
2. $D + F + L + P + T_A + E(\text{or } W)$		
3. $D + F + L + P'$		
Where:		
D	=	Dead Load
L	=	Appropriate Live Load
F	=	Appropriate Prestressing Load
P	=	Pressure Load (Varies with time from design pressure to zero pressure)
T_o	=	Thermal Loads Due to Operating Temperature
T_A	=	Thermal Loads Based on a Temperature Corresponding to a Pressure P
E	=	Design Earthquake
P'	=	Test Pressure = 1.15 P
W	=	Wind Load

Table 3-14. Accident, Wind, and Seismic Load Combinations and Factors for Class 1 Concrete Structures

$Y = 1/\varnothing 1.0D + 1.0P + 1.0T + E')$
$Y = 1/\varnothing\ (1.05D + 1.25P + 1.0T + 1.25E \text{ or } W)$
$Y = 1/\varnothing\ (1.05D + 1.5P + 1.0T)$
$Y = 1/\varnothing 1.0D + 1.0W_t + 1.0P_i)$ for Tornado Forces.

(Use 0.95 where dead load subtracts from critical stress.) (Wind, W, to replace earthquake, E, in the above formula where wind stresses control)

Where	Y	=	required yield strength of the structure as defined above.
	D	=	dead loads of structure and equipment plus any other permanent loadings contributing stress, such as hydrostatic or soils. In addition, a portion of "live load" should be added when it includes piping, cable trays, etc. suspended from floors and an allowance should be made for future additional permanent loads.
	P	=	design accident pressure.
	T	=	thermal loads based on a temperature corresponding to the factored design accident pressure.
	E	=	seismic load based on design earthquake.
	E'	=	seismic load based on maximum hypothetical earthquake.
	W	=	wind load.
	W_t	=	stress induced by tornado wind velocity (drag, lift and torsion).
	P_i	=	stress due to differential pressure.
	∅	=	Concrete capacity reduction factor.
	∅	=	0.90 for concrete flexure.
	∅	=	0.85 for tension, shear, bond and anchorage in concrete.
	∅	=	0.75 for spirally reinforced concrete compression members.
	∅	=	0.70 for tied compression members.
	∅	=	0.90 for fabricated structural steel embedments.
	∅	=	0.90 for mild reinforcing steel (not prestressed) in direct tension excluding splices.
	∅	=	0.85 for mild reinforcing steel with mechanical splices (for lap splices, ∅= 0.85 as above for bond and anchorage).
	∅	=	0.95 for prestressed tendons in direct tension.

Additional Notes:

The Class 1 structures are proportioned to maintain elastic behavior when subjected to various combinations of dead loads, accident loads, thermal loads and wind or seismic loads. The upper limit of elastic behavior is considered to be the yield strength of the effective load-carrying structural materials.

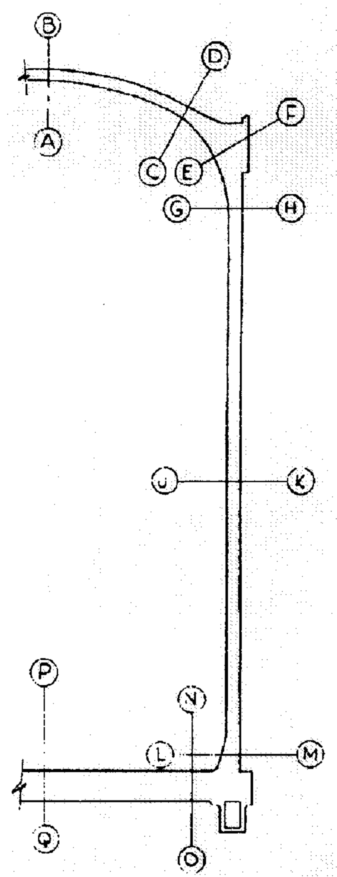
The yield strength for steel (including reinforcing steel) is considered to be the minimum given in the appropriate ASTM specification. Concrete structures are designed for ductile behavior wherever possible; that is, with steel stress controlling the design. The values for concrete, as given in the ultimate strength design portion of the ACI 318-63 Code, will be used in determining "Y", the required yield strength of the structure.

The design loads applied to the structures are increased by load factors based on the probability and conservatism of the predicted normal design loads.

Table 3-15. Inward Displacement of Liner Plate

Case	Nominal Plate Thickness (In.)	Initial Inward Displacement (In.)	Anchor Spacing L_1 (In.)	Anchor Spacing L_2 (In.)	Factor of Safety Against Failure
I	0.25	0.125	15	15	37.0
II	0.25	0.125	15	15	19.4
III	0.25	0.125	15	15	9.9
IV	0.25	0.125	15	15	6.28
V	0.25	0.25	30	15	4.25

Table 3-16. Stress Analysis Results



KEY ELEVATION

(SHOWING LOCATION OF REFERENCE SECTIONS)

