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BASKIN,K.P. Southern California Edison Co.
RECIP.NAME RECIPIENT AFFILIATION
* Office of Nuclear Reactor Regulation
BAER,R.L. Light Water Reactors Branch 2

SUBJECT: Forwards info needed to evaluate environ qualification program,in response to NRC 800109 request.Excerpts from FSAR encl.Addl info was provided in FSAR Amend 13.

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Southern California Edison Company

P. O. BOX 800
2244 WALNUT GROVE AVENUE
ROSEMEAD, CALIFORNIA 91770

K. P. BASKIN
MANAGER, GENERATION ENGINEERING

TELEPHONE
213-572-1401

January 21, 1980

Director, Office of Nuclear Reactor Regulation
Attention: Mr. Robert L. Baer, Chief
LWR Branch 2, DPM
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Gentlemen:

Subject: Docket Nos. 50-361 and 50-362
San Onofre Nuclear Generating Station
Units 2 and 3

Enclosed, as requested in the January 9, 1980 telephone conversation between your Mr. H. Rood and our Mr. T. Mercurio, are seven (7) packages of information needed to evaluate the San Onofre Units 2 and 3 environmental qualification program. The information provided herein is in the FSAR and additional information that needs to be included in the NRC review has been provided in the Combustion Engineering Reports CEN-95(S) and CEN-100(S) which were submitted in FSAR Amendment 13.

It is our understanding that the information provided herein and the Combustion Engineering Reports will be reviewed by Oak Ridge National Laboratory to evaluate the San Onofre Units 2 and 3 environmental qualification program. Therefore, if there are any questions or if additional information is necessary, please let me know.

Very truly yours,

KPBaskin /JH

Enclosures

None 1/7

Dist Per H. Rood see Attached

8001250512

D

ENVIRONMENTAL QUALIFICATION INFORMATION LIST

SAN ONOFRE UNITS 2 and 3

FSAR LOCATION	COMMENTS
Section 3.11	Environmental Design of Mechanical and Electrical Equipment
Appendix 3.11-A	Results of Environmental Tests and Analyses for Non-NSSS Equipment
Table 1.8-6	Documentation to Support Seismic and Environmental Qualification of Class 1E Equipment
Question 010.8	Reference Tables 2.3-3, 2-3-4, 2.5-5, 2.3-6
Question 010.47	Reference Tables 6.2-1 (Sheet 3), 6.2-2, 6.2-3
Question 032.5	Reference CEN-95(S) and CEN-100(S) Reports*
Question 032.6	
Question 032.25	
Question 032.28	
Question 032.29	
Question 040.50	
Question 040.51	
Question 040.52	Reference Section 8.3.3 Fire Protection for Cable Systems

Combustion Engineering Reports (Submitted in FSAR Amendment 13)*

CEN-95(S)	Environmental Qualification Data for NSSS-Supplied Instrumentation Equipment, July 1978
CEN-100(S)	Program for Environmental Qualification of NSSS-Supplied Instrumentation Equipment, August 1978

*Not Enclosed.

3.11 ENVIRONMENTAL DESIGN OF MECHANICAL AND ELECTRICAL EQUIPMENT

Environmental design criteria for the facilities conform to 10CFR50, Appendix A, General Design Criterion 4, Environmental and Missile Design Bases. Compatibility of mechanical and electrical equipment with environmental conditions is provided to fulfill the following design criteria:

A. For normal operation, systems and components required to mitigate the consequences of a design basis accident (DBA) or for safe shutdown are designed to remain functional after exposure to the following environmental conditions:

   1. Winter and summer design temperatures maintained at the equipment location during normal operation by the ventilating and cooling system described in section 9.4. Temperature values are given in table 3.11-1.

   2. Relative humidity values given in table 3.11-1.

   3. Pressures given in table 3.11-1.

   4. Maximum expected integrated radiation exposures for 40 years at the equipment location during normal operation given in table 3.11-1.

B. In addition to the normal operation environmental requirements given in listing A above, the mechanical and electrical systems and components required to mitigate the consequences of a DBA, or to attain a safe shutdown of the reactor are designed to remain functional after exposure to the environmental conditions anticipated following the specific DBA which they are intended to mitigate. Anticipated environmental conditions and requirements are as listed below.

   1. (Components inside containment.) The temperature, pressure, humidity, and chemical environment inside containment after a design basis loss-of-coolant accident (LOCA) or main steam line break (MSLB) accident. Specific values are indicated in table 3.11-1.

   2. (Components inside containment which are required after a design basis LOCA.) In addition to the requirements set forth in paragraph 3.11.B.1, the post-LOCA radiation dose rate calculated assuming that 100% of the core noble gas inventory, 25% of the core halogen inventory, and 1% of the core solid fission product inventory listed in paragraph 15.6.3.5. in accordance with TID-14844[1] and consistent with the recommendations of NRC Regulatory Guide 1.4. The total calculated dose is the integrated dose from the time of the LOCA to in excess of 40 days.

Table 3.11-1
NORMAL, ACCIDENT, AND DESIGN ENVIRONMENTAL CONDITIONS (Sheet 1 of 3)

Location		Environmental Conditions														
		Temperature (°F)			Pressure ($lb/in.^2g$)			Humidity (%)			Cumulative Radiation Dose (Rads)			Chemical Spray		
Description	Legend	Normal	Post-Accident	Design	Normal	Post-Accident	Design	Normal	Post-Accident	Design	Normal	Post-Accident	Design	Normal	Post-Accident	Design
Containment (a)	A	120	300	300 (b)	0	60	60 (b)	60	100	100	$1x10^7$ $2.4x10^7$ (d)	$5x10^7$ $5x10^6$ (d)	(b) $6x10^7$ $2.9x10^7$ (d)	NA	(c)	(c)
Auxiliary Building	B															
Charging pump rooms	B1	104	104	104	0	0	0	80	80	90	$4x10^6$	$3x10^4$	$4x10^6$	NA	NA	NA
Boric acid makeup pump rooms	B2	104	104	104	0	0	0	80	80	90	(e)	$3x10^4$	$4x10^4$	NA	NA	NA
Chiller rooms	B3	95	95	95	0	0	0	80	80	100	(e)	$3x10^4$	$3x10^4$	NA	NA	NA
Control rooms	B4	75	75	75	0	0	0	50	50	50	(e)	(e)	(e)	NA	NA	NA
ESF switchgear room area	B5	95	95	95	0	0	0	80	80	100	(e)	$3x10^4$	$3x10^4$	NA	NA	NA
Cabinet area of control room	B6	75	85	85	0	0	0	50	50	50	(e)	(e)	(e)	NA	NA	NA
Battery system rooms	B7	95	95	95	0	0	0	80	80	100	(e)	$3x10^4$	$3x10^4$	NA	NA	NA
CEDM MG cabinet room	B8	104	104	104	0	0	0	80	80	90	(e)	(e)	(e)	NA	NA	NA
Cable spreading rooms	B9	98	98	98	0	0	0	80	80	100	(e)	$3x10^4$	$3x10^4$	NA	NA	NA
Gas sample labs	B10	90	90	90	0	0	0	80	80	100	(e)	$3x10^4$	$3x10^4$	NA	NA	NA

a. Post-accident temperatures and pressures listed for the containment are short-term values applicable to the first 15 minutes after an accident. Other values are as follows:
Next 45 minutes: temperature, 250F; pressure, 50 $lb/in.^2g$
Next 23 hours: temperature, 200F; pressure, 40 $lb/in.^2g$
Next 30 days: temperature, 200F; pressure, 20 $lb/in.^2g$
In some cases, electrical equipment may be qualified to the more conservative values specified in IEEE 323-1974.

b. Certain selective equipment is qualified to environmental conditions less severe than specified. However, the qualification environmental conditions are consistent with the time requirement for operability.

c. Design maximum and post-accident spray conditions are a mixture of boric acid and sodium hydroxide with a Ph greater than 9.

d. These are point-specific doses that apply to NSSS instruments located in close proximity to the reactor coolant piping.

e. Negligible.

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Table 3.11-1

NORMAL, ACCIDENT, AND DESIGN ENVIRONMENTAL CONDITIONS (Sheet 2 of 3)

Location		Environmental Conditions																
		Temperature (°F)			Pressure (lb/in.²g)			Humidity (%)			Cumulative Radiation Dose (Rads)			Chemical Spray			
Description	Legend	Normal	Post-Accident	Design	Normal	Post-Accident	Design	Normal	Post-Accident	Design	Normal	Post-Accident	Design	Normal	Post-Accident	Design	
Radio-chemical labs	B11	75	75	75	0	0	0	80	80	100	(e)	$3x10^4$	$3x10^4$	NA	NA	NA	
Volume control tank rooms	B12	104	104	104	0	0	0	80	80	90	$2x10^8$	$3x10^4$	$2x10^8$	NA	NA	NA	
Safety Equipment Building	C																
Rooms for LPSI, HPSI, CCW and Containment Spray Pumps	C1	104	104	104	0	0	0	80	80	90	$3.1x10^6$	$5.6x10^6$	$8.7x10^6$	NA	NA	NA	3
Main steam valve rooms	C2	100	235	235	0	7	7	100	100	100	(e)	$1x10^6$	$1x10^6$	NA	NA	NA	15
Shutdown heat exchanger rooms	C3	104	130	130	0	0	0	80	80	90	$3.1x10^6$	$5.6x10^6$	$8.7x10^6$	NA	NA	NA	
Chemical injection tank and pump room	C4	104	104	104	0	0	0	80	80	90	(e)	(e)	(e)	NA	NA	NA	3
Component cooling water surge tank rooms	C5	104	104	104	0	0	0	80	80	100	(e)	(e)	(e)	NA	NA	NA	
Fuel Handling Building	D	104	150	150	0	0	0	80	80	100	$2x10^5$	$3x10^5$	$5x10^5$	NA	NA	NA	
Fuel pool pump rooms	D1	104	104	104	0	0	0	80	80	100	$2x10^5$	$3x10^5$	$5x10^5$	NA	NA	NA	
Penetration Area	E	100	104	104	0	0	0	80	80	90	$4x10^4$	$7x10^6$	$7x10^6$	NA	NA	NA	3

Table 3.11-1
NORMAL, ACCIDENT, AND DESIGN ENVIRONMENTAL CONDITIONS (Sheet 3 of 3)

Location		Environmental Conditions														
		Temperature (°F)			Pressure ($lb/in.^2g$)			Humidity (%)			Cumulative Radiation Dose (Rads)			Chemical Spray		
Description	Legend	Normal	Post-Accident	Design	Normal	Post-Accident	Design	Normal	Post-Accident	Design	Normal	Post-Accident	Design	Normal	Post-Accident	Design
Diesel Generator Rooms	F	95	122	122	0	0	0	80	80	100	(e)	$1x10^6$	$1x10^6$	NA	NA	NA
Tankage Area	G	104	104	104	0	0	0	100	100	100	(e)	$1x10^6$	$1x10^6$	NA	NA	NA
Auxiliary feedwater pump rooms	G1	104	104	104	0	0	0	80	80	100	(e)	$1x10^6$	$1x10^6$	NA	NA	NA
Intake Structure	H	100	100	100	0	0	0	80	80	100	(e)	$1x10^6$	$1x10^6$	NA	NA	NA
Salt water pump rooms	H1	100	100	100	0	0	0	80	80	100	(e)	$1x10^6$	$1x10^6$	NA	NA	NA
Electrical Tunnels	J	104	104	104	0	0	0	80	80	100	(e)	$1x10^6$	$1x10^6$	NA	NA	NA

3. (Components outside containment.) The expected temperature and humidity environmental conditions specified in table 3.11-1.

4. (Components outside the containment that are required to mitigate the consequences of a design basis LOCA.) The expected integrated accident radiation doses at the equipment locations in addition to the requirements are set forth in listing B.3 above. In computing such doses for equipment in contact with or in proximity to recirculation water, it is assumed that 50% of the core halogen inventory and 1% of the core solid fission product inventory, as listed in paragraph 15.6.3.5. are in the recirculation water after a design basis LOCA. For equipment located remotely from recirculation water, the containment leakage plume or other appropriate accidental release is assumed. These accidental releases may be from a fuel handling accident or waste gas tank rupture in the fuel handling building or auxiliary building, respectively.

3.11.1 EQUIPMENT IDENTIFICATION AND ENVIRONMENTAL CONDITIONS

Table 3.11-2 lists and categorizes systems required to mitigate a DBA or to attain a safe shutdown. Specific equipment and components for each system are discussed in the appropriate section of the safety analysis report as referenced in table 3.11-2. The major component categories, such as motor-operated valves, pump motors, cables and pressure boundary equipment in each system, and the location of the components by area are also provided.

The non-seismic vibration of safety-related equipment conforms to the requirements of the following standards or requirements:

Equipment	Standard or Requirement
Diesel fuel oil transfer pumps	Hydraulic Institute Standard
High pressure safety injection pumps	Pump bearing housing and pump shaft vibration double amplitude limited to $\leq$ .003 (a)
All other safety-related pumps	API 610 Sec. IV or better
Positive displacement charging pumps	(a)
Small centrifugal pumps	(a)
HVAC equipment	ASHRAE Systems Handbook

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a. A pump of design is disassembled following a shop test to detect wear or score marks or other damage by operation which includes self-induced non-seismic vibration. | 4

Table 3.11-2
IDENTIFICATION AND LOCATION OF MECHANICAL AND ELECTRICAL SAFETY-RELATED SYSTEMS AND COMPONENTS (Sheet 1 of 11)

System	Required Duration of Operation for Design Basis Accident: LOCA	Required Duration of Operation for Design Basis Accident: MSLB	Specified Environmental Conditions and Location (see table 3.11.1 for legend)	Equipment and Components	Remarks	Discussed in FSAR Section
I. Containment heat removal systems:						6.2.2
A. Containment spray system						
	Short-term	Not required	C4	Spray chemical tank		
	Short-term	Not required	C4	Chemical addition pumps and drivers		
	Continuous	Continuous	C1	Containment spray pumps and drivers		
	Continuous	Continuous	C3	Shutdown cooling heat exchangers		
	Continuous	Continuous	A	Spray nozzles and manifolds		
	Continuous	Continuous	A, C, E	Valves and piping		
	Continuous	Continuous	B4, C1, B6	Instruments and controls	Iodine removal instruments and controls are not required for MSLB	
B. Containment atmosphere emergency cooling system				See item XI.A		6.2.4
II. Containment isolation system						
	Continuous	Not required	E, A	Valves and piping		
	Continuous	Not required	E, A	Piping penetrations		
	Continuous	Not required	A1, B4, B6	Instruments and controls		
III. Combustible gas control system						6.2.5
	Continuous	Not required	A	Hydrogen recombiners	Started approximately 3.5 days after LOCA and run continuously thereafter for duration of accident.	
	Continuous	Continuous	A	Dome air circulators		

Table 3.11-2
IDENTIFICATION AND LOCATION OF MECHANICAL AND ELECTRICAL SAFETY-RELATED
SYSTEMS AND COMPONENTS (Sheet 2 of 11)

System	Required Duration of Operation for Design Basis Accident		Specified Environmental Conditions and Location (see table 3.11.1 for legend)	Equipment and Components	Remarks	Discussed in FSAR Section
	LOCA	MSLB				
III. Combustible gas control system (cont'd)						
	Continuous	Continuous	A	Fans and drivers		
	Continuous	Continuous	A	Ductwork and dampers		
	Continuous	Continuous	E, B4, A	Instruments and controls		
IV. Safety injection system						6.3
	Continuous	Continuous	A	Tanks		
	Continuous	Continuous	C1	Pumps and drivers		
	Continuous	Continuous	C, E, A	Valves and piping		
	Continuous	Continuous	A	Sump screens		
	Continuous	Continuous	C1, E, B4, B6	Instruments and controls		
V. Fission product removal and control systems:						6.5
A. Containment spray system				See item I.A		6.2.2
B. Containment hydrogen purge system				See item XI.B		9.4.1.2
C. Emergency operation control room ventilation system				See item XII.A		9.4.2.2
D. Fuel handling building post accident cleanup system				See item XII.G		9.4.3.1

Table 3.11-2
IDENTIFICATION AND LOCATION OF MECHANICAL AND ELECTRICAL SAFETY-RELATED SYSTEMS AND COMPONENTS (Sheet 3 of 11)

System	Required Duration of Operation for Design Basis Accident: LOCA	Required Duration of Operation for Design Basis Accident: MSLB	Specified Environmental Conditions and Location (see table 3.11.1 for legend)	Equipment and Components	Remarks	Discussed in FSAR Section
VI. Fuel handling building isolation system						7.3
	Not required	Not required	D	Dampers		
	Not required	Not required	D, B4	Instruments and controls		
VII. Onsite electrical power systems						8.3
A. AC power system						8.3.1
	Continuous	Continuous	B5	Switchgear load centers and MCC		
	Continuous	Continuous	F	Diesel generators		
	Continuous	Continuous	B5	Control power inverters		
	Continuous	Continuous	E	Electrical penetrations		
	Continuous	Continuous	All areas	Electrical cables		
B. DC power system						8.3.2
	Continuous	Continuous	B7	Battery chargers, distribution switchgear & panels		
	Continuous	Continuous	B7	Batteries		
	Continuous	Continuous	E	Electrical penetrations		
	Continuous	Continuous	All areas	Electrical cables		
VIII. Salt water cooling system						9.2.1
	Continuous	Continuous	H1	Pumps and drivers		
	Continuous	Continuous	H, C3	Valves and piping		

Table 3.11-2
IDENTIFICATION AND LOCATION OF MECHANICAL AND ELECTRICAL SAFETY-RELATED SYSTEMS AND COMPONENTS (Sheet 4 of 11)

System	Required Duration of Operation for Design Basis Accident: LOCA	Required Duration of Operation for Design Basis Accident: MSLB	Specified Environmental Conditions and Location (see table 3.11.1 for legend)	Equipment and Components	Remarks	Discussed in FSAR Section
VIII. Salt Water Cooling System (cont'd)						
	Continuous	Continuous	C3	Heat exchanger		
	Continuous	Continuous	H1, B4	Instruments and controls		
						9.2.2
IX. Component cooling water system	Continuous	Continuous	C	Tanks		
	Continuous	Continuous	C1	Pumps and drivers		
	Continuous	Continuous	B, C1, C3, E, D, A	Valves and piping		
	Continuous	Continuous	A, E	Piping penetrations		
	Continuous	Continuous	C3	Heat exchangers		
	Continuous	Continuous	C1, E, B4	Instruments and controls		
						9.3.4
X. Chemical and volume control system	Continuous	Continuous	B12	Tanks	Only the charging portion and boric acid makeup system is required for LOCA and MSLB.	
	Continuous	Continuous	B1, B2	Pumps and drivers		
	Continuous	Continuous	A, B, E	Valves and piping		
	Continuous	Continuous	E	Piping penetrations		
	Continuous	Continuous	A, B	Heat exchangers		
	Continuous	Continuous	B	Boric acid tank heaters		
	Continuous	Continuous	B1, B2, B4, B6	Instruments and controls		

Table 3.11-2
IDENTIFICATION AND LOCATION OF MECHANICAL AND ELECTRICAL SAFETY-RELATED SYSTEMS AND COMPONENTS (Sheet 5 of 11)

System	Required duration of Operation for Design Basis Accident		Specified Environmental Conditions and Location (see table 3.11.1 for legend)	Equipment and Components	Remarks	Discussed in FSAR Section
	LOCA	MSLB				
XI. Emergency operation, containment building ventilation systems						9.4.1.2
A. Containment atmosphere emergency cooling system	Continuous	Continuous	A	Air cooling units		
	Continuous	Continuous	A, A	Ductwork and dampers		
	Continuous	Continuous	A	Valves and piping		
	Continuous	Continuous	A, B4	Instruments and controls		
B. Containment hydrogen purge system	Continuous	Continuous			System does not start on a DBA but is available if required	9.4.1.2
	Continuous	Continuous	E	Fans and drivers		
	Continuous	Continuous	E	Filters and prefilters		
	Continuous	Continuous	E	Electrical heating coils		
	Continuous	Continuous	E	Valves and piping		
	Continuous	Continuous	E	Ductwork and dampers		
	Continuous	Continuous	E	Piping penetrations Instruments and controls		
XII. Emergency operation HVAC systems						9.4.2.2
A. Control room habitability system	Continuous	Continuous	B10	Filters and prefilters		
	Continuous	Continuous	B10	Air conditioning units		

Table 3.11-2
IDENTIFICATION AND LOCATION OF MECHANICAL AND ELECTRICAL SAFETY-RELATED
SYSTEMS AND COMPONENTS (Sheet 6 of 11)

System	Required Duration of Operation for Design Basis Accident		Specified Environmental Conditions and Location (see table 3.11.1 for legend)	Equipment and Components	Remarks	Discussed in FSAR Section
	LOCA	MSLB				
XII. Control room habitability system (cont'd)						
	Continuous	Continuous	B4, B10	Ductwork and dampers		
	Continuous	Continuous	B3, B4	Instruments and controls		
B. ESF switchgear room system	Continuous	Continuous	B5	Prefilters		
	Continuous	Continuous	B5	Air conditioning units		
	Continuous	Continuous	B5	Ductwork and dampers		
	Continuous	Continuous	B4, B5	Instruments and controls		
C. Charging and boric acid makeup pump room system	Continuous	Continuous	B1, B2	Air conditioning units		
	Continuous	Continuous	B1, B2, B4	Instruments and controls		
D. Battery room system	Continuous	Continuous	B11	Exhaust fans and drivers		
	Continuous	Continuous	B7, B11	Ductwork and dampers		
	Continuous	Continuous	B7, B4	Instruments and controls		
E. Chiller room system	Continuous	Continuous	B12	Prefilters		
	Continuous	Continuous	B12	Fans and drivers		
	Continuous	Continuous	B3, B12	Ductwork and dampers		
	Continuous	Continuous	B3, B4	Instruments and controls		

Table 3.11-2
IDENTIFICATION AND LOCATION OF MECHANICAL AND ELECTRICAL SAFETY-RELATED SYSTEMS AND COMPONENTS (Sheet 7 of 11)

System	Required Duration of Operation for Design Basis Accident		Specified Environmental Conditions and Location (see table 3.11.1 for legend)	Equipment and Components	Remarks	Discussed in FSAR Section
	LOCA	MSLB				
F. Emergency chilled water system						
	Continuous	Continuous	B3	Chillers		
	Continuous	Continuous	B3	Pumps and drivers		
	Continuous	Continuous	B3	Compression tanks		
	Continuous	Continuous	B3, A, C	Valves, strainers and piping		
	Continuous	Continuous	B3, B4	Instruments and controls		
G. Fuel handling building post-accident cleanup system						9.4.3.1
	Not required	Not required	D	Filters and prefilters		
	Not required	Not required	D	Air conditioning units		
	Not required	Not required	D	Ductwork and dampers		
	Not required	Not required	D, B4	Instruments and controls		
H. Safety equipment pump room emergency cooling system						9.4.3.1
	Continuous	Continuous	C1	Air conditioning units		
	Continuous	Continuous	C1	Ductwork and dampers		
	Continuous	Continuous	C1, B1, B2, B4	Instruments and controls		
I. Diesel generator building emergency ventilation system						9.4.3.4
	Continuous	Continuous	F	Exhaust fans and drivers		
	Continuous	Continuous	F, B4	Instruments and controls		

Table 3.11-2
IDENTIFICATION AND LOCATION OF MECHANICAL AND ELECTRICAL SAFETY-RELATED SYSTEMS AND COMPONENTS (Sheet 8 of 11)

System	Required Duration of Operation for Design Basis Accident: LOCA	Required Duration of Operation for Design Basis Accident: MSLB	Specified Environmental Conditions and Location (see table 3.11.1 for legend)	Equipment and Components	Remarks	Discussed in FSAR Section
J. Intake structure emergency ventilation system						9.4.3.6
	Continuous	Continuous	H	Prefilters		
	Continuous	Continuous	H	Fans and drivers		
	Continuous	Continuous	H1	Ductwork and dampers		
	Continuous	Continuous	H1, B4	Instruments and controls		
XIII. Emergency evacuation Alarm system						9.5.2
	1 hour	Not required	In all safety-related structures	Sirens	Additional siren located on roof of Unit 2 fuel handling building	
	1 hour	Not required	See remarks	Loudspeakers	Located on plant perimeter	
	1 hour	Not required	B	Amplifiers	Located in communications room	
	1 hour	Not required	B4	Microphones	Located in watch engineer's office	
	1 hour	Not required	All areas	Communication cable		
XIV. Diesel generator systems						9.5.4
A. Diesel generator fuel oil storage and transfer system						
	Continuous	Continuous	See remarks	Tanks	Located underground, adjacent to the diesel generator building	
	Continuous	Continuous	See remarks	Pumps and drivers	Located in a vault below grade near fuel storage tank	
	Continuous	Continuous	F	Valves, strainers, piping		
	Continuous	Continuous	F, B4	Instruments and controls		

Table 3.11-2
IDENTIFICATION AND LOCATION OF MECHANICAL AND ELECTRICAL SAFETY-RELATED
SYSTEMS AND COMPONENTS (Sheet 9 of 11)

System	Required Duration of Operation for Design Basis Accident		Specified Environmental Conditions and Location (see table 3.11.1 for legend)	Equipment and Components	Remarks	Discussed in FSAR Section
	LOCA	MSLB				
B. Diesel generator cooling water system						9.5.5
	Continuous	Continuous	F	Tanks	Pumps are engine-driven	
	Continuous	Continuous	F	Pumps and drivers		
	Continuous	Continuous	F	Heat exchangers		
	Continuous	Continuous	F	Valves and piping		
	Continuous	Continuous	F, B4	Instruments and controls		
C. Diesel generator starting system						9.5.6
	Up to 5-3 second starts	Up to 5-3 second starts	F	Air receivers		
	Up to 5-3 second starts	Up to 5-3 second starts	F	Compressors and drivers		
	Up to 5-3 second starts	Up to 5-3 second starts	F	Air dryers		
	Up to 5-3 second starts	Up to 5-3 second starts	F	Valves, filters and piping		
	Continuous	Continuous	F, B4	Instruments and controls		

Table 3.11-2
IDENTIFICATION AND LOCATION OF MECHANICAL AND ELECTRICAL SAFETY-RELATED SYSTEMS AND COMPONENTS (Sheet 10 of 11)

System	Required Duration of Operation for Design Basis Accident		Specified Environmental Conditions and Location (see table 3.11.1 for legend)	Equipment and Components	Remarks	Discussed in FSAR Section
	LOCA	MSLB				
D. Diesel generator lubrication system						9.5.7
	Continuous	Continuous	F	Tanks		
	Continuous	Continuous	F	Pumps and drivers		
	Continuous	Continuous	F	Valves and piping		
	Continuous	Continuous	F, B4	Instruments and controls		
E. Diesel generator combustion air intake and exhaust system						9.5.8
	Continuous	Continuous	F	Ducts, louvers, and dampers		
	Continuous	Continuous	F	Exhaust silencer		
	Continuous	Continuous	F	Instruments and controls		
XV. Auxiliary feedwater system						10.4.9
	Continuous	5 hours	G1	Pumps and drivers		
	Continuous	5 hours	G1, E, A, A	Valves and piping		
	Continuous	5 hours	E	Piping penetrations		
	Continuous	Continuous	G1, B4	Instruments and controls		
XVI. Fuel pool cooling system						9.1.3
	Not required	Not required	D	Pumps and drivers		
	Not required	Not required	D	Heat exchangers		
	Not required	Not required	D	Valves and piping		
	Not required	Not required	D	Piping penetrations		
	Not required	Not required	D, B4	Instruments and controls		

Table 3.11-2
IDENTIFICATION AND LOCATION OF MECHANICAL AND ELECTRICAL SAFETY-RELATED SYSTEMS AND COMPONENTS (Sheet 11 of 11)

System	Required Duration of Operation for Design Basis Accident		Specified Environmental Conditions and Location (see table 3.11.1 for legend)	Equipment and Components	Remarks	Discussed in FSAR Section
	LOCA	MSLB				
XVII. Reactor protection System						7.2
	Short-term	Short-term	B4, B6	PPS cabinets	Not required for a large break LOCA.	
				Process sensing channels		
				Reactor trip switchgear		
				PPS & CPC remote control modules		
				Auxiliary protective cabinet		
XVIII. Engineered safety features actuation system						7.3
	Short-term	Short-term	B4, B6	ESFAS auxiliary relay cabinets		
				Process sensing channels	Shared with RPS	
				Actuation logic	Shared with RPS	
XIX. Radiation monitors (airborne)						11.5
	Continuous	N/A	E	Airborne monitors		
XX. Shutdown cooling system						5.4.7
	Continuous	Continuous	A, C, E	Valves and piping		
			A, B4, B6, C	Instruments and controls		
XXI. Post accident monitoring						7.6
	Continuous	Continuous	A, B, E, K	Instruments		

Equipment	Standard or Requirement
Diesel engine generators	DEMA Standard Practices for Low and Medium Speed Stationary Diesel and Gas Engines
Electric Motors	NEMA MG-1

The absence of any significant non-seismic vibration caused by piping vibration (interaction) with the above equipment is verified as discussed in paragraph 3.9.2.1.

