14.4 ENVIRONMENTAL QUALIFICATION ANALYSES

14.4.1 Basis of Discussion

The following is applicable to both units unless otherwise noted. A feedwater line break is not part of the Unit 1 current license basis for the standby safeguards analyses contained in Section 14.2, Standby Safeguards Analyses. However, postulated feedwater line breaks are part of the environmental qualification analyses required for both units contained in this section.

14.4.2 Postulated Pipe Failure Analysis Outside Containment

Presented below is a discussion of analyses associated with high energy line breaks (HELBs) outside of containment.

Effect of the Replacement Steam Generators on Unit 1

The effect of the Unit 1 RSGs on postulated pipe failure analysis outside of containment has been evaluated. An evaluation of high energy line breaks outside of containment for the RSGs concludes that the difference in mass between the original and replacement steam generators will not have a significant effect on the calculated steam enthalpy for the steam line break outside containment. Also, the RSG has no effect on the pipe breaks outside of containment from a structural loading standpoint. Finally, steam generator replacement does not adversely affect any of the plant equipment and instrumentation required to shutdown the reactor listed in Table 14.4.2-1A. Therefore, the material presented in Section 14.4.2 is not affected by steam generator replacement.

14.4.2.1 High Energy Systems Definition

High energy piping systems are defined as those having a normal service temperature above 200°F, a normal operating pressure above 275 psig, and a nominal diameter greater than one inch.

The systems of the Donald C. Cook Nuclear Plant that fall under the above definition are:

1. Main Steam System
2. Feedwater System
3. Steam Generator Blowdown System
4. Chemical and Volume Control System
5. Steam Supply to Auxiliary Feedwater Pump Turbine
6. Other Systems as tabulated in Table 14.4.2-2

Specific high energy lines in each of the above systems are presented in Section 14.4.2.6.

14.4.2.2 Criteria for Pipe Rupture Postulation

14.4.2.2.1 Definition of a Piping System

A piping system is defined as having pressure-retaining components consisting of straight or curved pipe and pipe fittings such as elbows, tees and reducers. The boundaries of a system are described in terms of a piping run. A piping run interconnects components such as pressure vessels, pumps, valves, or structural anchors that may restrain pipe movement. A branch run differs from a main piping run only in that it originates at a piping intersection as a branch of the main pipe run.

14.4.2.2.2 Design Basis Breaks

Design basis breaks in high-energy piping systems are defined in this section. The criteria for considering the effects of pipe whip are considered in subsequent sections.

1. Break Location Based on High Stress Points

   There is no ASME Section III Code Class I piping outside the containment for the Donald C. Cook Nuclear Plant. The criteria used to determine the design basis piping break locations are as follows. Piping breaks were postulated to occur at the following locations in each piping run or branch run:

   A. The terminal ends except NUREG-800, "Standard Review Plan (SRP)", section 3.6.2 break exclusion zones are established between the containment penetration and the first outboard isolation valve in the steam generator blowdown and chemical and volume control system letdown lines outside containment based on piping support modifications and revised stress analyses (Reference 1).

B. At intermediate locations where:

i. the circumferential or longitudinal stresses derived on an elastically calculated basis under the loadings associated with seismic events and operational plant conditions exceed 0.8 $(S_h + S_A)$[1]; and

ii. for cases where no stress analysis was performed, breaks were postulated at any orientation, and the most adverse locations were examined.

2. Size and Orientation

Once a design basis break location has been established, as defined above, the break orientation and size depend upon the following additional conditions:

A. Longitudinal breaks in piping runs or branch runs were examined for pipes of 4" nominal diameter and larger. A longitudinal break is parallel to the pipe axis and oriented at any point around the pipe circumference. The break area is equal to the effective cross-sectional flow area upstream of the break location with the length of the break equivalent to twice the inside pipe diameter. Dynamic forces resulting from such breaks are assumed to cause lateral pipe movements in the direction normal to the pipe axis.

B. Circumferential breaks were examined in piping runs and branch runs exceeding a nominal 1-inch diameter. A circumferential break is perpendicular to the pipe axis, and the break area is equivalent to the cross-sectional flow area of the ruptured pipe. Dynamic forces resulting from such breaks are assumed to cause pipe movements perpendicular to the plane of the break.

[1] S_h is the stress calculated per ANSI B31.1.0-1967. S_A is the allowable stress range for expansion in stress calculated by the rules of the USA standard code of pressure piping. ANSI B31.1.0-1967.

14.4.2.2.3 Design Basis Crack

A design basis crack is defined as a single open crack of a size of one-half the pipe inside diameter in length and one-half the pipe wall thickness in width. The location of this crack can be anywhere along the length of the pipe.

Crack Location

Where high-energy pipes are routed in the vicinity of structures and systems necessary for safe shutdown of the nuclear plant, a single postulated crack in the pipe system has been postulated at the most adverse location except NUREG-800, "Standard Review Plan (SRP)", section 3.6.2 crack exclusion zone is established in the steam generator blowdown piping located in the steam generator normal blowdown flash tank room based on piping, piping support modifications and acceptable stress analysis (Reference 1). The criteria for evaluating the effects of jet impingement and resulting steam-air environment are discussed below.

Pipe rupture induced loads, such as pipe whip, jet impingement, and compartment pressure are analyzed below in Sections 14.4.5, 14.4.7 and 14.4.8, respectively.

14.4.2.3 Section Not Used

14.4.2.4 Section Not Used

14.4.2.5 Section Not Used

14.4.2.6 Pipe Rupture Locations and Evaluations

Rupture locations were established in each of the high energy system piping based on the stress analyses presented in Section 14.4.4. Major break locations, which establish the design basis, are tabulated in Table 14.4.2-5.

The consequences of each postulated break were evaluated with respect to (1) high compartment differential pressure, (2) jet effects, (3) potential pipe whip damage, and (4) environmental effects. All assessments of potential damage are expressed in terms of the postulated rupture not causing damage to any of the equipment (or supporting electrical cables, structures, etc.) required to assure safe shutdown of the plant. The consequences of each crack are evaluated with respect to jet effects and environmental effects. The evaluations are discussed below in Sections 14.4.5 through 14.4.8. The requirements to achieve safe shutdown in the event of these ruptures are discussed in Section 14.4.3 and environmental qualification of equipment required for safe shutdown is discussed in Section 14.4.11.

14.4.2.6.1 Main Steam Line Routing and Rupture Evaluation

Routing Description

The main steam piping from steam generators Nos. 1 and 4 have similar routing and were treated identically for the purpose of the rupture analysis. Each steam pipe exits the containment from the east side of the containment whereupon it enters its main steam stop valve and pipe rupture restraint. The two pipes then run around the south side of the containment wall (Unit 2), or north side of the containment wall (Unit 1) and into the West Steam Enclosure. They then enter the main steam accessway. The main steam piping from steam generators Nos. 2 and 3 exit the containment at the west main steam enclosure, enter the main steam stop valves and pipe rupture restraints. They then enter the main steam access way where they run horizontally to the turbine building. The above routing is shown isometrically in Figure 14.4.2-1 (Unit 2) and Figure 14.4.2-1A (Unit 1).

Rupture Locations

Potential design basis pipe break locations are shown on the Main Steam Isometric, Figure 14.4.2-1 (Unit 2) and Figure 14.4.2-1A (Unit 1) and are described below.

a. The terminal points of the main steam lines at the turbine stop valves in the Turbine Building and at the containment wall, and at the 5-way restraints located in the east and west main steam enclosures.

b. The branch point connection in the main steam line for the turbine bypass headers and the terminal point on this branch line.

The orientation and location of a design basis crack can be anywhere along the piping, shown on the Main Steam Isometric, Figure 14.4.2-1 (Unit 2) and Figure 14.4.2-1A (Unit 1).

14.4.2.6.2 Feedwater Routing and Rupture Evaluation

Routing Description

The 24" discharge of each main feedwater pump is routed through two check valves and a motor operated valve before joining in the Turbine Building into a single 30" line. The 30" line divides into two 20" lines, each of which goes to two feedwater heaters. After the two 20" lines leave the second feedwater heater, they join into a single 30" line. The single 30" line leaves the Turbine Building and divides into two 20" lines in the main steam accessway. One 20" line is routed through the Exterior Pipeway where it divides into two 14" lines which enter the Main Steam Enclosure (East). One 14" line supplies steam generator #1, and the other 14" line supplies steam generator #4. The other 20" line is routed through the Main Steam Line

Accessway where it divides into two 14" lines that enter the Main Steam Enclosure (West). One 14" line supplies steam generator #2, the other 14" line supplies steam generator #3. Each 14" line is provided with a flow nozzle, regulating valve, manual isolation valves, and a check valve before entering the containment.

Rupture Locations

Postulated design basis pipe break locations are shown on the feedwater isometric, Figure 14.4.2-2 (Unit 2) or Figure 14.4.2-2A (Unit 1). The locations have been determined on the basis of ANSI B31.1 calculated stress values based on the as-built system. These consist of the terminal points, at the high pressure feedwater heaters and containment penetrations. The orientation and location of a design basis crack can be anywhere along the piping, shown on the feedwater isometric, Figure 14.4.2-2 (Unit 2) or Figure 14.4.2-2A (Unit 1).

No intermediate locations in the Auxiliary Building or Turbine Building exceeded the 0.8 (S_h + S_A) stress criterion.

14.4.2.6.3 The CVCS Letdown Line Routing and Rupture Evaluation

Routing Description

The 2" CVCS letdown line exits the containment from the loop quadrant, passes through an isolation valve, and runs in an east-west direction through the auxiliary building into the letdown heat exchanger room. The high energy portion of the CVCS system is the letdown line from the point where it leaves the containment to the point where it enters the letdown heat exchanger.

Rupture Locations

A break is postulated to occur at the heat exchanger. The orientation and location of a design basis crack can be anywhere along the piping.

14.4.2.6.4 Steam Generator Blowdown Line Routing and Rupture Evaluation

Routing Description

The steam generator blowdown lines enter the auxiliary building from the containment through four individual penetrations. Each line is provided with an isolation valve and a blowdown control valve. The 2" blowdown lines combine to a single 3" line before entering the steam generator startup blowdown flash tank. The blowdown fluid flows to the normal blowdown flash tank via a four-inch line.

Rupture Locations

Terminal end breaks at the containment penetrations are eliminated based on the piping support modifications and revised stress analyses. The orientation and location of a design basis crack can be anywhere along the piping. (Note: the flash tanks operate at pressures below the HELB threshold and are therefore not considered terminal ends).

14.4.2.6.5 Main Steam Supply to Turbine-Driven Auxiliary Feedwater Pump

Routing Description

The steam supply to the auxiliary feedwater pump turbine is taken from the two main steam leads at the west steam enclosure. A four-inch pipe branches from each of the two 30" main steam lines between the containment wall and the main steam stop valves. The two four-inch lines each contain a motor-operated valve and a check valve before they join to a common 4" line which passes through the diesel generator pipe tunnels and before entering the auxiliary feedwater pump room. The routing of this piping is shown in Figure 14.4.2-1 (Unit 2) or Figure 14.4.2-1A (Unit 1).

Rupture Locations

Postulated design basis pipe break locations have been determined based on the criteria given in Section 14.4.2.2. These consist of the terminal points which are located at their branch connections on the main steam lines and at the auxiliary feed pump throttle valve. The orientation and location of a design basis crack can be anywhere along the piping shown on the Auxiliary Feedwater Isometric, Figure 14.4.2-1 (Unit 2) or Figure 14.4.2-1A (Unit 1).

14.4.2.6.6 Other High Energy Systems / Lines

Other high energy systems and lines are tabulated in Table 14.4.2-2.

14.4.2.7 Flooding

The Seismic Class I areas of the auxiliary building were reviewed for non-seismic Class I piping whose failure might furnish a flooding potential. The worst-case source of flooding water is considered to be an ESW line break with a subsequent pump runout at 13,000 gpm. ESW is conservatively chosen even though it is a seismic class I system. This is because ESW is an open system which could pump an unlimited amount of water into the auxiliary building if there were no operator action. Calculations show that it would take 21.4 minutes to flood the auxiliary building to a 12-inch depth on the 573'-0" elevation. This is the maximum flooding depth above which there is the potential for safety systems to be adversely affected. DLA-700, located in the auxiliary building sump, would trigger in 1-2 seconds into the event, which would alert operators and provide ample time for operator action in the event of a flooding condition. A review of the east steam enclosure and other Seismic Class I areas connected to this enclosure via openings indicated that failure of the main feedwater non-Class I seismic piping might furnish a flooding potential. Sufficient drainage paths exist to preclude flooding of any equipment required for safe shutdown of the reactor. In addition, the auxiliary building arrangement was reviewed for any potential damage to the required equipment due to the cascading water as it passes through floor penetrations and stairwells toward the lowest level. The floor drains, openings and stairwell are located such that no water will drip down on required equipment from the floor above.

14.4.2.8 Reference for Section 14.4.2

1. Letter from Mr. John F. Stang of Nuclear Reactor Regulation to Mr. Robert Powers of Indiana Michigan Power dated November 21, 2000 on subject "Donald C. Cook Nuclear Plant, Units 1 and 2 - Issuance of Amendments (TAC Nos. MA8893 and MA8894).

14.4.3 Safe Shutdown Following Pipe Rupture

14.4.3.1 Control Room Habitability

The control room will be maintained habitable and its equipment functional for all design bases events. Thus, the capability to bring the reactor to a cold shutdown condition from the control room will be maintained.

14.4.3.2 Redundancy

The capability to mitigate the consequences of an accident and to bring the reactor to a cold shutdown condition is assured. Loss of redundancy of equipment required for hot shutdown for a particular accident is not permitted in the protection system (as defined in IEEE-279) or for engineered safety features equipment, cable penetrations, and their interconnecting cables. Loss of function of equipment required for cold shutdown is not permitted. Environmentally-induced failures caused by a leak or rupture, which would not in itself result in protective action but might disable protective equipment, was also considered. In this regard, a loss of redundancy will be permitted but a loss of function will not be permitted. For such situations the capability for bringing the plant to cold shutdown is assured.

14.4.3.3 Separation Criteria

Separation criteria for cable systems are described in Chapter 7.

14.4.3.4 Emergency Procedures

General emergency procedures allow for evaluation of the specific incident and determination of appropriate actions to be taken to achieve a safe shutdown condition. Prompt achievement of hot shutdown will be assured by adherence to the aforementioned criteria; maintenance of hot shutdown will be accomplished by adherence to general emergency procedures. These procedures also allow for placing the reactor in a cold shutdown condition.

14.4.3.5 Analysis of Emergency Conditions

The analyses of emergency conditions listed below are general in nature since it is deemed appropriate to allow for assessment of the incident prior to ultimately bringing the reactor to cold shutdown.

Effect of the Replacement Steam Generators on Unit 1

The effect of the RSGs on the analysis of emergency conditions has been evaluated. The analysis contained in Section 14.4.3 is general in nature and presents the expected method of operation associated with the high energy line breaks outside of containment. Steam generator replacement does not adversely affect any of the plant equipment and instrumentation required to shut down the reactor listed in Table 14.4.2-1a. Therefore, the material presented in Section 14.4.3 is unaffected by steam generator replacement.

Effect of the RTD Bypass Elimination on Unit 1

Evaluation performed to support RTD Bypass Elimination demonstrates that the conclusions of the accident analysis remain valid.

14.4.3.5.1 Main Steam Line Rupture

The following systems provide for the necessary safeguards system response to a steam pipe rupture outside the containment.

1. Safety injection system actuation from any of the following:
   a. Two out of three low pressurizer pressure signals.
   b. Low main steam line pressure (two out of four lines).[2]
   c. High differential pressure between any two SGs.
2. The overpower reactor trips (neutron flux and ΔT) and the reactor trip occurring in conjunction with receipt of the safety injection signal.
3. Redundant isolation of the main feedwater lines. Sustained high feedwater flow would cause additional cooldown. Therefore, in addition to the normal control action which will close the main feedwater valves, a safety injection signal will rapidly close all feedwater control valves, and trip the main feedwater pumps.
4. Trip of the fast acting main steam isolation valves occurs on any of the following:
   a. Low steam line pressure (two out of four lines).[3]

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[2] This "HYBRID" Steamline Break Protection was installed in Unit 1 during the refueling outage of 1997. The previous "OLD" Steamline Break Protection required high steam line flow in two out of four main steam lines, in coincidence with either low-low reactor coolant system average temperature (two out of four loops) or low main steam line pressure (two out of four lines).

[3] This "HYBRID" Steamline Break Protection was installed in Unit 1 during the refueling outage of 1997. The previous "OLD" Steamline Break Protection required high steam flow in coincidence with low steam line pressure.

b. High steam flow in any two steam lines in coincidence with low-low reactor coolant system average temperature in any two loops. Each steam line has a fast-closing stop valve capable of stopping flow in either direction. These four valves prevent blowdown of more than one steam generator for any break location even if one valve fails to close. In addition each main steam line incorporates a 16 inch diameter venturi type flow restrictor which is located inside the containment. These components limit the rate of release of steam for an outside break.

   Steamline isolation is complete 11 seconds after the setpoint is reached. The isolation time allows 8 seconds for valve closure plus three seconds for electronic delays and signal processing.

5. Safety injection actuation will also initiate automatic start of the two motor-driven feed pumps. The low-low-level signal in any two steam generators will start the turbine-driven feed pump.

The plant is designed to accept the steam line rupture outside the containment with concurrent loss of offsite power (diesel power available only) and a single active failure in a required system. For small steam line breaks at power which do not cause the reactor power to reach a point at which an immediate reactor trip would occur, no reactor core safety limit will be violated. The small break will result in a continued loss of water from the secondary side of the plant and will eventually result in condenser hotwell low level. This low level will result in a loss of main feedwater, and the reactor will be tripped on low-low steam generator level or feed/steam flow mismatch. After the trip, steam release through the break will cause reactor coolant system cooldown. The cooldown would occur until the steam generator feeding the break empties. The cooldown will automatically initiate safety injection on low pressurizer pressure. Initiation of safety injection will isolate all main feedwater by tripping closed the main feedwater control valves, tripping closed the main feedwater isolation valves, and tripping the main feedwater pumps. The trip of the feed pump turbines initiates closure of the feed pump discharge valves.

Should the plant be at hot standby or subcritical at the time of a small steam line break, the plant will be cooled down by the operator who would have other systems available following the incident to facilitate an orderly shutdown of the reactor. Hence the method and procedure to be used for shutdown will be determined by the operator based on the equipment available.

14.4.3.5.2 Feedwater Line Rupture

The following systems provide necessary protection against a loss of normal feedwater:

1. Reactor trip on low-low water level in any steam generator.
2. Reactor trip on steam/feedwater flow mismatch coincident with low water level in any steam generator.
3. Two motor driven auxiliary feedwater pumps (450 gpm nominal each) which are started on:
    a. Low-low level in any steam generator
    b. Trip of all main feed pumps
    c. Any safety injection signal
    d. Blackout signal
    e. Manually

Each of these pumps feeds two steam generators in its unit.

4. One turbine driven auxiliary feedwater pump (900 gpm) which is started on:
    a. Low-low level in any two steam generators
    b. Reactor coolant pump bus undervoltage
    c. Manually

The turbine driven auxiliary feedwater pump feeds the four steam generators on its unit.

Following the reactor and turbine trip from full load, the water level in the steam generators will fall due to the reduction of steam generator void fraction and because steam flow through the safety valves continues to dissipate the stored and generated heat. Following the initiation of the low-low level trip, the auxiliary feedwater pumps are automatically started, reducing the rate of water level decrease. The capacity of the auxiliary feedwater pumps is such that the water level in the steam generators does not recede below the lowest level at which sufficient heat transfer area is available to dissipate core residual heat without water relief from the reactor coolant system relief or safety valves. The plant is designed to accept this failure (feedwater line rupture) with concurrent loss of off-site power (diesel generator power available only) and a single active failure in a required system. In addition, all required systems are operable from the control room or accessible for manual operation.

If a rupture should occur in the feedwater line that would not directly cause a reactor trip, the operator has numerous devices (steam flow versus feedwater flow, steam generator pressure, steam generator level, etc.) to detect such an event. If deemed necessary by the operator, the reactor and main feedwater pumps could be manually tripped, resulting in automatic start of the auxiliary feedwater pumps.

14.4.3.5.3 Letdown or Charging Line Rupture

In the event of a break in the letdown line downstream of the letdown orifices' isolation valves and upstream of the letdown heat exchanger, control room indication would come from one or more of the following:

1. Sudden drop in pressure in letdown line
2. Sudden loss of letdown flow
3. Decreasing pressurizer level
4. Decreasing volume control tank level
5. Excessive makeup to the volume control tank

On any of the above indications the operator would have several methods to isolate the letdown flow.

In the event of rupture of the letdown piping the operator would have multiple indication of such an event and redundant means of isolation.

14.4.3.5.4 Main Steam To Turbine-Driven Auxiliary Feedwater Pump and Steam Generator Blowdown Line Rupture

Both of these postulated accidents are considered as small steam line ruptures and are analyzed under Section 14.4.3.5.1.

14.4.3.6 Safe Shutdown Equipment

A list of safe shutdown equipment was compiled to identify systems and components required to achieve and maintain a safe shutdown. The approach in compiling the list was to identify the safe shutdown functions, and the systems required to perform those functions considering single active failure and redundancy requirements. For each of the required systems, including the support systems, such as the power, service, instrumentation and ventilation systems, plant flow diagrams, system descriptions and one line diagrams were used to identify the required flow paths and operational characteristics that must be established to accomplish the desired safe shutdown function. From this information, a list of the components which are required for the system to perform its safe shutdown function was developed. Equipment identification number, description, system, function, building, elevation and room were identified for each component.

The Safe Shutdown Lists developed for Cook Nuclear Plant contain the minimum required equipment necessary to safely shutdown the unit following a High Energy Line Break (HELB) outside the containment.

The assumptions used in generating the Safe Shutdown Equipment List (SSEL) are:

1. The unit is operating at 100% power prior to the occurrence of HELB and concurrent loss of off-site power.
2. The reactor is tripped either manually or automatically.
3. A single active failure (in addition to loss of off-site power) is assumed in systems used to mitigate the consequences of a postulated HELB.
4. No piece of equipment required for safe shutdown is assumed to be out of service.
5. No concurrent or sequential design basis accidents or transients are assumed to occur.

The safe shutdown systems selected are those that are capable of achieving and maintaining subcritical conditions in the reactor, maintaining reactor coolant inventory, achieving and maintaining hot shutdown conditions for an extended period of time, achieving cold shutdown conditions, and maintaining cold shutdown conditions thereafter.

The primary safe shutdown systems were determined to be as follows:

- Chemical & Volume Control System
- Safety Injection System
- Reactor Coolant System
- Main Steam System
- Auxiliary Feedwater System
- Residual Heat Removal System

The supporting systems were determined to be as follows:

- Component Cooling Water System
- Essential Service Water System
- Emergency Power Systems
- 4kV Electrical Distribution System
- 250 VDC Electrical Distribution System
- 600 VAC Electrical Distribution System
- 120 VAC Electrical Distribution System
- Diesel Generator System
- HVAC Systems

Other miscellaneous safe shutdown support functions/components were determined to be as follows:

- Blowdown System Isolation
- Feedwater System Isolation
- Control Air System
- Condensate Storage Tank
- Refueling Water Storage Tank

Safe shutdown components included in the list were:

1. Active components that need to be powered to establish, or assist in establishing, the primary flow path and/or the system's operation.
2. Active components in the primary flow path that normally are in the proper position but may affect availability of path.
3. Power-operated components that need to change position to establish or assist in establishing the primary flow path, whose loss of electrical or air supplies result in the component adopting the required safe shutdown position.
4. Major passive mechanical components that support safe shutdown (heat exchangers and storage tanks).
5. Active components and check valves that isolate those branch flow paths that must be isolated and remain isolated to assure that flow would not be substantially diverted from the primary flow path.

Table 14.4.2-1 (Unit 2) and Table 14.4.2-1a (Unit 1) provide this component list (HELB-SSEL).

14.4.3.7 References for Section 14.4.3

1. D. C. Cook Report, High Energy Line Break – Safe Shutdown Equipment List, AEP Report No. NED-2000-441-REP, Sargent & Lundy Report No. SL-5396, Rev. 0, 02/18/2000 (Unit 2).
2. D. C. Cook Report, "High Energy Line Break – Safe Shutdown Equipment List, (HELB-SSEL) Report for Unit 1," AE101-HELB-001 Rev. 0, 08/04/2000.

14.4.4 Stress Calculations

Stress analyses were made on the main steam line, the feedwater line, the main steam to auxiliary feedwater pump turbine line, CVCS letdown piping, blowdown piping, and portions of condensate and heater drain piping. On all other high energy lines, the postulated break was assumed to occur anywhere. Break locations were assumed to occur at locations based on the criteria of Section 14.4.2.2.

- The main steam piping system was analyzed from containment penetrations up to, and including, the 36" bypass header. The stresses for the main steam piping system were calculated with the aid of a computer program using general flexibility and response spectra model analysis technique. The combined stress values due to thermal expansion, pressure, weight, and seismic loading conditions have been computed. Postulated design basis break locations outside containment have been determined on the basis of ANSI B31.1.0-1967 calculated stress values and the criteria given in Section 14.4.2.2.
- The feedwater piping system was analyzed from the feedwater heaters to containment penetrations. The piping was analyzed for pressure, dead weight, thermal expansion (including anchor displacements, where required), building settlement, and seismic anchor movement. Both Code stress analysis and HELB stress analysis were performed. The branch piping was de-coupled from system model.
- The Steam Generator Blowdown (BD) piping was analyzed from containment penetrations to the normal and startup flash tanks. The piping was analyzed for pressure, dead weight, thermal expansion (including anchor displacements, where required), building settlement, and seismic anchor movement.
- The CVCS Letdown piping was analyzed from containment penetration to the heat exchanger. The piping was analyzed for pressure, dead weight, thermal expansion (including anchor displacements, where required), building settlement, and seismic anchor movement.
- The Main Steam supply line to the turbine driven Auxiliary Feedwater Pump (AFP) Turbine, which is 4" in diameter, was analyzed from where it branches off from the 30" headers in the auxiliary building to the AFP Turbine.

- The portion of condensate piping from the Main Feed Pump Suction back to the L. P. heaters was analyzed for pressure, weight, thermal expansion (including anchor displacements), seismic anchor movement and seismic OBE.
- The high energy piping, including heater drains, near the number 5 feedwater heater (adjacent to the 4kV switch gear room) was analyzed for pressure, dead weight, thermal expansion (including anchor displacements, where required), building settlement (if applicable), and seismic anchor movement.

In addition to the above design-basis-break locations, a critical crack was postulated.

14.4.5 Description of Pipe Whip Analysis

The reaction load resulting from pipe rupture has the duration and initial conditions to adequately represent the jet stream dynamics and the system pressure characteristics. The piping systems in which pipe ruptures were considered are defined in Section 14.4.2.1. The loads induced by pipe rupture include the effects of any line restrictions, for example, flow limiters, between the pressure source and the break location. If a whipping pipe impacts an adjacent pipe of equal or greater nominal pipe size and equal or heavier wall thickness, the impacted pipe will be considered to be free from rupture. Protection from pipe whip is not required if pipe rupture occurs in such a manner that the unrestrained movement of either end of the ruptured pipe about a plastic hinge, formed at the nearest restraint or anchorage, cannot impact any structure, system, or component required for that incident.

Each high energy system was reviewed to determine its proximity to other systems necessary to the safe shutdown of the reactor. Restraints are provided to prevent pipe whip where there is any possibility that whip following a pipe rupture would damage systems, components, or structures that are needed to mitigate the consequences of that pipe rupture.

14.4.5.1 Method of Analysis

The locations of breaks for pipe-whip considerations are those defined in Table 14.4.2-5. For extremely short, straight piping runs, with no changes in diameter or discontinuities, intermediate breaks were not postulated. At each intermediate break location, the determination of longitudinal and/or circumferential break types was based on the analysis of the stresses. Where the total hoop stress and the total longitudinal stress differed in magnitude by less than 20%, both break types were assumed and analyzed. Where the magnitude of these two stresses differed by 20% or greater, only the break type associated with the higher stress was assumed and analyzed.

The loads induced from pipe rupture include the effects of any line restrictions between the pressure source and the break location. Rupture restraint spacing was determined by calculating the allowable spans necessary for plastic hinges to form so as to prevent contact with any necessary structure or component essential to safety. Gaps were considered. The analyses utilized either a static analysis method or an energy-balance method.

Static Analysis Method:

The thrust force resulting from the blowdown was conservatively calculated by:

F = 1.2 x P x A

Where:

F = Thrust force in pounds

P = Maximum operating pressure in psig

A = Area = internal cross sectional area of the pipe in square inches.

The forces acting on the rupture restraint were taken to be twice the blowdown force. The potential for plastic hinge formation was evaluated for selected locations by a comparison of the energy necessary versus the energy available. The energy necessary was calculated from a material strength analysis. The energy available was calculated by using an isentropic expansion of the compressed liquid to atmospheric conditions. In addition to this comparison, the time duration of blowdown was calculated to determine if the force of blowdown is applied over a sufficient time period to cause hinge formation of the pipe.

Energy Balance Method:

This method is consistent with that accepted by the NRC in Section III of the Standard Review Plan, Section 3.6.2. Principle elements of this method include:

- The blowdown thrust force is time-dependent and depends on the fluid conditions in the pipe.
- The kinetic energy of the ruptured pipe that is imparted to the restraint is balanced by/compared to the strain energy of the whip restraint structural steel.
- The restraint structural steel is allowed to yield in absorbing the energy of the ruptured pipe.

14.4.5.2 Pipe Restraints

Piping restraints were designed to accommodate the loading induced by the reaction or whipping forces from design basis breaks. For a specific break location, the pipe restraint will accommodate a longitudinal break extending one pipe diameter on each side of the high-stress point or a circumferential break at the high-stress point.

Effect of the Replacement Steam Generators on Unit 1

Each high-energy system was reviewed in the UFSAR to determine its proximity to other systems necessary for the safe shutdown of the reactor. The mass and energy releases during high energy line breaks are not increased by the RSGs. Also, the RSG has no effect on the pipe breaks outside of containment from a structural loading standpoint. Consequently, the thrust forces do not increase as a result of steam generator replacement. Therefore, the discussion in this section is not affected by steam generator replacement.

14.4.6 Compartment Pressures and Temperatures

Based on the break locations chosen according to the criteria of Section 14.4.2.2, representative break locations were analyzed for their effect on compartment pressures. The results from two computer codes (TMD and COMPARE) were used to determine the pressure and temperature associated with the postulated breaks.

The TMD computer code was used to analyze the resultant pressure and temperature from larger breaks (double ended main steam and feedwater line breaks). The COMPARE code was used to analyze the effects of the breaks postulated for the four-inch main steam to auxiliary feedwater line.

Appendix O of the original FSAR contains the results of HELB outside containment. In 1984, the issue of steam generator superheat with the MSLB outside containment was raised in NRCIE Information Notice 84-90 (Reference 2). This notice described a potential problem pertaining to plant analysis and equipment qualification with respect to a MSLB with releases of superheated steam. An analysis for the affected compartments was performed in response to this Notice (Reference 1) and updated to reflect changes to plant operating parameters. These EQ analyses were reviewed in response to the HELB program reconstitution. This later analysis only is limiting for temperature due to the superheat issue, and the original analysis remains bounding for pressure response on structures.

Evaluation of TPR, RSGs, and MUR on Unit 1

An evaluation for D.C. Cook Unit 1 related to the Steamline Break mass and energy release analyses outside containment analysis has been performed. Numerous plant changes for Unit 1 are addressed by this evaluation, including Thimble Plug Removal (TPR), Replacement Steam Generators (RSGs), and a Measurement Uncertainty Recapture (MUR) uprate program in conjunction with redefined containment volume distribution. This evaluation addresses the combined effect of these changes.

The evaluation includes analysis of the 4.6 ft^2, 1.0 ft^2, 0.6 ft^2 and 0.1 ft^2 break areas at 3327 MWt NSSS power.

The current Analysis of Record (AOR) for MSLB outside containment is conservative for all Unit 1 operating parameters with the exception of the steam pressure and temperature. Therefore, the AOR remains bounding for mass and energy release data outside containment.

14.4.6.1 Compare Code

COMPARE is a computer code developed to analyze transient containment and other sub-compartment pressure response for nuclear power plants. The sub-compartments are treated as discrete volumes connected by junctions. The volumes are characterized as a homogenous mixture, assumed to be in thermodynamic equilibrium. The mixture consists of any one, or a combination of:

1. Steam
2. Two-phase water to its triple point
3. Any three perfect gases such as air, helium, etc.

Transient flow conditions are considered as quasi-steady approximations with a correction for fluid inertia effects. Several different methods can be used for handling fluid flow characteristics.

COMPARE was only used to analyze the effects of breaks postulated for the four inch steam supply line to the AFW pump turbines.

14.4.6.2 TMD Computer Code

The analytical methods used by the TMD computer code are described in WCAP-8078. The code has been modified to reflect the modeling required for: 1) the East Steam Enclosure and 2) the West Steam Enclosure/main steam accessway. The physical nodalization and the computer flow paths are shown in Figures 14.4.6-1 through Figure 14.4.6-4.

14.4.6.3 GOTHIC Computer Code

The GOTHIC (Generation of Thermal-Hydraulic Information for Containments) code is a general-purpose thermal-hydraulics computer program for design, licensing, and operating analysis of nuclear power plant containments and other compartments or buildings. The GOTHIC 6.0 (QA) computer code was used to analyze the environmental temperature and pressure response of a HELB. This current version of the computer code was developed by Numerical Applications, Inc. (NAI) of Richland, WA under contract to the Electric Power Research Institute (EPRI).

Within the GOTHIC computer code, conservation equations for the mass, momentum and energy are solved over a three-field fluid, consisting of a mixture of liquid water, liquid droplet, and water vapor. Non-equilibrium conditions may have existed simultaneously between the three fields. Gases may have been present in equilibrium in the vapor field. Mechanistic models are used to describe the mass, momentum and energy transfer between fields.

14.4.6.4 Input for Specific Break Analyses

14.4.6.4.1 Full Size Breaks or Main Steam Feedwater Lines

Full size main steam and feedwater line breaks were analyzed with regard to high compartment differential pressure in the main steam accessway and the steam enclosures. Conservatively representative terminal end breaks for both the main steam and feedwater lines were considered in the steam enclosures (see Figure 14.4.2-1 and Figure 14.4.2-1A, Figure 14.4.2-2 and Figure 14.4.2-2A). A conservatively representative feedwater line break was considered in the main steam accessway (Figure 14.4.2-2 and Figure 14.4.2-2A). Figures 14.4.6-1 through Figure 14.4.6-4 show schematics and TMD nodal networks for the enclosures. Table 14.4.6-1 and Table 14.4.6-2 give the volumes and vent areas of the TMD elements. Mass flow rates were determined for the following break locations:

a. A 4.6 ft^2 area main steam line break in east and west steam enclosures for the superheat issue and a 4.27 ft^2 break for the pressure response.

b. 14-inch main feedwater lines in east and west steam enclosures just outside the containment penetration.

c. 20-inch main feedwater line at tee with 30-inch main feedwater line in the main steam accessway.

The mass and energy releases for case (a) were calculated assuming a break area of 4.6 ft^2. The break for the east or west steam enclosure is in the same region of the pipe as the assumed break in the fan room discussed in Section 14.3.4.2.3. The mass and energy release to the east and west main steam enclosures (WMSE and EMSE) is shown in Table 14.4.6-5 and Table 14.4.6-5A. These data were used to generate a maximum temperature profile. The mass and energy releases used for the pressure response are provided in Tables 14.4.6-6a through Table 14.4.6-6c. The mass and energy release rates for case (b), feedwater break, were calculated for a complete double-ended break (break area for both forward and reverse flow was .85 ft^2). The mass velocity for forward flow was determined using the Moody model (CD = 1.0) assuming saturated liquid discharge of feedwater at 450°F. Backflow was determined using the Moody model (CD= 1.0) for saturated liquid discharge at a pressure corresponding to zero load steam generator pressure of 1020 psia, and was assumed to continue until zero load steam generator inventory plus the piping volume had been discharged. This assumes the worst condition on each side of the break location, leading to conservative pressure results. The blowdown is given in Table 14.4.6-6.

The mass and energy release rates for case (c), feedwater break, were calculated using a break area of 1.77 ft^2 for flow in both directions. Forward flow and reverse flow were determined using the Moody model (CD = 1.0) assuming saturated liquid discharge of 450°F. Backflow was terminated when the downstream piping volume was calculated to have emptied. This blowdown is given in Table 14.4.6-7.

14.4.6.4.2 Postulated Breaks Associated with the Four-Inch Main Steam to Auxiliary Feedwater Pump Line

One break location was analyzed with regard to the postulated consequences of high differential pressure associated with the break of the main steam to auxiliary feedwater line. The break location is inside the turbine driven feedpump room. Other break locations along this four-inch line were not analyzed for the specific differential pressures resulting from the break for one or more of the following reasons:

1. Intermediate breaks have been eliminated.
2. A more severe break had been analyzed in the potential break locations (at the terminal end inside the enclosure).

14.4.6.4.3 Other High Energy Lines

The consequences of high compartmental differential pressures associated with other high energy lines were not analyzed specifically because comparison with the analysis for the four-inch steam line to the auxiliary feedpump room indicated that pressure considerations along other, smaller, lines located in larger compartments would not be limiting.

14.4.6.5 Results of Analysis

Main Steam and Feedwater Line Breaks

The results of the analysis of the main steam and feedwater line break analyses with regard to peak compartment differential pressures are presented in Tables 14.4.6-9 through Table 14.4.6-13. These pressures are defined in terms of the nodalization presented in Figure 14.4.6-2 and Figure 14.4.6-4. The relation between the nodalization used in the computer analysis and the affected slab locations is presented in Table 14.4.6-8. Detailed pressure transients for the breaks analyzed are presented in Figures 14.4.6-8, through Figure 14.4.6-11. For the case where a steam and feedwater line break was analyzed in the same compartment, only the limiting transient is shown.

Main Steam to Auxiliary Feedwater Pump Breaks

The results of this analysis show the peak differential pressure to be less than 1.75 psi and the maximum temperature to be 298°F. A comparison with steady-state hand calculations has shown this value to be a very conservative estimate of the differential pressure in the compartment.

14.4.6.6 Structural Capability to Withstand Pressure

To determine the capability of the auxiliary building to withstand forces in addition to those imposed by the support of equipment, pipe, ducts, and electrical cable tray, an additional equivalent static analysis of the main steam accessway and east and west steam enclosures was made. The analysis considered taking the members from their working condition to 0.90 f_y for the reinforcing bars and 0.9 f_c' for the concrete.

The results of this analysis are presented in Tables 14.4.6-15 through Table 14.4.6-17 and summarized in Table 14.4.6-8. The analysis takes into account only the pressure capability once the initial peak has stabilized. Dynamic analyses accounting for the initial peaks and jet forces are included in the results shown in Table 14.4.6-18, Table 14.4.6-19 and Table 14.4.6-20.

Table 14.4.6-8 presents the slab capability in light of the postulated pressures once the initial peak has stabilized. These results show that with two exceptions, the panel static capability is capable of resisting anticipated design basis loads. However, as noted in Section 14.4.9.1, the slab was modified to accommodate the consequences of the postulated overpressurization.

Table 14.4.6-18 takes into account the combined effects of postulated pressure rise and jet effects due to postulated circumferential breaks. The results from this analysis have shown that, with two exceptions, existing portions of the east and west steam enclosures were capable of withstanding calculated peak differential pressures. One is the slab WSL-1 mentioned previously, the other is slab EW-4 which is discussed in Section 14.4.9.

Table 14.4.6-19 and Table 14.4.6-20 take into account the combined effects of pressure rise and longitudinal breaks at the postulated break locations. Slabs requiring protection are noted. For the break of the four-inch main steam to auxiliary feedwater pump line in the auxiliary feedwater pump room, the room peak pressure was evaluated and found to be within the structural capabilities.

14.4.6.7 References for Section 14.4.6.

1. MSLB Environmental Analysis, Donald C. Cook Units 1 and 2, Impell Report No. 01-0120-1524, Revision 0, September 1986.
2. NRC IE Information Notice No. 84-90, "MSLB Effect on Environmental Qualification of Equipment," December 7, 1984.
3. NS&L Calculation TH 90-07, December 12, 1990.
4. NS&L Calculation TH 93-01, March 4, 1993.
5. NS&L Calculation TH 95-15, December 12, 1995.

14.4.7 Description of Jet Impingement Load Analysis

The jet impingement load is defined as the load on a component (piping, equipment, or structure) of the undeflected jet from an instantaneous circumferential or longitudinal break in a high-energy pipe. The jet forces or loads at the point of rupture are consistent with those used in the pipe whip analysis, and were based on the most severe fluid pressure and temperature conditions occurring during normal operating modes. At the point of postulated rupture, full cross sectional area breaks were assumed to discharge the high energy fluid at a rate equal to the critical flow rate. Jet blowdown impingement forces were conservatively calculated by the following formula.

F = 1.2 x P x A

Where:

F = Impingement force in pounds

P = Maximum operating pressure in psig

A = Area = cross sectional area of rupture pipe in square inches

Based on the results included in NUREG/CR 2913, the effect of the jet impingement is limited within ten pipe diameters from postulated High Energy Line Breaks and ten diameter equivalent for critical cracks. The critical crack size is defined to be one-half the pipe diameter in length and one-half the wall thickness in width. The impingement effects for a critical crack will be modeled as a rupture of a pipe with a diameter equivalent to the critical area.

For pipes initially containing steam, the jet flow away from the point of rupture is assumed to diverge at an included angle (ϕ) of 20°. The angle of divergence (ϕ) for a jet from pipes initially containing saturated or sub cooled water is determined by the expansion ratio necessary to establish equilibrium at ambient pressure and depends on the initial fluid conditions. Hence, the area of the jet at some distance from the point of a longitudinal break is:

$$A_1 = [L_1/2 + (L_3) \text{ Tan } (\phi/2)] \text{ x } [L_2/2 + (L_3) \text{ Tan } (\phi/2)]$$

Where:

A_1 = area of the jet

L_1 = width of break

L_2 = length of break

L_3 = distance to target

ϕ = angle of divergence

The locations that require protection from postulated jets have been determined. These locations are the intersections between cabling required to support operation of equipment listed in the SSEL (Table 14.4.2-1 Unit 2 and Table 14.4.2-1a, Unit 1) and the high energy lines. Protection is provided at these locations by either 1) installation of impingement barriers, 2) moving the cable to non-critical locations, or 3) other appropriate measures.

14.4.7.1 Jet-Impingement Pressures and Temperatures

Pressure

Trays bearing cables associated with equipment required to bring the reactor to a cold shutdown after a high energy line incident are protected where required from jet impingement forces.

Temperature

All control and instrument cables used in the auxiliary building are qualified for use inside the containment for accident conditions. The qualification test environments envelope the temperature excursion for the worst case high energy line break. Power cables used in the auxiliary building for Class 1E service are all rated at 90°C (190°F) for continuous operation. Production samples of power cable were aged at 121°C (250°F) for 168 hours to verify the retention of adequate physical properties. Power cable standards anticipate emergency operation at 130°C (266°F) for one 36-hour period per year without significant loss of life or function. These temperatures exceed the high energy line break requirements.

Effect of the Replacement Steam Generators on Unit 1

Evaluations for the RSGs have shown that the mass and energy releases during high energy line breaks are not increased by the RSGs. Also, the RSG has no effect on the pipe breaks outside of containment from a structural loading standpoint. Therefore, the discussion in Section 14.4.7 is not affected by steam generator replacement.

14.4.7.2 Jet Erosion of Concrete

The erosion of concrete by steam jets was evaluated in WCAP-7391, "Pressurized Water and Steam Jets Effects On Concrete" by Westinghouse Atomic Power Division. In summary, five reinforced concrete beams were subjected to steam jets with nozzle diameters of 1, 2, and 4 inches. The distances investigated between nozzles and beams were 1 foot and 4 feet; the initial system pressure was 2250 psi. The results are as follows:

Section 4, "Evaluation of Beam Behavior," pg. 4-2:

"4.2 EROSION EFFECTS

> The erosion under all beam tests was observed to be (at most) 30 mils of surface paste removal, with no significant loss of either fine or coarse aggregate. The resultant surfaces showed the same appearance as would be present after light sandblasting. It can thus be concluded that short-term erosion of concrete surfaces as a result of either a loss-of-coolant accident or steam line break is definitely not a design consideration."

Section 5, "Conclusions and Design Recommendations," pg. 5-1:

"5.1 EROSION

> As a result of the test program, no evidence was seen that concrete erosion should be a concrete design consideration. On this basis, it is recommended that no consideration be given to erosion effects in the design of concrete structures to withstand the blowdown loads for pressure and temperature conditions used in this study."