Sheet 1 of 6

STRUCTURAL DATA

LOCATION	CONCRETE		REINFORCING STEEL		
	f'_c-psi	t-in	TYPE	p_m-%	p_h-%
A	5000	39	A615GR40	0.05	0.05
B	5000	39	A615GR40	0.23	0.23
C	5000	55	A615GR60	0.16	0.16
D	5000	55	A615GR60	0.30	0.30
E	5000	138	A615GR60	0.06	0.06
F	5000	138	A615GR60	0.18	0.18
G	5000	45	A615GR60	...	...
H	5000	45	A615GR60	0.53	0.53
J	5000	45	A615GR40	...	...
K	5000	45	A615GR40	0.25	0.25
L	5000	63	A615GR60	0.83	0.51
M	5000	83	A615GR60	0.74	0.72
N	5000	102	A615GR60	0.49	0.13
O	5000	102	A615GR60	0.87	0.31
P	5000	102	A615GR60	0.19	0.19
Q	5000	102	A615GR60	0.34	0.34

NOTES

1. LOADING CASES I, II, & III ARE WORKING STRESS ANALYSIS WHEREAS LOADING CASES IV, V, VI ARE YIELD STRESS ANALYSIS.
2. FOR NOTATION AND ALLOWABLE STRESSES SEE SHEET 2
3. ALL CONCRETE EXTREME FIBER STRESS (σ_e) ARE SHOWN FOR THE INSIDE SURFACE. OUTSIDE SURFACE STRESSES ARE INDICATED BY ( ). THE STRESSES LISTED ARE THE CONTROLLING STRESSES FOR THAT SECTION.
4. COMPUTED VS. ALLOWABLE RATIOS FOR CASES IV, V AND VI INCLUDE APPROPRIATE ϕ FACTORS, e.g. $\frac{f_a}{\phi f_a}$
5. ALLOWABLE SHEAR STRESSES INCLUDE STIRRUPS WHEREVER APPLICABLE
6. THE STRESSES SHOWN FOR THE LOAD CASES INCLUDING T_A ARE BASED ON CRACKED SECTION ANALYSIS UNLESS NOTED BY *.
7. DEVIATIONS IN ALLOWABLE STRESSES ARE IN ACCORDANCE WITH PSAR APPENDIX 5-C

Note: For stresses in the area of the construction opening installed and repaired during the steam generator replacement project see calculation OSC-8163.

Table 3-17. Stress Analysis Results

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NOTATION

D	DEAD LOAD
F	PRESTRESS
P	INTERNAL PRESSURE
E	EARTHQUAKE (DESIGN)
E'	EARTHQUAKE (HYPOTHETICAL)
T_A	ACCIDENT TEMPERATURE
fc	ULTIMATE CONCRETE STRESS
fy	STEEL RE-BAR YIELD STRESS
fa	ALLOWABLE CONCRETE AXIAL STRESS
fce	ALLOWABLE CONCRETE AXIAL & FLEXURE STRESS
v	ALLOWABLE CONCRETE SHEAR STRESS INCLUDING STIRRUPS IF APPLICABLE
fs	ALLOWABLE STEEL STRESS
σ_a	NOMINAL MEMBRANE STRESS
σ_e	COMBINED AXIAL & FLEXURE NOMINAL STRESS
τ	ACTUAL SHEAR STRESS
h	SUBSCRIPT INDICATING HOOP DIRECTION
m	SUBSCRIPT INDICATING MERIDIONAL DIRECTION
p_h	HOOP STEEL PERCENTAGE
p_m	MERIDIONAL STEEL PERCENTAGE
+	TENSILE STRESSES
-	COMPRESSIVE STRESSES
*	UNCRACKED SECTION ANALYSIS

ALLOWABLE STRESSES

	WORKING STRESS DESIGN	YIELD STRESS DESIGN
SHELL CONCRETE:	fa = 1500 psi	fa = ϕa (fc) = (0.85) (5000) = 4,250 psi
	fce = 3000 psi	fce = ϕce (fc) = (0.90) (5000) = 4,500 psi
BASE CONCRETE:	f_{ce} = 2250 psi	fa = ϕa (fc) = (0.85) (5000) = 4,250 psi
		fce = ϕce (fc) = (0.90) (5000) = 4,500 psi
STEEL: A615GR40	fs = 20,000 psi	fs = ϕ (fy) = (0.90) (40,000) = 36,000 psi
A615GR60	fs = 30,000 psi	fs = ϕ (fy) = (0.90) (60,000) = 54,000 psi

Table 3-18. Stress Analysis Results

Sheet 3 of 6

"D + F INITIAL" (Stresses in psi) Case I*

	SECTION	MERIDIONAL			HOOP			SHEAR		
		σ OUTSIDE	σ INSIDE	σ AXIAL	σ OUTSIDE	σ INSIDE	σ AXIAL	τ	V_{ci}	V_{cw}
SHELL	A - B	-1,340	-1,140	-1,250	-1,283	-1,096	-1,178	-14	111	605
	C - D	-218	-1,280	-668	-312	-460	-362	74	100+33	473+33
	E - F	-471	-581	-441	-353	-428	-386	47	185+145	411+145
	G - H	-667	-515	-584	-860	-872	-864	34	666	451
	J - K	-729	-673	-708	-1,205	-1,272	-1,251	-4	—	484
	L - M	-319	-881	-566	-211	-349	-273	-7	101+81	446+81
BASE	N - O	141	-84	23	10	-60	-36	-16	105+257	235+257
	P - Q	-27	-24	-26	-26	-20	-26	7	—	260

ALLOWABLE CONCRETE STRESSES.