3.11.2 QUALIFICATION TESTS AND ANALYSES

Qualification tests and analyses performed on instrumentation, electrical, and mechanical (motors) equipment fulfill the requirements of IEEE Standard 323-1971.

When sufficiently reliable data for equipment are available and proven analytical methods are known, environmental qualification is based on analysis. If such analytical methods are not feasible, qualification is based on environmental testing.

The typical environmental qualification test parameters are presented in table 3.11-3. CEN-100(S)[8] addresses environmental qualification methods and criteria of NSSS instrumentation and electrical equipment. CEN-95(S)[7] provides test results of NSSS-supplied equipment. 13

3.11.2.1 Component Environmental Design and Qualification for Normal Operation

Equipment listed in table 3.11-2 is designed for 40 years of continuous operation in the most severe temperature, pressure, humidity, and radiation environment that exists at the equipment location during normal operation, assuming proper routine preventive maintenance is performed, such as periodic replacement of seals and packing.

Table 3.11-1 provides the summer design temperatures and the pressures and humidities for each area in which the safety-related equipment listed in table 3.11-2 is located, as well as the exposures to radiation and chemical spray.

For most equipment, special qualification tests to verify operability at normal operating temperature, pressure, and humidity conditions are not required. Certification for this equipment is based on proven operating capability in similar environments in industrial and previous nuclear

Table 3.11-3
ENVIRONMENTAL QUALIFICATION TEST PARAMETERS (Sheet 1 of 7)

Equipment	Function Tested	Test Description and Duration	Parameter	Remarks
Electrical penetration assemblies	Gas leakage integrity, environmental compatibility, dielectric strength, insulation resistance, overload and fault capabilities, suitability of materials	Varies	Pressure, temperature, humidity, chemical spray, radiation	Prototype testing per requirements of IEEE Std 317-1972, paragraphs 5.1 and 5.2
Electrical penetration assemblies	Resistance to thermal shock	Thermal cycling for 120 cycles, through 100F minimum, to the maximum operating temperature (300F)	Temperature	Prototype testing
Electrical penetration assemblies	Operating temperatures	Loading of the prototype assembly having the highest calculated heat loss in each voltage class to rated operating current in all conductors, and measuring the equilibrium conductor and nozzle-concrete interface temperatures.	Current	Prototype testing

Table 3.11-3
ENVIRONMENTAL QUALIFICATION TEST PARAMETERS (Sheet 2 of 7)

Equipment	Function Tested	Test Description and Duration	Parameter	Remarks
Electrical penetration assemblies	Overload capability	Loading of three conductors of each of the same prototype assemblies used in the operating temperature test to rated short-time overload currents for 30 seconds, while the remaining conductors carry rated currents, and measuring the maximum conductor temperatures. Conductor seals shall be inspected for damage.	Current	Prototype testing
Electrical penetration assemblies	Insulation resistance	Insulation resistance at 500 V-dc, to be 10^{12} ohms minimum	dc voltage	Prototype testing (coaxial cable penetrations only)
Electrical penetration assemblies	Insulation dielectric strength	Insulation to withstand 1,500 V-dc for 1 minute	dc voltage, time	Prototype testing (coaxial cable penetrations only)

Table 3.11-3
ENVIRONMENTAL QUALIFICATION TEST PARAMETERS (Sheet 3 of 7)

Equipment	Function Tested	Test Description and Duration	Parameter	Remarks
Electrical penetration assemblies	Short circuit current withstand capability	Conductors of a medium voltage assembly and 3 conductors of a low voltage power assembly shall be subjected to a 3-phase momentary short circuit current as defined in ANSI Stds C37.9, Section 9-2.4.2.1 and C37.13, Section 13-8.2.4.1, respectively. Currents shall be 33,544 symmetrical amperes and 30,000 symmetrical amperes respectively.	Current, time	Prototype testing
Electrical penetration assemblies	Leakage rate	Leakage rate across penetration pressure boundary, exclusive of aperture seals, must not exceed $1x10^{-6}$ standard cm^3 of dry helium at 300F and 60 lb/in.^{2}g, after short circuit tests have been performed.	Temperature, pressure	Prototype testing
Electrical penetration assemblies	Leakage rate, dielectric strength, insulation resistance, conductor continuity, and identification tests	Varies	Pressure, temperature, voltage	Production testing per requirements of IEEE Std 317-1972, para. 6

Table 3.11-3
ENVIRONMENTAL QUALIFICATION TEST PARAMETERS (Sheet 4 of 7)

Equipment	Function Tested	Test Description and Duration	Parameter	Remarks
Electrical penetration assemblies	Structural integrity	Per requirements of ASME Code Section III, Article NE6320	Pressure	Production test
Electrical penetration assemblies	Leakage rate	Leakage rate across conductor pressure barriers must not exceed $1x10^{-6}$ standard cm^3/s of dry helium at 20C $\pm$15C and 60 $lb/in.^2g$.	Temperature and pressure	Production test
Electrical penetration assemblies	Insulation resistance	Insulation resistance at 500 V-dc to be 10^{12} ohms minimum	dc voltage	Production test (coaxial cable penetrations only)
Electrical penetration assemblies	Insulation dielectric strength	Insulation to withstand 1,500 V-dc for 1 minute	dc voltage and time	Production test (coaxial cable penetrations only)

Table 3.11-3
ENVIRONMENTAL QUALIFICATION TEST PARAMETERS (Sheet 5 of 7)

Equipment	Function Tested	Test Description and Duration	Parameter	Remarks
600-Volt power cable, 600V control and instrumentation cable, thermocouple cable	LOCA survival - voltage withstand	Heat-aged specimens of cable which have passed a 5-minute withstand test at 100 volts/mil ac or 300 volts/mil dc are subjected to gamma radiation dosage of $1x10^8$ rads at a maximum rate of $1x10^6$ rads/h. Samples must then pass a withstand test at 80% of the previous voltage.	Voltage, time	Prototype test
600-Volt power cable, 600V control and instrumentation cable, thermocouple cable	LOCA survival - total radiation tolerance	Heat-aged specimen to be exposed to total cumulative dosage of $1x10^8$ rads plus one LOCA exposure of $1x10^8$ rads. Maximum rate to be $1x10^6$ rads/h	Radiation, time	Prototype test
600-Volt power cable, 600V control and instrumentation cable, thermocouple cable	LOCA survival - environmental suitability	Irradiated specimens to be operated at rated voltage and current in a pressure vessel, while subjected to the following: • Boric acid-sodium hydroxide spray, 9-9.5 pH, 1,700 ppm boric acid • Relative humidity 100%	Temperature, pressure, humidity, chemical spray	Prototype test

Table 3.11-3
ENVIRONMENTAL QUALIFICATION TEST PARAMETERS (Sheet 6 of 7)

Equipment	Function Tested	Test Description and Duration	Parameter	Remarks
600-Volt power cable, 600V control and instrumentation cable, thermocouple cable	LOCA survival - environmental suitability (cont)	• Temperature-pressure envelope as follows: 360F, 60 lb/in.^{2}g - 0-50 s 300F, 60 lb/in.^{2}g - 50 s-15 min. 250F, 50 lb/in.^{2}g - 15-60 min. 200F, 40 lb/in.^{2}g - next 30 days, 23 hours	Temperature, pressure, humidity, chemical spray	Prototype test
600-Volt power cable, 600V control and instrumentation cable, thermocouple cable	LOCA survival final voltage withstand	Following environmental suitability test, specimens must again pass the voltage withstand test while immersed in water at room temperature	Voltage, time	Prototype test

Table 3.11-3
ENVIRONMENTAL QUALIFICATION TEST PARAMETERS (Sheet 7 of 7)

Equipment	Function Tested	Test Description and Duration	Parameter	Remarks
Valve Operators	LOCA survival-environmental suitability	2,000 cycles were used as a design life of which 500 were incorporated prior to test and 1,500 after test	Design Life-40 years (2000 cycles) Ambient Temperature-120F (PWR) Ambient Humidity-60-100% Aging-Motor Stator only 180C for 100 hours Total Radiation-2.04×10^8 rads (40 yrs integrated) Number of Transients-2 Transient Temperature-300F (PWR) Test Humidity-100% (saturated) Profile-PWR/IEEE382-73, Page 12, Table 1 BWR/IEEE382-73, Page 12, Table 2 Length of Test-30 days	Type tested to IEEE-382-1973

power plant applications. The preoperational and postoperational test programs for safety-related components further ensure that safety-related components will be available when required. Since the normal- and accident-integrated radiation doses have cumulative effects, the integrated radiation dose during normal operation is discussed in paragraph 3.11.2.12.

3.11.2.2 Component Environmental Design and Qualification for Operation after a Design Basis Accident

Equipment listed in table 3.11-2 is designed to remain functional in the most severe combination of temperature, pressure, humidity, and chemical spray environment conditions that exist at the equipment location after a design basis LOCA. This equipment is also designed for the maximum calculated integrated radiation exposure after the LOCA or other accident, as discussed in paragraph 3.11.5. The temperature, pressure, and humidity environment inside the containment after a LOCA is presented and discussed in detail in subsection 6.2.1. The containment spray characteristics are given in paragraph 6.2.2.1. The integrated post-accident radiation dose for plant locations in which the equipment is located is given in table 3.11-1. In addition, steam and feedwater line breaks outside the containment are analytically checked to ensure that no additional qualifications need be applied to components that could be affected by these breaks.

The requirements of the General Design Criteria, Appendix A to 10CFR50, are met as follows:

- Criterion 1 - Quality Standards and Records, refer to section 3.1.
- Criterion 4 - Environmental and Missile Design Basis, refer to section 3.1.
- Criterion 23 - Protection System Failure Modes, refer to section 3.1.
- Criterion 50 - Containment Design Basis, refer to sections 3.1 and 6.2.

The requirements of the Quality Assurance Criterion III, Appendix B to 10CFR50 are met as discussed in the Design and Procurement Q.A. program incorporated in appendix 3A. 1

The recommendations contained in the Regulatory Guides listed below, listings A through E, and other applicable Regulatory Guides and Standards, have been utilized as described in appendix 3A. Additional comments are included in listings F through J.

A. Regulatory Guide 1.30, Quality Assurance Requirements for the Installation, Inspection, and Testing of Instrumentation and Electric Equipment.

B. Regulatory Guide 1.40, Qualification Tests of Continuous - Duty Motors Installed Inside the Containment of Water-Cooled Nuclear Power Plants.

Continuous-duty motors used inside the containment are type-tested under simulated LOCA conditions. IEEE Standard 334-1971, Trial-Use Guide for Type Tests of Continuous-Duty Class I Motors Installed Inside the Containment of Nuclear Power Generating Stations, is used. Insofar as practicable, auxiliary equipment that is part of the installed motor assembly is likewise qualified in accordance with IEEE Standard 334 under simulated design basis event conditions.

C. Regulatory Guide 1.63, Electrical Penetration Assemblies in Containment Structures for Water-Cooled Nuclear Power Plants. Electrical containment penetrations are tested in accordance with IEEE Standard 317-1972, Electrical Penetration Assemblies in Containment Structures for Nuclear Power Generating Stations. Values of environmental parameters used in such tests are listed in table 3.11-3. Refer to section 8.1 for the discussion on this guide.

D. Regulatory Guide 1.73, Qualification Tests of Electric Valve Operators Installed Inside the Containment of Nuclear Power Plants. Non-NSSS motor-operated valves used inside the containment are type-tested in accordance with IEEE Standard 382-1972 (ANSI N41.6), Guide for Type Test of Class I Electric Operated Valve Operators for Nuclear Power Generating Station. A description of the tests and/or analysis that active NSSS valves are qualified for is provided in paragraph 3.9.3.2. Values of parameters used in such tests for non-NSSS valves are listed in table 3.11-3.

E. Regulatory Guide 1.89, Qualification of Class IE Equipment for Nuclear Power Plants. The qualification methods and documentation requirements of IEEE Standard 323-1971, IEEE Standard for Qualifying Class IE Equipment for Nuclear Power Generating Stations, are discussed in section 8.1 and CENPD-212[2].

F. Type tests to ensure acceptability for use in the containment post-accident environment are performed for each type of cable in accordance with IEEE Standard 383-1974, Standard for Type Tests for Class I Cables Field Splices and Connections for Nuclear Power Generating Stations. Values of environmental parameters used in such tests are given in table 3.11-3.

G. Pressure boundary components inside the containment are designed for the temperature, pressure, and humidity environment in accordance with the applicable code to which the component is constructed. Qualification testing is not considered necessary for such components.

H. A total (normal plus accident) integrated dose of less than 10^4 rads will not affect the strength or properties of materials

used;[3] hence, further qualification analyses and tests for components which will be exposed to less than 10^4 rads are not necessary. For higher integrated doses, components are qualified either by qualification testing or by evaluation of materials used. Reliable accumulated data on radiation effects, such as is contained in reference 3, is used to analyze the dose effects on particular materials.

I. The sources used in calculating the radiation levels following a LOCA are consistent with those set forth in reference 1, Regulatory Guide 1.4. All the active safety-related equipment located inside the containment is designed to withstand the maximum integrated doses listed in table 3.11-1 during the life of the plant. Verification of suitability of materials used are verified by test for all electrical penetration assembly materials, for an integrated dose rate of at least 5×10^7 rads, in accordance with the requirements of IEEE Standard 317-1972.

J. The materials used in the fabrication of the reactor coolant system pressure boundary and other mechanical and structural components inside the containment are selected so as to minimize corrosion and hydrogen generation resulting from contact with chemical spray solutions. Alternately, the components may be protected from contact with the spray. The use of aluminum and zinc is minimized in these components.

Cupronickel is used as a pressure boundary material only in the containment fan cooler coils since its corrosion rate in the spray solution is acceptably low.[4] Gaskets, when used in piping systems, are flexitallic or equivalent, and have metal windings and filler material compatible with the spray solution. Gasket materials on the fuel transfer tube and on the containment equipment and personnel hatches are selected to be compatible with the spray solution. Other pressure boundary and structural materials used are stainless and carbon steel and concrete, which do not suffer significant degradation in the spray environment.[4]

3.11.2.3 Auxiliary and Fuel Handling Building Equipment

Active safety-related equipment located in the auxiliary building, except that described in paragraph 3.11.2.6, and in the fuel handling building, normally operates in ambient temperatures of up to 104F during summer, and down to 36F during winter months. The design environmental temperature and humidity conditions in the auxiliary building are 36F to 104F and 90% relative humidity, respectively. The corresponding conditions for the fuel handling building are 36F to 150F and 100% relative humidity. The equipment is designed to be operable following a cumulative radiation exposure as listed in table 3.11-1 during the life of the plant.

In the event of a fuel handling accident, equipment in the fuel handling building, such as the ventilation system, would not be exposed to radiation levels higher than 3.9 x 10^5 rads. This level is well below the damage threshold of the ventilation equipment.

The safety-related equipment is designed to withstand the previously stated environmental conditions. Certifications based on equipment type testing and/or analysis will demonstrate that this equipment operates satisfactorily under the specified environmental conditions.

3.11.2.4 Control Room and Class 1E Electrical Equipment Areas

3.11.2.4.1 Control Room

The normal range of temperature in the control room is discussed in paragraph 9.4.2.1. In the event of a failure of the control room complex normal heating, ventilating, and air conditioning system, one of the control room complex emergency air conditioning systems provides the cooling, filtration, and ventilation required to maintain habitability of the control room and integrity of the control room equipment. The control room temperature is kept below 85F during summer design conditions. Humidity is kept below 50% under these conditions.

Safety-related control equipment in the control room is qualified to operate in an environment to 104F with no degradation of performance. The margin between the maximum temperature that will be experienced in the control room and the qualification limit ensures that degradation of performance will not occur.

The safety-related equipment in the control room is designed to operate satisfactorily under the above environmental conditions. Certifications of tests verify that this equipment operates satisfactorily under these environmental conditions.

3.11.2.4.2 Class 1E Electrical Equipment Areas

The air conditioning or ventilation systems installed for these areas are designed to maintain the room temperature at or below 95F under all operating conditions when the outdoor air is at summer design conditions.

The safety-related equipment in the Class 1E electrical equipment rooms is designed to operate at the specified environment conditions. Certifications of tests confirm that the equipment in these rooms operates satisfactorily under the specified environmental conditions.

3.11.2.5 Equipment Located Outside

For safety-related equipment exposed to ambient environmental conditions, and required to function in all local climatic extremes of temperature and precipitation, the ambient temperature varies from 36F to 85F and 5
weather variations include rain, wind, solar radiation, and dust. The construction materials and enclosures provided for this equipment are guaranteed to withstand these ambient conditions as confirmed by certified test results.

3.11.3 QUALIFICATION TEST RESULTS

3.11.3.1 NSSS Instrumentation and Electrical Equipment

Qualification test results are contained in reference 7. 13

3.11.3.2 NSSS Mechanical Equipment

Qualification test results and/or analysis for active pumps and valves are provided in paragraph 3.9.3.2.

3.11.3.3 Non-NSSS Equipment

The results of typical qualification tests for the equipment covered in 1
subsection 3.11.2 are contained in appendix 3.11A.

3.11.4 LOSS OF VENTILATION

The maximum temperatures considered in the sizing of air conditioning systems serving safety-related systems are determined by additive analysis of the following factors:

A. Recommended outdoor design temperatures for the geographical area of the plant[a] (both wet bulb and dry bulb readings) 5

B. Maximum internal piping thermal loads, if applicable, for the room, using maximum operating temperatures for the pipe contents and maximum footage of active pipe for each mode of operation (this value may be negative)

C. Maximum internal electrical load, assuming full lighting for the room, and using, if applicable, the maximum control and equipment resistance losses for each mode of operation

D. Maximum heat transfer from miscellaneous equipment surfaces, if applicable (e.g., outer surface of the diesel generator)

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a. Recommended Outdoor Design Temperatures, Southern California, Arizona, Nevada, published by the Southern California Chapter of ASHRAE 5
(Fourth Edition), October 1972

E. Maximum heat transfer from the surfaces of open pools and tanks, if applicable, using the maximum operating temperature of the contents.

F. Maximum heat transfer from the surfaces of the room including walls, floor, and ceiling, or roof (this value may be negative)

Seismic Category I air conditioning systems, described in section 9.4 are powered from the Class 1E electrical power supplies and are provided for the following locations.

A. Control room

B. Class 1E battery rooms

C. Class 1E switchgear rooms

D. High- and low-pressure safety injection pumps and containment spray pump rooms

E. Charging pump rooms

F. Saltwater cooling pump rooms

G. Component cooling water pump rooms

H. Diesel generator buildings

I. Emergency chiller rooms

J. Auxiliary feedwater pump rooms

K. Containment

L. Fuel handling building

They are designed so that the single failure of an active component, after a DBA, cannot impair the ability of the systems served by the air conditioning equipment to fulfill their safety functions. Should a train in a Seismic Category I air conditioning system become inoperative during normal operation, sufficient equipment is still available to mitigate the consequences of a DBA. In this event, action is taken in accordance with the technical specifications of chapter 16.

Two redundant Seismic Category I emergency air conditioning trains are provided in the auxiliary building for the control room complex. It is not considered credible that simultaneous loss of the two trains could occur.

Engineered safety feature and reactor protection system instrumentation located outside the containment, except the reactor trip switchgear (RTSG), which is not served by a Seismic Category I ventilation system, but by

two 50%-capacity normal ventilation systems, is designed for continued operation in the event of failure of both of the normal ventilation systems, concurrent with loss of offsite power. The ambient temperature for the RTSG is monitored by temperature sensors which actuate an alarm in the control room. Temperatures approaching the design limit of the RTSG will cause corrective action to be taken in accordance with the requirements of chapter 16, Technical Specification.

Power cable insulation is designed for a conductor temperature of 194F (90C). The allowable current carrying capacity of the cable is based on not exceeding this insulation design temperature while the surrounding air is at an ambient temperature of 104F (40C). If the ambient temperature is otherwise, the cable rating is modified by the appropriate factor listed in table 3.11-4.

Instrumentation cable is designed for a conductor temperature of 194F (90C). Operating currents of these cables are low and will not cause this temperature to be exceeded at maximum design ambient temperature. Instruments required to operate following a DBA are not located in pipe tunnels, in which the temperature may rise due to hot recirculation water flowing in the piping, but are mounted outside the tunnels.

Table 3.11-4
POWER CABLE TEMPERATURE CORRECTION FACTORS

Type Cable Tray	Ambient Temperature (°C)	Ampacity Correction Factor
Open top	30	1.09
	35	1.05
	40	1.00
	45	0.95
	50	0.90
	55	0.85
Covered	30	1.05
	35	1.01
	40	0.96
	45	0.91
	50	0.86
	55	0.81
All types in exposed conditions	40	1.00
	45	0.96
	50	0.90
	55	0.86

3.11.5 ESTIMATED CHEMICAL AND RADIATION ENVIRONMENT

3.11.5.1 Chemical Environment

Engineered safety feature (ESF) systems are designed to perform their safety-related functions in the temperature, pressure, and humidity conditions described in subsection 3.11.1, and sections 6.2 and 6.3. In addition, components of ESF systems inside the containment are designed to perform their safety-related functions in long-term contact with boric acid and sodium hydroxide solutions recirculated through the emergency core cooling system (ECCS) and containment spray systems (CSS).

The containment atmosphere is maintained below 4 wt% hydrogen consistent with the recommendations of Regulatory Guide 1.7 as discussed in subsection 6.2.5.

The spray chemical addition system and boron injection portion of the CVCS are designed for 40 wt% sodium hydroxide and 12 wt% boric acid respectively. The ECCS and CSS are designed for both the maximum and long-term boric acid concentration and pH. These chemical environment conditons are listed in table 3.11-1.

3.11.5.2 Radiation Environment

ESF systems and components are designed to perform their safety-related functions after the normal operational exposure plus an accident exposure. The normal operational exposure is based on the design source terms presented in chapter 11 and subsection 12.2.1 and the equipment and shielding configurations presented in section 12.3.

Post-accident ESF system and component radiation exposures are dependent on equipment location. In the containment and control room area, exposures are due to a hypothesized LOCA. Source terms and other accident parameters are presented in subsection 12.2.1, and chapter 15, and are consistent with the recommendations of Regulatory Guides 1.4 and 1.7.

In the safety equipment building, exposures are based on the assumption that 50% of the core halogen inventory and 1% of the core solid fission products, as listed in paragraph 15.6.3.5 are recirculated in the sump water. In the auxiliary building, exclusive of the control room area, exposures are based on the rupture of one waste gas decay tank if this rupture can result in a dose to the equipment in question. Source terms and other accident parameters are presented in paragraph 15.6.3.5. In the fuel handling building, exposures are based on a fuel handling accident. Source terms and other accident parameters are presented in chapter 15.

Normal, accident, and design (normal plus accident) radiation exposures based on the above assumptions are presented in table 3.11-1.

