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G9.19.2

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Denton:

River Bend Station-Unit 1
Docket No. 50-458

Enclosed is Gulf States Utilities Company's (GSU) response to Safety Evaluation Report (SER) Open Item No. (2) - Moderate Energy Line Crack. This information will be included in FSAR Appendix 3C in a future amendment.

Sincerely,

Eddie R. Grant
for J. E. Booker
Manager-Engineering,
Nuclear Fuels & Licensing
River Bend Nuclear Group

JEB/RJK/kt

Attachments

B001
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3C.1 GENERAL

This appendix describes the specific pipe failure protection provided to satisfy the requirements of Section 3.6.1A and demonstrates that the essential systems, components, and equipment are not adversely affected by pipe breaks or cracks.

The information provided by this appendix is separated into three sections: 3C.2, a discussion of high energy pipe breaks and the effects of pipe whip and jet impingement; 15
3C.3, a discussion of moderate energy pipe cracks and the effects of spraying; and 3C.4, a discussion of flooding as a result of breaks or cracks.

Subcompartment pressurization is discussed in detail in Section 6.2.1.2 (for inside the containment) and in Appendix 3B (for outside the containment).

~~The environmental effects of high and moderate energy pipe breaks/cracks are addressed in Section 3.11, Environmental~~ 15
~~Qualification of Mechanical and Electrical Equipment~~.

This appendix does not address the specific protection of field-routed essential instrument tubing or electrical conduit. However, these items are protected in accordance with the requirements of Section 3.6.1A.

For a detailed discussion of break/crack locations and types, break exclusion areas, guard pipes, and whip restraints which are frequently mentioned in this appendix, refer to Section 3.6.2A.

3C.3 MODERATE ENERGY PIPE CRACKS AND EFFECTS OF SPRAYING

3C.3.1 Discussion

The components and/or equipment required for safe shutdown of the reactor were evaluated for the effects of spraying from through-wall leakage cracks in moderate-energy systems. The evaluation demonstrates that the plant can be safely shut down, assuming a concurrent single active failure in systems necessary to mitigate the consequences of the postulated piping failure and shutdown the reactor. Where necessary, measures will be provided to protect and ensure and component operability. Flooding effects from cracks in moderate-energy systems are discussed in Section 3C.4.

Moderate-energy piping, as defined in Section 3.6.2.1.2A, includes piping systems where the maximum operating temperature is 200°F or less and maximum operating pressure is 275 psig or less. It also includes some systems that qualify as high-energy systems for short operational periods and moderate-energy for major operational periods.

Only high-energy piping is capable of producing breaks (Section 3.6.2.1.3A). Moderate-energy piping produces only through-wall leakage cracks. The limiting moderate-energy piping crack, i.e., RHR system, produces environmental conditions as severe as high-energy breaks.

The criteria used to define the location of cracks in moderate-energy systems outside containment are defined in Section 3.6.2.1.5.2.2A, and the criteria for calculating crack flow rates are given in Section 3.6.2.1.6.3A.

3C.3.2 Evaluation Procedure - Spraying

The evaluation was conducted in accordance with NRC Branch Technical Position ASB 3-1, which states that a leakage crack in moderate-energy piping is considered separately as a single, postulated initial event occurring during normal plant conditions. The essential equipment that must operate under these conditions is that required to bring the plant to safe shutdown condition and maintain long-term cooling. Figure 3C.3-1 defines four pathways to hot shutdown and two pathways to long term cooling of the reactor, including continued cooling of the spent fuel pool. The essential components making up these pathways (the "targets") were located by environmental zones. The evaluation of effects of spraying from moderate-energy cracks proceeded in all environmental zones containing targets. Included in the evaluation were the reactor building, auxiliary building, fuel building, diesel generator building, control building, standby service water cooling tower, and piping and electrical tunnels.

The following summary outlines the procedure used to evaluate spraying effects from moderate-energy cracks.

1. List by environmental zone all components and/or equipment (targets) required for safe shutdown in all buildings.

2. Evaluate all components and/or equipment to determine if they are waterproof (not susceptible to failure from spraying) and can withstand the effects of water temperature. Table 3C.3-2 shows the maximum spray temperatures in each building.