Shell: fa = 1500 psi
fce = 3000 psi

Note: For stresses in the area of the construction opening installed and repaired during the steam generator replacement project see calculation OSC-8163.

Table 3-19. Stress Analysis Results

Sheet 4 of 6

REACTOR BUILDING — SUMMARY OF CONCRETE AND REINFORCING STEEL STRESSES

SECTION	LOAD CASE	CONCRETE								REINFORCING STEEL			
		COMPUTED					COMPUTED VS. ALLOWABLE			COMPUTED		COMPUTED VS. ALLOWABLE	
		σem	σeh	σam	σah	τ	$\frac{\sigma e}{f'c}$	$\frac{\sigma a}{fa}$	$\frac{\tau}{v}$	σm	σh	$\frac{\sigma m}{fs}$	$\frac{\sigma h}{fs}$
A-B	II · $D+F+1.15P$	(-313)*	(-303)*	-282*	-271*	-5*	0.104*	0.188*	0.038*	—	—	—	—
	III · $D+F+P+T_A+E$	-1,632	-1,422	-412	-368	-22	.544	.275	0.089	11,608	12,408	.580	.620
	IV · $0.95D+F+1.5P+T_A$	-328	-223	+16	+58	0	0.073	0	0.000	26,723	22,326	.742	.620
	V · $0.95D+F+1.25P+1.25E+T_A$	-1029	-823	-198	-154	-23	0.229	.047	0.920	17,462	17,513	.485	.486
	VI · $0.95D+F+P+E'+T_A$	-1,632	-1422	-412	-368	-26	0.363	.097	0.105	11,608	12,408	.322	.345
C-D	II · $D+F+1.15P$	-310*	-329*	-259*	-278*	83*	0.110*	0.185*	0.216*	—	—	—	—
	III · $D+F+P+T_A+E$	-2040	-1638	-312	-296	103	0.680	.208	0.896	26,361	21,360	.879	.712
	IV · $0.95D+F+1.5P+T_A$	-502	-1493	-131	-240	79	0.329	.056	0.642	15,587	26,135	.288	.484
	V · $0.95D+F+1.25P+1.25E+T_A$	-920	-1482	-216	-268	109	0.329	.063	0.380	15,283	21,552	.283	.400
	VI · $0.95D+F+P+E'+T_A$	-2232	-1683	-312	-296	109	0.496	.073	0.752	28,762	21,360	.533	.396
E-F	II · $D+F+1.15P$	(-551)*	(-374)*	-328*	-363*	49*	0.183*	0.242*	0.245*	—	—	—	—
	III · $D+F+P+T_A+E$	-298	-1520	-274	-358	83	0.507	0.239	0.170	—	12,800	—	.427
	IV · $0.95D+F+1.5P+T_A$	-(305)	-1450	-233	-343	52	0.322	0.081	0.107	2,532	12,213	0.047	.226
	V · $0.95D+F+1.25P+1.25E+T_A$	-170	-2367	-230	-350	91	0.526	0.082	0.153	—	36,328	—	.673
	VI · $0.95D+F+P+E+T_A$	-295	-1520	-271	-358	91	0.338	0.084	0.151	—	12,800	—	.237

Note: For stresses in the area of the construction opening installed and repaired during the steam generator replacement project see calculation OSC-8163.

Table 3-20. Stress Analysis Results

Sheet 5 of 6

REACTOR BUILDING — SUMMARY OF CONCRETE AND REINFORCING STEEL STRESSES

SECTION	LOAD CASE	CONCRETE								REINFORCING STEEL			
		COMPUTED					COMPUTED VS. ALLOWABLE			COMPUTED		COMPUTED VS. ALLOWABLE	
		σ_{em}	σ_{eh}	σ_{am}	σ_{ah}	τ	$\frac{\sigma_e}{f_{ce}}$	$\frac{\sigma_a}{f_a}$	$\frac{\tau}{v}$	σ_m	σ_h	$\frac{\sigma_m}{f_s}$	$\frac{\sigma_h}{f_s}$
G H	II D+F+1.15P	(-147)*	(-299)*	-111*	-298*	-10*	0.10C*	0.199*	0.089*	—	—	—	—
	III D+F+P+T_A+E	-744	-1594	-143	-386	42	0.531	.257	0.500	21,517	12,890	.717	.430
	IV 0.95D+F+1.5P+T_A	-50	-616	+50	-124	-17	0.137	.029	0.233	27,548	20,924	.5101	.388
	V 0.95D+F+1.25P+1.25E+T_A	-319	-1108	-25	-255	-57	0.246	.060	0.626	25,157	16,924	.466	.313
	VI 0.95D+F+P+E'+T_A	-724	-1594	-137	-386	52	0.354	.091	0.584	21,696	12,890	.402	.239
J K	II D+F+1.15P	(-255)*	-250*	-228*	-254*	-4*	0.085*	0.169*	0.082*	—	—	—	—
	III D+F+P+T_A+E	-944	-2606	-229	-474	-61	0.869	.316	0.735	16,118	9,344	.806	.467
	IV 0.95D+F+1.5P+T_A	-21	-719	+111	+46	-11	0.160	0	0.847	29,315	19,273	.814	.535
	V 0.95D+F+1.25P+1.25E+T_A	-478	-1319	-98	-186	-73	0.293	.044	0.948	19,986	15,116	.555	.420
	VI 0.95D+F+P+E+T_A	-918	-2606	-222	-474	-73	0.579	.111	0.737	16,334	9,344	.454	.260
L M	II D+F+1.15P	(-567)*	(-289)*	-335*	-267*	78*	0.189*	0.223*	0.294*	1,900*	—	0.063*	—
	III D+F+P+T_A+E	-727	-595	-237	-166	159	0.242	.158	0.503	7760	12,325	.259	.411
	IV 0.95D+F+1.5P+T_A	—	-850	-154	-249	140	0.190	.059	0.356	(16,440)	8,997	.304	.167
	V 0.95D+F+1.25P+1.25E+T_A	-449	-340	-141	-144	198	0.100	.034	0.504	10,068	12,367	.186	.229
	VI 0.95D+F+P+E'+T_A	-630	-528	-203	-145	173	0.140	.048	0.456	8,595	12,881	.159	.238

