APPENDIX 3.6A

3.6A PIPE RUPTURE ANALYSIS

Section 3.6 describes the design bases and measures that are taken on Waterford 3 to demonstrate that the systems, components and structures required for safe shutdown and maintaining the reactor in a cold shutdown condition, are adequately protected against the dynamic effects associated with pipe rupture. This appendix presents the results of the pipe rupture analysis. Subsection 3.6A.1 discusses the results of high energy pipe break evaluation inside containment. High energy pipe breaks outside containment are discussed in Subsection 3.6A.2. Subcompartment Pressure Analyses both inside and outside containment are addressed in Subsection 3.6A.3. Moderate Energy Piping System analyses are described in Subsections 3.6A.4 and 3.6A.5. The Flooding Analysis is presented in Subsection 3.6A.6.

3.6A.1 HIGH ENERGY PIPE BREAK INSIDE CONTAINMENT

The high energy piping systems or portions of systems which are considered for pipe rupture analysis inside containment are:

1) Steam Generator Blowdown System
2) Reactor Coolant drain lines
3) Safety Injection System (includes Cold Leg Injection and Shutdown Cooling)
4) Chemical and Volume Control System (Letdown & Charging)
5) Reactor Coolant Loop
6) Pressurizer Relief
7) Pressurizer Spray

→(EC-19087, R305)

8) Pressurizer Surge *

←(EC-19087, R305)

9) Main Steam and Feedwater

→(EC-19087, R305)

* - The pressurizer surge line has been eliminated as a source of pipe rupture as discussed in Section 3.6.3 but is retained for historical purposes.

←(EC-19087, R305)

The criteria used to locate the postulated break points for high energy piping systems is described in Subsection 3.6.2. The various protective methods used to mitigate the consequences of the postulated pipe break are given in Subsection 3.6.1.2. This appendix presents the results of the high energy piping analysis: pipe break locations, dynamic analysis of pipe whip restraints, protection against jet impingement and environmental effects.

3.6A.1.1 Pipe Whip Analysis

This subsection describes the method of protection used against pipe whip for each pipe break in the system listed in Subsection 3.6A.1. The methodology used to evaluate the design load for pipe whip restraint is also included.

3.6A.1.1.1 Steam Generator Blowdown System

3.6A.1.1.1.1 General Description

The Steam Generator Blowdown System (SGBS) operation and design basis are described in Subsection 10.4.8. The SGBS lines are 4 inch nominal size schedule 40, carbon steel piping. The portion of the SGBS from the steam generators up to and including the air operated generators up to and including the air operated isolation valves outside the containment comprises an extension of the steam generator boundary. This portion of the system is designed in accordance with the ASME Code, Section III, Class 2 and seismic Category I requirements. The balance of the high energy piping from the penetration isolation valves outside containment to the nozzles on the Blowdown Tank is classified as non-nuclear (ANSI B31.1) but designed to seismic Category I requirements. Pneumatically operated isolation valves are also located near the penetrations.

3.6A.1.1.1.2 Pipe Whip Analysis

→(DRN 00-1032)

Isometrics of the two blowdown lines (2BD4-2 and 2BD4-1) along with two inch nominal size branch lines (2BD2-71 and 2BD2-71) indicating postulated break locations and pipe whip restraints are provided on Figures 3.6A-1 through 3.6A-4. All breaks in the SGBS are double ended guillotine (circumferential) type. Terminal end breaks are postulated at the steam generator nozzle and at the penetrations. In addition there are four intermediate break points in each main line. Breaks are also postulated at the intersection of the two inch branch lines (terminal end for the branch line). The stress level at all intermediate break locations are just below 50 percent of the stress limit criteria for break postulation.

←(DRN 00-1032)

The pipe whip restraints provided for the system are identified in Table 3.6A-1. For all breaks except for R-HBD-2-9 in-x direction, R-HBD-1-3 in +z direction and R-HBD-71-14 (in two inch branch line), pipe whip restraints are provided. The restraints are designed to ensure that any pipe whip will be minimized. The restraints are also designed to permit the predicted thermal and seismic movements of the piping. The type of restraints used (hard or soft) are indicated in the Table 3.6A-1. Typical Sketches of the various types of pipe whip restraints are shown in Figures 3.6-9 through 3.6-11. The pipe whip restraints are designed statically to withstand pipe rupture thrust load which includes a dynamic load factor appropriate for the gap between the pipe and the restraint.

For breaks where pipe whip protection is not provided by means of restraints, a detailed study was conducted to evaluate the effects of the whipping pipe on essential systems and components. It was found in one case (Break: R-HBD-2-9) that the whipping pipe would hit the high pressure lube system box and the main terminal box both for reactor coolant pump 2A. If the pipe went past these two items it might hit the concrete wall and pipe IRC12-39RL2 (tm = 0.985). As per the criteria for a small whipping pipe impacting on a larger pipe given in Subsection 3.6.1.3(f), it is noted that both the wall and the pipe would remain functional following impact. Since reactor coolant pump and its peripheral equipment are not needed for safe shutdown of the plant, these interactions are acceptable. For other breaks where pipe whip restraints are not provided it was observed that the whipping pipe would not hit any essential systems.

3.6A.1.1.2 Reactor Coolant Drain Lines

3.6A.1.1.2.1 General Description

The Reactor Coolant Loop Drain lines are connected to the Boron Management System. The drain connections are shown in the flow diagram, Figure 5.1-3. The drain lines are 2 inch nominal size, schedule 160, stainless steel piping. That portion of piping from the reactor coolant loop to the second normally closed valve comprises an extension of the reactor coolant pressure boundary. This portion of the system is designed in accordance with the ASME Code Section III, Class 1 and Seismic Category I requirements. The remainder of the piping system (Boron Management) is non-seismic.

3.6A.1.1.2.2 Pipe Whip Analysis

Isometrics of the four drain lines (1RC2-46RL1A, 1RC2-47RL1B, 1RC2-48RL2A and 1RC2-50A/B) indicating postulated break points and pipe whip restraints are provided in Figures 3.6A-5 through 3.6A-7. All breaks in the drain lines are double ended guillotine (circumferential) type. Terminal end breaks are postulated at-the first normally closed valve and the Reactor Coolant Loop nozzle. In addition, there are two intermediate break points. The intermediate break locations are based on Stress Criteria.

One pipe whip restraint is provided in each one of these four drain lines. The type of restraint and the direction in which it is capable of supporting the pipe rupture thrust load are indicated in Table 3.6A-2. For all breaks except for R-HRC-48RL2A-3, R-HRC-46RL1A-7, R-HRC-47RL1B-11, R-HRC-50A/B-14 and R-HRC-50A/B-15 pipe whip restraints are effective. The limited quantity of fluid and potential energy between the break and the closed valve will drain out quickly following the break and thus it will not produce significant whipping of the broken pipe downstream of the break. The short length of pipe upstream of the break point will not whip against any safety-related equipments and components except the reactor coolant loop piping. Thus no provision of pipe whip restraints for these breaks is justified.
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3.6A.1.1.3 Safety Injection System 3.6A.1-1.3.1 General Description

The Emergency Core Cooling System (ECCS) or the Safety Injection System (SIS) operation and design bases are described in Section 6.3. The flow diagram for Safety Injection System is shown on Figure 6.3-1 (for Figure 6.3-1, Sheet 1, refer to Drawing G167, Sheet 1).
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The cold leg injection piping from the safety injection tanks to the Reactor Coolant System (RCS) nozzles and to the check valves at the penetration inside containment is normally pressurized. This SIS piping inside containment is classified as high energy. All portions of the Safety Injection System outside containment are considered moderate energy by two percent rule explained in Subsection 3.6.1.2. The cold leg injection piping between the Safety Injection tanks and RCS nozzles is 12 inch nominal size with a wall thickness of 0.985 inch and 1.148 inch. The branch pipe from this 12 inch line to the check valves near the containment penetration is eight inch nominal size with a wall thickness of 0.72 inch. Another branch pipe from the 12 inch line to a normally closed valve is two inch schedule 80 pipe. The branch pipe from eight inch line near the penetration to the check valve is three inch schedule 160 piping. All of this piping is stainless steel, seismic Category I and has been designed in accordance with the ASME Code Section III Class I or 2 Criteria.

The common piping used for hot leg injection and shutdown cooling from the RCS nozzles to the branch connection for a three inch schedule 160 hot leg injection line and its continuation to the second normally closed isolation valve is 14 inch schedule 120 stainless steel piping. The piping is Seismic Category I and has been designed in accordance with the ASME Code Section III Class 1 Criteria.

3.6A.1.1.3.2 Piping Whip Analysis

Isometrics of each of the four cold leg injection lines along with all branch lines:

SI tank 2A:	2SI12-137TK2A 1SI12-136RL2A 1SI12-135RL2A 1RC12-39RL2A 1SI8 -134RL2A 1SI3 -133RL2A 2SI2 -152TK2A
SI tank 1A:	2SI12-121TK1A 1SI12-12OTX1A ISI12-119RL1A 1RC12-37RL1A 1SI8 -118RL1A 1SI3 -117RL1A 2SI2 -148TK01A
SI tank 1B:	2SI12-129TK1B 1SI12-128TK1B 1SI12-127RL1B 1RC12-38RL1B 1SI8 -126RL1B 1SI3 -125RL1B 2SI2 -149TK1B
SI tank 2B:	2SI12-145TK2B ISI12-144TK2B 1SI12-143RL2B 1RC12-40RL2B 1SI8 -142RL2B 1SI3 -141RL2B 2SI2 -153TK2B

and the hot leg injection lines; (1SI3-215, 1RC14-44RL1, 1SI14-146B, 1SI3-214, 1RC14-45RL2, ISI14-146A) indicating postulated break points and pipe whip restraint locations are provided in Figures 3.6A-8 through 3.6A-26. For all pipes four inch nominal size and above a double ended guillotine (circumferential) break as well as a slot break is considered at the postulated break location with the exceptions indicated in Paragraph 3.6.2.1.5(b).2. The break locations are selected on the basis of stress criteria for ASME Section III Code Class 1 and 2 piping.