3. Identify water sources in environmental zones that contain potential spray susceptible targets (cracks are not postulated for spray evaluation in zones without targets). If there is a water source in the zone, assume that all potential targets are sprayed. If there is no water source in the zone, evaluate the susceptibility of the equipment to failure as the result of dripping water from other zones.

4. Assume the failure of all targets in the zone that are not waterproof and identify available paths for safe shutdown and maintenance of long-term cooling. Figure 3C.3-1 depicts the safe shutdown paths.

   If it is concluded through this evaluation that the plant could not be shut down safely, a more detailed approach is taken to determine if components are actually sprayed and rendered inoperable. Using this basis, a reexamination of paths for safe shutdown is then conducted.

5. The spraying evaluation is conducted in conjunction with a flooding evaluation (Section 3C.4). If a spray source in a given zone is large enough to cause potential flooding problems in the given zone (or other zones), failures from flooding are combined with failures from spraying to evaluate available safe shutdown equipment.

6. In addition to the direct consequences of pipe crack, a single active failure is assumed in those systems required to mitigate the consequences of the piping failure and shut down the reactor.

3C.3.3 Evaluation Guidelines - Spraying

The basic guidelines used to evaluate the effects of spraying were:

1. If a water pipe is within an environmental zone, all targets within that zone are assumed to be sprayed. If this assumption yields unacceptable results, a more detailed review of spraying and component shielding is conducted.

2. Qualification for spraying is determined by a review of component specifications and test data.

3. All Class 1E electrical components which have NEMA 4 (or equivalent) enclosures are not assumed to fail as the result of water spray.

4. Unit cooler and fan motors are not assumed to fail since they are enclosed within the unit cooler housing or ductwork, which shields them from direct spraying.

5. Cables and splices are waterproof and unafffected by water spray.

6. All junction and terminal boxes for safe shutdown equipment containing termination boards have NEMA 12 (or equivalent) enclosures and are not assumed to fail as a result of dripping water, but are assumed to fail from spray.

7. If the actions required to stop the flow of water from the crack cause additional safe shutdown equipment to become inoperable, these systems will be assumed to fail as a consequence of the postulated pipe crack.

8. If the postulated piping failure results in a reactor or turbine trip, loss of offsite power is assumed.

9. Guidelines for single-failure evaluation are as follows:

   a. Plant shutdown is assumed to be a consequence of the pipe crack, and a single active failure is assumed in the safe shutdown systems.

   b. Where the postulated piping failure is assumed to occur in one train of a dual purpose, moderate-energy, safe shutdown system (e.g., safety-related RHR, service water, SFC and safety related chilled water are subsystems comprising such a safe shutdown system,) a single failure is not postulated in the redundant safety-related train of that system or subsystem.

10. In determining alternate paths to safe shutdown, credit was taken for all available systems (as defined by the above criteria).

3C.3.4 Analytical Methods

As described in the spraying evaluation procedure (Section 3C.3.2), all targets in a given zone were assumed to be sprayed by any water sources in the zone. Analytical calculations of spraying distance were not utilized in reevaluatiing problem areas. In these instances, shielding, moving equipment, and other modifications were considered.

3C.3.5 Results of Evaluation - Spraying

The following subsections present, building-by-building, the results of the spraying evaluation using the procedures and guidelines discussed in Sections 3C.3.2 and 3C.3.3.

The evaluation verifies that the plant can be safely shut down in the event of pipe cracks in fluid systems. As noted below, protective measures ensure the required system functional capability is maintained. A list of moderate-energy piping systems and system parameters is provided in Tables 3C.3-1 and 3C.3-2 for those buildings housing equipment required for safe shutdown.

3C.3.5.1 Reactor Building (Drywell, Containment, and Annulus)

In the reactor building all safety-related targets required for safe shutdown have been qualified for spray. All junction boxes and cable terminations supporting these targets have spliced connections which do not fail from spray.

3C.3.5.2 Auxiliary Building

In the auxiliary building, spray sources include both safety-related and nonsafety-related systems. Components susceptible to failure from spray are motors and motor control centers for RCIC, HPCS, RHR and LPCS system pumps. A single spray source does not affect more than one of these pump motors. Failure of an RCIC, HPCS or LPCS motor is acceptable; sufficient redundancy exists to safely shut down the plant when considering an additional single active failure as described in Section 3C.3.3, Item 9. The RHR pump motors are protected from spray as required to ensure safe shutdown of the plant. Motor control centers for these pumps are also protected from spray. The spray sources which would fail these components do not fail the redundant trains by flooding (Section 3C.4).