Organic materials that exist within the containment are identified in subsection 6.1.2. The design radiation exposures identified in table 3.11-1 are based on gamma radiation exposure only. The effect of beta radiation is effectively attenuated by small amounts of shielding, such as conduits for cable and casings for equipment. For the organic coating materials used inside the containment (see table 6.1-3), irradiation tests[5][6] have been performed for a cumulative gamma dose up to 1 x 10^9 rads, which exceeds the design calculated value in table 3.11-1 and therefore, conservatively accounts for the surface exposure due to beta radiation in the design basis accident environment.

REFERENCES

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3. Kircher, J. F. and Bowman, R. E., Effects of Radiation on Materials and Components, Van Nostrand Reinhold, New York, 1964.

4. Griess, J. C. and Bacarella, A. L., "Design Considerations of Reactor Containment Spray Solutions," CRNL-TM-2412, Part III, Oak Ridge National Laboratory, Oak Ridge, Tennessee, December 1969.

5. Letter, Oak Ridge National Laboratory (L. T. Corbin) to Mobile Chemical Company (M. J. Masciole), March 26, 1974.

6. Franklin Institute Research Laboratories, Technical Report No. F-C3349, May 1973.

7. "Environmental Qualification Data for NSSS-Supplied Instrumentation Equipment," Combustion Engineering, Inc., CEN-95(S), July 1978.

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8. "Program for Environmental Qualification for NSSS-Supplied Instrumentation Equipment," Combustion Engineering, Inc., CEN-100(S), August 1978.

APPENDIX 3.11A

RESULTS OF ENVIRONMENTAL TESTS AND/OR ANALYSES FOR NON-NSSS EQUIPMENT 1

APPENDIX 3.11A

RESULTS OF ENVIRONMENTAL TESTS AND/OR ANALYSES FOR NON-NSSS EQUIPMENT

3.11A.1 General

Table 3.11A-1 of this appendix summarizes the results of typical tests and/or analyses performed to demonstrate adequate environmental qualification of non-NSSS equipment. NSSS equipment environmental qualification methods and criteria are addressed in CEN-100(S). Specific test results for NSSS-supplied equipment are provided in CEN-95(S) (reference 7 of section 3.11).

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APPENDIX 3.11A

TABLES

3

Table 3.11A-1
RESULTS OF NON-NSSS EQUIPMENT ENVIRONMENTAL TESTS/ANALYSES (Sheet 1 of 2)

Equipment	Manufacturer (Model No.)	Qualification Method (Type Test, Operating Experience, Analysis, Combined Qualification, On-going Qualification)	Aging Simulation	Temperature Profile	Pressure Profile	Humidity (%)	Chemical Spray (pH)	Radiation Exposure (rads)	Summary of Results
Electrical Containment Penetration Assemblies	Westinghouse Electric Corporation (E-2865, E-2866)	Type Test	100 hours at 302F to simulate 40 years at 158F	0-3h 340F 3-5h 218F 5-8h 340F 8-11h 320F 11-15h 300F 15h - 5 days 250F 5 days - 32 days 212F	0-3h 80 lb/in.^{2}g 3-5h 0 lb/in.^{2}g 5-8h 80 lb/in.^{2}g 8-11h 70 lb/in.^{2}g 11-15h 22 lb/in.^{2}g 15h - 5 days 20 lb/in.^{2}g 5-32 days 0 lb/in.^{2}g	100	9.5 for 24h	$8x10^7$	Westinghouse report No. Pen-TR-76-29 documents that equipment is qualified for intended SONGS 2&3 service.
Power Cable 8 kV	Anaconda Company (EPR Insulation Hypalon Jacket)	Type Test	7 days at 250F	0-3h 340F 3-6.5h 320F 6.5h - 4 days 250F 4 days - 13 days, 210F 15h then 47 days 200F	0-3h 105 lb/in.^{2}g 3-6.5h 75 lb/in.^{2}g 6.5h - 4 days 15 lb/in.^{2}g 4 days - 13 days 15h 5 lb/in.^{2}g	100	9.5 for 60 days	$2x\ 10^8$	Franklin Institute reports F-C3341 and F-C2525 document that equipment is qualified for intended SONGS 2&3 service.
Power Cable 600V	General Electric Company (EPR Insulation Neoprene Jacket)	Type Test	130 hours at 302F	0-3h 346F 3-5h 140F 5-8h 346F 8-11h 335F 11-15h 315F 15h - 4 days 265F 4 days - 34 days 200F	0-3h 113 lb/in.^{2}g 3-5h 0 lb/in.^{2}g 5-8h 113 lb/in.^{2}g 8-11h 95 lb/in.^{2}g 11-15h 67 lb/in.^{2}g 15h - 4 days 24 lb/in.^{2}g 4 days - 34 days 4-9 lb/in.^{2}g	100	9.5 to 11 for 34 days	$2.2x10^8$	Franklin Institute reports F-C3913-1a, 2A and 3A document that equipment is qualified for intended SONGS 2&3 service.
Control Cable 600V	Raychem (XLPE Insulation, XLPE or Hypalon Jacket)	Type Test	7 days at 302F	0-10h 357F 10h - 4 days 275F 4 days - 30 days 212F	0-10h 70 lb/in.^{2}g 10h - 4 days 31 lb/in.^{2}g 4 days - 30 days 10 lb/in.^{2}g	100	9.5 to 11 for 30 days	$2x10^8$	Franklin Institute report F-C4033-1 documents that equipment is qualified for intended SONGS 2&3 service.

Table 3.11A-1
RESULTS OF NON-NSSS EQUIPMENT ENVIRONMENTAL
TESTS/ANALYSES (Sheet 2 of 2)

Equipment	Manufacturer (Model No.)	Qualification Method (Type Test, Operating Experience, Analysis, Combined Qualification, On-going Qualification)	Aging Simulation	Temperature Profile	Pressure Profile	Humidity (%)	Chemical Spray (pH)	Radiation Exposure (rads)	Summary of Results	
										3-022.18 9-032.28
Cable and wire connectors	AMP Inc. (AMP Power, PIDG, or Solistrand)	Type Test	120 hours at 163C	0-4s 280F 4s - 6 min. 24s 350F 6 min. 24s - 3h 352F 3h - 3h 21 min. 323F 3h 21 min. - 6h 323F 6h - 6h 54 min. 253F 6h 54 min. - 96h 253F	0-4s 80 lb/in.^{2}g 4s - 6 min. 24s 122 lb/in.^{2}g 6 min. 24s - 3h 121 lb/in.^{2}g 3h - 3h 21 min. 77 lb/in.^{2}g 3h 21 min. - 6h 77 lb/in.^{2}g 6h - 6h 54 min. 14 lb/in.^{2}g 6h 54 min. - 96h 14 lb/in.^{2}g	100	9 for 4 days	2×10^8	AMP test reports ELR-186-10/S-174, GPR 575-98, and GPR-575-99 document that equipment is qualified for intended service.	3-022.18 9-032.28 3-022.18
Hydrogen Recombiner	Westinghouse (N/A)	Type Test	80 normal recombiner heatup and cooldown cycles followed by 6 post-LOCA steam pressure, temperature, and spray transients	0-4h - Saturation for 85 lb/in.^{2}a 4-24h - Saturation for 35 lb/in.^{2}a 1-22 days varies between 138F and 200F	0-4h 85 lb/in.^{2}a 4-24h 35 lb/in.^{2}a 1-22 days 20 lb/in.^{2}a	100	10 for 25h	2×10^8	Westinghouse report No. WCAP-7709-L documents that equipment is qualified for intended SONGS 2&3 service.	9-032.28 3-022.18
Heat-shrinkable insulation	Raychem (WCSF)	Type Test	7 days at 150C	0-10h 351F 10h-4d22h 275F 4d22h-30d22h 212F	0-10h 70 lb/in.^{2}g 10h-4d22h 31 lb/in.^{2}g 4d22h-30d22h 10 lb/in.^{2}g	100	9.5 for 9 days	2×10^8	Franklin Institute report F-C4033-3 documents that equipment is qualified for intended SONGS 2&3 service.	9-040.51
Electrical Connector Assemblies	Westinghouse Electric Corp. (Amphenol "N" type)	Type Test	100 Hours at 134C	0.2h 268F 0.3h 308F 0.7-2.8h 312F 3.0h 255F 4.0-27.h 250F	0.0h Ambient 0.2h 26 lb/in.^{2}g 0.3h 60 lb/in.^{2}g 0.7-1.0h 65 lb/in.^{2}g 2.0-2.8h 68 lb/in.^{2}g 3.0h 18 lb/in.^{2}g 4.0-27.h 15 lb/in.^{2}g	100	>9.5	2.2×10^8	Westinghouse test report No. PEN-TR-79-29 documents that equipment is qualified for intended SONGS 2&3 service.	16

Table 1.8-6 4-032.6

DOCUMENTATION TO SUPPORT SEISMIC AND ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT (Sheet 1 of 4) 15

Document Number	Title	
ENV-8805, Rev. 0	Procedures for Environmental Testing to Meet the Intent of IEEE-323-1971, CRM-71 Counting Ratemeter, CRM 74 Counting Ratemeter, Nuclear Measurements Corporation, February 17, 1978	9-032.29
F-C3913-1A	Normal Life Qualification Tests of Electric Cables; Franklin Institute Research Laboratories, May 1975	
F-C3913-2A	Qualification Tests of Electric Cables Under Simulated Reactor Containment Service Conditions Including Loss-of-Coolant Accident; Franklin Institute Research Laboratories, May 1975	
F-C3913-3A	Qualification Tests of Electric Cables Under Simulated Reactor Containment Service Conditions Including Loss-of-Coolant Accident; Franklin Institute Research Laboratories, April 1975	
NPX-65829	Clarification of Joy Seismic Analysis Applicable to Southern California Edison Company; Joy Manufacturing Company, February 1976	
S023-302-3	Quality Class II and III Specification for 480 V-Load Center; Bechtel Power Corporation, October 1974 with Addenda 1-3 dated April 1975, July 1975, and October 1977, respectively	9-040.50
S023-302-4	Quality Class II and III Specification for Motor Control Centers; Bechtel Power Corporation, August 1974 with Addenda 1-7 dated October 1974, March 1975, August 1975, September 1975, January 1976, October 1976, and November 1977, respectively	
S023-304-11	Quality Class II Specification for 600 Volt Power Cable, Bechtel Power Corporation, November 1974 with Addenda 1-3 dated August 1976, December 1976, and April 1977, respectively	
S023-403-12	Specification S023-403-12, Quality Class II for Diesel Driven Electrical Generating Sets, Revision 1; Southern California Edison Company, September 1975 with Revision 2 and Addenda 1-4 dated October 1975, September 1976, January 1977, June 1977, and September 1977	

Table 1.8-6
15 DOCUMENTATION TO SUPPORT SEISMIC AND ENVIRONMENTAL QUALIFICATION OF CLASS 1E EQUIPMENT (Sheet 2 of 4)

	Document Number	Title
	S023-403-12-126-0	Effect of the Hawaiian Earthquake of April 26, 1973 Upon EMD Power Generating Sets Located in the Hawaiian Islands; Electromotive Division, General Motors Corporation, July 1973
	S023-403-12-127-0	Illustration of Typical Final Analysis Report; Section II, Summary of Reports; Stewart & Stevenson Services, Inc. (no date)
9-040.50	S023-403-12-134-0	Seismic Qualification Procedure for Southern California Edison Company; Steward & Stevenson Services, Inc., June 1977 (Revised October 1977)
	S023-410-2	Quality Class II and III Specifications for Containment Building Fans; Bechtel Power Corporation, October 1973 with Addenda 1-4 dated November 1973, April 1974, November 1976, and January 1977, respectively
	S023-504-1	Quality Class II, III, and IV Specification for Transmitters; Bechtel Power Corp., August 1974
	S023-507-2	Quality Class II, III, and IV Specification for Butterfly Valves; Bechtel Power Corporation, June 1974 with Addenda 1-6 dated September 1975, December 1975, April 1976, April 1976, January 1977, and July 1977, respectively
	S023-507-2-1-410-2	Limitorque Corporation Test Report Summary
4-032.6	S.O. 713-51220	Seismic Certification Report for Class 1E Electrical Equipment; I-T-E Imperial Corporation, April 1976
	S023-606-1	Quality Class II, III, and IV Specification for Process and Airborne Radiation Monitoring System; Bechtel Power Corp., July 1974 with Addenda 1-4 dated October 1974, March 1975, May 1976, and July 1976, respectively
	SP-501 - Rev. 3	Seismic Test Procedure, San Onofre Nuclear Station Units 2 and 3; Nuclear Measurements Corporation March 15, 1977
	T3-1013	Test of E-10 Series Differential and Pressure Gauge Pressure Transmitters; Foxboro Company, June 1973

Table 1.8-6
DOCUMENTATION TO SUPPORT SEISMIC AND ENVIRONMENTAL
QUALIFICATION OF CLASS 1E EQUIPMENT (Sheet 3 of 4) 15

Document Number	Title	
TS-1013 (Supplementary)	Test of E-10 Series Differential and Gauge Pressure Transmitters (Supplemental); Foxboro Company, March 1973	
T3-1091	Seismic Vibration Test of E-10 Series Amplifiers; Foxboro Company, December 1973	4-032.6
T3-1097	Radiation Test of E-10 Series Amplifiers; Foxboro Company, November 1973	
T6-0020-AT	Type Test of an E13DM-MCA/RR/CI Style "C" Electric Differential Pressure Transmitter; Foxboro Company, January 1977	9-032.29
43220-1	Seismic Qualification Report for Model 4 Motor Control Centers; Square D Company, November 1976	
X-604	Qualification Testing of Joy Anvane Fan and Reliance Electric Motor for Class 1E Service for Nuclear Containment per CEEE 334-1974; Joy Manufacturing Company, April 1977	9-040.50
TDR-42478	Analysis of Seismic Test Results of Radiation Monitors for the San Onofre Nuclear Generating Station, Units 2&3; Nuclear Measurements Corporation, June 1978	11
CEN-94(S)	Seismic Qualification Data for NSSS-Supplied Instrumentation Equipment, Combustion Engineering, Inc., July 1978.	
CEN-95(S)	Environmental Qualification Data for NSSS-Supplied Instrumentation Equipment, Combustion Engineering Inc., July 1978.	13
CEN-99(S)	Seismic Program for Qualification of NSSS-Supplied Instrumentation Equipment; Combustion Engineering, Inc., August 1978.	
CEN-100(S)	Program for Environmental Qualification of NSSS-Supplied Instrumentation Equipment, Combustion Engineering, Inc., August 1978.	

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Table 1.8-6
DOCUMENTATION OF SUPPORT SEISMIC AND ENVIRONMENTAL
QUALIFICATION OF CLASS 1E EQUIPMENT (Sheet 4 of 4)

Document Number	Title
Bulletin 871	Limitorque Type SMB Valve Controls (pages 5 and 6)
	Raychem Conforming Specification for San Onofre Nuclear Generating Station Units 2&3, Bechtel Job 10079, Specification S023-304-6, Purchase Order D4103291, dated June 16, 1975.
DPE13DM 1H/P	Foxboro Dimension Print, October 1971, San Onofre Log No. S023-924-307-3
N0144CC	Foxboro Drawing (to be submitted later)
H33385-9001, Rev. C	Rosemont Engineering Company, Connection Head Assembly, San Onofre Log No. S023-924-284-3
022.58 75G-001	Target Rock Corp. 1 in. Schedule 40S Solenoid O per. Globe Valve Assembly; "Y" Pattern, Fail Closed with Position Indicators, San Onofre Log No. S023-507-4-1-2.
NPX-66680	Letter - Joy Manufacturing to Bechtel dated August 24, 1978
FF-14598	Joy Manufacturing Co. RCP Nuclear Dimension Sheet
	Westinghouse Electric Corporation Medium Voltage Penetration 24 in. Nozzle San Onofre Log No. S023-304-1-2-14
	Westinghouse Electric Corporation Modular Penetration - 18 in. Nozzle San Onofre Log No. S023-304-1-3-14
	Westinghouse Electric Corporation Inboard Enclosure Box Modular Penetration San Onofre Log No. S023-304-1-19-4

Question 010.8

With regard to potential failures or malfunctions caused by freezing, icing, and other adverse environmental conditions, discuss the protective measures that are provided to assure the proper function of those components not housed within temperature controlled areas, and that are essential in attaining and maintaining a safe reactor shutdown.

Response

All auxiliary equipment discussed in chapter 9 and safety-related equipment not housed in temperature controlled areas are environmentally qualified to local ambient temperature extremes of from 36F to 104F as stated in paragraph 3.11.2.5. Based on the environmental qualifications of this equipment, there are no adverse environmental conditions which would prohibit equipment, located outside, from performing the required function.

Design and operating temperatures are based on data reflected in section 2.3, tables 2.3-3, 2.3-4, 2.3-5, and 2.3-6 as well as design temperature recommendations of ASHRAE. Based on the above, there is no condition of icing or freezing to which equipment, related to safety or essential for safe reactor shutdown, could be exposed.

Reference

Section 2.3 and chapter 9. See revised subsection 2.3.2.

Los Angeles, California, International Airport[(a)(b)]

Month	Temperatures (°F) Normal Daily Maximum	Normal Daily Minimum	Normal Monthly	Extremes Record Highest	Year	Record Lowest	Year	Normal Degree Days (Base 65F) Heating	Cooling	Precipitation (in.) Water Equivalent Normal	Maximum Monthly	Year	Minimum Monthly	Year	Maximum in 24 Hours	Year
(c)				16		16					39		39		39	
J	63.5	45.4	54.5	86	1971	30	1963	331	5	2.52	9.60	1969	0.00	1972	6.19	1956
F	64.1	47.0	55.6	92	1963	37	1965	270	7	2.32	11.07	1962	T	1964	4.16	1962
M	64.3	48.6	56.5	88	1964	39	1971	267	0	1.71	5.98	1938	0.00	1959	3.54	1968
A	65.9	51.7	58.8	95	1966	43	1965	195	9	1.10	4.52	1965	0.00	1962	1.88	1960
M	68.4	55.3	61.9	96	1967	45	1964	114	17	0.08	0.56	1956	0.00	1943	0.56	1956
J	70.3	58.6	64.5	92	1973	50	1971	71	56	0.03	0.29	1964	0.00	1971	0.29	1964
J	74.8	62.1	68.5	92	1960	55	1964	19	127	0.01	0.15	1969	0.00	1973	0.15	1969
A	75.8	63.2	69.5	91	1967	59	1970	15	154	0.02	0.30	1961	0.00	1971	0.21	1961
S	75.7	61.6	68.7	110	1963	55	1971	23	134	0.07	4.39	1939	0.00	1968	4.20	1939
O	72.9	57.5	65.2	106	1961	43	1971	77	83	0.22	2.34	1936	0.00	1969	1.77	1972
N	69.6	51.3	60.5	101	1966	38	1964	158	23	1.76	7.92	1946	0.00	1956	5.60	1967
D	66.5	47.3	56.9	88	1959	32	1968	267	0	2.39	6.57	1936		1963	3.01	1951
YR	69.2	54.1	61.7	110	SEP 1963	30	JAN 1963	1819	615	11.59	11.07	FEB 1962	0.00	JUL 1973	6.19	JAN 1956

Month	Snow, Ice Pellets Maximum Monthly	Year	Maximum in 24 Hours	Year	Relative Humidity (%) Hour 04 (Local Time)	Hour 10	Hour 16	Hour 22	Wind Mean Speed (mi/h)	Prevailing Direction	Peak Gust Speed (mi/h)	Direction	Year	% of Possible Sunshine	Mean Sky Cover, Tenths, Sunrise to Sunset	Sunrise to Sunset Clear	Partly Cloudy	Cloudy
(c)	39		39		15	15	15	15	26	28	25	25			26	39	39	3
J	(e)	1974	(e)	1974	68	54	59	69	6.7	W	48	SW	1951		5.2	12	8	1
F	(e)	1951	(e)	1951	72	57	61	70	7.3	W	57	N	1953		5.0	12	6	1
M	0.0		0.0		78	61	65	74	8.0	W	62	W	1952		5.1	11	9	1
A	0.0		0.0		79	59	63	75	8.4	WSW	59	N	1957		4.8	11	9	1
M	0.0		0.0		81	65	65	79	8.2	WSW	45	N	1953		5.2	10	10	1
J	0.0		0.0		85	70	68	82	7.9	WSW	32	W	1954		5.2	9	11	1
J	0.0		0.0		86	68	68	83	7.6	WSW	29	W	1954		4.0	12	13	
A	0.0		0.0		85	68	69	83	7.5	WSW	33	SE	1955		3.9	13	12	
S	0.0		0.0		83	65	67	80	7.1	WSW	28	SW	1972		4.1	13	11	
O	0.0		0.0		78	58	64	77	6.8	W	46	W	1974		4.5	13	10	
N	0.0		0.0		75	59	64	74	6.6	W	55	N	1953		4.6	14	8	
D	(e)	1971	(e)	1971	70	55	61	69	6.6	W	49	S	1952		4.7	13	8	1
YR	(e)	JAN 1974	(e)	JAN 1974	78	62	65	76	7.4	W	62	W	MAR 1952		4.7	143	115	10

a. Means and extremes above are from existing and comparable exposures. Annual extremes have been exceeded at other sites in the locality as follows: Lowest temperature 25 in January maximum monthly precipitation 9.26 in December 1921; maximum precipitation in 24 hours 3.62 in December 1940; fastest mile of wind 53 from Southeast in February 1938. Normals - Base for the 1941-1970 period; Date of an Extreme - The most recent in cases of multiple occurrence; Prevailing Wind Direction - Record through 1963; Wind Direction - Numerals indicate te degrees clockwise from true north. 00 indicates calm; Fastest Mile Wind - Speed is fastest observed 1-minute value when the direction is in tens of degrees.

b. Source, Local Climatological Data, Environmental Data Service, NOAA.

c. Length of record, years, through the current year unless otherwise noted, based on January data.

d. 70° and above at Alaskan stations.

e. Trace.

f. Less than one half.

San Diego, California, Lindbergh Field[a][b]

Month	Temperature (°F) Normal Daily Maximum	Normal Daily Minimum	Normal Monthly	Extremes Record Highest	Year	Record Lowest	Year	Normal Degree Days (Base 65F) Heating	Cooling	Precipitation in inches: Water Equivalent Normal	Maximum Monthly	Year	Minimum Monthly	Year	Maximum in 24 Hours	Year
(c)				14		14					34		34		34	
J	64.6	45.8	55.2	86	1969	31	1963	314	10	1.88	6.26	1943	(e)	1948	2.65	1943
F	65.6	47.8	56.7	85	1963	38	1965	237	0	1.48	5.31	1941	0.00	1967	1.71	1941
M	66.0	50.1	58.1	85	1964	39	1971	219	5	1.55	5.89	1941	(e)	1972	2.40	1952
A	67.6	53.8	60.7	91	1971	44	1965	144	15	0.81	3.58	1965	(e)	1966	1.40	1965
M	69.4	57.2	63.3	91	1967	48	1967	79	26	0.15	0.95	1971	0.00	1952	0.42	1957
J	71.1	59.9	65.5	90	1973	51	1967	52	67	0.05	0.38	1972	0.00	1946	0.28	1972
J	75.3	63.9	69.6	92	1972	57	1964	6	149	0.01	0.13	1968	0.00	1964	0.10	1968
A	77.3	65.4	71.4	90	1972	60	1968	0	201	0.07	0.87	1945	0.00	1970	0.83	1951
S	76.5	63.2	69.9	111	1963	56	1966	16	163	0.13	1.90	1963	0.00	1964	0.90	1963
O	73.8	58.4	66.1	107	1961	43	1971	43	77	0.34	2.90	1941	0.00	1967	1.20	1941
N	70.1	51.5	60.8	97	1966	38	1964	140	14	1.25	5.82	1965	0.00	1956	2.44	1944
D	66.1	47.2	56.7	88	1963	36	1974	257	0	1.73	7.60	1943	0.03	1953	3.07	1945
YR	70.3	55.4	62.9	111	SEP 1963	31	JAN 1963	1507	727	9.45	7.60	DEC 1943	0.00	AUG 1970	3.07	DEC 1945

Month	Snow, Ice Pellets Maximum Monthly	Year	Maximum in 24 Hours	Year	Relative Humidity (%) Hour 04 (Local Time)	Hour 10	Hour 16	Hour 22	Wind Mean Speed (mi/h)	Prevailing Direction	Fastest Mile Speed (mi/h)	Direction	Year	% of Possible Sunshine	Mean Sky Cover, Tenths, Sunrise to Sunset	Sunrise to Sunset Clear	Partly Cloudy	Cloudy
(c)	34		34		14	14	14	14	34	15	31	31		34	34	34	34	[illegible]
J	(e)	1949	(e)	1949	69	54	55	68	5.6	NE	39	SW	1955	71	5.0	13	7	[illegible]
F	0.0		0.0		72	56	57	71	6.3	WNW	35	S	1969	72	5.0	11	7	[illegible]
M	0.0		0.0		74	59	59	72	7.2	WNW	46	SW	1945	71	5.1	11	10	[illegible]
A	0.0		0.0		74	58	58	71	7.6	WNW	37	S	1958	65	5.2	10	10	[illegible]
M	0.0		0.0		76	64	63	74	7.6	WNW	27	SW	1947	58	5.7	9	11	[illegible]
J	0.0		0.0		80	69	67	78	7.5	SSW	26	S	1948	56	5.6	9	12	[illegible]
J	0.0		0.0		81	69	66	79	7.1	WNW	23	NW	1968	68	4.5	13	13	[illegible]
A	0.0		0.0		80	67	66	78	6.9	WNW	23	SW	1945	69	4.1	15	12	[illegible]
S	0.0		0.0		78	65	65	77	6.7	NW	25	W	1955	68	4.0	16	9	[illegible]
O	0.0		0.0		74	58	60	73	6.3	WNW	31	N	1961	67	4.3	15	9	[illegible]
N	0.0		0.0		74	58	63	73	5.6	NE	51	SE	1944	73	4.2	15	8	[illegible]
D	(e)	1967	(e)	1967	71	55	57	70	5.5	NE	34	S	1951	71	4.7	14	8	[illegible]
YR	(e)	DEC 1967	(e)	DEC 1967	75	61	61	74	6.7	WNW	51	SE	NOV 1944	67	4.8	151	116	[illegible]

Station: LOS ANGELES, CALIFORNIA INTERNATIONAL AIRPORT Standard time used: PACIFIC Latitude: 33° 56' N Longitude: 118° 24' W

Month	Temperature (°F) Averages Daily Maximum	Daily Minimum	Monthly	Extremes Highest	Date	Lowest	Date	Degree days (Base 65F) Heating	Cooling	Precipitation (in.) Water Equivalent Total	Greatest in 24 Hours	Date	Snow, Ice Pellets Total	Greatest in 24 Hours	Date	Relative Humidity (%) Hour 04 (Local Time)	Hour 10	Hour 16	Hour 22	Wind Resultant Direction	Speed (mi/h)	Average Speed (mi/h)	Peak Gust Speed (mi/h)	Direction (a)	Date	Percentage of Possible Sunshine	Average Sky Cover Sunrise to Sunset	Sur… S Clear
JAN	62.7	46.5	54.6	77	14	37	5	314	1	3.16	1.70	16	0.0	0.0		67	53	59	67	31	0.4	7.4	46	N	19		4.8	11
FEB	65.6	51.4	58.5	78	20	45	17	177	0	4.87	1.82	6-7	0.0	0.0		81	68	67	79	17	1.2	7.6	38	S	11		6.8	6
MAR	62.3	48.6	55.5	68	16[d]	43	21	287	0	2.42	0.75	8	0.0	0.0		80	63	68	73	25	4.7	9.6	40	W	20		4.8	14
APR[c]	67.8	52.3	60.1	80	4	48	21[d]	146	4	(e)	(e)	29[d]	0.0	0.0		74	55	61	76	25	4.8	8.9	43	SE[c]	4		4.6	14
MAY	68.4	56.4	62.4	84	28	52	6[d]	89	14	0.01	0.01	30-31	0.0	0.0		87	71	70	84	24	6.0	7.6	25	W	5		6.4	7
JUN	73.7	59.7	66.7	92	20	55	15	12	70	(e)	(e)	22[d]	0.0	0.0		87	68	68	85	24	6.1	7.6	25	SW	23[d]		6.1	7
JUL	74.3	61.6	68.0	87	3	58	24[d]	0	99	0.00	0.00		0.0	0.0		89	70	68	87	24	5.7	7.6	23	SW	20[d]		5.1	8
AUG	75.0	63.1	69.1	85	19	60	31[d]	0	134	0.02	0.02	13	0.0	0.0		88	70	70	84	25	5.7	7.3	28	W	22		4.6	12
SEP	74.0	61.1	67.6	98	27	57	6	1	83	(e)	(e)	22[d]	0.0	0.0		84	68	68	82	24	4.4	7.0	23	W	5[d]		5.3	7
OCT	74.6	56.7	65.7	91	27	53	29[d]	24	52	0.08	0.04	23[d]	0.0	0.0		84	57	64	81	24	3.3	6.3	25	W	10		3.8	15
NOV	67.1	51.9	59.5	77	28[d]	44	24	159	2	1.92	0.98	22	0.0	0.0		78	60	63	74	27	1.8	6.9	37	W	18		5.0	12
DEC	67.8	48.8	58.3	85	9	42	3	207	8	0.45	0.30	1	0.0	0.0		72	52	57	71	34	0.2	6.0	36	NE	23		6.2	6
YEAR	69.4	54.8	62.1	98	SEP 27	37	JAN 5	1416	467	12.93	1.82	FEB 6-7	0.0	0.0		81	63	65	79	24	3.6	7.5	46	N	JAN 19		5.3	119

a. To 8 compass points only.
b. 70° at Alaskan stations.
c. Data corrected after publication of the monthly issue.
d. Also on earlier dates, months, or years.
e. Trace, an amount too small to measure.
f. The National Weather Service considers the accuracy of solar radiation data questionable; therefore, publication is suspended pending determination of corrected values.