The pipe whip restraints provided for the system are identified in Table 3.6A-3. The restraints are designed to ensure that the pipe whip will be minimized. The type of restraint coordinate directions in which the restraints are capable of supporting the pipe whip load and the identification of breaks which activate each restraint are given in Table 3.6A-3. For the breaks where no pipe whip restraints are provided, a detailed study was conducted to evaluate the effects of the whipping pipe on essential systems and components. It was observed that there is no case in which the safe shutdown of the plant is compromised.

3.6A.1.1.4 Chemical and Volume Control System (Letdown and Charging)

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3.6A.1.1.4.1 General Description

The Chemical and Volume Control System (CVCS) operation and design bases are described in Subsection 9.3.4. The flow diagram for the Chemical and Volume Control System is shown on Figure 9.3-6 (for Figure 9.3-6, Sheet 1, refer to Drawing G168, Sheet 1).
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The letdown piping inside containment from the Reactor Coolant Loop to the containment penetration is Schedule 160, two inch nominal size and three inch nominal size with one inch wall thickness. The portion of piping from the Reactor Coolant Loop up to the second isolation valve, located upstream of the Regenerative Heat Exchanger, is designed in accordance with the ASME Code, Section III, Class 1 and Seismic Category I Criteria. The remainder of the line to the Containment penetration is ASME Code Section III, Class 2 seismic Category I pipe. The letdown line from the Reactor Coolant Loop to the letdown back pressure valve (2CH-PM627 A/B) downstream of the letdown heat exchanger located in Reactor Auxiliary Building and a portion of the letdown heat exchanger downstream piping is classified as high energy.

The charging lines inside containment are schedule 160, two inch nominal size, except for a portion of it near the penetration which is three inch nominal size with a wall thickness of one inch. The two charging lines and the auxiliary spray line for the pressurizer are ASME Code, section III Class 1 from the Reactor Coolant Loop to the second isolation valve in each line. The reminder of the charging line is Class 2. The charging system piping inside Containment is designed to seismic Category I criteria and is all considered high energy.

3.6A.1.1.4.2 Pipe Whip Analysis

Isometrics of the letdown lines inside containment indicating the locations of postulated break points and pipe whip restraints are provided in Figures 3.6A-27 through 3.6A-29. All breaks in the letdown line are double ended guillotine (circumferential) type only. Breaks are postulated at the Reactor Coolant Loop nozzle, inlet and outlet nozzles of the Regenerative Heat Exchanger and the penetration. There are two intermediate breaks in between the Reactor Coolant Loop nozzle and the inlet nozzle of the Regenerative Heat exchanger. Two more intermediate breaks are postulated in the pipe run between the Regenerative Heat exchanger outlet nozzle and the penetration. The pipe whip restraints provided for the letdown piping inside containment are identified in Table 3.6A-4.

Isometrics of the charging lines inside containment indicating the locations of postulated break points and pipe whip restraints are provided in Figures 3.6A-30 through 3.6A-36c. All breaks in the charging lines are double ended guillotine (circumferential) type only. Breaks are postulated at the Reactor Coolant Loop nozzles, Regenerative Heat exchanger nozzles and the penetration. At least two breaks are postulated in the pipe run between the two terminal ends. The pipe whip restraints provided for the charging lines inside containment are identified in Table 3.6A-5.

A review of the components in the area of the three intermediate breaks shown on Figure 3.6A-36c (Auxiliary Spray Line) was conducted to determine the effects of the whipping pipe ends on safety related components. This review demonstrated that whip restraints are not required due to the separation of safety related equipment. At no time would the safe shutdown of the plant be compromised.

3.6A.1.1.5 Reactor Coolant System

3.6A.1.1.5.1 General Description

The Reactor Coolant System (RCS) operation and design bases are described in Section 5.1. The flow diagram of the system is shown on Figure 5.1-3. The Reactor Coolant Loop piping is stainless steel clad, carbon steel piping designed and fabricated in accordance with the ASME Code, Section III Class I Criteria. The two-loop RCS piping system consists of eight 30 inch inside diameter "cold legs" (reactor coolant pump suction and discharge) and two 42 inch inside diameter "hot legs". The layout of RCS piping is shown on Figures 5.1-1 and 5.1-2.

3.6A.1.1.5.2 Pipe Whip Analysis

→(DRN 03-2056, R14)

The break locations for both the BLPBs and the eliminated MCLBs are described in Subsection 3.6.2.5.1. The eliminated MCLB locations are shown on Figures 3.6A-36A and 3.6A-36B. The BLPBs that affect RCS response are located in the tributary piping systems listed in Section 3.6.2.1.1.1d. Pipe stops provided in the system are described in the Reference 1 of Section 3.6. The reactor cavity wall, the biological shield wall and the floor are used for supporting pipe stops. The results of containment and subcompartment pressure analyses are provided in Subsection 6.2.1. The systems and equipment necessary to mitigate the consequences of a Main Coolant Loop Pipe (MCLB, or LOCA) are described in Subsection 3.6.1.1.

With the elimination of MCLBs via LBB, the main coolant loop piping is not subject to whipping. Per Section 3.6.2.3.1, the RCS analytical results for BLPBs under power uprate conditions demonstrate that BLPBs do not cause the main coolant loop pipes to engage the existing RCS pipe whip restraints.

←(DRN 03-2056, R14)

3.6A.1.1.6 Pressurizer Relief Piping

3.6A.1.1.6.1 General Description

The pressurizer relief valve inlet lines are six inch nominal size schedule 160 stainless steel pipe. The portion of the piping between the pressurizer nozzle and the relief valve is kept pressurized during normal plant operating condition. This piping is classified as high energy. This piping is designed in accordance with ASME Code, Section III Class 1 and seismic Category 1 criteria. The piping downstream of the valves is non-safety, non-seismic. The Pressurizer Relief System operation and design basis are described in Subsection 5.2.2.

3.6A.1.1.6.2 Pipe Whip Analysis

An isometric of the two Pressurizer relief lines (1RC6-18A and 1RC6-18B) indicating postulated break points and pipe whip restraint locations are provided on Figure 3.6A-37. The systems and equipment necessary to mitigate the consequences of a relief valve line break are described in Subsection 3.6.1.1. Pipe breaks are postulated at the terminal ends of the high energy portion of the piping. The piping has only one change in direction and the effects of intermediate breaks are the same as the terminal end breaks, therefore no intermediate breaks were postulated. Table 3.6A-6 identifies the breaks in this piping, note that because of separation from other essential components no restraints are required.

3.6A.1.1.7 Pressurizer Spray

3.6A.1.1.7.1 General Description

The Pressurizer Spray System operation and design bases are described in Subsection 5.4.10. The spray line is a four inch schedule 120 pipe at the pressurizer end reduced to a three inch schedule 160 pipe between the pressurizer and the pressurizer spray control valves and to the cold legs of loops 1A and 1B. The stainless steel spray piping is in accordance with ASME Code, Section III, Class 1 and seismic Category I requirements.

3.6A.1.1.7.2 Pipe Whip Analysis

Isometrics of the spray line indicating the postulated break points and pipe whip restraint locations are provided on Figures 3.6A-38 through 3.6A-38b. In addition to the pipe breaks at the terminal ends, six intermediate breaks are postulated. The breaks are based on the stress criteria described in Subsection 3.6.2.1.1.2. All breaks in the three inch pipe are guillotine (circumferential) type breaks. Circumferential and longitudinal pipe breaks are postulated in the four inch portions as per the criteria presented in Subsection 3.6.2.1.5. Pipe whip is minimized by the restraints such that the function of essential systems and equipment are not affected. The pipe whip restraints provided for the spray line are identified in Table 3.6A-7.

3.6A.1.1.8 Pressurizer Surge

3.6A.1.1.8.1 General Description

→(EC-19087, R305)

The pressurizer surge line has been eliminated as a potential rupture location under LBB analysis as discuss in Section 3.6.3. The following discussion on pipe whip restraints is historical but is retained since some of the restraints still exist in the plant.

←(EC-19087, R305)

The Pressurizer Surge System operation and design bases are described in Subsection 5.4.10. The surge line is a 12 inch nominal size schedule 160 stainless steel pipe. The surge line is designed in accordance with ASME Code, Section III, Class 1 and seismic Category I requirements.

3.6A.1.1.8.2 Pipe Whip Analysis

→(DRN 00-1032, R11-A)

The isometric of the pressurizer surge line indicating postulated break points and pipe whip restraint locations is provided on Figure 3.6A-38c. Pipe breaks are conservatively postulated at each fitting or welded attachment. Circumferential as well as longitudinal breaks are postulated at each location since the piping is larger than four inches. Rupture restraints are located in the piping to prevent adverse pipe whip effects on essential systems and components. Table 3.6A-8 lists all rupture restraints provided in the system.