3C.3.5.3 Control Building

The spray sources in the control building include chilled, service, makeup, domestic and fire protection water systems (Table 3C.3-2). The spray-susceptible targets are the control panels, ventilation systems, and pump motors. The chiller equipment room is divided into two compartments and division A and B equipment is physically separated. However, service water for the division B compartment passes through, and can spray targets in the division A compartment. Additionally, in the division B compartment, division B targets may be sprayed by a nonsafety-related makeup water line. These compartments are shielded from potential spraying, as required, to ensure availability of the system safe shutdown function when considering an additional single active failure as described in Section 3C.3.3, Item 9.

3C.3.5.4 Diesel Generator Building

The only potential spray source in the diesel generator building is service water (Table 3C.3-2).

Although there are many spray susceptable targets in the diesel generator building, there is sufficient separation such that any given spray source could potentially fail only one division of emergency power. This is acceptable since the spray would not cause a reactor or turbine trip, and offsite power would still be available. The plant can be safely shut down considering an additional single active failure as described in Section 3C.3.3., Item 9. Potential flooding from the spray source would not result in loss of the redundant trains of emergency power (Section 3C.4.5.4).

3C.3.5.5 Piping Tunnels

There are no spray-susceptible targets in the piping tunnels.

3C.3.5.6 Electrical Tunnels

There are no spray-susceptible targets in the electrical tunnels.

3C.3.5.7 Standby Service Water Cooling Tower

The sources of water in the standby service water cooling tower are service water and make-up water. The spray susceptible targets are the standby service water pumps, their associated MCC's, and the cooling tower fan motors. There is adequate physical separation such that only one division (A or B) of standby service water could potentially be failed by spray from a single MELC. An MELC in these zones would not cause a unit trip. Offsite power would be available, and safe shutdown could be achieved using the normal service water system. Flooding from the postulated cracks does not affect the redundant trains (Section 3C.4.5.7).

3C.3.5.8 Fuel Building

The water sources in the fuel building are listed in Table 3C.3-1. The spray susceptible targets are the SFC pump motors and associated SFC components. There is sufficient physical separation such that spray from SFC division A does not affect SFC division B components, and visa versa. No single failure was postulated in the opposite train of SFC since the SFC system is a dual-purpose moderate-energy system.

TABLE 3C.3-1

MODERATE ENERGY SYSTEMS LOCATED IN BUILDINGS

CONTAINING SAFE SHUTDOWN EQUIPMENT

Moderate Energy Piping System	Reactor Building Drywell	Reactor Building Containment (Annulus)	Aux. Bldg.	Fuel Bldg.	Control Bldg	Diesel Gen. Bldg.	SWP Pump House	Piping & Elect. Tunnels PT-1A	PT-4	PT-3	PT-1,2,8
Condensate Makeup and Drawoff (CNS)		X	X	X						X	X
Fire Protection (FPW)		X	X	X	X	X					X
Reactor Plant Component Cooling Water (CCP)	X	X	X	X							X
Service Water (SWP)	X	X	X		X	X	X	X	X	X	X
Makeup Water (MWS)			X		X		X	X	X	X	X
Turbine Plant Sampling (SST)			X								
Reactor Plant Sampling (SSR)	X	X	X								
Ventilation Chilled Water (HVN)		X	X	X							X
High Pressure Core Spray (HPCS)	X	X	X							X	X
Low Pressure Core Spray (LPCS)	X	X	X								
Reactor Core Isolation Cooling (ICS)		X	X	X							X
Residual Heat Removal (RHR)	X	X	X							X	
Radioactive Liquid Waste (LWS)			X							X	X
Fuel Pool Cooling and Cleanup (SFC)			X	X	X						X X
Control Rod Drive (RDS)	X	X	X	X							X
Fuel Transfer (SPT)				X							
Domestic Water (DWS)					X						
Control Building Chilled Water (HVK)						X					
Standby Liquid Control (SLS)	X	X									