Station: LOS ANGELES, CALIFORNIA INTERNATIONAL AIRPORT Standard time used: PACIFIC Latitude 33° 56' N Longitude: 118° 24' W Eleva

Month	Temperature (°F) Averages: Daily Maximum	Averages: Daily Minimum	Averages: Monthly	Extremes: Highest	Extremes: Date	Extremes: Lowest	Extremes: Date	Degree Days (Base 65F): Heating	Degree Days: Cooling	Precipitation (in.) Water Equivalent: Total	Water Equivalent: Greatest in 24 Hours	Water Equivalent: Date	Snow, Ice Pellets: Total	Snow, Ice Pellets: Greatest in 24 Hours	Snow, Ice Pellets: Date
JAN	61.1	47.5	54.3	79	14	39	2	323	0	5.68	1.93	3-4	(e)	(e)	6
FEB	66.8	48.1	57.5	80	24	43	7	208	3	0.13	0.13	28	0.0	0.0	
MAR	62.1	51.0	56.6	68	14	43	4	256	0	2.49	1.05	1-2	0.0	0.0	
APR	67.5	51.8	59.7	78	5	46	25	158	2	0.14	0.14	1-2	0.0	0.0	
MAY	68.9	56.9	62.9	77	25	50	19	62	5	0.02	0.02	5	0.0	0.0	
JUN	73.1	60.2	66.7	80	28	56	17	2	58	(e)	(e)	7	0.0	0.0	
JUL	76.7	64.3	70.5	84	23	60	11	0	179	(e)	(e)	29	0.0	0.0	
AUG	74.8	64.4	69.6	78	6	61	16	0	150	(e)	(e)	8	0.0	0.0	
SEP	75.1	62.8	69.0	86	22	59	28	0	125	(e)	(e)	25	0.0	0.0	
OCT	72.2	59.6	65.9	100	16	52	31	26	65	0.54	0.45	28	0.0	0.0	
NOV	72.9	52.4	62.7	94	12	44	29	100	40	(e)	(e)	21-22	0.0	0.0	
DEC	65.7	45.9	55.8	78	16	35	25	279	0	3.76	2.28	3-4	0.0	0.0	
YEAR	69.7	55.4	62.6	100	OCT 16	35	DEC 25	1414	627	12.76	2.28	DEC 3-4	(e)	(e)	JAN 6

Month	Relative Humidity (%) Hour 04 (Local Time)	Hour 10	Hour 16	Hour 22	Wind Resultant: Direction	Wind Resultant: Speed (mi/h)	Wind: Average Speed (mi/h)	Peak Gust: Speed (mi/h)	Peak Gust: Direction(a)	Peak Gust: Date	% of Possible Sunshine	Average Sky Cover Sunrise to Sunset	Sunrise to Sunset: Clear	Sunrise to Sunset: Partly Cloudy
JAN	83	70	71	79	16	0.7	6.8	40	W	1		6.5	7	9
FEB	67	48	56	63	28	1.4	6.4	32	NW	19		3.6	15	7
MAR	91	76	78	86	25	3.4	7.1	30	W	3		6.8	6	10
APR	83	55	63	76	26	5.3	8.6	46	W	9		2.5	22	5
MAY	84	65	65	80	26	6.0	7.9	36	W	18		6.1	7	11
JUN	88	66	64	83	25	6.3	8.1	30	W	25		4.3	15	4
JUL	87	66	67	82	25	6.2	7.8	26	W	10		3.9	13	15
AUG	89	71	71	88	25	6.7	8.0	24	W	13		4.7	11	15
SEP	91	71	75	88	25	5.4	7.2	26	W	16		5.3	8	15
OCT	87	69	72	85	26	4.9	7.2	46	W	28		5.9	7	13
NOV	75	49	64	76	27	1.7	5.6	30	W	1		3.7	16	8
DEC	77	54	60	73	34	0.8	5.9	41	N	22		4.2	16	7
YEAR	84	63	67	80	26	3.9	7.2	45	W	OCT 28		4.8	143	119

Station: SAN DIEGO, CALIFORNIA LINDBERGH FIELD Standard time used: PACIFIC Latitude: 32° 44' N Longitude: 117° 10' W Ele

Month	Temperature (°F) Averages Daily Maximum	Daily Minimum	Monthly	Extremes Highest	Date	Lowest	Date	Degree Days (Base 65F) Heating	Cooling	Precipitation (in.) Water Equivalent Total	Greatest in 24 Hours	Date	Snow, Ice Pellets Total	Greatest in 24 Hours	Date	Relative Humidity (%) Hour 04 (Local Time)	Hour 10	Hour 16	Hour 22	Wind Resultant Direction	Speed (mi/h)	Average Speed (mi/h)	Fastest Mile Speed (mi/h)	Direction[a]	Date	% of Possible Sunshine	Average Sky Cover Sunrise to Sunset	Sunr Su Clear
JAN	63.9	47.2	55.6	76	13	38	5	286	0	1.68	0.48	16	0.0	0.0		63	51	53	63	29	2.1	6.8	30	S	18	78	5.1	12
FEB[b]	67.3	52.5	59.9	75	20	47	1	131	0	1.63	0.54	11-12	0.0	0.0		73	60	57	71	24	1.8	7.2	33	S	11	78	6.1	6
MAR	64.1	52.0	58.1	71	16	46	14	208	0	2.26	0.71	11	0.0	0.0		70	58	56	65	26	4.3	9.8	25	NW	13	66	6.0	9
APR	67.8	55.1	61.5	81	9	49	3[e]	107	10	0.05	0.03	29-30	0.0	0.0		64	53	52	62	28	4.2	8.4	26	N	4	63	5.0	13
MAY	68.0	58.7	63.4	81	28[e]	55	5[e]	61	17	(f)	(f)	31	0.0	0.0		77	65	64	73	26	4.6	7.8	20	W	1	47	6.5	6
JUN	73.4	62.5	68.0	90	20	59	9[e]	1	97	(f)	(f)	14	0.0	0.0		78	65	64	76	26	4.4	8.2	19	NW	5	56	6.3	8
JUL	74.3	63.8	69.1	80	3	62	26[e]	0	133	(f)	(f)	12	0.0	0.0		78	70	65	76	26	4.4	8.0	18	W	2	54	5.7	8
AUG	75.5	65.4	70.5	83	20[e]	63	31[e]	0	176	(f)	(f)	20	0.0	0.0		76	67	66	75	27	4.6	8.2	21	S	19	62	5.1	10
SEP	74.3	63.3	68.8	93	27	60	7	0	121	0.02	0.02	4	0.0	0.0		71	61	60	70	28	4.3	8.0	19	NW	5	53	5.5	10
OCT	74.7	58.9	66.8	90	28	54	30	6	70	0.01	0.01	8	0.0	0.0		67	55	57	69	30	4.3	7.0	18	NW	28[e]	73	3.7	18
NOV	67.3	53.9	60.6	82	11	46	20	132	8	1.63	0.65	17-18	0.0	0.0		73	60	61	70	27	2.5	6.6	24	W	18	62	5.6	7
DEC	67.0	49.3	58.2	81	9	44	3	205	1	0.19	0.13	22	0.0	0.0		68	52	59	67	29	1.4	4.5	19	NW	22	75	5.7	9
YEAR	69.8	56.9	63.4	93	SEP 27	38	JAN 5	1137	633	7.47	0.71	MAR 11	0.0	0.0		72	60	60	70	27	3.5	7.5	33	S	FEB 11	63	5.5	116

a. To 8 compass points only.
b. Data corrected after publication of the monthly issue.
c. Climatological normals (1941-1970).
d. >70° at Alaskan stations.
e. Also on earlier dates, months, or years.
f. Trace, an amount too small to measure.

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Station: SAN DIEGO, CALIFORNIA LINDBERGH FIELD Standard time used: PACIFIC Latitude: 32° 44' N Longitude: 117° 10' W Elevati

Month	Temperature (°F) Averages Daily Maximum	Daily Minimum	Monthly	Extremes Highest	Date	Lowest	Date	Degree Days (Base 65F) Heating	Cooling	Precipitation (in.) Water Equivalent Total	Greatest in 24 Hours	Date	Snow, Ice Pellets Total	Greatest in 24 Hours	Date	Relative Humidity (%) Hour 04 (Local Time)	Hour 10	Hour 16	Hour 22	Wind Resultant Direction	Speed (mi/h)	Average Speed (mi/h)	Fastest Mile Speed (mi/h)	Direction (a)	Date	% of Possible Sunshine	Average Sky Cover Sunrise to Sunset	Sunrise to Sunse… Clear	Partly
JAN	63.9	49.8	56.9	73	14	44	31	243	0	2.96	1.28	7-8	0.0	0.0		71	57	60	72	27	1.3	6.6	32	SE	7	62	6.3	8	
FEB	67.9	48.4	58.2	80	25	44	14	184	0	0.04	0.04	19	0.0	0.0		58	43	45	61	31	3.4	5.9	23	NW	28	86	4.1	15	
MAR	64.8	53.4	59.1	72	1	46	5	176	0	1.70	1.15	7-8	0.0	0.0		76	65	63	74	28	3.2	7.2	33	SW	8	68	7.0	7	
APR	69.0	54.9	62.0	80	5	51	4	85	2	0.02	0.01	9	0.0	0.0		71	54	54	67	29	4.7	7.7	26	NW	9	84	3.4	18	
MAY	68.1	58.5	63.3	76	25	53	20	55	9	0.01	0.01	9	0.0	0.0		72	62	61	70	25	4.6	7.5	21	W	19	49	7.2	5	
JUN	72.2	61.6	66.9	82	27	59	19	4	69	0.02	0.02	6-7	0.0	0.0		80	68	64	75	29	5.0	7.9	20	NW	19	62	4.7	13	
JUL	76.5	66.3	71.4	86	20	62	12	0	204	0.01	0.01	29	0.0	0.0		77	65	63	75	28	4.8	7.6	20	W	4	67	4.8	10	
AUG	74.9	65.4	70.2	77	26	61	30	0	169	(f)	(f)	1	0.0	0.0		77	67	66	76	29	5.2	7.7	17	W	26	58	5.3	10	
SEP	75.1	65.4	70.3	84	2	61	28	0	164	(f)	(f)	26	0.0	0.0		80	70	67	77	29	4.4	6.9	17	NW	21	60	5.2	11	
OCT	72.5	61.0	66.8	92	16	54	31	14	75	1.03	0.78	28-29	0.0	0.0		74	63	61	72	29	4.5	7.1	28	W	29	49	6.2	9	
NOV	71.0	53.4	62.2	91	12	46	26	97	19	0.14	0.10	1	0.0	0.0		68	50	55	66	30	2.1	5.1	19	W	1	73	4.1	16	
DEC	65.7	46.9	56.3	77	16	36	25	265	0	2.20	1.43	4	0.0	0.0		66	46	47	61	31	1.9	5.3	25	NW	22	87	3.9	16	
YEAR	70.1	57.1	63.6	92	OCT 16	36	DEC 25	1123	711	8.13	1.43	DEC 4	0.0	0.0		73	59	59	71	29	3.6	6.9	33	SW	MAR 8	66	5.2	138	

Table 2.3-6
TEMPERATURE SUMMARY FOR SAN ONOFRE SITE
LEVEL: 6:1/10 METERS[(a)] (Sheet 1 of 2)

Period of Record 1/25/74 - 1/24/76														
Hour	January		February		March		April		May		June		July	
	(°C)	(°F)	(°C)	(°F)	(°C)	(°F)	(°C)	(°F)	(°C)	(°F)	(°C)	(°F)	(°C)	(°F)
1	11.3	52.3	10.4	50.7	10.3	50.5	10.8	51.4	12.9	55.2	14.0	57.2	16.4	61.5
2	10.9	51.6	10.1	50.2	10.1	50.2	10.5	50.9	12.8	55.0	13.8	56.8	16.3	61.3
3	10.9	51.6	9.9	49.8	9.9	49.8	10.3	50.5	12.5	54.5	13.6	56.5	16.1	61.0
4	10.8	51.4	9.6	49.3	9.6	49.3	10.0	50.0	12.4	54.3	13.6	56.5	16.1	61.0
5	10.6	51.1	9.5	49.1	9.4	48.9	9.7	49.5	12.2	54.0	13.5	56.3	15.8	60.4
6	10.5	50.9	9.4	48.9	9.4	48.9	9.5	49.1	12.2	54.0	13.7	56.7	16.1	61.0
7	10.5	50.9	9.3	48.7	9.7	49.5	9.4	48.9	12.5	54.5	14.1	57.4	16.6	61.9
8	11.2	52.2	9.7	49.5	10.4	50.7	10.7	51.3	13.2	55.8	14.5	58.1	17.2	63.0
9	12.5	54.5	11.0	51.8	11.3	52.3	11.9	53.4	13.7	56.7	15.0	59.0	17.6	63.7
10	13.3	55.9	12.0	53.6	12.0	53.6	12.3	54.1	13.9	57.0	15.6	60.1	18.0	64.4
11	13.6	56.5	12.3	54.1	12.3	54.1	13.0	55.4	14.2	57.6	16.1	61.0	18.3	64.9
12	14.0	57.2	12.7	54.9	12.5	54.5	13.4	56.1	14.6	58.3	16.5	61.7	18.6	65.5
13	14.3	57.7	13.1	55.6	12.8	55.0	13.9	57.0	14.9	58.8	16.5	61.7	18.7	65.7
14	14.4	57.9	13.4	56.1	13.0	55.4	14.3	57.7	15.3	59.5	16.8	62.2	18.8	65.8
15	14.6	58.3	13.7	56.7	13.0	55.4	14.4	57.9	15.2	59.4	16.8	62.2	18.6	65.5
16	14.5	58.1	13.8	56.8	12.8	55.0	14.3	57.7	15.2	59.4	16.5	61.7	18.5	65.3
17	14.3	57.7	13.6	56.5	12.7	54.9	14.0	57.2	15.0	59.0	16.3	61.3	18.2	64.8
18	13.5	56.3	12.9	55.2	12.2	54.0	13.5	56.3	14.6	58.3	15.9	60.6	17.8	64.0
19	13.0	55.4	12.2	54.0	11.9	53.4	13.1	55.6	14.1	57.4	15.5	59.9	17.4	63.3
20	12.4	54.3	11.7	53.1	11.4	52.5	12.6	54.7	13.6	56.5	15.3	59.5	17.2	63.0
21	11.9	53.4	11.1	52.0	11.1	52.0	12.3	54.1	13.5	56.3	15.0	59.0	17.1	62.8
22	11.8	53.2	10.8	51.4	10.8	51.4	11.8	53.2	13.4	56.1	14.7	58.5	17.0	62.8
23	11.7	53.1	10.6	51.1	10.5	50.9	11.2	52.2	13.2	55.8	14.5	58.1	16.8	62.2
24	11.2	52.2	10.5	50.9	10.5	50.9	11.0	51.8	13.1	55.6	14.2	57.6	16.7	62.1
Mean	12.4	54.3	11.4	52.5	11.2	52.2	12.0	53.6	13.7	56.7	15.1	59.2	17.3	63.1
Mean Min	9.0	48.2	7.9	46.2	8.5	47.3	8.5	47.3	11.5	52.7	12.5	54.5	15.3	59.5
Mean Max	15.6	60.1	14.4	57.9	13.5	56.3	14.9	58.8	15.9	60.6	17.4	63.3	19.2	66.6
Absolute Min	0.6	33.1	3.5	38.3	3.8	38.8	4.0	39.2	5.7	42.3	9.5	49.1	10.4	50.7
Absolute Max	26.5	79.7	19.7	67.5	17.3	63.1	19.7	67.5	19.9	67.8	20.3	68.5	23.2	73.8

a. Temperature measurement raised from 6.1 meters to 10 meters on October 25, 1975.

Table 2.3-6
TEMPERATURE SUMMARY FOR SAN ONOFRE SITE
LEVEL: 6.1/10 METERS[a] (Sheet 2 of 2)

Period of Record 1/25/74 - 1/24/76

Hour	August		September		October		November		December		Annual Averages	
	(°C)	(°F)	(°C)	(°F)	(°C)	(°F)	(°C)	(°F)	(°C)	(°F)	(°C)	(°F)
1	15.3	59.5	16.1	61.0	14.5	58.1	12.9	55.2	11.2	52.2	13.0	55.4
2	15.3	59.5	16.0	60.8	14.7	58.5	13.0	55.4	11.1	52.0	12.9	55.2
3	15.0	59.0	15.8	60.4	14.5	58.1	12.3	54.1	11.1	52.0	12.7	54.9
4	14.9	58.8	15.7	60.3	14.3	57.7	12.4	54.3	10.7	51.3	12.5	54.5
5	14.5	58.1	15.5	59.9	14.4	57.9	12.1	53.8	10.7	51.3	12.3	54.1
6	14.7	58.5	15.6	60.1	14.4	57.9	12.0	53.6	10.8	51.4	12.4	54.3
7	15.2	59.4	16.0	60.8	14.7	58.5	12.1	53.8	10.5	50.9	12.6	54.7
8	15.6	60.1	16.3	61.3	15.9	60.6	13.1	55.6	11.1	52.0	13.3	55.9
9	16.1	61.0	17.0	62.6	16.3	61.3	14.2	57.6	12.4	54.3	14.1	57.4
10	16.6	61.9	17.6	63.7	16.6	61.9	14.6	58.3	13.3	55.9	14.6	58.3
11	17.0	62.6	18.0	64.4	17.1	62.8	15.0	59.0	13.8	56.8	15.0	59.0
12	17.6	63.7	18.5	65.3	17.4	63.3	15.3	59.5	14.1	57.4	15.4	59.7
13	17.8	64.0	18.6	65.5	18.0	64.4	15.6	60.1	14.3	57.7	15.7	60.3
14	18.1	64.6	18.7	65.7	17.9	64.2	16.0	60.8	14.5	58.1	15.9	60.6
15	18.2	64.8	18.7	65.7	18.0	64.2	16.1	61.0	14.6	58.3	16.0	60.8
16	17.8	64.0	18.5	65.3	17.8	64.0	15.9	60.6	14.5	58.1	15.8	60.4
17	17.5	63.5	18.1	64.6	17.3	63.1	15.7	60.3	13.9	57.0	15.6	60.1
18	17.0	62.6	17.8	64.0	16.9	62.4	15.1	59.2	13.1	55.6	15.0	59.0
19	16.5	61.7	17.6	63.7	16.5	61.7	14.6	58.3	12.7	54.9	14.6	58.3
20	16.4	61.5	17.4	63.3	16.1	61.0	14.0	57.2	12.4	54.3	14.2	57.6
21	16.1	61.0	16.9	62.4	15.8	60.4	13.6	56.5	12.0	53.6	13.9	57.0
22	15.8	60.4	16.8	62.2	15.3	59.5	13.6	56.5	11.9	53.4	13.7	56.7
23	15.7	60.3	16.5	61.7	15.0	59.0	13.4	56.1	11.6	52.9	13.4	56.1
24	15.4	59.7	16.4	61.5	14.9	58.8	13.2	55.8	11.6	52.9	13.2	55.8
Mean	16.2	61.2	17.1	62.8	16.0	60.8	14.0	57.2	12.4	54.3	14.1	57.4
Mean Min	13.8	56.8	14.8	58.6	13.2	55.8	10.8	51.4	9.4	48.9	11.3	52.3
Mean Max	18.6	65.5	19.5	67.1	18.7	65.7	16.9	62.4	15.3	59.5	16.7	62.1
Absolute Min	8.0	46.4	10.1	50.2	9.2	48.6	5.4	41.7	4.6	40.3	0.6	33.1
Absolute Max	25.2	77.4	34.3	93.7	30.3	86.5	27.5	81.5	23.7	74.7	34.3	93.7

Question 010.47 (RSP)

Figure 1.2-12 of the FSAR shows a main steam and feedwater line valve room adjacent to the reactor building. For safety, we require the valve room be designed to withstand the environmental effects of a main steam or feedwater line break equivalent to the flow area of a single ended pipe rupture, e.g., by venting. In conjunction with the above, we require the applicant to provide a subcompartment pressure analysis to confirm that the valve room as designed will withstand the environmental effects of a break in this area. In addition we require the applicant to qualify any equipment including the main steam isolation valves and operators, located in the valve room and required for safe shutdown. Such equipment must be capable of operating in the resulting environment.

Response

The San Onofre 2&3 design provides two physically separated main steam and feedwater valve rooms per unit. FSAR figures 1.2-3 and 1.2-4 show this physical separation. Each of the main steam and feedwater valve rooms contain one train of main steam and feedwater piping. The only safety-related components in these rooms are the main feedwater isolation valves,
11 main steam isolation valves, main steam isolation bypass valves, auxiliary feedwater isolation valve, steam line safety-relief valves, and steam dump valves associated with the particular safety train in these rooms. The main steam and feedwater valve rooms have been designed and constructed to withstand the environmental effects of a main steam or feedwater line break in that room. The main steam line break is the limiting break. figures 010.47-1 through 010.47-5 show the main steam line break zones used to establish the building design. Vent areas and blowout panels in the building dissipate the blowdown energy. Safety-related components that are required for safe shutdown are being qualified to the environmental conditions resulting from the limiting pipe breaks described above.

The subcompartment pressure analysis of the valve rooms was performed using the Bechtel computer program, COPDA. This computer program is described in FSAR paragraph 6.2.1.2.3.1 item B. Nodalization of the north and south main steam and feedwater enclosure buildings is shown in figures 010.47-6 and 010.47-7, respectively. Detailed description of the nodalization for these structures, including vent paths, is contained in tables 010.47-1 through 010.47-4. The subcompartment nodalization models are determined by major physical flow restrictions within each structure. These restrictions include concrete obstructions, doorways, windows, grating, steam
11 piping, HVAC ducting, and steam piping restraints. Most vent paths between nodes can be modeled as orifices; some paths are more complex and have been evaluated using reference 5 (FSAR chapter 6.2). Venting from the roof and north walls of the valve rooms is via hinged steel doors, which are assumed to open fully and begin flowing at a pressure difference of 6 lb/in.^{2}. The loss coefficient for these doors is taken from reference 5 (FSAR chapter 6.2) for a vertically hung, top-hinged door open at a 90 degree angle to the wall.

