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TECHNICAL EVALUATION OF THE SUSCEPTIBILITY OF
SAFETY-RELATED SYSTEMS TO FLOODING CAUSED BY
THE FAILURE OF NON-CATEGORY 1 SYSTEMS FOR
THE SAN ONOFRE NUCLEAR POWER PLANT, UNIT 1

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ABSTRACT

This report documents the technical evaluation of Southern California Edison Company's San Onofre Nuclear Power Plant, Unit 1, to determine whether the failure of any non-Category 1 (seismic) equipment could result in a condition, such as flooding, that might potentially adversely affect the performance of safety-related equipment required for the safe shutdown of the facility or to mitigate the consequences of an accident. Criteria developed by the U.S. Nuclear Regulatory Commission were used to evaluate the acceptability of the existing protection as well as measures taken by Southern California Edison Company to minimize the danger of flooding and to protect safety-related equipment.

DISCLAIMER

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1. INTRODUCTION

By letter to the Southern California Edison Company (SCEC) dated August 8, 1972, the Nuclear Regulatory Commission (NRC) requested a review of the San Onofre Nuclear Power Plant, Unit 1, to determine whether the failure of any non-Category 1 (seismic) equipment outside of containment, particularly in the circulating water system and fire protection system, could result in a condition such as flooding that might adversely affect the performance of safety-related equipment required for safe shutdown of the facilities or which may be required to limit the consequences of an accident [Ref. 1]. By letter dated October 5, 1972, [Ref. 2] and subsequent letters and reports, [Ref. 4-7 & Ref. 9-11] the Southern California Edison Company submitted the additional information requested by the NRC, as well as descriptions of various plant changes implemented to mitigate the effects of failure of some non-Category 1 systems on safety-related equipment. The NRC guidelines [Ref. 3] are provided as an Appendix to this report.

For classification of Category 1 (seismic) components, SCEC has used the equivalent terminology "Category A equipment" throughout their submittals as defined and listed in Section 9.2 of the SO-1 Final Safety Analysis.

The purpose of this technical evaluation is to determine, on the basis of the information provided (refer to References), whether the Licensee's response and/or equipment/plant modifications are adequate to mitigate the effects of flooding on equipment important to safety.

2. EVALUATION OF SAN ONOFRE, UNIT 1

2.1 INTRODUCTION

Four separate reviews of the San Onofre facility were conducted by the SCEC between 1972 and 1980. Initially, at the request of NRC in 1972, the SCEC reviewed the circulating water system as a source of flooding [Ref. 1, 2]. Subsequently, as a result of the generation of new criteria, the NRC requested that the San Onofre, Unit 1 facility be again reviewed [Ref. 3]. This review resulted in the SCEC report "Effects of Non-Category A Equipment Failure on Safety-Related Equipment, San Onofre Nuclear Power Plant, Unit 1," dated March 1975 [Ref. 6]. Further, the facility was also reviewed to answer several questions regarding chemical release and its effect on electrical cables.

The various sources of flooding identified by the licensee and the appropriate safety equipment are discussed in Sections 2.2 and 2.3, Section 2.4 provides an evaluation of existing protection as well as measures that were taken by SCEC to minimize the danger of flooding and to protect safety-related equipment.

2.2 SOURCES OF FLOODING

During the licensee's reviews of the San Onofre, Unit 1, plant, the following major sources of flooding were identified:

- (1) Circulating Water System
- (2) Fire Protection System
- (3) Auxiliary Coolant System
- (4) Condensate System
- (5) Turbine Plant Cooling Water System
- (6) Domestic Water System
- (7) Auxiliary Building Service Water System

2.3 SAFETY-RELATED EQUIPMENT SUBJECT TO FLOODING DAMAGE

The following safety-related systems were reviewed to determine whether or not they were subject to flooding:

1. Auxiliary Feedwater Pump
2. Feedwater and Condensate System
3. Auxiliary Coolant System
4. Emergency Diesel Generators
5. Switchgear Rooms
6. Safety Injection System
7. Chemical and Volume Control System
8. Compressed Air System
9. Motor Control Centers
10. Circulating Water System
11. Battery Rooms
12. Control Room
13. Component Cooling Equipment

In order to facilitate this review, the following evaluation was performed on an area basis rather than a system basis.