TABLE 3C.3-2

MAXIMUM LEAKAGE RATES FOR EACH BUILDING CONTAINING SAFE SHUTDOWN EQUIPMENT

Safety Related Location	System with Max. Leakage Rate	System Max. Operating Conditions (4) Pressure(psig)	Temperature(°F)	Nominal Line Size (5) inches	Maximum Flooding Leakage Rate (GPM)
Reactor Building Drywell	Residual Heat Removal (RHR) (1)	160	350 (6)	18	1320
Containment/Annulus	Residual Heat Removal (RHR) (1)	180	350 (6)	12	870
Auxiliary Building/ Main Steam Tunnel	Residual Heat Removal (RHR) (1)(2)	160	350 (6)	20	1610
Fuel Building	Reactor Plant Component Cooling Water (CCP) (3)	100	125 (7)	12	540
Fuel Building (El.148'-0")	Fire Protection (FPW)	120	70	4	100
Control Building	Fire Protection (FPW)	120	70	6	190
Diesel Generator Building	Service Water (SWP)	120	95	8	290
Standby Service Water Pump House	Make Up Water (MWS)	150	95 (8)	4	120
Tunnel PT-4	Service Water(SWP)	120	95	16	910
Tunnel PT-3	Service Water (SWP)	100	95	18	1040
Tunnels PT-1,2,8 Interconnected	Service Water (SWP)	100	95	24	1800

NOTES:

1. The RHR System leakage rates are associated with the shutdown cooling mode.

2. The leakage rates from the HPCS, LPCS, RHR-LPCI A,B,C and RCIC (ICS) systems were based on the standby mode of operation. These leakage rates are exceeded by the RHR System shutdown cooling mode leakage rate.

3. The Reactor Plant Component Cooling Water (CCP) System is a closed system that is automatically served by the service water system when the CCP system pressure is low.

4. The maximum system operating pressures are established to the next higher (psig) in increments of 20 psig for calculation envelopes.

5. Piping schedule 80 was used for calculation envelopes; for line sizes greater than 24" specified piping wall thicknesses were applied.

6. This is the maximum temperature during the RHR shutdown cooling mode. Note that the spray temperature wetting any components would be 212°F since the fluid would flash to atmospheric pressure on leaving the pipe.

7. The maximum temperature is based upon the spent fuel pool cooling system.

8. The maximum temperature is based upon the service water system.

FIGURE 3C.3-1

SAFE SHUTDOWN PATHS (1)

Division A - Path 1	Division B - Path 2	Division A - Path 3	Division B - Path 4
Short Term	**Short Term**	**Short Term**	**Short Term**
RCIC	HPCS	ADS-A 6 or 7 SRV's	ADS-B 6 of 7 SRV's
LSV/3 of 7 SRVS-ADS-A	LSV/3 of 7 SRVS-ADS-B	LPCS	LPCI(RHR-C)
RHR-A (Sup. Pool Cool.)	RHR-B (Sup. Pool Cool.)	RHR-B (Sup. Pool Cool.)	
SWP-A	SWP-B	SWP-A	SWP-B
SFC-A	SFC-B	SFC-A	SFC-B
HVAC,MCC's, Controls etc.	HVAC, MCC's, Controls etc.	HVAC, MCC's, Controls etc.	HVAC, MCC's, Controls etc.
Long Term	**Long Term**	**Long Term**	**Long Term**
3 of 7 SRVS/LSV-RHR-A	3 of 7 SRVS/LSV RHR-B	3 of 7 SRVS/LSV RHR-A	3 of 7 SRVS/LSV RHR-B
(Alternate)Shutdown Cooling	(Alternate)Shutdown Cooling	(Alternate)Shutdown Cooling	(Alternate)Shutdown Cooling
SWP-A	SWP-B	SWP-A	SWP-B
SFC-A	SFC-B	SFC-A	SFC-B
HVAC, MCC's etc.	HVAC, MCC's etc.	HVAC, MCC's etc.	HVAC, MCC's etc.

LEGEND

RCIC	Reactor Core Isolation Cooling System
SRV	Main Steam System Safety Relief Valves
RHR	Residual Heat Removal System
SWP	Standby Service Water System
SFC	Spent Fuel Pool Cooling System
HVAC	Ventilation and Cooling Systems
MCC	Motor Control Centers
LSV	Positive Valve Leakage Control System (SRV Air Supply)

NOTES

1. When a loss of offsite power is postulated, all safe shutdown paths require the emergency diesels and support systems.