←(DRN 00-1032, R11-A)

3.6A.1.1.9 Main Steam and Feedwater

3.6A.1.1.9.1 General Description

The piping systems considered for pipe rupture analysis are two Main Steam (MS) and two Feedwater (FW) lines commencing at the steam generators and terminating at the turbine stop valves and feedwater pumps respectively. The results of pipe rupture analysis for the segments of MS and FW piping inside containment are presented in this section. The piping outside containment is addressed in Subsection 3.6A.2.

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The main steam and feedwater lines are carbon steel ASME SA-106 Gr.C piping. The piping is designed in accordance with the ASME code, Section III, Class 2 and seismic Category I criteria. The main steam lines consist of 34 inch and 40 inch segments. The feedwater lines consist of 18 inch and 20 inch sections. The mathematical models of the main steam and feedwater lines inside containment used for the analysis are shown on Figures 3.6-1 and 3.6-2.

←

3.6A.1.1.9.2 Pipe Whip Analysis

Selection of break locations in the main steam and feedwater piping was accomplished in accordance with the criteria presented in Subsection 3.6-2. Resulting break locations for the main steam and feedwater piping, inside containment, are shown on Figures 3.6A-38e and 3.6A-38f. Stresses in the main steam and feedwater piping inside containment due to occasional loads and thermal expansion are shown on Figure 3.6A-38d. For the main steam and feedwater piping where a break is postulated to occur at an elbow tangency point, the breaks are postulated at both elbow tangency points (due to the uncertainty in predicting where on the elbow the break would occur). The rationale for break selection along with break locations are shown in Tables 3.6A-9 through 3.6A-12. In accordance with the criteria of Subsection 3.6.2.1.5(b)(2) only circumferential breaks were postulated at these locations.

Pipe whip restraints provided for the main steam and feedwater piping are shown on Figures 3.6A-38e and 3.6A-38f. Restraint systems are selected to prevent unacceptable pipe whip resulting from the identified break locations. The coordinate directions in which the restraints are designed to support the pipe rupture load are given in Tables 3.6A-13 and 3.6A-14. Adequacy of the restraint systems to prevent pipe whips was demonstrated using computer programs PIPERUP (Reference 6 in Section 3.6) and RAP (Reference 7 in Section 3.6).

Analysis performed on the piping/restraint systems include all system nonlinearities and connectivity in addition to a nonlinear representation of restraints.

→(DRN 00-1032)

Consideration was also given to variations in stress-strain properties encountered in piping materials. The particular properties used in an analysis will influence both the prediction of pipe whip and the values calculated for impact force on piping restraints. It has been found that the statistical "lower bound" of the pipe's stress-strain curve will provide the weakest and most flexible piping system possible, and is conservative for the prediction of pipe whip. The statistical "upper bound" of the piping stress-strain curve may in some cases result in maximum restraint loads and in other cases may not. Therefore, for each rupture location selected for pipe whip analysis, a judgmental evaluation was made to determine whether "upper bound", or "lower bound", or both pipe material properties should be utilized.

←(DRN 00-1032)

A pipe whip evaluation of main steam lines A and B, and feedwater lines A and B inside containment, found that postulated ruptures at nodes 150 and 2090 and 190 and 9000, respectively (see Figures 3.6A-38e and f) will result in several inches of movement of the broken end of the pipe in a direction orthogonal to the longitudinal axis of the pipe. This movement is sufficient to close the annular gap between the process pipe and guard pipe, resulting in an impact load on the guard pipe. Such impact is considered acceptable since the resultant guard pipe stresses (taken in proper combination with other loads) do not exceed appropriate allowables.

3.6A.1.2 Jet Impingement Analysis Inside Containment

The essential components and systems required for safe shutdown of the plant, located inside containment, are evaluated for the effects of jet impingement. The jet impingement analysis procedure and the results of the analysis are presented here.

The jet envelopes were drawn on General Arrangement drawings for all high energy pipe breaks (identified for the various piping systems in Section 3.6A.1) inside containment. The shape of the jets is dependent on the fluid phase. The various jet shapes used for the analysis are described in Subsection 3.6.2.3.4. The jet envelope drawings along with the Component/ System layout drawings for Electrical, Instrumentation and Control, HVAC and Mechanical Systems are used to identify all component-jet interactions for each high energy pipe break. Component-jet interactions were judged acceptable or unacceptable according to the plant shutdown logic, single active failure criteria, and environmental effects. The interactions identified as unacceptable were either moved out of the jet completely or were further analyzed for operability of the components under the jet impingement loading. The procedure for calculating jet impingement force on a target is given in Subsection 3.6.2.3.4. If the equipment/component cannot be qualified with the jet loading, they are protected from the jet impingement forces by the methods described in Subsection 3.6.1.2.

3.6A.1.2.1 HVAC Jet Interactions

All HVAC jet interactions were evaluated and found to be acceptable. No special protective devices were required.

3.6A.1.2.2 Electrical Jet Interactions

The original layout of electrical cable trays and conduit runs was evaluated. Many unacceptable interactions between jets and essential safety related cables were found. Protection of these cables was achieved by rerouting and/or imbedding in the concrete walls and floors. This design procedure eliminated all unacceptable jet/component interactions

3.6A.1.2.3 Structural Jet Interactions

All safety related structures are capable of withstanding the additional loads imposed on them by the various jets. Certain other structures, not safety related, were evaluated and found to be stressed over the normally accepted allowable stress limit. However, these structures (staircases, platforms, etc.) would only be distorted. Any distortion of these components would not affect essential components or create missiles.

3.6A.1.2.4 Instrumentation and Control Systems

All instrumentation and control systems jet interactions are acceptable and no special protective devices are provided. Any unacceptable interactions were corrected by relocating out of the jet envelope.

3.6A.1.2.5 Mechanical Systems

Typical cases for jet impingement loading on piping were analyzed. The pipe supports/restraints are assumed to be functional under jet impingement load on piping. Based on this assumption, the essential piping under jet impingement load was found to meet stress criteria of ASME Section III.

The fluid jet emanating from the Mainsteam, Feedwater or Safety Injection System pipe breaks will impinge on the shutdown cooling isolation valves. The operability of the isolation valves is not guaranteed under the jet impingement load. To satisfy the single active failure criteria in addition to the direct consequences of the break, jet impingement barriers are provided over the shutdown cooling isolation valves on both trains to assure the operability of the valves.

3.6A.1.3 <u>Environmental Effects of High Energy Breaks Inside Containment</u>

As discussed in Subsection 6.2.1.1.3, the environmental conditions (pressure, temperature, humidity and radiation) inside the containment are the most severe after a design basis accident (DBA). The DBAs include LOCA and Main Steam Line Break (MSLB). All safety related mechanical and electrical equipments located inside containment must be capable of functioning under the environmental conditions resulting from the design basis accident. Furthermore, as discussed in Subsection 3.6A.6, flooding will not affect the operation of the safety related equipment located in the RCB. Thus the environmental conditions resulting from all high energy pipe breaks (discussed in Subsection 3.6A.1) will not affect the operation of the safety related equipment.

3.6A.2 HIGH ENERGY PIPE BREAK OUTSIDE CONTAINMENT

The high energy piping systems which are considered for pipe rupture analysis outside containment are:

1) Chemical and Volume Control System (Charging and Letdown)

2) Steam Generator Blowdown System (SGBS)

3) Main Steam (MS) and Feedwater (FW)

The criteria used to locate the break points for high energy piping outside containment is described in Subsection 3.6.2-1.2. The various protective methods used to mitigate the consequences of the postulated pipe break are given in Subsection 3.6.1.2. This subsection presents the results of pipe rupture analyses: pipe break locations, evaluation of the consequences of pipe whip, and jet impingement and environmental effects.

3.6A.2.1 Pipe Whip Analysis

The Subsection 3.6A.2.1 describes the method of protection used against pipe whip for each break in the systems listed in Subsection 3.6.2.

3.6A.2.1.1 Chemical and Volume Control System (Charging and Letdown)

→(DRN 00-1032)

3.6A.2.1.1.1 General Description

←(DRN 00-1032)

The Chemical and Volume Control System (CVCS) operation and design bases are described in Subsection 9.3.4. The flow diagram for the CVCS is shown on Figure 9.3-6 (for Figure 9.3-6, Sheet 1, refer to Drawing G168, Sheet 1).

The high energy portion of the charging system outside containment extends from the charging pump discharge to the penetration. This portion of charging line is two inch schedule 160 pipe except for about six feet of 2 1/2 inch schedule 160 pipe. The charging pipe is made of stainless steel and is designed in accordance with the ASME Code, Section III Class 2 and seismic Category I criteria.

The letdown piping from the penetration to the letdown back pressure valve 2CH-PM627 A/B in the piping downstream of the letdown heat exchanger is classified as high energy. The letdown line outside containment is two inch schedule 160 and 80S pipe. The entire high energy portion of the system is made of stainless steel and designed in accordance with the ASME Code, Section III Class 2 and seismic Category I criteria.

3.6A.2.1.1.2 Pipe Whip Analysis

Isometrics of the charging lines outside containment, indicating postulated break points and pipe whip restraint locations are provided on Figures 3.6A -39 through 3.6A-43b. The layout of the charging line along with the layout of equipment is shown in Figures 3.6A-43a and 3.6A-43b. All breaks in this line are a double ended guillotine (circumferential) type. Terminal end breaks are postulated at the penetration, the intermediate anchor points, the closed valve end and the charging pumps discharge nozzles. The intermediate break locations are selected based on the stress criteria given in Subsection 3.6.2.1.1.3. The type of restraint, coordinate direction in which the restraints are capable of supporting the pipe whip load and the identification of breaks which activate each restraint are given in Table 3.6A-15. It is evident from the table that the pipe whip is minimized by the provision of rupture restraints in both sides of all break points except for the break A-HCH-53 A/B-21 in - x direction. This break is in the section of the pipe routed in the chase. The whipping pipe may hit the letdown pipe located in the same pipe chase. However, the letdown pipe will not be damaged since it is the same size and thickness as the whipping pipe.