Table 010.47-1
NORTH MSIV ROOM NODAL DESCRIPTION

Break Type: Single Area Main Steam Line Break
Break Location: Volume No. 1

Volume No.(a)	Description	Height (ft)	Horizontal Cross-Sectional Area (ft^2)	Net Free Volume (ft^3)	Initial Conditions			Calc. Peak Pressure Differential (lb/in.^{2})	Design	
					Temperature (°F)	Pressure (lb/in.^{2}a)	Humidity (%)		Peak Pressure Differential (lb/in.^{2})	Margin (%)
1	Safety building/enclosure building passageway below bottom of safety building ledge at el. 48'-6" and above floor at el. 30'-0"	18.5	233	3,960	120	14.7	50	21.8	35.8	64
2	South part of MSIV room between grating at el. 43'-0" and floor at el. 35'-10-1/2"; bounded on north by MSL center line	7.125	242	1,263	120	14.7	50	6.8	35.8	426
3	North part of MSIV room between grating at el. 43'-0" and floor at el. 35'-10-1/2"; bounded on south by MSL center line	7.125	346	1,331	120	14.7	50	6.6	35.8	442
4	MSIV enclosure room above grating at el. 43'-0" and bounded on top by roof at el. 61'-6"	18.5	588	9,780	120	14.7	50	6.4	15.3	139
5	Safety building/enclosure building passageway above top of safety building ledge at el. 50'-0" and below el. 61'-6"	11.5	237	2,194	120	14.7	50	3.9	15.3	292
6	FWIV room above grating at el. 43'-0" and below roof at el. 61'-6"	18.5	198	3,357	120	14.7	50	6.6	10.6	60
7	FWIV room below grating at el. 43'-0" and above floor at el. 30'-0"	13.0	186	2,309	120	14.7	50	7.4	10.6	43
8	FW tunnel below grating at el. 30'-0"	5.0	60	250	120	14.7	50	11.8	17.36	47
9	Atmospheric Reference Node	-	-	-	120	14.7	50	-	Conditions remain constant	

a. See figure 010.47-6

11

Table 010.47-2
NORTH MSIV ROOM VENT PATH DESCRIPTION

Break Type: Single area main steam line break
Break Location: Volume No. 1

Vent Path Number	Volume Node Number		Description of Vent Path Flow		Area (ft^2)	Length (ft)	Hydraulic Diameter (ft)	Head Loss, k					L/A (ft^{-1})
	From	To	Choked	Unchoked				Friction k, fl/d	Turning and Obstruction Loss, k	Expansion, k	Contraction, k	Total k	
1	1	2	X		34.5	-	-			Modeled as an orifice			0.40[b]
2	1	3	X		26.6	-	-			Modeled as an orifice			0.64[b]
3	1	4	X		85.1	-	-	-	0.78	1.0	-	1.78	0.080
4	1	5	X		17.7	-	-			Modeled as an orifice			0.065
5	1	6	X		13.1	-	-			Modeled as an orifice			0.053
6	1	7	X		56.8	-	-			Modeled as an orifice			0.053
7	1	8		X	29.5	-	-	-	0.22	1.0	-	1.22	0.093
8	1	9	X		194.3	-	-			Modeled as an orifice			0.24
9	2	3		X	50.6	-	-			Modeled as a nozzle			0.24
10	2	4		X	132.1	-	-	-	0.52	1.0	-	1.52	0.043
11	2	7		X	28.5	-	-			Modeled as an orifice			0.075
12	3	4		X	202.8	-	-	-	0.52	1.0	-	1.52	0.033
13	3	9		X	30.0	-	-			Modeled as an orifice			0.029
14	4	5		X	89.0	-	-			Modeled as an orifice			0.050
15	4	6		X	219.7	-	-			Modeled as an orifice			0.044
16	4	9		X	44.9	-	-			Modeled as an orifice			0.016
17[a]	4	9		X	345.8	-	-	-	-	-	-	2.6	0.019
18	5	6		X	15.6	-	-			Modeled as an orifice			0.055
19	5	9		X	276.0	-	-			Modeled as an orifice			0.094
20	6	7		X	92.9	-	-	-	0.33	1.0	-	1.33	0.080
21[a]	6	9		X	81.2	-	-	-	-	-	-	2.6	0.047
22	7	8		X	3.4	-	-			Modeled as an orifice			0.12
23	8	9		X	39.4	-	-	-	0.07	1.0	-	1.07	0.17

11

a. Hinged blowout door; assumed fully open and flowing at ΔP = 6 psi; total head loss k based on vertically hung, top hinged flap.

b. Complex flow path; conservative estimate of L/A based on minimum vent area. 11

Table 010.47-3
SOUTH MSIV ROOM NODAL DESCRIPTION

Break Type: Single Area Main Steam Line Break
Break Location: Volume No. 1

Volume No. (a)	Description	Height (ft)	Horizontal Cross-Sectional Area (ft^2)	Net Free Volume (ft^3)	Initial Conditions			Calc. Peak Pressure Differential ($lb/in.^2$)	Design	
					Temperature (°F)	Pressure ($lb/in.^2a$)	Humidity (%)		Peak Pressure Differential ($lb/in.^2$)	Margin (%)
1	Safety building/enclosure building passageway below bottom of safety building ledge at el. 49'-0" and above floor at el. 30'-6"	18.5	270	4,536	120	14.7	50	18.2	35.8	96
2	South part of MSIV room between grating at el. 43'-0" and floor at el. 35'-10-1/2"; bounded on north by MSL center line.	7.125	253	1,204	120	14.7	50	7.2	35.8	397
3	North part of MSIV room between grating at el. 43'-0" and floor at el. 35'-10-1/2"; bounded on south by MSL center line.	7.125	243	1,083	120	14.7	50	7.4	35.8	383
4	MSIV enclosure room above grating at el. 43'-0" and bounded on top by roof at el. 61'-6"	18.5	495	8,080	120	14.7	50	7.0	15.3	118
5	Safety building/enclosure building passageway above top of safety building ledge at el. 50'-6" and below el. 61'-6"	11.0	278	2,696	120	14.7	50	2.7	15.3	466
6	FWIV room above grating at el. 43'-0" and below roof at el. 61'-6"	18.5	258	4,555	120	14.7	50	7.1	10.6	49
7	FWIV room below grating at el. 43'-0" and above floor at el. 30'-0"	13.0	222	2,762	120	14.7	50	9.6	10.6	10
8	Atmospheric Reference Node	-	-	-	120	14.7	50	-	Conditions remain constant	

a. See figure 010.47-7.

Table 010.47-4
SOUTH MSIV ROOM VENT PATH DESCRIPTION

Break Type: Single area main steam line break
Break Location: Volume No. 1

Vent Path Number	Volume Node Number From	Volume Node Number To	Description of Vent Path Flow: Choked	Description of Vent Path Flow: Unchoked	Area (ft^2)	Length (ft)	Hydraulic Diameter (ft)	Head Loss, k: Friction k, fl/d	Head Loss, k: Turning and Obstruction Loss, k	Head Loss, k: Expansion, k	Head Loss, k: Contraction, k	Head Loss, k: Total k	L/A (ft^{-1})
1	1	2		X	8.9	–	–	Modeled as an orifice					2.08 (b)
2	1	3		X	11.8	–	–	Modeled as an orifice					1.57 (b)
3	1	4		X	54.7	–	–	–	0.85	1.0	–	1.85	0.145
4	1	5	X		32.4	–	–	Modeled as an orifice					0.059
5	1	6		X	81.0	–	–	Modeled as an orifice					0.089
6	1	7		X	151.7	–	–	Modeled as an orifice					0.104
7	1	8	X		242.0	–	–	Modeled as an orifice					0.01
8	2	3		X	49.5	–	–	Modeled as a nozzle					0.18
9	2	4		X	138.0	–	–	–	0.52	1.0	–	1.52	0.044
10	3	4		X	124.1	–	–	–	0.52	1.0	–	1.52	0.047
11	3	7		X	57.0	–	–	Modeled as an orifice					0.11
12	4	5		X	47.8	–	–	Modeled as an orifice					0.065
13	4	6		X	240.5	–	–	–	0.35	1.0	–	1.35	0.039
14	4	8		X	26.1	–	–	Modeled as an orifice					0.019
15 (a)	4	8		X	139.7	–	–	–	–	–	–	2.60	0.019
16	5	6		X	63.0	–	–	Modeled as an orifice					0.21
17	5	8		X	274.9	–	–	Modeled as an orifice					0.029
18	6	7		X	169.4	–	–	–	0.22	1.0	–	1.22	0.072
19	6	8		X	6.0	–	–	Modeled as an orifice					0.039
20 (a)	6	8		X	231.0	–	–	–	–	–	–	2.60	0.023
21	7	8		X	3.4	–	–	Modeled as an orifice					0.022

a. Hinged blowout door; assumed fully open and flowing at $\Delta P = 6$ lb/in.^{2}; total head loss k based on vertically hung, top hinged flap.

b. Complex flow path; conservative estimate of L/A based on minimum vent area.

Table 010.47-5
MASS AND ENERGY RELEASE RATES FOR MAIN STEAM AND FEEDWATER ISOLATION VALVE ROOM PEAK PRESSURE ANALYSIS[(a)]

Single area main steam line break outboard of MS forging and restraint Pipe I.D., 36.85 in. Break area, 7.406 ft^2			
Time (s)	Mass Release Rate (lb_m/s)	Enthalpy (Btu/lb_m)	Energy Release Rate (Btu/s)
0	13,782	1,192.9	16.441×10^6
0.098	13,782	1,192.9	16.441×10^6
0.098	15,242	1,192.9	18.182×10^6
0.740	15,242	1,192.9	18.182×10^6
0.740	34,868	705.0	24.583×10^6
1.008	34,868	705.0	24.583×10^6
1.008	47,990	568.6	27.287×10^6
10.0[(b)]	47,990	568.6	27.287×10^6

11

a. Calculated per ANSI N-176, Draft (January 1977) with minimum elapsed time to 4% quality blowdown condition (maximum mass and energy flowrate condition).

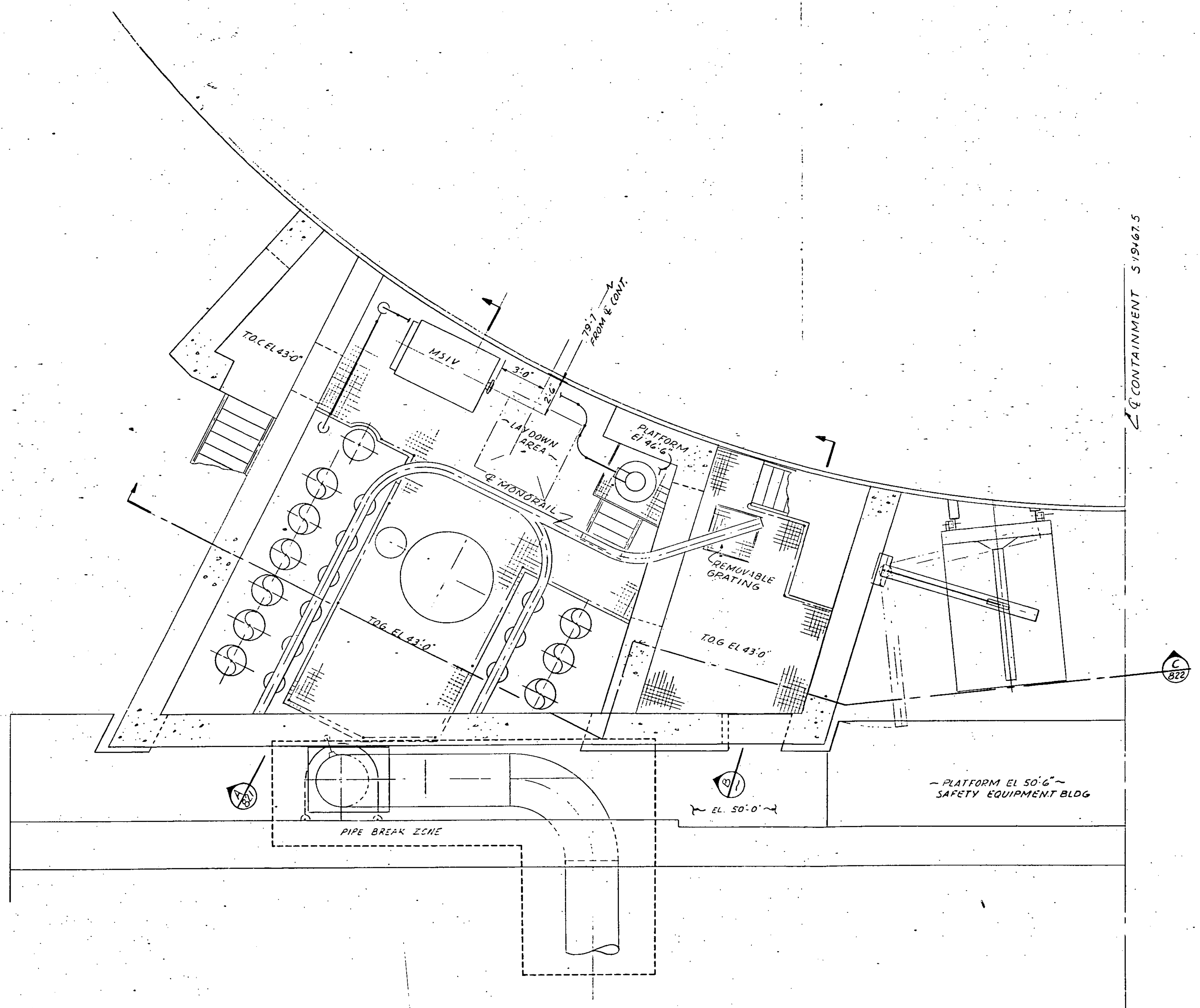
b. Arbitrary time for purpose of peak pressure analysis.

Table 010.47-5 presents the mass and energy flowrates for a single area rupture of the south main steam line outboard of the main steam restraint structure. The break flow was generated using the methodology of ANSI N-176 (Jan. 1977, Draft) and includes a minimum elapsed time to reach the maximum flow condition existing at 4% quality. The north and south main steam systems are sufficiently similar such that break flows calculated for the south main steam line can be used for a break of the north steam line. A single area rupture of a main feedwater line is not considered as severe an accident as a main steam line break due to the signifi-
11 cantly lower mass and energy flowrate estimated for a feed line break.

The results of the subcompartment analysis are presented graphically in figures 010.47-8 and 010.47-9 for the north enclosure building and in figures 010.47-10 and 010.47-11 for the south enclosure building. Calculated peak differential pressures between various subcompartments and the external atmosphere at 14.7 lb/in.^{2}a are shown on tables 010.47-1 (north) and 010.47-3 (south) together with design values and margin. Safety-related components required for safe shutdown are being qualified to the environmental conditions calculated to exist in the subcompartment containing the specific component in question.

Reference

See FSAR sections 3.6 and 6.2; figures 1.2-3, 1.2-4, and 010.47-1 through 010.47-11; and tables 010.47-1 through 010.47-5. No FSAR change was made.

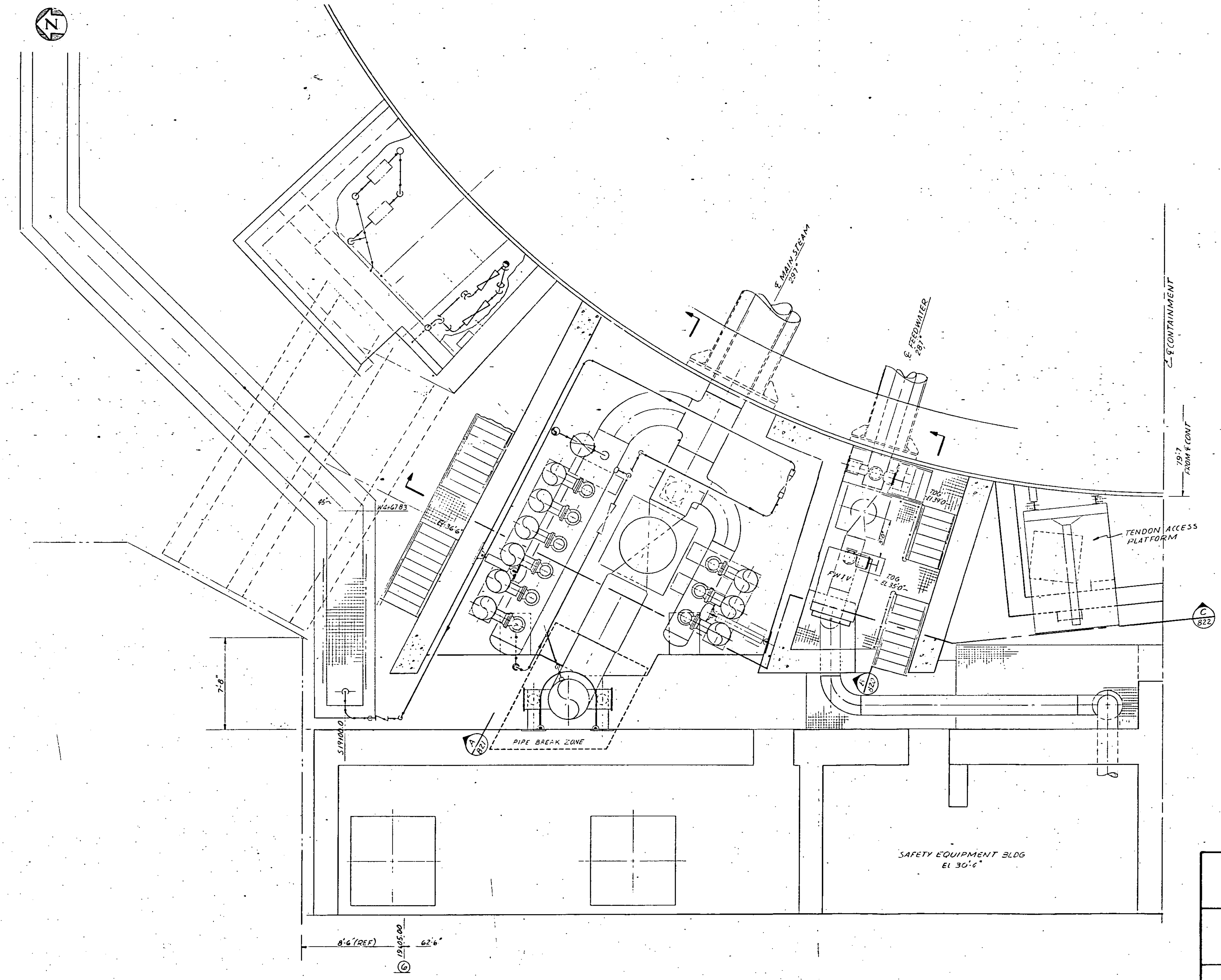


10079-12A-288
18JA8

SAN ONOFRE NUCLEAR GENERATING STATION Units 2 & 3

MAIN STEAM AND FEEDWATER ENCLOSURE (NORTH) PLAN & SECTION EL 43'-0" TO 61'-6"

Figure 010.47-1

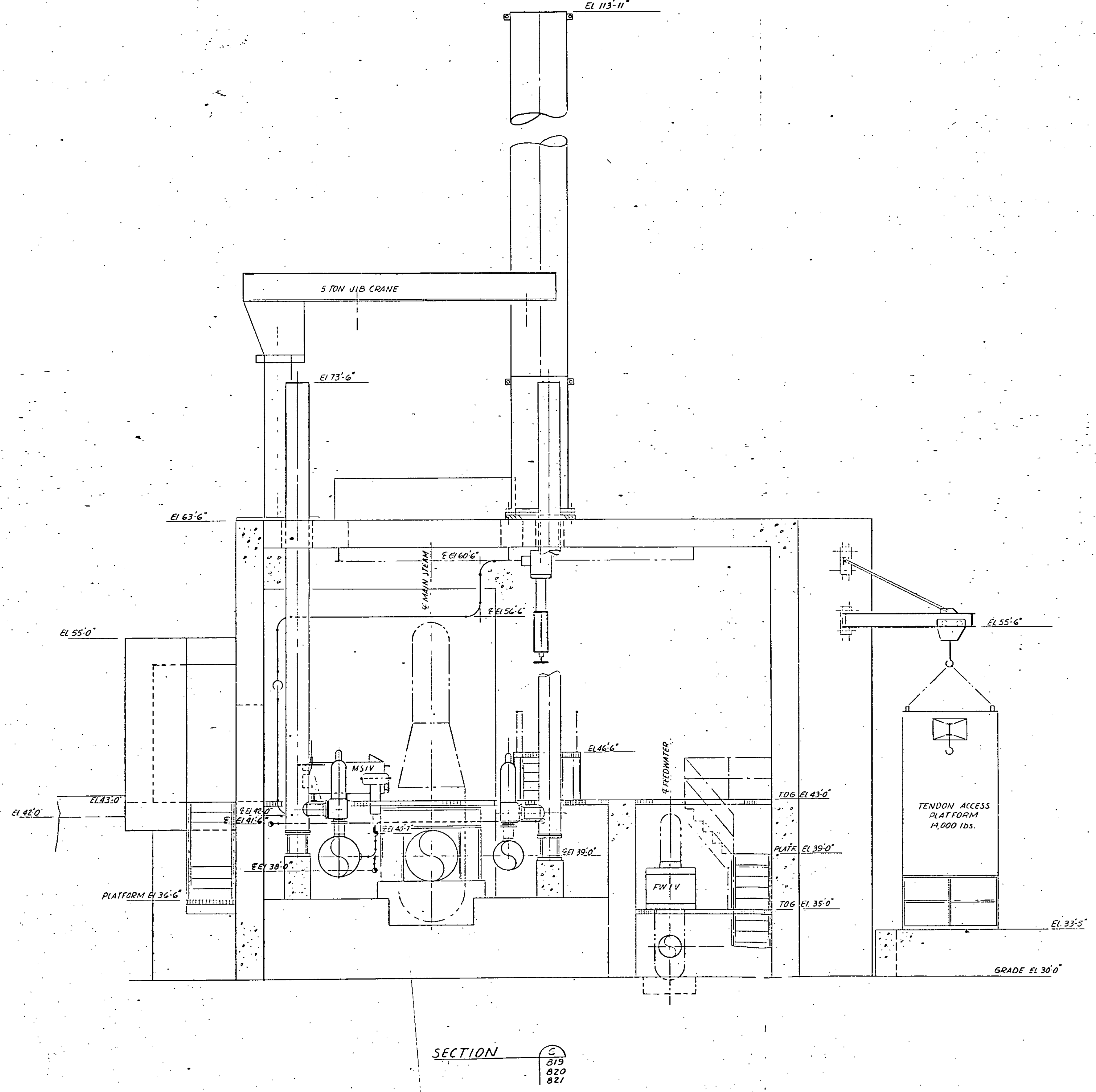


SAN ONOFRE
NUCLEAR GENERATING STATION
Units 2 & 3

MAIN STEAM AND FEEDWATER
ENCLOSURE (NORTH) PLAN
EL 30'-0" TO 43'-0"

Figure 010.47-2

10079-12A-289
18JA8

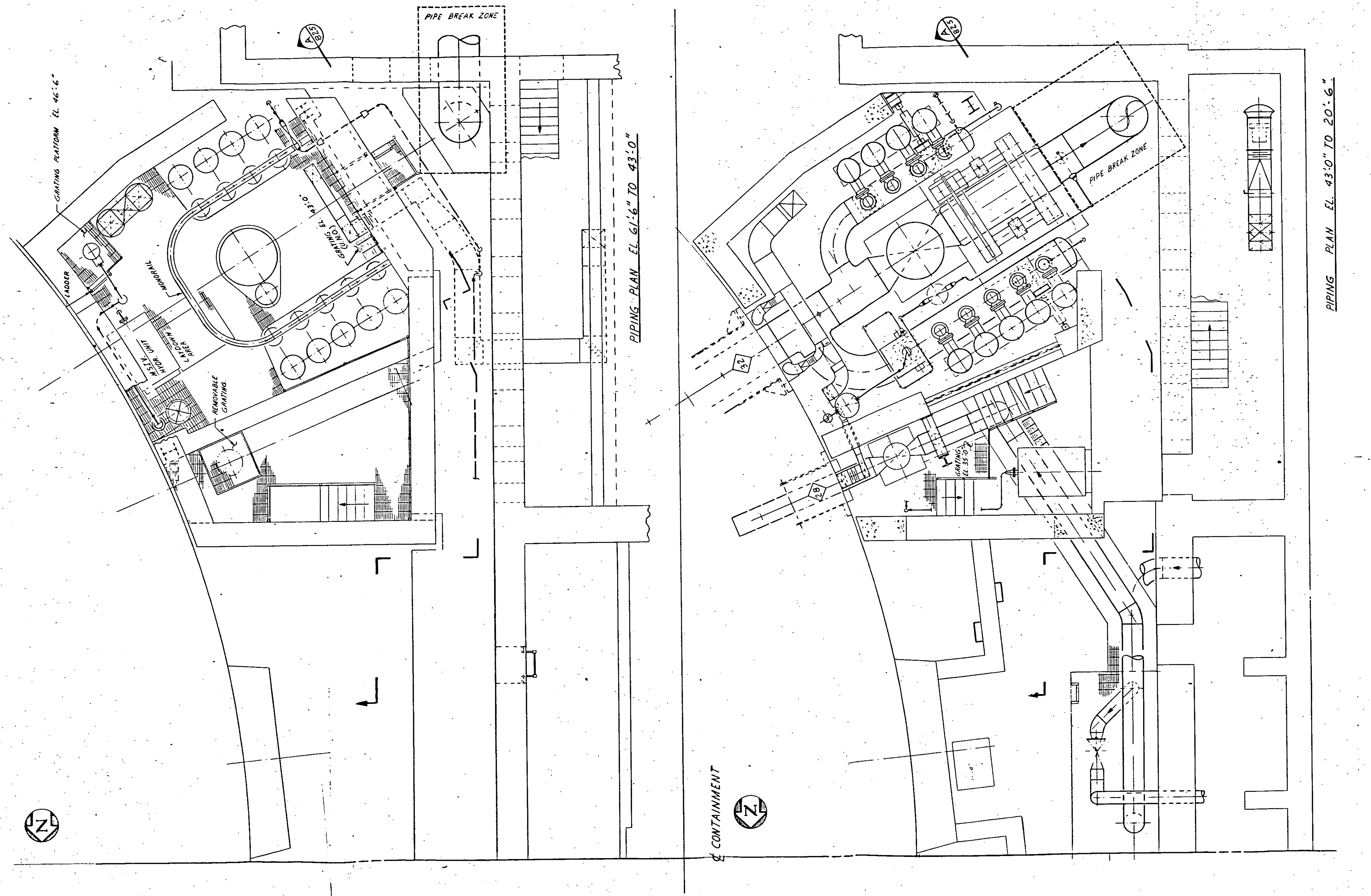


SAN ONOFRE
NUCLEAR GENERATING STATION
Units 2 & 3

MAIN STEAM AND FEEDWATER
ENCLOSURE (NORTH) SECTION
EL 30'-0" TO 113'-11"