14.4.7.3 Impingement Barrier

The following requirements were met for the application of an impingement barrier at design basis break locations as a means of preventing the jet from impinging on needed safeguard systems in the event of a pipe break:

- The impingement barrier was designed to withstand the jet forces resulting from the escape of high energy fluid at the postulated pipe break location.

- The stresses imposed on the impingement barrier during dynamic pressurization shall be limited for membrane stresses produced by pressure to 90 percent of Yield Strength.
- The impingement barrier shall be a Class I structure.

Barriers are provided to protect needed equipment from adverse jet force loadings from all design bases events. The barriers provided will withstand the impingement loads, as well as the normal working loads.

14.4.8 Concrete Structure Evaluation

14.4.8.1 Containment Integrity

The present restraint system design precludes any functional damage to the containment building or to any penetrations, seals, and engineered-safety-features related piping or cables due to any of the previously described postulated breaks.

The containment shell was analyzed to verify the ability to maintain integrity with the presence of the short term pressure peak that occurs locally due to a postulated rupture of a main steam line in either the east or west steam enclosures.

Analysis has shown the ability of the structure to withstand a local pressure transient inside the containment in this same area of the containment shell (fan accumulator room) for a greater differential pressure than developed in this case for a break outside the containment.

Effect of the Replacement Steam Generators on Unit 1

Evaluations for the RSGs have shown that the mass and energy releases during a main steam line break or a LOCA are not increased by the RSGs. Therefore, the discussion in Section 14.4.8 is not affected by steam generator replacement.

14.4.8.2 Compartment Pressure-Loading Stress

The walls and slabs in the following areas were analyzed to determine the ultimate capability for a postulated high energy line break outside containment:

a. Main Steam Enclosure (East)

b. Main Steam Enclosure (West)

c. Auxiliary Building Adjacent to Main Steam Line Accessway.

Figure 14.4.8-1 and Figure 14.4.8-2 show the layout and identification marks for the walls and slabs analyzed.

To accommodate the consequences of the postulated main steam line breaks discussed previously, pressure relief panels are provided on the East and West Main Steam Enclosures that provide venting area to limit the maximum pressure developed in the enclosures. In addition, it was necessary to modify the roofs of the East and West Steam Enclosures to provide additional venting area. The extent and nature of these modifications are presented in Section 14.4.9.

In order to protect the equipment listed in Table 14.4.2-1 and Table 14.4.2-1a the (SSEL) from the consequences of high compartment differential pressure following the feedwater line break, it was necessary to analyze for the break consequences inside the main steam accessway and in the main steam enclosures. Details of the analysis are presented in Section 14.4.6. These analyses have shown that the postulated feedwater line break is less severe than that associated with the steam lines in the East and West Steam Enclosures.

Similar analyses for the postulated feedwater line breaks have been performed in the main steam accessway and the results of the analyses are also presented in Section 14.4.6. As a result of these analyses, it was found that no additional structural modifications in the main steam accessway were required to accommodate the consequences of the feedwater break.

The combined time-history representing the compartment pressure and the jet impingement force was used for the non-linear dynamic analysis. Where a slab or wall panel was not affected by jet impingement, only the compartment pressure time-history was used. No other load was assumed to be acting simultaneously.

14.4.8.3 Structural Resistance to the Loading

The resistance or ultimate load capability of each wall or slab panel was determined as follows:

a. The ultimate moment capacity was determined using principles presented in ACI 318-71. The exact expression used is given in Table 14.4.8-1.

b. Failure by flexure occurs when the yield line pattern (collapse mechanism formed by plastic hinge lines) giving the lowest over-burden load is formed.

c. The ultimate shear capacity and permissible shear stress were determined according to the provisions of ACI 318-71. The exact expressions used are given in Table 14.4.8-1 and Table14.4.8-2.

d. The ultimate load capability determined by the above requirements defines the yield force of the elastic-plastic resistance function used for the non-linear dynamic analysis.

e. The allowable limit of the ductility factor, defined as the ratio of the maximum displacement to elastic displacement, is 10.0 in panels where flexure governs the failure and 3.0 in panels where shear or diagonal tension governs.

14.4.8.4 Analysis

The following analyses were performed for walls and slabs identified in Figure 14.4.8-1 and Figure 14.4.8-2.

14.4.8.4.1 Evaluation of Ultimate Pressure Capacity

The ultimate pressure capacities of the structural elements were evaluated using yield line theory. The yield line method assumes that after initial cracking of the concrete at points of maximum moment, yielding spreads until the full moment capacity is developed along the length of the cracks on which failure will take place. Tests indicate that the actual location and extent of these lines differs only slightly at failure from theoretical ones. Use of the idealized yield lines results in little error in the determination of the ultimate resistance, and that error is on the side of safety.

To assure ductile behavior, the actual tension reinforcement ratio "p" was compared with the balanced reinforcement ratio "pg," thereby indicating sufficient ductility of the structure. The ultimate load was evaluated by assuming a yield line pattern and using the virtual work principle. For the most general cases of (i) panels with all four edges fixed, and (ii) panels with three edges fixed and one edge free, solutions were obtained for minimum uniformly distributed loads, presented in Figure 14.4.8-3 and Figure 14.4.8-4. For nonstandard cases, solutions were worked out separately. In all cases, the possibility of local collapse of a part of the structural element was considered. For the pressure capability obtained by yield line analysis, the ultimate shear stresses were evaluated at critical sections to check the possibility of premature shear failure. The shear expressions are listed in Table 14.4.8-2. The expression for the permissible ultimate shear stress is shown in Table 14.4.8-1. Where shear governed, the pressure capability was reduced in proportion to the ratio between the permissible ultimate shear stress and the calculated ultimate shear stress.

The presence of openings was considered in the analysis. The effect of openings depends on their location, size, and shape. Small compact openings located away from regions of high stress were ignored. When they were located near yield lines, the length of the yield line in the virtual work equation was reduced, by conservatively assuming the edge of the openings to be located on the yield line. In some cases, the possibility of gross relocation of yield lines due to large openings was also considered. Solutions of such cases were obtained by modifying the yield line pattern for minimum energy and, hence, minimum load.

14.4.8.4.2 Evaluation of Ultimate Impingement Force Capacity

To adapt the use of yield line analysis to this situation, the jet impingement loads were assumed to be concentrated point loads. Yield line patterns assumed for the standard cases are presented in Figure 14.4.8-5, Figure 14.4.8-6, and Figure14.4.8-7. Punching shear was checked using the impingement area as the bearing area of the concentrated load.

The effects of openings in panels were considered to be negligible because heavy bands of reinforcement were placed around all openings. A jet directed at an opening will pass through the opening to affect an adjacent area, but will have insignificant effects on the panel itself.

14.4.8.4.3 Capacity Under Combined Pressure and Impingement Force

For any panel, the pressure capacity is generally different from the impingement force capacity. From yield line theory, it was determined that a straight-line interaction curve between the pressure and impingement force capacities gave a conservative estimate of the combined capacity. The combined capacity due to a particular combination of pressure and impingement force, equivalent to a point on the interaction curve, was estimated by taking the weighted average of the pressure and impingement force capacities based on the proportions of applied pressure and impingement force. This combined capacity defines the yield force of the elasto-plastic resistance function used for the non-linear dynamic analysis, when this combined loading acts on the panel under consideration.

14.4.8.5 Structural Components

Existing Seismic Class I structures have been reviewed for their adequacy, and where required, these structures were modified to the extent necessary to ensure their integrity. Seismic Class I structural elements such as floors, interior walls, exterior walls, building penetrations and the building as a whole, were analyzed for possible reversal of loads due to the postulated accident.

Failure of any structure, including seismic Class II or Class III structures, caused by the postulated accident was reviewed to assure that it would not cause failure of any other structure, system, or component in a manner to preclude the capability to bring the plant to a safe shutdown condition.

The auxiliary building, a Seismic Class I structure, was designed to Working Stress Criteria (WSD) in accordance with Building Code ACI 318-63 for all operating load conditions including the operating basis earthquake. The structure was designed to Ultimate Strength Criteria (USD) in accordance with ACI 318-63 for all loading conditions which include the design basis earthquake and/or the design basis pipe breaks.

The structural elements which would be exposed to a pressure differential across the element are analyzed for this additional load in accordance with USD concepts of the ACI Building Code.

14.4.9 Plant Modifications

14.4.9.1 Structural

To accommodate the consequences of the postulated main steam line break in the enclosure, it was found necessary to modify the roofs of the east and west steam enclosures to provide additional vent area. The modified roof design is presented in Figure 14.4.9-1 and Figure 14.4.9-2. The modified roof design provides 491 additional square feet of vent area. This modification results in pressures that are below the design pressures in all but three areas of the enclosures. These exceptions are slabs W-SLl in the west steam enclosure (Figure 14.4.8-1) and slab EW4 (Figure 14.4.8-1) in the east steam enclosure. Slab W-SL1 was modified to accommodate the consequences of the postulated accident without failure of that segment of the slab which is safety related. The lightly reinforced section of E-W4 can fail and still allow the plant to be safely shut down.

Analyses taking into account the combined effect of jets and pressure rise have shown that jets produced by postulated full-area circumferential breaks would only cause slab W-SL1 to fail in a manner where safe shutdown of the plant would not be assured. As indicated above, this slab was modified to accommodate the consequences of the postulated accidents, such that safe shutdown was assured.

Postulation of full area longitudinal breaks will, however, result in significant design loadings on the areas indicated in Table 14.4.6-19 and Table 14.4.6-20. These walls are protected from the direct effects of a jet.

CCW Pump Protection

Main Steam (MS) and Feedwater (FW) pipes are located within a pipe chase in the vicinity of the CCW pump room. A critical crack in any of these pipes could impact any or all of the three (3) access doors, and cause them to fail to remain closed. This would create a harsh environment in the CCW pump area, for which the pumps are not qualified. Therefore, the critical crack could conceivably disable all of the CCW components for both units. In order to resolve this concern, a modification was made to install door restraints on all three (3) of the pipe chase access doors, so that they would not fail following a pipe rupture. (Reference 1)

West Main Steam Enclosure Door Enhancement

Doors 1-DR-AUX428 and 2-DR-AUX429 which open to the Auxiliary building roof from the West Main Steam Enclosures of Unit 1 and Unit 2 (respectively) were modified to ensure that the doors would open before 1 psid is reached following a Main Steam line break. These modifications were completed to ensure that the EQ requirements for the equipment within the enclosures are met during HELB conditions.

Turbine Building Block Wall Reinforcement

To preclude an adverse consequence from the postulated steam line break in the Turbine Building to the Essential Service Water Pumps, roof vent area is provided to assure the Turbine Building pressure does not exceed the structural capability of the block wall separating the Turbine Building from the Screenhouse. The block wall has been reinforced to achieve the required structural capability.

14.4.9.2 Mechanical

Based on the pipe rupture analysis, it has been concluded that:

1. No changes in pipe routing of any high-energy lines are required.
2. No movement of the mechanical equipment or valves listed in the SSEL (Table 14.4.2-1 and Table 14.4.2-1a) are required; instrumentation was relocated or protected as necessary.
3. Sufficient drainage capacity was provided to preclude flooding of any equipment required for safe shutdown of the reactor.
4. Two additional major pipe restraints were required for each unit. One restraint was added along the main feedwater line to steam generators #1 and #4 where the line splits from a single 20-inch line to two 14-inch lines outside the containment. The second restraint was at the location inside the main steam accessway, where the 20-inch feedwater line branches from the 30-inch feedwater line. These restraints prevented pipe movement from damaging the equipment listed in the SSEL. Gaps between piping and restraints were measured at temperatures. (Note: These restraints are no longer required since intermediate breaks were eliminated on feedwater piping).

AFW Pump Room Protection

The AFW pump rooms have been modified to protect them from the consequences of a HELB in the Turbine Building as well as a break of the 4 inch main steam piping in the TDAFW pump room. The rooms have been completely isolated from each other as well as the Turbine Building by maintaining the doors closed, removing the ventilation fans, and sealing opening. Safety related coolers are installed in all of the MDAFP rooms. The Unit 1 West MDAFP and Unit 2

West MDAFP Room Coolers are designed to maintain the Unit l West MDAFP Room and Unit 2 West MDAFP Room temperatures at or below 85°F normally and 104°F with the pumps running. The Unit l East MDAFP and Unit 2 East MDAFP Room Coolers are designed to maintain the room temperatures for the Unit l East MDAFP Room and Unit 2 East MDAFP Room at or below 85°F normally and 115 °F with the pumps running. The coolers reject heat to the ESW system and are powered from safety related sources.

A single cooler has been installed in each of the East and West motor driven pump rooms. These coolers are powered from the same division as the motor driven AFW pump they serve. Their ESW supply is also from the same division as its power. Redundant coolers have been provided in the TDAFW pump room. The coolers are powered from opposite divisions and are supplied with ESW from the same division as their power. This ensures that a failure of a division of power will not impair both a motor driven AFW pump and the Turbine Driven AFW pump.

Blow out panels have been installed in the TDAFW pump room to prevent over-pressurization in the event of a line break in that room. The limiting room pressure has been calculated, and the room structure as well as the seals has been qualified for this pressure.

Any safety related equipment in the AFW corridor has been qualified for the HELB environment resulting from a worst case break in the Turbine Building, a steam line break in the TDAFW pump room which may cause the room doors to open, or a critical crack of the TDAFW pump steam piping in the corridor

Pipe Support Modifications

Main Steam (Unit 1 only), Feedwater, Steam Generator Blowdown, CVCS Letdown, Condensate and Heater Drain pipes were re-analyzed. The objective was to determine ways to reduce stresses, in order to eliminate the need to postulate any intermediate breaks in accordance with the criteria discussed in Section 14.4.2. It was determined that some of the existing pipe supports need to be modified or removed, and new supports need to be added to the piping. Modifications were implemented to carry out these changes. (References 3, 4, 5)

SWGR Rooms

The ventilation air from the East and West 600V Transformer Rooms, CRID Room and CRD Equipment room was exhausted to the Turbine Building through a normally open roll-up door. A steam line break in the Turbine Building would result in steam entering the rooms listed above. The resulting environment would impact the mild environment zone classification of these rooms.

The following modifications were made to alleviate these concerns. The roll-up door and the wire mesh barrier separating the West 600V Transformer Room and Turbine Building was replaced with a single fire rated and security controlled door. HELB backdraft dampers were provided between the switchgear area and the Turbine Building. (Reference 6)

14.4.9.3 Electric and Instrumentation and Control

Based on the break location criteria defined in Section 14.4.2.2, it was concluded that minimal protective measures or revisions to present electrical cable routings, instrumentation locations, and controls routings were required. For trays containing cables associated with equipment, listed in the SSEL (Table 14.4.2-1 and Table 14.4.2-1a), they are limited in exposure to the environment for which they were designed (Section 14.4.7.1) by provision of shields, enclosures, or pipe restraints as necessary. Additional reviews were performed and no equipment or cables were identified which required protection from damage resulting from breaks or cracks.

Effect of the Replacement Steam Generators on Unit 1

Evaluations for the RSGs have shown that the mass and energy releases during high energy line breaks are not increased by the RSGs. Also, the RSG has no effect on the pipe breaks outside of containment from a structural loading standpoint. Therefore, the discussion in Section 14.4.9 is not affected by steam generator replacement.

14.4.9.4 References

1. CNP Design Change Package 2-DCP-4258, Structural Door Restraints for # 406, 407 and 408. (No Unit 1 Mod).
2. CNP Limited Design Change Package 2-LDCP-4614, West Main Steam Enclosure Door Enhancement. (1-LDCP-4736, Unit 1)
3. CNP Design Change Package 2-DCP-4259, Feedwater Support Modifications. (1-DCP-4790, Unit 1)
4. CNP Design Change Package 2-LDCP-4447, Support Modifications to CVCS Letdown and BD Piping. (1-DCP-4789, Unit 1)
5. CNP Limited Design Change Package 2-LDCP-4535, Heater Drain Line Piping Support Removal. (No Unit 1 Mod)
6. CNP Design Change Package 2-DCP-4247, HELB dampers/doors to 600V transformer Rooms. (1-DCP-4578, Unit 1).
7. CNP Engineering Change Package EC-0000051586, "Screenhouse - Turbine Building Masonry Wall HELB Boundary Modification".

14.4.10 Environment

14.4.10.1 Location of Required Equipment

The equipment required to bring the reactor to cold shutdown after a high energy line incident, and their locations in the plant, are listed in the Safe Shutdown Equipment List (SSEL) (Table 14.4.2-1 and Table 14.4.2-1a).

14.4.10.2 Equipment Capability for Operation During Incident

Motors

All motors have a Type "B," or better, insulation. Type "B" insulation consists of mica, asbestos, fiber glass, other inorganic materials, and synthetic resins capable of operation at a total temperature of 130°C (266°F). Motors for the equipment listed in the SSEL are located in areas that are not affected by the adverse environment. Total temperature includes expected temperature rise above ambient due to electrical current passing through the insulated wiring in question. Total temperature is important in that it is the maximum value that the insulation can be exposed to without degradation of the insulation. As a rule of thumb, each 10°C of temperature rise above the specified total temperature will approximately halve the effective life of Type "B" insulation. Degradation of the overall life of the motor after the accident is not of prime concern. There is no immediate problem of the device failing to function during the accident and for a reasonable time thereafter.

Solenoid Valves

All solenoid valves have a Type "H" insulation. This insulation consists basically of silicones capable of operating at an ambient temperature of 212°F. All solenoid valves exposed to an adverse environment are encased with either a weather proof or explosion proof water tight housing.

Electrical Cables

All control and instrument cables used in the auxiliary building are qualified for use inside the containment for accident conditions. The qualification test environments envelope the temperature excursion for the worst case high energy line break. Power cables used in the auxiliary building for Class 1E service are all rated at 90°C (194°F) for continuous operation. Production samples of power cable were aged at 121°C (250°F) for 168 hours to verify the retention of adequate physical properties. Power cable standards anticipate emergency operation at 130°C (266°F) for one 36-hour period per year without significant loss of life or function.

These temperatures exceed the high energy line break requirements. Because of this, no routing changes or cabling replacements were required.

Motor Starters

Motor starters are draw outs mounted in centralized motor control centers which are reasonably drip-proof, but not sealed from gradual penetration of temperature and humidity. ☐

Instruments

The instruments required for the high energy line incident were enclosed and /or modified to withstand the anticipated adverse environment. The affected instrumentation supply and signal lines and cable routings were reviewed and relocated or protected as necessary.

14.4.10.3 Seals

The control room and electrical switchgear room are provided with seals on doors and penetrations which adequately protect these areas from the adverse environment associated with the high-energy line incident. For those areas containing equipment which is not qualified to perform its function under this adverse environment, seals are provided on doors and penetrations.

These areas contain equipment which is not qualified to perform its function under this adverse environment.

The only door from the above areas to the auxiliary building is an emergency fire exit from the back of the control room panel. This door is under strict administrative control, sealed to control room isolation criteria, and exits to an area containing no high energy lines.

14.4.10.4 Ventilation

Protection from Auxiliary Building Environment

No structural modifications were required to prevent the adverse steam environment from entering the electrical switchgear room or the control rod drive equipment room. Seals on the doors adequately control the steam input from a line rupture.

Protection from Turbine Building Environment

The Seismic Class I battery rooms, and the 4160 volt switchgear rooms are similarly isolated from any adverse environment resulting from postulated high-energy pipe ruptures in the turbine building by the inclusion of back-draft or fire curtain dampers in each ventilation duct penetrating its boundary and by sealed doors. The ventilation systems for Seismic Class I auxiliary feedwater pump rooms do not interface with the Turbine Building atmosphere.

Effect of the Replacement Steam Generators on Unit 1

Evaluations for the RSGs have shown that the mass and energy releases during high energy line breaks are not increased by the RSGs. Therefore, the discussion in Section 14.4.10 is not affected by steam generator replacement.

14.4.11 Electrical Equipment Environmental Qualification

Introduction

In December 1982, the NRC issued a Safety Evaluation Report (SER) on the Donald C. Cook Nuclear Plant electrical equipment environmental qualification program (Reference 1). Attached to this SER was a four-volume Technical Evaluation Report (TER) prepared by the NRC's consultant, Franklin Research Center (FRC). Initial responses to the FRC TER were submitted to the NRC on January 24, 1983, March 4, 1983, and March 29, 1983, via letter Nos. AEP:NRC:0775, AEP:NRC:0775B, and AEP:NRC:0775A, respectively (References 2, 3, and 4).

Between receipt of the TER and submittal of the responses to the NRC, the final rulemaking on electrical equipment environmental qualification, 10 CFR 50.49, was published in the Federal Register (Vol. 48, No. 15, dated January 21, 1983). This rulemaking went into effect as of February 22, 1983.

A list of equipment items believed to be within the scope of 10 CFR 50.49 has been provided to the NRC. This list, as currently revised, is provided in Reference 11).

On January 11, 1985, the NRC issued the final SER on environmental qualification for the Cook Nuclear Plant. Specific modifications to the facility have been scheduled pursuant to the SER and agreements with the NRC.

Analytical Bases

Detailed information regarding environment temperatures, pressures, radiation doses, and chemical sprays required for qualification of safety related electrical equipment is given here. The equipment must be qualified to demonstrate that it can perform its safety-related function following a high-energy line break (HELB). (See Section 14.4.2.2 for a definition of HELB). Loss-of-coolant accident (LOCA), main steam line break (MSLB), and feedwater line break are examples of HELBs. In addition, the environment resulting from a "critical crack" (see Section 14.4.2.2 for a definition of "design basis" or "critical" crack) in the 4" branch of the main steam line that feeds the turbine-driven auxiliary feedwater pump (TDAFP), was also considered. The location of the crack has been postulated at the most adverse location.

Limiting temperature and pressure for the LOCA and MSLB in various compartments are shown. Also shown are the predicted temperature and pressure profiles in containment (to which equipment is qualified), the radiological dose rates, and the chemical spray requirements. The postulated accidents and the environmental conditions calculated for the accidents are also discussed in this section. However, the qualification conditions or testing profiles for each safety-related equipment item are not included.

Additional break locations exist within the containment structure as determined by High Energy Line Break (HELB) analyses performed per the allowances given in Generic Letter 87-11. These break locations were evaluated for their impact on surrounding structures and components. The results of these evaluations are contained within the HELB evaluation report. These breaks are of less magnitude (less mass and energy release) than the LOCA and MSLB and are bounded by those breaks.

14.4.11.1 Definition of Mild Environment

Section(c)(3) of 10 CFR 50.49 states that "Requirements for... environmental qualification of electrical equipment important to safety located in a mild environment are not included within the scope of this section. A mild environment is an environment that would at no time be significantly more severe than the environment that would occur during normal plant operation, including anticipated operational occurrences". For Cook Nuclear Plant, a harsh environment is any location related to the pipe break analysis described in the FSAR, and having the potential for the temperature of operating electrical equipment or instrumentation to greatly exceed that of normal operating conditions, as well as a relative humidity of nearly 100%. For radiation considerations, a mild environment is one in which the integrated dose is less than 104 rads. For organic materials, radiation qualification may be readily justified by existing test data or operating experience for radiation exposures below 10^4 rads. For electronic components, however, failures in metal oxide semiconductor devices occur at somewhat lower doses. For this reason, radiation qualification for electronic components may have a lower exposure threshold.

14.4.11.2 HELB Inside Containment

The LOCA and the MSLB are considered inside containment, in addition to other smaller diameter High Energy Lines (HELs). The LOCA will result in maximum radiation doses, and elevated temperatures and pressures. The LOCA may also activate the containment spray system, producing an environment of chemical spray for some portion of the accident.

The MSLB will usually produce higher temperatures and pressures, but will release less radiation, although it may also activate the containment spray system. Radiation doses from the MSLB are essentially nil when steam generator tube integrity is maintained.

High Energy Line Break (HELB) evaluations for both Units for the following High Energy Lines inside the containment have been performed.

- 32” and 30” MS Piping
- 16” and 14” FW Piping
- 14” RHR Supply Piping
- 3” Letdown Line and 2” Drain Line
- 3” and 2” Letdown Piping
- 3” Normal Charging Line
- 4” Pressurizer Spray Line
- 3” and 2” Instrument Manifold Piping (Unit 2 only)
- 2” Steam Generator Blowdown Piping from SG #1 to CPN-6
- 2” Steam Generator Blowdown Piping from SG #2 to CPN-77
- 2” Steam Generator Blowdown Piping from SG #3 to CPN-78
- 2” Steam Generator Blowdown Piping from SG #4 to CPN-79

The postulated breaks for the above lines are terminal end circumferential breaks. In addition to the terminal end breaks, intermediate breaks were also postulated on the 3” and 2” Letdown Piping (U1), the 3” Normal Charging Line (Unit 2), the 2” SG Blowdown Piping from SG #1 to CPN-6 (Both Units) and the 2” Steam Generator Blowdown Piping from SG #3 to CPN-78 (Unit 1).

The LOCA and the MSLB provide bounding conditions for temperature, pressure, and radiation.

Environment conditions are further discussed below.

14.4.11.2.1 Temperature and Pressure

The long-term temperature and pressure profiles for the LOCA in Unit 1 and Unit 2 are shown in Figure 14.3.4-6 and Figure 14.3.4-7 of the respective Unit 1 and Unit 2 UFSAR Section 14.3.4. Temperature and pressure profiles for the MSLB inside lower containment are shown in Figures 14.3.4-11 through Figure 14.3.4-16 of the respective Unit 1 and Unit 2 UFSAR Section 14.3.4. Table 14.4.11-1 of the Unit 2 UFSAR tabulates the Unit 1 and 2 peak calculated temperatures and pressures for the LOCA and MSLB and feedwater line breaks inside containment.

14.4.11.2.2 Chemical Spray

Following the LOCA or MSLB, the containment spray system initially sprays a mixture of boric acid from the RWST and sodium hydroxide from the Spray Additive Tank. When the RWST low level is reached, the containment spray pumps are realigned from the RWST to the containment recirculation sump. The containment recirculation sump water will consist of RWST water, sodium hydroxide, melted ice impregnated with sodium tetraborate, primary system water and accumulator water.

The Technical Specifications limits for capacity and boron concentration for the various contributors to the containment spray were used to evaluate the range of boron in the containment spray. Generally, containment spray will have a pH in the range of 7.0 to 10.0. This pH range is the result of a spray solution consisting of boric acid, sodium hydroxide, and after the transfer to cold leg recirculation, sodium tetraborate. If the Spray Additive Tanks are not isolated before the transfer to cold leg recirculation, the combination of recirculation sump water and sodium hydroxide from the Spray Additive Tank results in the maximum spray pH. The envelope for the maximum pH spray conditions is a pH of 13.1 and an operation time of 10 minutes.

14.4.11.2.3 Flooding Elevation

The flood level for the containment sump is 614'-0" for Unit 1 and 613'-6" for Unit 2 (Reference 9). Any safety related instrumentation located below the flood level will actuate before it becomes submerged except for containment high and low water level indicating switches, boron injection flow transmitters and their associated cable assemblies. This equipment is qualified to function after submergence.

14.4.11.2.4 Humidity

It is assumed that the containment atmosphere will be pure steam or a mixture of steam and noncondensibles at 100% relative humidity.

14.4.11.2.5 Radiation

Radiation doses inside containment are calculated by using the integrated gamma and beta radiation dose tables for either the upper or lower volume compartments of the containment. For devices above elevation 614'-0" (Unit 1); 613'-6" (Unit 2) the radiation doses in Table 14.4.11-2 are used. For devices that have been submerged below elevation 614'-0" (Unit 1); 613'-6" (Unit 2), the radiation doses in Table 14.4.11-3 are used.

Credit is taken for certain material covers to reduce the radiation dose. Only beta radiation is reduced by an attenuation factor. The attenuation factors for unit density material (e.g., water or organics such as cable jacket materials), for aluminum, and for steel are shown in Table 14.4.11-4, Table 14.4.11-5, and Table 14.4.11-6, respectively.

The inside containment integrated dose can then be calculated as follows:

Inside radiation dose (MRads) = Integrated Gamma (MRads) + Integrated Beta (MRad) x % attenuated Beta Factor.

Some equipment outside containment must also be qualified for radiation, for the LOCA event, due to radioactive liquids recirculating during the recirculation phase of the accident. Radiation doses to this equipment were determined from the calculations in Reference 10. The radiation exposure is based on the distance of a device to a discharge line. The majority of the outside containment radiation doses are calculated using a worst-case method, which assumes that the device is at the surface of a discharge line with the maximum outer diameter to wall thickness ratio. This worst-case method is used when the location of an outside containment device with respect to a discharge or sampling line cannot be ascertained. For those devices in which the distances to radioactive lines can be determined a reduction factor is used.

Table 14.4.11-7 lists the pipes and piping systems considered in calculating outside containment doses.

14.4.11.3 HELB Outside Containment

The categories of high-energy lines outside containment considered are identified in section 14.4.2.6. For each line, the criteria at the Cook Nuclear Plant require that breaks be considered at terminal ends and at intermediate points of high stress, and that "critical crack" be considered at any location.

Following the postulated break, equipment must be available to mitigate the consequences of the accident. No other accident other than the rupture need be considered.

Only temperature, pressure, and humidity need be considered for environmental consequences. Radiation is not a problem because of the limited amount of exposure. Letdown flow is radioactive, but was not considered to be a concern due to rapid isolation. Chemical environment is not a problem. Table 14.4.11-8 gives the limiting temperatures and pressures in various compartments due to a HELB outside containment.

Effect of Replacement Steam Generators on Unit 1

Evaluations for the RSGs have shown that environment temperatures, pressures, radiation doses and pH for safety related electrical equipment are not adversely affected by the use of the RSGs. Therefore, the discussion in Section 14.4.11 is not affected by steam generator replacement.

14.4.11.4 References

1. Letter dated December 30, 1982 (Varga to Dolan) enclosing the Safety Evaluation Report and Technical Evaluation Reports dated October 28, 1982.
2. AEP:NRC:0775, January 24, 1983 (Hunter to Denton).
3. AEP:NRC:0775B, March 4, 1983 (Hunter to Denton).
4. AEP:NRC:0775A, March 29, 1983 (Hering to Denton).
5. AEP:NRC:1067, "Reduced Temperature and Pressure Program Analyses and Technical Specification Changes," dated October 17, 1988.
6. Reference deleted.
7. Reference deleted.
8. Reference deleted.
9. Nuclear Safety and Licensing Calculation TH-97-16.
10. Nuclear Safety and Licensing Calculation RS-80-01.
11. DCC-QA105-QCN Revision 9, "Environmental Qualification Equipment List," February 13, 1996.
12. NED-2000-514-REP, “HELB Program – Target Evaluation Report”, Revision 0, April 20, 2000 (NDIS File MV-ENV-03).
13. Calculation SD-000727-001, “HELB: Identification of the Unit 1 High Energy Lines and Postulation of High Energy Line Breaks”.
14. Calculation SD-990825-003, “HELB: Identification of the Unit 2 High Energy Lines and Postulation of High Energy Line Breaks”.

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
12-HV-ACCP-1	CCW Pump Ventilation North Supply Fan	Auxiliary Building Ventilation	Auxiliary	633	633 Hallway	633
12-HV-ACCP-2	CCW Pump Ventilation Middle Supply Fan	Auxiliary Building Ventilation	Auxiliary	633	633 Hallway	633
12-HV-ACCP-3	CCW Pump Ventilation South Supply Fan	Auxiliary Building Ventilation	Auxiliary	633	633 Hallway	633
12-HV-ESW-1	Unit 2 East Essential Service Water Pump Room Supply Ventilation Fan	ESW Ventilation	Screenhouse	591	East ESW Pump Room	135
12-HV-ESW-2	Unit 2 East Essential Service Water Pump Room Supply Ventilation Fan	ESW Ventilation	Screenhouse	591	East ESW Pump Room	135
12-HV-ESW-3	Unit 2 West Essential Service Water Pump Room Supply Ventilation Fan	ESW Ventilation	Screenhouse	591	West ESW Pump Room	136

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
12-HV-ESW-4	Unit 2 West Essential Service Water Pump Room Supply Ventilation Fan	ESW Ventilation	Screenhouse	591	West ESW Pump Room	136
12-TK-47-AB	Diesel Fuel Oil Storage Yard Tanks AB	Diesel Fuel Oil	Grounds	609	Inner Plant Grounds	244
12-TK-47-CD	Diesel Fuel Oil Storage Yard Tanks CD	Diesel Fuel Oil	Grounds	609	Inner Plant Grounds	244
2-20-SV-1-AB	Solenoid Valve to POV-1-AB	Compressed Air	Auxiliary	587	AB EDG Room	121
2-20-SV-1-CD	Solenoid Valve to POV-1-CD	Compressed Air	Auxiliary	587	CD EDG Room	122
2-20-SV-2-AB	Solenoid Valve to POV-2-AB	Compressed Air	Auxiliary	587	AB EDG Room	121
2-20-SV-2-CD	Solenoid Valve to POV-2-CD	Compressed Air	Auxiliary	587	CD EDG Room	122

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-20-SV-3-AB	Solenoid Valve to XRV-220	Compressed Air	Auxiliary	587	AB EDG Room	121
2-20-SV-3-CD	Solenoid Valve to XRV-225	Compressed Air	Auxiliary	587	CD EDG Room	122
2-21A	600Vac Bus 21A	600Vac	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-21A11	600Vac Bus 21A Supply Breaker	600Vac	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-21A2	600Vac MCC AM-A Supply Breaker	600Vac	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-21A5	600Vac MCC ABD-A Supply Breaker	600Vac	Auxiliary	609	4kv Room - 600v Switchgear Area	204

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-21A6	600Vac MCCs AB-A, PS-A, TPP-A, and VCCS ABV-A, AZV-A Supply Breaker	600Vac	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-21A9	600Vac MCC EZC-A Supply Breaker	600Vac	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-21B	600Vac Bus 21B Supply Breaker	600Vac	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-21B1	600Vac MCC ABD-B Supply Breaker (2-ELSC)	600Vac	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-21B11	600Vac Bus 21B Supply Breaker	600Vac	Auxiliary	609	4kv Room - 600v Switchgear Area	204

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-21B2	600Vac MCC EZC-B Supply Breaker	600Vac	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-21C	600Vac Bus 21C	600Vac	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-21C1	600v Bus 21C Supply Breaker	600Vac	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-21C10	600Vac MCC ABD-C and 2-AFW Supply Breaker	600Vac	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-21C6	600Vac MCC EZC-C Supply Breaker	600Vac	Auxiliary	609	4kv Room - 600v Switchgear Area	204

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-21D	600Vac Bus 21D	600Vac	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-21D1	600v Bus 21D Supply Breaker	600Vac	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-21D14	600Vac MCC 2-AB-D, VCC 2-ABV-D, MCC 2-PS-D Supply Breaker	600Vac	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-21D5	600Vac MCC ABD-D Supply Breaker	600Vac	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-21D6	600Vac MCC EZC-D Supply Breaker	600Vac	Auxiliary	609	4kv Room - 600v Switchgear Area	204

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-21D8	600Vac MCC AM-D Supply Breaker	600Vac	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-52-BYA	Reactor Rod Control TR-A Reactor Trip Bypass Circuit Breaker	Reactor Trip Breaker (Rod Control & Inst.)	Auxiliary	609	Control Rod Drive Equipment Room	203
2-52-BYB	Reactor Rod Control Train B Reactor Trip Bypass Circuit Breaker	Reactor Trip Breaker (Rod Control & Inst.)	Auxiliary	609	Control Rod Drive Equipment Room	203
2-52-RTA	Reactor Rod Control Train 'A' Reactor Trip Circuit Breaker	Rod Control and Instrumentation	Auxiliary	609	Control Rod Drive Equipment Room	203

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-52-RTB	Reactor Rod Control Train 'B' Reactor Trip Circuit Breaker	Rod Control and Instrumentation	Auxiliary	609	Control Rod Drive Equipment Room	203
2-AB-A	600Vac Motor Control Center AB-A	600Vac	Auxiliary	587	587 Hallway	587
2-AB-D	600Vac Motor Control Center AB-D	600Vac	Auxiliary	587	587 Hallway	587
2-ABD-A	600Vac Motor Control Center ABD-A	600Vac	Auxiliary	587	AB EDG Room	121
2-ABD-B	600Vac Motor Control Center ABD-B	600Vac	Auxiliary	587	AB EDG Room	121
2-ABD-C	600Vac Motor Control Center ABD-C	600Vac	Auxiliary	587	CD EDG Room	122
2-ABD-D	600Vac Motor Control Center ABD-D	600Vac	Auxiliary	587	CD EDG Room	122

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-AB-N	Control Center Valve	250Vdc Control and Instrumentation	Auxiliary	587	587 Hallway	587
2-ABV-A	600Vac Valve Control Center ABV-A	600Vac	Auxiliary	587	587 Hallway	587
2-ABV-D	600Vac Valve Control Center ABV-D	600Vac	Auxiliary	587	587 Hallway	587
2-AFW	120/208 Vac AFW Distribution Panel	120/208Vac Misc Safety Related Power Distribution	Auxiliary	587	CD EDG Room	122
2-AFWX	120/208 Vac AFW Auxiliary Distribution Panel	120/208Vac Misc Safety Related Power Distribution	Auxiliary	587	CD EDG Room	122
2-AM-A	600Vac Motor Control Center AM-A	600Vac	Auxiliary	633	633 Hallway	633

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-AM-D	600Vac Motor Control Center AM-D	600Vac	Auxiliary	633	633 Hallway	633
2-ARA-2	Reactor Protection Train 'A' Auxiliary Relay Cabinet #2	120/208Vac Misc Safety Related Power Distribution	Auxiliary	633	Control Room	123
2-ARB-2	Reactor Protection Train 'B' Auxiliary Relay Cabinet #2	120/208Vac Misc Safety Related Power Distribution	Auxiliary	633	Control Room	123
2-AZV-A	600Vac Valve Control Center AZV-A	600Vac	Auxiliary	609	609 Hallway	609
2-BATT-AB	Plant Battery AB	250Vdc	Auxiliary	609	AB BATT Equip Area	200
2-BATT-AB-SH	Plant Battery BATT-AB Ammeter Shunt	250Vdc	Auxiliary	613	4kv Room - Mezzanine Area	205

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-BATT-CD	Plant Battery CD	250Vdc	Auxiliary	626	CD BATT Equip Area	201
2-BATT-CD-SH	Plant Battery BATT-CD Ammeter Shunt Cabinet	250Vdc	Auxiliary	626	CD BATT Equip Area	201
2-BATT-N	Train 'N' Plant Battery	250Vdc Control and Instrumentation	Auxiliary	633	Plant Battery Train 'N' Auxiliary Equipment Room	263
2-BATT-N-SH	Train 'N' Plant Battery Ammeter Shunt Cabinet	250Vdc Control and Instrumentation	Auxiliary	633	633 Hallway	633
2-BC-A	Battery Charger A for N-Train Battery	250Vdc Control and Instrumentation	Auxiliary	633	633 Hallway	633
2-BC-AB1	Plant Battery BATT-AB Battery Charger #1	250Vdc	Auxiliary	613	4kv Room - Mezzanine Area	205

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-BC-AB2	Plant Battery BATT-AB Charger #2	250Vdc	Auxiliary	613	4kv Room - Mezzanine Area	205
2-BC-AB-SH	Plant Battery Charger Ammeter BC-AB Shunt Cabinet	250Vdc	Auxiliary	613	4kv Room - Mezzanine Area	205
2-BC-B	Battery Charger B for N-Train Battery	250Vdc Control and Instrumentation	Auxiliary	633	633 Hallway	633
2-BC-CD1	Plant Battery BATT-CD Charger #1	250Vdc	Auxiliary	626	CD BATT Equip Area	201
2-BC-CD2	Plant Battery BATT-CD Charger #2	250Vdc	Auxiliary	626	CD BATT Equip Area	201
2-BC-CD-SH	Plant Battery Charger BC-CD Shunt Cabinet	250Vdc	Auxiliary	626	CD BATT Equip Area	201
2-BCTC-AB	Plant Battery Chargers BC-AB1 and BC-AB2 Transfer Switch Cabinet	250Vdc	Auxiliary	613	4kv Room - Mezzanine Area	205

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-BCTC-CD	Plant Battery Chargers BC-CD1 and BC-CD2 Transfer Cabinet	250Vdc	Auxiliary	626	CD BATT Equip Area	201
2-BLI-110	Steam Generator OME-3-1 Wide Range Level Indicator Transmitter	Main Steam	Containment	612	Accumulator Tank #1 Area	68
2-BLI-120	Steam Generator OME-3-2 Wide Range Level Indicator Transmitter	Main Steam	Containment	612	West Containment Lower Vent Room	73
2-BLI-130	Steam Generator OME-3-3 Wide Range Level Indicator Transmitter	Main Steam	Containment	612	Accumulator Tank #3 Area	70
2-BLI-140	Steam Generator OME-3-4 Wide Range Level Indicator Transmitter	Main Steam	Containment	612	Accumulator Tank #4 Area	71
2-BLP-110	Steam Generator OME-3-1 Channel 4 Reactor Protection Input Narrow Range Level Transmitter	Main Steam	Containment	612	Accumulator Tank #1 Area	68

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-BLP-111	Steam Generator OME-3-1 Channel 2 Reactor Protection Input Narrow Range Level Transmitter	Main Steam	Containment	612	East Containment Lower Vent Room	72
2-BLP-112	Steam Generator OME-3-1 Channel 3 Reactor Protection Input Narrow Range Level Transmitter	Main Steam	Containment	612	East Containment Lower Vent Room	72
2-BLP-120	Steam Generator OME-3-2 Channel 4 Reactor Protection Input Narrow Range Level Transmitter	Main Steam	Containment	612	West Containment Lower Vent Room	73
2-BLP-121	Steam Generator OME-3-2 Channel 1 Reactor Protection Input Narrow Range Level Transmitter	Main Steam	Containment	612	West Containment Lower Vent Room	73

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-BLP-122	Steam Generator OME-3-2 Channel 3 Reactor Protection Input Narrow Range Level Transmitter	Main Steam	Containment	612	Accumulator Tank #2 Area	69
2-BLP-130	Steam Generator OME-3-3 Channel 4 Reactor Protection Input Narrow Range Level Transmitter	Main Steam	Containment	612	West Containment Lower Vent Room	73
2-BLP-131	Steam Generator OME-3-3 Channel 1 Reactor Protection Input Narrow Range Level Transmitter	Main Steam	Containment	612	West Containment Lower Vent Room	73
2-BLP-132	Steam Generator OME-3-3 Channel 3 Reactor Protection Input Narrow Range Level Transmitter	Main Steam	Containment	612	West Containment Lower Vent Room	73

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-BLP-140	Steam Generator OME-3-4 Channel 4 Reactor Protection Input Narrow Range Level Transmitter	Main Steam	Containment	612	East Containment Lower Vent Room	72
2-BLP-141	Steam Generator OME-3-4 Channel 2 Reactor Protection Input Narrow Range Level Transmitter	Main Steam	Containment	612	East Containment Lower Vent Room	72
2-BLP-142	Steam Generator OME-3-4 Channel 3 Reactor Protection Input Narrow Range Level Transmitter	Main Steam	Containment	612	Accumulator Tank #4 Area	71
2-CA-711	Containment 85 PSI Control Air Ring Header #2 to Control Valve NRV-152 Check Valve	Control Air	Containment	625	Lower Containment, Quadrant #4	63
2-CA-713	Containment 85 PSI Control Air Ring Header to Control Valve NRV-153 Check Valve	Control Air	Containment	625	Lower Containment, Quadrant #4	63

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-CAS	Containment Auxiliaries Subpanel (Ventilation)	Containment Ventilation	Auxiliary	633	633 Hallway	633
2-CCV-AB	250Vdc Train 'B' Critical Solenoid Valves Distribution Panel	250Vdc	Auxiliary	633	Control Room	123
2-CCV-CD	250Vdc Train 'A' Critical Solenoid Valves Distribution Panel	250Vdc	Auxiliary	633	Control Room	123

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-CMO-410	East CCW Heat Exchanger HE-15E CCW Outlet Shutoff Valve	Component Cooling Water	Auxiliary	609	609 Hallway	609
2-CMO-411	CCW Pumps Suction Crosstie Train 'A' Misc. Service Shutoff Valve	Component Cooling Water	Auxiliary	609	609 Hallway	609
2-CMO-412	CCW Pumps Discharge Crosstie Train 'A' Shutoff Valve	Component Cooling Water	Auxiliary	609	609 Hallway	609
2-CMO-413	CCW Pumps Suction Crosstie Train 'B' Misc. Service Shutoff Valve	Component Cooling Water	Auxiliary	609	609 Hallway	609
2-CMO-414	CCW Pumps Discharge Crosstie Train 'B' Shutoff Valve	Component Cooling Water	Auxiliary	609	609 Hallway	609
2-CMO-415	CCW to Miscellaneous Service Train 'A' Shutoff Valve	Component Cooling Water	Auxiliary	609	609 Hallway	609