Isometrics of the letdown lines outside containment indicating postulated break points and pipe whip restraint locations are provided on Figures 3.6A-44 through 3.6A-49. All breaks postulated for the piping are double-ended guillotine (circumferential) type. Terminal end breaks are postulated at the penetration, the normally closed valves and the inlet and outlet nozzles of the letdown heat exchanger. The intermediate break points are selected based on the stress criteria given in Subsection 3.6.2.1.1.3. All rupture restraints designed for the letdown line are hard type. These restraints are capable of supporting the pipe rupture loads in any radial direction of the pipe.

3.6A.2.1.2 Steam Generator Blowdown System

3.6A.2.1.2.1 General Description

The Steam Generator Blowdown System (SGBS) operation and design bases are described in Subsection 10.4.8. The flow diagram of the SGBS is shown on Figure 10.4-5.

The high energy portion of the SGBS outside containment extends from the penetration to the blowdown tank. The two SGBS lines from the steam generators up to the containment isolation valves are ASME Code, Section III Class 2 pipe. The remaining portion of the SGBS piping from the containment isolation valves to the blowdown tank is ANSI B31.1 piping. This portion of the SGBS is also designed to seismic Category I criteria. This piping is stress analyzed in accordance with the ASME Code, Section III Class 2 Criteria. The results of this analysis are used to select the break locations.

The SGBS lines outside containment are four inch nominal size schedule 40 pipe. Portions of this piping are eight inch schedule 40 and two inch schedule 40. The entire SGBS piping outside containment is made of carbon steel.

3.6A.2.1.2.2 Pipe Whip Analysis

Break locations are selected in the two SGBS lines in accordance with the stress criteria for Class 2 pipe presented in Subsection 3.6.2. Isometrics of the SGBS lines outside containment indicating postulated break points and pipe whip restraint locations are provided on Figures 3.6A-50 through 3.6A-53. All breaks in the SGBS piping are a double ended guillotine (circumferential) type. Terminal end breaks are postulated at the penetrations and the blowdown tank nozzles. Breaks are also postulated at the terminal ends for the two inch branch piping. Two intermediate break points are selected for each of the two main lines. The branch pipe 5BD2-6 (Figure 3.6A-51) also contain two intermediate break locations. However, in the other branch pipe, 6BD2-45 (Figure 3.6A-53), no intermediate breaks are postulated. The branch run is short and the effects of intermediate breaks will be the same as the breaks in the terminal ends. The stress level at all intermediate break locations are below the stress limit criteria for break postulation.

The type of restraint, coordinate direction in which the restraints are capable of supporting the pipe whip load and the identification of break which activates each restraint are given in the Table 3.6A-17.

For those breaks which have no pipe whip protection, a detailed study was conducted to evaluate the effects of the whipping pipe on the essential systems and components. It was found that the whipping pipe will not affect the operation of any essential systems needed to mitigate the consequences of the break, and to shut down the plant.

3.6A.2.1.3 Main Steam and Feedwater

3.6A.2.1.3.1 General Description

The main steam and feedwater lines outside containment are carbon steel ASME SA-106 Grade C piping. These lines between the penetrations and outboard isolation valves are designed in accordance with the ASME Code, Section M, Class 2 and seismic Category I Criteria. These lines past the isolation valves to the Turbine Building interface restraints are classified as ANSI B31.1, seismic Category 1. However, the design rules for this section of piping are equivalent to ASME Section III, Class 2 requirements. The criteria for break selection for this piping is provided in Subsection 3.6.2.1.2. The criteria for pipe rupture analysis for the piping in the penetration is given in the Subsection 3.6.2.1.4.

The main steam line is 40.5 inch OD with 1.25 inch minimum wall thickness. The feedwater line is 20 inch OD with 0.902 inch minimum wall thickness. (These are nominal dimensions from purchase specifications; actual thicknesses may vary.) Figures 3.6-3 through 3.6-6 are mathematical models, used for the analysis, of the main steam and feedwater lines outside containment.

The main steam and feedwater piping systems located in the Turbine Building are classified as ANSI B31.1, non-seismic. In accordance with the criteria of SRP 3.6.2, breaks are postulated to occur at terminal ends and at each intermediate pipe fitting, welded attachment, and valve.

3.6A.2.1.3.2 Pipe Whip Analysis

→(DRN 00-1032)

As discussed in Subsection 3.6.2.1.4, no breaks are postulated in the area near the isolation valves. Tables 3.6A-18 through 3.6A-21 present comparisons of the combined pipe stresses versus the required allowables for the operating and pipe rupture conditions. The comparison of stress levels is also shown on Figure 3.6A-54. The node points selected were at the containment anchors, elbows, and valves, since they exhibit the highest associated stresses. The reported pipe rupture stress at each node was individually determined from the various pipe whip analyses. Lengths of the main steam and feedwater piping in the penetration area (from penetration to isolation valves), when no breaks are postulated are shown on Figures 3.6A-54a and 3.6A-54b.

←(DRN 00-1032)

→(DRN 00-1032)

Main steam and feedwater piping between the outboard isolation valves and the Turbine Building interface restraints: Isometrics of MS and FW lines indicating postulated break points and pipe whip restraint locations are provided in Figures 3.6A-55 and 3.6A-56. Stress levels along the selection of break locations in the MS and FW piping are shown on Figure 3.6A-57. If a break is postulated to occur at an elbow tangency point, then breaks are postulated at both elbow tangency points (due to the uncertainty in predicting where on the elbow the break would occur). The rationale for break selection along with break locations are shown in Tables 3.6A-22 through 3.6A-25.

←(DRN 00-1032)

At each of the postulated break locations, dynamic analyses were performed to determine the fluid duct forcing functions and pipe whip restraint loads. The method of accounting for the variation in the dynamic analysis of stress-strain properties encountered in piping material, is discussed in Subsection 3.6A.1.1-9.2. The coordinate directions in which the restraints are capable of supporting the pipe whip loads are given in Tables 3.6A-26 and 3.6A-27.

MS and FW - Turbine Building:

A study of the main steam and feedwater piping inside the Turbine Building was performed to determine if a postulated pipe rupture could result in damage to the auxiliary building structure. In particular, the possibility of a whipping pipe destroying intervening columns inside the Turbine Building and then impacting on, and causing damage to the auxiliary building wall was examined. It was found that this situation would not occur since the kinetic energy developed in a ruptured pipe would be limited by an early collapse of the pipe cross-section. This cross-section collapse serves to choke off the blow down force. In addition, it was found that the motion developed in the ruptured piping would be of sufficiently small magnitude so that pipe movement would be arrested by impact of the pipe on the intervening columns.

3.6A.2.2 Jet Impingement Analysis Outside Containment

The jet impingement analysis was conducted as a review of pipe routing with findings by the systems outlined below:

a) Main Steam (MS) and Feedwater (FW) are routed outside on top of the Reactor Auxiliary Building roof. The jets from MS and FW breaks will not adversely affect any essential components/systems or the safety related structures.

b) Steam Generator Blowdown (SGBS) - No safety related equipment would be affected by the jets from the SGBS pipe breaks.

c) Chemical and Volume Control System - (Letdown and Charging) - The CVCS piping is routed through the chase from the containment penetration to the letdown heat exchanger room and the charging pump rooms. The letdown heat exchanger and the charging pumps are located in individual compartments. The fluid jets from the CVCS pipe breaks will be contained in these compartments and thus safety related equipment are not affected.

3.6A.2.3 Environmental Effects

The high energy piping systems located in the Reactor Auxiliary Building are given in Subsection 3.6A.2. Since the main steam and feedwater systems are located outside of the structure, the environmental conditions produced by the pipe breaks in these systems will not affect any safety-related equipment or components. The CVCS letdown and charging lines are routed in a chase and thus the environmental conditions produced by the piping failure are contained and no safety-related equipment is affected. A break in the Steam Generator Blowdown System will not result in any adverse environmental impact on essential systems or components.

3.6A.3 SUBCOMPARTMENT PRESSURE ANALYSIS

This section presents the results of subcompartment pressure analysis in which the integrity of subcompartments is evaluated for the differential pressure loading resulting from high energy piping failures.

3.6A.3.1 Subcompartment Pressure Analysis - Inside Containment

The subcompartments inside Containment which are subject to pressure transients caused by the mass and energy releases from postulated high energy pipe breaks within their boundaries are the reactor cavity, the pressurizer and the steam generator subcompartments. Subsection 6.2.1.2 presents a complete description and the results of this analysis.

3.6A.3.2 Subcompartment Pressure Analysis - Outside Containment

The subcompartment pressure analysis in the Reactor Auxiliary Building (RAB) is limited to the high energy piping failures. The high energy piping systems located in the RAB are:

1. Main steam (MS) and Feedwater (FW)

2. Steam Generator Blowdown System (SGBS)

3. Chemical and Volume Control System (CVCS) (Charging and Letdown)

Since the mainsteam and feedwater piping is routed outside on top of the Reactor Auxiliary Building Roof, a subcompartment pressure analysis is not required. The Steam Generator Blowdown System lines are located in a large compartment where the internal pressure buildup due to pipe break is not possible. Thus the only cases to be considered for this analysis are the pipe breaks in the CVCS system.