Figure 010.47-3

10079-12A-290
18JA8



SAN ONOFRE
NUCLEAR GENERATING STATION
Units 2 & 3

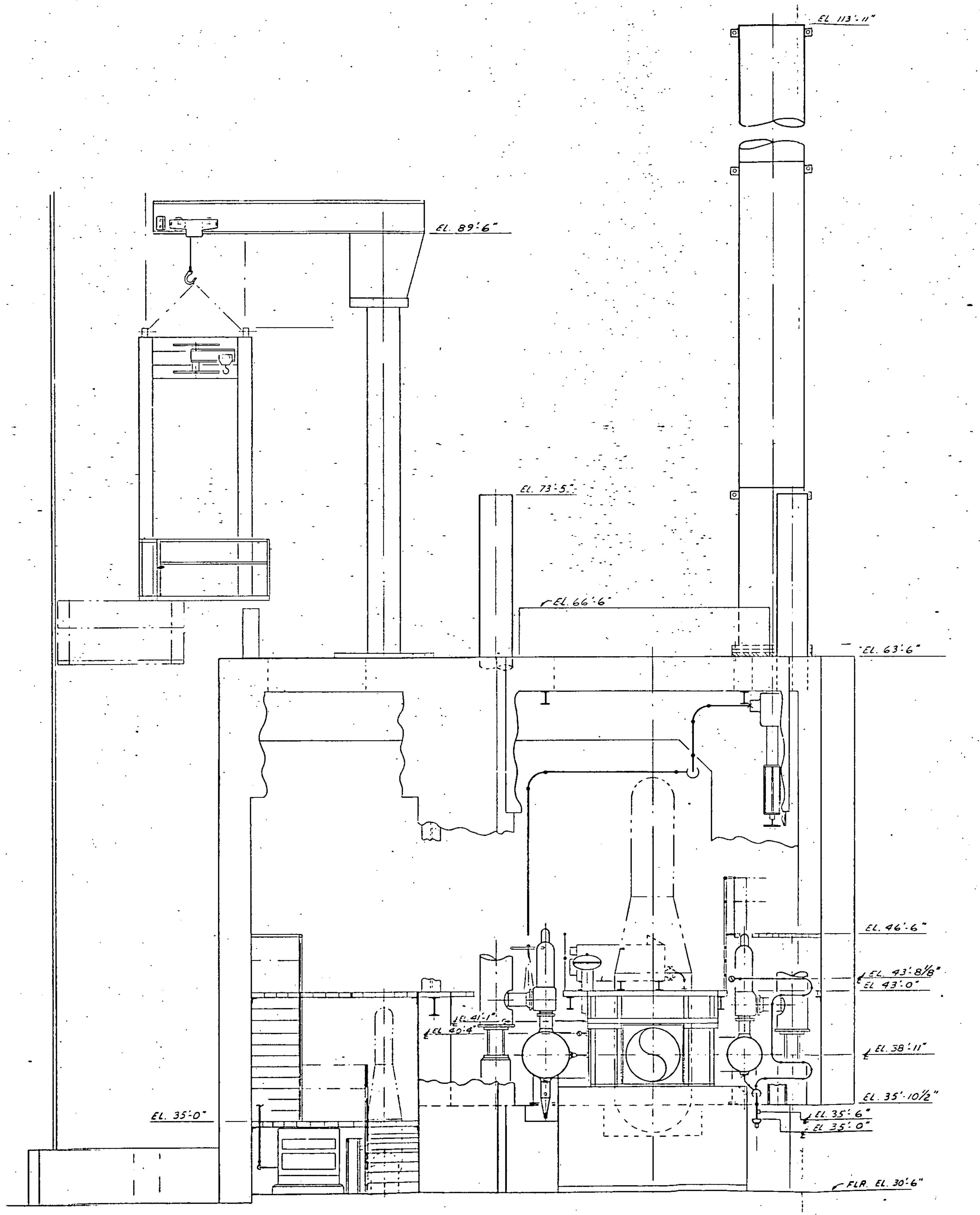
MAIN STEAM AND FEEDWATER
ENCLOSURE SOUTH.
EL 61'-6" TO 20'-6"

Figure 010.47-4

1/78 Amendment 6

10079-12A-292
18JA8

15



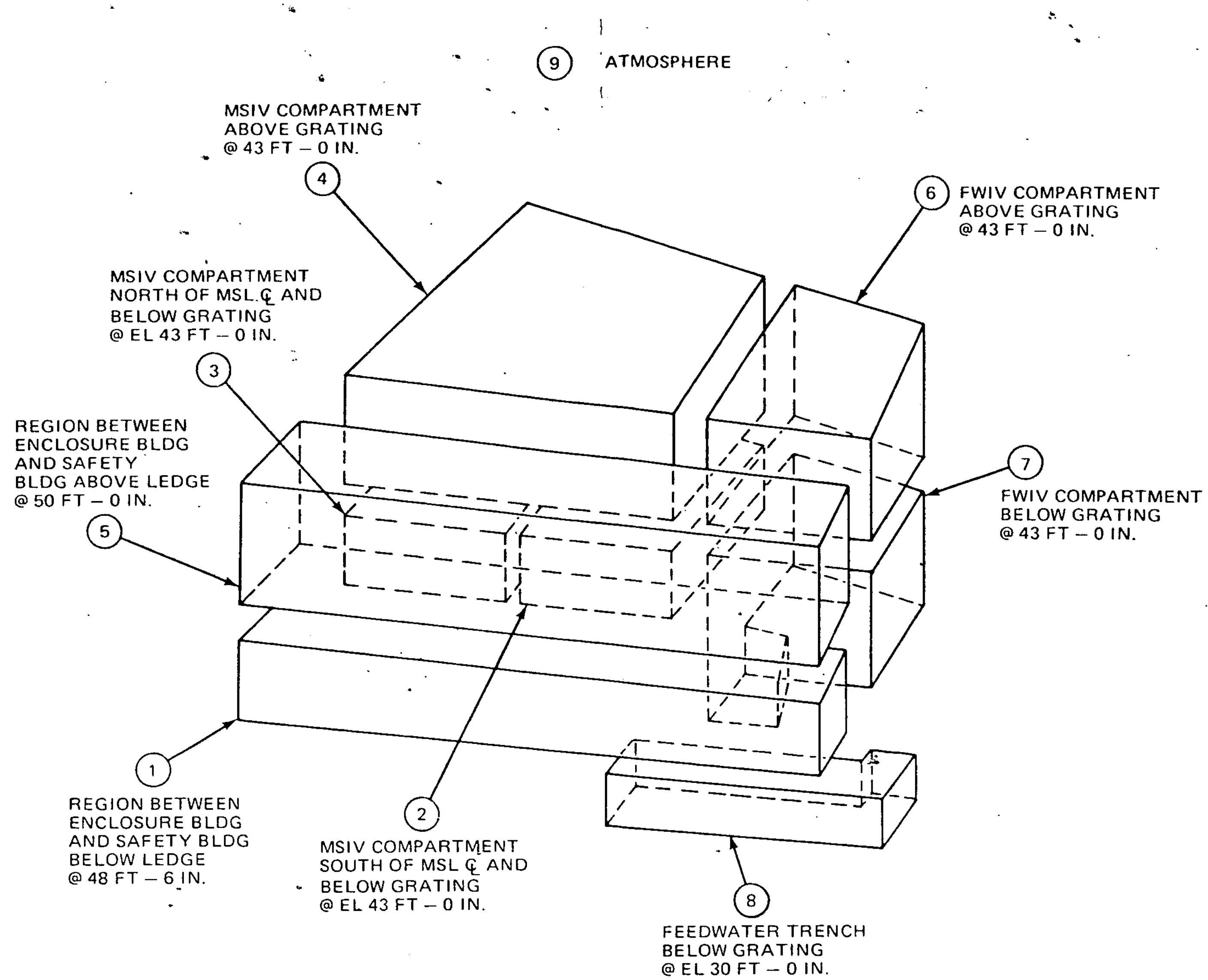
10079-12A-291
18JA8

SAN ONOFRE
NUCLEAR GENERATING STATION
Units 2 & 3

MAIN STEAM AND FEEDWATER
ENCLOSURE SECT. A

Figure 010.47-5

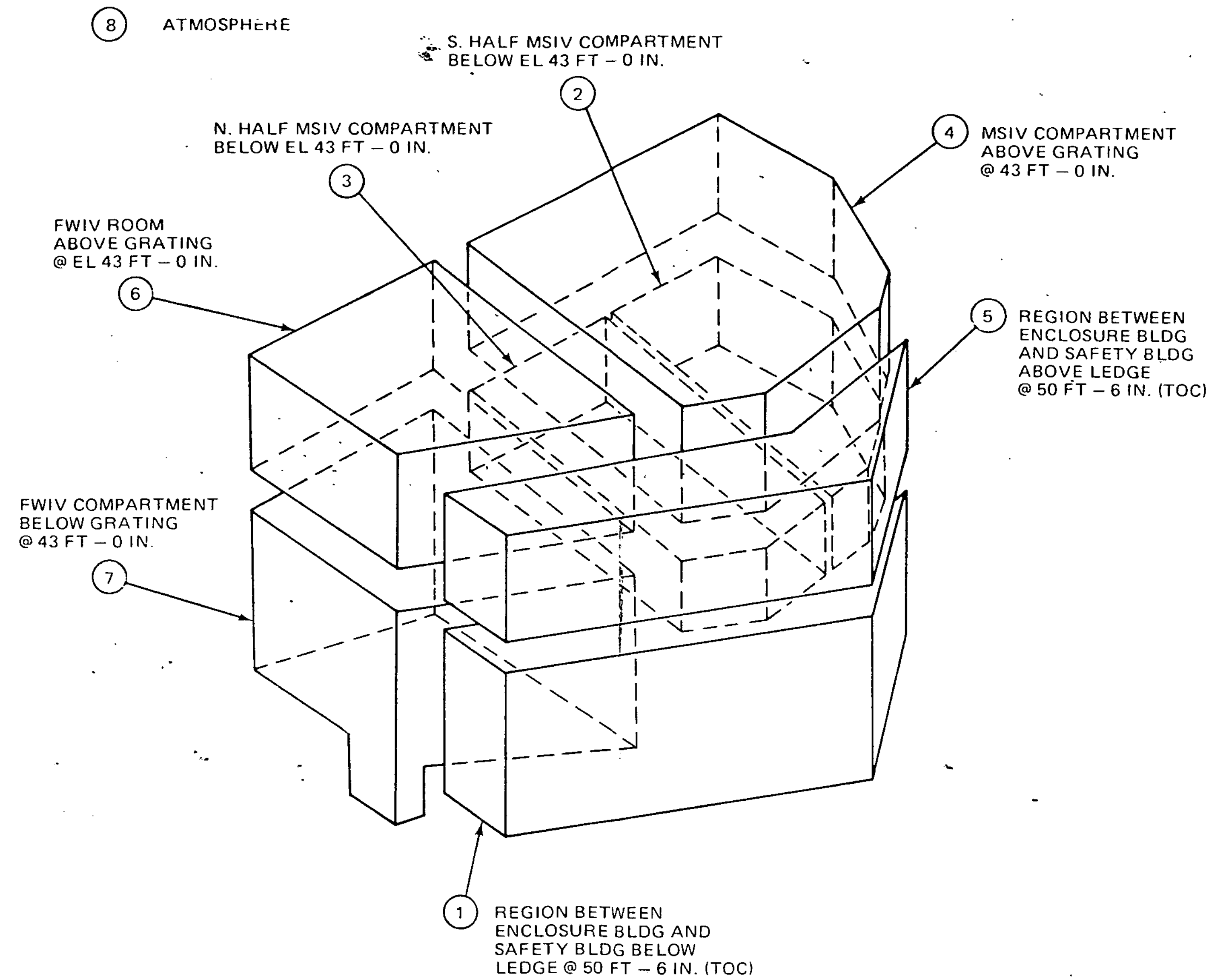
1/78 Amendment 6



10079-12A-475
21AU78

SAN ONOFRE NUCLEAR GENERATING STATION Units 2 & 3
NORTH ENCLOSURE BUILDING NODAL MODEL - MSL BREAK
Figure 010.47-6

17

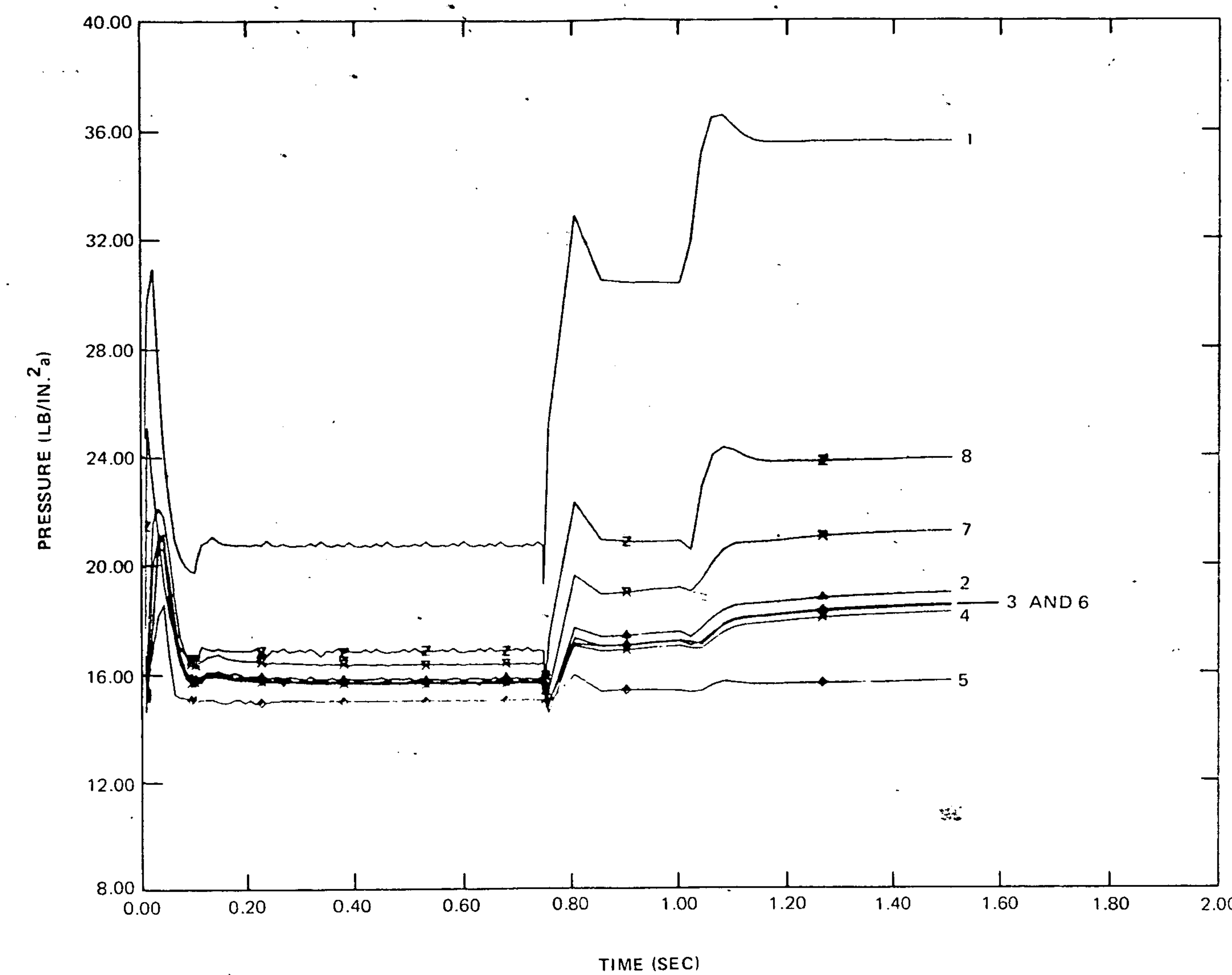


10079-12A-476
21AU78

SAN ONOFRE
NUCLEAR GENERATING STATION
Units 2 & 3

SOUTH ENCLOSURE BUILDING
NODAL MODEL - MSLB UNDER JET
IMPINGEMENT BARRIER

Figure 010.47-7



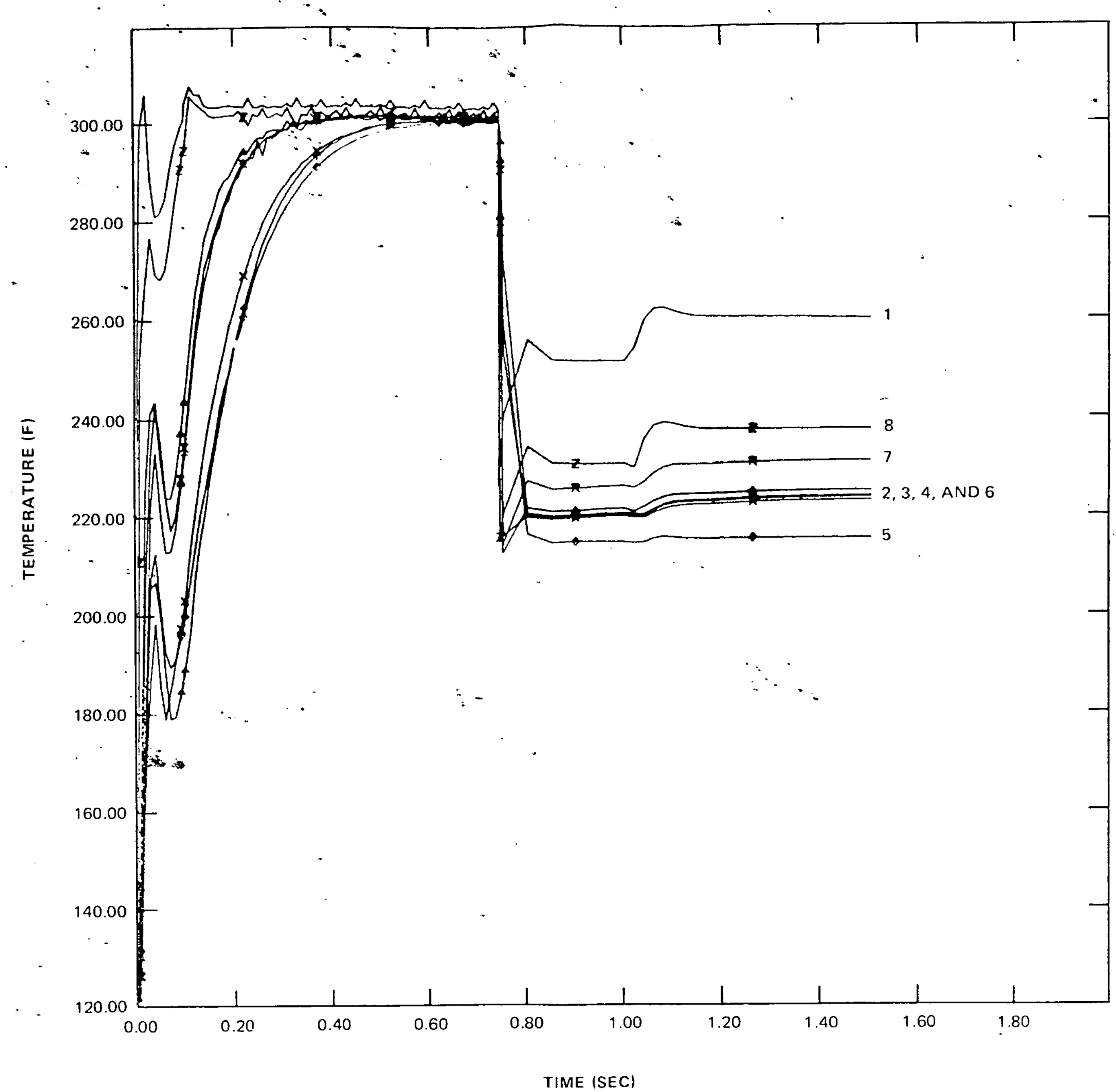
LEGEND:
COMPARTMENT 1 (BREAK COMP)
COMPARTMENT 2
COMPARTMENT 3
COMPARTMENT 4
COMPARTMENT 5
COMPARTMENT 6
COMPARTMENT 7
COMPARTMENT 8
COMPARTMENT 9

SAN ONOFRE
NUCLEAR GENERATING STATION
Units 2 & 3

SEMSLB OUTBOARD OF MSL
FORGING NORTH SIDE

Figure 010.47-8

10079-12A-477
21AU78



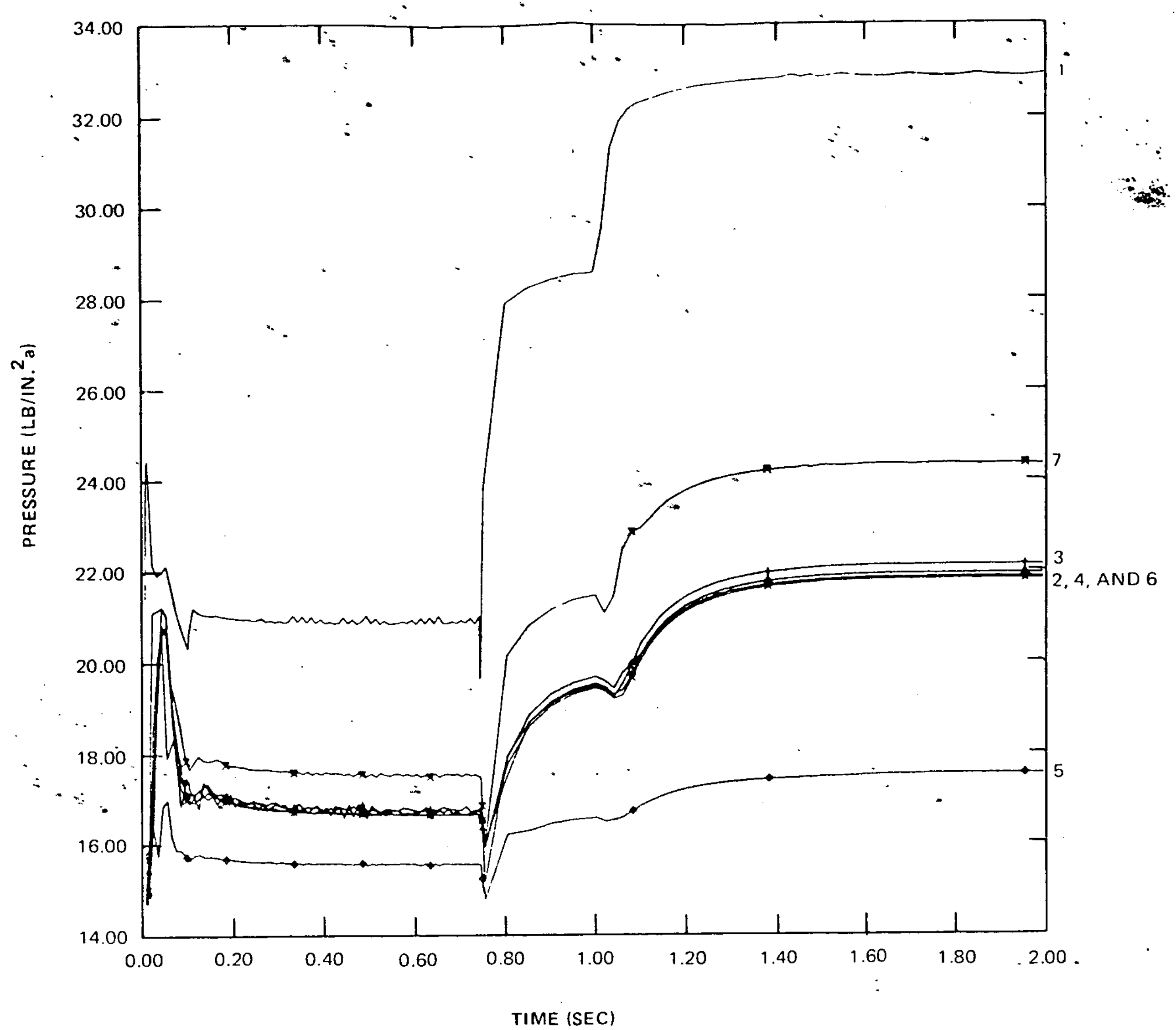
LEGEND:
TEMPERATURE 1
TEMPERATURE 2
TEMPERATURE 3
TEMPERATURE 4
TEMPERATURE 5
TEMPERATURE 6
TEMPERATURE 7
TEMPERATURE 8