Note: For stresses in the area of the construction opening installed and repaired during the steam generator replacement project see calculation OSC-8163.

Table 3-21. Stress Analysis Results

Sheet 6 of 6

REACTOR BUILDING — SUMMARY OF CONCRETE AND REINFORCING STEEL STRESSES

SECTION	LOAD CASE	CONCRETE								REINFORCING STEEL			
		COMPUTED					COMPUTED VS. ALLOWABLE			COMPUTED		COMPUTED VS. ALLOWABLE	
		σ_{em}	σ_{eh}	σ_{am}	σ_{ah}	τ	$\frac{\sigma_e}{f_{ce}}$	$\frac{\sigma_a}{f_a}$	$\frac{\tau}{v}$	σ_m	σ_h	$\frac{\sigma_m}{f_s}$	$\frac{\sigma_h}{f_s}$
N-O	II · $D+F+1.15P$	-215*	-183*	223*	-35*	-182*	0.095*	$f_a = .3f'_c$ NOT APPLICABLE TO SLAB	0.361*	7,755*	7,236*	0.259*	0.241*
	III · $D+F+P+T_A+E$	-24	—	+151	+73	284	0.011		0.563	23,130	27,666	.838	.922
	IV · $0.95D+F+1.5P+T_A$	-50	-627	+188	+15	323	0.139		0.455	27,386	24,980	.507	.463
	V · $0.95D+F+1.25P+1.25E+T_A$	—	—	+188	+98	330	—		0.482	30,034	36,326	.556	.673
	VI · $0.95D+F+P+E'+T_A$	-28	—	+157	+90	293	—		0.442	26,379	32,501	.490	.602
P-O	II · $D+F+1.15P$	-13*	(-14)*	-14*	-15*	9*	0.006*	$f_a = .3f'_c$ NOT APPLICABLE TO SLAB	0.035*	—	—	—	—
	III · $D+F+P+T_A+E$	-1000	-960	-16	-15	29	0.444		0.492	31,000	29,475	1.03	.9825
	IV · $0.95D+F+1.5P+T_A$	-811	-501	-11	-10	6	0.360		0.130	32,600	34,097	.604	.631
	V $0.95D+F+1.25P+1.25E+T_A$	-944	-581	-13	-13	36	0.420		0.563	36,502	36,162	.676	.670
	VI · $0.95D+F+P+E'+T_A$	-1026	-632	-16	-15	35	0.456		0.556	38,844	37,315	.719	.691

Note: For stresses in the area of the construction opening installed and repaired during the steam generator replacement project see calculation OSC-8163.

Table 3-22. Bent Wire Test Results

Sample		**STRESS (psi)**					
Group No.		1	2	3	4	5	6
Bend Angle (Degrees)		-	30	60	90	30	60
Bend Radius (inch)		-	1.25	1.25	1.25	0	0
	1	251,500	257,650	257,650	259,650	251,550	230,150
	2	254,600	259,650	257,650	257,650	251,550	237,250
	3	256,600	257,650	259,650	256,600	252,550	240,300
SERIES I Heat #A67386	4	258,650	258,650	258,650	256,600	247,450	235,250
	5	259,650	261,700	259,650	258,650	248,450	237,250
	6	258,650	259,650	260,700	258,650		
	7	260,700	254,600	261,700	258,650		
	8	259,650	258,650	260,700	258,650		
	9	260,700	258,650	260,700	257,650		
	10	260,700	258,650	255,600	260,700		
Average		258,850	258,550	259,250	258,350	250,300	236,050
	11	252,550	249,500	249,500		243,400	229,100
	12	252,550	249,500	251,550		243,400	227,100
	13	249,500	249,500	248,450		243,400	229,100
SERIES II Heat #A72005	14	248,450	249,500	250,500		242,350	227,100
	15	247,450	250,500	248,450		241,350	228,100
	16	250,500	249,500	248,450			
	17	254,600	253,550	252,550			
	18	251,550	251,550	251,550			
	19	252,550	251,550	249,500			
	20	249,500	254,600	249,500			
Average		250,900	250,900	250,000		242,750	228,100

Table 3-23. Auxiliary Building Loads and Conditions

AREA	CONDITIONS	
Control Room	A,B,C,D,E	
Cable Room	A,B,C,D,E	
Electrical Equipment Room	A,B,C,D,E	
Spent Fuel Pool	A,B,C,D,E	Blow out panels designed to relieve 3 psi differential pressure
Spent Fuel Storage Racks	A,D	Inherently resistant to wind loads
Spent Fuel Handling Crane	A,D,E	Inherently resistant to wind loads. Hold down device provided
Penetration Room Frames	A,B,D	Physical separation provided for missile protection
Cable Shaft	A,B,C,D,E	
Elevator Steel Shaft	A,D	
Main Steam Pipe Supports	A,B,D	
Hot Machine Shop	A,D	
Balance of Auxiliary Building	A,B,D	Frame designed for B, but not external walls above grade. Areas below grade are inherently protected against missiles in C and E.