The CVCS letdown and charging lines are a maximum of 2-1/2 inch nominal size and are routed through a pipe chase from the Containment penetrations to the letdown heat exchanger room and the charging pump rooms. The maximum internal pressure build-up in the pipe chase, due to a break in the letdown piping was found to be 4.064 psig and 0.784 psi in the valve pit using the computer program RELAP-4/MOD 5. The pipe chase is designed to withstand this differential pressure loading.

3.6A.4 MODERATE ENERGY PIPING FAILURES - INSIDE CONTAINMENT

The high energy pipe breaks inside containment are design basis, therefore the effects of moderate energy piping failures need not be evaluated.

3.6A.5 MODERATE ENERGY PIPING FAILURES - OUTSIDE CONTAINMENT

This section presents the results of the analysis performed for moderate energy piping failures in the Reactor Auxiliary Building. The flooding and environmental conditions resulting from the moderate energy piping failures are considered for evaluating the availability of the essential systems and components to mitigate the consequences of the piping failure. The flooding analysis in the RAB due to moderate energy piping failures is described in Subsection 3.6A.6.4.2.

3.6A.5.1 Environmental Effects - Outside Containment

The environmental conditions due to moderate energy piping failures in the Reactor Auxiliary Building were considered for evaluating the functional capability of safety-related equipment and components.

The pressure, temperature and humidity conditions for which the equipment is qualified is given in Section 3.11 and the Environmental Qualification Report (Reference 1 of Section 3.11). A moderate energy piping failure in a confined area may result in a temperature higher than that listed. However, because of redundancy and separation of essential equipment and systems the safe shutdown of the plant is assured.

3.6A.6 FLOODING ANALYSIS

3.6A.6.1 Scope

The following subsections present the results of an evaluation of systems design and layout in the Reactor Containment Building (RCB) and Reactor Auxiliary Building (RAB) regarding the effects of flooding resulting from postulated piping failures. The areas investigated and the features incorporated in the plant design in order to comply with these criteria are also described.

3.6A.6.2 Criteria and Assumptions

The criteria employed in the flooding analysis are based on Branch Technical Positions APCSB 3-1, "Protection Against Postulated Piping Failures in Fluid Systems Outside Containment" and MEB 3-1, "Postulated Break and Leakage Locations in fluid System Piping Outside Containment."

3.6A.6.3 Reactor Containment Building

→(DRN 00-215; 03-2056, R14; 05-163, R14)

The Safety Injection System Sump and Containment Sump in the Reactor Containment Building (RCB) are designed to collect the fluid due to the Design Basis Break along with the entire content of the Refueling Water Storage Pool. All portions of safety related equipment in the RCB needed for accident mitigation are located above the highest possible water level of less than +6.79" MSL. Thus the flooding analysis for RCB is not required. The consequences of flooding in Turbine Building and Fuel Handling Building are not addressed because no equipment essential for safe shutdown is located in these buildings.

←(DRN 00-215; 03-2056, R14; 05-163, R14)

3.6A.6.4 Reactor Auxiliary Building

3.6A.6.4.1 High Energy Pipe Breaks

The high energy piping systems outside containment are:

a - Chemical and Volume Control System (CVCS) (Charging and Letdown)

b - Steam Generator Blowdown System (SGBS)

c - Main Steam (MS)

d - Feedwater (FW)

The effects of flooding resulting from postulated breaks in high energy piping in the RAB are not critical because of the reasons discussed below:

→(DRN 05-1388, R14-A)

The CVCS Charging and Letdown piping is a maximum of 2-1/2 in. nominal size and is routed through a pipe chase from the penetration to the charging pump room and the letdown heat exchanger area. Flooding of the pipe chase due to breaks in CVCS charging or letdown piping inside will be confined to the pipe chase. Furthermore, blowdown of reactor coolant resulting from a charging line break outside containment is not considered credible due to check valves on the lines that penetrate containment as discussed in subsection 15.6.3.1.1. The mass of coolant released in a letdown line break is provided in table 15.6-3. This fluid mass is not large enough to cause equipment flooding in the affected areas.

←(DRN 05-1388, R14-A)

The charging pumps are located in three separate compartments. Flooding in one compartment due to a break in the charging system will not affect the operation of the other two charging pumps. Similarly the flooding due to a letdown piping failure in the letdown heat exchanger area will not result in the loss of any safety related equipment since none are located in the communicating compartments.

→(DRN 05-1388, R14-A)

The Steam Generator Blowdown System piping in the penetration area is a maximum four in. nominal size. The flow rate during normal plant operating conditions is 47.3 gpm. If there is a line break in this system, the blowdown goes to the floor at elevation -4.00 ft MSL. The floor is not compartmentalized and the drains located in the floor will conduct the fluid to sumps at elevation -35.0 ft MSL. This prevents flood level from reaching safety-related equipment. Additionally, any break of a significant size that could result in flooding in the event that the sump is unavailable would cause a blowdown isolation due to area pressurization prior to reaching safety-related equipment.

←(DRN 05-1388, R14-A)

Consequences of flooding from failure of main steam and feedwater lines is not considered because the piping is located on the roof of RAB and the roof drains will prevent fluid accumulation. Control room habitability is also discussed in Subsections 3.6A.7 and 6.4.

3.6A.6.4.2 Moderate Energy Piping Failures

The worst flooding in the RAB for Waterford 3 results from postulated cracks in moderate energy piping including both seismic and non-seismic piping systems.

The assumptions and guidelines used in the moderate energy flooding evaluation are as follows:

a) No earthquake is postulated in concurrence with a crack in moderate energy piping. Components designed to non-seismic standards such as floor drainage system, sump pumps, etc., are available to mitigate the flooding consequences of the piping failure.

→ (DRN 99-2225)

b) Offsite power is assumed unavailable where a postulated crack results in an automatic reactor trip or automatic turbine generator trip causing automatic separation of the turbine generator from the power grid.

← (DRN 99-2225)

c) A single active failure is assumed in systems used to shut down the plant or to mitigate consequences of the crack. The single active component failure is assumed in addition to the postulated pipe failure and any direct consequences of the pipe break. However, a single active failure is not assumed in a redundant train of a dual purpose moderate energy essential system when the crack is postulated in the other train.

d) All available systems including those actuated by operator actions may be used to mitigate the consequences of the crack.

e) Operator actions are taken into account based on ample time and access to equipment for the proposed actions. Thirty minutes from event alarm to completion of protective action such as closing or opening valve, shutting off or starting a pump etc., is considered to be ample time.

f) Moderate energy fluid system pipe failure is considered separately as a single postulated initial event occurring during normal plant operation.

g) All equipment which will not survive wetting is assumed to be unavailable.

h) Rate of flow from cracks is assumed to be from an infinite reservoir.

3.6A.6.4.2.1 Evaluation Technique

→ (DRN 99-2225)

Based on a review of the RAB, the following compartments containing safety related equipments are considered for the flooding analysis due to the effects of a moderate energy line crack:

← (DRN 99-2225)

- Safeguard pump rooms
- Component Cooling Water pump rooms.
- Emergency Diesel Generator rooms.

- ° Component Cooling Water make-up pump room.
- ° Shutdown Cooling Heat Exchanger room
- ° Component Cooling Water Heat Exchanger room
- ° HVAC Control and Equipment room
- ° HVAC Switchgear Equipment room

→(DRN 99-2225, R11)

- ° Remote Shutdown room

←(DRN 99-2225, R11)

- ° Battery rooms
- ° Electrical Equipment room

→(DRN 99-2225, R11)

←(DRN 99-2225, R11)

- ° Miscellaneous Equipment room
- ° Mechanical Penetration Area

→(DRN 99-2225, R11)

- ° Diesel Oil Storage Tank Rooms
- ° Diesel Oil Feed Tank Rooms
- ° Charging Pump Rooms
- ° EFW Pump Rooms
- ° Wet and Dry Tower Areas
- ° RAB Hallways

←(DRN 99-2225, R11)

The potential for flooding the safety related compartments due to the moderate energy piping failures in these compartments, as well as in communicating compartments of areas, is evaluated using the procedure described below.

→(DRN 99-2225, R11)

The volume of the compartments and the communicating compartments is calculated using general arrangement, masonry, and foundation drawings as applicable. The moderate energy piping failure in the compartment or in the communicating compartment which produces the worst flooding condition for each compartment is selected for the evaluation.

→(DRN 03-774, R13)

The analysis determines the time required for the water level to rise to a critical flood level within each area with no credit for drainage through floor drains. Walkdowns have been performed to determine the critical flood level for each area and confirm that safety related equipment is not located below the area flood level. The acceptable time to reach the critical flood level is thirty minutes or greater as discussed in 3.6A.6.4.2e.