3C.4 COMPARTMENT FLOODING AS A RESULT OF BREAKS OR CRACKS

3C.4.1 Discussion

The components and/or equipment required for safe shutdown of the reactor were evaluated for the effects of flooding from through-wall leakage cracks in moderate-energy systems, breaks in high-energy lines, and failure of nonseismic tanks, vessels and pipes. The evaluation verifies that the plant can be safely shut down, assuming a concurrent single active failure in systems necessary to safely shutdown the reactor and maintain long-term cooling. Where necessary, measures are provided to ensure component operability. Spraying effects from cracks in moderate-energy systems are discussed in Section 3C.3. A detailed discussion of break/crack locations and types is provided in Sections 3.6.1A and 3.6.2A.

As discussed in the following sections, flooding effects from high-energy pipe breaks outside of containment are enveloped by moderate-energy crack flooding. This is primarily due to rapid detection and isolation of high-energy pipe breaks based on automatic isolation on area high temperature.

The total mass released by high-energy pipe breaks is shown in Table 3C.4-1, and the capacity of nonseismic tanks and vessels inside buildings containing safe shutdown equipment is shown in Table 3C.4-2. Flooding effects from external water sources are discussed in Section 3.4.

3C.4.2 Evaluation Procedure - Flooding

The approach for the flooding evaluation was similar to the procedure described in Section 3C.3.2 for the spraying evaluation. The evaluation was conducted utilizing the essential components making up the pathways to safe shutdown defined in Figure 3C.3-1, and located by environmental zones.

The following summary outlines the procedure used to evaluate flooding effects:

1. List by environmental zone all components and/or equipment required for safe shutdown in all buildings (See Figure 3C.3-1).

2. Locate all safe shutdown targets by elevation.

3. Identify the hydraulic boundaries of each area to determine the extent of flooding. These were generally more extensive than the environmental zones.

4. Identify flood sources and calculate either maximum mass released or limiting crack flow rate (Section 3C.4.4) from postulated water sources.

5. Determine flood levels within each hydraulic boundary based on either total mass released or balance of flow in/out of

the boundary. In this determination no credit is taken initially for the normal plant drainage system.

6. Identify all safe shutdown targets which could possibly be submerged rendered inoperable. Evaluate all components and/or equipment to determine if they are waterproof (not susceptible to failure from submergence) and can withstand the effects of the water temperature. Table 3C.3-2 shows the maximum spray temperatures in each building.

7. Assume the failure of all targets in the hydraulic boundary that are determined to be below flood level and susceptible to failure. Identify the available paths to safe shutdown and maintenance of long-term cooling.

   If it was concluded through this evaluation that the plant could not be shut down safely, a more detailed evaluation, including consideration of the normal plant drainage systems and possible protective measures, was conducted.

8. In addition to the direct consequences of flooding, a single active failure is assumed in those systems required to mitigate the consequences of the piping failure and shut down the reactor.

9. Review drainage systems to ensure that leakage from one failed redundant train does not backflow through drains and flood the other train.

3C.4.3 Evaluation Guidelines - Flooding

The basic guidelines used to evaluate the effects of flooding were:

1. Within a given hydraulic boundary, the largest water source located anywhere in that boundary is used to calculate flood heights for all areas included. In many cases this leads to the largest water source being used for flood calculations on all floors within a building. A cross check was made for sources from one building flooding into another building.

2. Credit is taken for flood protection by doorways and penetrations only if the particular doorway or penetration is specified as watertight.

3. All motors, including valve motor operators and solenoids, are assumed to fail if submerged.

4. All junction and terminal boxes containing termination boards are assumed to fail if submerged.

5. All instruments are assumed to fail if submerged.

6. All cables are nonhydroscopic and are not assumed to fail if submerged.

7. Motor control centers and switchgear are assumed to fail if submerged.

8. Guidelines for single active failures are the same as those assumed for failure due to spraying (Section 3C.3.3).

9. Credit is taken for operator action to isolate the leak 30 min after detection.

3C.4.4 Analytical Methods

For a pipe in any given area, a through-wall leakage crack is assumed to occur at a location that would result in the most several consequences due to flooding. The flow rate of the fluid is evaluated by assuming that the crack acts as an orifice. The following equation is used:

$$Q = 19.65\ C\ d^2\ (h_L)^{0.5}$$

Where:

Q = Crack flow (gpm)

C = Orifice coefficient

d = Equivalent diameter of crack (in)

h_L = Fluid head (ft)

The diameter of the crack is determined by assuming that the crack area is circular in shape. The area is defined as:

$$A = (D/2)\ (t/2)$$

Where:

A = Crack area (in^2)

D = Nominal pipe diameter (in)

t = Nominal wall thickness (in)

The equivalent crack diameter is then defined as:

$$d = (4A/\pi)^{0.5}$$

In calculating flow over stairways, hatches, and other floor openings or curbs, weir flow is assumed to determine the height of the water above the top of the weir as follows:

$$h_w = (q/3.33L)^{2/3}$$

Where

h_w = Water head above weir (ft)

q = Flow (ft^3/sec)

L = Length of weir (ft)

If there is an intervening door which is not watertight, an additional head loss (modeled as a thick-edged orifice) is assumed for the door.

3C.4.5 Results of Evaluation - Flooding

The following subsections present, building-by-building, the results of the flooding evaluation using the procedures and guidelines discussed in Sections 3C.4.2 and 3C.4.3. The evaluation verifies that the plant can be safely shut down in the event of pipe cracks in fluid systems.

3C.4.5.1 Reactor Building (Drywell, Containment, and Annulus)

Leakage from a moderate energy system within the drywell would result in a flood height to the top of the drywell weir wall. Once this level is reached additional leakage would spill over the weir wall into the suppression pool. All equipment within the drywell which must operate during or after a LOCA is qualified for the appropriate environmental conditions as described in Section 3.11. Leakage from a moderate energy system is within the bounds of that qualification, therefore, the ability to safely shut down the plant is not impaired by this leakage.

Leakage from a moderate energy system within the containment causes flood levels that do not affect equipment required for safe shutdown. The general floor elevations except for elevation 186'-3" consist mostly of grating, therefore, no water accumulations can occur. Leakage into elevation 186'-3" would result in a maximum flood height of approximately 4". Build up above this level is prevented by spillage through grating. All leakage into general areas spills into the suppression pool.

Cubicle volumes within the containment may flood to elevations greater than 10", however, these do not contain equipment that is required for safe shutdown or spent fuel pool cooling.

In the annulus volume there is no equipment required for safe shutdown or spent fuel pool cooling, however, flooding of this area is unacceptable for structural loading. The maximum limiting flood elevation is approximately 24" which is based upon redundant safety related level switch alarms and 30 minutes for operator action to isolate the flood source. This flood level is acceptable for structural loading. There are no external flooding sources to the Reactor Building.

3C.4.5.2 Auxiliary Building - Including Main Steam Tunnel

The maximum flood height on the upper levels of the Auxiliary Building is approximately 6" in the general floor areas and 12" in cubicles. These flood heights are based on steady state water levels for weir floow over curbs surrounding equipment hatches and other openings, plus additional head losses for flow under doors.

The lowest elevation of the Auxiliary Building (elevation 70') is comprised of separate water-tight ECCS pump rooms, and a crescent area containing isolation valves. The crescent area contains two safety related level indicators (powered from the same bus) and two non-safety related level detectors which alarm in the main control room. The maximum flood level in the crescent area is below all safe shutdown equipment, allowing 30 minutes for operator action to isolate the leakage.

Flooding in any one of the pump rooms does not affect the other ECCS pump rooms. Each drain line that penetrates the cubicles has redundant safety related back flow check valve. The RCIC, LPCS, RHR and HPCS pump rooms each have a single safety related level indicator. Also, each cubicle has a second non-safety related level detector which alarms in the main control room. Thirty minute operator action after detection of flooding in any of these rooms is sufficient to keep water from flowing through ventilation openings high up in these cubicles and affecting the redundant ECCS pump rooms. The cubicles are capable of withstanding the additional structural loads due to this flooding.

Flooding on the 95' elevation could potentially enter both the LPCS and HPCS cubicles at the same time from above. In this instance the level detectors in each cubicle provide redundant level detection, such that 30-minute operator action would prevent the failure of any safe shutdown equipment.

There is no leakage from external sources into this building. External doors that may be subjected to flooding are designed as water tight.

The Annulus Building main stream tunnel may flood to an elevation of approximately 110'-0". This flood level is limited by spillage through piping penetrations into the Turbine Building. There is no equipment located in this volume that is required for safe shutdown.