2.4 EVALUATION

2.4.1 General Considerations

For the San Onofre Nuclear Power Plant, Unit 1, SCEC has made systematic evaluations of all safety-related equipment required for shutdown or to limit the consequences of an accident, as well as all water and liquid chemical systems and components, which are listed in Appendix B of this report. SCEC has performed these evaluations by location, i.e., in the plant outside containment and inside containment. This evaluation addresses only those areas outside containment.

SCEC has investigated potential failures in non-Category A components that might affect the operability of Category A safety-related equipment

installed outside the containment. SCEC's evaluation has determined that much of this safety-related equipment is located in open areas, installed at elevations, or they are separated by distance from non-Category A systems such that they are not vulnerable to flooding. Our review of plant layout drawings has confirmed SCEC's conclusions.

2.4.2 Reactor Auxiliary Building

The following safety-related equipment is located on the roof of the Reactor Auxiliary Building (RAB), elevation 20':

- Volume Control Tank
- Boric Acid Tank
- Reactor Coolant Filter
- Component Cooling Heat Exchangers
- Component Cooling Surge Tank
- Component Cooling Pumps
- Recirculation Heat Exchangers
- Spent Fuel Pit Heat Exchanger

There are several sources of flooding on the roof of the Reactor Auxiliary Building (the largest is identified below); however, they pose no threat to any safety related equipment for the following reasons:

1. There is no lip or sill around the roof of the building.
2. The volume control tank (VCT) is Seismic Category A and therefore, is not considered as a source of flooding. In addition, the capacity of the tank is 1,575 gallons and is smaller than the Boric Acid Tank (7,000 gallons).
3. The largest tank located on the Reactor Auxiliary Building roof is the 7,000 gallon Boric Acid Tank. If the entire contents of this tank drained onto the roof, the flooding would be less than 2 inches, not taking credit for any run off. This is not sufficient to flood any safety-related equipment on the roof.

The following safety-related equipment is located in the Reactor Auxiliary Building (elevation 20'):

- Boric Acid Injection Pumps
- Boric Acid Transfer Pumps
- Boric Acid Filter
- Boric Acid Batching Tank and Heater

The only non Category A chemical equipment in the Reactor Auxiliary Building (elevation 20') that could fail and cause chemical impingement on safety-related equipment is the Boric Acid Batching Tank. A "pinhole" leak in the tank could cause the boric acid solution to impinge on safety-related control cable. However, tests have determined that the control cable jacket material will not react with the 12% boric acid solution and hence no additional measures are required.

The following safety-related equipment is located in the Reactor Auxiliary Building (elevation 5'):

- Charging Pumps and Oil Coolers
- Demineralizers
- Seal Water Heat Exchanger and Filter
- Test Pump
- Motor Control Center 2A

Failures of non-Category A systems that could cause flooding of the Reactor Auxiliary Building are limited to a potential severance of the pipe (3 inch) downstream of the liquid radwaste holdup tank recirculation pump; severance of a service water line (1 inch); and severance of a primary water supply line (3 inch). Assuming the worst pipe break, the escaping water would spill into the Reactor Auxiliary Building sump and completely fill the sump before slowly flooding the main floor of the building. Results of SCEC's calculations show that if water spill were to remain unchecked it would take seven hours before any safety related equipment would be endangered by flooding. This is discussed in more detail below.

The largest source of water located on the +5' level of the Reactor Auxiliary Building is the 2,600 gallon decontamination drain tank. (The spent resin storage tank is larger, but contains less water.) Flooding from this tank to a maximum depth of approximately 3", could result if no credit is taken for run off down the stairs to the sump on the -5' level. The maximum acceptable flood level on this floor (+5 feet) is 6".