←(DRN 99-2225, R11; 03-774, R13)

→ (DRN 99-2225, R11)
Based on this procedure it is determined that the postulated flooding due to a moderate energy line crack will not affect safe shutdown of the plant in the following areas / rooms:

Room / Area	**Room / Area**
Component Cooling Water make-up pump room	Diesel Room A and B
EFW Room A and B	Switch Gear Room A, B and A/B
Charging Pump Rooms	Battery Room A, B and A/B
Dry Tower A and B	Computer Battery Room
Valve Gallery A and B	Control Room
Wing Areas	Control Room HVAC Room
HVAC Room	Switch Gear HVAC Room
HVAC/Chiller Room	Computer Room
Hallway/Open Rooms	Decon HVAC Room

Thus the discussion presented in this section is limited to the cases where a detail analysis is needed to evaluate the effects of flooding on the safety related equipment. The compartments considered for the flooding analysis are:
← (DRN 99-2225, R11)

° Safeguard pump rooms

° Component Cooling water pump rooms

→ (DRN 99-2225, R11)

° Emergency Diesel Generator Storage Tank and Feed Tank Rooms

° Component Cooling Heat Exchanger Rooms

° Shutdown Heat Exchanger Rooms

° Elevator Room

° Remote Shutdown Room

° Wet Cooling Tower Area

° West and East Vault Areas

← (DRN 99-2225, R11)

→ (DRN 00-0958, R12-B)
In addition, the following plant rooms and areas were evaluated for components that may be potentially impacted by water spray initiating from a moderate energy line break:

Room 124 – HVAC Room at RAB+07
Room 299 – Essential Chillers & HVAC Room at RAB+46
Room 314 – Control Room HVAC at RAB+46
Room 323 – HVAC Room at RAB+46 Col. 12A&G
Room 416 – HVAC Chilled Water Tank Room at RAB+91
Room 417 – Component Cooling Water Surge Tank Room at RAB+91
Room B002 – Charging Pump A at RAB-35
Room B003 – Charging Pump AB at RAB-35

← (DRN 00-0958, R12-B)

→(DRN 00-0958, R12-B)

Room B004 – Charging Pump B at RAB-35
Room B005 – Corridor in Front of Motor Driven EFW Pumps at RAB-35
Room B049 – Turbine Driven EFW Pump Area at RAB-35
Room B053 – Wing Area at RB-35
Room B100 – Wing Area at RB-04
Room B116 – Corridor at RAB-04

All the components in those area/rooms were determine to be either acceptable for spray wetting or would not be subjected to spray wetting (ER-W3-2000-0563-00).
←(DRN 00-0958, R12-B)

3.6A.6.4.2.2 Safeguard Pump Rooms

Two separate rooms containing safeguard pumps are located in the RAB at elevation -35.0 ft MSL. The north room contains Train B pumps for the High Pressure Safety Injection (HPSI), Low Pressure Safety Injection (LPSI) and Containment Spray (CS) systems. This room also contains the reactor drain tank pump and equipment drain tank pump. The south room contains HPSI pump A, HPSI pump A/B, LPSI pump A and CS pump A. There is a door connecting these two rooms. The bottom elevation of the door is -22.67 ft MSL (and is about 12 ft above the room floor). The north safeguard pump room (Train B) has a doorway at elevation -35.0 ft MSL leading to the room housing Shutdown Cooling heat exchanger B.

Each of the two Safeguard pump rooms and the Shutdown Cooling heat exchanger room contain the following piping systems:

a - Safety Injection
b - Containment Spray
c - Condensate
d - Fuel Pool
e - Component Cooling Water
f - Boron Management
g - Waste Management
h - Chemical and Volume Control
→(DRN 06-291, R14-B)
i - Essential Chilled Water System
←(DRN 06-291, R14-B)
→(DRN 00-1032, R11-A)
The nominal pipe sizes vary from 1 in. to 24 in. Accounting for pressure and temperature conditions in addition to the crack size, the critical piping failure is selected.
←(DRN 00-1032, R11-A)
Each room has two floor drain sumps. Each sump is provided with two sump pumps. Level switch and level operated mechanical alternator are provided for controlling the sump pumps. The level control is delineated in the following steps:

1) When the level reaches the predetermined "high" the alternator starts the selected pump. The mechanical alternator initiates operation of the pumps alternately on successive low level incidence. The pump is also tripped off automatically on low level.

2) If the level continues to rise and reaches the predetermined "high-high", the alternator will start the second pump.

3) An independent level switch is provided to detect that the level in the sump is high enough to necessitate operation of the standby pump and will initiate an alarm in the main control room.

A local control switch is provi ded for each pump to enable its manual operation.

In addition Class 1E safety-related flood detection switches mounted on the compartment floors will alert the operator in the main control room when the sumps overflow and the water at the room's lowest spot is two in. deep. Two out of four sump pumps are assumed to be failed because of a single active failure in the motor control center.

→ (DRN 99-2225, R11)

In Safeguards Room A and A/B there is no adverse impact to safe shutdown of the plant due to the effects of flooding from moderate energy breakers by virtue of not exceeding the flood level of one foot in thirty minutes for all but four (4) lines. Since redundant system components are located in the same area a pipe stress evaluation was performed for these lines to determine if the design pipe stresses are below the code allowable for postulating moderate energy crack [0.4 (1.2 S_H + S_A)]. The results of the evaluation shows that the design pipe stresses are below the threshold for postulating a moderate energy crack. Therefore flooding from these lines is not postulated and there is no adverse impact to plant safety.

In Safeguards Room B there is no adverse impact to safe shutdown of the plant due effects of flooding from moderate energy breaks by virtue of not exceeding the flood level of one foot in thirty minutes for all but five (5) lines. Should one of these five lines crack and flood the room redundant system equipment located in a separate room are available for safe shutdown of the plant and therefore there is no adverse impact to plant safety. All pumps in this room are mounted on one ft. high concrete pedestals. The operator is alerted by the level switch in the sump as well as by flood detection switches on the floor and enough time is available for corrective action. Since the fluid would be wholly contained within the pump room by the surrounding walls except leakage around the door frame to the Shutdown Cooling Heat Exchanger room, the safeguard pumps in the neighboring room will remain unaffected.

← (DRN 99-2225, R11)

The operator can isolate the affected shutdown cooling train by manually closing one of the valves 1SI-V15O3A, 1SI-V15O4A and 2SI-V327A in train A and 1SI-V1502B, 1SI-V1501B and 2SI-V326B in train B, from the main control room.

In addition to the above, a Post LOCA passive failure flood analysis was performed based on the following assumptions:

a. A maximum passive flow rate of 50 gpm in each ECCS pump room.

b. Sump pumps are inoperative.

c. The safety-related alarm in the control room is annunciated when water level in the ECCS room is 3" above floor level.

The analysis results demonstrate that, after receipt of the safety-related alarm in the control room, more than three hours will elapse until water level in the ECCS room rises one foot above the floor. This level of water will cause no damage to the pumps. Three hours is sufficient time for the operator to isolate the faulty train and secure the leak.

3.6A.6.4.2.3 Component Cooling Water Pump Rooms

The three component cooling water (CCW) pumps are housed in separate rooms in the Reactor Auxiliary Building at elevation +21.0 ft. MSL, between Columns 4A and 7A in east-west direction and Columns K and L in north-south direction (Drawing G135). Pump A is located in the west room, Pump B is located in the

→(DRN 06-291, R14-B)

east room. The standby Pump A/B is located in the middle room. Access to the pump room is via the doors leading from the corridor. The doors are not watertight. However, the consequences of flooding of the component cooling water pump room by leakage through the door is not as critical as a piping failure inside the room. Each pump room has one three in. floor drain leading to a sump at elevation -35.0 ft. MSL. All three compartments contain only Component Cooling Water System piping. The maximum nominal pipe size is 20 in., and the maximum operating fluid conditions are 162° F and 110 psig.

←(DRN 06-291, R14-B)

→(DRN 99-2225, R11)

For the flooding analysis, the highest flow crack would be in the discharge piping of the pumps. The resulting maximum flow from the pipe is 462 gpm. Fluid leakage through the door is assumed to be negligible for a conservative flooding analysis inside the room. Without taking credit for the floor drainage system it was found that the time required for the fluid level to reach one foot in the compartment is approximately five minutes. The pump is mounted on one foot high concrete pedestal. The operator is alerted to excessive leakage in the closed component cooling water system by level switches in the CCW surge tank and loss of flow from the particular train which has the crack. In addition to the failure of the pump located in the room, the standby pump cannot be aligned in the second channel, because of the postulated through wall crack in the common discharge header. The two channels are automatically isolated by level switches in the surge tank. One channel with a 100 percent capacity pump is still available for mitigating the consequences of the original crack. The Component Cooling Water system design permits plant operation with one 100 percent capacity operating or safe plant shutdown if needed. Active failures are not postulated in the redundant train as per APCSB 3-1, Section B.3.b(3). Refer to Subsection 3.6.1.3(e).

3.6A.6.4.2.4 Emergency Diesel Generator Rooms

The Emergency Diesel Generators are located in the Reactor Auxiliary Building at elevation +21.0 ft. MSL. Access to the Diesel Generator rooms is via doors from the south corridor (see Figure 1.2-9). The west room also has an access door from the Component Cooling Water Heat Exchanger room. There is no access between the two Diesel Generator rooms.

The two compartments contain Component Cooling Water and Fire Protection piping. For flooding analysis the highest flow crack would be in a six inch Component Cooling Water pipe. The resulting postulated room flooding will not reach six inches in thirty minutes. A walkdown of the room confirmed that important to safety equipment which could be impacted from rising water is located at least six inches above the floor. Therefore there is no adverse impact to plant safety due to postulated flooding from a moderate energy line crack.

3.6A.6.4.2.5 Emergency Diesel Generator Storage Tank and Feed Tank Rooms

There are fire protection lines in the Emergency Diesel Generator Storage Tank and Feed Tank Rooms which are postulated to flood the room in less than thirty minutes due to a moderate energy crack. Since there are redundant systems / components located in separate rooms available to provide the necessary functions for the safe shutdown of the plant and therefore there is no adverse impact to plant safety.