A = All normal dead, equipment, live, and wind loads due to 95 mph wind or design basis earthquake.

B = Normal dead and equipment loads plus tornado wind load due to 300 mph wind.

C = Tornado missiles of (1) 8 in. diameter x 12 ft. long piece of wood, 200 pounds, 250 mph, and (2) 2,000 pound automobile, 100 mph, 20 sq. ft. impact area, for 25 ft. above grade.

D = Normal dead and equipment loads plus maximum hypothetical earthquake loads.

E = Turbine-generator missile, 5,944 pounds, 502 fps, kinetic energy of 23.25×10^6 ft.-lbs., side on impact area of 8.368 sq. ft. and end on impact area of 3.657 sq. ft.

Deleted row(s) Per 2009 Update

Table 3-24. Mark-BZ Fuel Assembly Seismic and Loca Results at 600°F

Loading Case	Allowable Impact Load (lbs)	Grid Deformation	Allowable Grid Deformation (in.)
SSE	2824 [(1)]	None	0.0
LOCA Core Flood Line Guillotine	2824	None	0.0
LOCA Decay Heat Line Guillotine	2824	None	0.0
SSE and LOCA	2824	None	0.0

Note:

1. That the allowable load is actually higher than the elastic load limit given, since the criteria of SSE is to ensure control rod insertion. Therefore, the value given is conservative.

Table 3-25. Deleted per 1996 Update

Table 3-26. Stress Limits for Seismic, Pipe Rupture and Combined Loads

Case	Loading Combination	Stress Limits
I	Design loads + operating basis earthquake loads	$P_m \le 1.0S_m$ $(P_L + P_b) \le 1.5S_m$
II	Design loads + safe shutdown earthquake loads	$P_m \le 1.2S_m$ $(P_L + P_b) \le 1.2(1.5S_m)$
III	Design Loads + pipe rupture loads	$P_m \le 1.2S_m$ $(P_L + P_b) \le 1.2(1.5S_m)$
IV	Design loads + safe shutdown earthquake loads + pipe rupture loads	$P_m \le 2/3S_u$ $(P_L + P_b) \le 2/3S_u$

[1] where	P_L	=	Primary local membrane stress intensity
	P_m	=	Primary general membrane stress intensity
	P_b	=	Primary bending stress intensity
	S_m	=	Allowable membrane stress intensity
	S_u	=	Ultimate stress for unirradiated material at operating temperature

Note:

1. All symbols have the same definition or connotation as those in ASME B&PV Code Section III, Nuclear Vessels.
2. All components will be designed to insure against structural instabilities regardless of stress levels.

Table 3-27. Deleted Per 1999 Update

Table 3-28. Deleted Per 2004 Update

Table 3-29. Deleted Per 2004 Update

Table 3-30. Deleted Per 2004 Update

Table 3-31. Deleted Per 2004 Update

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Table 3-50. Deleted Per 2004 Update

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Table 3-61. Deleted Per 2004 Update

Table 3-62. Deleted Per 2004 Update

Table 3-63. Deleted Per 2004 Update

Table 3-64. Deleted Per 2004 Update

Table 3-65. Deleted Per 2004 Update

Table 3-66. Deleted Per 2004 Update

Table 3-67. Deleted Per 2004 Update

Table3-68. Electrical Equipment Seismic Qualification

	Equipment Identification	Seismic Qualification Documentation Reference
1.	Reactor Protective System Cabinets/Components	Deleted Per 2013 Update. Reactor Protective System Engineered Safeguards Protective System Replacement Equipment Qualification Report AREVA NP 66-5065212 (OM 201.N-0021.001); TXS Supplemental Equipment Qualification Summary Test Report AREVA NP 66-5015893 (OM 201.N-0021.017); Seismic Anchorage Calculation OSC-8743; Seismic Qualification of ES and RPS Cabinets AREVA NP 51-9002920; Seismic and Isolation Qualification Test Report of Phoenix Contact Relays AREVA NP 38-9057729; Test Report for Seismic Qualification of Additional Hardware for use within Teleperm XS System Areva NP 58-5066097 Deleted Per 2013 Update.
2.	Engineered Safeguards Protective Cabinets/Components	Deleted Per 2013 Update. Reactor Protective System and Engineered Safeguards Protective System Replacement Equipment Qualification Report AREVA NP 66-5065212 (OM 201.N-0021.001); TXS Supplemental Equipment Qualification Summary Test Report AREVA NP 66-5015893 (OM 201.N-0021.017); Seismic Anchorage Calculation OSC-8743; Seismic Qualification of ES and RPS Cabinets AREVA NP 51-9002920; Seismic and Isolation Qualification Test Report of Phoenix Contact Relays AREVA NP 38-9057729; Test Report for Seismic Qualification of Additional Hardware for use within Teleperm XS System Areva NP 58-5066097 Deleted Per 2013 Update.