The +5' level floor would drain water down the stairway to the -5' level. The capacity of the room at -5' level and the adjacent tank room at the -2' level is approximately 86,000 gallons below the +5' level. There is a sump located at the -5' level with a high water alarm at elevation of -5' 8". The sump is drained by an automatic sump pump with a capacity of 100 gal/min. Two level switches (Magnetrol Models A-153F-VP and A-103F-VP) are located in the sump.

One initiates the level alarm and the other actuates the sump pump. Flooding of the Reactor Auxiliary Building is also limited by the plant operators, who enter the building at least twice per shift. Any flood would be detected in less than eight hours and action taken. Thus, flooding rates up to approximately 130 gpm would not result in flooding any safety-related equipment on the +5 level, not taking credit for the sump pump or alarm. In addition, Emergency Procedure 5.3.5.27, Rev. 9, Earthquake, provides that a plant inspection be conducted to assess damage following a moderate or strong earthquake. Therefore, failure of any non-Seismic Category A pipe would not result in the flooding of any safety-related equipment in the auxiliary building.

Failure of one of the three liquid radwaste hold-up tanks on the -2' level would be completely contained below the +5' level and no safety-related equipment would be flooded.

High water level in the RAB is alarmed at the radwaste annunciator panel in the auxiliary building and also in the control room when the water level is 8 inches below the top of the sump. Therefore, we find that the existing provisions (sump pump, alarms, and operational procedures) provide acceptable protection against flooding of safety-related equipment on the main floor (elevation +5 feet) of the Reactor Auxiliary Building.

We conclude that the safety-related equipment in the Reactor Auxiliary Building (at both the 5' and 20' levels) is in no danger of flooding or sustaining chemical damage.

2.4.3 Control Room

The Control Room, located at 42' elevation above grade is not endangered from flooding since no water or chemical lines pass through the area. The domestic water supplies in the vicinity of the control room are in the kitchen, toilet room, radiochemistry lab and the turbine plant lab. There is also a drinking fountain in the hallway outside the control room. There are three floor drains in the turbine plant lab and one floor drain in the toilet room. The potential flooding rate from a domestic water line is small and the control room is continuously manned. Thus, flooding of the control room area is not considered to be a concern.

2.4.4 Turbine Building

The following safety-related equipment is located in the Turbine Building at elevation 14' in the immediate area of the main condenser:

- Feedwater pumps
- Motor Driven Auxiliary Feedwater Pumps
- Turbine Driven Auxiliary Feedwater Pump
- Air Compressors
- Motor Operated Valve 850C Inverter Battery

The following safety-related equipment is located in the Turbine Building (elevation 20'):

- Motor Operated Valve (MOV) 850C Inverter and Battery Charger
- Motor Control Center (MCC) 3
- Shutdown Panel

The following safety-related equipment is located in areas adjacent to the Turbine Building (elevation 14'):

- Switchgear Rooms 1 and 2
- Safety Injection Pumps
- Auxiliary Cooling Pump
- Auxiliary 480 Volt Transformers
- Primary Plant Makeup Pumps
- Refueling Water Pumps
- Spent Fuel Pit Pumps
- Service Water pumps

The safety-related equipment located at the 14' elevation in the immediate area of the main condenser and are subject to flooding resulting from failure of circulating water piping or expansion joints. The failure of the expansion joint is considered the major source of flooding, resulting in a flooding rate of 173,000 GPM (capacity of one circulating water pump). Also in the immediate area and subject to this flooding of the 14' elevation are switchgear rooms 1 and 2. Room 1 contains 4160 volt switchgear trains one and two, train one 480 volt load center, MCC 1 and 1A and other electrical distribution panels. Switchgear room no. 2 contains train two 480 volt load center, MCC 2 and other electrical distribution panels.

The flooding resulting from the failure of any one of the four inlet circulating water line expansion joints will result in flooding the condenser bay (floor elevation 8'6"). The condenser bay would flood to the 14' elevation in approximately 1.7 minutes. At 173,000 GPM rate the water will flood the 14' elevation floor to a 6" depth in another minute (total time 2.7 minutes). At the six inch depth the electrical equipment in the switchgear rooms are jeopardized. To control and mitigate the flooding, the licensee has installed redundant Magnetrol Model A-103 EP/VP level switches on opposite walls of the condenser bay, 6" above the condenser bay floor, at elevation 9'-0" which annunciate in the control room.