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-CMO-416	CCW to Miscellaneous Service Header 'B' 16" Motor Operated Shutoff Valve	Component Cooling Water	Auxiliary	609	609 Hallway	609
2-CMO-419	East RHR Heat Exchanger HE-17E CCW Outlet Shutoff Valve	Component Cooling Water	Auxiliary	609	609 Hallway	609
2-CMO-420	West CCW Heat Exchanger HE-15W CCW Outlet Shutoff Valve	Component Cooling Water	Auxiliary	609	609 Hallway	609
2-CMO-429	West RHR Heat Exchanger HE-17W CCW Outlet Shutoff Valve	Component Cooling Water	Auxiliary	633	633 Hallway	633
2-CPS-312	AB Emergency Diesel Jacket Water Pump QT-130-AB1 Discharge Pressure Switch	Diesel Jacket Water	Auxiliary	587	AB EDG Room	121
2-CPS-314	AB Emergency Diesel Jacket Water Pump QT-130-AB2 Discharge Pressure Switch	Diesel Jacket Water	Auxiliary	587	AB EDG Room	121

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-CPS-317	CD Emergency Diesel Jacket Water Pump QT-130-CD1 Discharge Pressure Switch	Diesel Jacket Water	Auxiliary	587	CD EDG Room	122
2-CPS-319	CD Emergency Diesel Jacket Water Pump QT-130-CD2 Discharge Pressure Switch	Diesel Jacket Water	Auxiliary	587	CD EDG Room	122
2-CPS-410	East Component Cooling Water Pump PP-10E Discharge Pressure Switch	Component Cooling Water	Auxiliary	609	609 Hallway	609
2-CPS-420	West Component Cooling Water Pump PP-10w Discharge Pressure Switch	Component Cooling Water	Auxiliary	609	609 Hallway	609
2-CRAB	250Vdc Control Room Distribution Panel CRAB	250Vdc	Auxiliary	633	Control Room	123
2-CRCD	250Vdc Control Room Distribution Panel CRCD	250Vdc	Auxiliary	633	Control Room	123

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-CRID-I	120Vac Control Room Instrument Distribution Channel I Distribution Panel	120Vac Control Room Instrumentation Distr	Auxiliary	633	Control Room	123
2-CRID-I-CVT	120Vac Control Room Instrument Distribution Channel I Constant Voltage Transformer	120Vac Control Room Instrumentation Distr	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-CRID-II	120Vac Control Room Instrument Distribution Channel II Distribution Panel	120Vac Control Room Instrumentation Distr	Auxiliary	633	Control Room	123
2-CRID-II-CVT	120Vac Control Room Instrument Distribution Channel II Constant Voltage Transformer	120Vac Control Room Instrumentation Distr	Auxiliary	609	4kv Room - 600v Switchgear Area	204

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-CRID-III	120Vac Control Room Instrument Distribution Channel III Distribution Panel	120Vac Control Room Instrumentation Distr	Auxiliary	633	Control Room	123
2-CRID-III-CVT	120Vac Control Room Instrument Distribution Channel III Constant Voltage Transformer	120Vac Control Room Instrumentation Distr	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-CRID-III-INV	120Vac Control Room Instrumentation Distribution System Channel III Inverter	120Vac Control Room Instrumentation Distr	Auxiliary	609	Inverter Area	202
2-CRID-II-INV	120Vac Control Room Instrument Distribution System Channel II Inverter	120Vac Control Room Instrumentation Distr	Auxiliary	609	Inverter Area	202

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-CRID-I-INV	120Vac Control Room Instrument Distribution System Channel I Inverter	120Vac Control Room Instrumentation Distr	Auxiliary	609	Inverter Area	202
2-CRID-IV	120Vac Control Room Instrument Distribution Channel IV Distribution Panel	120Vac Control Room Instrumentation Distr	Auxiliary	633	Control Room	123
2-CRID-IV-CVT	120Vac Control Room Instrument Distribution Channel IV Constant Voltage Transformer	120Vac Control Room Instrumentation Distr	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-CRID-IV-INV	120Vac Control Room Instrument Distribution System Channel IV Inverter	120Vac Control Room Instrumentation Distr	Auxiliary	609	Control Room	123

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-CS-304	CVCS Reciprocating Charging Pump Inlet Isolation Valve	(CVCS) Charging	Auxiliary	587	Reciprocating Charging Pump Room	39
2-CS-306	CVCS Reciprocating Charging Pump Outlet Isolation Valve	(CVCS) Charging	Auxiliary	587	Reciprocating Charging Pump Room	39

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-CTR-415	East Component Cooling Water Heat Exchanger HE-15E CCW Outlet Temperature Recorder Thermal Sensor	Component Cooling Water	Auxiliary	609	609 Hallway	609
2-CTR-425	West Component Cooling Water Heat Exchanger CCW Outlet Temperature Recorder Thermal Sensor	Component Cooling Water	Auxiliary	609	609 Hallway	609
2-DCN	250Vdc Distribution Panel DCN	250Vdc Control and Instrumentation	Auxiliary	633	633 Hallway	633
2-DCR-310	Steam Generator OME-3-1 Blowdown Containment Isolation Valve	Blowdown	Auxiliary	591	Startup Blowdown Flashtank Room	29
2-DCR-320	Steam Generator OME-3-2 Blowdown Containment Isolation Valve	Blowdown	Auxiliary	591	Startup Blowdown Flashtank Room	29

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-DCR-330	Steam Generator OME-3-3 Blowdown Containment Isolation Valve	Blowdown	Auxiliary	591	Startup Blowdown Flashtank Room	29
2-DCR-340	Steam Generator OME-3-4 Blowdown Containment Isolation Valve	Blowdown	Auxiliary	591	Startup Blowdown Flashtank Room	29
2-DG-102A	AB Emergency Diesel Starting Air Compressor QT-142-AB2 Outlet Check Valve	Diesel Starting Air	Auxiliary	587	AB EDG Room	121
2-DG-102C	CD Emergency Diesel Starting Air Compressor QT-142-CD2 Outlet Check Valve	Diesel Starting Air	Auxiliary	587	CD EDG Room	122
2-DG-104A	AB Emergency Diesel Starting Air Compressor QT-142-AB1 Outlet Check Valve	Diesel Starting Air	Auxiliary	587	AB EDG Room	121

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-DG-104C	CD Emergency Diesel Starting Air Compressor QT-142-CD1 Outlet Check Valve	Diesel Starting Air	Auxiliary	587	CD EDG Room	122
2-DGAB	AB Emergency Diesel Generator OME-150-AB Control Subpanel	Diesel Generator, Control & Instrumentation	Auxiliary	587	AB EDG Room	121
2-DGAB-FFCKT	AB Emergency Diesel Generator OME-150-AB Field Flash Circuit Transformer	Diesel Generator, Control & Instrumentation	Auxiliary	587	AB EDG Room	121
2-DGAB-INV	AB Emergency Diesel Generator OME-150-AB Inverter	Diesel Generator, Control & Instrumentation	Auxiliary	587	AB EDG Room	121

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-DGAB-X	Equip Ctrl and Indication STN/AB Emergency Diesel Generator 150 Aux Panel	Diesel Generator, Control & Instrumentation	Auxiliary	587	AB EDG Room	121
2-DGCD	CD Emergency Diesel Generator OME-150-CD Control Subpanel	Diesel Generator, Control & Instrumentation	Auxiliary	587	CD EDG Room	122
2-DGCD-FFCKT	CD Emergency Diesel Generator OME-150-CD Field Flash CKT Transformer	Diesel Generator, Control & Instrumentation	Auxiliary	587	CD EDG Room	122
2-DGCD-INV	CD Emergency Diesel Generator OME-150-CD Inverter	Diesel Generator, Control & Instrumentation	Auxiliary	587	CD EDG Room	122

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-DGCD-X	Equip Ctrl and Indication STN/CD Emergency Diesel Generator 150 Aux Panel	Diesel Generator, Control & Instrumentation	Auxiliary	587	CD EDG Room	122
2-DW-163N	Control Room Vent North Chill Water Circulation Manual Isolation Valve	Control Room Ventilation	Auxiliary	650	Control Rm A/C Room	129
2-DW-163S	Control Room Vent South Chill Water Circulation Manual Isolation Valve	Control Room Ventilation	Auxiliary	650	Control Rm A/C Room	129
2-ELSC	120/208 Vac Emergency Local Shutdown Distribution Panel	120/208Vac Misc Safety Related Power Distribution	Auxiliary	587	AB EDG Room	121
2-ELSCX	120/208Vac Emergency Local Shutdown Auxiliary Distribution Panel	120/208Vac Misc Safety Related Power Distribution	Auxiliary	587	AB EDG Room	121

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-ESW-240	ESW Supply Valve to Turbine-Driven AFW Pump PP-4	Essential Service Water	Turbine	591	TDAFP Room	49
2-ESW-243	ESW Supply Valve to Motor-Driven AFW Pump PP-3W	Essential Service Water	Turbine	591	West MDAFP Room	51
2-EZC-A	600Vac Motor Control Center EZC-A	600Vac	Auxiliary	613	4kv Room - Mezzanine Area	205
2-EZC-B	600Vac Motor Control Center EZC-B	600Vac	Auxiliary	613	4kv Room - Mezzanine Area	205
2-EZC-C	600Vac Motor Control Center EZC-C	600Vac	Auxiliary	613	4kv Room - Mezzanine Area	205
2-EZC-D	600Vac Motor Control Center EZC-D	600Vac	Auxiliary	613	4kv Room - Mezzanine Area	205
2-FFC-210	Feedwater to Steam Generator #1 Channel I Flow Control Transmitter	Feedwater	Auxiliary	621	East Main Steam Stop Enclosure	10
2-FFC-211	Feedwater to Steam Generator #1 Channel II Flow Control Transmitter	Feedwater	Auxiliary	621	East Main Steam Stop Enclosure	11

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-FFC-220	Feedwater to Steam Generator #2 Channel I Flow Control Transmitter	Feedwater	Auxiliary	587	West Feedwater Regulating Valve Area	48
2-FFC-221	Feedwater to Steam Generator #2 Channel II Flow Control Transmitter	Feedwater	Auxiliary	587	West Feedwater Regulating Valve Area	48
2-FFC-230	Feedwater to Steam Generator #3 Channel I Flow Control Transmitter	Feedwater	Auxiliary	587	West Feedwater Regulating Valve Area	48
2-FFC-231	Feedwater to Steam Generator #3 Channel II Flow Control Transmitter	Feedwater	Auxiliary	587	West Feedwater Regulating Valve Area	48
2-FFC-240	Feedwater to Steam Generator #4 Channel I Flow Control Transmitter	Feedwater	Auxiliary	612	East Feedwater Regulating Valve Area	13

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-FFC-241	Feedwater to Steam Generator #4 Channel II Flow Control Transmitter	Feedwater	Auxiliary	612	East Feedwater Regulating Valve Area	13
2-FFI-210	Auxiliary Feedwater to Steam Generator OME-3-1 Flow Indicator Transmitter	Auxiliary Feedwater	Auxiliary	621	East Main Steam Stop Enclosure	10
2-FFI-220	Auxiliary Feedwater to Steam Generator OME-3-2 Flow Indicator Transmitter	Auxiliary Feedwater	Auxiliary	621	West Main Steam Stop Enclosure	9
2-FFI-230	Auxiliary Feedwater to Steam Generator OME-3-3 Flow Indicator Transmitter	Auxiliary Feedwater	Auxiliary	621	West Main Steam Stop Enclosure	9
2-FFI-240	Auxiliary Feedwater to Steam Generator OME-3-4 Flow Indicator Transmitter	Auxiliary Feedwater	Auxiliary	621	East Main Steam Stop Enclosure	10
2-FFS-244	West Motor Driven Auxiliary Feedwater Pump PP-3W Discharge Flow Switch	Auxiliary Feedwater	Turbine	591	West MDAFP Room	51
2-FFS-245	West Motor Driven Auxiliary Feedwater Pump PP-3W Discharge Flow Switch	Auxiliary Feedwater	Turbine	591	West MDAFP Room	51

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-FFS-254	East Motor Driven Auxiliary Feedwater Pump PP-3E Discharge Flow Switch	Auxiliary Feedwater	Turbine	591	Auxiliary Feed Pump East Hallway	83
2-FFS-255	East Motor Driven Auxiliary Feedwater Pump PP-3E Discharge Flow Switch	Auxiliary Feedwater	Turbine	591	Auxiliary Feed Pump East Hallway	83
2-FFS-258	Turbine Driven Auxiliary Feedwater Pump PP-4 Discharge Flow Switch	Auxiliary Feedwater	Turbine	591	Auxiliary Feed Pump East Hallway	83
2-FFS-260	Turbine Driven Auxiliary Feedwater Pump PP-4 Discharge Flow Switch	Auxiliary Feedwater	Turbine	591	TDAFP Room	49
2-FMO-211	Turbine Driven Auxiliary Feed Pump PP-4 Discharge to Steam Generator OME-3-1 4" Motor Operated Control Valve	Auxiliary Feedwater	Auxiliary	612	East Main Steam Stop Enclosure	10

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-FMO-212	West Motor Driven Auxiliary Feedwater Pump PP-3W Supply to Steam Generator OME-3-1 4" Motor Operated Control Valve	Auxiliary Feedwater	Auxiliary	612	East Main Steam Stop Enclosure	10
2-FMO-221	Turbine Driven Auxiliary Feed Pump PP-4 Discharge to Steam Generator OME-3-2 4" Motor Operated Control Valve	Auxiliary Feedwater	Auxiliary	591	Startup Blowdown Flashtank Room	29
2-FMO-222	East Motor Driven Auxiliary Feedwater Pump PP-3E Supply to Steam Generator OME-3-2 4" Motor Operated Control Valve	Auxiliary Feedwater	Auxiliary	591	Startup Blowdown Flashtank Room	29
2-FMO-231	Turbine Driven Auxiliary Feed Pump PP-4 Supply to Steam Generator OME-3-3 4" Motor Operated Control Valve	Auxiliary Feedwater	Auxiliary	591	Startup Blowdown Flashtank Room	29
2-FMO-232	East Motor Driven Auxiliary Feedwater Pump PP-3E Supply to Steam Generator OME-3-3 4" Motor Operated Control Valve	Auxiliary Feedwater	Auxiliary	591	Startup Blowdown Flashtank Room	29

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-FMO-241	Turbine Driven Auxiliary Feed Pump PP-4 Supply to Steam Generator OME-3-4 4" Motor Operated Control Valve	Auxiliary Feedwater	Auxiliary	612	East Main Steam Stop Enclosure	10
2-FMO-242	West Motor Driven Auxiliary Feedwater Pump PP-3W Supply to Steam Generator OME-3-4 4" Motor Operated Control Valve	Auxiliary Feedwater	Auxiliary	612	East Main Steam Stop Enclosure	10
2-FRV-210	Steam Generator OME-3-1 Feedwater Regulating Valve	Feedwater	Auxiliary	612	East Feedwater Regulating Valve Area	13
2-FRV-220	Steam Generator OME-3-2 Feedwater Regulating Valve	Feedwater	Auxiliary	587	West Feedwater Regulating Valve Area	48
2-FRV-230	Steam Generator OME-3-3 Feedwater Regulating Valve	Feedwater	Auxiliary	587	West Feedwater Regulating Valve Area	48

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-FRV-240	Steam Generator OME-3-4 Feedwater Regulating Valve	Feedwater	Auxiliary	612	East Feedwater Regulating Valve Area	13
2-FRV-245	West Motor Driven Auxiliary Feed Pump PP-3W 2" Air Operated Test Valve	Auxiliary Feedwater	Turbine	591	West MDAFP Room	51
2-FRV-247	West Motor Driven Auxiliary Feed Pump PP-3W Emergency 1" Air Operated Leakoff Globe Valve	Auxiliary Feedwater	Turbine	591	West MDAFP Room	51
2-FRV-255	East Motor Driven Auxiliary Feedwater Pump PP-3E 2" Air Operated Test Valve	Auxiliary Feedwater	Turbine	591	East MDAFP Room	50
2-FRV-256	Turbine Driven Auxiliary Feed Pump PP-4 2" Air Operated Test Valve	Auxiliary Feedwater	Turbine	591	TDAFP Room	49
2-FRV-257	East Motor Driven Auxiliary Feedwater Pump PP-3E Emergency 1" Air Operated Leakoff Valve	Auxiliary Feedwater	Turbine	591	East MDAFP Room	50

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-FRV-258	Turbine Driven Auxiliary Feed Pump PP-4 Emergency 1" Air Operated Leakoff Globe Valve	Auxiliary Feedwater	Turbine	591	TDAFP Room	49
2-FW-118-1	Feedwater to Steam Generator #1 Containment Isolation Check Valve	Feedwater	Auxiliary	621	East Main Steam Stop Enclosure	10
2-FW-118-2	Feedwater to Steam Generator #2 Containment Isolation Check Valve	Feedwater	Auxiliary	621	West Main Steam Stop Enclosure	9
2-FW-118-3	Feedwater to Steam Generator #3 Containment Isolation Check Valve	Feedwater	Auxiliary	621	West Main Steam Stop Enclosure	9
2-FW-118-4	Feedwater to Steam Generator #4 Containment Isolation Check Valve	Feedwater	Auxiliary	621	East Main Steam Stop Enclosure	10
2-FW-129	East Motor Driven Aux Feedwater Pump PP-3E Disc to Unit 1 Crosstie Shutoff Valve	Auxiliary Feedwater	Turbine	591	East MDAFP Room	50

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-HE-11	Reactor Coolant Pump Seal Water Heat Exchanger (Pressure Boundary Only)	Reactor Coolant Pump Seal Water INJ/Leakoff	Auxiliary	609	Seal Water Heat Exchanger Room	18
2-HE-15E	East CCW Heat Exchanger	Component Cooling Water	Auxiliary	609	609 Hallway	609
2-HE-15W	West CCW Heat Exchanger	Component Cooling Water	Auxiliary	609	609 Hallway	609
2-HE-17E	East Residual Heat Removal Heat Exchanger	Residual Heat Removal	Auxiliary	609	East RHR Heat Exchanger Room	5
2-HE-17W	West Residual Heat Removal Heat Exchanger	Residual Heat Removal	Auxiliary	609	West RHR Heat Exchanger Room	6
2-HE-32E	East Residual Heat Removal Pump PP-35E Mechanical Seal Heat Exchanger	Component Cooling Water	Auxiliary	573	East RHR Pump Room	54

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-HE-32W	West Residual Heat Removal Pump PP-35W Mechanical Seal Heat Exchanger	Component Cooling Water	Auxiliary	573	West RHR Pump Room	55
2-HE-34NE	North Safety Injection Pump Mech Seal Heat Exchanger	Component Cooling Water	Auxiliary	587	North Safety Injection Pump Room	42
2-HE-34NW	North Safety Injection Pump Mech Seal Heat Exchanger	Component Cooling Water	Auxiliary	587	North Safety Injection Pump Room	42
2-HE-34SE	South Safety Injection Pump Mech Seal Heat Exchanger	Component Cooling Water	Auxiliary	587	South Safety Injection Pump Room	43
2-HE-34SW	South Safety Injection Pump Mech Seal Heat Exchanger	Component Cooling Water	Auxiliary	587	South Safety Injection Pump Room	43
2-HE-35N	North Safety Injection Pump Oil Cooler	Component Cooling Water	Auxiliary	587	North Safety Injection Pump Room	42

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-HE-35S	South Safety Injection Pump Oil Cooler	Component Cooling Water	Auxiliary	587	South Safety Injection Pump Room	43
2-HE-37E	East Centrifugal Charging Pump Gear Oil Cooler	Component Cooling Water	Auxiliary	587	East Centrifugal Charging Pump Room	40
2-HE-37W	West Centrifugal Charging Pump Gear Oil Cooler	Component Cooling Water	Auxiliary	587	West Centrifugal Charging Pump Room	41
2-HE-38E	East Centrifugal Charging Pump Bearing Oil Cooler	Component Cooling Water	Auxiliary	587	East Centrifugal Charging Pump Room	40
2-HE-38W	West Centrifugal Charging Pump Bearing Oil Cooler	Component Cooling Water	Auxiliary	587	West Centrifugal Charging Pump Room	41
2-HE-47-ABN	AB Emergency Diesel North Combustion Air Aftercooler	Diesel Combustion Air	Auxiliary	587	AB EDG Room	121

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-HE-47-ABS	AB Emergency Diesel South Combustion Air Aftercooler	Diesel Combustion Air	Auxiliary	587	AB EDG Room	121
2-HE-47-CDN	CD Emergency Diesel North Combustion Air Aftercooler	Diesel Combustion Air	Auxiliary	587	CD EDG Room	122
2-HE-47-CDS	CD Emergency Diesel South Combustion Air Aftercooler	Diesel Combustion Air	Auxiliary	587	CD EDG Room	122
2-HE-63N	Control Room Air Conditioning North Liquid Chiller HV-ACR-1 Evaporator	Control Room Ventilation	Auxiliary	650	Control Rm A/C Room	129
2-HE-63S	Control Room Air Conditioning South Liquid Chiller HV-ACR-2 Evaporator	Control Room Ventilation	Auxiliary	650	Control Rm A/C Room	129
2-HE-64N	Control Room Air Conditioning North Liquid Chiller HV-ACR-1 Condenser	Control Room Ventilation	Auxiliary	650	Control Rm A/C Room	129
2-HE-64S	Control Room Air Conditioning South Liquid Chiller HV-ACR-2 Condenser	Control Room Ventilation	Auxiliary	650	Control Rm A/C Room	129

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-HV-ACR-1	Control Room Air Conditioning North Liquid Chiller	Control Room Ventilation	Auxiliary	650	Control Rm A/C Room	129
2-HV-ACR-2	Control Room Air Conditioning South Liquid Chiller	Control Room Ventilation	Auxiliary	650	Control Rm A/C Room	129
2-HV-ACRA-1	Control Room Ventilation North Air Conditioning Unit	Control Room Ventilation	Auxiliary	650	Control Rm A/C Room	129
2-HV-ACRA-2	Control Room Ventilation South Air Conditioning Unit	Control Room Ventilation	Auxiliary	650	Control Rm A/C Room	129
2-HV-ACR-DA-1	Outside Air to Control Room Ventilation Units HV-ACRA-1 and HV-ACRA-2 Vent Damper	Control Room Ventilation	Auxiliary	650	Control Rm A/C Room	129
2-HV-ACR-DA-2	Control Room Ventilation Outside Air Intake Damper	Control Room Ventilation	Auxiliary	650	Control Rm A/C Room	129
2-HV-ACR-DA-3	Control Room Ventilation Return Air Damper	Control Room Ventilation	Auxiliary	650	Control Rm A/C Room	129

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-HV-ACRF-1	Control Room Pressurizer/Cleanup Filter Supply Fan	Control Room Ventilation	Auxiliary	650	Control Rm A/C Room	129
2-HV-ACRF-2	Control Room Pressurizer/Cleanup Filter Supply Fan	Control Room Ventilation	Auxiliary	650	Control Rm A/C Room	129
2-HV-AES-1	Auxiliary Building Ventilation Engineered Safety Feature Exhaust - Unit 1	Auxiliary Building Ventilation	Auxiliary	633	Normal Blowdown Flashtank Room	8
2-HV-AES-1 (FLT)	Auxiliary Building Ventilation Engineered Safety Feature Exhaust Air Filter	Auxiliary Building Ventilation	Auxiliary	633	Normal Blowdown Flashtank Room	8
2-HV-AES-1D1	Auxiliary Building Ventilation Engineered Safety Feature Exhaust Unit HV-AES-1 Charcoal Filter Bypass Damper #1	Auxiliary Building Ventilation	Auxiliary	633	Normal Blowdown Flashtank Room	8
2-HV-AES-1D2	Auxiliary Building Ventilation Engineered Safety Feature Exhaust Unit HV-AES-1 Charcoal Filter Bypass Damper #2	Auxiliary Building Ventilation	Auxiliary	633	Normal Blowdown Flashtank Room	8

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-HV-AES-1D3	Aux Building Ventilation Engineered Safety Feature Exhaust Unit HV-AES-1 Charcoal Filter Face Damper	Auxiliary Building Ventilation	Auxiliary	633	Normal Blowdown Flashtank Room	8
2-HV-AES-2	Auxiliary Building Ventilation Engineered Safety Feature Exhaust Unit	Auxiliary Building Ventilation	Auxiliary	633	Normal Blowdown Flashtank Room	8
2-HV-AES-2 (FLT)	Auxiliary Building Ventilation Engineered Safety Feature Exhaust Air Filter	Auxiliary Building Ventilation	Auxiliary	633	Normal Blowdown Flashtank Room	8
2-HV-AES-2D1	Aux Building Ventilation Engineered Safety Feature Exhaust Unit HV-AES-2 Charcoal Filter Bypass Damper #1	Auxiliary Building Ventilation	Auxiliary	633	Normal Blowdown Flashtank Room	8
2-HV-AES-2D2	Aux Building Ventilation Safety Feature Exhaust Unit HV-AES-2 Charcoal Filter Bypass Damper #2	Auxiliary Building Ventilation	Auxiliary	633	Normal Blowdown Flashtank Room	8

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-HV-AES-2D3	Aux Building Ventilation Engineered Safety Feature Exhaust Unit HV-AES-2 Charcoal Filter Face Damper	Auxiliary Building Ventilation	Auxiliary	633	Normal Blowdown Flashtank Room	8
2-HV-AFP-BRE-1	Train 'N' Battery Room East Exhaust Fan	AFW Battery Rm Ventilation	Auxiliary	633	Plant Battery Train 'N' Auxiliary Equipment Room	263
2-HV-AFP-BRE-2	Train 'N' Battery Room West Exhaust Fan	Auxiliary Building Ventilation	Auxiliary	633	Normal Blowdown Flashtank Room	8
2-HV-AFP-EAC	East Motor Driven Auxiliary Feedwater Pump Room Cooler	Turbine Building Ventilation	Turbine	591	East MDAFP Room	50
2-HV-AFP-T1AC	Turbine Driven Auxiliary Feedwater Pump Room Cooler	Turbine Building Ventilation	Turbine	591	TDAFP Room	49

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-HV-AFP-T2AC	Turbine Driven Auxiliary Feedwater Pump Room Cooler	Turbine Building Ventilation	Turbine	591	TDAFP Room	49
2-HV-AFP-WAC	West Motor Driven Auxiliary Feedwater Pump Room Cooler	Turbine Building Ventilation	Turbine	591	West MDAFP Room	51
2-HV-DDP-AB1	AB Emergency Diesel Generator Room Ventilation Exhaust Fan HV-DGX-2 Tempering Air Damper	Emergency Diesel Generator Room Ventilation	Auxiliary	587	AB EDG Room	121
2-HV-DDP-AB2	AB Emergency Diesel Generator Room Ventilation Supply Fan HV-DGS-2 Tempering Air Damper	Emergency Diesel Generator Room Ventilation	Auxiliary	587	AB EDG Room	121
2-HV-DDP-CD1	CD Emergency Diesel Generator Room Ventilation Exhaust Fan HV-DGX-1 Tempering Air Damper	Emergency Diesel Generator Room Ventilation	Auxiliary	587	CD EDG Room	122

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-HV-DDP-CD2	CD Emergency Diesel Generator Room Ventilation Supply Fan HV-DGS-1 Tempering Air Damper	Diesel Room Ventilation	Auxiliary	587	CD EDG Room	122
2-HV-DGS-1	CD Emergency Diesel Generator Room Ventilation Supply Fan	Diesel Room Ventilation	Auxiliary	587	CD EDG Room	122
2-HV-DGS-2	AB Emergency Diesel Generator Room Ventilation Supply Fan	Diesel Room Ventilation	Auxiliary	587	AB EDG Room	121
2-HV-DGS-3	AB Emergency Diesel Generator Room Cabinet Ventilation Supply Fan	Diesel Room Ventilation	Auxiliary	587	AB EDG Room	121
2-HV-DGS-4	CD Emergency Diesel Generator Room Cabinet Ventilation Supply Fan	Diesel Room Ventilation	Auxiliary	587	CD EDG Room	122

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-HV-DGS-DAB	AB Emergency Diesel Generator Room Ventilation Supply Fan HV-DGS-1 Outside Air Shutoff Damper	Diesel Room Ventilation	Auxiliary	609	Inner Plant Grounds	244
2-HV-DGS-DCD	CD Emergency Diesel Generator Room Ventilation Supply Fan HV-DGS-2 Outside Air Shutoff Damper	Emergency Diesel Generator Room Ventilation	Auxiliary	596	Reactor Cable Tunnel Quad #3	26
2-HV-DGX-1	CD Emergency Diesel Generator Room Ventilation Exhaust Fan	Emergency Diesel Generator Room Ventilation	Auxiliary	587	CD EDG Room	122
2-HV-DGX-2	AB Emergency Diesel Generator Room Ventilation Exhaust Fan	Emergency Diesel Generator Room Ventilation	Auxiliary	587	AB EDG Room	121
2-HV-SGR-MD-1	Control Rod Drive Equipment Room and Inverter Area Ventilation Recirculating Air Inlet Damper	ELEC. SWGR. Ventilation	Auxiliary	609	4kv Room - 600v Switchgear Area	204

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-HV-SGR-MD-2	Control Rod Drive Equipment Room and Inverter Area Ventilation Outside Air Inlet Damper	ELEC. SWGR. Ventilation	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-HV-SGR-MD-3	4kv Rm 600 Volt Switchgear Xformers TR21A & TR21C Area Vent Supply Fan HV-SGRS-8 Suction Damper	ELEC. SWGR. Ventilation	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-HV-SGR-MD-4	4kv Room 600v Switchgear Transformers Area Ventilation Supply Fan HV-SGRS-7 Suction Damper	ELEC. SWGR. Ventilation	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-HV-SGR-MD-5	600Vac Motor Control Center Mezzanine Area Ventilation Supply Fan HV-SGRS-9 Vent Damper	ELEC. SWGR. Ventilation	Auxiliary	613	4kv Room - Mezzanine Area	205
2-HV-SGRS-1A	Control Rod Drive Equipment Room and Inverter Area Ventilation North Supply Fan	ELEC. SWGR. Ventilation	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-HV-SGRS-2	4kv Room AB 4kv Switchgear Area Ventilation Supply Fan	ELEC. SWGR. Ventilation	Auxiliary	609	4kv Room - AB 4kv Switchgear Area	140

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-HV-SGRS-3	4kv Room CD 4kv Switchgear Area Ventilation Supply Fan	ELEC. SWGR. Ventilation	Auxiliary	609	4kv Room - CD 4kv Switchgear Area	206
2-HV-SGRS-4A	Control Rod Drive Equipment Room and Inverter Area Ventilation South Supply Fan	ELEC. SWGR. Ventilation	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-HV-SGRS-7	4kv Room 600 Volt Switchgear Transformers TR21B and TR21D Area Ventilation Supply Fan	ELEC. SWGR. Ventilation	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-HV-SGRS-8	4kv Room 600 Volt Switchgear Transformers TR21A and TR21C Area Ventilation Supply Fan	ELEC. SWGR. Ventilation	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-HV-SGRS-9	600Vac Motor Control Center Mezzanine Area Ventilation Supply Fan	ELEC. SWGR. Ventilation	Auxiliary	613	4kv Room - Mezzanine Area	205
2-HV-SGRX-2	4kv Room AB 4kv Switchgear Area Ventilation Exhaust Fan	ELEC. SWGR. Ventilation	Auxiliary	609	4kv Room - AB 4kv Switchgear Area	140

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-HV-SGRX-3	4kv Room CD 4kv Switchgear Area Ventilation Exhaust Fan	ELEC. SWGR. Ventilation	Auxiliary	609	4kv Room - CD 4kv Switchgear Area	206
2-HV-SGRX-5	AB Battery Equipment Area Battery Room Ventilation Exhaust Fan	ELEC. SWGR. Ventilation	Auxiliary	609	AB BATT Equip Area	200
2-HV-SGRX-6	CD Battery Equipment Area Battery Room Ventilation Exhaust Fan	ELEC. SWGR. Ventilation	Auxiliary	626	CD BATT Equip Area	201
2-ICM-111	RHR to Reactor Coolant Loops #2 & #3 Cold Legs Containment Isolation Valve	Residual Heat Removal	Containment	598	Annulus - Quadrant #2	59
2-ICM-129	Reactor Coolant Loop #2 Hot Leg to Residual Heat Removal Pumps Suction Containment Isolation Valve	Residual Heat Removal	Containment	598	Annulus - Quadrant #2	59
2-ICM-250	Boron Injection Tank Train 'A' Outlet Containment Isolation Valve	Boron Injection	Auxiliary	612	BIT Outlet Valve Room	15
2-ICM-251	Boron Injection Tank Train 'B' Outlet Containment Isolation Valve	Boron Injection	Auxiliary	612	BIT Outlet Valve Room	15

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-ICM-260	North Safety Injection Pump PP-26N Discharge Containment Isolation Valve	Safety Injection	Auxiliary	587	North Safety Injection Pump Room	42
2-ICM-265	South Safety Injection Pump PP-26S Discharge Containment Isolation Valve	Safety Injection	Auxiliary	587	South Safety Injection Pump Room	43
2-ICM-305	Recirculation Sump to East RHR/CTS Pumps Suction Containment Isolation Valve	Residual Heat Removal	Auxiliary	591	Vestibule	28
2-ICM-306	Recirculation Sump to West RHR/CTS Pumps Suction Containment Isolation Valve	Residual Heat Removal	Auxiliary	591	Vestibule	28
2-ICM-311	East Residual Heat Removal to RC Loops #1 and #4 Cold Legs Containment Isolation Valve	Residual Heat Removal	Auxiliary	609	East RHR Heat Exchanger Room	5
2-ICM-321	West RHR to Reactor Coolant Loops #2 and #3 Cold Legs Containment Isolation Valve	Residual Heat Removal	Auxiliary	609	West RHR Heat Exchanger Room	6

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-IFC-315	East Residual Heat Removal Pump PP-35E Discharge Flow Switch	Residual Heat Removal	Auxiliary	573	573 Hallway	573
2-IFC-325	West Residual Heat Removal Pump PP-35W Discharge Flow Switch	Residual Heat Removal	Auxiliary	573	573 Hallway	573
2-IFI-260	Safety Injection Pump Discharge Flow Indicator	Safety Injection	Auxiliary	587	North Safety Injection Pump Room	42
2-IFI-266	Safety Injection Pump Discharge Flow Indicator	Safety Injection	Auxiliary	587	South Safety Injection Pump Room	43
2-IFI-310	East Residual Heat Removal Heat Exchanger HE-17E Outlet Low Range Flow Indicator Transmitter	Residual Heat Removal	Auxiliary	609	609 Hallway	609
2-IFI-311	East Residual Heat Removal Heat Exchanger HE-17E Outlet High Range Flow Indicator Transmitter	Residual Heat Removal	Auxiliary	609	609 Hallway	609

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-IFI-320	West Residual Heat Removal Heat Exchanger HE-17W Outlet Low Range Flow Indicator Transmitter	Residual Heat Removal	Auxiliary	609	609 Hallway	609
2-IFI-321	West Residual Heat Removal Heat Exchanger HE-17W Outlet High Range Flow Indicator Transmitter	Residual Heat Removal	Auxiliary	609	609 Hallway	609
2-IFI-335	Residual Heat Removal to Reactor Coolant Loops #2 and #3 Cold Legs Flow Indicator Transmitter	Residual Heat Removal	Auxiliary	591	Vestibule	28
2-IFI-51	Boron Injection to Reactor Coolant Loop #1 Flow Indicator Transmitter	Boron Injection	Containment	598	Annulus - Quadrant #1	58
2-IFI-52	Boron Injection to Reactor Coolant Loop #2 Flow Indicator Transmitter	Boron Injection	Containment	598	Annulus - Quadrant #2	59
2-IFI-53	Boron Injection to Reactor Coolant Loop #3 Flow Indicator Transmitter	Boron Injection	Containment	598	Annulus - Quadrant #3	56
2-IFI-54	Boron Injection to Reactor Coolant Loop #4 Flow Indicator Transmitter	Boron Injection	Containment	598	Annulus - Quadrant #4	57

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-IMO-128	Reactor Coolant Loop #2 Hot Leg to Residual Heat Removal Pumps Suction Shutoff Valve	Residual Heat Removal	Containment	617	Lower Containment, Quadrant #2	61
2-IMO-215	RWST to East Containment Spray Pump PP-9E Suction Motor Operated Shut-Off Valve	Containment Spray	Auxiliary	573	East Containment Spray Pump Room	53
2-IMO-225	RWST to West Containment Spray Pump PP-9W Suction Motor Operated Shut-Off Valve	Containment Spray	Auxiliary	573	West Containment Spray Pump Room	52
2-IMO-255	Boron Injection Tank Train 'A' Inlet Shutoff Valve	Boron Injection	Auxiliary	612	BIT Room	16
2-IMO-256	Boron Injection Tank Train 'B' Inlet Shutoff Valve	Boron Injection	Auxiliary	612	BIT Room	16
2-IMO-261	Refueling Water Storage Tank TK-33 Supply to Safety Injection Pumps Shutoff Valve	Safety Injection	Auxiliary	587	South Safety Injection Pump Room	43

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-IMO-262	Safety Injection Pumps Recirc to Refueling Water Storage Tank TK-33 Train 'A' Shutoff Valve	Safety Injection	Auxiliary	587	North Safety Injection Pump Room	42
2-IMO-263	Safety Injection Pumps Recirc to Refueling Water Storage Tank TK-33 Train 'B' Shutoff Valve	Safety Injection	Auxiliary	587	North Safety Injection Pump Room	42
2-IMO-270	Safety Injection Pumps Discharge Crosstie Train 'A' Shutoff Valve	Safety Injection	Auxiliary	587	North Safety Injection Pump Room	42
2-IMO-275	Safety Injection Pumps Discharge Crosstie Train 'B' Shutoff Valve	Safety Injection	Auxiliary	587	South Safety Injection Pump Room	43
2-IMO-310	East Residual Heat Removal Pump PP-35E Suction Shutoff Valve	Residual Heat Removal	Auxiliary	573	East RHR Pump Room	54
2-IMO-312	East Residual Heat Removal Heat Exchanger HE-17E Outlet Mini-Flow Line Shutoff Valve	Residual Heat Removal	Auxiliary	609	East RHR Heat Exchanger Room	5

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-IMO-314	East Residual Heat Removal Heat Exchanger 2-HE-17E to RC Loops #2 and #3 Cold Legs Shutoff Valve	Residual Heat Removal	Auxiliary	609	East RHR Heat Exchanger Room	5
2-IMO-315	East RHR and North Safety Injection to Reactor Coolant Loops #1 and #4 Hot Legs Shutoff Valve	Residual Heat Removal	Containment	612	East Containment Lower Vent Room	72
2-IMO-316	East RHR and North Safety Injection to Reactor Coolant Loops #1 and #4 Cold Legs Shutoff Valve	Residual Heat Removal	Containment	612	East Containment Lower Vent Room	72
2-IMO-320	West Residual Heat Removal Pump PP-35W Suction Shutoff Valve	Residual Heat Removal	Auxiliary	573	West RHR Pump Room	55
2-IMO-322	West Residual Heat Removal Heat Exchanger HE-17W Outlet Mini-Flow Line Shutoff Valve	Residual Heat Removal	Auxiliary	609	West RHR Heat Exchanger Room	6

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-IMO-324	West Residual Heat Removal Heat Exchanger 2-HE-17W to RC Loops #2 and #3 Cold Legs Shutoff Valve	Residual Heat Removal	Auxiliary	609	West RHR Heat Exchanger Room	6
2-IMO-325	West RHR and South Safety Injection to Reactor Coolant Loops #2 and #3 Hot Legs Shutoff Valve	Residual Heat Removal	Containment	612	West Containment Lower Vent Room	73
2-IMO-326	West RHR and South Safety Injection to Reactor Coolant Loops #2 and #3 Cold Legs Shutoff Valve	Residual Heat Removal	Containment	612	West Containment Lower Vent Room	73
2-IMO-330	East Residual Heat Removal to Upper Containment Spray Shutoff Valve	Residual Heat Removal	Auxiliary	609	East RHR Heat Exchanger Room	5
2-IMO-331	West RHR to Upper Containment Spray Shutoff Valve	Residual Heat Removal	Auxiliary	609	West RHR Heat Exchanger Room	6

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-IMO-340	East Residual Heat Removal Heat Exchanger to Charging Pumps Suction Shutoff Valve	Residual Heat Removal	Auxiliary	609	East RHR Heat Exchanger Room	5
2-IMO-350	West RHR Heat Exchanger Outlet to Safety Injection Pump Suction Shutoff Valve	Residual Heat Removal	Auxiliary	609	West RHR Heat Exchanger Room	6
2-IMO-360	Safety Injection Pumps to CVCS Charging Pumps Suction Header Crosstie Shutoff Valve	(CVCS) Charging	Auxiliary	587	West Centrifugal Charging Pump Room	41
2-IMO-361	Safety Injection Pumps Suction to and From Charging Pumps Suction Train 'A' Shutoff Valve	Safety Injection	Auxiliary	587	North Safety Injection Pump Room	42
2-IMO-362	Safety Injection Pumps Suction to and From Charging Pumps Suction Train 'B' Shutoff Valve	Safety Injection	Auxiliary	587	North Safety Injection Pump Room	42
2-IMO-390	Refueling Water Storage Tank TK-33 to Residual Heat Removal Pumps Suction Shutoff Valve	Residual Heat Removal	Auxiliary	591	Vestibule	28

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-IMO-51	Boron Injection to Reactor Coolant Loop #1 Shutoff Valve	Boron Injection	Containment	598	Annulus - Quadrant #1	58
2-IMO-52	Boron Injection to Reactor Coolant Loop #2 Shutoff Valve	Boron Injection	Containment	598	Annulus - Quadrant #2	59
2-IMO-53	Boron Injection to Reactor Coolant Loop #3 Shutoff Valve	Boron Injection	Containment	598	Annulus - Quadrant #3	56
2-IMO-54	Boron Injection to Reactor Coolant Loop #4 Shutoff Valve	Boron Injection	Containment	598	Annulus - Quadrant #4	57
2-IMO-910	Refueling Water Storage Tank to CVCS Charging Pumps Suction Header Train 'A' Shutoff Valve	(CVCS) Charging	Auxiliary	587	Reciprocating Charging Pump Room	39
2-IMO-911	Refueling Water Storage Tank to CVCS Charging Pumps Suction Header Train 'B' Shutoff Valve	(CVCS) Charging	Auxiliary	587	East Centrifugal Charging Pump Room	40
2-IRV-310	East Residual Heat Removal Heat Exchanger HE-17E 8" Air Operated Outlet Flow Control Valve	Residual Heat Removal	Auxiliary	609	East RHR Heat Exchanger Room	5

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-IRV-311	Residual Heat Removal Heat Exchangers Bypass Flow 8" Air Operated Control Valve	Residual Heat Removal	Auxiliary	609	East RHR Heat Exchanger Room	5
2-IRV-320	West Residual Heat Removal Heat Exchanger HE-17W 8" Air Operated Outlet Flow Control Valve	Residual Heat Removal	Auxiliary	609	West RHR Heat Exchanger Room	6
2-IRV-60	Safety Injection to Accumulator Fill Line Control Valve	Safety Injection	Containment	598	Annulus - Quadrant #2	59
2-ITR-335	Residual Heat Removal to Reactor Coolant Loops #2 & #3 Cold Legs Temperature Recorder Thermal Sensor	Residual Heat Removal	Auxiliary	591	Vestibule	28
2-LLS-120	AB Emergency Diesel Fuel Oil Day Tank QT-107-AB High Level Switch #1	Diesel Fuel Oil	Auxiliary	587	AB EDG Room	121
2-LLS-121	AB Emergency Diesel Fuel Oil Day Tank QT-107-AB Low Level Switch #1	Diesel Fuel Oil	Auxiliary	587	AB EDG Room	121

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-LLS-122	AB Emergency Diesel Fuel Oil Day Tank QT-107-AB High Level Switch #2	Diesel Fuel Oil	Auxiliary	587	AB EDG Room	121
2-LLS-123	AB Emergency Diesel Fuel Oil Day Tank QT-107-AB Low Level Switch #2	Diesel Fuel Oil	Auxiliary	587	AB EDG Room	121
2-LLS-125	CD Emergency Diesel Fuel Oil Day Tank QT-107-CD High Level Switch #1	Diesel Fuel Oil	Auxiliary	587	CD EDG Room	122
2-LLS-126	CD Emergency Diesel Fuel Oil Day Tank QT-107-CD Low Level Switch #1	Diesel Fuel Oil	Auxiliary	587	CD EDG Room	122
2-LLS-127	CD Emergency Diesel Fuel Oil Day Tank QT-107-CD High Level Switch #2	Diesel Fuel Oil	Auxiliary	587	CD EDG Room	122
2-LLS-128	CD Emergency Diesel Fuel Oil Day Tank QT-107-CD Low Level Switch #2	Diesel Fuel Oil	Auxiliary	587	CD EDG Room	122