	Equipment Identification	Seismic Qualification Documentation Reference
3.	Reactor Protective System Sensors 1. RC Pressure Transmitters (NR) 2. RC Temperature RTD's 3. RC Flow Transmitters 4. RB Pressure Switches 5. RCP Power Monitors	Rosemount Report 2758&127516 &D8400102 also B & W 58-0261-00 Rosemount Report 1177117A, and B & W 58-0082-00 B & W 58-0081-00 and Rosemount Report D8400102 Herron Lab Report F-7040, and B & W 58-0080-00 (OM 360-0010) Duke/Exide Test Report PH58644 WEED Instrument Report D6-8680-003(OM-357.-0008-0001) Deleted Per 2013 Update. Wyle Test Report No. 52511-1, Seismic Test Report; NTS Environmental and Seismic Testing of Ancillary Equipment for Oconee ES/RPS Replacement AREVA NP 38-9004984; Seismic Qualification Report Lampbox and Switches AREVA NP 38-9005550
4.	Engineered Safeguards Protective System Sensors 1. RC Pressure Transmitters (WR) 2. RB Pressure Transmitters 3. RB Pressure Switches	Rosemount Test Report D830040(OM-0267.A-0114) &D8400102 (OM-0267-0969) ITT-Barton Test Report R3-764-9 (OM-0267.A-0041) ASCO Test Report AQR-101083 (OM-0267.A-0050)
5.	4160 VAC Station Auxiliary Switchgear (1TC, 1TD, 1TE; 2, 3)	ITE Report No. R-8793, and Gould Report No. 33-53719-SS (OM 302-0617)
6.	600 VAC Load Centers (1X8, 1X9, 1X10; 2, 3)	Gould Report No. 33-53729-SSA (OM 301-0079)
7.	Motor Control Centers (1XS1, 1XS2, 1XS3; 2; 3) 1. A.O. Smith Type "CY" Starters 2. Joslyn Clark Type "TM" Starters a. Oconee (1XS1, 1XS2, 1XS3j2;3) b. Keowee (1XA, 1XS, 2XA, 2XS)	Oconee Nuclear Station, Units 1-2-3 Motor Control Centers, DC Distribution Centers, DC Panelboards, Original QA Documentation Files Seismic Qualification of size 1-4 Joslyn Clark Motor Starters DPC-1393.00-00-0041
8.	DC Distribution Centers (1DCA, 1DCB; 2; 3)	Oconee Nuclear Station, Units 1-2-3 Motor Control Centers, DC Distribution Centers, DC Panelboards, Original QA Documentation Files

	Equipment Identification	Seismic Qualification Documentation Reference
9.	AC Panelboards (1KVIA, 1KVIB, 1KVIC, 1KVID; 2; 3)	Wyle Lab Report 42729-1 (OM-304.0002)
	1SKJ, 1SKK, 1SKL; 2,3	Square-D Report No. 8998-10.09-L31 (OM-0137)
10.	DC Panelboard (1DIA, 1DIB, 1DIC, 1DID; 2; 3)	Wyle Lab Report 42729-1 (OM-304.0002)
11.	Control Batteries/Racks (1CA, 1CB; 2; 3)	C & D Technologies, Environment and Seismic Qualification Report of 125 Volt Vital Instrumentation and Control Batteries, Model LCU-27 and RD-903-28EP3 Two Step Battery Racks (OM-1320.-101-001)
12.	Battery Chargers (1CA, 1CB, 1CS; 2; 3)	Wyle Lab Report 43185-2 (OM 346-0105-1)
13.	Inverters (1DIA, 1DIB, 1DIC, 1DID; 2; 3)	Wyle Lab Report 43185-2 (OM 346-0105-1)
14.	Isolating Diode Assemblies (1ADA, 1ADB, 1ADC, 1ADD; 2; 3)	Exide Power Systems Div. "Seismic Test of Diode Monitors"
15.	Oconee Main Control Boards	Wyle Lab Report WR 73-1 (OM 1393-0008), OSC-1525 [(1)], OSC-3942[(1)], OSC-2509[(1)]
16.	Engineered Safeguards Terminal Cabinets	Wyle Lab Report WR 73-1 (OM 1393-0008)
17.	Emergency Power Switching Logic Cabinets	Wyle Lab Report WR 73-1 (OM 1393-0008)
18.	Oconee Unit Boards	Wyle Lab Report WR 73-1 (OM 1393-0008), OSC-1525[(1)], OSC-3942[(1)], OSC-2509[(1)]
19.	Oconee Vertical Boards	Wyle Lab Report WR 73-1 (OM 1393-0008), OSC-1525[(1)], OSC-3942[(1)], OSC-2509[(1)]
20.	Oconee Auxiliary Boards	Wyle Lab Report WR 73-1 (OM 1393-0008), OSC-1525[(1)], OSC-3942[(1)], OSC-2509[(1)]
21.	Keowee Emergency Start Cabinets	Wyle Lab Report WR 73-1 (OM 1393-0008)
22.	Keowee Control Boards	Wyle Lab Report WR 73-1 (OM 1393-0008), Loose Parts, NLI-Nuclear Logistics INC. QR-29412516-4 (KM 303. --0045.001)
23.	Keowee Miscellaneous Terminal Cabinets	Wyle Lab Report WR 73-1 (OM 1393-0008)