The licensee has stated that potential flooding from the failure of a condenser bellows will be mitigated by water flow restrictors in the form of sleeves being installed over the expansion joints. These flow restrictors

will limit the flow to the capacity of the condenser bay sump pumps (700 GPM). In the event of a high water alarm, indicating a sump pump failure; there is sufficient time for the operator, after receiving the alarm of high water in the condenser pit, to walk to the condenser area and determine which circulating water line has ruptured and shut down the appropriate pump. Upon shutting down a recirculating water pump, the reactor can be ramped back to 80% power level which can be maintained with one recirculating water pump out of service.

The installation of the expansion joint flow restrictors will be completed by approximately June 1, 1981. We conclude that this design and the time table for installation are acceptable.

In addition to the above flooding sources, failure of the condensate storage tank (CST) could possibly cause flooding of MCC3, the remote shutdown panel, the uninterruptable power supply (UPS) for MOV-850C and the batteries for the UPS. However, as part of the seismic evaluation of San Onofre Unit 1, the CST is to be analyzed by June, 1981 to determine its seismic capability. Attached are specifications showing the similarity in design and construction of the CST and the Seismic Category A Refueling Water Storage Tank (RWST). If required, the tank foundations will be upgraded to Seismic Category A following the seismic evaluation. This will remove the CST as a source of flooding for this review.

In the meantime, the door between the turbine building +20' level and the CST will be locked closed during normal plant operation and the air ventilator in the lower portion of the door and the glass window will be blocked off. These steps would minimize flooding in the unlikely event the CST should rupture. We conclude that these short term measures coupled with long term modifications of seismically qualifying the tank foundations, if required, are adequate and acceptable.

COMPARISON OF THE CONDENSATE STORAGE TANK AND REFUELING WATER STORAGE TANK

<u>DATA</u>	<u>REFUELING WATER STORAGE TANK</u>	<u>CONDENSATE STORAGE TANK</u>
Tank Height, Straight Shell	37 ft. 1 in.	37 ft. 1 in.
Tank Diameter, Mean	34 ft. 0 in.	34 ft. 0 in.
Number of Courses	5	5
Size of Courses	88-5/16 in.	88-5/16 in.
Plate Material	A283C	A283C
Plate Thickness		
Bottom	5/16 in.	5/16 in.
Roof	1/4 in.	1/4 in.
Course 1	0.329 in.	.16 in.
Courses 2, 3, 4, 5	1/4 in.	.26 in.
Size of Top Angle in	3-1/2 x 3 x 1/4 in.	3-1/2 x 3 x 1/4
Size Anchor Bearing Plates	3-1/8 x 5/8 x 7 in.	None
Number of Anchor Bolts	34	None
Tank Capacity	240,000 gal.	240,000 gal.

The area adjacent to and out of doors from the Turbine Building (elevation 14') contains the Safety Injection Pumps, Auxiliary Cooling Pump, Primary Makeup Pumps, Refueling Water Pumps, Spent Fuel Pit Pump, Service Water Pumps and the Auxiliary 480 volt transformer. The 14 foot elevation is protected from any flooding by a 3 by 4 foot area flood drain which flows to the circulating water pit.

2.4.5 Circulating Water Pump Pit

The following safety-related equipment is located in the Circulating Water Pit (elevation -5'):

Saltwater Cooling Pumps

Failure of a circulating water bellows in the circulating water pit (part of the intake structure) will render the saltwater cooling pumps (also in the pit) inoperative in about one minute. These saltwater pumps supply cooling water to the RHR heat exchangers. The auxiliary saltwater cooling pump located in a second pit remote from the circulating water pump pit will act as a backup in this situation precluding the need for a level alarm in the pit. Further flooding will render the circulating water pumps inoperative, hence eliminating the source of flooding. No additional modifications for the control of flooding are required. We find this acceptable.