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-LRV-240	AB Emergency Diesel Upper Valve Gear Lube Oil Regulator #1	Diesel Lube Oil	Auxiliary	587	AB EDG Room	121
2-LRV-241	AB Emergency Diesel Upper Valve Gear Lube Oil Regulator #2	Diesel Lube Oil	Auxiliary	587	AB EDG Room	121
2-LRV-245	CD Emergency Diesel Upper Valve Gear Oil Pressure Regulating Valve #1	Diesel Lube Oil	Auxiliary	587	CD EDG Room	122
2-LRV-246	CD Emergency Diesel Upper Valve Gear Lube Oil Regulator #2	Diesel Lube Oil	Auxiliary	587	CD EDG Room	122
2-LSO-240	AB Emergency Diesel Upper Valve Gear Lubrication Control Solenoid #1	Diesel Lube Oil	Auxiliary	587	AB EDG Room	121
2-LSO-241	AB Emergency Diesel Upper Valve Gear Lubrication Control Solenoid #2	Diesel Lube Oil	Auxiliary	587	AB EDG Room	121
2-LSO-245	CD Emergency Diesel Gen Upper Valve Gear Lubrication Control Solenoid #1	Diesel Lube Oil	Auxiliary	587	CD EDG Room	122

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-LSO-246	CD Emergency Diesel Gen Upper Valve Gear Lubrication Control Solenoid #2	Diesel Lube Oil	Auxiliary	587	CD EDG Room	122
2-MCAB	250Vdc Distribution Panel MCAB	250Vdc	Auxiliary	609	AB BATT Equip Area	200
2-MCCD	250Vdc Distribution Panel MCCD	250Vdc	Auxiliary	626	CD BATT Equip Area	201
2-MCM-221	Main Steam Lead #2 to Auxiliary Feed Pump Turbine 4" Motor Operated Shutoff Valve	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9
2-MCM-231	Main Steam Lead #3 to Auxiliary Feed Pump Turbine 4" Motor Operated Shutoff Valve	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9
2-MDAB	250Vdc Distribution Panel MDAB	250Vdc	Auxiliary	609	AB BATT Equip Area	200
2-MDCD	250Vdc Distribution Panel MDCD	250Vdc	Auxiliary	626	CD BATT Equip Area	201

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-MFC-110	Steam Generator OME-3-1 Channel I Steam Flow Control Transmitter	Main Steam	Containment	598	Annulus - Quadrant #1	58
2-MFC-111	Steam Generator OME-3-1 Channel II Steam Flow Control Transmitter	Main Steam	Containment	598	Annulus - Quadrant #1	58
2-MFC-120	Steam Generator OME-3-2 Channel II Steam Flow Control Transmitter	Main Steam	Containment	598	Annulus - Quadrant #2	59
2-MFC-121	Steam Generator OME-3-2 Channel I Steam Flow Control Transmitter	Main Steam	Containment	598	Annulus - Quadrant #2	59
2-MFC-130	Steam Generator OME-3-3 Channel II Steam Flow Control Transmitter	Main Steam	Containment	598	Annulus - Quadrant #3	56
2-MFC-131	Steam Generator OME-3-3 Channel I Steam Flow Control Transmitter	Main Steam	Containment	598	Annulus - Quadrant #3	56
2-MFC-140	Steam Generator OME-3-4 Channel I Steam Flow Control Transmitter	Main Steam	Containment	598	Annulus - Quadrant #4	57

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-MFC-141	Steam Generator OME-3-4 Channel II Steam Flow Control Transmitter	Main Steam	Containment	598	Annulus - Quadrant #4	57
2-MMO-210	Steam Stop Valve MRV-210 Steam Cylinder Dump 4" Motor Operated Valves Selector Valve	Main Steam	Auxiliary	633	East Main Steam Stop Enclosure	10
2-MMO-220	Steam Stop Valve MRV-220 Steam Cylinder Dump 4" Motor Operated Valves Selector Valve	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9
2-MMO-230	Steam Stop Valve MRV-230 Steam Cylinder Dump 4" Motor Operated Valves Selector Valve	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9
2-MMO-240	Steam Stop Valve MRV-240 Steam Cylinder Dump 4" Motor Operated Valves Selector Valve	Main Steam	Auxiliary	633	East Main Steam Stop Enclosure	10
2-MPP-210	Steam Generator OME-3-1 Channel I Steam Pressure Transmitter	Main Steam	Auxiliary	633	East Main Steam Stop Enclosure	10

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-MPP-211	Steam Generator OME-3-1 Channel II Steam Pressure Transmitter	Main Steam	Auxiliary	633	East Main Steam Stop Enclosure	10
2-MPP-212	Steam Generator OME-3-1 Channel IV Reactor Protection Input Steam Pressure Transmitter	Main Steam	Auxiliary	633	East Main Steam Stop Enclosure	10
2-MPP-220	Steam Generator OME-3-2 Channel I Steam Pressure Transmitter	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9
2-MPP-221	Steam Generator OME-3-2 Channel II Steam Pressure Transmitter	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9
2-MPP-222	Steam Generator OME-3-2 Channel III Reactor Protection Input Steam Pressure Transmitter	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9
2-MPP-230	Steam Generator OME-3-3 Channel I Steam Pressure Transmitter	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-MPP-231	Steam Generator OME-3-3 Channel II Steam Pressure Transmitter	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9
2-MPP-232	Steam Generator OME-3-3 Channel III Reactor Protection Input Steam Pressure Transmitter	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9
2-MPP-240	Steam Generator OME-3-4 Channel I Steam Pressure Transmitter	Main Steam	Auxiliary	633	East Main Steam Stop Enclosure	10
2-MPP-241	Steam Generator OME-3-4 Channel II Steam Pressure Transmitter	Main Steam	Auxiliary	633	East Main Steam Stop Enclosure	10
2-MPP-242	Steam Generator OME-3-4 Channel IV Reactor Protection Input Steam Pressure Transmitter	Main Steam	Auxiliary	633	East Main Steam Stop Enclosure	10
2-MRV-210	Steam Generator OME-3-1 Stop Valve	Main Steam	Auxiliary	633	East Main Steam Stop Enclosure	10

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-MRV-211	Steam Generator #1 Stop Valve MRV-210 Steam Cylinder Train 'A' Dump Valve	Main Steam	Auxiliary	633	East Main Steam Stop Enclosure	10
2-MRV-212	Steam Generator #1 Stop Valve MRV-210 Steam Cylinder Train 'B' Dump Valve	Main Steam	Auxiliary	633	East Main Steam Stop Enclosure	10
2-MRV-213	Steam Generator OME-3-1 Power Operated Relief Valve	Main Steam	Auxiliary	633	East Main Steam Stop Enclosure	10
2-MRV-220	Steam Generator OME-3-2 Stop Valve	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9
2-MRV-221	Steam Generator #2 Stop Valve MRV-220 Steam Cylinder Train 'A' Dump Valve	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9
2-MRV-222	Steam Generator #2 Stop Valve MRV-220 Steam Cylinder Train 'B' Dump Valve	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-MRV-223	Steam Generator OME-3-2 Power Operated Relief Valve	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9
2-MRV-230	Steam Generator OME-3-3 Stop Valve	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9
2-MRV-231	Steam Generator #3 Stop Valve MRV-230 Steam Cylinder Train 'A' Dump Valve	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9
2-MRV-232	Steam Generator #3 Stop Valve MRV-230 Steam Cylinder Train 'B' Dump Valve	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9
2-MRV-233	Steam Generator OME-3-3 Power Operated Relief Valve	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9
2-MRV-240	Steam Generator OME-3-4 Stop Valve	Main Steam	Auxiliary	633	East Main Steam Stop Enclosure	10

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-MRV-241	Steam Generator #4 Stop Valve MRV-240 Steam Cylinder Train 'A' Dump Valve	Main Steam	Auxiliary	633	East Main Steam Stop Enclosure	10
2-MRV-242	Steam Generator #4 Stop Valve MRV-240 Steam Cylinder Train 'B' Dump Valve	Main Steam	Auxiliary	633	East Main Steam Stop Enclosure	10
2-MRV-243	Steam Generator OME-3-4 Power Operated Relief Valve	Main Steam	Auxiliary	633	East Main Steam Stop Enclosure	10
2-NIS-I	Nuclear Instrumentation System Protection Channel I Control Panel	Equipment Control and Indication Stations	Auxiliary	633	Control Room	123
2-NIS-III	Nuclear Instrumentation System Protection Channel III Control Panel	Equipment Control and Indication Stations	Auxiliary	633	Control Room	123
2-NLI-151	Pressurizer OME-4 Level Indicator Transmitter	Reactor Coolant	Containment	612	Instrumentation Room	67

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-NLP-151	Pressurizer OME-4 Protection Channel I Level Transmitter	Reactor Coolant	Containment	612	Instrumentation Room	67
2-NLP-152	Pressurizer OME-4 Protection Channel II Level Transmitter	Reactor Coolant	Containment	612	Instrumentation Room	67
2-NLP-153	Pressurizer OME-4 Protection Channel III Level Transmitter	Reactor Coolant	Containment	612	Instrumentation Room	67
2-NMO-151	Pressurizer Relief Valve NRV-151 Upstream 3" Motor Operated Shutoff Valve	Reactor Coolant	Containment	650	Pressurizer Enclosure, Interior	81
2-NMO-152	Pressurizer Relief Valve NRV-152 Upstream 3" Motor Operated Shutoff Valve	Reactor Coolant	Containment	650	Pressurizer Enclosure, Interior	81
2-NMO-153	Pressurizer Relief Valve NRV-153 Upstream 3" Motor Operated Shutoff Valve	Reactor Coolant	Containment	650	Pressurizer Enclosure, Interior	81
2-NPP-151	Pressurizer OME-4 Protection Channel I Pressure Transmitter	Reactor Coolant	Containment	612	Instrumentation Room	67

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-NPP-152	Pressurizer OME-4 Protection Channel II Pressure Transmitter	Reactor Coolant	Containment	612	Instrumentation Room	67
2-NPP-153	Pressurizer OME-4 Protection Channel III Pressure Transmitter	Reactor Coolant	Containment	612	Instrumentation Room	67
2-NPS-121	Reactor Coolant Loop #2 Hot Leg Wide Range Pressure Transmitter	Reactor Coolant	Containment	612	West Containment Lower Vent Room	73
2-NPS-122	Reactor Coolant Loop #1 Hot Leg Wide Range Pressure Transmitter	Reactor Coolant	Containment	612	East Containment Lower Vent Room	72
2-NPS-153	Pressurizer OME-4 Protection Channel IV Pressure Transmitter	Reactor Coolant	Containment	612	Instrumentation Room	67

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-NRI-1	Nuclear Instrumentation Source Range Monitor	Reactor Coolant	Auxiliary	633	Control Room	123
2-NRI-21	Nuclear Instrumentation Source Range Radiation Detector	Nuclear Instrumentation	Containment	626	Reactor Cavity	105
2-NRI-21-AMP	Nuclear Instrumentation Wide Range Radiation Amplifier Cabinet	Nuclear Instrumentation	Auxiliary	596	Reactor Cable Tunnel, Quadrant #1	25
2-NRI-21-PRCSR	Nuclear Instrumentation Wide Range Signal Processor Cabinet	Nuclear Instrumentation	Auxiliary	633	Control Room	123
2-NRI-23	Nuclear Instrumentation Source Range Radiation Detector	Nuclear Instrumentation	Containment	626	Reactor Cavity	105
2-NRI-23-AMP	Nuclear Instrumentation Source Range Radiation Detector NRI-23 Amplifier Cabinet	Nuclear Instrumentation	Auxiliary	596	Reactor Cable Tunnel, Quadrant #1	25
2-NRI-23-ISOL	Nuclear Instrumentation Source Range Signal Isolator Cabinet	Nuclear Instrumentation	Auxiliary	596	Reactor Cable Tunnel, Quadrant #1	25

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-NRI-23-PRCSR	Nuclear Instrumentation Source Range Signal Processor Cabinet	Nuclear Instrumentation	Auxiliary	633	Control Room	123
2-NRI-5	Nuclear Instrumentation Source Range Monitor	Reactor Coolant	Auxiliary	633	Control Room	123
2-NRV-151	Pressurizer Train 'B' Pressure Relief Valve	Reactor Coolant	Containment	650	Pressurizer Enclosure, Interior	81
2-NRV-152	Pressurizer Train 'B' Pressure Relief Valve	Reactor Coolant	Containment	650	Pressurizer Enclosure, Interior	81
2-NRV-153	Pressurizer OME-4 Train 'A' Pressure Relief Valve	Reactor Coolant	Containment	650	Pressurizer Enclosure, Interior	81
2-NSO-62	Pressurizer OME-4 Post Accident Vent Train 'A' Solenoid Valve	Reactor Coolant	Containment	650	Pressurizer Enclosure, Interior	81

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-NSO-61	Post-Accident Vent Valve	Reactor Coolant	Containment	650	Pressurizer Enclosure, Interior	81
2-NSO-63	Post-Accident Vent Valve	Reactor Coolant	Containment	650	Pressurizer Enclosure, Interior	81
2-NSO-64	Pressurizer OME-4 Post Accident Vent Train 'B' Solenoid Valve	Reactor Coolant	Containment	650	Pressurizer Enclosure, Interior	81
2-NTP-110A	Reactor Coolant Loop #1 Hot Leg Channel I Reactor Protection Input Narrow Range Thermal Sensor	Reactor Coolant	Containment	598	Lower Containment, Quadrant #1	60
2-NTP-110B	Reactor Coolant Loop #1 Hot Leg Channel I Reactor Protection Input Spare Narrow Range Thermal Sensor	Reactor Coolant	Containment	598	Lower Containment, Quadrant #1	60
2-NTP-111A	Reactor Coolant Loop #1 Hot Leg Channel I Reactor Protection Input Narrow Range Thermal Sensor	Reactor Coolant	Containment	598	Lower Containment, Quadrant #1	60

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-NTP-111B	Reactor Coolant Loop #1 Hot Leg Channel I Reactor Protection Input Spare Narrow Range Thermal Sensor	Reactor Coolant	Containment	598	Lower Containment, Quadrant #1	60
2-NTP-112A	Reactor Coolant Loop #1 Hot Leg Channel I Reactor Protection Input Narrow Range Thermal Sensor	Reactor Coolant	Containment	598	Lower Containment, Quadrant #1	60
2-NTP-112B	Reactor Coolant Loop #1 Hot Leg Channel I Reactor Protection Input Spare Narrow Range Thermal Sensor	Reactor Coolant	Containment	598	Lower Containment, Quadrant #1	60
2-NTP-120A	Reactor Coolant Loop #2 Hot Leg Channel II Reactor Protection Input Narrow Range Thermal Sensor	Reactor Coolant	Containment	598	Lower Containment, Quadrant #2	61
2-NTP-120B	Reactor Coolant Loop #2 Hot Leg Channel II Reactor Protection Input Spare Narrow Range Thermal Sensor	Reactor Coolant	Containment	598	Lower Containment, Quadrant #2	61
2-NTP-121A	Reactor Coolant Loop #2 Hot Leg Channel II Reactor Protection Input Narrow Range Thermal Sensor	Reactor Coolant	Containment	598	Lower Containment, Quadrant #2	61

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-NTP-121B	Reactor Coolant Loop #2 Hot Leg Channel II Reactor Protection Input Spare Narrow Range Thermal Sensor	Reactor Coolant	Containment	598	Lower Containment, Quadrant #2	61
2-NTP-122A	Reactor Coolant Loop #2 Hot Leg Channel II Reactor Protection Input Narrow Range Thermal Sensor	Reactor Coolant	Containment	598	Lower Containment, Quadrant #2	61
2-NTP-122B	Reactor Coolant Loop #2 Hot Leg Channel II Reactor Protection Input Spare Narrow Range Thermal Sensor	Reactor Coolant	Containment	598	Lower Containment, Quadrant #2	61
2-NTP-130A	Reactor Coolant Loop #3 Hot Leg Channel III Reactor Protection Input Narrow Range Thermal Sensor	Reactor Coolant	Containment	598	Lower Containment, Quadrant #3	62
2-NTP-130B	Reactor Coolant Loop #3 Hot Leg Channel III Reactor Protection Input Spare Narrow Range Thermal Sensor	Reactor Coolant	Containment	598	Lower Containment, Quadrant #3	62
2-NTP-131A	Reactor Coolant Loop #3 Hot Leg Channel III Reactor Protection Input Narrow Range Thermal Sensor	Reactor Coolant	Containment	598	Lower Containment, Quadrant #3	62

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-NTP-131B	Reactor Coolant Loop #3 Hot Leg Channel III Reactor Protection Input Spare Narrow Range Thermal Sensor	Reactor Coolant	Containment	598	Lower Containment, Quadrant #3	62
2-NTP-132A	Reactor Coolant Loop #3 Hot Leg Channel III Reactor Protection Input Narrow Range Thermal Sensor	Reactor Coolant	Containment	598	Lower Containment, Quadrant #3	62
2-NTP-132B	Reactor Coolant Loop #3 Hot Leg Channel III Reactor Protection Input Spare Narrow Range Thermal Sensor	Reactor Coolant	Containment	598	Lower Containment, Quadrant #3	62
2-NTP-140A	Reactor Coolant Loop #4 Hot Leg Channel IV Reactor Protection Input Narrow Range Thermal Sensor	Reactor Coolant	Containment	598	Lower Containment, Quadrant #4	63
2-NTP-140B	Reactor Coolant Loop #4 Hot Leg Channel IV Reactor Protection Input Spare Narrow Range Thermal Sensor	Reactor Coolant	Containment	598	Lower Containment, Quadrant #4	63
2-NTP-141A	Reactor Coolant Loop #4 Hot Leg Channel IV Reactor Protection Input Narrow Range Thermal Sensor	Reactor Coolant	Containment	598	Lower Containment, Quadrant #4	63

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-NTP-141B	Reactor Coolant Loop #4 Hot Leg Channel IV Reactor Protection Input Spare Narrow Range Thermal Sensor	Reactor Coolant	Containment	598	Lower Containment, Quadrant #4	63
2-NTP-142A	Reactor Coolant Loop #4 Hot Leg Channel IV Reactor Protection Input Narrow Range Thermal Sensor	Reactor Coolant	Containment	598	Lower Containment, Quadrant #4	63
2-NTP-142B	Reactor Coolant Loop #4 Hot Leg Channel IV Reactor Protection Input Spare Narrow Range Thermal Sensor	Reactor Coolant	Containment	598	Lower Containment, Quadrant #4	63
2-NTP-210A	Reactor Coolant Loop #1 Cold Leg Channel I Reactor Protection Input Narrow Range Thermal Sensor	Reactor Coolant	Containment	625	Lower Containment, Quadrant #1	60
2-NTP-210B	Reactor Coolant Loop #1 Cold Leg Channel I Reactor Protection Input Spare Narrow Range Thermal Sensor	Reactor Coolant	Containment	625	Lower Containment, Quadrant #1	60
2-NTP-220A	Reactor Coolant Loop #2 Cold Leg Channel II Reactor Protection Input Narrow Range Thermal Sensor	Reactor Coolant	Containment	617	Lower Containment, Quadrant #2	61

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-NTP-220B	Reactor Coolant Loop #2 Cold Leg Channel II Reactor Protection Input Spare Narrow Range Thermal Sensor	Reactor Coolant	Containment	617	Lower Containment, Quadrant #2	61
2-NTP-230A	Reactor Coolant Loop #3 Cold Leg Channel III Reactor Protection Input Narrow Range Thermal Sensor	Reactor Coolant	Containment	617	Lower Containment, Quadrant #3	62
2-NTP-230B	Reactor Coolant Loop #3 Cold Leg Channel III Reactor Protection Input Spare Narrow Range Thermal Sensor	Reactor Coolant	Containment	617	Lower Containment, Quadrant #3	62
2-NTP-240A	Reactor Coolant Loop #4 Cold Leg Channel IV Reactor Protection Input Narrow Range Thermal Sensor	Reactor Coolant	Containment	625	Lower Containment, Quadrant #4	63
2-NTP-240B	Reactor Coolant Loop #4 Cold Leg Channel IV Reactor Protection Input Spare Narrow Range Thermal Sensor	Reactor Coolant	Containment	625	Lower Containment, Quadrant #4	63
2-OME-150-AB	AB Emergency Diesel Generator	Diesel Generator, Control & Instrumentation	Auxiliary	587	AB EDG Room	121

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-OME-150-CD	CD Emergency Diesel Generator	Diesel Generator, Control & Instrumentation	Auxiliary	587	CD EDG Room	122
2-OME-3-1	Steam Generator No. 1	Main Steam	Containment	609	Lower Containment, Quadrant #1	60
2-OME-3-2	Steam Generator No. 2	Main Steam	Containment	609	Lower Containment, Quadrant #2	61
2-OME-3-3	Steam Generator No. 3	Main Steam	Containment	609	Lower Containment, Quadrant #3	62
2-OME-3-4	Steam Generator No. 4	Main Steam	Containment	609	Lower Containment, Quadrant #4	63
2-OME-34E	East Essential Service Water Pump PP-7E Discharge Strainer	Essential Service Water	Screenhouse	591	East ESW Pump Room	135

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-OME-34W	West Essential Service Water Pump PP-7W Discharge Strainer	Essential Service Water	Screenhouse	591	West ESW Pump Room	136
2-OME-39	Auxiliary Feed Pump Turbine	Auxiliary Feedwater/Main Steam	Turbine	591	TDAFP Room	49
2-POV-1-AB	Starting Air Syst/Pilot Operated 4-Way Valve for Air Start of XRVs for Diesel Engine	Compressed Air	Auxiliary	587	AB EDG Room	121
2-POV-1-CD	Starting Air Syst/Pilot Operated 4-Way Valve for Air Start of XRVs for Diesel Engine	Compressed Air	Auxiliary	587	CD EDG Room	122
2-POV-2-AB	Starting Air Syst/Pilot Operated 4-Way Valve for Air Start of XRVs for Diesel Engine	Compressed Air	Auxiliary	587	AB EDG Room	121
2-POV-2-CD	Starting Air Syst/Pilot Operated 4-Way Valve for Air Start of XRVs for Diesel Engine	Compressed Air	Auxiliary	587	CD EDG Room	122

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-PP-10E	East CCW Pump	Component Cooling Water	Auxiliary	609	609 Hallway	609
2-PP-10W	West CCW Pump	Component Cooling Water	Auxiliary	609	609 Hallway	609
2-PP-120-AB	Engine Driven Pump	Diesel Fuel Oil	Auxiliary	587	AB EDG Room	121
2-PP-120-CD	Engine Driven Pump	Diesel Fuel Oil	Auxiliary	587	CD EDG Room	122
2-PP-26N	North Safety Injection Pump	Safety Injection	Auxiliary	587	North Safety Injection Pump Room	42
2-PP-26S	South Safety Injection Pump	Safety Injection	Auxiliary	587	South Safety Injection Pump Room	43
2-PP-35E	East Residual Heat Removal Pump	Residual Heat Removal	Auxiliary	573	East RHR Pump Room	54
2-PP-35W	West Residual Heat Removal Pump	Residual Heat Removal	Auxiliary	573	West RHR Pump Room	55

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-PP-3E	East Motor Driven Auxiliary Feedwater Pump	Auxiliary Feedwater	Turbine	591	East MDAFP Room	50
2-PP-3W	West Motor Driven Auxiliary Feedwater Pump	Auxiliary Feedwater	Turbine	591	West MDAFP Room	51
2-PP-4	Turbine Driven Auxiliary Feed Pump	Auxiliary Feedwater	Turbine	591	TDAFP Room	49
2-PP-50E	East Centrifugal Charging Pump	(CVCS) Charging	Auxiliary	587	East Centrifugal Charging Pump Room	40
2-PP-50W	West Centrifugal Charging Pump	(CVCS) Charging	Auxiliary	587	West Centrifugal Charging Pump Room	41
2-PP-7E	East Essential Service Water Pump	Essential Service Water	Screenhouse	591	East ESW Pump Room	135
2-PP-7W	West Essential Service Water Pump	Essential Service Water	Screenhouse	591	West ESW Pump Room	136
2-PP-82N	Control Room Air Conditioning North Chill Water Circulation Pump	Control Room Ventilation	Auxiliary	650	Control Rm A/C Room	129

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-PP-82S	Control Room Air Conditioning South Chill Water Circulation Pump	Control Room Ventilation	Auxiliary	650	Control Rm A/C Room	129
2-PPP-301	Lower Containment Channel III Pressure Protection Transmitter	Containment Ventilation	Auxiliary	612	612 Airlock Area	12
2-PPP-302	Lower Containment Channel II Pressure Protection Transmitter	Containment Ventilation	Auxiliary	612	612 Airlock Area	12
2-PPP-303	Lower Containment Channel I Pressure Protection Transmitter	Containment Ventilation	Auxiliary	612	612 Airlock Area	12
2-PRV-1-AB	Pressure Regulator for Starting Air Solenoid 20-SV-1-AB	Compressed Air	Auxiliary	587	AB EDG Room	121
2-PRV-1-CD	Pressure Regulator for Starting Air Solenoid 20-SV-1-CD	Compressed Air	Auxiliary	587	AB EDG Room	121
2-PRZ	Pressurizer Control Panel	Reactor Coolant	Auxiliary	633	Control Room	123
2-PS-A	600Vac Motor Control Center PS-A	600Vac	Screenhouse	594	Traveling Screen MCC Upper Room	221

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-PS-D	600Vac Motor Control Center PS-D	600Vac	Screenhouse	594	Traveling Screen MCC Upper Room	221
2-QCM-250	Reactor Coolant Pump Seal Water Return Train 'A' Containment Isolation 4" Motor Operated Valve	(CVCS) Letdown	Containment	598	Annulus - Quadrant #2	59
2-QCM-350	Reactor Coolant Pump Seal Water Return Train 'B' Containment Isolation 4" Motor Operated Valve	(CVCS) Letdown	Auxiliary	591	Vestibule	28
2-QCR-300	Reactor Coolant Letdown Train 'B' Containment Isolation Valve	(CVCS) Letdown	Auxiliary	591	Vestibule	28
2-QCR-301	CVCS Letdown Isolation	(CVCS) Letdown	Containment	598	Annulus - Quadrant #2	59
2-QFA-210	RCP Seal Water Injection to Reactor Coolant Pump PP-45-1 Low Flow Alarm Transmitter	Reactor Coolant Pump Seal Water INJ/Leakoff	Auxiliary	587	587 Hallway	587

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-QFA-220	RCP Seal Water Injection to Reactor Coolant Pump PP-45-2 Low Flow Alarm Transmitter	Reactor Coolant Pump Seal Water INJ/Leakoff	Auxiliary	587	587 Hallway	587
2-QFA-230	RCP Seal Water Injection to Reactor Coolant Pump PP-45-3 Low Flow Alarm Transmitter	Reactor Coolant Pump Seal Water INJ/Leakoff	Auxiliary	587	587 Hallway	587
2-QFA-240	RCP Seal Water Injection to Reactor Coolant Pump PP-45-4 Low Flow Alarm Transmitter	Reactor Coolant Pump Seal Water INJ/Leakoff	Auxiliary	587	587 Hallway	587
2-QFI-200	CVCS Charging Pumps Discharge Flow Indicator Transmitter	(CVCS) Charging	Auxiliary	587	587 Hallway	587
2-QMO-200	CVCS Charging to Regenerative Heat Exchanger Train 'A' Shutoff Valve	(CVCS) Charging	Auxiliary	587	Reciprocating Charging Pump Room	39

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-QMO-201	CVCS Charging to Regenerative Heat Exchanger Train 'B' Shutoff Valve	(CVCS) Charging	Auxiliary	587	Reciprocating Charging Pump Room	39
2-QMO-225	East Centrifugal Charging Pump Mini-Flow to RCP Seal Water Heat Exchanger HE-11 2" Motor Operated Shutoff Valve	(CVCS) Charging	Auxiliary	587	East Centrifugal Charging Pump Room	40
2-QMO-226	West Centrifugal Charging Pump Mini-Flow to RCP Seal Water Heat Exchanger HE-11 2" Motor Operated Shutoff Valve	(CVCS) Charging	Auxiliary	587	West Centrifugal Charging Pump Room	41
2-QMO-451	Reactor Coolant Letdown Volume Control Tank TK-10 to CVCS Charging Pumps Train 'A' Shutoff 4" Motor Operated Valve	(CVCS) Letdown	Auxiliary	609	Volume Control Tank East Hallway	19
2-QMO-452	Reactor Coolant Letdown Volume Control Tank TK-10 to CVCS Charging Pumps Train 'B' Shutoff 4" Motor Operated Valve	(CVCS) Letdown	Auxiliary	609	Volume Control Tank East Hallway	19
2-QRV-10	Reactor Coolant Pump #1 Seal #1 Leakoff to RCP Seal Water Return Filter QC-109 2" Air Operated Shutoff Valve	Reactor Coolant Pump Seal Water INJ/Leakoff	Containment	617	Lower Containment, Quadrant #1	60

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-QRV-150	Reactor Coolant Pumps Startup Seal System Bypass to Seal Water Return Filter QC-109 0.75" Air Operated Shutoff Valve	Reactor Coolant Pump Seal Water INJ/Leakoff	Containment	598	Annulus - Quadrant #2	59
2-QRV-20	Reactor Coolant Pump #2 Seal #1 Leakoff to RCP Seal Water Return Filter QC-109 2" Air Operated Shutoff Globe Valve	Reactor Coolant Pump Seal Water INJ/Leakoff	Containment	625	Lower Containment, Quadrant #2	61
2-QRV-251	CVCS Centrifugal Charging Pumps Discharge Flow 3" Air Operated Control Globe Valve	(CVCS) Charging	Auxiliary	587	Reciprocating Charging Pump Room	39
2-QRV-30	Reactor Coolant Pump #3 Seal #1 Leakoff to RCP Seal Water Return Filter QC-109 2" Air Operated Shutoff Globe Valve	Reactor Coolant Pump Seal Water INJ/Leakoff	Containment	612	Lower Containment, Quadrant #3	62
2-QRV-40	Reactor Coolant Pump #4 Seal #1 Leakoff to RCP Seal Water Return Filter QC-109 2" Air Operated Shutoff Globe Valve	Reactor Coolant Pump Seal Water INJ/Leakoff	Containment	612	Lower Containment, Quadrant #4	63

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-QT-100-AB	AB Emergency Diesel Air Intake Filter	Diesel Combustion Air	Grounds	609	Inner Plant Grounds	244
2-QT-100-CD	CD Emergency Diesel Air Intake Filter	Diesel Combustion Air	Grounds	609	Inner Plant Grounds	244
2-QT-101-AB	AB Emergency Diesel Air Intake Silencer	Diesel Combustion Air	Auxiliary	587	AB EDG Room	121
2-QT-101-CD	CD Emergency Diesel Air Intake Silencer	Diesel Combustion Air	Auxiliary	587	CD EDG Room	122
2-QT-104-AB	AB Emergency Diesel Exhaust Silencer	Diesel Combustion Air	Grounds	609	Inner Plant Grounds	244
2-QT-104-CD	CD Emergency Diesel Exhaust Silencer	Diesel Combustion Air	Grounds	609	Inner Plant Grounds	244
2-QT-106-AB1	AB Emergency Diesel Fuel Oil Transfer Pump #1	Diesel Fuel Oil	Auxiliary	587	AB EDG Fuel Oil Transfer Pump Room	126
2-QT-106-AB2	AB Emergency Diesel Fuel Oil Transfer Pump #2	Diesel Fuel Oil	Auxiliary	587	AB EDG Fuel Oil Transfer Pump Room	126

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-QT-106-CD1	CD Emergency Diesel Fuel Oil Transfer Pump #1	Diesel Fuel Oil	Auxiliary	587	CD EDG Fuel Oil Transfer Pump Room	125
2-QT-106-CD2	CD Emergency Diesel Fuel Oil Transfer Pump #2	Diesel Fuel Oil	Auxiliary	587	CD EDG Fuel Oil Transfer Pump Room	125
2-QT-107-AB	AB Emergency Diesel Fuel Oil Day Tank	Diesel Fuel Oil	Auxiliary	587	AB EDG Room	121
2-QT-107-CD	CD Emergency Diesel Fuel Oil Day Tank	Diesel Fuel Oil	Auxiliary	587	CD EDG Room	122
2-QT-110-AB	AB Emergency Diesel Lube Oil Cooler	Diesel Lube Oil	Auxiliary	587	AB EDG Room	121
2-QT-110-CD	CD Emergency Diesel Lube Oil Cooler	Diesel Lube Oil	Auxiliary	587	CD EDG Room	122
2-QT-111-AB	AB Emergency Diesel Lube Oil Before and After Pump	Diesel Lube Oil	Auxiliary	579	AB EDG Lube Oil Pit	257
2-QT-111-CD	CD Emergency Diesel Lube Oil Before and After Pump	Diesel Lube Oil	Auxiliary	579	CD EDG Lube Oil Pit	258

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-QT-112-AB	AB Emergency Diesel Full Flow Lube Oil Filter	Diesel Lube Oil	Auxiliary	579	AB EDG Lube Oil Pit	257
2-QT-112-CD	CD Emergency Diesel Full Flow Lube Oil Filter	Diesel Lube Oil	Auxiliary	579	CD EDG Lube Oil Pit	258
2-QT-113-AB1	AB Emergency Diesel Full Flow Lube Oil Strainer #1	Diesel Lube Oil	Auxiliary	579	AB EDG Lube Oil Pit	257
2-QT-113-AB2	AB Emergency Diesel Full Flow Lube Oil Strainer #2	Diesel Lube Oil	Auxiliary	579	AB EDG Lube Oil Pit	257
2-QT-113-CD1	CD Emergency Diesel Full Flow Lube Oil Strainer #1	Diesel Lube Oil	Auxiliary	579	CD EDG Lube Oil Pit	258
2-QT-113-CD2	CD Emergency Diesel Full Flow Lube Oil Strainer #2	Diesel Lube Oil	Auxiliary	579	CD EDG Lube Oil Pit	258
2-QT-114-AB	AB Emergency Diesel Lube Oil Cooler QT-110-AB Lube Oil Thermostatic Inlet/Bypass Valve	Diesel Lube Oil	Auxiliary	587	AB EDG Room	121
2-QT-114-CD	CD Emergency Diesel Lube Oil Cooler QT-110-CD Lube Oil Thermostatic Inlet/Bypass Valve	Diesel Lube Oil	Auxiliary	587	CD EDG Room	122

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-QT-115-AB	AB Emergency Diesel Lube Oil Sump Tank	Diesel Lube Oil	Auxiliary	579	AB EDG Lube Oil Pit	257
2-QT-115-CD	CD Emergency Diesel Lube Oil Sump Tank	Diesel Lube Oil	Auxiliary	579	CD EDG Lube Oil Pit	258
2-QT-116-AB	AB Emergency Diesel Lube Oil Heater Tank	Diesel Lube Oil	Auxiliary	579	AB EDG Lube Oil Pit	257
2-QT-116-CD	CD Emergency Diesel Lube Oil Heater Tank	Diesel Lube Oil	Auxiliary	579	CD EDG Lube Oil Pit	258
2-QT-117-AB	AB Emergency Diesel Lube Oil Heater QT-116-AB Pump	Diesel Lube Oil	Auxiliary	579	AB EDG Lube Oil Pit	257
2-QT-117-CD	CD Emergency Diesel Lube Oil Heater QT-116-CD Pump	Diesel Lube Oil	Auxiliary	579	CD EDG Lube Oil Pit	258
2-QT-118-AB	AB Emergency Diesel Bypass Lube Oil Filter	Diesel Lube Oil	Auxiliary	579	AB EDG Lube Oil Pit	257
2-QT-118-CD	CD Emergency Diesel Bypass Lube Oil Filter	Diesel Lube Oil	Auxiliary	579	CD EDG Lube Oil Pit	258

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-QT-119-AB	AB Emergency Diesel Bypass Lube Oil Filter QT-118-AB Pump	Diesel Lube Oil	Auxiliary	579	AB EDG Lube Oil Pit	257
2-QT-119-CD	CD Emergency Diesel Bypass Lube Oil Filter QT-118-CD Pump	Diesel Lube Oil	Auxiliary	579	CD EDG Lube Oil Pit	258
2-QT-130-AB1	AB Emergency Diesel Jacket Water Pump #1	Diesel Jacket Water	Auxiliary	587	AB EDG Room	121
2-QT-130-AB2	AB Emergency Diesel Jacket Water Pump #2	Diesel Jacket Water	Auxiliary	587	AB EDG Room	121
2-QT-130-CD1	CD Emergency Diesel Jacket Water Pump #1	Diesel Jacket Water	Auxiliary	587	CD EDG Room	122
2-QT-130-CD2	CD Emergency Diesel Jacket Water Pump #2	Diesel Jacket Water	Auxiliary	587	CD EDG Room	122
2-QT-131-AB	AB Emergency Diesel Jacket Water Cooler	Diesel Jacket Water	Auxiliary	587	AB EDG Room	121
2-QT-131-CD	CD Emergency Diesel Jacket Water Cooler	Diesel Jacket Water	Auxiliary	587	CD EDG Room	122

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-QT-132-AB	AB Emergency Diesel Jacket Water Cooler QT-131-AB Jacket Water Thermostatic Inlet/Bypass Valve	Diesel Jacket Water	Auxiliary	587	AB EDG Room	121
2-QT-132-CD	CD Emergency Diesel Jacket Water Cooler QT-131-CD Jacket Water Thermostatic Inlet/Bypass	Diesel Jacket Water	Auxiliary	587	CD EDG Room	122
2-QT-133-AB	AB Emergency Diesel Jacket Water Surge Tank	Diesel Jacket Water	Auxiliary	587	AB EDG Room	121
2-QT-133-CD	CD Emergency Diesel Jacket Water Surge Tank	Diesel Jacket Water	Auxiliary	587	CD EDG Room	122
2-QT-134-AB	AB Emergency Diesel Auxiliary Jacket Water Heater	Diesel Jacket Water	Auxiliary	587	AB EDG Room	121
2-QT-134-CD	CD Emergency Diesel Auxiliary Jacket Water Heater (Tank)	Diesel Jacket Water	Auxiliary	587	CD EDG Room	122
2-QT-135-AB	AB Emergency Diesel Auxiliary Jacket Water Pump	Diesel Jacket Water	Auxiliary	587	AB EDG Room	121
2-QT-135-CD	CD Emergency Diesel Auxiliary Jacket Water Pump	Diesel Jacket Water	Auxiliary	587	CD EDG Room	122

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-QT-141-AB1	AB Emergency Diesel Starting Air Receiver #1	Diesel Starting Air	Auxiliary	587	AB EDG Room	121
2-QT-141-AB2	AB Emergency Diesel Starting Air Receiver #2	Diesel Starting Air	Auxiliary	587	AB EDG Room	121
2-QT-141-CD1	CD Emergency Diesel Starting Air Receiver #1	Diesel Starting Air	Auxiliary	587	CD EDG Room	122
2-QT-141-CD2	CD Emergency Diesel Starting Air Receiver #2	Diesel Starting Air	Auxiliary	587	CD EDG Room	122
2-QT-143-AB1	AB Emergency Diesel Control Air Dryer #1	Diesel Control Air	Auxiliary	587	AB EDG Room	121
2-QT-143-AB2	AB Emergency Diesel Control Air Dryer #2	Diesel Control Air	Auxiliary	587	AB EDG Room	121
2-QT-143-CD1	CD Emergency Diesel Control Air Dryer #1	Diesel Control Air	Auxiliary	587	CD EDG Room	122
2-QT-143-CD2	CD Emergency Diesel Control Air Dryer #2	Diesel Control Air	Auxiliary	587	CD EDG Room	122

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-QT-144-AB	AB Emergency Diesel Fuel Oil Transfer Filter	Diesel Fuel Oil	Auxiliary	587	AB EDG Room	121
2-QT-144-CD	CD Emergency Diesel Fuel Oil Transfer Filter	Diesel Fuel Oil	Auxiliary	587	CD EDG Room	122
2-QT-502-AB	AB Emergency Diesel Turbocharger	Diesel Combustion Air	Auxiliary	587	AB EDG Room	121
2-QT-502-CD	CD Emergency Diesel Turbocharger	Diesel Combustion Air	Auxiliary	587	CD EDG Room	122
2-QT-506	Turbine Driven Aux Feed Pump PP-4 Trip and Throttle Valve	Auxiliary Feedwater/Main Steam	Turbine	591	TDAFP Room	49
2-QT-507	TDAFP Governor Valve	Main Steam	Turbine	591	TDAFP Room	49
2-RC	Reactor Control Rods Control Panel	Rod Control and Instrumentation	Auxiliary	633	Control Room	123
2-RH-117	RHR Bypass Isolation Manual Valve	Residual Heat Removal	Auxiliary	609	East RHR Heat Exchanger Room	5

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-RHR	Residual Heat Removal Control Panel	Residual Heat Removal	Auxiliary	633	Control Room	123
2-RPC-I	Reactor Protection Channel I Cabinet #1, 2, 3 & 4	Reactor Protection	Auxiliary	633	Control Room	123
2-RPC-II	Reactor Protection Channel II Cabinet #5, 6 & 7	Reactor Protection	Auxiliary	633	Control Room	123
2-RPC-III	Reactor Protection Channel III Cabinet #9, 10 & 11	Reactor Protection	Auxiliary	633	Control Room	123
2-RPC-IV	Reactor Protection Channel IV Cabinet #12	Reactor Protection	Auxiliary	633	Control Room	123
2-RPS-A	Reactor Protection and Safeguard Actuation Train 'A' Cabinet	Reactor Protection	Auxiliary	633	Control Room	123
2-RPS-B	Reactor Protection and Safeguard Actuation Train 'B' Cabinet	Reactor Protection	Auxiliary	633	Control Room	123
2-RPSX-A	Reactor Protection and Safeguard Actuation Train "A" Auxiliary Cabinet	Reactor Protection	Auxiliary	633	Control Room	123

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-RPSX-B	Reactor Protection and Safeguard Actuation Train "B" Auxiliary Cabinet	Reactor Protection	Auxiliary	633	Control Room	123
2-SA	Station Auxiliaries Control Panel	4160Vac	Auxiliary	633	Control Room	123
2-SG	Steam Generator and Auxiliary Feed Pump Control Panel	Auxiliary Feedwater	Auxiliary	633	Control Room	123
2-SI-152N	RHR to SI Pumps Check Valve	Residual Heat Removal	Containment	612	East Containment Lower Vent Room	72
2-SI-152S	RHR to SI Pumps Check Valve	Residual Heat Removal	Containment	612	West Containment Lower Vent Room	73
2-SI-210	Boron Injection to Charging Pump Crosstie Check Valve	Boron Injection	Auxiliary	612	BIT Room	16
2-SSV-A1	250Vdc Train 'A' Nuclear Sampling Feeder Panel #1	250Vdc	Auxiliary	587	Nuclear Sampling Room	36

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-SSV-A2	250Vdc Train 'A' Nuclear Sampling Feeder Panel #2	250Vdc	Auxiliary	587	Nuclear Sampling Room	36
2-SSV-B	250Vdc Train 'B' Nuclear Sampling Feeder Panel	250Vdc	Auxiliary	587	Nuclear Sampling Room	36
2-SV-102	Residual Heat Removal to Reactor Coolant Loops #2 & #3 Cold Legs Safety Valve	Residual Heat Removal	Containment	598	Annulus - Quadrant #2	59
2-SV-103	Reactor Coolant Loop #2 Hot Leg to Residual Heat Removal Pumps Safety Valve	Residual Heat Removal	Containment	598	Annulus - Quadrant #2	59
2-SV-104E	East Residual Heat Removal Heat Exchanger HE-17E Outlet Safety Valve	Residual Heat Removal	Auxiliary	609	East RHR Heat Exchanger Room	5
2-SV-104W	West Residual Heat Removal Heat Exchanger HE-17W Outlet Safety Valve	Residual Heat Removal	Auxiliary	609	West RHR Heat Exchanger Room	6
2-SV-120-AB	2-XTC-301 & 2-XTC-302 Control Air Safety Valve	Control Air	Auxiliary	587	AB EDG Room	121