10079-12A-478
21AU78

SAN ONOFRE
NUCLEAR GENERATING STATION
Units 2 & 3

SEMSLB OUTBOARD OF MSL
FORGING NORTH SIDE

Figure 010.47-9



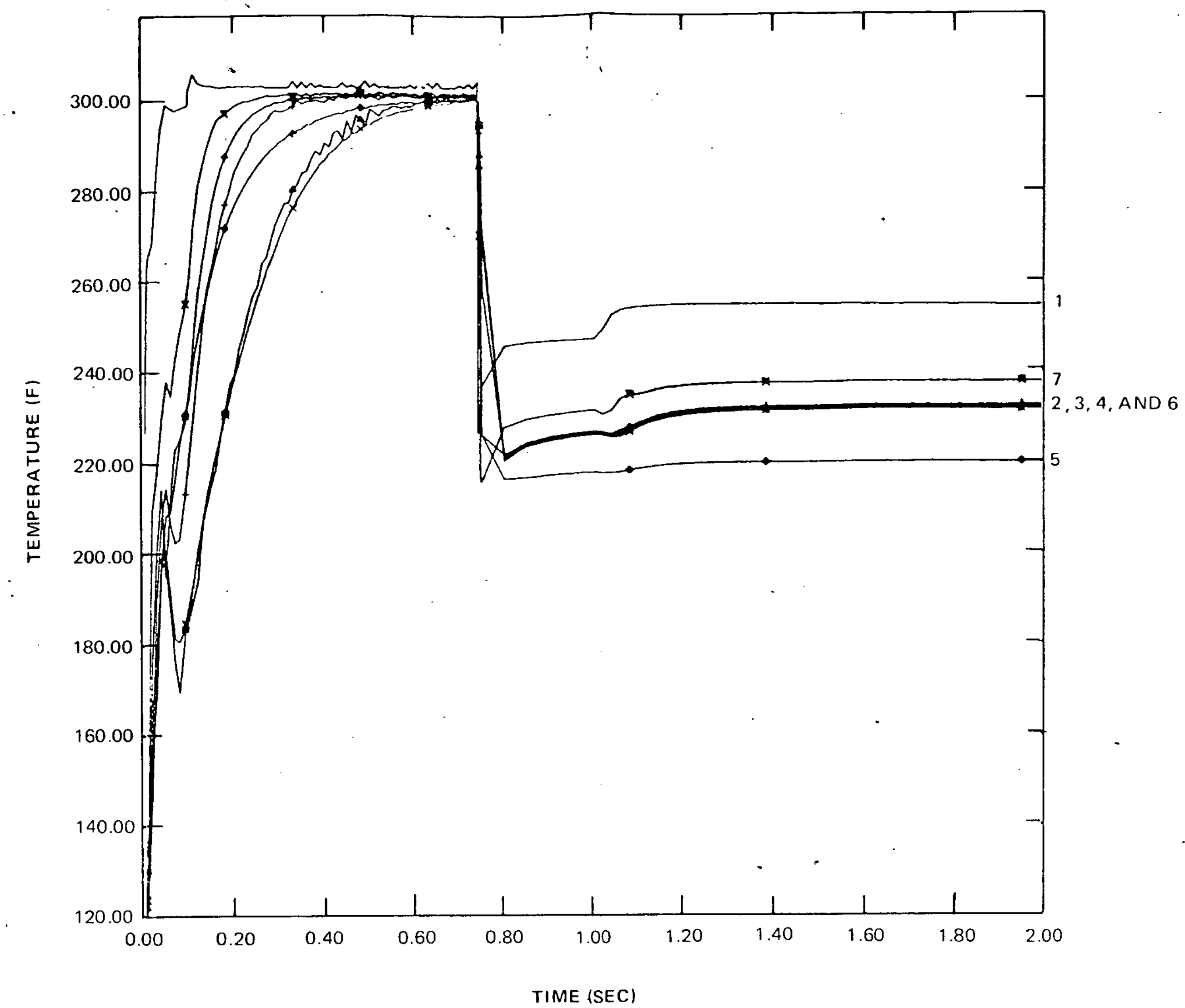
LEGEND:
COMPARTMENT 1 BREAK COMP.
COMPARTMENT 2
COMPARTMENT 3
COMPARTMENT 4
COMPARTMENT 5
COMPARTMENT 6
COMPARTMENT 7
COMPARTMENT 8

10079-12A-479
21AU78

SAN ONOFRE
NUCLEAR GENERATING STATION
Units 2 & 3

SEMSLB OUTBOARD OF FORGING
SOUTH SIDE

Figure 010.47-10



LEGEND:
TEMPERATURE 1
TEMPERATURE 2
TEMPERATURE 3
TEMPERATURE 4
TEMPERATURE 5
TEMPERATURE 6
TEMPERATURE 7

SAN ONOFRE
NUCLEAR GENERATING STATION
Units 2 & 3

SEMSLB OUTBOARD OF FORGING
SOUTH SIDE

Figure 010.47-11

10079-12A-480
21AU78

Table 6.2-1
POSTULATED ACCIDENTS FOR CONTAINMENT DESIGN (Sheet 3 of 3)

Containment Design Parameter	Postulated Accidents Considered
Peak pressure/temperature (cont)	
Subcompartment peak	Reactor Cavity
	100 $in.^2$ hot leg guillotine (HLG)
	350 $in.^2$ discharge leg guillotine (DLG)
	Steam generator compartment
	600 $in.^2$ HLG
	480 $in.^2$ DLG
	430 $in.^2$ suction leg guillotine (SLG)
	592 $in.^2$ SLG
	532 $in.^2$ suction leg slot (SLS)
	Pressurizer compartment
	161 $in.^2$ pressurizer surge line guillotine break
	19.6 $in.^2$ pressurizer spray line guillotine break
	21.2 $in.^2$ pressurizer relief line guillotine break
External pressure	Inadvertent operation of the containment heat removal systems
	Misoperation of the containment normal purging system

Table 6.2-2
CALCULATED VALUES FOR CONTAINMENT PRESSURE PARAMETERS

Parameter	Design Basis Accident[a]	Calculated Value
Peak pressure	102% power MSLB	55.7 $lb/in.^2g$
Peak subcompartment pressure	Reactor cavity	
	350 $in.^2$ DLG	92 $lb/in.^2d$
	Steam generator compartment	
	592 $in.^2$ SLG	20.6 $lb/in.^2d$
	Pressurizer compartment	
	592 $in.^2$ SLG	20.6 $lb/in.^2d$
External pressure	Inadvertent operation of the containment spray system	See figure 6.2-11
Minimum pressure	DEDLG	See figure 6.2-30

3-022.16

a. See table 6.2-1 for definition of abbreviations used.

Table 6.2-3
PRINCIPAL CONTAINMENT DESIGN PARAMETERS

Parameter	Value
Containment	
Internal design pressure, $lb/in.^2g$	60.0
Design temperature, ^oF	300
6-022.34 External design pressure, $lb/in.^2g$	5.0
Net free volume, 10^6 ft^3	
minimum	2.305
maximum	2.366
Design leak rate, percent free volume per day at 60.0 $lb/in.^2g$	0.1
Subcompartments	
Reactor cavity design wall loading, $lb/in.^2$	228.9
Steam generator compartment design wall loading, $lb/in.^2$	28.8
Pressurizer compartment design wall loading, $lb/in.^2$	28.8

Question 032.5

Reference is made to Combustion Engineering Topical Report, CENPD-212 for the environmental qualification of the Class IE instrumentation and control equipment in the NSSS scope of supply.

This topical report is dated May 1977 and has not been submitted to the NRC staff for review.

In order to avoid any delay in the scheduled review of San Onofre, all the information pertaining to the environmental qualification of Class 1E instrumentation and control in NSSS scope should be provided on this docket for staff review consistent with the San Onofre schedule. Therefore, provide this requested information.

Response

The information required for the Staff to review the environmental qualification of Class 1E instrumentation and control equipment in the NSSS scope of supply is contained in CEN-100(S)[b] and CEN-95(S)[a] and submitted to NRC in September 1978. 13

Reference

See revised FSAR sections 1.6, 3.11, and 7.1.

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a. "Environmental Qualification Data for NSSS-Supplied Instrumentation Equipment," Combustion Engineering, Inc., CEN-95(S), July 1978.

b. "Program for Environmental Qualification of NSSS-Supplied Instrumentation Equipment," Combustion Engineering, Inc., CEN-100(S), August 1978. 13

Question 032.6

With regard to the seismic and environmental qualification of the Class IE instrumentation and control equipment in the balance of plant scope, the staff requires the following qualification test program information along with the results of the tests:

a. Equipment Design specifications
b. Test Plan
c. Test set up
d. Test procedures and
e. Acceptability goals and requirements.

This information shall be provided for at least one item in each of the following groups of Class IE instrumentation and control equipment.

a. Transmitters
b. Logic equipment

Response

Qualification Test Program documents for the auxiliary feedwater flow indicating transmitters and the airborne radiation monitoring system logic equipment have been submitted to the NRC as indicated in table 1.8-6.

a. Auxiliary Feedwater Flow Indicator Transmitters (Foxboro E13DM)

The environmental qualification requirements called out in the specification (Section 4.6.2 of S023-504-1) are completely enveloped by the generic, post-LOCA environmental tests conducted by Foxboro (T3-1013, T3-1013 (Supplementary), and T3-1097).

Seismic qualification requirements are set forth in Section 4.6.4 of S023-504-1. Acceptability goals and requirements are set forth in Appendix 4F of S023-504-1. The seismic test plan, test setup, test procedure and results are presented in T3-1091.

b. Logic Equipment

The airborne radiation monitoring system logic equipment is located in three panels in the control room - Unit 2 cabinet 2L103, Unit 3 cabinet 3L103, and common cabinet 2/3L104. Seismic qualification is being conducted in accordance with test procedure SP-501 and specification S023-606-1 (provided as indicated in table 1.8-6). This complies with
11 section 3.10 of the FSAR. The seismic test results and an analysis of those results are presented in TDR-42478.

The airborne radiation monitoring system logic equipment is designed to remain functional after exposure to both normal and DBE environmental conditions. As can be seen in FSAR table 3-11-1, item B-4, these environmental conditions are essentially benign and are identical for both normal and accident conditions. The logic cabinets installed in San Onofre 2 and 3 are similar to those cabinets supplied for previous nuclear power plants (Millstone 2, Zion, and Brunswick) and have many years of operating history. As discussed in FSAR paragraphs 3.11.2.1 and 3.11.2.2, listing H, such equipment is not retested. A discussion of the environmental control capability of the control room and of the qualification of control room equipment is provided in FSAR paragraph 3.11.2.4.

Reference

See revised FSAR table 1.8-6 and paragraphs 3.11.2.1; 3.11.2.2, listing H; and 3.11.2.4. 11

Question 032.25

With regard to the plant protection system failure mode and effects analysis, address the following items:

a. IEEE 352-1972, Section 4.13, "Preparatory Steps for Failure Mode and Effect Analysis," lists as an essential step the "Description of the environmental conditions." This area is critical because the environment can be the source of common mode failure causes. Therefore, describe the environmental conditions (including noise) which have been considered in the system design, and describe the effects of failures under extreme environmental conditions.

b. On sheet 39 of the FMEA, there is a bistable relay contact (Normally open, assumed fails open) for which it is stated that the method of detection is a "Bench test." Since failure of this relay cannot be detected by the routine periodic testing of the system discuss the consequences of this undetected failure and then another single failure (worst case), occurring simultaneously in the protection system.

c. For the FMEA, there are entries which conclude that spurious actuation of equipment will occur. For such entries confirm that the results of such spurious actuation are acceptable.

Response

a. The environmental conditions that have been considered in the system design are described in CENPD-148, Review of Reactor Shutdown System for Common Mode Failure Susceptibility, and CENPD-212, Environmental Qualification of C-E Instrumentation Equipment. CENPD-212 describes the environmental conditions to which the equipment was qualified.

The equipment was qualified by test to its normal and extreme environmental conditions, thus addressing the environment as a source of common mode failure. The effects of a failure under extreme environmental conditions are the same as those addressed in the FMEA.

b. The referenced failure is the failure of the bistable relay contact for one parameter in one channel (parameter 1, channel A assumed to be typical). The failure mode, normally open contact fails open, results in the AB matrix being in the half tripped state for parameter 1. This failure mode is not considered credible. Even if this failure were to occur, its effect on the plant protection system under normal operating conditions would be in the safe direction. Furthermore, failure of 9
this relay coincident with the existence of an independent single failure (RAS or EFAS) in conjunction with a design basis event, which requires the actuation of RAS and/or EFAS, would be even less credible. Assuming that Channel D is bypassed for all parameters, the worst single failure that could occur in conjunction with the referenced failure is the failure of the bistable relay for parameter 1 in

channels B or C, in the untrippable state. Given either of these two failures, the trip logic for parameter 1 becomes 2-out-of-2 (channel A and channel C) given failure of the B bistable, or 1-out-of-2 selective or 2-out-of-2 given failure of the C bistable. In both cases, the reactor is still trippable given the referenced failure and the single failure. Therefore, the plant protection system still meets the single failure criterion given the referenced failure.

The failure of the bistable relay in the untrippable state for parameter 1 in either channel B or channel C is detectable by periodic PPS testing.

c. There are 22 entries in the FMEA which conclude that spurious actuation of equipment will occur. These entries are:

Sheet 40; entry 1, entry 3
Sheet 42; entry 1, entry 3
Sheet 43; entry 1
Sheet 91; entry 7
Sheet 92; entry 4, entry 5, entry 6
Sheet 93; entry 3
Sheet 105; entry 3*
Sheet 106; entry 1*
Sheet 107; entry 2*, entry 4*
Sheet 108; entry 2*, entry 4*
Sheet 109; entry 2*, entry 4*
Sheet 110; entry 1*, entry 3*
Sheet 111; entry 3*
Sheet 112; entry 2*

The first five entries above require multiple failure of redundant components before spurious actuation of equipment will occur. The starred entries above conclude that spurious actuation of certain equipment in specific safety systems will occur given the failure of a component in the actuation logic in the auxiliary relay cabinet for specific ESFAS actuation signals (i.e., SIAS, CSAS, CIAS, CCAS, RAS, or EFAS).

The five entries on sheets 91, 92 and 93 are specific component failure modes for components within a typical actuation logic "module" which would result in spurious equipment actuation in a "typical" safety system. These five entries provide a more detailed breakdown of failure modes applicable to the starred entries.

The spurious equipment actuations that can result from a single component failure are limited to a valve or group of valves in one train of a safety system, or one pump or a group of pumps in one train of a safety system. All spurious equipment actuations are detectable by alarm and/or visual indications. Actuated equipment can be returned to its normal state by the operator. In no case can a single component failure cause the spurious actuation of an entire safety system or an entire train of a safety system.

The spurious actuation of a valve or group of valves in one train of a safety system will not result in actuation of that train because the pump or pumps associated with the train will not be actuated. The train will also still be isolated from the operating system by a check valve. The spurious actuation of a pump or group of pumps in one train of a safety system will not result in actuation of that train because the valve or valves associated with that train will not be actuated. All pumps in the safety systems have recirculation lines with normally open valves that will prevent pump damage due to dead-heading.

Reference

Section 7.2. No FSAR change was made.

Question 032.28

Regarding the information presented for environmental qualification, provide the following information:

1) Include the specific manufacturer's model number for the non-NSSS equipment of Table 3.11A-1.

2) Provide a list, in the San Onofre docket, of manufacturer, model number and function for the specific NSSS equipment to be qualified per topical report CENPD-212.

Response

1) FSAR table 3.11A-1 has been expanded to include the specific manufacturers model number for the non-NSSS equipment.

2) The requested information is provided in CEN-95(S)[a] with the exception of that equipment for which Data Sheets are not yet available. 13

Table 032.28-1 provides the requested information for that equipment which is not presently described in CEN-95(S). This information, along with a test summary, will be included on individual Data Sheets which will be submitted to the NRC on the dates shown in table 032.28-1. 13

Reference

See revised FSAR table 3.11A-1.

a. "Environmental Qualification Data for NSSS-Supplied Instrumentation Equipment," Combustion Engineering, Inc., CEN-95(S), July 1978. 13

Table 032.28-1
NSSS EQUIPMENT TO BE QUALIFIED PER CEN-100(S) (Sheet 1 of 3)

Equipment	Manufacturer	Model No.	Function	Data Sheet No.	CEN-95(S) Data Sheet Transmittal to NRC
Auxiliary Protective Cabinet	Reliance Electric Co.	N/A	Houses components for Plant Protection System and Remote Input for the Plant Computer	2	December 1978
Incore Amplifiers	Electro-Mechanics	N/A	Amplifies signal from in-core detectors to useful level	2k	December 1978
Process Instrument Rack	Foxboro	2ES-N	Provides support for process electronics modules	6	December 1978
Controller	Foxboro	2AC-D+A5+RM	Receives external signals and and produces output changes as a function of the difference of these signals	6a	December 1978
Current to Voltage Converter	Foxboro	2AI-12V	Converts an input current signal to an output voltage signal	6b	December 1978
Resistance to Voltage Converter	Foxboro	2AI-P2V	Provides an output voltage proportional to sensed input	6c	December 1978
Square Root Extractor	Foxboro	2AP+SQ	Provides an output proportional to the square root of the input signal	6e	December 1978

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Table 032.28-1
NSSS EQUIPMENT TO BE QUALIFIED PER CEN-100(S) (Sheet 2 of 3)

Equipment	Manufacturer	Model No.	Function	Data Sheet No.	CEN-95(S) Data Sheet Transmittal to NRC
Contact Isolator	Foxboro	2AO-L2C-R	Used as an interface between low level signal and a high power load	6g	December 1978
Signal Distribution Module	Foxboro	2AX-DSI	Provide terminals for termination of signal connections, simplifying wiring between components	6L	December 1978
Indicators	Sigma	9270	Indication	108	December 1978
Indicators	Sigma	1136	Indication	109	December 1978
Controller	Foxboro	250	Provides indication of setpoint output and measurement valves and controls for adjustment of setpoint and output	110	December 1978
Recorder	Foxboro	226	Indicates value of process variable and records same on strip chart	111	December 1978

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Table 032.28-1
NSSS EQUIPMENT TO BE QUALIFIED PER CEN-100(S) (Sheet 3 of 3)

Equipment	Manufacturer	Model No.	Function	Data Sheet No.	CEN-95(S) Data Sheet Transmittal to NRC
Magnetic Flow Detector	Foxboro	2800	Provides electrical output signal proportional to fluid flow rate thru tube	212	December 1978
Containment Purge Isolation Transmitter	Nuclear Measurements Corp.	N/A	Isolate containment purge system due to LOCA or fuel handling accident	215	December 1978

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Question 032.29

With respect to the response to question 032.6 on the BOP equipment qualification provide the following additional information:

a) Regarding the transmitter qualifications:

(1) Explain how the transmitter specification clearly defines the location of the equipment involved for determination of the appropriate environmental and seismic input parameters.

(2) The specification refers to certain environmental conditions such as dust, sand, etc. Explain how these conditions are factored into the qualification.

(3) Describe what component parts (ex. connections, cabling, mounting, power supply) if any, were part of the total equipment qualification by tests/analyses (both environmental and seismic). For any such component parts that were not part of the total qualification by tests/analyses, provide assurance that each such part was separately qualified under equivalent tests/analyses.

(4) Explain how the transmitter test set ups (including mounting and connections) were determined to be fully representative of the actual transmitter installations.

(5) It appears that the only acceptance goal is the requirement that there be "no loss of function." It is necessary that the acceptance criteria for equipment such as transmitters be more precisely defined. Therefore, describe the specific functional requirements for this transmitter as part of the acceptance goals. Furthermore, explain how the test results demonstrate that these goals were satisfied.

(6) Justify the assumption that the test conditions do envelope the design basis conditions for the transmitter. Include the basis for the sequence of the simulated environmental conditions.

b) Regarding the logic equipment qualification:

(1) The use of previous operating experience and history can be acceptable (per IEEE 323-1971) for environmental qualification, however, the information must be complete especially with regard to service conditions and equipment performance and presented in an auditable form.

Therefore provide this information as outlined in Section 5.3 of IEEE 323-1971.

c) Regarding qualification in general:

(1) Provide a discussion of how the acceptance goals for the various types of instrumentation and control equipment are established and then where these goals are specified, for the qualification tests to be performed.

(2) For equipment inside containment, list any connectors, or other means of connection used in the instrumentation and control systems and provide the associated qualification information.

(3) The Foxboro test report (T3-10103) contains information on transmitter model number E11GH. Indicate whether or not it is utilized in the safety related system of SONGS. If it is, provide the information on its application for SONGS and the acceptance requirements.

(4) Provide a summary of the temperature qualification of the safety related instrumentation and control equipment in all areas of the plant outside the containment.

This summary should include:

(a) The plant location under consideration (e.g. the room and building)

(b) The type of instrumentation and control equipment located in the area, (e.g. transmitter and controller)

(c) The ventilation provided for the area.

(d) The temperature extremes postulated for the area and equipment (including consideration of loss of forced ventilation, if applicable) and any temperature monitoring instrumentation in such areas.

(e) The equipment temperature qualification limits.

(f) The list of supporting qualification documentation for the equipment (e.g. test reports and industry standards)

(5) Specify the requirements which are imposed upon the test equipment with respect to periodic calibration against known standards.

Response

a) Regarding the transmitter qualifications:

(1) The location of the transmitter is defined on the data sheets in the notes entitled "Equipment Requirements ..." as described in sections 4.6.2.3 and 4.11 of specification S023-504-1, which is listed in FSAR table 1.8-6. In the case of the auxiliary feedwater to steam generator flow transmitter, the specified location was turbine plant (actual location is tank building).

(2) Foxboro transmitters Model E13DM are provided with NEMA Type 4 enclosures to protect against the effect of sand, dust, dirt, salt air, and humidity as specified in section 4.6.2 of S023-504-1. Temperature requirements were factored into the environmental qualification of the transmitter as documented in Foxboro test reports T3-1013 and T6-0020AT, which are also listed in revised FSAR table 1.8-6.

(3) The transmitter, including the junction box was seismically tested as a unit as documented in Foxboro test report T3-1091. No power supply integral with the transmitter is used. The connector and junction box assembly were environmentally qualified separately from the transmitter as documented in Foxboro test report T3-1013.

(4) Instrument installation details drawings (mounting plates) were prepared to define the mounting for safety-related transmitters in the same position they were tested. In addition, actual instrument installation drawings are reviewed to ensure proper mounting and connections.

(5) Foxboro seismic and environmental tests are generic tests intended to qualify the transmitters for various applications. Accordingly the criteria for acceptable performance are not included in the test reports.

San Onofre 2 and 3 acceptance criteria are specified in section 4.7.6 of S023-504-1.

The test results were reviewed to ensure that these acceptance criteria were met.

(6) The auxiliary feedwater flow transmitters are located outside of the containment in the tank building and accordingly are not exposed to LOCA or MSLB environments. The Foxboro generic test results referenced above qualified the transmitter for a LOCA environment and as such enveloped the less severe environmental parameters present at the transmitter location.

Since the transmitter is not exposed to an accident environment, radiation, or chemical sprays, for which it is required to function, no test sequences were specified for these conditions.

b) Regarding the logic equipment qualification:

(1) The logic equipment being supplied for the radiation monitors has a history of successful operation in nuclear power plants. This operating history is detailed in table 032.29-1. In addition, the logic equipment is being environmentally qualified by test to meet the requirements of IEEE 323-1971. The test procedure (ENV-8805) is listed in revised FSAR table 1.8-6 and is being forwarded for review. This combination of operating experience and testing ensures that the radiation monitoring logic equipment meets the intent of IEEE 323-1971.

Operating History:

The CRM-70 series of counting ratemeters was designed and developed for application at Zion Nuclear Power Station, Units 1 and 2, Commonwealth Edison Company, Zion, Illinois. Since the delivery of these units, design evolution has resulted in the improved electronics being supplied for San Onofre Units 2 and 3. In each case listed below, the discrete circuits of each system are essentially identical, and the function of each circuit is identical to the earlier Zion system. Because of this similarity, the accumulated operating history is indicative of operating performance.

Systems are listed in the order of their delivery date. Spare parts order dates are listed with the realization that ordering a spare does not indicate a failure.

Table 032.29-1
LOGIC EQUIPMENT OPERATING HISTORY

Plant	Shipping Date	Spare Parts Ordered	Repairs Ordered
Commonwealth Edison Zion Station	1/72	8/73, 10/73, 12/76, 1/77	9/73, 2/74, 1/75
Northern States Power Prairie Island Station	6/72	9/73	7/73, 11/73
Nebraska Public Power Cooper Station	10/72	6/74	None
Northeast Utilities Milstone Station	4/74	9/75	7/74, 10/76
Caroline Power & Light Brunswick Station	9/74	3/76	None
Yankee Atomic Yankee Rowe	12/74	None	None

c) Regarding qualification in general:

(1) A discussion of how the seismic qualification acceptance goals were established for the various types of instrumentation and control equipment is provided in FSAR section 3.10. The criteria for the acceptable methods and procedures to achieve these goals in the seismic qualification of instrumentation and control equipment is delineated in the equipment specification. With respect to seismic qualification, the information contained in FSAR appendix 3.10A parallels that included in the equipment specification. A discussion of how the environmental qualification acceptance goals were established is provided in FSAR section 3.11. The environmental design criteria for San Onofre Units 2 and 3 conforms to 10CFR50, Appendix A, General Design Criterion 4, Environmental and Missile Design Bases. The electrical systems and components required to mitigate the consequences of a DBA, or to attain a safe shutdown of the reactor, are designed and qualified to assure that they will remain functional after exposure to the environmental conditions anticipated following the specific DBA which they are intended to mitigate. As with seismic qualification goals, the equipment specification is the mechanism used to specify environmental qualification goals.

(2) Inside the containment, the Class 1E electrical equipment and devices in the balance-of-plant instrumentation and control system are connected to the field cables using splices, electrical connector assemblies, and terminal blocks.

The connection means employed at the containment electrical penetration assemblies inside the containment are discussed in the response to the NRC Question 040.51.

Splices are used for all Class 1E connections where electrical connector assemblies or terminal blocks are not employed. The splices are made up of AMP termination lugs and Raychem Thermofit Type WCSF-N or MCK-N heat-shrinkable sleeves, which are the same splicing materials used in the connection methods discussed in response for NRC Question 040.51. The qualification environment and the supportive documentation for the qualification of the splicing material is also addressed in the same response. 13

The majority of the Class 1E electrical connector assemblies is located within the reactor head area and are utilized for quick and easy removal and reinstallation of cable assemblies during refueling. The electrical connector assemblies (i.e., both the mating connectors and their associated cabling) will be qualified in accordance with the operability requirements of the instrumentation and control system that uses

the electrical connector assemblies. The qualification environment is discussed in table 032.29-1A. The supportive documentation for the qualification will be provided upon completion of testing in an amendment to the FSAR by approximately March 1979.

Terminal blocks are used only where supplied by the vendor within their device mounted enclosures. Conventional terminal type connections are utilized employing AMP terminals. Qualification of the terminal block connection is performed
13 by the vendor as part of the qualification of the device.