2.4.6 Station Battery Room

The following safety-related equipment is located in the Station Battery Room (elevation 20'):

Station Batteries
DC Switchgear
DC-AC Inverters

There are two (2 inch) floor drains located in the station battery room. The only sources of water are the 3/4" hot and cold domestic water lines. The maximum acceptable flood level in the battery room is 36" (floor to bottom of batteries). The drains would adequately drain the floor.

There are no floor drains in the battery charger room. The only water sources are the above mentioned domestic water lines. The maximum acceptable flood level in the charger room is 6 inches. There is a normally closed door between the charger room and the battery room. The door is 36 inches wide and there is a 1/2 inch gap between the bottom of the door and the floor. This would provide adequate space for water to drain from the charger room to the floor drains in the battery room (approximately 175 gpm). The door to the outside is relatively tight and drainage under that door would be minimal.

In addition, the plant operator enters this room at least twice per shift and immediately following an earthquake; and would detect any water leaking into the room.

The battery/charger rooms are located on the +20' level and the floor drains flow to the storm drains. This would preclude any flooding from backflow in the drain. We conclude that the above configuration is adequate to prevent flooding of safety-related equipment in the battery/charger rooms.

2.4.7 Diesel Generator Building

The following safety-related equipment is located in the Diesel Generator Building (elevation 20.6'):

Diesel Generators

Battery Room

Diesel Generator Control Panel

The largest non-seismic piping in the Diesel/Generator Building is the one and one-half inch service water header. There is a large sump located under each end diesel/generator. Each sump drains to a basin which is served by a sump pump (85 GPM). The total sump pump capacity (170 GPM) is adequate to mitigate the flooding from failure of the service water header.

The battery room, located at the west end of the north Diesel/Generator Building has an eye wash basin and a 4 inch floor drain. Flooding of this room from this source is not credible.

The station operators enter the building at least twice per shift and immediately following an earthquake; and would detect any water leakage. We conclude that these measures are adequate to prevent damage to any safety-related equipment in the Diesel/Generator Building.

2.4.8 Safety Injection System (SIS)

The failure of a chemical feed line (containing phosphates) near the feedwater header could cause chemical impingement upon the SIS piping. Since phosphates do not react with stainless steel, there exists no need for protective measures for the SIS piping.

2.4.9 Electrical Cables

From the San Onofre Nuclear Generating Station Unit 1 Pipe Whip Report the locations of all the safety-related electrical cables can be identified. The only potential threat to the cables from the failure of any non-Category A equipment occurs in Areas 5, 6 and 14. In Areas 5 and 6 neoprene-jacketed cables (for safety injection system MOVs in feedwater pump areas) are in trays near the hydrazine/amine chemical feed lines. A chemical feed line failure could result in a hydrazine spray onto these cables. In Area 14 neoprene-jacketed and aluminum-armored cables (for the safety injection pumps) are in trays directly beneath the turbine plant cooling water header. The water in this header contains about 3000 ppm of potassium chromate. This chemical could spray onto the the cables beneath the header should a pipe failure occur.

As indicated in their May 30, 1975, submittal [Ref. 9], SCEC performed tests which indicate that cables immersed at 100 F in a dilute hydrazine solution will suffer no adverse effects for at least 2-1/2 days.

The concern that a chemical feed line break could occur and remain undetected for a length of time which would result in cable degradation and compromise equipment response to LOCA conditions has been met by plant operating instructions. Operating Instruction S-0-1, Revision 3, dated February 13, 1974, specifically provides for a minimum of two Plant Equipment Operator inspections per shift of the Plant Chemical Addition Area.