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-SV-120-CD	2-XTC-306 and 2-XTC-307 Control Air Safety Valve	Control Air	Auxiliary	587	CD EDG Room	122
2-SV-139-AB	AB Emergency Diesel Starting Air to Turbocharger Safety Valve	Diesel Starting Air	Auxiliary	587	AB EDG Room	121
2-SV-139-CD	CD Emergency Diesel Starting Air to Turbocharger Safety Valve	Diesel Starting Air	Auxiliary	587	CD EDG Room	122
2-SV-140-1	Turbine Driven Aux Feed Pump Governor Oil Cooler Cooling Water Inlet Safety Valve	Auxiliary Feedwater	Turbine	591	TDAFP Room	49
2-SV-140-2	Turbine Driven Aux Feed Pump Oil Cooler Cooling Water Inlet Safety Valve	Auxiliary Feedwater	Turbine	591	TDAFP Room	49
2-SV-169E	East Motor Driven Auxiliary Feedwater Pump PP-3E Suction Safety Valve	Auxiliary Feedwater	Turbine	591	East MDAFP Room	50
2-SV-169W	West Motor Driven Auxiliary Feed Pump PP-3W Suction Safety Valve	Auxiliary Feedwater	Turbine	591	West MDAFP Room	51

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-SV-1A-1	Steam Generator OME-3-1 Safety Valve 1A	Main Steam	Auxiliary	633	East Main Steam Stop Enclosure	10
2-SV-1A-2	Steam Generator OME-3-2 Safety Valve 1A	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9
2-SV-1A-3	Steam Generator OME-3-3 Safety Valve 1A	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9
2-SV-1A-4	Steam Generator OME-3-4 Safety Valve 1A	Main Steam	Auxiliary	633	East Main Steam Stop Enclosure	10
2-SV-1B-1	Steam Generator OME-3-1 Safety Valve 1B	Main Steam	Auxiliary	633	East Main Steam Stop Enclosure	10
2-SV-1B-2	Steam Generator OME-3-2 Safety Valve 1B	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-SV-1B-3	Steam Generator OME-3-3 Safety Valve 1B	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9
2-SV-1B-4	Steam Generator OME-3-4 Safety Valve 1B	Main Steam	Auxiliary	633	East Main Steam Stop Enclosure	10
2-SV-200-AB	AB Emergency Diesel Fuel Oil Manifolds to Fuel Oil Day Tank Safety Valve	Diesel Fuel Oil	Auxiliary	587	AB EDG Room	121
2-SV-200-CD	CD Emergency Diesel Fuel Oil Manifolds to Fuel Oil Day Tank Safety Valve	Diesel Fuel Oil	Auxiliary	587	CD EDG Room	122
2-SV-201-AB1	AB Emergency Diesel Front Bank Fuel Oil Manifold Safety Valve	Diesel Fuel Oil	Auxiliary	587	CD EDG Room	122
2-SV-201-AB2	AB Emergency Diesel Rear Bank Fuel Oil Manifold Safety Valve	Diesel Fuel Oil	Auxiliary	587	AB EDG Room	121

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-SV-201-CD1	CD Emergency Diesel Front Bank Fuel Oil Manifold Safety Valve	Diesel Fuel Oil	Auxiliary	587	CD EDG Room	122
2-SV-201-CD2	CD Emergency Diesel Rear Bank Fuel Oil Manifold Safety Valve	Diesel Fuel Oil	Auxiliary	587	CD EDG Room	122
2-SV-2A-1	Steam Generator OME-3-1 Safety Valve 2A	Main Steam	Auxiliary	633	East Main Steam Stop Enclosure	10
2-SV-2A-2	Steam Generator OME-3-2 Safety Valve 2A	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9
2-SV-2A-3	Steam Generator OME-3-3 Safety Valve 2A	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9
2-SV-2A-4	Steam Generator OME-3-4 Safety Valve 2A	Main Steam	Auxiliary	633	East Main Steam Stop Enclosure	10
2-SV-2B-1	Steam Generator OME-3-1 Safety Valve 2B	Main Steam	Auxiliary	633	East Main Steam Stop Enclosure	10

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-SV-2B-2	Steam Generator OME-3-2 Safety Valve 2B	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9
2-SV-2B-3	Steam Generator OME-3-3 Safety Valve 2B	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9
2-SV-2B-4	Steam Generator OME-3-4 Safety Valve 2B	Main Steam	Auxiliary	633	East Main Steam Stop Enclosure	10
2-SV-3-1	Steam Generator OME-3-1 Safety Valve #3	Main Steam	Auxiliary	633	East Main Steam Stop Enclosure	10
2-SV-3-2	Steam Generator OME-3-2 Safety Valve #3	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9
2-SV-3-3	Steam Generator OME-3-3 Safety Valve #3	Main Steam	Auxiliary	633	West Main Steam Stop Enclosure	9

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-SV-3-4	Steam Generator OME-3-4 Safety Valve #3	Main Steam	Auxiliary	633	East Main Steam Stop Enclosure	10
2-SV-45A	Pressurizer OME-4 Safety Valve 'A'	Reactor Coolant	Containment	650	Pressurizer Enclosure, Interior	81
2-SV-45B	Pressurizer OME-4 Safety Valve 'B'	Reactor Coolant	Containment	650	Pressurizer Enclosure, Interior	81
2-SV-45C	Pressurizer OME-4 Safety Valve 'C'	Reactor Coolant	Containment	650	Pressurizer Enclosure, Interior	81
2-SV-50	RC Pumps Seal #1 and Startup Seal System Bypass to Seal Water Return Filters Safety Valve	Reactor Coolant Pump Seal Water INJ/Leakoff	Containment	598	Annulus - Quadrant #3	56
2-SV-54	Reactor Coolant Pump Seal Water Heat Exchanger HE-11 Safety Valve	(CVCS) Letdown	Auxiliary	609	Seal Water Heat Exchanger Room	18

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-SV-56	CVCS Charging Pumps Suction Header Safety Valve	(CVCS) Charging	Auxiliary	587	Reciprocating Charging Pump Room	39
2-SV-61-AB	AB Emergency Diesel Auxiliary Jacket Water Heater QT-134-AB Safety Valve	Diesel Jacket Water	Auxiliary	587	AB EDG Room	121
2-SV-61-CD	CD Emergency Diesel Auxiliary Jacket Water Heater QT-134-CD Safety Valve	Diesel Jacket Water	Auxiliary	587	CD EDG Room	122
2-SV-78-AB1	AB Emergency Diesel Starting Air Receiver QT-141-AB1 Safety Valve	Diesel Starting Air	Auxiliary	587	AB EDG Room	121
2-SV-78-AB2	AB Emergency Diesel Starting Air Receiver QT-141-AB2 Safety Valve	Diesel Starting Air	Auxiliary	587	AB EDG Room	121
2-SV-78-CD1	CD Emergency Diesel Starting Air Receiver QT-141-CD1 Safety Valve	Diesel Starting Air	Auxiliary	587	CD EDG Room	122

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-SV-78-CD2	CD Emergency Diesel Starting Air Receiver QT-141-CD2 Safety Valve	Diesel Starting Air	Auxiliary	587	CD EDG Room	122
2-SV-79-AB1	AB Emergency Diesel Control Air Dryer QT-143-AB1 Safety Valve	Diesel Starting Air	Auxiliary	587	AB EDG Room	121
2-SV-79-AB2	AB Emergency Diesel Control Air Dryer QT-143-AB2 Safety Valve	Diesel Starting Air	Auxiliary	587	AB EDG Room	121
2-SV-79-CD1	CD Emergency Diesel Control Air Dryer QT-143-CD1 Safety Valve	Diesel Starting Air	Auxiliary	587	CD EDG Room	122
2-SV-79-CD2	CD Emergency Diesel Control Air Dryer QT-143-CD2 Safety Valve	Diesel Starting Air	Auxiliary	587	CD EDG Room	122
2-SV-96	Safety Injection Pumps Suction Header Safety Valve	Safety Injection	Auxiliary	587	South Safety Injection Pump Room	43

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-SV-97	Boron Injection Tank TK-11 Outlet Safety Valve	Boron Injection	Auxiliary	612	BIT Room	16
2-SV-98N	North Safety Injection Pump PP-26N Discharge Header Safety Valve	Safety Injection	Auxiliary	587	North Safety Injection Pump Room	42
2-SV-98S	South Safety Injection Pump PP-26S Discharge Header Safety Valve	Safety Injection	Auxiliary	587	South Safety Injection Pump Room	43
2-T21A	4kv Bus T21A Switchgear	4160Vac	Auxiliary	609	4kv Room - AB 4kv Switchgear Area	140
2-T21A10	Transformer TR21A to 600Vac Bus 21A Supply Breaker	4160Vac	Auxiliary	609	4kv Room - AB 4kv Switchgear Area	140
2-T21A11	AB Emergency Diesel Generator to 4kv Bus T21A Supply Breaker	4160Vac	Auxiliary	609	4kv Room - AB 4kv Switchgear Area	140

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-T21A12	Circuit Breaker From 69kv to Bus T21A	4160Vac	Auxiliary	609	4kv Room - AB 4kv Switchgear Area	140
2-T21A2	West Motor Driven Aux Feedwater Pump PP-3W Supply Breaker	4160Vac	Auxiliary	609	4kv Room - AB 4kv Switchgear Area	140
2-T21A4	West Residual Heat Removal Pump PP-35W Supply Breaker	4160Vac	Auxiliary	609	4kv Room - AB 4kv Switchgear Area	140
2-T21A5	West Essential Service Water Pump PP-7W Supply Breaker	4160Vac	Auxiliary	609	4kv Room - AB 4kv Switchgear Area	140
2-T21A7	West Component Cooling Water Pump PP-10W Supply Breaker	4160Vac	Auxiliary	609	4kv Room - AB 4kv Switchgear Area	140
2-T21A8	West Centrifugal Charging Pump PP-50W Supply Breaker	4160Vac	Auxiliary	609	4kv Room - AB 4kv Switchgear Area	140

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-T21A9	4kv Bus 2A to Bus T21A Tie Breaker	4160Vac	Auxiliary	609	4kv Room - AB 4kv Switchgear Area	140
2-T21B	4kv Bus T21B Switchgear	4160Vac	Auxiliary	609	4kv Room - AB 4kv Switchgear Area	140
2-T21B1	4kv Bus 2B to 4kv Bus T21B Tie Breaker	4160Vac	Auxiliary	609	4kv Room - AB 4kv Switchgear Area	140
2-T21B2	Circuit Breaker From 69kv Bus to Bus T21B	4160Vac	Auxiliary	609	4kv Room - AB 4kv Switchgear Area	140
2-T21B4	AB Emergency Diesel Generator to 4kv Bus T21B Supply Breaker	4160Vac	Auxiliary	609	4kv Room - AB 4kv Switchgear Area	140
2-T21C	4kv Bus T21C Switchgear	4160Vac	Auxiliary	609	4kv Room - CD 4kv Switchgear Area	206

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-T21C1	4kv Bus 2c to 4kv Bus T21C Tie Breaker	4160Vac	Auxiliary	609	4kv Room - CD 4kv Switchgear Area	206
2-T21C2	Circuit Breaker - 4kv From 69kv to Bus T21C	4160Vac	Auxiliary	609	4kv Room - CD 4kv Switchgear Area	206
2-T21C3	CD Emergency Diesel Generator to 4kv Bus T21C Supply Breaker	4160Vac	Auxiliary	609	4kv Room - CD 4kv Switchgear Area	206
2-T21D	4kv Bus T21D Switchgear	4160Vac	Auxiliary	609	4kv Room - CD 4kv Switchgear Area	206
2-T21D1	4kv Emergency Power Bus EP to 4kv Bus T21D Supply Breaker	4160Vac	Auxiliary	609	4kv Room - CD 4kv Switchgear Area	206
2-T21D10	East Essential Service Water Pump PP-7E Supply Breaker	4160Vac	Auxiliary	609	4kv Room - CD 4kv Switchgear Area	206

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-T21D11	East Motor Driven Auxiliary Feedwater Pump PP-3E Supply Breaker	4160Vac	Auxiliary	609	4kv Room - CD 4kv Switchgear Area	206
2-T21D12	4kv Bus 2d to 4kv Bus T21D Tie Breaker	4160Vac	Auxiliary	609	4kv Room - CD 4kv Switchgear Area	206
2-T21D2	Transformer TR21D to 600Vac Bus 21D Supply Breaker	4160Vac	Auxiliary	609	4kv Room - CD 4kv Switchgear Area	206
2-T21D3	East Component Cooling Water Pump PP-10E Supply Breaker	4160Vac	Auxiliary	609	4kv Room - CD 4kv Switchgear Area	206
2-T21D6	East RHR Pump PP-35E Supply Breaker	4160Vac	Auxiliary	609	4kv Room - CD 4kv Switchgear Area	206
2-T21D7	East Centrifugal Charging Pump PP-50e Supply Breaker	4160Vac	Auxiliary	609	4kv Room - CD 4kv Switchgear Area	206

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-T21D8	CD Emergency Diesel Generator to 4kv Bus T21D Supply Breaker	4160Vac	Auxiliary	609	4kv Room - CD 4kv Switchgear Area	206
2-TDAB	250 Vdc Train 'B' Transfer Cabinet	250Vdc	Auxiliary	609	AB BATT Equip Area	200
2-TDCD	250 Vdc Train 'A' Transfer Cabinet	250Vdc	Auxiliary	626	CD BATT Equip Area	201
2-TK-11	Boron Injection Tank	Boron Injection	Auxiliary	612	BIT Room	16
2-TK-253-1	Pressurizer Train 'B' Pressure Relief Valve NRV-152 Reserve Control Air Tank	Control Air	Containment	625	Lower Containment, Quadrant #3	62
2-TK-253-2	Pressurizer Train 'A' Pressure Relief Valve NRV-153 Reserve Control Air Tank	Control Air	Containment	625	Lower Containment, Quadrant #3	62
2-TK-253-3	Pressurizer Train 'B' Pressure Relief Valve NRV-152 Emergency Air Tank	Control Air	Containment	650	Upper Containment, Quadrant #4	86

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-TK-253-4	Pressurizer Train 'A' Pressure Relief Valve NRV-153 Emergency Air Tank	Control Air	Containment	650	Upper Containment, Quadrant #4	86
2-TK-32	Condensate Storage Tank	Condensate Storage Tank Supply	Grounds	609	Condensate Storage Tank Area	20
2-TK-33	Refueling Water Storage Tank	RWST Supply	Grounds	609	RWST Area	21
2-TK-37	Component Cooling Water Surge Tank	Component Cooling Water	Auxiliary	650	650 Hallway	650
2-TK-76N	Control Room Air Conditioning North Chill Water Expansion Tank	Control Room Ventilation	Auxiliary	650	Control Rm A/C Room	129
2-TK-76S	Control Room Air Conditioning South Chill Water Expansion Tank	Control Room Ventilation	Auxiliary	650	Control Rm A/C Room	129
2-TR21A	600v Bus 21A Supply Transformer	600Vac	Auxiliary	609	4kv Room - 600v Switchgear Area	204

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-TR21B	600v Bus 21B Supply Transformer	600Vac	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-TR21C	600v Bus 21C Supply Transformer	600Vac	Auxiliary	609	4kv Room - CD 4kv Switchgear Area	206
2-TR21D	600v Bus 21D Supply Transformer	600Vac	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-TR-AFW	Auxiliary Feedwater 120/208Vac Distribution Panel AFW Supply Transformer	120/208Vac Misc Safety Related Power Distribution	Auxiliary	587	CD EDG Room	122
2-TR-ELSC	120/208Vac Emergency Local Shutdown Distribution Transformer	120/208Vac Misc Safety Related Power Distribution	Auxiliary	587	AB EDG Room	121

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-VDAB-1	250Vdc Valve Distribution Panel VDAB-1	250Vdc	Auxiliary	633	Control Room	123
2-VDAB-2	250Vdc Valve Distribution Panel VDAB-2	250Vdc	Auxiliary	633	Control Room	123
2-VDCD-1	250Vdc Valve Distribution Panel VDCD-1	250Vdc	Auxiliary	633	Control Room	123
2-VDCD-2	250Vdc Valve Distribution Panel VDCD-2	250Vdc	Auxiliary	633	Control Room	123
2-VRV-315	Control Room Ventilation Unit HV-ACRA-1 Chill Water Inlet/Bypass Valve	Control Room Ventilation	Auxiliary	650	Control Room A/C Room	129
2-VRV-325	Control Room Ventilation Unit HV-ACRA-2 Chill Water Inlet/Bypass Valve	Control Room Ventilation	Auxiliary	650	Control Room A/C Room	129
2-VTS-201	East Motor Driven Auxiliary Feedwater Pump Room Cooler 2- HV-AFP-EAC Temperature Switch	Turbine Building Ventilation	Turbine	591	East MDAFP Room	50

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-VTS-203	Turbine Driven Auxiliary Feed Pump Room Cooler 2- HV-AFP-T1AC Temperature Switch	Turbine Building Ventilation	Turbine	591	TDAFP Room	49
2-VTS-204	Turbine Driven Auxiliary Feed Pump Room Cooler 2-HV-AFP-T2AC Temperature Switch	Turbine Building Ventilation	Turbine	591	TDAFP Room	49
2-VTS-206	West Motor Driven Auxiliary Feedwater Pump Room Cooler 2-HV-AFP-WAC Temperature Switch	Turbine Building Ventilation	Turbine	591	West MDAFP Room	51
2-VTS-340	AB Emergency Diesel Generator Room Ventilation Supply Fan HV-DGS-2 Outside Air Thermostat	Emergency Diesel Generator Room Ventilation	Grounds	609	RWST Area	21
2-VTS-341	AB Emergency Diesel Generator Room Ventilation Fans HV-DGX-2 Thermostat	Emergency Diesel Generator Room Ventilation	Auxiliary	587	AB EDG Room	121

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-VTS-345	CD Emergency Diesel Generator Room Ventilation Supply Fan HV-DGS-1 Outside Air Thermostat	Emergency Diesel Generator Room Ventilation	Auxiliary	596	Reactor Cable Tunnel, Quadrant #3	26
2-VTS-346	CD Emergency Diesel Generator Room Ventilation Exhaust Fan HV-DGX-1 Thermostat	Emergency Diesel Generator Room Ventilation	Auxiliary	587	CD EDG Room	122
2-VTS-350	Control Rod Drive Equip Room and Inv Area Vent North Supply Fan HV-SGRS-1a Temperature Switch	ELEC. SWGR. Ventilation	Auxiliary	609	Inverter Area	202
2-VTS-351	Control Rod Drive Equip Room and Inv Area Vent North Supply Fan HV-SGRS-1a Temperature Switch	ELEC. SWGR. Ventilation	Auxiliary	609	Control Rod Drive Equipment Room	203
2-VTS-352	4kv Room 600 Volt Switchgear Xfrms TR21B and TR21D Area Vent Supply Fan HV-SGRS-7 Temperature Switch	ELEC. SWGR. Ventilation	Auxiliary	609	4kv Room - 600v Switchgear Area	204

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-VTS-353	600Vac Motor Control Center Mezzanine Area Vent Supply Fan HV-SGRS-9 Temperature Switch	ELEC. SWGR. Ventilation	Auxiliary	613	4kv Room - Mezzanine Area	205
2-VTS-354	Ctrl Rod Drv Equip Room and Inv Area Vent Outside Air Inlet Damper HV-Sgr-MD-2 Temperature Switch	ELEC. SWGR. Ventilation	Auxiliary	609	Inverter Area	202
2-VTS-355	Ctrl Rod Drive Equip Room and Inv Area Vent Recirc Air Inlet Damper HV-Sgr-MD-1 Temperature Switch	ELEC. SWGR. Ventilation	Auxiliary	609	Inverter Area	202
2-VTS-356	Crd Equipment Room and Inverter Area Ventilation North Supply Fan HV-SGRS-4A Temp Switch	ELEC. SWGR. Ventilation	Auxiliary	609	Inverter Area	202
2-VTS-357	Ctrl Rod Drive Equip Room and Inv Area Ventilation South Supply Fan HV-SGRS-4A Temperature Switch	ELEC. SWGR. Ventilation	Auxiliary	609	Control Rod Drive Equipment Room	203
2-VTS-702	Unit 2 East ESW Pump Room Temperature Switch	ESW Ventilation	Screenhouse	591	East ESW Pump Room	135

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-VTS-704	Unit 2 West ESW Pump Room Temperature Switch	ESW Ventilation	Screenhouse	591	West ESW Pump Room	136
2-VTS-802	4kv Room AB 4kv Switchgear Area Ventilation Supply Fan HV-SGRS-2 Thermal Sensor	ELEC. SWGR. Ventilation	Auxiliary	609	4kv Room - AB 4kv Switchgear Area	140
2-VTS-803	4kv Room CD 4kv Switchgear Area Ventilation Supply Fan HV-SGRS-3 Thermal Sensor	ELEC. SWGR. Ventilation	Auxiliary	609	4kv Room - CD 4kv Switchgear Area	206
2-VTS-805	4kv Room 600v SWGR Xfmrs TR21B and TR21D Area Vent Supply Fan HV-SGRS-7 Temp Switch Thermal Sensor	ELEC. SWGR. Ventilation	Auxiliary	613	4kv Room - Mezzanine Area	205
2-VTS-808	4kv Room 600v SWGR Xfmrs TR21A and TR21C Area Vent Supply Fan HV-SGRS-8 Temp Switch Temp Switch	ELEC. SWGR. Ventilation	Auxiliary	609	4kv Room - 600v Switchgear Area	204
2-WFA-702	East Essential Service Water Supply Header Flow Transmitter	Essential Service Water	Turbine	569	ESW Pipe Tunnel	131

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-WFA-706	West Essential Service Water Supply Header Flow Transmitter	Essential Service Water	Turbine	569	ESW Pipe Tunnel	131
2-WMO-703	East Essential Service Water Pump PP-7E Discharge Shutoff Valve	Essential Service Water	Screenhouse	591	East ESW Pump Room	135
2-WMO-704	West Essential Service Water Pump PP-7W Discharge Shutoff Valve	Essential Service Water	Screenhouse	591	West ESW Pump Room	136
2-WMO-706	West Essential Service Water Supply Header Crosstie to Unit 1 Shutoff Valve	Essential Service Water	Turbine	569	ESW Pipe Tunnel	131
2-WMO-708	East Essential Service Water Supply Header Crosstie to Unit 1 Shutoff Valve	Essential Service Water	Turbine	569	ESW Pipe Tunnel	131
2-WMO-712	East CS Hx HE-18E ESW Inlet Shutoff Valve	Essential Service Water	Auxiliary	633	633 Hallway	633
2-WMO-716	West CS Hx ESW Inlet Shutoff Valve	Essential Service Water	Auxiliary	633	633 Hallway	633

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-WMO-722-AB	West Essential Service Water Supply Header to AB Emergency Diesel Heat Exchangers Shutoff Valve	Essential Service Water	Auxiliary	587	CD EDG Room North Pipe Tunnel	171
2-WMO-724-AB	East Essential Service Water Supply Header to AB Emergency Diesel Heat Exchangers Shutoff Valve	Essential Service Water	Auxiliary	587	CD EDG Room North Pipe Tunnel	171
2-WMO-726-CD	East Essential Service Water Supply Header to CD Emergency Diesel Heat Exchangers Shutoff Valve	Essential Service Water	Auxiliary	587	CD EDG Room North Pipe Tunnel	171
2-WMO-728-CD	West Essential Service Water Supply Header to CD Emergency Diesel Heat Exchangers Shutoff Valve	Essential Service Water	Auxiliary	587	CD EDG Room North Pipe Tunnel	171
2-WMO-732	East Component Cooling Water Heat Exchanger HE-15E Essential Service Water Inlet Shutoff Valve	Essential Service Water	Auxiliary	609	609 Hallway	609
2-WMO-734	East Component Cooling Water Heat Exchanger HE-15E Essential Service Water Outlet Shutoff Valve	Essential Service Water	Auxiliary	609	609 Hallway	609

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-WMO-736	West Component Cooling Water Heat Exchanger Essential Service Water Inlet Shutoff Valve	Essential Service Water	Auxiliary	609	609 Hallway	609
2-WMO-738	West Component Cooling Water Heat Exchanger Essential Service Water Outlet Shutoff Valve	Essential Service Water	Auxiliary	609	609 Hallway	609
2-WPI-706	West Essential Service Water Supply Header Pressure Indicator Transmitter	Essential Service Water	Turbine	569	ESW Pipe Tunnel	131
2-WPI-708	East Essential Service Water Supply Header Pressure Indicator Transmitter	Essential Service Water	Turbine	569	ESW Pipe Tunnel	131
2-WPS-702	East Essential Service Water Supply Header Pressure Switch	Essential Service Water	Turbine	569	ESW Pipe Tunnel	131

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-WPS-706	West Essential Service Water Supply Header Pressure Switch	Essential Service Water	Turbine	569	ESW Pipe Tunnel	131
2-WRV-711-1N	ESW from CRAC N Lqd Chiller 2-HV-ACR-1 Cndsr Wtr Reg Vlv (Ckt 1)	Essential Service Water	Auxiliary	650	Control Rm A/C Room	129
2-WRV-711-2N	ESW from CRAC N Lqd Chiller 2-HV-ACR-1 Cndsr Wtr Reg Vlv (Ckt 2)	Essential Service Water	Auxiliary	650	Control Rm A/C Room	129
2-WRV-712-1S	ESW from CRAC S Lqd Chiller 2-HV-ACR-2 Cndsr Wtr Reg Vlv (Ckt 1)	Essential Service Water	Auxiliary	650	Control Rm A/C Room	129
2-WRV-712-2S	ESW from CRAC S Lqd Chiller 2-HV-ACR-2 Cndsr Wtr Reg Vlv (Ckt 2)	Essential Service Water	Auxiliary	650	Control Rm A/C Room	129
2-WRV-722-CD	CD Emergency Diesel North Combustion Air Aftercooler HE-47-CDn ESW Inlet/Bypass Valve	Essential Service Water	Auxiliary	587	CD EDG Room	122
2-WRV-724-CD	CD Emergency Diesel South Combustion Air Aftercooler HE-47-CDS ESW Inlet/Bypass Valve	Essential Service Water	Auxiliary	587	CD EDG Room	122

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-WRV-726-AB	AB Emergency Diesel North Combustion Air Aftercooler HE-47-ABN ESW Inlet/Bypass Valve	Essential Service Water	Auxiliary	587	AB EDG Room	121
2-WRV-728-AB	AB Emergency Diesel South Combustion Air Aftercooler HE-47-ABS ESW Inlet/Bypass Valve	Essential Service Water	Auxiliary	587	AB EDG Room	121
2-XPS-300	Diesel Combustion Air/AB Front Bank Air Chest Extreme High Pressure Switch	Diesel Combustion Air	Auxiliary	587	AB EDG Room	121
2-XPS-305	Diesel Combustion Air/CD Front Bank Air Chest Extreme High Pressure Switch	Diesel Combustion Air	Auxiliary	587	CD EDG Room	122
2-XRV-152	Backup Air to 2-NRV-152 Pressure Regulator Valve	Control Air	Containment	650	Upper Containment, Quadrant #4	86
2-XRV-153	Backup Air to 2-NRV-153 Pressure Regulator Valve	Control Air	Containment	650	Upper Containment, Quadrant #4	86

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-XRV-154	Backup Air to 2-NRV-152 Low Pressure Trip Valve	Control Air	Containment	650	Upper Containment, Quadrant #4	86
2-XRV-155	Backup Air to 2-NRV-152 Positive Air Shutoff Valve	Control Air	Containment	650	Upper Containment, Quadrant #4	86
2-XRV-156	Backup Air to 2-NRV-153 Low Pressure Trip Valve	Control Air	Containment	650	Upper Containment, Quadrant #4	86
2-XRV-157	Backup Air to 2-NRV-153 Positive Air Shutoff Valve	Control Air	Containment	650	Upper Containment, Quadrant #4	86
2-XRV-220	AB Emergency Diesel Starting Air Jet Assist Control Valve	Diesel Starting Air	Auxiliary	587	AB EDG Room	121
2-XRV-221	AB Emergency Diesel Front Bank Starting Air Shutoff Valve	Diesel Starting Air	Auxiliary	587	AB EDG Room	121

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-XRV-222	AB Emergency Diesel Rear Bank Starting Air Shutoff Valve	Diesel Starting Air	Auxiliary	587	AB EDG Room	121
2-XRV-223	AB Emergency Diesel Starting Air to Turbocharger Pressure Reducing Valve	Diesel Starting Air	Auxiliary	587	AB EDG Room	121
2-XRV-225	CD Emergency Diesel Starting Air Jet Assist Control Valve	Diesel Starting Air	Auxiliary	587	AB EDG Room	121
2-XRV-226	CD Emergency Diesel Front Bank Starting Air Shutoff Valve	Diesel Starting Air	Auxiliary	587	AB EDG Room	121
2-XRV-227	CD Emergency Diesel Rear Bank Starting Air Shutoff Valve	Diesel Starting Air	Auxiliary	587	CD EDG Room	122
2-XRV-228	CD Emergency Diesel Starting Air to Turbocharger Pressure Reducing Valve	Diesel Starting Air	Auxiliary	587	CD EDG Room	122
2-XRV-231	AB Emergency Diesel Starting Air to Control Air Dryer #1 Pressure Reducing Valve	Diesel Starting Air	Auxiliary	587	AB EDG Room	121

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-XRV-232	AB Emergency Diesel Starting Air to Control Air Dryer #2 Pressure Reducing Valve	Diesel Starting Air	Auxiliary	587	AB EDG Room	121
2-XRV-236	CD Emergency Diesel Starting Air to Control Air Dryer #1 Pressure Reducing Valve	Diesel Starting Air	Auxiliary	587	CD EDG Room	122
2-XRV-237	CD Emergency Diesel Starting Air to Control Air Dryer #2 Pressure Reducing Valve	Diesel Starting Air	Auxiliary	587	CD EDG Room	122
2-XRV-240	2-XTC-301 and 2-XTC-302 Control Air Pressure Reducing Valve (AB)	Diesel Control Air	Auxiliary	587	AB EDG Room	121
2-XRV-245	2-XTC-306 and 2-XTC-307 Control Air Pressure Reducing Valve (CD)	Diesel Control Air	Auxiliary	587	CD EDG Room	122
2-XRV-RACK-152	Pressurizer Train 'B' Pressure Relief Valve NRV-152 Valve Rack Emergency Air Pressure Regulator	Control Air	Containment	652	Upper Containment, Quadrant #4	82

Equipment Required to Shutdown Reactor (Unit 2)

(For High Energy Pipe Ruptures Outside the Containment)

Equip Id	Equipment Description	System	Building	Elev	Room	Rm#
2-XRV-RACK-153	Pressurizer Train 'A' Pressure Relief Valve NRV-153 Valve Rack Emergency Air Pressure Regulator	Control Air	Containment	652	Upper Containment, Quadrant #4	82
2-XSO-255	East Motor Driven Auxiliary Feed Pump Test Valve	AFW	Turbine	591	East Motor Driven Auxiliary Feed Pump Room	50
2-XSO-345	West Motor Driven Auxiliary Feed Pump Test Valve	AFW	Turbine	591	West Motor Driven Auxiliary Feed Pump Room	51
2-XSO-505	Pressurizer Train 'B' Pressure Relief Valve NRV-152 Control Solenoid	Control Air	Containment	652	Pressurizer Enclosure, Interior	81
2-XSO-507	Pressurizer Train 'A' Pressure Relief Valve NRV-153 Control Solenoid	Control Air	Containment	652	Pressurizer Enclosure, Interior	81

OTHER HIGH ENERGY SYSTEMS/LINES

System	
Sampling System	Steam Generator Sample Lines
	Steam Generator Blowdown Sample Lines
	Pressurizer Sample Lines
	Reactor Coolant System Sample Lines

System	**From**	**To**
Bleed Steam	Turbine	Heater 6
	Turbine	Heater 6A
	Turbine	Heater 6B
Blowdown	Control Valves	Seat Drains
Condensate	Heater Bypass	Feed Pump
	Heater 2A	Heater 3A
	Heater 2B	Heater 3B
	Heater 3A	Heater 4A
	Heater 3B	Heater 4B
	Heater 4A	Feed Pump
	Heater 4B	Feed Pump
	Heater 4A & 4B	Feed Pump
	Heater 4A & 4B	Feed Pump E
Reheater Coil Drain	Moisture Separator	Reheater Drain Tank
	Reheater Coil Drain	
	Reheater Drain Tank	Heater 6A

Peak Environmental Qualification Conditions for LOCA, MSLB, and Feedwater Line Break Inside Containment

LOCA

Location	Temperature (°F)	Pressure (psig)
Upper Compartment	160[1]	11.6[2]
Lower Compartment	235[3]	11.6[2]
Instrument and F/A Room	235[4,3]	13.9[5]

MSLB and Feedwater Line Break

Location	Temperature (°F)	Pressure (psig)
Upper Compartment	135 (U1)[6], 128 (U2)[6]	20.8[5]
Lower Compartment	325[7]	20.8[5]

[1] UFSAR Figure 14.3.4-7

[2] UFSAR Figure 14.3.4-6A

[3] UFSAR Figure 14.3.4-8

[4] Deleted

[5] UFSAR Table 14.3.4-40 reports this value calculated for the Steamline Break in the Steam Generator Doghouse. The Steam Generator Doghouse peak pressure is a bounding value for Upper and Lower Containment.

[6] UFSAR Figure 14.3.4-11 (Unit 1) and Figure 14.3.4-11A (Unit 2)

[7] UFSAR Figure 14.3.4-12 (Unit 1) and Figure 14.3.4-12B (Unit 2)

AIRBORNE SOURCE TERM DOSES AND DOSE RATES

Containment Centerline Dose Rates and Doses[1]						
Time	Gamma Dose Rate [rad/hr[	Beta Dose Rate [rad/hr[	Total Dose Rate [rad/hr]	Gamma Dose [rad]	Beta Dose [rad]	Total Dose [rad]
1 second	4.293E+06	2.028E+07	2.46E+07	5.962E+02	2.817E+03	3.41E+03
30 minutes	1.905E+06	7.674E+06	9.58E+06	1.330E+06	5.196E+06	6.53E+06
1 hour	1.418E+06	6.592E+06	8.01E+06	2.145E+06	8.756E+06	1.09E+07
2 hours	9.818E+05	4.849E+06	5.83E+06	3.319E+06	1.443E+07	1.77E+07
8 hours	4.013E+05	1.508E+06	1.91E+06	6.889E+06	3.046E+07	3.73E+07
1 day	2.181E+05	5.753E+05	7.93E+05	1.131E+07	4.382E+07	5.51E+07
7 days	8.274E+04	2.350E+05	3.18E+05	3.014E+07	9.492E+07	1.25E+08
30 days	4.543E+03	1.708E+04	2.16E+04	4.480E+07	1.385E+08	1.83E+08
90 days	3.484E+01	5.456E+03	5.49E+03	4.580E+07	1.487E+08	1.94E+08
180 days	2.515E+01	5.352E+03	5.38E+03	4.586E+07	1.603E+08	2.06E+08
365 days	2.431E+01	5.175E+03	5.20E+03	4.597E+07	1.837E+08	2.30E+08
Inside Containment Wall Surface Dose Rates and Doses (1)						
Time	Gamma Dose Rate [rad/hr[	Beta Dose Rate [rad/hr[	Total Dose Rate [rad/hr]	Gamma Dose [rad]	Beta Dose [rad]	Total Dose [rad]
1 second	3.408E+06	2.028E+07	2.37E+07	4.734E+02	2.817E+03	3.29E+03
30 minutes	1.906E+06	7.674E+06	9.58E+06	1.205E+06	5.196E+06	6.40E+06
1 hour	1.499E+06	6.592E+06	8.09E+06	2.046E+06	8.756E+06	1.08E+07
2 hours	1.080E+06	4.849E+06	5.93E+06	3.314E+06	1.443E+07	1.77E+07
8 hours	4.627E+05	1.508E+06	1.97E+06	7.346E+06	3.046E+07	3.78E+07
1 day	2.259E+05	5.753E+05	8.01E+05	1.228E+07	4.382E+07	5.61E+07
7 days	6.730E+04	2.350E+05	3.02E+05	2.832E+07	9.492E+07	1.23E+08
30 days	5.276E+03	1.708E+04	2.24E+04	4.141E+07	1.385E+08	1.80E+08
90 days	3.538E+01	5.456E+03	5.49E+03	4.274E+07	1.487E+08	1.91E+08
180 days	1.313E+01	5.352E+03	5.37E+03	4.277E+07	1.603E+08	2.03E+08
365 days	1.268E+01	5.175E+03	5.19E+03	4.283E+07	1.837E+08	2.27E+08

[1] Per Calculation RS-C-0046

SUBMERGED LOWER VOLUME / CONTAINMENT SUMP DOSE RATES & DOSES[1]

Time	Gamma Dose Rate (rad/hr)	Beta Dose Rate (rad/hr)	Total Dose Rate (rad/hr)	Gamma Dose (rad)	Beta Dose (rad)	Total Dose (rad)
1 second	1.201E+06	1.791E+05	1.38E+06	1.668E+02	2.488E+01	1.92E+02
30 minutes	9.675E+05	1.388E+05	1.11E+06	5.377E+05	7.812E+04	6.16E+05
1 hour	8.100E+05	1.177E+05	9.28E+05	9.799E+05	1.418E+05	1.12E+06
2 hours	6.118E+05	9.462E+04	7.06E+05	1.682E+06	2.467E+05	1.93E+06
8 hours	2.834E+05	5.775E+04	3.41E+05	4.061E+06	6.719E+05	4.73E+06
1 day	1.315E+05	3.291E+04	1.64E+05	7.072E+06	1.364E+06	8.44E+06
7 days	3.467E+04	8.429E+03	4.31E+04	1.511E+07	3.346E+06	1.85E+07
30 days	9.922E+03	3.262E+03	1.32E+04	2.527E+07	6.123E+06	3.14E+07
90 days	3.470E+03	1.753E+03	5.22E+03	3.307E+07	9.351E+06	4.24E+07
180 days	1.733E+03	1.221E+03	2.95E+03	3.838E+07	1.249E+07	5.09E+07
365 days	7.349E+02	7.538E+02	1.49E+03	4.328E+07	1.673E+07	6.00E+07

[1] Per Calculation RS-C-0046

BETA DOSE FACTORS[1]

DOSE FROM AIRBORNE SOURCE AFTER ATTENUATION

(PERCENTAGE OF DOSE PASSING THROUGH SHIELD)

Thickness of Unit Density Material (mils)

Time	10	20	30	40	50	60	70
1 second	78.68%	68.30%	60.73%	54.66%	49.58%	45.22%	41.38%
30 minutes	75.18%	64.48%	56.96%	51.04%	46.14%	41.94%	38.30%
1 hour	75.37%	65.13%	57.92%	52.22%	47.48%	43.41%	39.83%
2 hours	75.21%	65.41%	58.57%	53.16%	48.62%	44.71%	41.28%
8 hours	70.04%	60.58%	54.41%	49.62%	45.62%	42.23%	39.24%
1 day	58.35%	48.97%	43.53%	39.50%	36.24%	33.49%	31.11%
7 days	31.56%	23.58%	20.49%	18.47%	16.88%	15.57%	14.44%
30 days	24.49%	16.73%	14.23%	12.73%	11.60%	10.68%	9.90%
90 days	24.78%	16.40%	13.60%	12.01%	10.87%	9.98%	9.24%
180 days	25.51%	16.28%	13.08%	11.34%	10.18%	9.30%	8.59%
365 days	26.67%	16.08%	12.22%	10.24%	9.03%	8.18%	7.52%

[1] Per Calculation RS-C-0046

BETA DOSE FACTORS[1]

DOSE FROM AIRBORNE SOURCE AFTER ATTENUATION

(PERCENTAGE OF DOSE PASSING THROUGH SHIELD)

Thickness of Aluminum (mils)

Time	10	20	30	40	50	60	70
1 second	62.82%	47.77%	37.66%	30.25%	24.53%	20.03%	16.43%
30 minutes	59.01%	44.39%	34.79%	27.80%	22.49%	18.33%	15.05%
1 hour	59.89%	45.77%	36.38%	29.42%	24.07%	19.84%	16.46%
2 hours	60.44%	46.99%	37.93%	31.11%	25.77%	21.51%	18.05%
8 hours	56.09%	44.21%	36.31%	30.30%	25.53%	21.64%	18.42%
1 day	44.98%	35.09%	28.78%	24.07%	20.33%	17.27%	14.74%
7 days	21.26%	16.33%	13.36%	11.16%	9.42%	8.00%	6.83%
30 days	14.81%	11.21%	9.15%	7.65%	6.45%	5.48%	4.68%
90 days	14.25%	10.50%	8.53%	7.12%	6.01%	5.11%	4.36%
180 days	13.81%	9.80%	7.93%	6.61%	5.58%	4.74%	4.04%
365 days	13.09%	8.65%	6.92%	5.77%	4.87%	4.14%	3.53%

[1] Per Calculation RS-C-0046

BETA DOSE FACTORS[1]

DOSE FROM AIRBORNE SOURCE AFTER ATTENUATION

(PERCENTAGE OF DOSE PASSING THROUGH SHIELD)

Thickness of Steel (mils)

Time	10	20	30	40	50	60	70
1 second	38.44%	20.75%	11.76%	6.82%	4.01%	2.39%	1.43%
30 minutes	35.52%	19.00%	10.83%	6.41%	3.89%	2.41%	1.52%
1 hour	37.10%	20.53%	12.05%	7.34%	4.59%	2.92%	1.88%
2 hours	38.62%	22.20%	13.46%	8.42%	5.39%	3.50%	2.30%
8 hours	36.91%	22.27%	14.05%	9.08%	5.96%	3.95%	2.64%
1 day	29.27%	17.77%	11.29%	7.33%	4.83%	3.22%	2.16%
7 days	13.58%	8.23%	5.23%	3.40%	2.24%	1.49%	1.00%
30 days	9.31%	5.64%	3.58%	2.33%	1.53%	1.02%	0.68%
90 days	8.68%	5.26%	3.34%	2.17%	1.43%	0.95%	0.64%
180 days	8.06%	4.88%	3.10%	2.01%	1.33%	0.88%	0.59%
365 days	7.05%	4.26%	2.70%	1.76%	1.16%	0.77%	0.52%

[1] Per Calculation RS-C-0046

PIPES CONSIDERED IN CALCULATING OUTSIDE CONTAINMENT DOSES[1]

System	Designation [2]	Outside Diameter OD (inches)	Wall Thickness, T (inches)	OD/T
CC	M-14	4.5	0.438	10.3
CC	M-14	3.5	0.438	7.99
CC	M-14	2.0	0.344	5.81
CC	B-14	6.625	0.134	49.44
CC	B-14	8.625	0.148	58.28
SI	K-14	4.5	0.337	13.35
SI	B-14	4.5	0.12	37.5
SI	B-14	6.625	0.134	49.44
SI	K-14	2.375	0.276	8.61
SI	K-14	1.9	0.2	9.5
SI	K-14	1.05	0.154	6.82
RHR	G-14	14.0	0.438	31.96
RHR	G-14	3.5	0.216	16.20
RHR	G-14	8.625	0.322	26.79
CS	E-14	10.75	0.365	29.45
CS	E-14	8.625	0.322	26.79
CS	E-14	6.625	0.28	23.66
CS	E-14	3.5	0.216	16.20
CS	E-14	1.315	0.133	9.89
CS	B-14	8.625	0.148	58.28
CS	G-14	12.75	0.406	31.40
CS	G-14	2.375	0.154	15.42

Key:

CC - Centrifugal Charging

SI - Safety Injection

RHR - Residual Heat Removal

CS - Containment Spray

[1] AEP: NRC: 05781, Attachment 4

[2] Note: Pipe designation indicates materials of construction, seismic classification, and quality level. For further information, AEPSC specifications should be consulted.

PEAK ENVIRONMENTAL QUALIFICATION CONDITIONS FOR HELB OUTSIDE CONTAINMENT

COMPARTMENT	TEMPERATURE (ºF)	PRESSURE (psia)
East Main Steam Enclosure	440	18.7
West Main Steam Enclosure	485	20.6
Main Steam Accessway	347.8	18.2
Diesel Generator Pipe Tunnel	300	15.3
Turbine Driven Pump Room	298	16.7
ESW Tunnel	300	15.1
Turbine Room (Turbine Bldg. 609' Elev.)	473.8	15.45
Startup Blowdown Flashtank Room	216.5	15.2

NOTE:
Only major areas are identified in the table above.

POSTULATED MAJOR HIGH ENERGY LINE BREAKS

System	Line Size (in)	No. of Line Breaks	Description/Location	Building	Area
MS	30	2	Containment Penetrations	Auxiliary	ESE
MS	30	2	Containment Penetrations	Auxiliary	WSE
MS	30	2	5-way Restraint	Auxiliary	ESE
MS	30	2	5-way Restraint	Auxiliary	WSE
MS	4	2	At 30 in. Header	Turbine	Near Main Turbine
MS	4	1	AFP Turbine	Turbine	TDAFP Room
FW	14	2	Containment Penetrations	Auxiliary	ESE
FW	14	2	Containment Penetrations	Auxiliary	WSE
FW	20	1	Heater 6 Nozzle	Turbine	Heater 6 (A&B)
AFW/FW	6	2	At 14 in. Heater	Auxiliary	ESE
AFW/FW	6	2	At 14 in. Heater	Auxiliary	WSE
CVCS-LD	2	1	Letdown Heat Exchanger	Auxiliary	Letdown Heat Exchanger Room

Notes:

1. Breaks in high energy systems that are not listed above are postulated to occur anywhere in the high energy portion of piping.