3C.4.5.3 Control Building

Leakage from a moderate energy system within this building could result in flood levels from approximately 2" to 14" in the upper elevations. A buildup above these levels is prevented by spillage through doorways and stairwells. Safe shutdown equipment is above these flood levels except for electrical switchgear on elevation 98'-0". This area has an approximate flood level of 2". Curbs have been incorporated into the plant design to prevent the switchgear areas from flooding. There are no water sources within these areas and the penetrations from above are water sealed.

The lowest elevation has a limiting flood level of approximately 18" which is based upon an eight hour per shift surveillance detection plus 30 minutes for operator action to isolate the flood source. Safe shutdown equipment items are above this flood level.

There is one external source of flooding to this building which is from the Diesel Generator Building. There is a non-water tight door that provides access between the Control and Diesel Generator Building at elevation 98'-0".

The potential maximum flooding flow rate from the Diesel Generator Building to the Control Building is enveloped by the maximum flooding flow rate that is posutlated for the Control Building.

3C.4.5.4 Diesel Generator Building

Technical Specifications require safe plant shutdown based upon standby diesel generator availability. Leakage from a moderate energy system within this building would effect the emergency power sources only and not result in a trip of the turbine generator or reactor protection system. Therefore, safe shutdown is performed using offsite power.

3C.4.5.5 Piping and Electrical Tunnels

The three tunnel volumes have limiting flood levels of approximately 12" to 14". These flood levels are limited by redundant safety related level switch alarms and 30 minutes for operator action to isolate the flood source. Safe shutdown equipment within the tunnels that is susceptable to flooding are above the flood levels.

There are no external flooding sources to two tunnel volumes because of water-tight access doors and sealed penetrations. One tunnel volume has an external flood source from the standby service water cooling tower pump house. This external flood source flow rate is enveloped by the maximum postulated flooding flow rate postulated for this tunnel volume.

3C.4.5.6 Standby Service Water Cooling Tower Pump House

Leakage from moderate energy system within these areas could result in flood levels from approximately 2" to 12". A build up above these levels is prevented by spillage through doorways and stairwells into the piping tunnel, reference Section 3C.4.5.5. Safe shutdown equipment items are above the flood levels.

There is one external source of flooding to this area which is the piping tunnel. The maximum flood level from the tunnel source is limited by its maximum flood elevation of approximately 12" reference Section 3C.4.5.5. The safe shutdown items are above this flood level.

3C.4.5.7 Fuel Building

Leakage from moderate energy systems within this building could result in flood levels from approximately 2" to 27" in the upper elevations. A build up above these levels is prevented by spillage through doorways and stairwells. Equipment required for spent fuel pool cooling is above these flood levels.

The lowest elevation has a limiting flood level of approximately 11" which is based upon redundant safety related level switch alarms and 30 minutes for operator action to isolate the flood source. Equipment required for spent fuel pool cooling is above this flood level. There are no external flooding sources to this building because of water tight doors and sealed penetrations.

TABLE 3C.4-1

TOTAL MASS RELEASED BY HIGH-ENERGY LINE BREAKS (HELB)

Building	HELB	Total Mass (lb)
Auxiliary Building*	RWCU	7,776
Control Building	None	-
Diesel Generator Building	None	-
Piping & Electrical Tunnels	Main Steam Line	164,352
Standby Service Water Cooling Tower	None	-
Fuel Building	None	-
Reactor Building	**	-

* Mass released by the high-energy liquid line (RWCU) envelopes the RCIC steam line break releases.

** Included in LOCA analyses. Refer to Sections 6.2.1 and 6.2.2.

TABLE 3C.4-2

CAPACITY OF NONSEISMIC TANKS AND VESSELS WITHIN BUILDINGS CONTAINING SAFE SHUTDOWN EQUIPMENT

Building	Mark No.	Capacity (gal) (total)
Reactor Building	None	-
Auxiliary Building	1CCP-TK1	3,000
Control Building	None	-
Diesel Generator Building	1EGF-TK3A	35
	1EGF-TK3B	35
Piping Tunnels	None	-
Electrical Tunnels	None	-
Standby Service Water Cooling Tower	None	-
Fuel Building	1SFC-TK2	560
	1SFT-TK1	1,525