In addition, instructions pertaining to charging of the Hydrazine feed (Operating Instruction S-4-2, Revision 2, of July 25, 1974) specifically require circulation and mixing of the tank contents and restarting of the hydrazine pump. Thus, operation of most of the equipment is checked before the operator leaves the area and any line break or similar occurrence would be detected at this time. Charging of this tank generally takes place once per

We conclude that chemical release or flooding from non-Category A equipment failure will not impair the function of safety-related electrical

3. CONCLUSIONS

The San Onofre Unit 1 Nuclear Power Plant is designed so as to mitigate or prevent potential damage caused by flooding of safety-related equipment required for the safety and/or the safe shutdown of the plant. Modifications made to the facility to control the rapid flooding of circulating water in the condenser pit include the installation of redundant level alarm switches in the condenser pit which alarm in the control room. Proposed modifications include the installation of flow restrictors over the circulating water line expansion joints. These changes will be accomplished by approximately June 1, 1981. Changes have been made to operating procedures which require operators to enter vital areas twice per shift when the plant is in operation.

It is concluded that with the modifications already accomplished and those alterations scheduled to be completed along with the changes to operating procedures described in this evaluation, the "NRC Guidelines for Protection from Flooding of Equipment Important to Safety" (Appendix A) have been satisfied.

4. REFERENCES

1. NRC letter (D. J. Skovholt) to Southern California Edison Company (SCEC) dated August 8, 1972.
2. SCEC letter (O. J. Ortega) to NRC (D. J. Skovholt) dated October 5, 1972.
3. NRC letter with enclosures (R. A. Purple) to SCEC (J. B. Moore) dated December 13, 1974.
4. SCEC letter (J. B. Moore) to NRC (K. Goller) dated January 10, 1975.
5. SCEC letter (K. P. Baskin) to NRC (K. Goller) dated February 14, 1975.
6. SCEC letter with enclosure (K. P. Baskin) to NRC (K. Goller) dated March 25, 1975.
7. SCEC letter with enclosure (K. P. Baskin) to NRC (K. Goller) dated May 30, 1975.
8. NRC letter with enclosure (R. A. Purple) to SCEC (J. B. Moore) dated September 23, 1975.
9. SCEC letter (K. P. Baskin) to NRC (R. A. Purple) dated October 28, 1975.
10. SCEC letter (K. P. Baskin) to NRC (D. M. Crutchfield) dated August 29, 1980.
11. SCEC letter (K. P. Baskin) to NRC (D. M. Crutchfield) dated October 15, 1980.

APPENDIX A:

NRC GUIDELINES FOR PROTECTION FROM FLOODING OF EQUIPMENT IMPORTANT TO SAFETY

Licenseses are required to investigate their facilities or review their designs to assure that equipment important to safety will not be damaged by flooding due to rupture of a non-Class I system component or pipe such that engineered safety features will not perform their design function. No single incident of a non-Class I system component or pipe failure shall prevent safe shutdown of the facility

Further guidelines:

1. Separation for redundancy - single failures of non-Class I system components or pipes shall not result in loss of a system important to safety. Redundant safety equipment shall be separated and protected to assure operability in the event a non-Class I system or component fails.
2. Access doors and alarms - watertight barriers for protection from flooding of equipment important to safety shall have all access doors or hatches fitted with reliable switches and circuits that provide an alarm in the control room when the access is open.
3. Sealed water passages - passages or piping and other penetrations through walls of a room containing equipment important to safety shall be sealed against water leakage from any postulated failure of non-Class I water systems. The seals shall be designed for the SSE, including seismically indicated wave action of water inside the affected compartments during the SSE.

4. Class I watertight structures - walls, doors, panels or other compartment closures designed to protect equipment important to safety from damage due to flooding from a non-Class I system rupture shall be designed for the SSE, including seismically induced wave action of water inside the affected compartment during the SSE
5. Water level alarms and trips - rooms containing non-Class I system components and pipes whose rupture could result in flood damage to equipment important to safety shall have level alarms and pump trips (where necessary) that alarm in the control room and limit flooding to within the design flood volume. Redundance of switches is required. Critical pump (i.e., high volume flow, such as condenser circulating water pumps) trip circuits should meet IEEE 279 criteria.
6. Class I equipment should be located or protected such that rupture of a non-Class I system connected to a tower containing water or body of water (river, lake etc.) will not result in failure of the equipment from flooding.
7. The safety analysis shall consider simultaneous loss of offsite power with the rupture of a non-Class I system component or pipe.