WEST STEAM ENCLOSURE/MAIN STEAM ACCESSWAY VENT AREA AND VOLUME INPUTS TO TMD

Element No.[1]	Vent Area (ft^2)	Volume (ft^3)
1	Atmosphere	Atmosphere
2	827	2919
3	875	4737
4	988	5736
5	487	6145
6	336	3900
7	530	9078
8	816	9078
9	558	9078
10	258	2033
11	507	7006
12	320	3266

[1] Element numbers refer to Figures 14.4.6-1 and 14.4.6-2.

EAST STEAM ENCLOSURE
VENT AREA AND VOLUME INPUTS TO TMD

Element No.[1]	Vent Area (ft^2)	Volume (ft^3)
1	Atmosphere	Atmosphere
2	898	4608
3	899	5102
4	880	4102
5	532	8145
6	547	7093
7	834	4041

[1] Element numbers refer to Figures 14.4.6-3 and 14.4.6-4.

MODEL PARAMETERS
(WEST MAIN STEAM ENCLOSURE AND MAIN STEAM ACCESSWAY)

LARGE BREAK

Element No.[1]	Volume (ft^3)	Height (ft)	Elevation (ft)	Heat Slab Area (ft^2)
2	10600	29	633	2400
3	10600	29	633	2500
4	8400	11.5	621.5	1500
5	4500	21	600.5	3950
6	173000	20	587	3950
7	173000	20	587	1900
8	11300	18	662	1900
9	11300	18	662	

[1] Element numbers refer to Figure 14.4.6-5.

MODEL PARAMETERS
(WEST MAIN STEAM ENCLOSURE AND MAIN STEAM ACCESSWAY)
SMALL BREAK

Element No.[1]	Volume (ft^3)	Height (ft)	Elevation (ft)
2	10600	29	633
3	10600	29	633
4	8400	11.5	622
5	4500	21	601
6	173000	20	587
7	173000	20	587
8	11300	18	664
9	11300	18	664

[1] Element numbers refer to Figure 14.4.6-5.

MODEL PARAMETERS
(EAST MAIN STEAM ENCLOSURE)
LARGE BREAK

Element No.[1]	Volume (ft^3)	Height (ft)	Elevation (ft)	Heat Slab Area (ft^2)
2	10600	29	633	2250
3	10600	29	633	2550
4	8100	11.5	621.5	2500
5	5800	9.5	612	4700
6	9600	16.	612	1400
7	6900	18	662	1400
8	6900	18	662	
9				

[1] Element numbers refer to Figure 14.4.6-6.

MODEL PARAMETERS
(EAST MAIN STEAM ENCLOSURE)
SMALL BREAK

Element No.[1]	Volume (ft^3)	Height (ft)	Elevation (ft)
2	10600	29	633
3	10600	29	633
4	8100	11.5	622
5	5800	9.5	612
6	9600	16.	612
7	6900	18	664
8	6900	18	664

[1] Element numbers refer to Figure 14.4.6-6.

MASS AND ENERGY RELEASE FOR STEAM LINE BREAK IN MAIN STEAM ENCLOSURE
LARGE BREAK

Time (sec)	Mass/Flow (lbm/sec)	Enthalpy (Btu/lbm)
0	0	1198
0.001 [1]	6508	1198
0.5	6508	1198
1.5	6124	1199
4.0	5599	1201
4.5	6091	1201
7.0	6091	1201
12.5	5788	1202
13.0	1976	1202
30.0	1158	1204
40.0	994.7	1204
60.0	890.3	1203
74.0	874.9	1205
75.0	866.8	1209
85.0	644.1	1245
95.0	256.2	1276
105.0	29.1	1294
200.0	29.2	1310
400.0	34.6	1312
600.0	34.6	1311
1800.00	34.6	1311
1800.01	0	1311
3600.0	0	1311

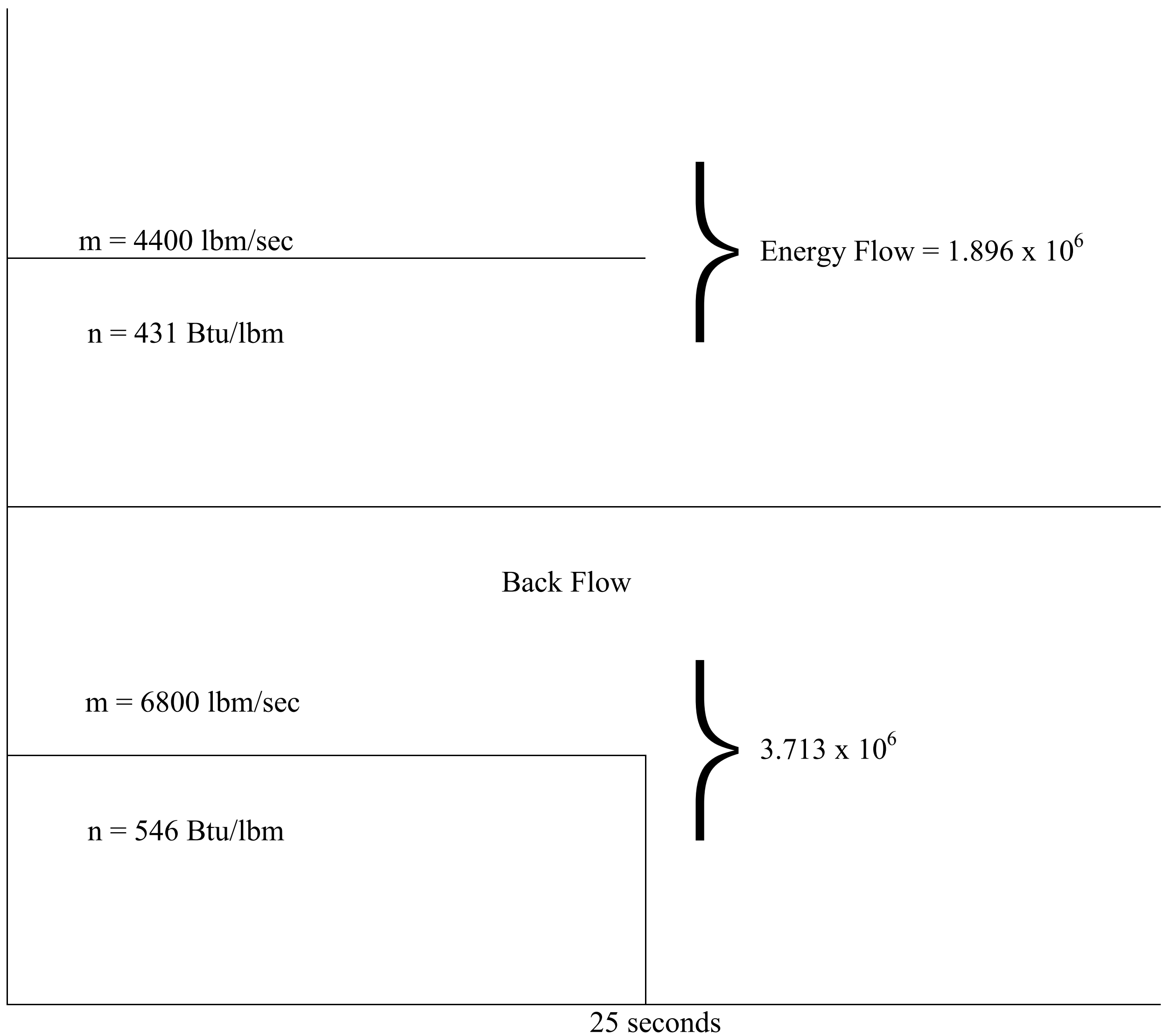
[1] Full break opening assumed in 0.001 sec.

MASS AND ENERGY RELEASE FOR STEAM LINE BREAK IN MAIN STEAM ENCLOSURE
SMALL BREAK

Time (sec)	Flow (lbm/sec)	Enthalpy (Btu/lbm)
0.5	2102.	1196.
10.0	1832.	1199.
25.0	1645.	1201.
50.0	1575.	1202.
100.0	1568.	1202.
108.0	1568.	1202.
109.0	1673.	1201.
117.0	2057.	1197.
135.0	1823.	1200.
150.0	1642.	1202.
179.0	1453.	1203.
181.0	1447.	1204.
200.0	1410.	1208.
258.0	1099.	1238.
259.0	1089.	1239.
275.0	226.1	1281.
300.0	29.9	1296.
400.0	34.4	1297.
500.0	34.6	1298.
600.0	34.6	1299.

FEEDWATER LINE BREAK
AT THE CONTAINMENT PENETRATION
(APPLICABLE TO EAST OR WEST STEAM ENCLOSURE)

Mass and Enthalpy
Forward Flow



Total = 5.609 x 10^6
(Up to 25 Seconds)

STEAM LINE BREAK - FORWARD FLOW EAST/WEST STEAM ENCLOSURES
(Pressure Response)

Time (sec)	Mass Flow 10^3 lb/sec	Energy Release 10^6 Btu/sec
0.0	5.55	6.62
0.1	4.15	4.94
0.2	3.05	3.64
0.4	2.95	3.52
0.6	2.90	3.46
0.8	2.78	3.31
1.0	2.75	3.28
1.5	2.67	3.19
2.0	3.45	3.38
2.5	9.50	5.26
3.0	9.42	5.21
3.5	9.38	5.19
4.0	9.33	5.16
4.5	9.28	5.13
5.0	9.23	5.10
5.5	9.16	5.07
6.0	9.10	5.04
6.5	9.03	5.01
7.0	8.95	4.97
7.5	8.86	4.93
8.0	8.80	4.91
8.5	8.70	4.86
9.0	8.58	4.81
9.5	8.46	4.76
10.0	8.33	4.70

STEAM LINE BREAK - FORWARD FLOW EAST/WEST STEAM ENCLOSURES
(Pressure Response)

Time (sec)	Mass Flow 10^3 lb/sec	Energy Release 10^6 Btu/sec
12.0	7.67	4.42
14.0	6.75	4.05
16.0	5.49	3.53
18.0	4.04	2.95
19.0	3.37	2.67

EAST STEAM ENCLOSURE STEAMLINE BREAK - BACKFLOW (PRESSURE RESPONSE)

Time (sec)	Mass Flow 10^3 lb/sec	Energy Release 10^6 Btu/sec
0.0	7.54	8.99
0.1	5.09	6.07
0.2	4.61	5.50
0.3	4.41	5.26
0.4	4.34	5.17
0.5	4.26	5.08
0.6	4.19	4.99
0.7	4.36	5.20
0.8	4.80	5.72
0.9	4.78	5.70
1.0	4.77	5.69
1.5	4.90	5.84
2.0	5.00	5.96
2.5	4.75	5.66
3.0	4.71	5.61
3.5	4.65	5.54
4.0	4.59	5.47
4.5	4.52	5.39
5.0	4.35	5.19
5.5	4.15	4.95
6.0	3.98	4.75
6.5	3.96	4.72
7.0	4.26	4.50

EAST STEAM ENCLOSURE STEAMLINE BREAK - BACKFLOW (PRESSURE RESPONSE)

Time (sec)	Mass Flow 10^3 lb/sec	Energy Release 10^6 Btu/sec
7.5	4.93	4.70
8.0	5.71	5.03
8.5	6.45	5.37
9.0	7.14	5.81
9.5	7.70	6.05
10.0	8.23	6.39

WEST STEAM ENCLOSURE STEAMLINE BREAK - BACKFLOW (PRESSURE RESPONSE)

Time (sec)	Mass Flow 10^3 lb/sec	Energy Release 10^6 Btu/sec
0.0	7.54	8.99
0.1	5.09	6.07
0.2	4.61	5.50
0.3	4.41	5.26
0.4	4.30	5.13
0.5	4.58	5.46
0.6	4.97	5.92
0.7	5.09	6.07
0.8	5.11	6.09
0.9	5.13	6.11
1.0	5.07	6.04
1.5	5.29	6.31
2.0	5.11	6.10
2.5	4.96	5.91
3.0	4.93	5.88
3.5	4.81	5.77
4.0	4.68	5.58
4.5	4.59	5.47
5.0	4.53	5.40
5.5	4.65	5.16
6.0	5.28	5.17
6.5	5.90	5.55
7.0	6.46	5.78
7.5	6.88	5.93

WEST STEAM ENCLOSURE STEAMLINE BREAK - BACKFLOW (PRESSURE RESPONSE)

Time (sec)	Mass Flow 10^3 lb/sec	Energy Release 10^6 Btu/sec
8.0	7.32	6.10
8.5	7.79	6.32
9.0	8.23	6.53
9.5	8.61	6.72
10.0	8.92	6.88

FEEDWATER LINE BREAK AT THE TEE BETWEEN THE 20 INCH AND 30 INCH LINES, 20 INCH LINE RUNNING TO STEAM GENERATORS 2 AND 3

(APPLICABLE TO MAIN STEAM ACCESSWAY)

Mass and Enthalpy

Forward Flow

m = 9050 lbm/sec
n = 431 Btu/lbm

Back Flow

m = 9050 lbm/sec
n = 431 Btu/lbm

1.5 seconds

RELATION OF NODE CALCULATED PRESSURE TO PRESSURE CAPABILITY OF SLABS

Area	Node Number	Long Term Pressure Following Anticipated Transient Psi [1]	Weakest Slab Capability for Static Differential Pressure Psi
East Steam Enclosure	2	5.5	13.4
(See Figure 14.4.6-3)	3	5.5	11.6
	4	5.5	11.6
	5	5.5	11.6 [2]
	6	5.5	11.6 (2)
	7	5.5	13.4
West Steam Enclosure	2	4.7	10.9 (1)
(See Figure14.4.6-1)	3	4.7	10.9 (1)
	4	4.7	22.1
	5	4.7	4.5 [3] (W SL1)
	6	4.7	26.2
	11	4.7	4.5 (3) (W SL1)
	12	4.7	22.1
Main Steam Accessway	7	5.8	9.3
(See Figure14.4.6-1)	8	5.3	9.3
	9	5.1	9.4
	10	1.0	15.7

[1] Tables 14.4.6-18, -19 and -20 show results of dynamic analyses for the respective slabs.
[2] Other than lightly reinforced portion panel section E-W4, which will be allowed to fail without causing any damage to equipment required to safely shutdown the plant.
[3] See Section 14.4.9.

PEAK PRESSURE DIFFERENTIAL MAIN STEAM LINE BREAK WEST STEAM ENCLOSURE

Element No. [1]	Peak Pressure Differential (psi)
1	0
2	11.9
3 (Break Location)	11.3
4	8.7
5	11.7
6	6.2
7	4.2
8	4.1
9	3.7
10	.65
11	8.8
12	7.6

[1] Element numbers refer to Figure 14.4.6-1.

PEAK DIFFERENTIAL PRESSURE

FEEDWATER LINE BREAK IN WEST STEAM ENCLOSURE

Element No. [1]	Peak Pressure (psig)
1	0
2	4.2
3 (Break Location)	4.3
4	2.7
5	3.7
6	2.1
7	1.7
8	1.6
9	1.4
10	.3
11	3.2
12	2.6

[1] Element numbers refer to Figure 14.4.6-1.

PEAK DIFFERENTIAL PRESSURE FEEDWATER LINE BREAK IN MAIN STEAM ACCESSWAY

Element No. [1]	Peak Pressure (psi)
1	0
2	1.8
3	1.8
4	1.8
5	2.0
6	2.5
7 (Break Location)	5.8
8	5.3
9	5.1
10	1.0
11	2.0
12	1.8

[1] Element numbers refer to Figure 14.4.6-1.

PEAK DIFFERENTIAL PRESSURE MAIN STEAM LINE BREAK IN EAST STEAM ENCLOSURE

Element No. [1]	Peak Pressure (psi)
1	0
2	7.7
3	7.8
4 (Break Location)	11.8
5	8.3
6	12.0
7	11.0

[1] Element numbers refer to Figure 14.4.6-3.

PEAK DIFFERENTIAL PRESSURE FEEDWATER LINE BREAK IN EAST STEAM ENCLOSURE

Element No. [1]	Peak Pressure (psig)
1	0
2	2.7
3	2.8
4 (Break Location)	4.1
5	3.0
6	4.2
7	3.9

[1] Element numbers refer to Figure 14.4.6-3.

RELATION OF NODES USED IN MAIN STEAM ACCESSWAY ANALYSIS TO PANEL IDENTIFICATION PRESENTED IN TABLE 14.4.6-17

Node No. [1]	Affected Slabs
7	W-SL3, W-SL4, W-WN3, W-WS7, WS9, W-W7
8	W-SL3, W-SL4, W-SL5, W-WN3, W-WS7, W-WS8, W-WS9
9	W-SL3, W-SL5, W-WN4, W-WN3, W-WS8, W-WS9, W-WS10
10	W-W8, W-W9, W-WN4, W-W10, W-W9A

[1] Node numbers refer to Figure 14.4.6-1.

PRESSURE CAPABILITY OF WALLS & SLABS AROUND MAIN STEAM LINE ENCLOSURE EAST OF CONTAINMENT

1. MATERIAL PROPERTIES

a. Concrete f_c' = 3500 psi;
b. Reinforcing steel f_y= 40000 psi

2. PRESSURE CAPABILITIES TABULATED

a. Are ultimate values under static conditions;
b. Do not include any other loading condition

Panel ID	Thickness (in.)	Pressure Capability (psi)	Remarks
E-SL2	12	11.6	Punching Shear Around Col. Governs
E-SL3	30	72.5 [1]	
E-WN1	24	16.1 (1)	
E-WN2	24	80.0 (1)	
E-WS1	24	16.0 (1)	
E-WS2	24	83.2 (1)	
E-W1	24	13.4 (1)	
E-W2	24	78.0 (1)	
E-W3	24	11.6 (1)	E-W3 & E-W4, both curved are solved using planar projections
E-W4	24	4.5	Critical Value of 4.5 PSI. Results from 1 way action of lightly reinforced portion of panel between the two large openings. The side portions of the panel have capability of 86.1 (1)

See Figure 14.4.6-3 for wall and slab identification.

[1] Indicates diagonal tension failure governs.

RELATION OF NODES USED IN EAST STEAM ENCLOSURE ANALYSIS TO PANEL IDENTIFICATION PRESENTED IN TABLE 14.4.6-15

Node No. [1]	Affected Slabs
2	E-WS1, E-W1
3	E-WS1, E-W3
4	E-WS3, E-WN1
5	E-W1, E-WS1, E-SL2, E-W4, E-W3, E-WS2, E-W2
6	E-W3, E-W4, E-SL2, E-WN1, E-WN2, E-W1, E-W2
7	E-W1, E-WN1

[1] Node numbers refer to Figure 14.4.6-3.

PRESSURE CAPABILITY OF WALLS AND SLABS AT MAIN STEAM ENCLOSURE WEST OF CONTAINMENT

1. MATERIAL PROPERTIES

a. Concrete f_c' = 3500 psi;

b. Reinforcing steel f_y = 40000 psi

2. PRESSURE CAPABILITIES TABULATED

a. Are ultimate values under static conditions;

b. Do not include any other loading condition

Panel ID	Thickness (in.)	Pressure Capability (psi)	Remarks
W-SL1	12	4.5	
W-SL2	12	26.2 [1]	
W-WN1	24	10.9	
W-WN2	24	48.6 (1)	
W-WS1	24	36.7	
W-WS2	24	22.1	
W-WS3	24	46.4	
W-WS4	24	62.7	
W-WS5	12	40.2 (1)	
W-WS6	12	34.9 (1)	
W-W1	12	27.3	
W-W2	12	26.8 (1)	
W-W3	36	54.9	
W-W4	36	36.5 (1)	
W-W5	36	84.5	
W-W6	36	113.1	
W-W7	36	121.6 (1)	

See Figure 14.4.2-10 for wall and slab identification.

[1] Indicates diagonal tension failure governs

RELATION OF NODES USED IN WEST STEAM ENCLOSURE ANALYSIS TO PANEL IDENTIFICATION PRESENTED IN TABLE 14.4.6-16

Node No. [1]	Affected Slabs
2	W-W3, W-W4, W-W5, W-WN1
3	W-WN1
4	W-WS1, W-WS2
5	W-W4, W-W5, W-WN1, W-SL1
6	W-W5, W-W6, W-WN2, W-SL2, W-WS6, W-WS5
11	W-W4, W-W5, W-SL1, W-WS2, W-WS3
12	W-WS1, W-WS2, W-W3, W-W4

[1] Node numbers refer to Figure 14.4.6-1.

PRESSURE CAPABILITY OF WALLS AND SLABS OF AUXILIARY BUILDING ADJACENT TO MAIN STEAM LINE ACCESSWAY

1. MATERIAL PROPERTIES

a. Concrete f_c' = 3500 psi;

b. Reinforcing steel f_y = 40000 psi

2. PRESSURE CAPABILITIES TABULATED

a. Are ultimate values under static conditions;

b. Do not include any other loading condition

Panel ID	Thickness (in.)	Pressure Capability (psi)	Remarks
W-SL3	24	9.8 [1]	
W-SL4	12	46.5 (1)	
W-SL5	12	47.9 (1)	
W-WN3	36	37.4 (1)	
W-WN4	36	126.0 (1)	
W-WS7	12	9.3	
W-WS8	12	9.4	
W-WS9	28	26.6 (1)	
W-W8	12	15.7	
W-W9	12	41.0	
W-W10	42	30.0	
W-W9A	12	38.4	

See Figure 14.4.8-1 for layout and identification of walls and slabs.

[1] Indicates diagonal tension failure governs

EFFECTS OF PRESSURES AND CIRCUMFERENTIAL BREAK IMPINGEMENT LOADS ON WALLS AND SLABS

(1) PANELS AT MAIN STEAM LINES ENCLOSURE EAST OF CONTAINMENT

Panel Identification	Governing Pipe Break	Peak Applied Impingement Force (Kips)	Peak Applied Pressure (Psi)	Required Ductility Factor	Allowable Ductility Factor	Adequacy of Panel	Remarks
E-SL2	4F (MSB)	0	12.0	2.33	3.0	O.K.	
E-SL3	4F (MSB)	0	12.0	1.00	3.0	O.K.	
W-WN1	4G (MSB)	0	12.0	1.42	3.00	O.K.	Assuming 4G has same pressure build up as 4F
E-WN2	4F (MSB)	0	12.0	1.00	3.00	O.K.	
E-WN1	1C (MSB)	0	12.0	1.42	2.00	O.K.	Assuming 1C has same pressure build up as 1F
E-WS2	1F (MSB)	0	12.0	1.00	3.00	O.K.	
E-W1	1F or 4F (MSB)	0	12.0	2.13	3.00	O.K.	
E-W2	1F or 4F (MSB)	0	12.0	1.00	3.00	O.K.	
E-W3	1F or 4F (MSB)	0	12.0	1.51	3.00	O.K.	
E-W4	1F or 4F	0	12.0	1.00	3.00	O.K.	Assuming central portion of panel is allowed to fail, but the larger side portions are adequate

EFFECTS OF PRESSURES AND CIRCUMFERENTIAL BREAK IMPINGEMENT LOADS ON WALLS AND SLABS

(2) PANELS AT MAIN STEAM LINES ENCLOSURE WEST OF CONTAINMENT

Panel Identification	Governing Pipe Break	Peak Applied Impingement Force (Kips)	Peak Applied Pressure (Psi)	Required Ductility Factor	Allowable Ductility Factor	Adequacy of Panel	Remarks
W-SL1	2E or 3E (MSB)	0	11.7	60.44	10.0	N.G	Slab modified and determined to be acceptable (see 14.4.9.1)
W-SL2	2E or 3E (MSB)	0	6.2	1.00	3.00	O.K.	
W-WN1	3D (MSB)	0	11.9	2.56	10.00	O.K.	Assuming 3D has same pressure build up as 3E
W-WN2	2E or 3E (MSB)	0	6.2	1.00	3.00	O.K.	
W-WS1	2E (MSB)	0	11.9	1.00	10.00	O.K.	
W-WS2	2D (MSB)	0	11.9	1.00	10.00	O.K.	Assuming 2D has same pressure build up as 2E
W-WS3	2E (MSB)	0	11. 7	1.00	10.00	O.K.	
W-WS4							Not affected by any pipe break within the west enclosure
W-WS5	2E or 3E (MSB)	0	6.2	1.00	3.00	O.K.	
W-WS6	2E or 3E (MSB)	0	6.2	1.00	3.00	O.K.	
W-W1	2E or 3E (MSB)	0	6.2	1.00	10.0	O.K.	

EFFECTS OF PRESSURES AND CIRCUMFERENTIAL BREAK IMPINGEMENT LOADS ON WALLS AND SLABS

(2) PANELS AT MAIN STEAM LINES ENCLOSURE WEST OF CONTAINMENT

Panel Identification	Governing Pipe Break	Peak Applied Impingement Force (Kips)	Peak Applied Pressure (Psi)	Required Ductility Factor	Allowable Ductility Factor	Adequacy of Panel	Remarks
W-W2	2E or 3E (MSB)	0	6.2	1.00	3.00	O.K.	
W-W3	2E or 3F (MSB)	0	11.9	1.00	10.00	O.K.	
W-W4	2E or 3E (MSB)	0	11.9	1.00	3.00	O.K.	
W-W5	2E or 3E (MSB)	0	11.9	1.00	10.00	O.K.	
W-W6	2E or 3E (MSB)	0	11.9	1.00	10.00	O.K.	

EFFECTS OF PRESSURES AND CIRCUMFERENTIAL BREAK IMPINGEMENT LOADS ON WALLS AND SLABS

[3] AUXILIARY BUILDING PANELS ADJACENT TO MAIN STEAM LINES ACCESSWAY

Panel Identification	Governing Pipe Break	Peak Applied Impingement Force (Kips)	Peak Applied Pressure (Psi)	Required Ductility Factor	Allowable Ductility Factor	Adequacy of Panel	Remarks
W-SL3	F8 (FWB)	355	5.8	1.00	3.00	O.K.	
W-SL4	F8 (FWB)	0	5.8	1.00	3.00	O.K.	
W-SL5	F8 (FWB)	0	5.3	1.00	3.00	O.K.	
W-WN3	F8 (FWB)	0	5.8	1.00	3.00	O.K.	
W-WN4	F8 (FWB)	0	1.0	1.00	3.00	O.K.	
W-WS7	F8 (FWB)	0	5.8	1.17	10.00	O.K.	
W-WS8	F8 (FWB)	0	5.8	1.05	10.00	O.K.	
W-WS9	F8 (FWB)	0	5.8	1.00	3.00	O.K.	
W-W7	F8 (FWB)	0	5.8	1.00	3.00	O.K.	
W-W8	F8 (FWB)	0	1.0	1.00	10.00	O.K.	
W-W9	F8 (FWB)	0	1.0	1.00	10.00	O.K.	
W-W9A	F8 (FWB)	0	1.0	1.00	10.00	O.K.	
W-W10	F10 (FWB)	355	5.1	1.00	10.00	O.K.	Assuming F10 has same pressure build up as F8

[3] MSB = main steam line break
FWB = feedwater line break
N.G. = no good

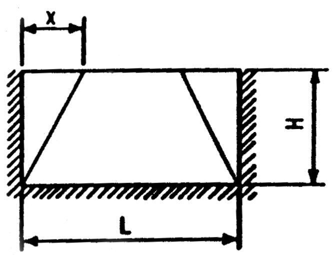
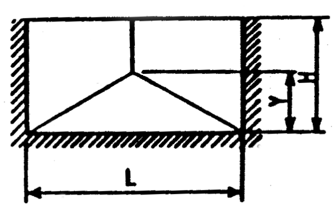
PANELS TO BE PROTECTED FROM MAIN STEAM LINE LONGITUDINAL BREAKS

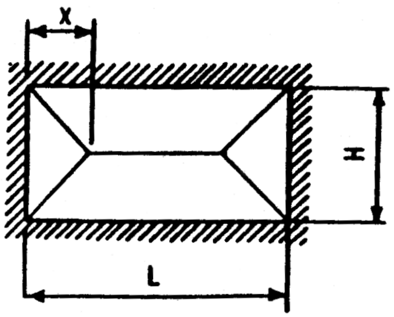
Longitudinal Breaks	Panels To Be Protected	Remarks
1F	E-SL1, E-WN1, E-WS1	
4F	E-SL2, E-WN1, E-WS1	
1G	E-SL2, E-W1	
4G	E-SL2, E-W1	
2E	W-WS2, W-SL1, W-WN1	
3E	W-WS2, W-SL1, W-WN1	
2D	W-SL1, W-W4	
3D	W-SL1, W-W4	

FEEDWATER LINE BREAKS

Longitudinal Breaks	Panels To Be Protected	Remarks
F26, F25	E-SL2	
F15, F16, F17	W-SL1	Calculations made for F15
F9, F10, F11, F12, F13	W-WS7	Calculations made for F9 only

ULTIMATE SHEAR STRESS AT DISTANCE D_E FROM THE SUPPORTS FOR TWO-WAY ELEMENTS

I. THREE EDGES FIXED AND ONE EDGE FREE	LIMITS	ULTIMATE HORIZONTAL SHEAR STRESS (Vμ)H	LIMITS	ULTIMATE VERTICAL SHEAR STRESS(Vμ)r
	$\frac{1}{2}$	$$\frac{3r_{\mu}\left(1-\frac{d_e}{x}\right)^2}{\frac{d_e}{x}\left(5-\frac{4d_e}{x}\right)}$$	$0 \le d_e/H \le \frac{1}{2}$	$$\frac{3r_{\mu}\left(1-\frac{d_e}{H}\right)\left(1-\frac{x}{L}-d_e\frac{x}{HL}\right)}{\frac{d_e}{H\left(3-\frac{x}{L}-4d_e\frac{x}{HL}\right)}}$$
	1	$$\frac{r_{\mu}\left(1-\frac{d_e}{x}\right)}{2\left(\frac{d_e}{x}\right)}$$	$\frac{1}{2} \le d_e/H \le 1$	$$\frac{r_{\mu}\left(1-\frac{d_e}{H}\right)\left(1-\frac{x}{L}-d_e\frac{x}{HL}\right)}{\frac{d_e}{H\left(1-2d_e\frac{x}{HL}\right)}}$$
	$\frac{1}{4}$	$$\frac{3r_{\mu}\left(1-\frac{2d_e}{L}\right)\left(2-\frac{y}{H}-2d_e\frac{y}{LH}\right)}{\frac{2d_e}{L\left(6-\frac{y}{H}-8d_e\frac{y}{LH}\right)}}$$	$0 \le d_e/y \le 1$	$$\frac{3r_{\mu}\left(1-\frac{d_e}{y}\right)^2}{\frac{d_e}{y\left(5-4\frac{d_e}{y}\right)}}$$
	$\frac{1}{2}$	$$\frac{r_{\mu}\left(1-\frac{2d_e}{L}\right)\left(2-\frac{y}{H}-2d_e\frac{y}{LH}\right)}{\frac{4d_e}{L\left(1-2d_e\frac{y}{LH}\right)}}$$	$\frac{1}{2} \le d_e/y \le 1$	$$\frac{r_{\mu}\left(1-\frac{d_e}{y}\right)}{\frac{2d_e}{y}}$$

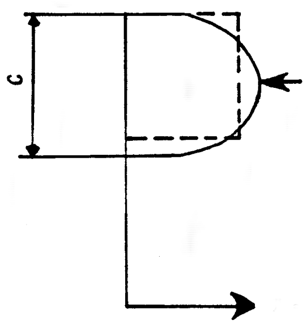
II. FOUR EDGES FIXED	NOTE: L MAY EITHER BE LONGER OR SHORTER THAN H		
	$\dfrac{3r_\mu\left(1-\frac{d_e}{x}\right)^2}{d_e x\left(5-4\frac{d_e}{x}\right)}$	$0 \le d_e/H \le \frac{1}{4}$	$\dfrac{3r_\mu\left(\frac{1}{2}-\frac{d_e}{H}\right)\left(1-\frac{x}{L}-2d_e\frac{x}{HL}\right)}{\frac{d_e}{H\left(3-\frac{x}{L}-8d_e\frac{x}{HL}\right)}}$
	$\dfrac{r_\mu\left(1-\frac{d_e}{x}\right)}{2\left(\frac{d_e}{x}\right)}$	$\frac{1}{4} \le d_e/H \le \frac{1}{2}$	$\dfrac{r_\mu\left(\frac{1}{2}-\frac{d_e}{H}\right)\left(1-\frac{x}{L}-2d_e\frac{x}{HL}\right)}{\frac{d_e}{H\left(1-4d_e\frac{x}{HL}\right)}}$

r_μ = ULTIMATE PRESSURE LOAD ON ELEMENT d_e = EFFECTIVE DEPTH OF ELEMENT
NOTE: EXPRESSIONS IN THIS TABLE ARE TAKEN FROM REF. 2

Material Properties

Concrete: f'c = 3500 psi
Reinforcing Steel: f_y = 40,000 psi

Ultimate Moment of 1 ft wide Rectangular Section



$$T = C$$

$$C = \frac{\Delta s f_y}{(0.85f'c)(12)(0.85)}$$

Mu = T(d-0.425c)

After Substitutions, Mu = 3.33Δs(d-0.56Δs) (1)

Permissible Diagonal Tension Shear Stress

$$V_c = \phi\left[1.9\sqrt{f'c} + 2500\rho\right] \leq 2.28\phi\sqrt{f'c} \qquad (2)$$

Permissible Punching Shear Stress

$$V_c = 4\phi\sqrt{f'c} \qquad (3)$$

Strength Increase Due to Dynamic Effects (Ref: 2)

(1) Where shear or diagonal tension governs, no increase is allowed.

(2) Where flexure governs, the following increases were used:

$\Delta f'c = +25\%$, $\Delta f_y = +10\%$

Ultimate Moment of 1 ft Wide Rectangular Section: Mu = 3.67Δs(d-0.49Δs)

Peak Environmental Qualification Conditions for LOCA, MSLB, and Feedwater Line Break Inside Containment

LOCA

Location	Temperature (°F)	Pressure (psig)
Upper Compartment	160[1]	11.6[2]
Lower Compartment	235[3]	11.6[2]
Instrument and F/A Room	235[4,3]	13.9[5]

MSLB and Feedwater Line Break

Location	Temperature (°F)	Pressure (psig)
Upper Compartment	135 (U1)[6], 128 (U2)[6]	20.8[5]
Lower Compartment	325[7]	20.8[5]

[1] UFSAR Figure 14.3.4-7

[2] UFSAR Figure 14.3.4-6A

[3] UFSAR Figure 14.3.4-8

[4] Deleted

[5] UFSAR Table 14.3.4-40 reports this value calculated for the Steamline Break in the Steam Generator Doghouse. The Steam Generator Doghouse peak pressure is a bounding value for Upper and Lower Containment.

[6] UFSAR Figure 14.3.4-11 (Unit 1) and Figure 14.3.4-11A (Unit 2)

[7] UFSAR Figure 14.3.4-12 (Unit 1) and Figure 14.3.4-12B (Unit 2)

AIRBORNE SOURCE TERM DOSES AND DOSE RATES

Containment Centerline Dose Rates and Doses[1]						
Time	Gamma Dose Rate [rad/hr[	Beta Dose Rate [rad/hr[	Total Dose Rate [rad/hr]	Gamma Dose [rad]	Beta Dose [rad]	Total Dose [rad]
1 second	4.293E+06	2.028E+07	2.46E+07	5.962E+02	2.817E+03	3.41E+03
30 minutes	1.905E+06	7.674E+06	9.58E+06	1.330E+06	5.196E+06	6.53E+06
1 hour	1.418E+06	6.592E+06	8.01E+06	2.145E+06	8.756E+06	1.09E+07
2 hours	9.818E+05	4.849E+06	5.83E+06	3.319E+06	1.443E+07	1.77E+07
8 hours	4.013E+05	1.508E+06	1.91E+06	6.889E+06	3.046E+07	3.73E+07
1 day	2.181E+05	5.753E+05	7.93E+05	1.131E+07	4.382E+07	5.51E+07
7 days	8.274E+04	2.350E+05	3.18E+05	3.014E+07	9.492E+07	1.25E+08
30 days	4.543E+03	1.708E+04	2.16E+04	4.480E+07	1.385E+08	1.83E+08
90 days	3.484E+01	5.456E+03	5.49E+03	4.580E+07	1.487E+08	1.94E+08
180 days	2.515E+01	5.352E+03	5.38E+03	4.586E+07	1.603E+08	2.06E+08
365 days	2.431E+01	5.175E+03	5.20E+03	4.597E+07	1.837E+08	2.30E+08
Inside Containment Wall Surface Dose Rates and Doses (1)						
Time	Gamma Dose Rate [rad/hr[	Beta Dose Rate [rad/hr[	Total Dose Rate [rad/hr]	Gamma Dose [rad]	Beta Dose [rad]	Total Dose [rad]
1 second	3.408E+06	2.028E+07	2.37E+07	4.734E+02	2.817E+03	3.29E+03
30 minutes	1.906E+06	7.674E+06	9.58E+06	1.205E+06	5.196E+06	6.40E+06
1 hour	1.499E+06	6.592E+06	8.09E+06	2.046E+06	8.756E+06	1.08E+07
2 hours	1.080E+06	4.849E+06	5.93E+06	3.314E+06	1.443E+07	1.77E+07
8 hours	4.627E+05	1.508E+06	1.97E+06	7.346E+06	3.046E+07	3.78E+07
1 day	2.259E+05	5.753E+05	8.01E+05	1.228E+07	4.382E+07	5.61E+07
7 days	6.730E+04	2.350E+05	3.02E+05	2.832E+07	9.492E+07	1.23E+08
30 days	5.276E+03	1.708E+04	2.24E+04	4.141E+07	1.385E+08	1.80E+08
90 days	3.538E+01	5.456E+03	5.49E+03	4.274E+07	1.487E+08	1.91E+08
180 days	1.313E+01	5.352E+03	5.37E+03	4.277E+07	1.603E+08	2.03E+08
365 days	1.268E+01	5.175E+03	5.19E+03	4.283E+07	1.837E+08	2.27E+08

[1] Per Calculation RS-C-0046

SUBMERGED LOWER VOLUME / CONTAINMENT SUMP DOSE RATES & DOSES[1]

Time	Gamma Dose Rate (rad/hr)	Beta Dose Rate (rad/hr)	Total Dose Rate (rad/hr)	Gamma Dose (rad)	Beta Dose (rad)	Total Dose (rad)
1 second	1.201E+06	1.791E+05	1.38E+06	1.668E+02	2.488E+01	1.92E+02
30 minutes	9.675E+05	1.388E+05	1.11E+06	5.377E+05	7.812E+04	6.16E+05
1 hour	8.100E+05	1.177E+05	9.28E+05	9.799E+05	1.418E+05	1.12E+06
2 hours	6.118E+05	9.462E+04	7.06E+05	1.682E+06	2.467E+05	1.93E+06
8 hours	2.834E+05	5.775E+04	3.41E+05	4.061E+06	6.719E+05	4.73E+06
1 day	1.315E+05	3.291E+04	1.64E+05	7.072E+06	1.364E+06	8.44E+06
7 days	3.467E+04	8.429E+03	4.31E+04	1.511E+07	3.346E+06	1.85E+07
30 days	9.922E+03	3.262E+03	1.32E+04	2.527E+07	6.123E+06	3.14E+07
90 days	3.470E+03	1.753E+03	5.22E+03	3.307E+07	9.351E+06	4.24E+07
180 days	1.733E+03	1.221E+03	2.95E+03	3.838E+07	1.249E+07	5.09E+07
365 days	7.349E+02	7.538E+02	1.49E+03	4.328E+07	1.673E+07	6.00E+07

[1] Per Calculation RS-C-0046

BETA DOSE FACTORS[1]

DOSE FROM AIRBORNE SOURCE AFTER ATTENUATION

(PERCENTAGE OF DOSE PASSING THROUGH SHIELD)

Thickness of Unit Density Material (mils)

Time	10	20	30	40	50	60	70
1 second	78.68%	68.30%	60.73%	54.66%	49.58%	45.22%	41.38%
30 minutes	75.18%	64.48%	56.96%	51.04%	46.14%	41.94%	38.30%
1 hour	75.37%	65.13%	57.92%	52.22%	47.48%	43.41%	39.83%
2 hours	75.21%	65.41%	58.57%	53.16%	48.62%	44.71%	41.28%
8 hours	70.04%	60.58%	54.41%	49.62%	45.62%	42.23%	39.24%
1 day	58.35%	48.97%	43.53%	39.50%	36.24%	33.49%	31.11%
7 days	31.56%	23.58%	20.49%	18.47%	16.88%	15.57%	14.44%
30 days	24.49%	16.73%	14.23%	12.73%	11.60%	10.68%	9.90%
90 days	24.78%	16.40%	13.60%	12.01%	10.87%	9.98%	9.24%
180 days	25.51%	16.28%	13.08%	11.34%	10.18%	9.30%	8.59%
365 days	26.67%	16.08%	12.22%	10.24%	9.03%	8.18%	7.52%

[1] Per Calculation RS-C-0046

BETA DOSE FACTORS[1]

DOSE FROM AIRBORNE SOURCE AFTER ATTENUATION

(PERCENTAGE OF DOSE PASSING THROUGH SHIELD)

Thickness of Aluminum (mils)

Time	10	20	30	40	50	60	70
1 second	62.82%	47.77%	37.66%	30.25%	24.53%	20.03%	16.43%
30 minutes	59.01%	44.39%	34.79%	27.80%	22.49%	18.33%	15.05%
1 hour	59.89%	45.77%	36.38%	29.42%	24.07%	19.84%	16.46%
2 hours	60.44%	46.99%	37.93%	31.11%	25.77%	21.51%	18.05%
8 hours	56.09%	44.21%	36.31%	30.30%	25.53%	21.64%	18.42%
1 day	44.98%	35.09%	28.78%	24.07%	20.33%	17.27%	14.74%
7 days	21.26%	16.33%	13.36%	11.16%	9.42%	8.00%	6.83%
30 days	14.81%	11.21%	9.15%	7.65%	6.45%	5.48%	4.68%
90 days	14.25%	10.50%	8.53%	7.12%	6.01%	5.11%	4.36%
180 days	13.81%	9.80%	7.93%	6.61%	5.58%	4.74%	4.04%
365 days	13.09%	8.65%	6.92%	5.77%	4.87%	4.14%	3.53%

[1] Per Calculation RS-C-0046

BETA DOSE FACTORS[1]

DOSE FROM AIRBORNE SOURCE AFTER ATTENUATION

(PERCENTAGE OF DOSE PASSING THROUGH SHIELD)

Thickness of Steel (mils)

Time	10	20	30	40	50	60	70
1 second	38.44%	20.75%	11.76%	6.82%	4.01%	2.39%	1.43%
30 minutes	35.52%	19.00%	10.83%	6.41%	3.89%	2.41%	1.52%
1 hour	37.10%	20.53%	12.05%	7.34%	4.59%	2.92%	1.88%
2 hours	38.62%	22.20%	13.46%	8.42%	5.39%	3.50%	2.30%
8 hours	36.91%	22.27%	14.05%	9.08%	5.96%	3.95%	2.64%
1 day	29.27%	17.77%	11.29%	7.33%	4.83%	3.22%	2.16%
7 days	13.58%	8.23%	5.23%	3.40%	2.24%	1.49%	1.00%
30 days	9.31%	5.64%	3.58%	2.33%	1.53%	1.02%	0.68%
90 days	8.68%	5.26%	3.34%	2.17%	1.43%	0.95%	0.64%
180 days	8.06%	4.88%	3.10%	2.01%	1.33%	0.88%	0.59%
365 days	7.05%	4.26%	2.70%	1.76%	1.16%	0.77%	0.52%

[1] Per Calculation RS-C-0046

PIPES CONSIDERED IN CALCULATING OUTSIDE CONTAINMENT DOSES[1]

System	Designation [2]	Outside Diameter OD (inches)	Wall Thickness, T (inches)	OD/T
CC	M-14	4.5	0.438	10.3
CC	M-14	3.5	0.438	7.99
CC	M-14	2.0	0.344	5.81
CC	B-14	6.625	0.134	49.44
CC	B-14	8.625	0.148	58.28
SI	K-14	4.5	0.337	13.35
SI	B-14	4.5	0.12	37.5
SI	B-14	6.625	0.134	49.44
SI	K-14	2.375	0.276	8.61
SI	K-14	1.9	0.2	9.5
SI	K-14	1.05	0.154	6.82
RHR	G-14	14.0	0.438	31.96
RHR	G-14	3.5	0.216	16.20
RHR	G-14	8.625	0.322	26.79
CS	E-14	10.75	0.365	29.45
CS	E-14	8.625	0.322	26.79
CS	E-14	6.625	0.28	23.66
CS	E-14	3.5	0.216	16.20
CS	E-14	1.315	0.133	9.89
CS	B-14	8.625	0.148	58.28
CS	G-14	12.75	0.406	31.40
CS	G-14	2.375	0.154	15.42

Key:

CC - Centrifugal Charging

SI - Safety Injection

RHR - Residual Heat Removal

CS - Containment Spray

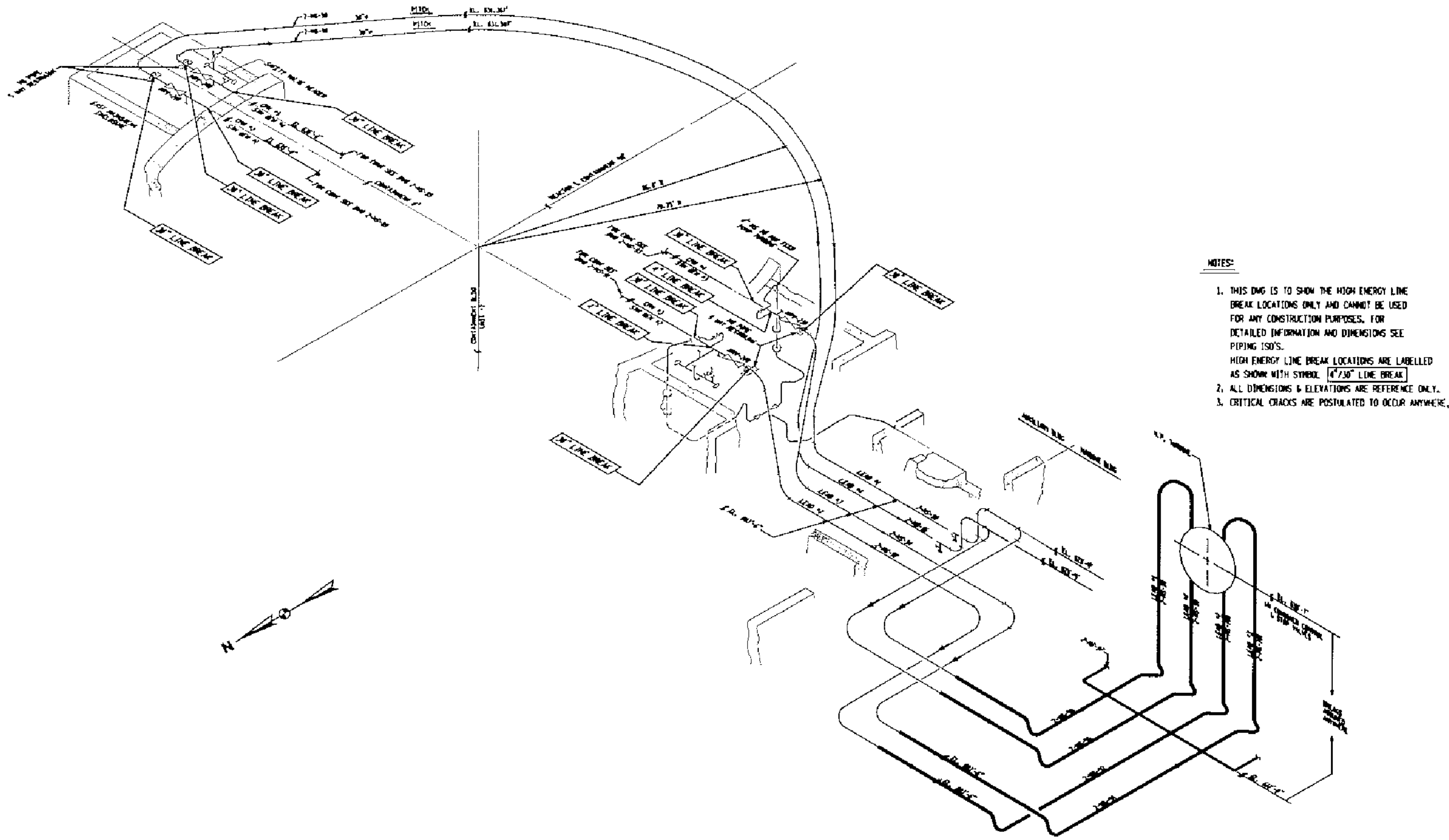
[1] AEP: NRC: 05781, Attachment 4

[2] Note: Pipe designation indicates materials of construction, seismic classification, and quality level. For further information, AEPSC specifications should be consulted.