3.6A.6.4.2.6 Component Cooling Heat Exchanger Rooms

The Component Cooling Heat Exchanger Rooms do not have any safety related equipment below thirty inches from the floor. Therefore the analysis for these rooms uses a maximum flood level of less than thirty inches in thirty minutes. The resulting analysis shows that the flood level will be less than thirty inches in thirty minutes and therefore there is no adverse impact to plant safety due to postulated flooding from a moderate energy line crack.

←(DRN 99-2225, R11)

→ (DRN 99-2225, R11)

3.6A.6.4.2.7 Shutdown Cooling Heat Exchanger Rooms

The Shutdown Cooling Heat Exchanger Rooms do not have any safety related equipment below thirty inches from the floor. Therefore the analysis for these rooms uses a maximum flood level of less than thirty inches in thirty minutes. The resulting analysis shows that the flood level will be less than thirty inches in thirty minutes and therefore there is no adverse impact to plant safety due to postulated flooding from a moderate energy line crack.

3.6A.6.4.2.8 Elevator Room

There is a fire protection line in the Elevator Room which is postulated to flood the room in approximately twenty five minutes due to a moderate energy line crack. Fans located in this area provide ventilation of the battery room. The loss of the exhaust fans has been reviewed by the Fire Hazard Analysis and it was determined that the ventilation of the battery rooms will not be adversely affected. Therefore there is no adverse impact to plant safety due to postulated flooding from a moderate energy line crack to the fire protection line in this room.

3.6A.6.4.2.9 Remote Shutdown Room

In the Remote Shutdown Panel Room there are two fire protection lines which could potentially flood the room in less than thirty minutes. Since there is no redundant Remove Shutdown Panel an evaluation of the pipe stresses was performed. It was determined that the design pipe stresses are below the code allowable for postulating moderate energy crack [$0.4 (1.2 S_H + S_A)$] and therefore flooding from these lines is not postulated. Therefore there is no adverse impact to plant safety due to postulated flooding from a moderate energy line crack.

3.6A.6.4.2.10 Wet Cooling Tower Areas

There are lines in the Wet Cooling Tower Areas which are postulated to flood the area in less than thirty minutes due to a moderate energy crack. Since there is a redundant Wet Cooling Tower located in a separate area available to provide the necessary functions for the safe shutdown of the plant there is no adverse impact to plant safety. In addition for the circulating water and fire protection lines in this area which could potentially flood the area in less than thirty minutes it was determined that the design pipe stresses are below the code allowable for postulating moderate energy crack [$0.4 (1.2 S_H + S_A)$] and therefore flooding from these lines is not postulated. Therefore there is no adverse impact to plant safety due to postulated flooding from a moderate energy line crack.

3.6A.6.4.2.11 West & East Vault Areas

There are lines in the West and East Vault Areas, which are postulated to flood the area in less than thirty minutes due to a moderate energy crack. Since the equipment located in West and East vault areas are redundant and their locations separated from each other, the redundant systems / equipment will be available to provide the necessary functions for the safe shutdown of the plant. There is not adverse impact to plant safety due to postulated flooding from a moderate energy line crack.

← (DRN 99-2225, R11)

3.6A.7 MAIN CONTROL ROOM HABITABILITY

The main steam and feedwater pipe routing near the main control room is shown on Drawing G134. The main control room is protected from the whipping pipe by providing whip restraints for the breaks postulated in the main steam and feedwater piping. In addition it is also observed that the fluid jet from the main steam or feedwater break will not impinge on the main control room. Thus the main control room habitability is not jeopardized by the dynamic effects of pipe rupture.

TABLE 3.6A-1 Revision 307 (07/13)

STEAM GENERATOR BLOWDOWN SYSTEM - PIPE WHIP RESTRAINTS
INSIDE CONTAINMENT

Line Designation	Pipe Break No.	Type of Break	Pipe Whip Restraint Identification No.	Protection Direction	Type of* Restraint
2BD4-2	R-HBD-2-8 at S/G Nozzle	C	R-BD-2-R-7	-z	Soft
2BD2-71	R-HBD-71-14	C	No Restraint	-	-
2BD4-2	R-HBD-2-9	C	No Restraint	-	-
2BD4-2	R-HBD-2-10	C	R-BD-2-R-9	+y	Soft
			R-BD-2-R-10	-y	Soft
2BD4-2	R-HBD-2-11	C	Biological Wall Penetration	+y	Hard
			R-BD-2-R-12	-y	Soft
2BD4-2	R-HBD-2-12	C	R-BD-2-R-11	-x	Hard
			R-BD-2-R-13	+x	Soft
			R-BD-2-R-23	+x	Hard
2BD4-2	R-HBD-2-13	C	R-BD-2-R-24	-x; -z	Soft
			Anchor @ Pen. #6	+x; +z	Hard
2BD4-1	R-HBD-1-1 at S/G Nozzle	C	R-BD-1-R-1	+z	Hard
→(EC-8435, R307)					
2BD2-71	R-HBD-71-7	C	R-BD-1-R-26	+y	Hard
			R-BD-1-R-2	-z	Hard
←(EC-8435, R307)					
2BD4-1	R-HBD-1-2	C	R-BD-1-R-2	+x	Hard
			R-BD-1-R-4	-x	Hard
2BD4-1	R-HBD-1-3	C	R-BD-1-4-3	-z	Hard
			No Restraint	-	-
2BD4-1	R-HBD-1-4	C	R-BD-1-R-25	+z	Hard
			R-BD-1-R-5	-z	Soft
2BD4-1	R-HBD-1-5	C	R-BD-1-R-6	-y	Soft
			Biological Wall Penetration	+y	Hard
2BD4-1	R-HBD-1-6	C	R-BD-1-R-28 Anchor at Pen. #5	+x; -z	Hard

*Soft - This type of restraint utilizes the U-bolt materials' strength characteristics in absorbing the energy of the whipping pipel

Hard - This type of restraint transmits the energy of the whipping pipe to the attached structure.

NOTE; C - Circumferential Break L - Slot Break

TABLE 3.6A-2

REACTOR COOLANT SYSTEM DRAIN LINES - PIPE WHIP RESTRAINTS
INSIDE CONTAINMENT

Line Designation	Pipe Break No.	Type of Break	Pipe Whip Restraint Identification No.	Protection Direction	Type of* Restraint
IRC2-46RLIA	R-HRC-46 RLIA-5	C	R-RC-46 RLIA-R-2	± y	Hard
IRC2-46RLIA	R-HRC-46 RLIA-6	C	R-RC-46 RLIA-R-2	± y	Hard
IRC2-46RLIA	R-HRC-46 RLIA-8	C	R-RC-46 RLIA-R-2	± y	Hard
IRC2-47RLIB	R-HRC-47 RLIB-9	C	R-RC-47 RLIB-R-3	± y	Hard
IRC2-47RLIB	R-HRC-47 RLIB-10	C	R-RC-47 RLIB-R-3	± y	Hard
IRC2-47RLIB	R-HRC-47 RLIB-12	C	R-RC-47 RLIB-R-3	± Y	Hard
IRC2-48RL2A	R-HRC-48 RL2A-1	C	R-RC-48 RL2A-R-1	± y	Hard
IRC2-48RL2A	R-HRC-48 RL2A-2	C	R-RC-48 RL2A-R-1	± y	Hard
IRC2-48RL2A	R-HRC-48 RL2A-4	C	R-RC-48 RL2A-R-1	± y	Hard
IRC2-50A/B	R-HRC-50 A/B-13	C	R-RC- 50A/B-R-4	± y	Hard
IRC2-50A/B	R-HRC-50 A/B-16	C	R-RC- 50A/B-R-4	± y	Hard

NOTE: C - Circumferential Break L - SLot Break

TABLE 3.6A-3 (Sheet 1 of 5) Revision 307 (07/13)

SAFETY INJECTION SYSTEM - PIPE WHIP RESTRAINTS - LOOP "2A"
INSIDE CONTAINMENT

Line Designation	Pipe Break No.	Type of Break	Pipe Whip Restraint Identification No.	Protection Direction	Type of* Restraint
2SI12-137-TK2A	R-HSI-137-35	C			
2SI12-137-TK2A	R-HSI-137-36	L;C			
1SI12-136-RL2A	R-HSI-136-37	L;C	R-SI-136-R-25	±x;-y	Soft
1SI12-136-RL2A	R-HSI-136-38	L;C	R-SI-135-R-26	+z;+x	Soft
ISI12-136-RL2A	R-HSI-136-39	L;C			
→(EC-8439, R307)		L;C	R-RC-39-R-15	-x	Hard
1RC12-39 RL2A	R-HRC-39-9 (Note 1)		R-RC-39-R-(Note 1) 14	+z,±y	Hard
	R-HSI-135 (Note 1) 45	L;C	R-SI-135-R 28	±y,+x	Hard
←(EC-8439, R307)					
1RC12-39 RL2A	R-HRC-39-3	C	R-RC-39-R-14A	+z	Hard
			R-RC-39-R-16A	-z	Hard
1RC12-39 RL2A	R-HRC-39-7	C;L	R-RC-39-R-16A	+x;-z	Hard
			R-RC-39-R-15A	±x;±y	Hard
1S18-134 RL2A	R-HSI-135-40 at branch	C	R-SI-134-R-29	+x	Hard
1SI8-134 RL2A	R-HSI-134-43	C;L	R-SI-134-R-31	+z;±y	Soft
1SI3-133 RL2A	R-HSI-133-44	C	R-SI-133-R-32	-z;-x	Hard
2SI2-152 TK2A	R-HSI-152-45	C	No Restraint	-	-