	Equipment Identification	Seismic Qualification Documentation Reference
24.	Keowee Main Turbine - Generators	ONS Emergency Power Source Seismic Evaluation Technical Position Paper
25.	Keowee – Oconee Underground Power Circuit	ONS Emergency Power Source Seismic Evaluation Technical Position Paper
26.	Keowee Logic Cabinets	Wyle Lab Report WR 73-1 (OM 1393-0008)
27.	Keowee 125 VDC Battery Chargers	OM 320-0167
28.	Keowee 125 VDC Battery/Racks	Keowee Battery Environmental Qualification Report (KM 320-16)
29.	Keowee 125 VDC Distribution Centers	Oconee Nuclear Station, Units 1-2-3 Motor Control Centers, DC Distribution Centers, DC Panelboards, Original QA Documentation Files
30.	230 KV Swyd Battery Chargers	OM 320-0167
31.	230 KV Swyd Control Batteries	C & D Charter Power Systems Report Number QR-27189-01 (OM-320-163)
32.	230 KV Swyd Distribution Centers	Oconee Nuclear Station, Units 1-2-3 Motor Control Centers, DC Distribution Centers, DC Panelboards, Original QA Documentation Files
33.	230 KV Swyd Panelboards	Wyle Lab Report 42729-1, (OM 304.0002)
34.	Oconee/Keowee Overhead Power Path Equipment	
	a. Keowee Main Stepup Transformer	G. E. letter to R. S. Thompson, 09-06-76, and G. E. letter to J. E. Stoner, 04-03-77 (K-301)
	b. Oconee Startup Transformers	G. E. letter to R. S. Thompson, 09-06-76, and G. E. letter to J. E. Stoner, 04-03-77 (OS-83-B)
	c. 230 KV Disconnect Switches	ITE letter & Attachment to R. S. Thompson, 08-26-76, (OS-96-C) and OSC-926

	Equipment Identification	Seismic Qualification Documentation Reference
	d. 230 KV Power Circuit Breakers	R. B. Priory letter to J. E. Stoner, 03-21-78, (OS-96), J. G. Hester letter to J. E. Stoner, 03-24-78, (OS-96) and Wyle Lab Report 43852-1 (OM 323-0313-001), Cogenel Breakers (OM-323.0313-001(1)), Cogenel CTs (OM 323.0314-001(1)) MEPPI Breakers (OM 323.0335.001), OSC-7895
	e. 230 KV Swyd. Coupling Capacitor	G. E. letter & Attachments to J. C. Papaspyrou, 08-18-76, (OS-96-D), OSC-926, OM-330-0040-001, and OSC-7895
	f. 230 KV Swyd. Lightning Arrestors	G. E. letter & Attachments to J. C. Papaspyrou, 08-06-76, (OS-96-E), and OSC-926
	h. 230 KV Swyd. DC Panelboards	ITE letter & Attachments to J. E. Stoner, 08-16-76, (OS-89)
	i. 230 KV Swyd. Control Batteries/Racks	C & D letter to C. J. Wylie, 09-02-76 (OS-93)
	k. 230 KV Swyd. Relay House Lighting System (Anchoring Only)	J. P. Bultman letter to J. E. Stoner, 09-23-76, (OS-89)
	l. 230 KV Swyd. Relay Panels/Equipment	Wyle Lab Report WR 76-17 (OM 393-0006)
35.	AC Control Rod Drive Breaker Cabinet	FANP Qualfication Test Report QR 02-10 – Cutler Hammer DSII Series Low Voltage AC Trip Circuit Breakers and Switchgear– Rev 03, dated 12-19-03. (OM 2201.M-0377.001)
36.	Standby Shutdown Facility	
	a. Control Console	Wyle Lab Report 45676-1 (OM 1393-0013), OSC-279(1)
	b. Miscellaneous Equipment and Interconnecting Cabinets	Wyle Lab Report 45676-1 (OM 1393-0013), OSC-279(1)
	c. Diesel Generator	Flight Dynamics Inc. Report No. A-11-80 (OM 351-0206)
	d. 4160 VAC Switchgear	Gould Report No. 33-53566-SS(OM-302-0615)
	e. 600 VAC Motor Control Centers	GTE Seismic Report (OM 308-0361-001, -002, and 003)
	f. 208 VAC Motor Control Centers	GTE Seismic Report (OM 308-0361-001, -002, and -003)