PEAK ENVIRONMENTAL QUALIFICATION CONDITIONS FOR HELB OUTSIDE CONTAINMENT

COMPARTMENT	TEMPERATURE (ºF)	PRESSURE (psia)
East Main Steam Enclosure	440	18.7
West Main Steam Enclosure	485	20.6
Main Steam Accessway	347.8	18.2
Diesel Generator Pipe Tunnel	300	15.3
Turbine Driven Pump Room	298	16.7
ESW Tunnel	300	15.1
Turbine Room (Turbine Bldg. 609' Elev.)	473.8	15.45
Startup Blowdown Flashtank Room	216.5	15.2

NOTE:
Only major areas are identified in the table above.



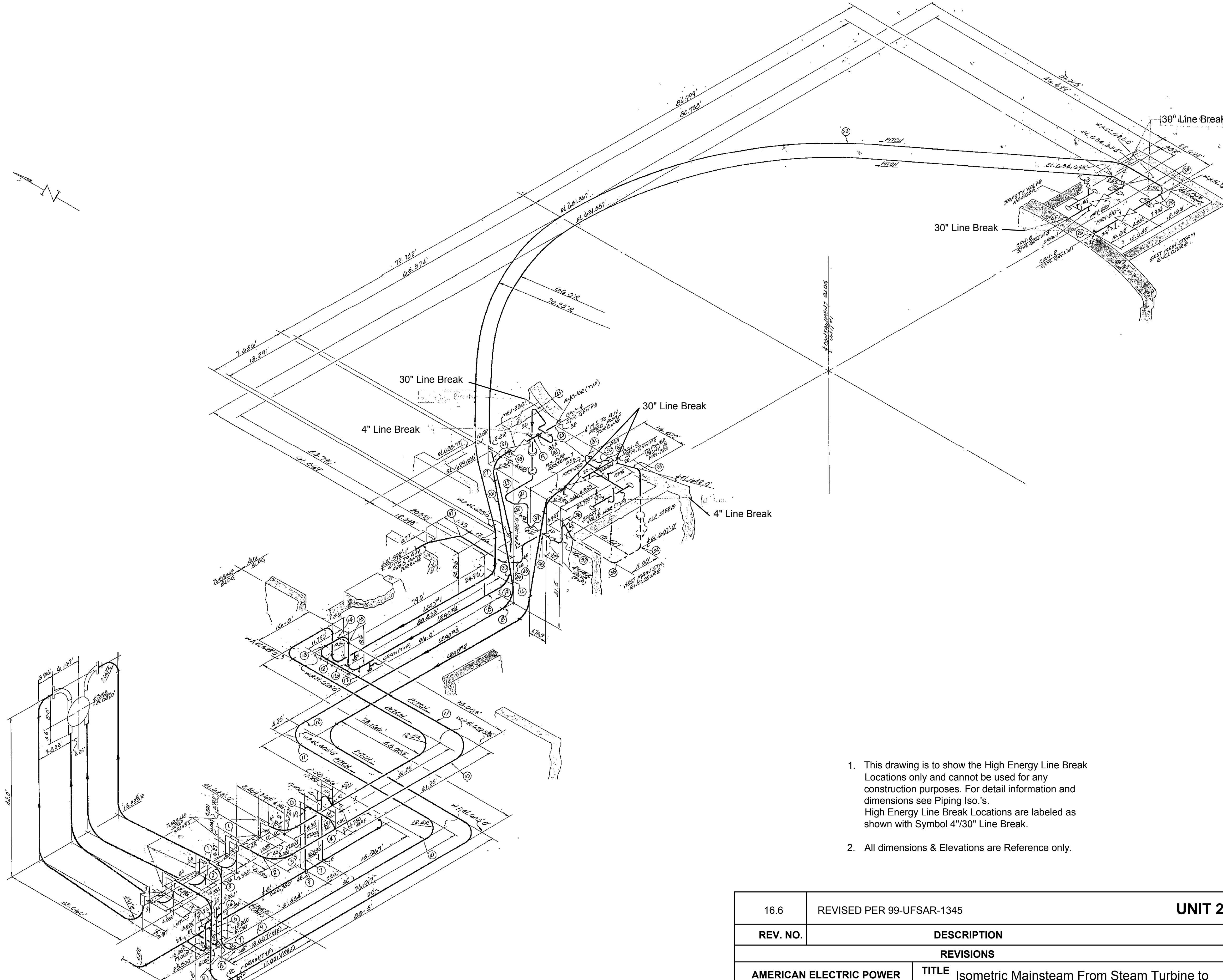
REV. NO.	DESCRIPTION	
16.4	REVISED PER 98-UFSAR-0779	UNIT 2

REVISIONS

AMERICAN ELECTRIC POWER
COOK NUCLEAR PLANT
NUCLEAR GENERATION GROUP
BRIDGMAN, MICHIGAN

TITLE **Isometric Mainsteam from Steam Turbine to Containment Penetration Sleeve Unit No.2**

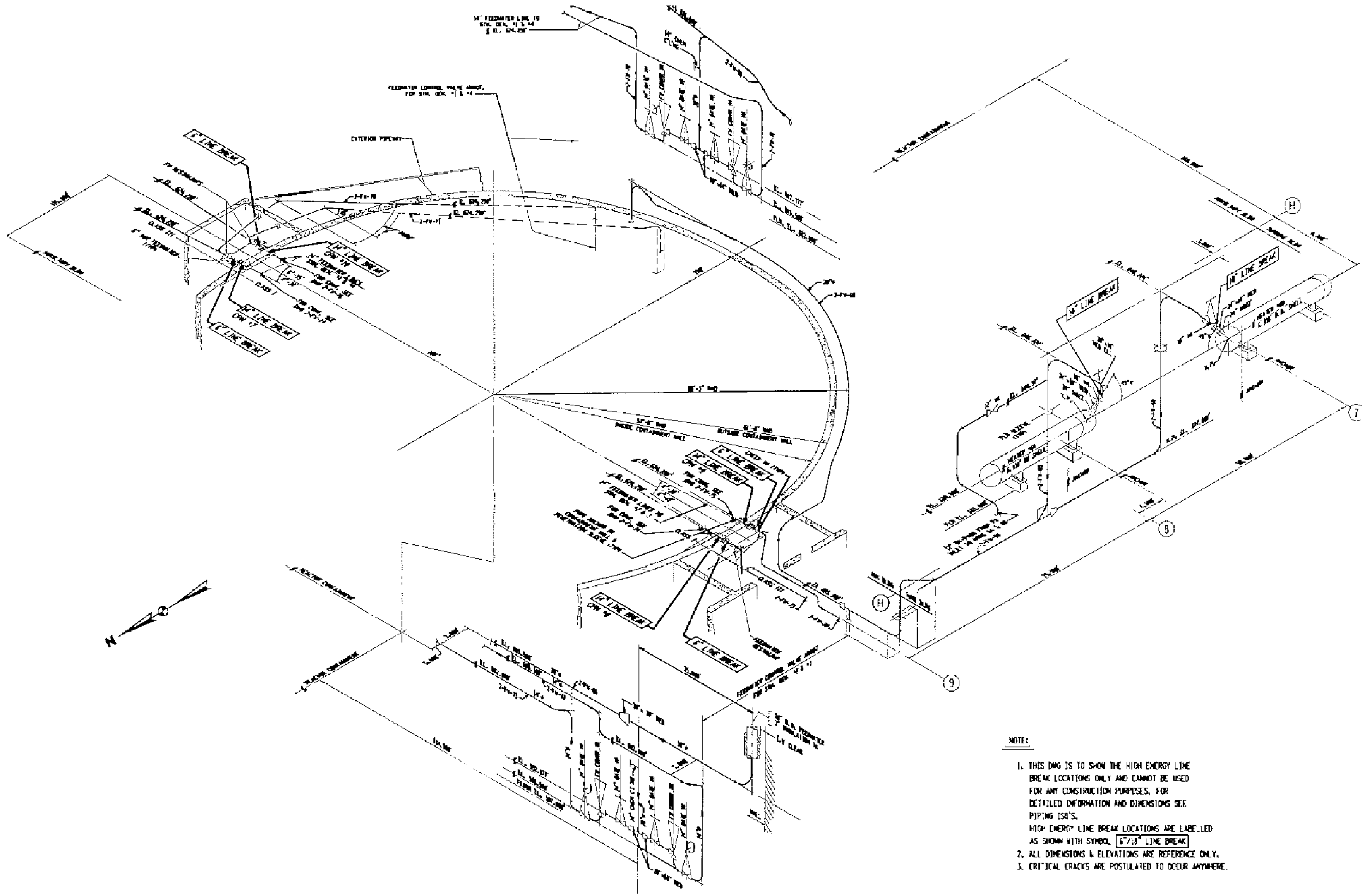
DWG. NO. **FSAR FIG. 14.4.2-1** SH 1 of 1



1. This drawing is to show the High Energy Line Break Locations only and cannot be used for any construction purposes. For detail information and dimensions see Piping Iso.'s.
   High Energy Line Break Locations are labeled as shown with Symbol 4"/30" Line Break.
2. All dimensions & Elevations are Reference only.

16.6	REVISED PER 99-UFSAR-1345	**UNIT 2**
REV. NO.	**DESCRIPTION**	
REVISIONS		

AMERICAN ELECTRIC POWER **COOK NUCLEAR PLANT** **NUCLEAR GENERATION GROUP** **BRIDGMAN, MICHIGAN**	**TITLE** Isometric Mainsteam From Steam Turbine to Containment Penetration Sleeve for Unit 1	
	DWG. NO. **FSAR FIG. 14.4.2-1A**	SH 1 of 1



NOTE:

1. THIS DWG IS TO SHOW THE HIGH ENERGY LINE BREAK LOCATIONS ONLY AND CANNOT BE USED FOR ANY CONSTRUCTION PURPOSES, FOR DETAILED INFORMATION AND DIMENSIONS SEE PIPING ISO'S.
   HIGH ENERGY LINE BREAK LOCATIONS ARE LABELLED AS SHOWN WITH SYMBOL [6"/18" LINE BREAK]
2. ALL DIMENSIONS & ELEVATIONS ARE REFERENCE ONLY.
3. CRITICAL CRACKS ARE POSTULATED TO OCCUR ANYWHERE.

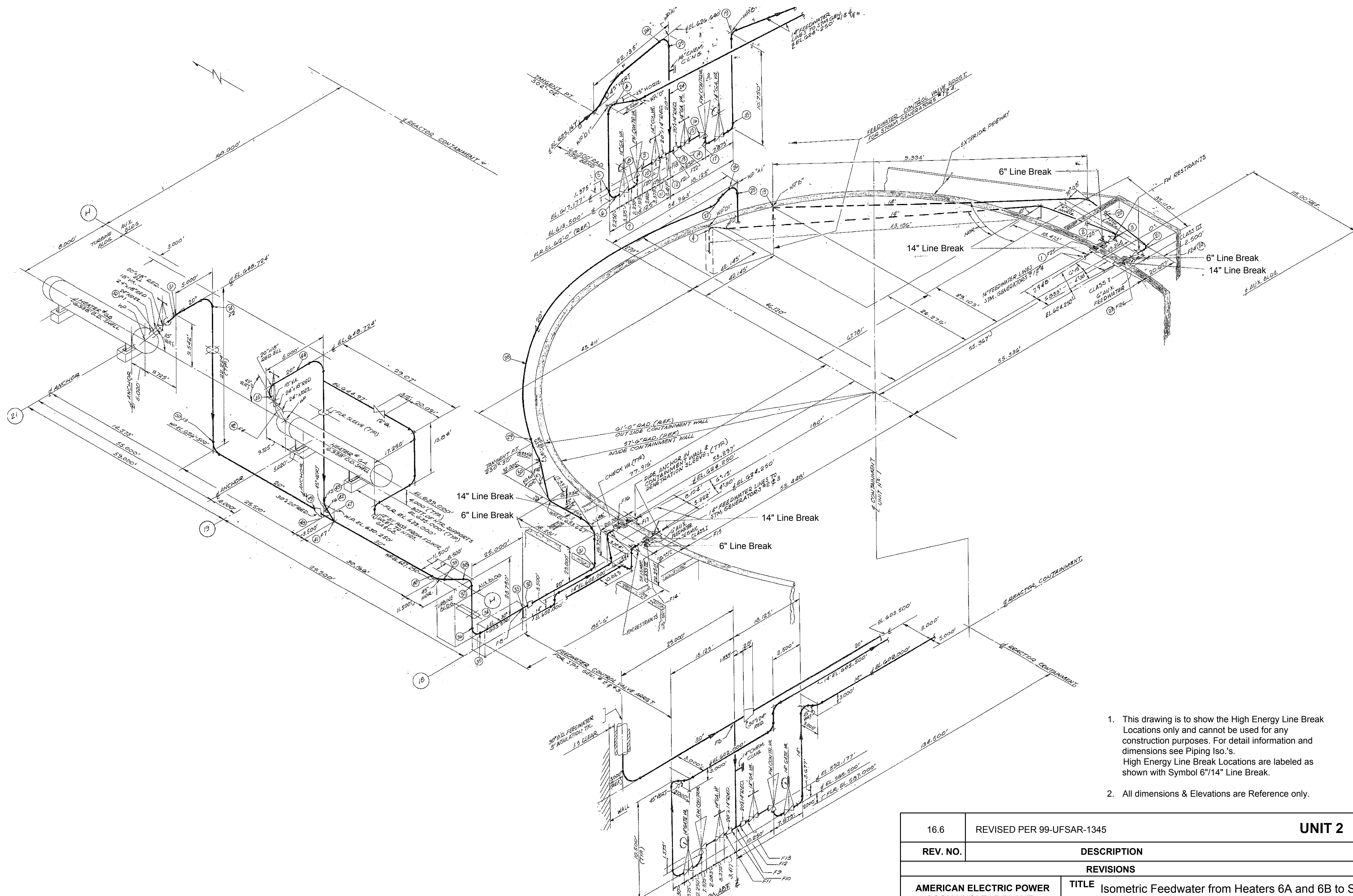
REV. NO.	DESCRIPTION	
16.4	REVISED PER 98-UFSAR-0779	**UNIT 2**

REVISIONS

AMERICAN ELECTRIC POWER
COOK NUCLEAR PLANT
NUCLEAR GENERATION GROUP
BRIDGMAN, MICHIGAN

TITLE **Isometric of Feedwater from Heaters # 6A & 6B to Steam Generators Unit No. 2**

DWG. NO. FSAR FIG. 14.4.2-2 SH 1 of 1



1. This drawing is to show the High Energy Line Break Locations only and cannot be used for any construction purposes. For detail information and dimensions see Piping Iso.'s.
   High Energy Line Break Locations are labeled as shown with Symbol 6"/14" Line Break.
2. All dimensions & Elevations are Reference only.

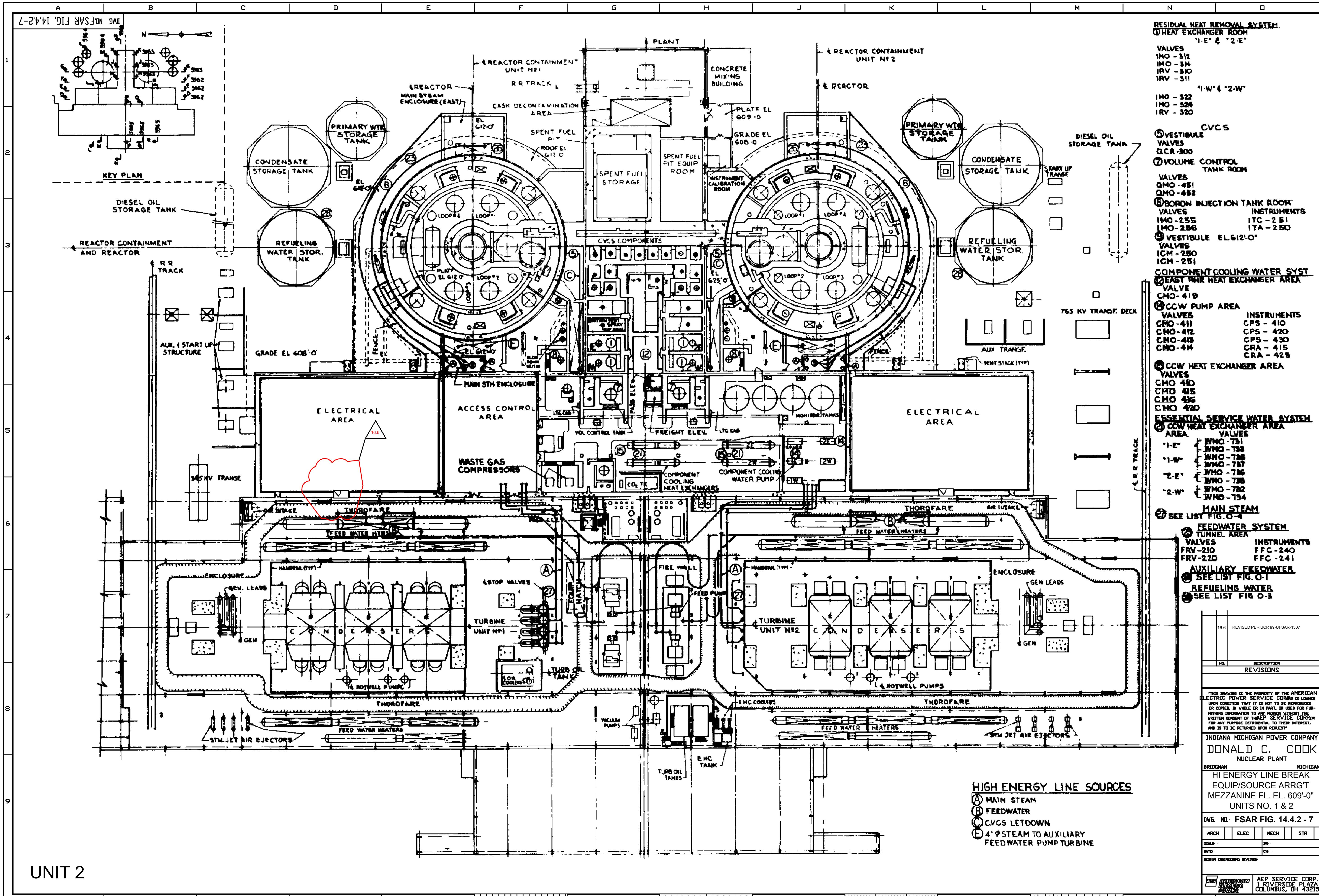
REV. NO.	DESCRIPTION	
16.6	REVISED PER 99-UFSAR-1345	**UNIT 2**

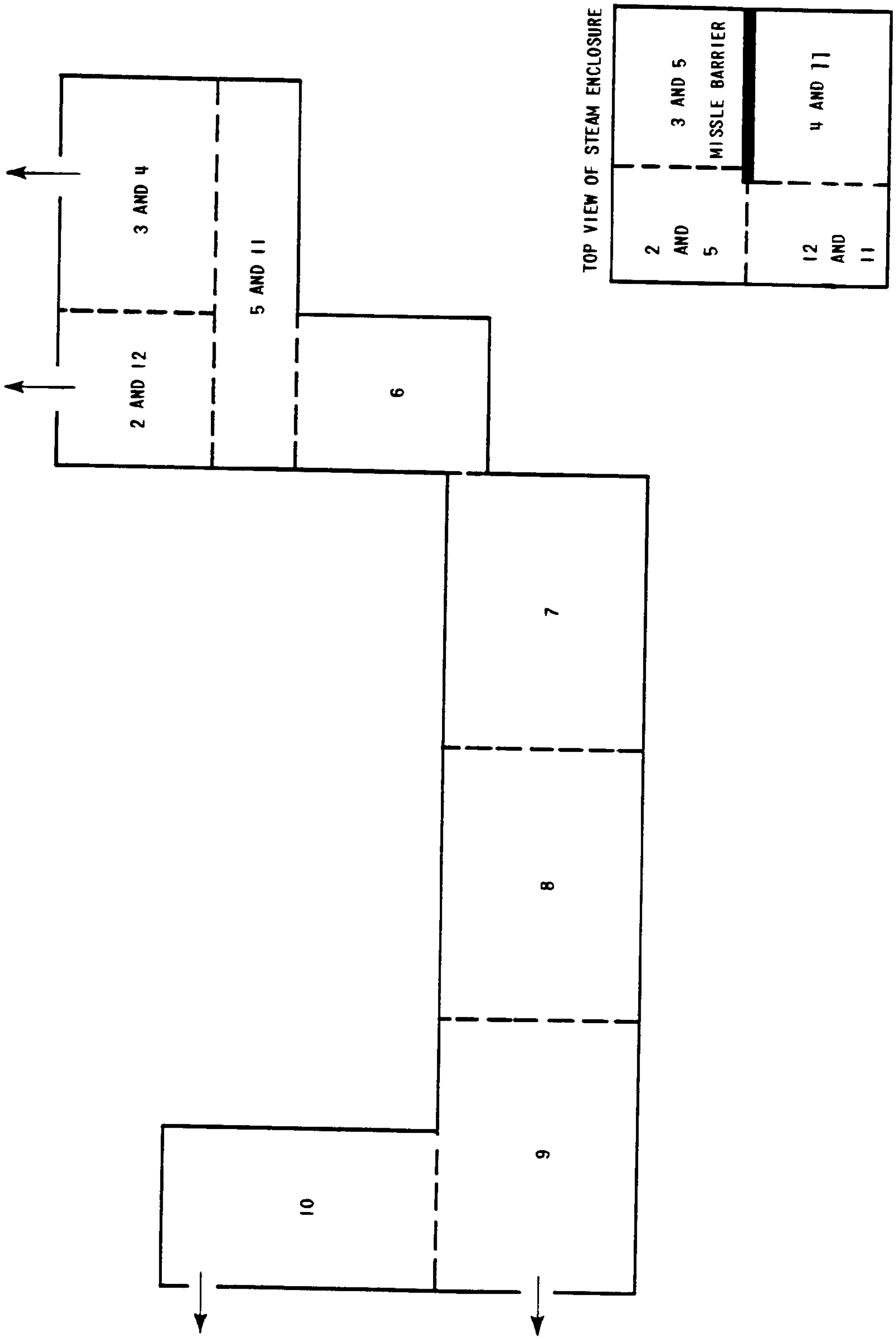
REVISIONS

AMERICAN ELECTRIC POWER
COOK NUCLEAR PLANT
NUCLEAR GENERATION GROUP
BRIDGMAN, MICHIGAN

TITLE Isometric Feedwater from Heaters 6A and 6B to Steam Generators for Unit 1

DWG. NO. **FSAR FIG. 14.4.2-2A** SH 1 of 1


DWG. NO. FSAR FIG. 14.4.2-7
KEY PLAN
PLANT
REACTOR CONTAINMENT UNIT NO 1
REACTOR CONTAINMENT UNIT NO 2
REACTOR
CONCRETE MIXING BUILDING
CASK DECONTAMINATION AREA
SPENT FUEL PIT
SPENT FUEL STORAGE
SPENT FUEL PIT EQUIP ROOM
PRIMARY WTR STORAGE TANK
CONDENSATE STORAGE TANK
REFUELING WATER STOR. TANK
DIESEL OIL STORAGE TANK
REACTOR CONTAINMENT AND REACTOR
R R TRACK
AUX. & START UP STRUCTURE
GRADE EL 608'-0"
CVCS COMPONENTS
765 KV TRANSF. DECK
AUX TRANSF.
ELECTRICAL AREA
ACCESS CONTROL AREA
WASTE GAS COMPRESSORS
MAIN STM ENCLOSURE
VOL CONTROL TANK
FREIGHT ELEV.
COMPONENT COOLING HEAT EXCHANGERS
COMPONENT COOLING WATER PUMP
345 KV TRANSF.
THOROFARE
FEED WATER HTRS
ENCLOSURE
GEN. LEADS
GEN
CONDENSER
STOP VALVES
TURBINE UNIT NO 1
TURBINE UNIT NO 2
HOTWELL PUMPS
TURB OIL TANK
FIRE WALL
FEED PUMP
EHC COOLERS
EHC TANK
VACUUM PUMPS
TURB OIL TANKS
STM. JET AIR EJECTORS
FEED WATER HEATERS
RESIDUAL HEAT REMOVAL SYSTEM
HEAT EXCHANGER ROOM
CVCS
COMPONENT COOLING WATER SYST
ESSENTIAL SERVICE WATER SYSTEM
MAIN STEAM
FEEDWATER SYSTEM
AUXILIARY FEEDWATER
REFUELING WATER
HIGH ENERGY LINE SOURCES
(A) MAIN STEAM
(B) FEEDWATER
(C) CVCS LETDOWN
(E) 4" φ STEAM TO AUXILIARY FEEDWATER PUMP TURBINE
16.6 REVISED PER UCR 99-UFSAR-1307
REVISIONS
INDIANA MICHIGAN POWER COMPANY
DONALD C. COOK NUCLEAR PLANT
BRIDGMAN MICHIGAN
HI ENERGY LINE BREAK EQUIP/SOURCE ARRG'T MEZZANINE FL. EL. 609'-0" UNITS NO. 1 & 2
DWG. NO. FSAR FIG. 14.4.2 - 7
AEP SERVICE CORP. 1 RIVERSIDE PLAZA COLUMBUS, OH 43215
UNIT 2



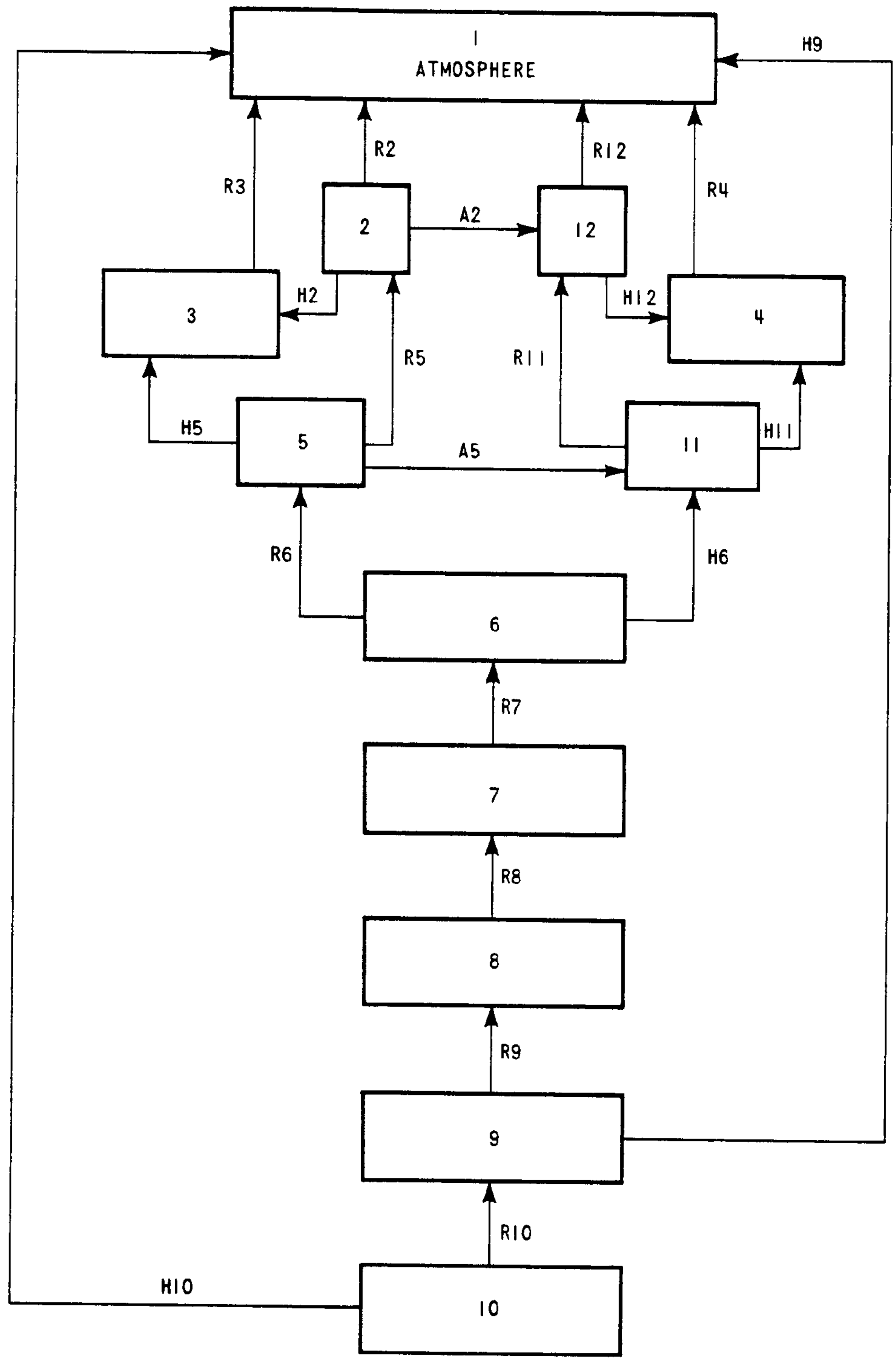
16.6	REVISED PER 99-UFSAR-1345	**UNIT 2**
REV. NO.	**DESCRIPTION**	

REVISIONS

AMERICAN ELECTRIC POWER
COOK NUCLEAR PLANT
NUCLEAR GENERATION GROUP
BRIDGMAN, MICHIGAN

TITLE Schematic of West Steam Enclosure/Main Steam Accessway

DWG. NO. **FSAR FIG. 14.4.6-1** SH 1 of 1



16.6	REVISED PER 99-UFSAR-1345	**UNIT 2**
REV. NO.	**DESCRIPTION**	

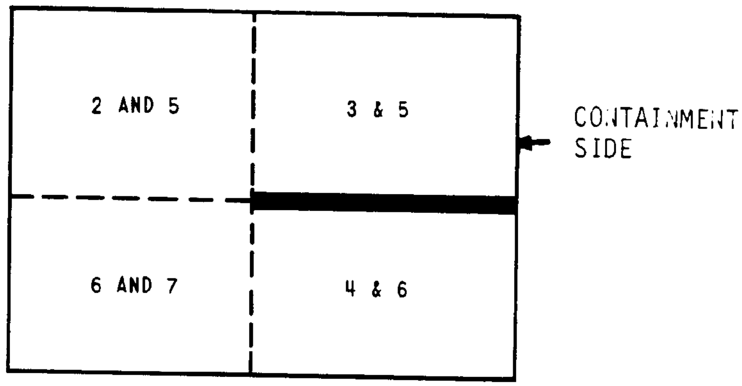
REVISIONS

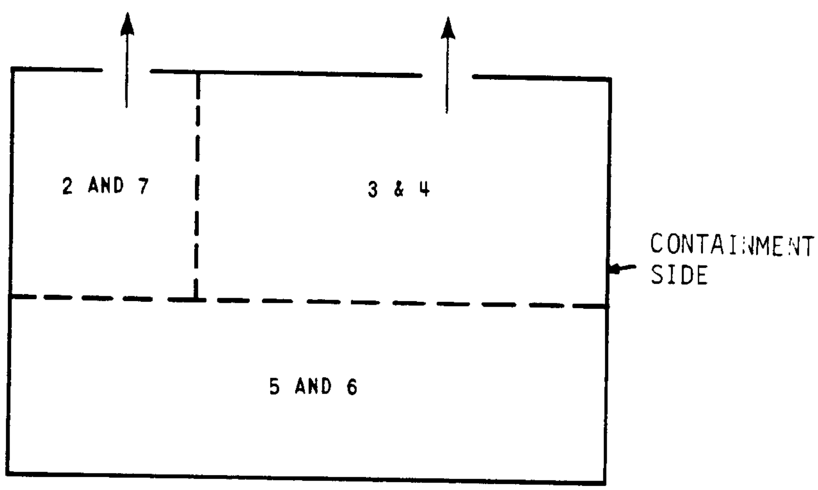
AMERICAN ELECTRIC POWER
COOK NUCLEAR PLANT
NUCLEAR GENERATION GROUP
BRIDGMAN, MICHIGAN

TITLE TMD Network for West Steam Enclosure/Main Steam Accessway

DWG. NO. **FSAR FIG. 14.4.6-2**

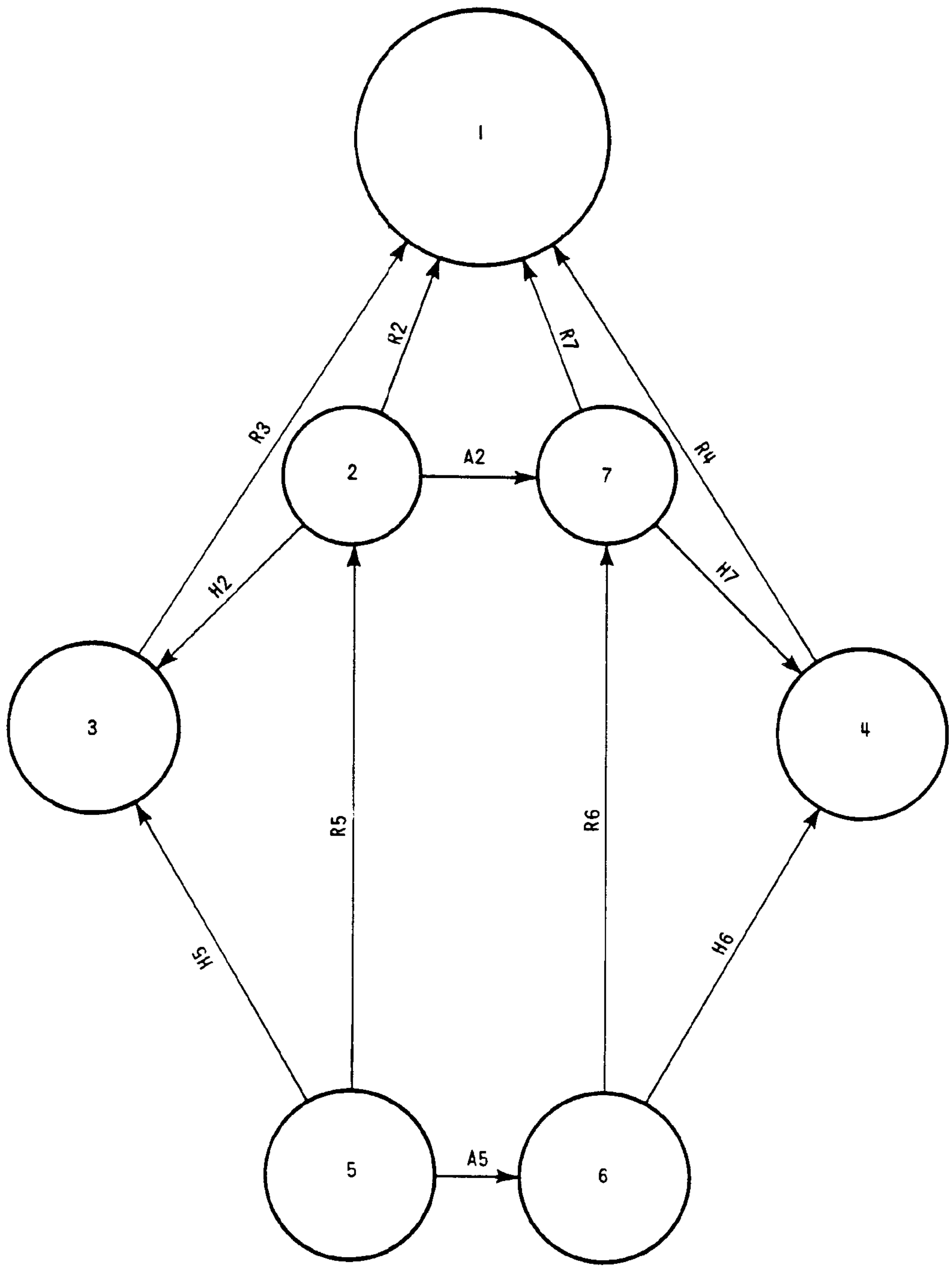
SH 1 of 1





16.6	REVISED PER 99-UFSAR-1345	**UNIT 2**
REV. NO.	**DESCRIPTION**	
REVISIONS		

AMERICAN ELECTRIC POWER **COOK NUCLEAR PLANT** **NUCLEAR GENERATION GROUP** **BRIDGMAN, MICHIGAN**	**TITLE** Schematic of East Steam Enclosure	
	DWG. NO. **FSAR FIG. 14.4.6-3**	SH 1 of 1

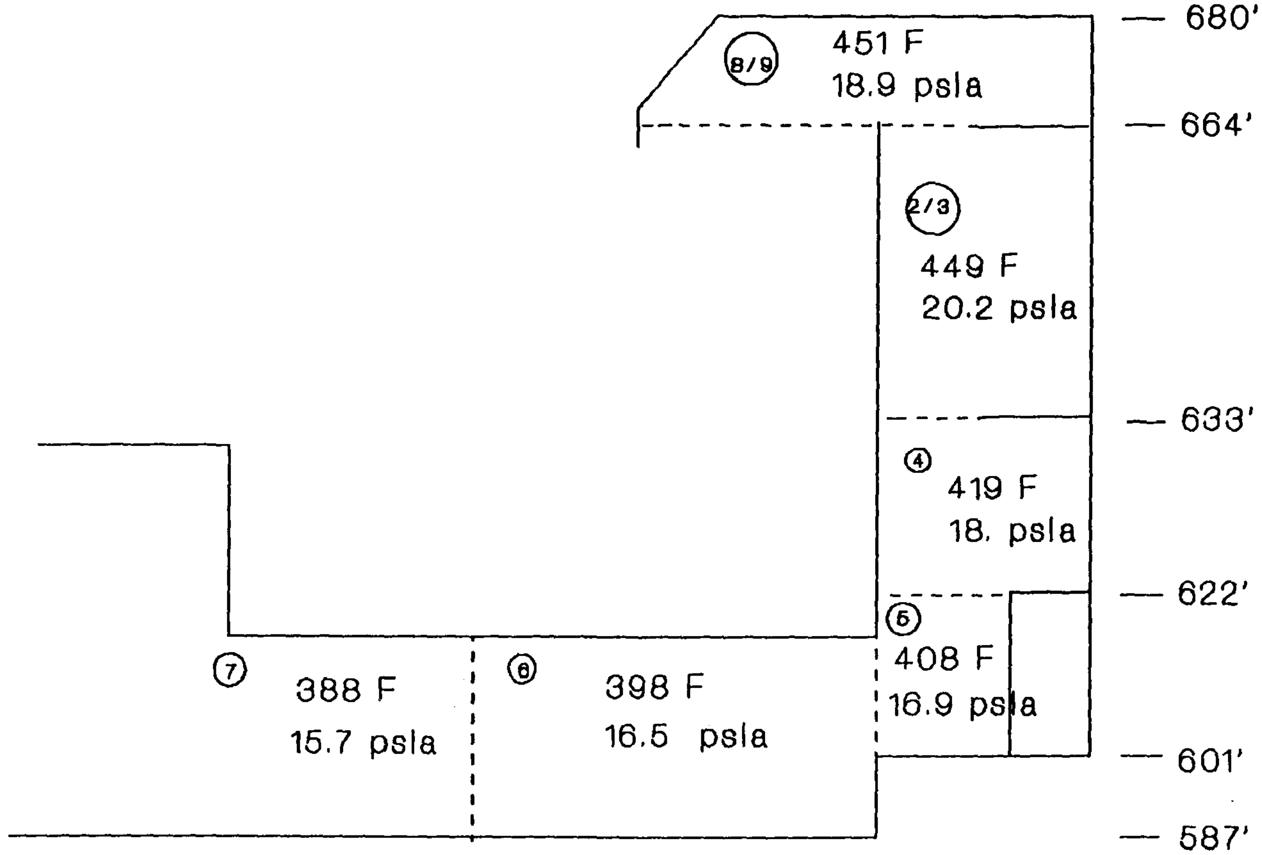


16.6	REVISED PER 99-UFSAR-1345	UNIT 2
REV. NO.	**DESCRIPTION**	
	REVISIONS	

AMERICAN ELECTRIC POWER
COOK NUCLEAR PLANT
NUCLEAR GENERATION GROUP
BRIDGMAN, MICHIGAN

TITLE TMD Network for East Steam Enclosure

DWG. NO. **FSAR FIG. 14.4.6-4** SH 1 of 1



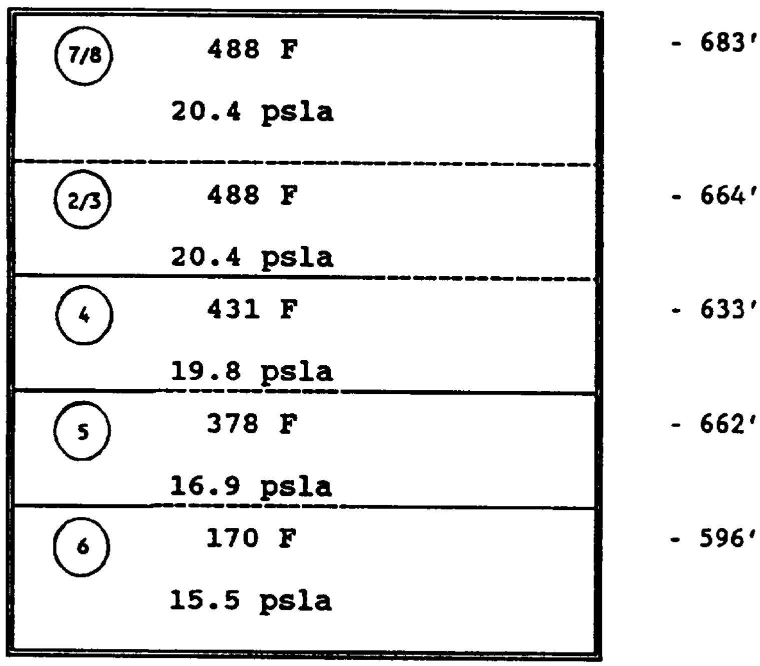
16.6	REVISED PER 99-UFSAR-1345	UNIT 2
REV. NO.	DESCRIPTION	