Interface with the vendor-furnished equipment or devices is in accordance with the manufacturer's instruction and is coordinated with the vendor to be consistent with the method of interface used by the vendor for the environmental qualification testing of the equipment or device.

Table 032.29-1A summarizes the environmental qualification testing of the different connection means used to connect the balance-of-plant Class 1E equipment or device to the field cables inside the containment.

(3) Transmitter model number E11GH, which is referred to in the Foxboro test report T3-10103, is not used in the non-NSSS safety-related systems for San Onofre Units 2 and 3. Considering that the Foxboro test report T3-10103 contained information on more than one transmitter, confusion may have arisen concerning which transmitters were safety related.

(4) Table 032.29-2 provides a summary of the temperature qualification of safety-related instrumentation and control equipment in areas of the plant outside containment. This tabulation includes the building and area under consideration, the type of instrumentation and control equipment, the ventilation provided for the area, postulated temperature extremes, temperate monitoring equipment within the area, if applicable, the temperature qualification limits of the equipment and supporting documentation for the equipment that has completed temperature qualification.

(5) The quality program requirements for vendors of Quality Class II equipment are included in the equipment specification. With respect to periodic calibration of test equipment against known standards, the specification has required that tools, gauges, instruments, and other measuring and testing devices shall be routinely maintained and calibrated on a planned basis. Additionally, it is required that, calibration be performed at established intervals against valid standards having a known relationship to rational

standards. This requirement is imposed by requiring the Quality Class II vendors to have a quality assurance program in accordance with 10CFR50 Appendix B.

References

FSAR sections 3.10 and 3.11. See revised FSAR table 1.8-6.

Table 032.29-1A

ENVIRONMENTAL QUALIFICATION TESTING SUMMARY FOR THE DIFFERENT ELECTRICAL CONNECTION METHODS EMPLOYED IN CLASS 1E I AND C SYSTEM EQUIPMENT OR DEVICES LOCATED INSIDE CONTAINMENT (Sheet 1 of 2)

Physical Electrical Interface Points						
Methods	Components (Manufacturer and Model No.)	Qualification Environment	Documentation	Termination Area	Equipment or Device	Remarks
Splice	Termination Lugs (AMP Inc. - PIDG or Solistrand)	See section 3.11	AMP test reports ELR-186-10/S-174, GPR-575-98, and GPR-575-99 document that components are qualified for intended service.	Intermediate termination boxes remote from device or equipment, or termination boxes within device or equipment and penetrations.	Transmitters, valves	
	Heat-Shrinkable Sleeves (RAYCHEM - Type WCSF-N)	See section 3.11	Franklin Institute report F-C4033-3 documents that equipment is qualified for intended service.	Intermediate termination boxes remote from device or equipment, or termination boxes within device or equipment and penetrations.	Transmitters, valves	
	(RAYCHEM-Type MCK-N)	See section 3.11	Test results expected in December, 1978.	Intermediate termination boxes remote from device or equipment, or termination boxes within device or equipment and penetrations.	Transmitters, valves	
Electrical connector assembly	Plug and socket					
	Gulton PNT106-12-10S-TC4-F2-H3-HR Bendix 85-524691-28P, 85-523552-28P, 85-523552-28S, 85-523531-14P, 85-523549-1P	Pressure = 69 lb/in.^{2}g Temperature = 90C Radiation = 1×10^8 Rads Total 40 Yr. Humidity = 100%	Test of completed electrical connector assembly due in March 1979.	Reactor head area and local bulkheads.	Fixed in-core detector instrumentation.	This instrumentation is not required for post-accident monitoring and is qualified in accordance with its operability requirements.
	Pyle-National, NS2-B1712-6165-F-A242, NS2-S1012-616P-20010G-A242				Reed switch position transmitter	This instrumentation is not required for post-accident monitoring and is qualified in accordance with its operability requirements.
	Bendix, 10-560556,275 BT02MA-20-27R					

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Table 032.29-1A

ENVIRONMENTAL QUALIFICATION TESTING SUMMARY FOR THE DIFFERENT ELECTRICAL CONNECTION METHODS EMPLOYED IN CLASS 1E I AND C SYSTEM EQUIPMENT OR DEVICES LOCATED INSIDE CONTAINMENT (Sheet 2 of 2)

Physical Electrical Interface Points						
Methods	Components (Manufacturer) and Model No.)	Qualification Environment	Documentation	Termination Area	Equipment or Device	Remarks
Electrical connector assembly (cont)	Pyle-National NS1-1712-648, Amphenol, Plug-18250 coax Socket-34500 coax	See section 3.11	Test results expected in January 1979.	Electrical penetration assembly inboard termination boxes.	Area radiation monitor containment purge isolation sensors and ex-core detector instrumentation pre-amplifiers.	
Terminal blocks for equipment in column (6)	Supplied by vendor with device.	See section 3.11	Franklin Institute report F-C3834 documents that equipment is qualified for intended service.	Termination boxes within device.	Containment emergency sumps level transmitters and thermocouple elements.	All terminal blocks supplied with devices have been tested with the device.

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Table 032.29-2
TEMPERATURE QUALIFICATION SUMMARY OF SAFETY-RELATED INSTRUMENTATION AND CONTROL EQUIPMENT LOCATED OUTSIDE CONTAINMENT (Sheet 1 of 2)

Location (Building and Room)	Instrument/ Control Equipment Type	Area Ventilation	Area Postulated Temperature Extremes (^{o}F)	Area Temperature Monitoring Instrumentation	Equipment Temperature Qualification Limits (^{o}F)	Supporting Qualification Documentation
Auxiliary Building/ Evacuation Shutdown Panel Room	Switches	Air conditioning	50-95	None	34-145	Master Specialties Test Report 058-1191-77
	Controllers				40-120	Foxboro Test Report Pending
Auxiliary Building/ Control Room Cabinet Area	Converters (L-188)	Air conditioning	70-85	Indicator, TI-9719 (Non-1E) on L-154 in control room cabinet area	40-122	Foxboro Test Reports T5-0030AT(1/V) T5-0027AT(MV/V)
Auxiliary Building/ Control Room	Switches	Heating, ventilation, and air conditioning	70-75	Indicator, TI-9701 (Non-1E) on L-154 in control room cabinet area. Sensor located in HVAC discharge ducts	34-145	Master Specialties Test Report 058-1191-77
	Recorders (FR-4720-1, TR-9903-1)				40-120	Foxboro Test Report Pending
	Controllers (HIC-8419A1 HIC-8421A2)				40-120	Foxboro Test Report Pending
	Indicators				32-131	Sigma Test Report QCTR-103

a. After this equipment has performed its safety function and initiated a FHIS, the temperature extremes may be 36F-150F.

Table 032.29-2
TEMPERATURE QUALIFICATION SUMMARY OF SAFETY-RELATED INSTRUMENTATION
AND CONTROL EQUIPMENT LOCATED OUTSIDE CONTAINMENT (Sheet 2 of 2)

Location (Building and Room)	Instrument/ Control Equipment Type	Area Ventilation	Area Postulated Temperature Extremes (^{o}F)	Area Temperature Monitoring Instrumentation	Equipment Temperature Qualification Limits (^{o}F)	Supporting Qualification Documentation
Auxiliary Building/ Control Room (Continued)	Radiation Monitor (Recorder, Sensor, Transmitter, Switches, Indicator, Motor)	Heating, ventilation, and air conditioning	70-75	Indicator, TI-9701 (Non-1E) on L-154 in control room cabinet area. Sensor located in HVAC discharge ducts	40-120	NMC Test Report Pending
Tank Building/ Pump Room	Transmitters (FIT-4720-1, FIT-4725-2)	Ventilation, space heaters	50-104	None	30-180	Foxboro Test Report T6-0020AT
Fuel Handling Building/Fuel	Radiation Monitor (Recorder, Sensor, Transmitter, Switches, Indicator, Motor)	Heating, ventilation, and air conditioning	45-104 [(a)]	None	40-120	NMC Test Report Pending
Containment Exterior Wall	ERMS Radiation Sensor	N/A	Refer to FSAR Paragraph 2.3.2.3	None	40-120	NMC Test Report Pending

Question 040.50

With regard to the seismic and environmental qualification of the Class 1E power system equipment in the balance of plant scope, the staff requires the following qualification test program information along with the results of the tests:

a. Equipment design specification
b. Test plan
c. Test set up
d. Test procedures
e. Acceptability goals and requirements

This information shall be required for at least one item in each of the following groups of Class 1E power systems equipment.

a. Switchgear
b. Motor control centers
c. Value operators
d. Motors
e. Cables
f. Diesel generator control equipment

Response

FSAR table 1.8-6 has been revised to reflect the submittal of equipment specifications and qualification test reports relevant to at least one item in each group of the Class 1E power system equipment delineated above. Table 040.50-1 references the equipment specification and test report of at least one item of the Class 1E power system equipment listed above to determine the following information:

a. Equipment design specification
b. Test plan
c. Test setup
d. Test procedures
e. Acceptability goals and requirements

An additional discussion, directed at qualification in general for instrumentation and control equipment, but applicable to the qualification of all safety-related equipment, is provided in the response to question 032.29.

Reference

See revised FSAR table 1.8-6.

Table 040.50-1
CROSS REFERENCE OF SELECTED CLASS 1E POWER SYSTEM EQUIPMENT
TO DESIGN SPECIFICATIONS AND RELATED QUALIFICATION INFORMATION (Sheet 1 of 2)

Class 1E Equipment	Equipment Design Specification	Test Plan	Test Setup	Test Procedures	Acceptability Goals and Requirements
480 Volt AC Switchgear	S023-302-3	ITE Report S0713-51220 (a)	ITE Report S0713-51220 (a)	ITE Report S0713-51220 (a)	Specification S023-302-3
480 Volt AC Motor Control Centers	S023-302-4	Square D Report 43220-1 (a)	Square D Report 43220-1 (a)	Square D Report 43220-1 (a)	Specification S023-302-4
Valve Operators	S023-507-2	S023-507-2-1-410-2 Limitorque Corporation Test Report Summary	S023-507-2-1-410-2 Limitorque Corporation Test Report Summary	S023-507-2-1-410-2 Limitorque Corporation Test Report Summary	Specification S023-507-2
Containment Dome Circulating Fan Motor	S023-410-2	Joy Report X-604, NPX-65829	Joy Report X-604, NPX-65829	Joy Report X-604, NPX-65829	Specification S023-410-2

a. In consideration of the design environmental conditions contained in FSAR table 3.11-1 for some of the Class 1E equipment identified in FSAR 3.11-2, special environment qualification tests to verify operability are not required. Certification for this equipment is based on proven operability in similar environments in industrial and previous nuclear power plant applications.

b. This report is provided for additional information.

Table 040.50-1

CROSS REFERENCE OF SELECTED CLASS 1E POWER SYSTEM EQUIPMENT
TO DESIGN SPECIFICATIONS AND RELATED QUALIFICATION INFORMATION (Sheet 2 of 2)

Class 1E Equipment	Equipment Design Specification	Test Plan	Test Setup	Test Procedures	Acceptability Goals and Requirements
Diesel Generator Control Equipment	S023-403-12	S023-403-12-134-0 S023-403-12-127-0 S023-403-12-126 (b)	S023-403-12-134-0 S023-403-12-127-0 S023-403-12-126 (b)	S023-403-12-134 S023-403-12-127 S023-403-12-126 (b)	Specification S023-403-12
600 Volt Power Cables	S023-403-11	Franklin Institute Test Reports F-C3913-1A, F-C3913-2A, and F-C3913-3A	Franklin Institute Test Reports F-C3913-1A, F-C3913-2A, and F-C3913-3A	Franklin Institute Test Reports F-C3913-1A, F-C3913-2A, and F-C3913-3A	Specification S-23-304-11

Question 040.51

Provide a description of the physical arrangement utilitized in your design to connect the field cables inside containment to the containment penetrations, e.g. connectors, splices, or terminal blocks. Provide supportive documentation that these physical interfaces are qualified to withstand a LOCA or steam line break environment.

Response

The field cables inside the containment are connected to the containment electrical penetration assemblies, utilizing electrical connector assemblies, terminal blocks and splices. The connections are made inside the electrical penetration assembly termination boxes.

Westinghouse, the supplier of the electrical penetration assemblies, will
qualify the electrical connector assemblies used for Class 1E service to
13 the LOCA and MSLB environment, to satisfy the electrical connector assem-
blies' operability requirements. The qualification environment is describ-
ed in FSAR section 3.11. Supportive documentation for the qualification
15 will be provided in an amendment to the FSAR by approximately July 1979.

The splices used for Class 1E service inside the containment electrical
penetration assembly termination boxes are made up of termination lugs and
Raychem Thermofit Type WCSF-N and MCK-N heat-shrinkable sleeves. The termi-
13 nation lugs and Type WCSF-N heat-shrinkable sleeves are qualified to with-
stand a LOCA or MSLB environment. The qualification environment is describ-
ed in FSAR section 3.11. The supportive documentation for the qualification
is included in revised FSAR table 3.11A-1.

The Raychem Type MCK-N heat-shrinkable sleeves are being environmentally
qualified. The supportive documentation for the qualification will be pro-
15 vided in an amendment to the FSAR by approximately July 1979. This product,
however, uses material similar to that used in Raychem Thermofit WCSF-N,
13 which is an indication that it will also pass the environmental qualifica-
tion tests.

Reference

FSAR section 3.11. See revised FSAR table 3.11A-1.

Question 040.52

The FSAR states that all non-NSSS cables meet the requirements of IEEE Std 383. Provide documentation as to the qualification of the NSSS cables.

Response

All NSSS cables, at a minimum, meet the flame test requirements of IEEE Standard 383-1974.

Reference

See revised FSAR paragraph 8.3.3.1

8.3.3 FIRE PROTECTION FOR CABLE SYSTEMS

8.3.3.1 Cable Derating and Cable Tray Fill

11 The base ampacities for all power cables, other than the CEDM power cables and pressurizer heater pigtail cables, were established in accordance with manufacturers' recommendations, IPCEA publications P-54-440 and P-46-426 or IEEE 70-TP557-PWR, Ampacities for Cables in Randomly Filled Trays, by J. Stolpe. The criteria used for the CEDM power cables and pressurizer heater pigtail cables is the 1975 edition of the National Electric Code. These power cables are routed in a separate raceway system.

As a minimum, all power cables were selected using a 100% load factor with all cables fully loaded and 90C conductor temperature. Correction factors for ambient temperature other than 40C were incorporated in accordance with IPCEA publication P-54-440. The correction factors are listed in table 3.11-6 in subsection 3.11.4.

9-040.52 All cable insulations installed in trays are required to pass the flame test specified in IEEE 383-1974.

11 In general, power cables supplied from load centers, cables with sizes 4/0 ANG and larger, and all feeder sizes in voltages above the 600V-ac operating level are designed for single-layer power cable installation with maintained spacing. For cable derating purposes, a maintained spacing equal to or greater than one-fourth the effective cable diameter is generally used. However, certain other maintained spaced cables may have ampacity ratings based on installation at greater than one effective cable diameter.

All other power cables from loadcenters (except those indicated above), motor control centers, panels, etc. are, in general, routed on a random-fill basis to 30% fill by cross-sectional area of the 3-5/8-inch loading depth for ventilated and solid-bottom trays.

Trays containing both power and control cables are considered as containing only power cables.

Trays containing only control cables or instrument cables are designed for 30% maximum fill by cross-sectional area of any standard depth tray used.
11 The designs are exceeded only after engineering evaluation proves that the actual cable fill does not protrude above the side rails of the tray at any point of a given cross-section.

Conduit fill is in compliance with the provisions of chapter 9 of the National Electrical Code, 1975.

8.3.3.2 Fire Detection for Cable Systems

Smoke and/or fire detectors have been located in areas of high cable concentration as noted in table 8.3-4 for early warning of incipient cable fires. Table 8.3-4 is not to be interpreted as a complete list of all plant smoke and fire detectors.

Table 8.3-4
SMOKE AND FIRE DETECTOR LOCATIONS
IN AREAS OF CABLE TRAY CONCENTRATION (Sheet 1 of 2)

Location	Elevation (ft)	Detection Device[a]
Control Building		
Cable spreading	9	I, HA
Relay room	9	I
Communication rooms	9	I
Cable spreading and riser	9	I, HA
Cable riser	30	I, HA
Computer rooms (includes under floor)	30	I, HA
Cable gallery and riser	50	I, HA
Switchgear rooms	50	I
Evacuation room	50	I
Cable spreading areas	50	I
Battery rooms	50	I
Cable gallery and riser	70	I
Switchgear room	85	I
Radwaste		
CEDM MG sets and control cabinets	37	I
Radwaste control panel	63'-6"	I

a. Devices:

I - Ionization
HA - Heat actuated (rate of rise) fixed temperature
UV - Ultraviolet

Table 8.3-4
SMOKE AND FIRE DETECTOR LOCATIONS
IN AREAS OF CABLE TRAY CONCENTRATION (Sheet 2 of 2)

Location	Elevation (ft)	Detection Device[a]
Electrical Penetration Area		
General area	45	I
General area	63'-6"	I
Cable Tunnels and Risers	Varies	I, HA
Turbine Building		
250V-dc switchgear	7	I
MCCs	7	I
Tray runs	7	I
Switchgear room	30	I
Control cubicles	30	I
MCCs	30	I
Tray runs	56	HA
Diesel Generator Building	9	UV, HA
Administration Warehouse Shop		
Communications room	1st floor	I

Details of the fire protection system are covered in subsection 9.5.1.

Fire stops have been provided where cable trays pass through wall or floor openings to prevent spreading of fire from one area to another. The details of protection of redundant cables have been included in subsection 8.3.1.

8.3.3.3 Fire Barriers and Separation Between Redundant Trays

The arrangement of electrical equipment and cabling has been planned so as to minimize the propagation of fire from one separation group to another separation group. In the absence of confirming analyses to support less stringent requirements, the following general rules are applied to those areas in which the only source of fire is electrical. Refer to paragraph 8.3.1.3 for the identification of the different separation groups.

8.3.3.3.1 General Plant Areas and Cable Spreading Areas

A. Minimum horizontal separation between trays for different separa- 11
tion groups is 3 feet. In areas where 3-foot separation is unattainable, a fire barrier is installed extending at least 1 foot above the top of the tray (or to the ceiling), and 1 foot below the bottom of the tray (or to the floor).

B. When the trays are stacked vertically, minimum vertical separation between different separation groups is 5 feet. In areas where 5-foot separation is unattainable, a fire barrier is installed extending at least 1 foot from both sides of the tray (or to the wall if it exists). The minimum allowable separation between the top tray and the barrier is 1 inch.

C. When the trays cross each other, minimum vertical separation between different separation groups is 5 feet. In areas where
5-foot separation is unattainable, a fire barrier is installed 11
between the trays. The minimum allowable clearance between the barrier and the top tray is 1 inch. The barrier extends 1 foot minimum from each side of the top tray and 3 feet minimum from
each side of the bottom tray. 11

Fire stops and seals are provided for cable penetrations in openings in the floor for vertical runs of raceways, at each access opening in ceilings, and at fire-rated wall penetrations. In vertical tray runs, fire breaks are provided at every 10-foot intervals.

Fire stops and seals are also provided at the top, bottom, or sides of
every electrical equipment enclosure where cable enters the enclosure from 11
the cable tray system.

The fire stops and breaks are furnished to provide a method of completely
sealing off air spaces around cable penetrations at the different locations
indicated above: The-stops are made up of fire-resistant material equal to
11 the fire rating of the walls, floors, or ceilings.

Fire seals and breaks are constructed as a composite of ceramic fiberboard and silicone foam to a depth required to achieve a fire rating equivalent to the barrier being penetrated in accordance with ASTM E119-73, Fire Tests of Building Construction and Materials.

The ceramic fiberboard, manufactured by Babcock & Wilcox and trade named Koowool M Board, is formed from high-purity alumina-silica fireclay fibers and binders. The board exhibits the following physical properties:

Density, $lb/ft.^3$	12-16
Melting point, ^oF	3200
Modulus of rupture, $lb/in.^2$	120
Compressive strength, $lb/in.^2$	
@ 5% deformation	800-1400
@ 10% deformation	1400-2800
Loss on ignition, %	4-7
Thermal conductivity, Btu-in./h-ft^2-^oF	
@ 400F	0.45
@ 1000F	0.68
9 @ 1600F	1.12

The silicone foam, manufactured by Dow Corning and tradenamed 3-6548 silicone RTV foam, is foamed in place through the mixture of two components in equal amounts. The cured foam exhibits the following physical properties:

Cure time, minutes	1-3
Density, $lb/ft.^3$	17
Cell structure, closed cell, %	>50
Tensite strength, $lb/in.^2$	33
Compression deflection, $lb/in.^2$	
@ 20% compression	5.2
@ 40% compression	10.1
@ 60% compression	21.2
Thermal conductivity, Btu-in./h-ft^2-^oF	0.542
Flame spread rating, per ASTM E84-76	20
Radiation resistance	Resilient after 124 Megarads

Where it is necessary that cables of different separation groups approach
the same or adjacent control panels, switchboards, equipment cabinets, or
termination boxes with less than 3-foot horizontal or 5-foot vertical
11 separation, isolation is maintained by installing cables of all but one of
the separation groups in metallic conduit, solid bottom or top cable tray,
or by installing suitable barriers between separation groups. The barriers
installed in lieu of horizontal separation extend from 1 foot below the
bottom of the tray or to the floor to 1 foot above the top of the tray or
to the ceiling. The barriers installed in lieu of vertical separation
extends 1 foot beyond each side of the tray system or to a wall.

Isolation between separation groups is considered to be adequate where physical separation is less than that indicated in items A, B, and C above, provided that all but one of the separation groups are routed in metallic conduit, metallic wireways, or solid bottom or top cable tray, and the only source of fire hazard is electrical. 11

Non-class 1E cables are not routed through Class 1E raceways. However, a non-class 1E power cable may be fed from a Class 1E power source through an isolation device. When this is done, the circuit, after leaving the isolation device, is not classified as an associated circuit and is not routed through safety-related raceways.

Furthermore, the non-Class 1E instrumentation and control circuits originating from 1E equipment are not treated as Class 1E circuits nor are they classified as associated circuits. These circuits are run in non-Class 1E raceways together with the other non-Class 1E instrumentation and control circuits. See paragraph 8.1.4.3.14.A.2 for a detailed discussion.

8.3.3.3.2 Reactor Containment Penetration Areas

Two separate penetration areas are provided for all cables that must pass through the containment wall. Elevation 63-foot penetration area contains cable for separation groups B, C, and X; each group having separate penetration assemblies. Elevation 45-foot penetration area contains cable for separation groups A, D, and X; each group again having separate penetration assemblies.

Cables and raceways in each separation group are separated from cables and raceways designated in other separation groups in the penetration areas. Separation distances are discussed in paragraph 8.3.3.3.1 (refer to paragraph 8.3.1.3 for identification of different separation groups).

8.3.3.3.3 Control Boards and Other Panels

Single control devices to which different separation groups are connected are avoided. Within the main control boards, non-Class 1E wiring is run separated from Class 1E wiring except for low-energy cabling connecting position contacts from Class 1E switches with the non-Class 1E plant computer and annunciator. In these cases, it is specifically verified that the non-Class 1E cables are routed with only one Class 1E separation group. 16
Within the other panels, however, non-Class 1E wiring is run and harnessed together with Class 1E wiring. The potential of the low energy non-Class 1E wirings in the panels providing a mechanism whereby a failure could affect the Class 1E wiring because of the proximity of the non-Class 1E wirings to the Class 1E wirings is so low that a requirement for them to be separated is not warranted. Harnesses of different separation groups are separated physically by a distance of 6 inches, or where physical separation is impracticable, metal barriers, metallic conduit, metallic gutter, or wire duct is used for maintenance of independence. 11

A. A 6-inch minimum physical separation is maintained between field cables of different separation groups (paragraph 8.3.1.3) entering an enclosure (main control boards, switchboards, equipment cabinets, panels, and termination boxes, etc.) between any of these cables and the internal wiring of the separation groups within the enclosure and between the internal wiring of different separation groups within the enclosure.

Where a 6-inch minimum physical separation between two separation groups cannot be maintained, one of the following is performed:

1. The cables or cable conductors of at least one of the separation groups are installed in an enclosed raceway (rigid steel conduit, EMT, enclosed metallic gutter or stripwound stainless steel conduit). The enclosed raceways are installed over the entire length of the cables or cable conductors from/to the point where a 6-inch minimum separation distance can be established.

2. A metal barrier is erected between the cabling, terminal blocks, or components of the separation groups.

B. For Class 1E enclosures, (switchboards, equipment cabinets, panels an termination boxes, etc.), or devices which contain non-Class 1E instrumentation and/or control wiring (field cabling or internal wiring), and wiring (field cabling or internal wiring) of only a single Class 1E separation group, no separation is required between 11 the wiring within the enclosures or devices.

C. When a non-Class 1E power cable circuit enters an enclosure with Class 1E wiring (field cabling or internal wiring), a 6-inch minimum plysical separation is maintained between the non-Class 1E power cable circuit and any Class 1E wiring. Where a 6-inch separation cannot be accomplished, the non-Class 1E power cable and/or the Class 1E wiring is barriered or installed in an enclosed raceway in similar manner to that described in paragraphs 8.3.3.3.3 A.1 and 8.3.3.3.3 A.2.

D. For Class 1E enclosures (main control boards, switchboards, equipment cabinets, panels, termination boxes, etc.), or devices which contain non-Class 1E wiring (field cabling or internal wiring), and wiring (field cabling or internal wiring) for two or more. Class 1E separation groups, the "6-inch free air" separation is maintained between wiring for any separation group or any separation group wiring and non-Class 1E wiring.

Where a 6-inch minimum physical separation between wiring for two Class 1E separation groups, or between Class 1E separation group or non-Class 1E wiring cannot be maintained, the wiring is barriered or installed in an enclosed raceway in a similar manner to that described in paragraphs 8.3.3.3.3 A.1 and 8.3.3.3.3 A.2.