	Equipment Identification	Seismic Qualification Documentation Reference
	g. 120 VAC/125 VDC Panelboards	GTE Seismic Report (OM 308-0361-001, 002, and 003)
	h. 600 VAC Load Centers	Gould Report No. 33-53729-SSA (OM301-80)
	i. Inverters	SCI Seismic Evaluation (OM 320-0214-001)
	j. Battery Chargers	OM-320-0202.001 (Environmental and Seismic Qualification Report 125 VDC/500 AMP SSF Chargers CSF & CSFS)
	k. Voltage Regulators	Wyle Lab Report 44741-1 (OM 352-0012)
	l. Control Batteries/Racks	OM-320-0202.002 (Environmental and Seismic Qualification Report, 125 Volt SSf Batteries DCSf & DCSf-S Model LCR-21 on Two-Step and Single-Row Battery Racks)
	m. SSF Transmitters	Rosemount Test Reports D8400102, Rev. B (OM-267-0969) D8300040 (OM-267.A-0114)
37.	TMI Action Item Additions	
	a. Reactor Building High Range Radiation Monitors	Victoreen Report No. 950-301 (OM 360-35)
	b. Anticipatory Reactor Trip Pressure Switches and RPS Logic Equipment	B & W Report No. BWNP-20210-1 (OM-304-0001, OM-2304-0001) or Static-O-Ring Report Nos. 9058-102 (OM-267A-0124) and 9058-104 (OM-267-1284)
	c. Hydrogen Analyzer Control Panel (Duke Portion)	Wyle Lab Report No. 45477-1 (OM 1393-0009)
	d. Post-Accident Monitoring Recorders	Wyle Lab Report WR-80-48, Rev. 1 (OM 1393-0012)
	e. Post-Accident Monitoring Indicators	Wyle Lab Report WR-80-48, Rev. 1 (OM 1393-0012)
	f. Emergency Feedwater Initiation Pressures Switches	Custom Component Switches, Inc. Report No. QTR 604-01 (CG 3008.02-01, CG 3008.02-06) or Static-O-Ring Report Nos. 9058-102 (OM-267A-0124) and 9058-104 (OM-267-1284)
	g. Normal and Emergency Sump Level Transmitters	FCI Test Report No. 708143 (OM 267-0762)
	h. RB Pressure Transmitters	RMT Report No. D8400102 Rev. B (OM-267-0969)

	Equipment Identification	Seismic Qualification Documentation Reference
	i. Post Accident Sampling Solenoid Valves (Air)	Valcor Test Report QR-70900-65 (CNM-1210.04-0394) Valcor Test Report QR-52600-5940-2 (OM 360-34)
	j. Post Accident Sampling Solenoid Valves (Liquid)	Target Rock Report No. 2375 (OM 360-32)
	k. High Point Vent System Solenoid Valves	Target Rock Report No. 2375 (OM-360-32)
	l. RVLIS (Reactor Vessel Level Cabinets Instrumentation System)	Westinghouse Reports WCAP-8687 EQTR-E53A (OM-311.B-24), EQDP-ESE-4 (OM-311.B-25), WCAP8687 EQTR-E04A (OM-311.B-26), WCAP8687 EQAR-E61B (OM-311.B-32), WCAP8687 EQTR-E02A (OM-311.B-35) and E04A-ADD1 (OM-311.B-40).
	m. OTSG Level Control System Cabinets	Wyle Lab Report No. 44662-1 (OM 393-0001).
38.	Reactor Coolant Pump Monitor Cabinet	Rochester Instrument Systems SN 909335 (OM 393-0007)
39.	OSW Upgrade	
	1. Electrical Equipment in the ESV Bldg.	
	a. 600/240/120 VAC, Single-phase 7.5 kVA Transformer (1, 2, and 3SKMT, 3SKNT)	Technical Document No CGD-3014.04-01-0002
	b. 600/240/120 VAC, Single-phase 2 kVA Transformer (1, 2, 3SKPT)	Technical Document No CGD-3014.04-01-0002
	c. 240/120 VAC, Single-phase panelboards (1, 2, and 3SKM, N, P)	Technical Document No CGD-3014.01-24-0002
	d. ESV Local Control Panels (1, 2, 3ESVLCP)	Calc 7330 - Seismic Qualification of Service Water Equipment using NARE Guidelines
	2. Electrical Equipment in the Plant Control Complex.	
	a. ESV Relay Panel (1, 2 ESV1 and 3ESV1, 2, 3)	Calc 7330 - Seismic Qualification of Service Water Equipment using NARE Guidelines
	b. Joslyn/Clark, size #2 "TM" Starter (1 ea. in MCCs 1, 2, 3XS1, 2, 3)	Seismic Qualification Test of a Joslyn/Clark Motor Starter DPC 1393.00-00-0032.

	Equipment Identification	Seismic Qualification Documentation Reference
40.	Motor Control Centers (1, 2 and 3XS4, 3XS5, 3XS6)	Qualification of Cutler Hammer MCCs. (OM 308.-0443.001)
41.	600VAC Load Centers (1, 2 and 3X10)	Qualification of ABB Load Centers (OM 303.-0167.001)
42.	Automatic Feedwater Isolation System (AFIS)	Qualification Report of Modified Star Components (OM-1311.D.0020)
43.	Keowee 13.8 kV Switchgear (KPF1, KPF2)	NLI-Nuclear Logistics Inc. QR-29412516-1 (KM 303. --0037.001)
44.	Keowee Relay Panelboard (EB20)	NLI-Nuclear Logistics Inc. QR-29412516-3 (KM 303. --0042.001)
45.	Generator Bus Transition Junction Box (GEN1, GEN2)	NLI-Nuclear Logistics Inc. QR-29412516-2 (KM 303. --0039.001)
46.	PSW 125 VDC Panelboard (1A, 2A)	Kinectrics K-115099-FR-0001 (KM 303. --0049.002)

Note:

1. Where past and current documentation is shown within the table, these calculations and reports represent the current qualification documents for the equipment.