REVISIONS

AMERICAN ELECTRIC POWER
COOK NUCLEAR PLANT
NUCLEAR GENERATION GROUP
BRIDGMAN, MICHIGAN

TITLE Peak Environmental Parameters (West Main Steam Enclosure and Accessway) (Structural Qualification)

DWG. NO. **FSAR FIG. 14.4.6-5** SH 1 of 1



REV. NO.	DESCRIPTION	
16.6	REVISED PER 99-UFSAR-1345	**UNIT 2**

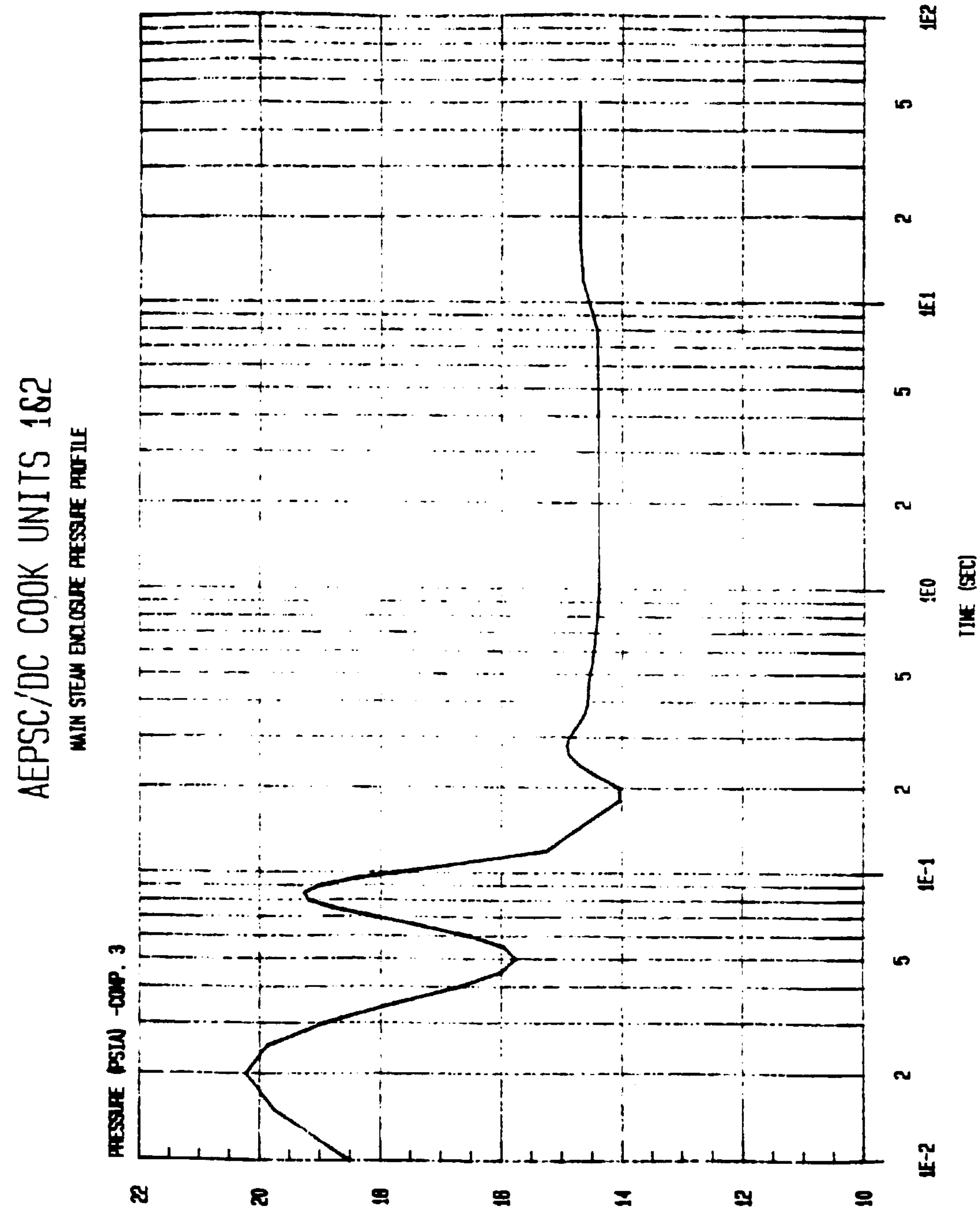
REVISIONS

AMERICAN ELECTRIC POWER
COOK NUCLEAR PLANT
NUCLEAR GENERATION GROUP
BRIDGMAN, MICHIGAN

TITLE Peak Environmental Parameter (East Main Steam Enclosure) (Structural Qualification)

DWG. NO. **FSAR FIG. 14.4.6-6**

SH 1 of 1



REV. NO.	DESCRIPTION	
16.6	REVISED PER 99-UFSAR-1345	**UNIT 2**

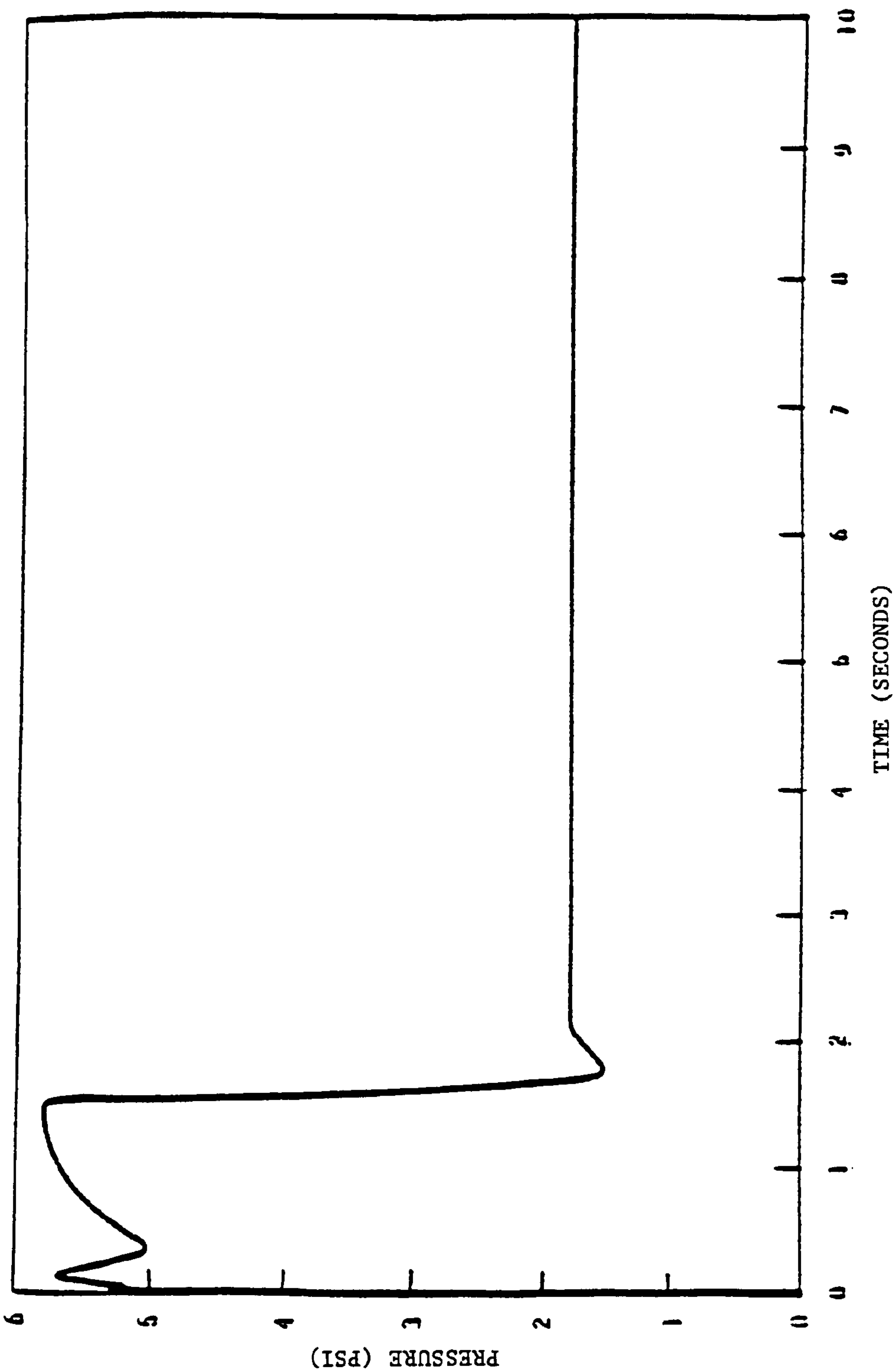
REVISIONS

AMERICAN ELECTRIC POWER
COOK NUCLEAR PLANT
NUCLEAR GENERATION GROUP
BRIDGMAN, MICHIGAN

TITLE East Main Steam Enclosure Pressure Profile in Elements 2 and 3

DWG. NO. **FSAR FIG. 14.4.6-8**

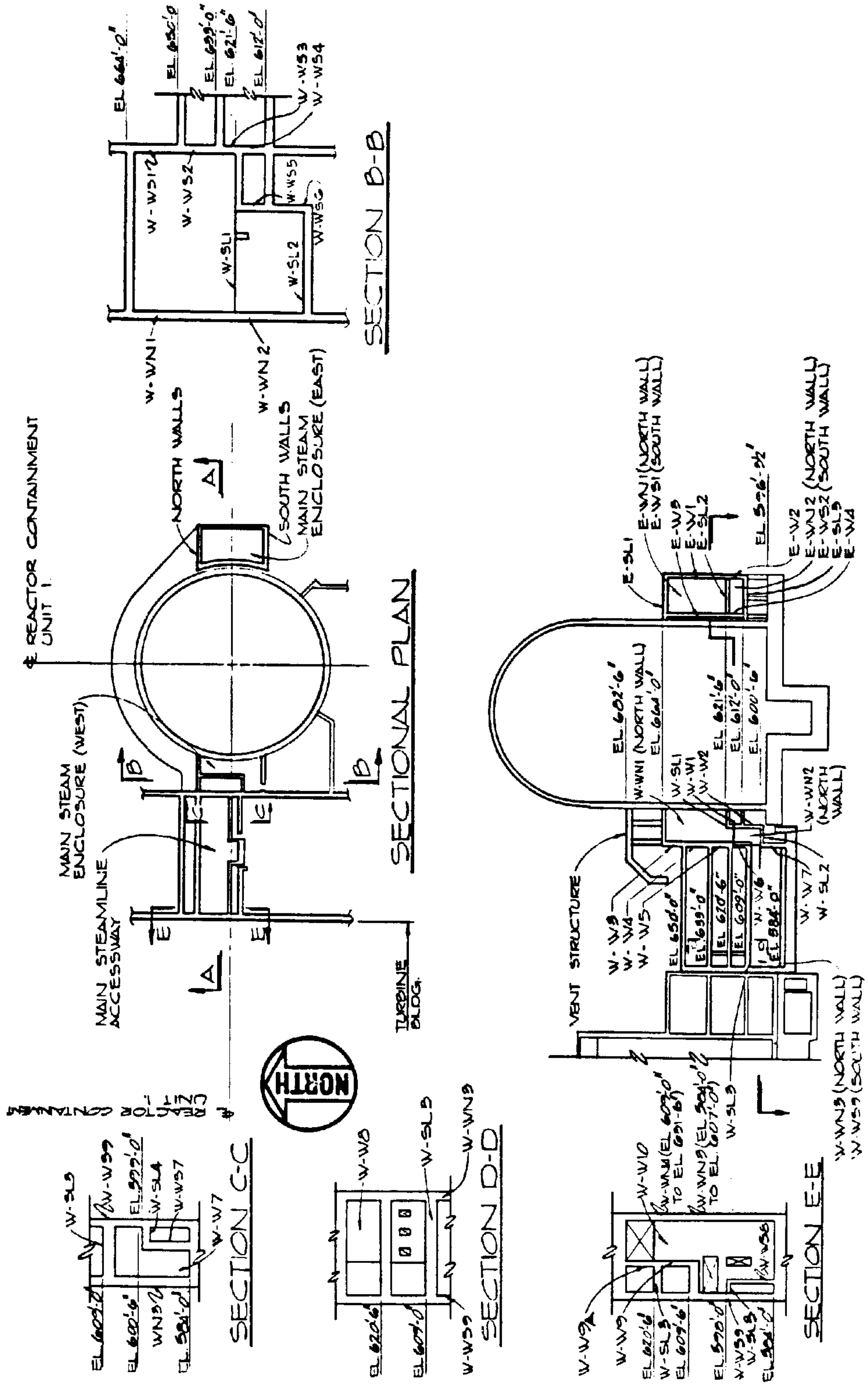
SH 1 of 1



REV. NO.	DESCRIPTION	
16.6	REVISED PER 99-UFSAR-1345	**UNIT 2**

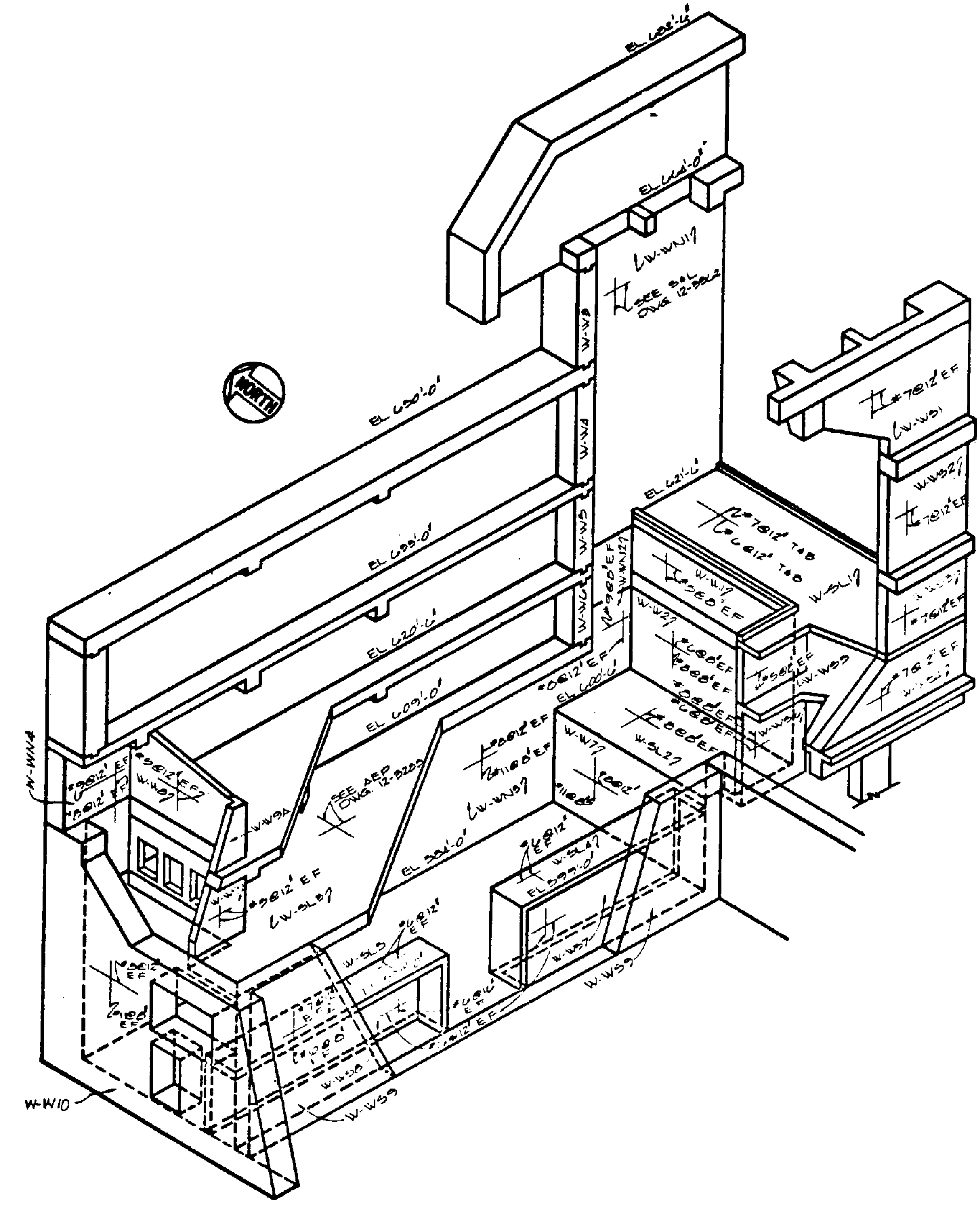
REVISIONS

AMERICAN ELECTRIC POWER **COOK NUCLEAR PLANT** **NUCLEAR GENERATION GROUP** **BRIDGMAN, MICHIGAN**	**TITLE** Feedwater Line Break in Main Steam Accessway (Element 7) Pressure VS. Time
	DWG. NO. **FSAR FIG. 14.4.6-11** — SH 1 of 1



16.6	Revised per 99-UFSAR-1345	UNIT 2
REV. NO.	DESCRIPTION	
	REVISIONS	

AMERICAN ELECTRIC POWER COOK NUCLEAR PLANT NUCLEAR GENERATION GROUP BRIDGMAN, MICHIGAN	TITLE LAYOUT AND IDENTIFICATION OF WALLS AND SLABS FOR EAST MAIN STEAM ENCLOSURE, WEST MAIN STEAM ENCLOSURE, MAIN STEAM ACCESSWAY
	DWG. NO. **FSAR FIG. 14.4.8-1** — SH 1 of 1



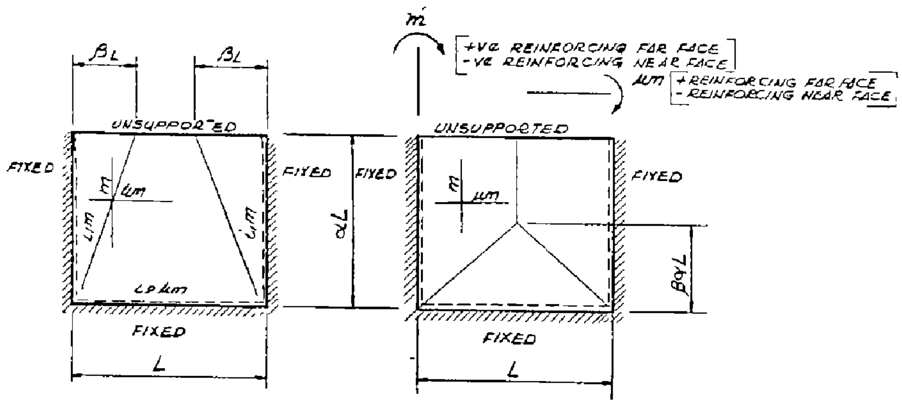
16.6	REVISED PER 99-UFSAR-1345	UNIT 2
REV. NO.	**DESCRIPTION**	

REVISIONS

AMERICAN ELECTRIC POWER
COOK NUCLEAR PLANT
NUCLEAR GENERATION GROUP
BRIDGMAN, MICHIGAN

TITLE **Isometric View of Main Steam Enclosure Accessway West of Containment**

DWG. NO. **FSAR FIG. 14.4.8-2** SH 1 of 1



FAILURE PATTERN (a) FAILURE PATTERN (b)

FOR PATTERN (a):

$$\beta = \frac{\alpha^2}{\mu}\frac{(1+i_1)}{(3+i_2)}\left[\sqrt{4+3\frac{\mu\,(3+i_2)}{\alpha^2(1+i_1)}}-2\right] < 0.5 \text{ FOR PATTERN (a) TO BE VALID.}$$

$$p_{max} = m\frac{6\mu}{\alpha^2 L^2}\frac{(4\beta+i_2)}{(3-4\beta)}$$

FOR PATTERN (b):

$$\beta = \frac{1}{4}\frac{\mu}{\alpha^2}\frac{(1+i_2)}{(1+i_1)}\left[\sqrt{1+12\frac{\alpha^2}{\mu}\frac{(1+i_1)}{(1+i_2)}}-1\right] < 1.0 \text{ FOR PATTERN (b) TO BE VALID.}$$

$$p_{max} = m\frac{24(1+i_1)}{L^2(3-2\beta)}$$

EVALUATE BOTH CASES AND USE MINIMUM VALUE FOR p_{max}.

———— POSITIVE YIELD LINE
– – – – NEGATIVE YIELD LINE

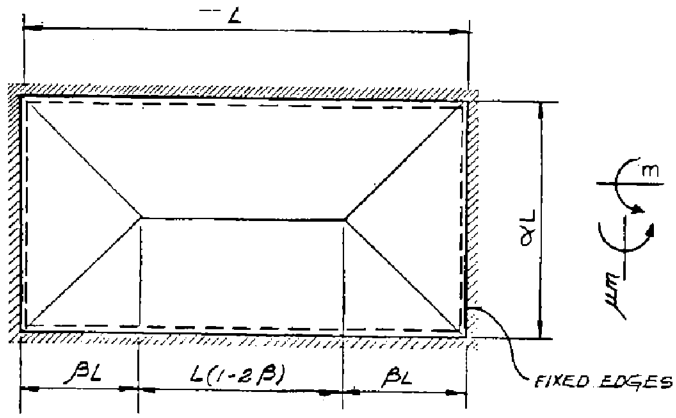
REV. NO.	DESCRIPTION	
16.6	REVISED PER 99-UFSAR-1345	UNIT 2

REVISIONS

AMERICAN ELECTRIC POWER
COOK NUCLEAR PLANT
NUCLEAR GENERATION GROUP
BRIDGMAN, MICHIGAN

TITLE **Yield Line Pattern for Panels with Three Edges Fixed & One Edge Unsupported Subjected to Uniformly Distributed Load**

DWG. NO. **FSAR FIG. 14.4.8-3** SH 1 of 1



——— POSITIVE YIELD LINE
– – – – NEGATIVE YIELD LINE
m = YIELD MOMENT (+) & (-) (SHORT DIRECTION)
μm = YIELD MOMENT (+) & (-) (LONG DIRECTION)

$$\beta = \frac{\mu\alpha^2}{2}\left\{\sqrt{\left[1+\frac{3}{\mu\alpha^2}\right]}-1\right\}$$

IF $\beta > 0.5$ INTERCHANGE "L" & "αL"

$$p_{max} = \frac{24m\left[\frac{2}{\alpha}+\frac{\alpha\mu}{\beta}\right]}{\alpha L^2(3-2\beta)}$$

REV. NO.	DESCRIPTION
16.6	REVISED PER 99-UFSAR-1345

UNIT 2

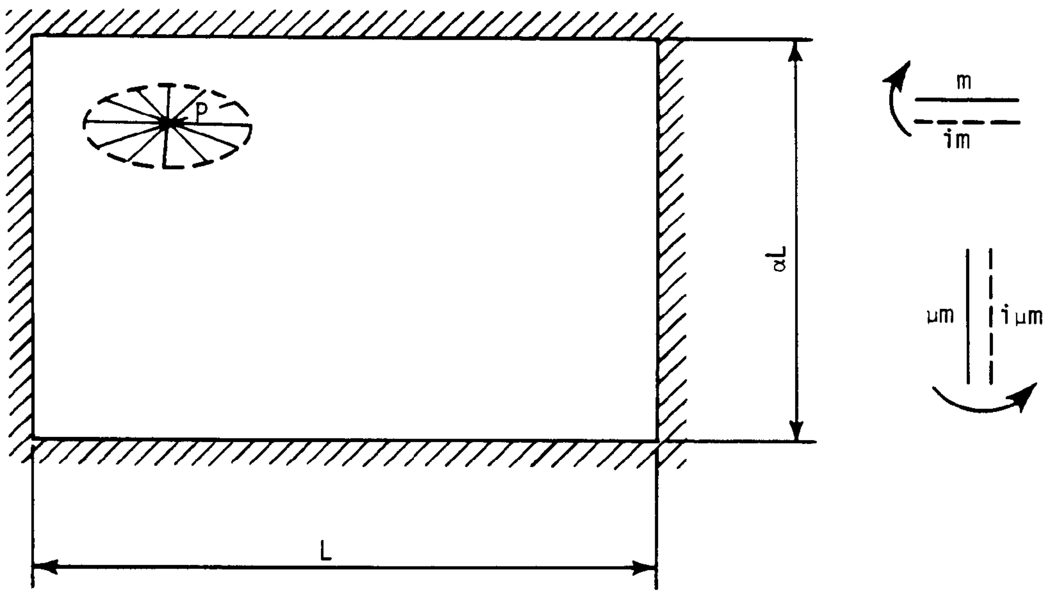
REVISIONS

AMERICAN ELECTRIC POWER
COOK NUCLEAR PLANT
NUCLEAR GENERATION GROUP
BRIDGMAN, MICHIGAN

TITLE **Yield Line Pattern for Panels with Four Edges Fixed Subjected to Uniformly Distributed Load**

DWG. NO. **FSAR FIG. 14.4.8-4**

SH 1 of 1



——— POSITIVE YIELD LINE
– – – – NEGATIVE YIELD LINE

m = +YIELD MOMENT
im = -YIELD MOMENT
μm = +YIELD MOMENT
iμm = -YIELD MOMENT

$$P_{max} = 2\pi\sqrt{\mu}\ (1+i)\ m$$

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REV. NO.	**DESCRIPTION**	
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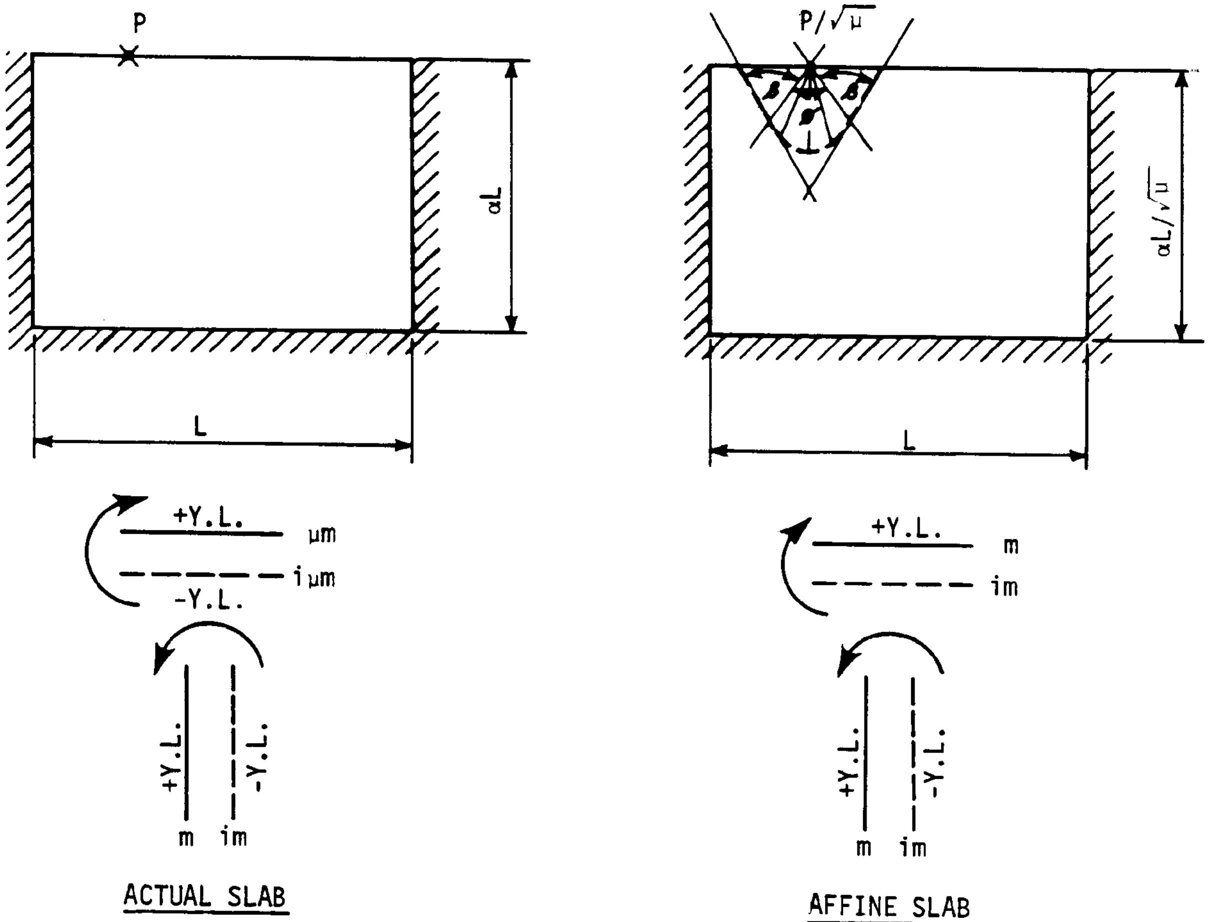
TITLE **Yield Line Pattern for Panels with Four Edges Fixed Subjected to Concentrated Point Load**

DWG. NO. **FSAR FIG. 14.4.8-5**

SH 1 of 1



Y.L. = YIELD LINE

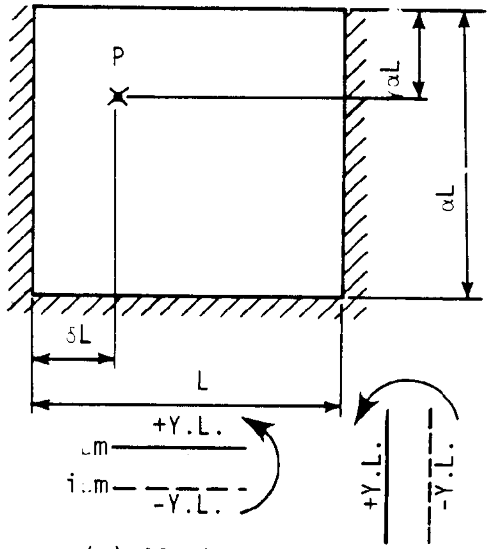
FOR (P/m) min., $\beta = 90°$, $\tan\left(\frac{\theta}{2}\right) = \sqrt{i}$

$$P_{max} = \sqrt{\mu}\, m \{(1+i)\phi + 2\sqrt{i}\}$$

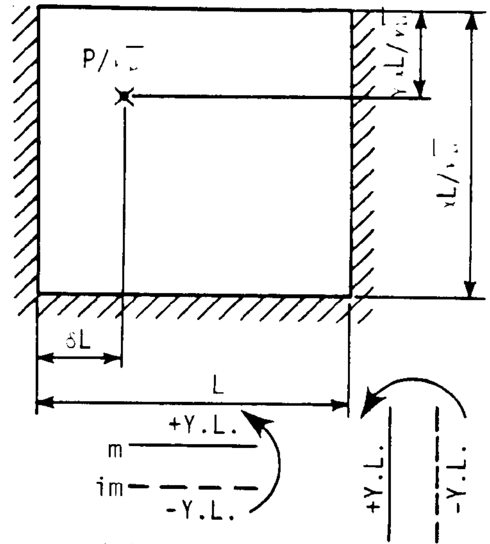
16.6	REVISED PER 99-UFSAR-1345	**UNIT 2**
REV. NO.	**DESCRIPTION**	

REVISIONS

AMERICAN ELECTRIC POWER **COOK NUCLEAR PLANT** **NUCLEAR GENERATION GROUP** **BRIDGMAN, MICHIGAN**	**TITLE** **Yield Line Pattern for Panels with Three Edges Fixed and Fourth Edge Free Subjected to a Concentrated Point Load at the Free Edge**
	DWG. NO. FSAR FIG. 14.4.8-6 — SH 1 of 1

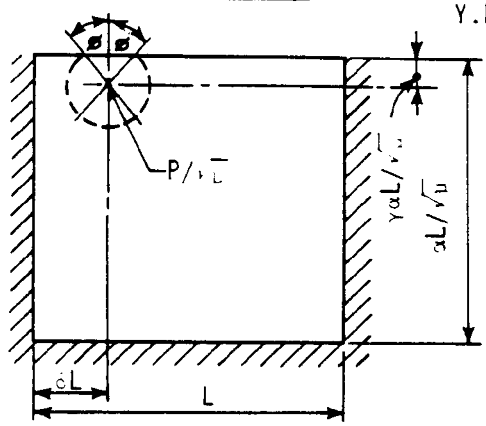


(a) ACTUAL SLAB



(b) AFFINE SLAB

Y.L.=YIELD LINE



MIN=MINIMUM OF THE QUANTITIES $\delta L, (1-\delta)L, (1-\gamma)\alpha L/\sqrt{\mu}$

$R = \dfrac{\gamma\alpha L}{\sqrt{\mu}\cos\psi}$

(c) POSSIBLE YIELD PATTERN

POSSIBLE YIELD PATTERNS

FIND $R = \dfrac{\gamma\alpha L}{\sqrt{\mu}\cos\psi}$, WHERE $\psi = \tan^{-1}\sqrt{i}$

(i) R<MIN USE $\phi = \tan^{-1}\sqrt{i}$

$P = 2\sqrt{\mu}\, m\{\tan\phi + (1+i)(\pi-\phi)\}$

FIG. (c) REPRESENTS THIS CASE

(ii) R>MIN, MIN $< \dfrac{\gamma\alpha L}{\sqrt{\mu}}$

SET R'=MIN

$\cos\psi' = \dfrac{\gamma\alpha L}{\sqrt{\mu}\, R'}$

$P = 2\sqrt{\mu}\, m\{\tan\psi' + (1+i)(\pi-\psi')\}$

FIG. (c) REPRESENTS THIS CASE

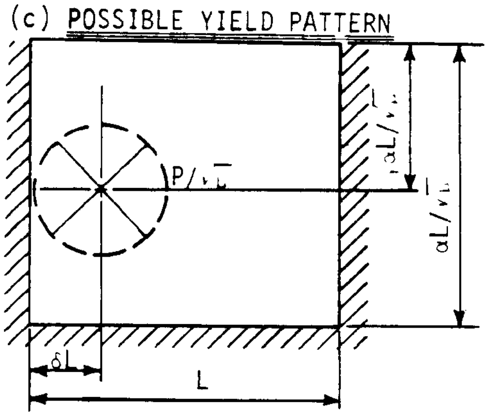
(iii) R>MIN, MIN $\leq \dfrac{\gamma\alpha L}{\sqrt{\mu}}$

$\phi = 0$

$P = 2\pi(1+i)m\sqrt{\mu}$

FIG. (d) REPRESENTS THIS CASE

WHEN MIN = δL



(d) POSSIBLE YIELD PATTERN

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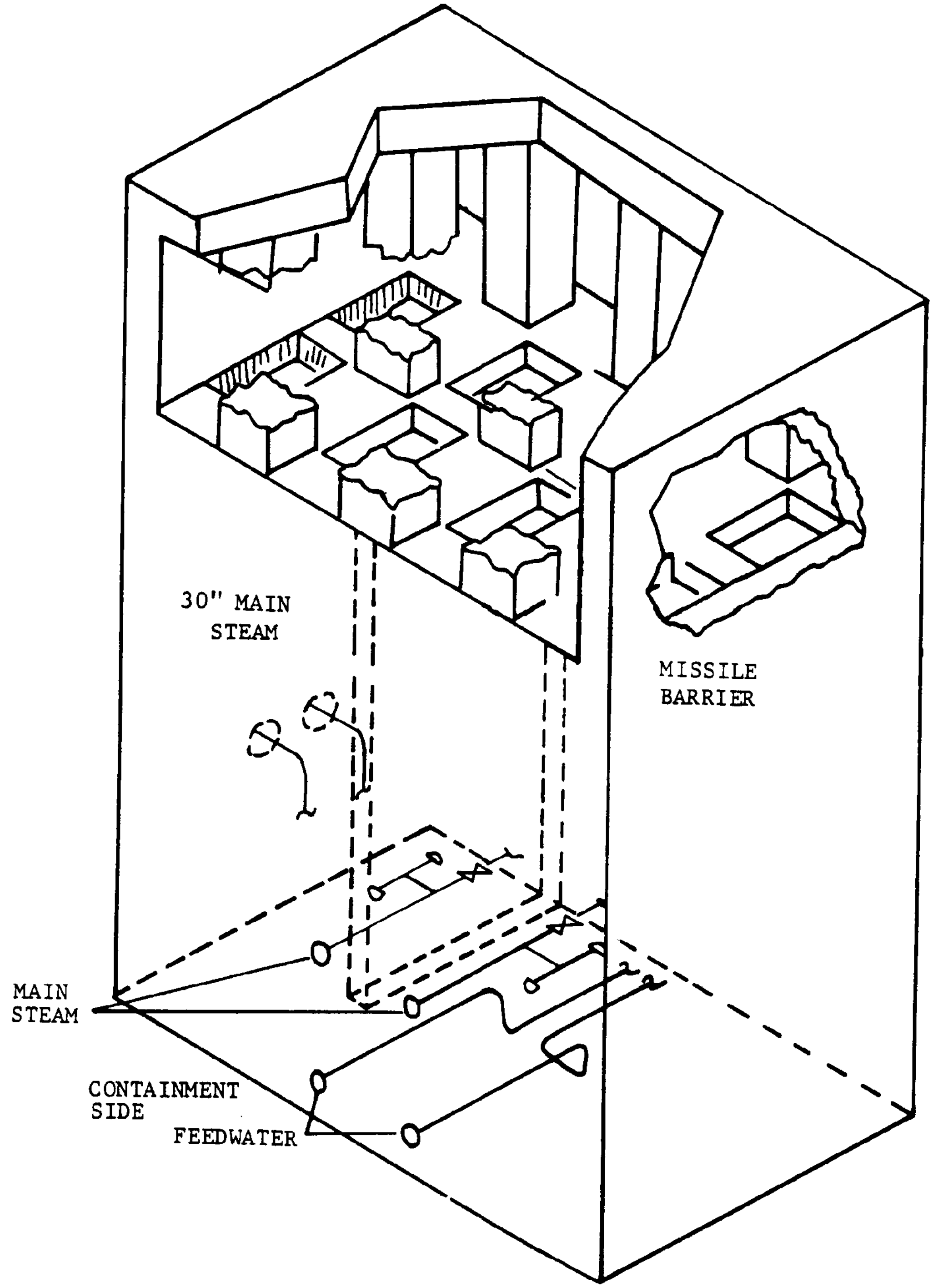
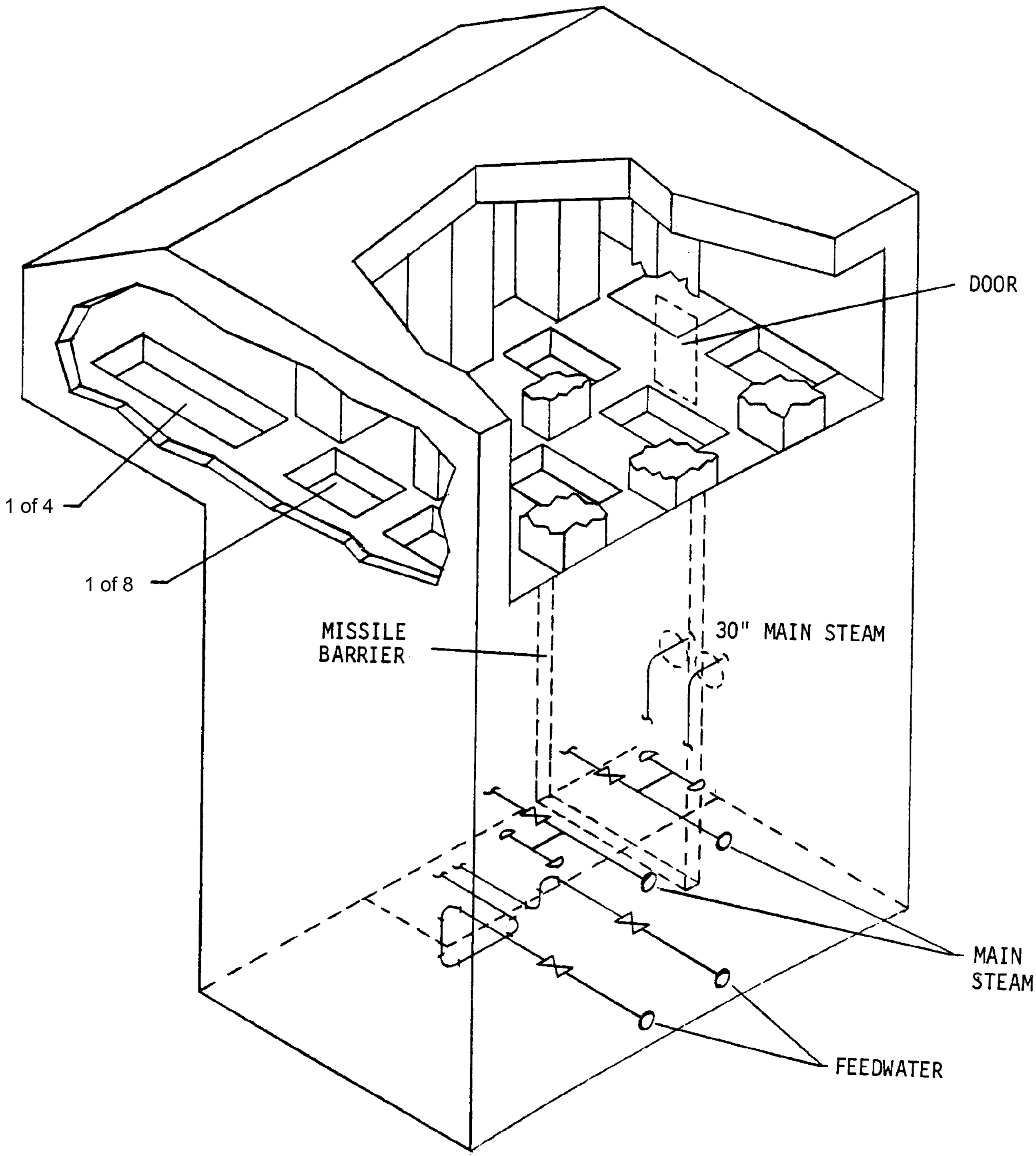
REVISIONS		

AMERICAN ELECTRIC POWER **COOK NUCLEAR PLANT** **NUCLEAR GENERATION GROUP** **BRIDGMAN, MICHIGAN**	**TITLE** **Yield Line Patterns for Panels with Three Edges Fixed and Fourth Edge Free Subjected to a Concentrated Point Load at Interior**
	DWG. NO. **FSAR FIG. 14.4.8-7** — SH 1 of 1



16.6	REVISED PER 99-UFSAR-1345	**UNIT 2**
REV. NO.	**DESCRIPTION**	
REVISIONS		

AMERICAN ELECTRIC POWER COOK NUCLEAR PLANT NUCLEAR GENERATION GROUP BRIDGMAN, MICHIGAN	**TITLE** East Steam Enclosure	
	DWG. NO. **FSAR FIG. 14.4.9-1**	SH 1 of 1



16.6	REVISED PER 99-UFSAR-1345	UNIT 2
REV. NO.	DESCRIPTION	
REVISIONS		

AMERICAN ELECTRIC POWER
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TITLE West Steam Enclosure

DWG. NO. FSAR FIG. 14.4.9-2

SH 1 of 1