The licensees' responses should include a listing of the non-Class I systems considered in their analysis. These should include at least the following systems.

Firewater	Demineralized Water
Service Water	Drains
Condensate	Heating Boiler Condensate
Feedwater	Condenser Circulating Water
Reactor Building Cooling Water	Makeup
Turbine Building Cooling Water	Potable Water

APPENDIX B

I. Water and Chemical Systems at San Onofre Unit 1

A. Water Systems

1. Reactor Coolant System (all Category A)
2. Chemical and Volume Control System
3. Auxiliary Coolant System
4. Safety Injection System (all Category A)
5. Reactor Cycle Sampling System
6. Vents and Drains
7. Steam System (primarily Category A)
8. Feedwater System (Primarily Category A)
9. Condensate System
10. Circulating Water System
11. Turbine Plant Cooling Water System
12. Domestic Water System
13. Fire Protection System
14. Turbine Cycle Sampling System
15. Service Water System
16. Primary Make-up Water
17. Auxiliary Building Service Water
18. Screen Wash System
19. Chilled Water System

B. Chemical Systems

1. Chemical and Volume Control System
2. Radioactive Waste Disposal System
3. Chemical Feed System
4. Acid Storage

II. Safety-Related Equipment Required for Shutdown or to Limit the Consequences of an Accident.

A. Auxiliary Coolant System

1. Equipment

- a. Component Cooling Heat Exchanger
- b. Component Cooling Pumps
- c. Component Cooling Surge Tank
- d. Charging Pump Oil Coolers
- e. Spent Fuel Pit Pump and Heat Exchanger

2. Valves

- a. MOV-720 A, B
- b. TCV-601 A, B
- c. Valves 788 & 796

B. Reactor Coolant System

1. Equipment

All equipment is inside containment

C. Safety Injection System

1. Equipment

- a. Feedwater Pumps
- b. Safety Injection Pumps
- c. Recirculation Heat Exchanger
- d. Refueling Water Storage Tank

2. Valves

- a. MOV-356, 357, 358
- b. NOV-851 A,B; 852 A,B; 853 A,B; 854 A,B
- c. CV-36, 37
- d. CV-875 A,B

D. Chemical and Volume Control System

1. Equipment

- a. Charging Pumps
- b. Volume Control Tank
- c. Boric Acid Tank and Heaters
- d. Boric Acid Injection Pump
- e. Boric Acid Batching Tank and Heater
- f. Boric Acid Transfer Pumps
- g. Test Pump
- h. Boric Acid Filter
- i. Seal Water Heat Exchanger
- j. Mixed Bed Demineralizers
- k. Reactor Coolant Filter
- l. Seal Water Filter

2. Valves

- a. PCV 1105
- b. TCV 1105
- c. LCV 1100A
- d. LCV 1100 B,C,D
- e. CV 334
- f. FCV 1112
- g. MOV 18, 19

E. Miscellaneous Water Systems

1. Equipment

- a. Primary Plant Make-up Tank
- b. Primary Plant Make-up Pumps

F. Feedwater and Condensate Systems

1. Equipment

- a. Auxiliary Feedwater Pump
- b. Turbine Drive Auxiliary Feedwater Pump

G. Circulating Water System

1. Equipment

- a. Saltwater Cooling Pumps

2. Valves

- a. POV-5, 6

H. Compressed Air

I. Electrical

1. Equipment

- a. High Voltage Switchyard
- b. Generator Bus and Bus Disconnect
- c. Generator Step-up Transformer (Main Transformer)
- d. Auxiliary Power Transformers A, B, C
- e. Control and Relaying Equipment
- f. 4160 Switchgear
- g. 480V Auxiliary Switchgear
- h. Maintained A-C Source
- i. Diesel Generator
- j. Electrical Cable associated with items in A through I

J. Structures

1. Spent Fuel Pit
2. Reactor Auxiliary Building
3. Control Room
4. Switchgear Rooms
5. Battery Room
6. Turbine Support Pedestal
7. Intake Structure