NOTE: C - Circumferential Break L - SLot Break

→(EC-8439, R307)
1 Pipe Breaks R-HRC-39-9 and R-HSI-135-45 and pipe whip restraint function of R-RC-39-R-14 deleted by EC8439.
←(EC-8439, R307)

TABLE 3.6A-3 (2 of 5)

SAFETY INJECTION SYSTEM - PIPE WHIP RESTRAINTS - LOOP "1A"

Line Designation	Pipe Break No.	Type of Break	Pipe Whip Restraint Identification No.	Protection Direction	Type of* Restraint
2SI12-121 TK1A	R-HSI-121-24	C			
2SI12-121 TK1A	R-HSI-121-25	C;L	R-SI-119-R-17	-y;±x	Soft
1SI12-120 TK1A	R-HSI-120-26	C;L	R-SI-119-R-34	-x;-z	Hard
1SI12-120 TK1A	R-HSI-120-27	C;L			
1SI12-119 RL1A	R-HSI-119-28	C;L	R-SI-119-R-17	-y;±z	Soft
1SI12-119 RL1A	R-HSI-119-29	C	R-SI-119-R-34	-x;-z	Hard
1SI12-119 RL1A	R-HSI-119-31	C;L	R-SI-119-R-19	-z;±x	Hard
1RC12-37 RL1A	R-HRC-37-10	C;L	R-RC-37-R-9	±y	Soft
			R-RC-37-R-10	+z;-x	Hard
1RC12-37 RL1A	R-HRC-37-2	C	R-RC-37R-11	-z	Hard
	R-HRC-37-5	C;L	R-RC-37-R-13	+z;±y	Hard
			R-RC-37-R-12	-x	Hard
1SI3-117 RL1A	R-HSI-117-34	C	R-SI-117-R-20	-z	Hard
1SI8-118 RL1A	R-HSI-118-33	C;L	No Restraint	-	-
5SI2-94	R-HSI-94-46	C	No Restraint	-	-

NOTE: C - Circumferential Break L - Slot Break

TABLE 3.6A-3 (Sheet 3 of 5) Revision 307 (07/13)

SAFETY INJECTION SYSTEM - PIPE WHIP RESTRAINTS - LOOP "1B"

Line Designation	Pipe Break No.	Type of Break	Pipe Whip Restraint Identification No.	Protection Direction	Type of* Restraint
2SI12-129 TK1B	R-HSI-129-11	C	No Restraint	-	-
2SI12-129 TK1B	P-HSI-129-12	C;L			
1SI12-128-TK1B	R-HSI-128-13	C;L			
1SI12-128-TK1B	R-HSI-128-14	C;L	R-SI-128-R-10	±x;±z	Hard
1SI12-128-TK1B	R-HSI-128-15	C;L	R-SI-127-R-11A	±y	Hard
1SI12-127 RL1B	R-HSI-127-16	C			
1SI12-127 RL1B	R-HSI-127-18	C;L	R-SI-127-R-11	-x;±y	Hard
1RC12-38 RL1B	R-HRC-38-8	C;L	R-RC-38-R-6	±y;+z	Hard
→(EC-8439, R307)					
1RC12-38 ←(EC-8439, R307) RL1B	R-HRC-38-1 (Note 1)	C	R-RC-38-R-(Note 1) 5	+z	Soft
			R-RC-38-R-7	+x;-z	Hard
1RC12-38 RL1B	R-HRC-38-6	C;L	R-RC-38-R-8	±x;±y	Soft & Hard
1SI3-125 RL1B	R-HSI-125-21	C	R-SI-125-R-12	+x	Hard
1SI3-125 RL1B	R-HSI-125-23	C	R-SI-125-R-13	+x;-z	Hard
(DRN 07-39, R15)					
1SI1-151 TK1B	R-HSI-137 20	C	No Restraint	-	-
(DRN 07-39, R15)					

SAFETY INJECTION SYSTEM - PIPE WHIP RESTRAINT - LOOP "2B"

2SI12-145 TK2B	R-HSI-145-1	C	No Restraint	-	-
25I12-145 TK2B	R-HSI-145-2	C;L	No Restraint	-	-
1SI12-144 TK2B	R-HSI-144-3	C;L	No Restraint	-	-
1SI12-144 TK2B	R-HSI-144-4	C;L	No Restraint	-	-
1SI12-144 TK2B	R-HSI-144-4	C;L	R-SI-144-R-2	+y	Hard

NOTE: C - Circumferential L - Slot Break

→(EC-8439, R307)
1 Pipe Break R-HRC-38-1 and pipe whip restraint function of R-RC-38-R-5 deleted by EC8439.
←(EC-8439, R307)

TABLE 3.6A-3 (Sheet 4 of 5) Revision 307 (07/13)

SAFETY INJECTION SYSTEM - PIPE WHIP RESTRAINTS - LOOP "2B" (Cont'd)

Line Designation	Pipe Break No.	Type of Break	Pipe Whip Restraint Identification No.	Protection Direction	Type of* Restraint
2SI2-153 TK2B	R-HSI-153-10 11	C	No Restraint	-	-
1SI12-143 RL2B	R-HSI-143-6	C;L	R-SI-143-R-3	-z;±x	Hard
1RC12-40 RL2B	R-HRC-40-11	C;L	R-RC-40-R-1	±y	Soft
			R-RC-40-R-2	±x;±y;±z	Hard
1RC12-40 RL2B	R-HRC-40-4	C;L	R-RC-40-R-3	-z;±x	Soft & Hard
			R-RC-40-R-4	+z;-x	Soft
1SI8-142 RL2B	R-HSI-142-8	C;L	No Restraint	-	-
1SI3-141 RL2B	R-HSI-141-9	C	No Restraint	-	-

SAFETY INJECTION SYSTEM - PIPE WHIP RESTRAINTS - HOT LEG INJECTION LOOP 1 AND SHUTDOWN COOLING

Line Designation	Pipe Break No.	Type of Break	Pipe Whip Restraint Identification No.	Protection Direction	Type of* Restraint
1SI3-215	R-HSI-215-29	C	R-SI-215-R-18	-z;+x	Soft
1S13-215	R-HSI-215-28	C	R-SI-215-R-21	+z	Soft
1SI3-215	R-HSI-215-27	C	R-SI-215-R-20	+y	Soft
1SI3-215	R-HSI-215-25	C	R-SI-215-R-19	+x;-z	Hard
1RC14-44 RL1	R-HRC-44RLI1-17	C;L	R-RC-44RL1-R-14	-y	Hard
			R-RC-44RL1-R-13	-z	Soft
→(EC-8439, R307) 1RC14-44 RL1 ←(EC-8439, R307)	R-HRC-44RL1-(Note 1) 19	C;L	R-RC-44RL1-R-(Note 1) 16	+x;±y	Soft
			R-RC-44RL1-R-15	-z	Soft
			R-RC-44RL1-R-17	±z;±x	Hard

NOTE: C - Circumferential Break L - Slot Break

→(EC-8439, R307)
1 Pipe Break R-HRC-44RL1-19 and pipe whip restraint function of R-RC-44RL1-R-16 deleted by EC8439.
←(EC-8439, R307)

TABLE 3.6A-3 (Sheet 5 of 5) Revision 307 (07/13)

SAFETY INJECTION SYSTEM - PIPE WHIP RESTRAINTS - HOT LEG INJECTION LOOP 1 AND SHUTDOWN COOLING

Line Designation	Pipe Break No.	Type of Break	Pipe Whip Restraint Identification No.	Protection Direction	Type of* Restraint
1RC14-44 RL1	R-HRC-44RL1-20	C,L	R-RC-44RL1-R-17	±x;±z	Hard
1SI14-146B	R-HSI-146B-21	C			
	R-HSI-146B-23	C			

SAFETY INJECTION SYSTEM - PIPE WHIP RESTRAINTS - HOT LEG INJECTION LOOP 2 AND SHUTDOWN COOLING

Line Designation	Pipe Break No.	Type of Break	Pipe Whip Restraint Identification No.	Protection Direction	Type of* Restraint
1SI3-214	R-HSI-214-15	C	R-SI-214-R-8	-x;-z	Soft
1SI3-214	R-HSI-214-9	C	R-SI-214-R-9	-y	Hard
1SI3-214	R-HSI-214-8	C	R-SI-214-R-11	-z	Hard
1SI3-214	R-HSI-214-11	C			
1SI3-214	R-HSI-214-12	C	R-SI-214-R-10	-x	Hard
1SI3-214	R-HSI-214-13	C			
→(EC-8439, R307)					
1SI14-146A	R-HSI-146A 1	C	R-RC-45RL2-R-5	±x;±z	Hard & Soft
1SI14-146A	R-HSI-146A-3	C	R-SI-18A-R-7	+z;-x	Soft
1RC14-45RL2	R-HRC-45RL2-4	C	R-4		
1RC14-45RL2	R-HRC-45RL2-(Note 1) 7	C,L	R-RC-45RL2-R-3	-z	Soft
			R-RC-45RL2-(Note 1) R-4	-x;±z	Soft
			R-RC-45RL2-R-5	±x;±z	Hard
1RC14-45RL2	R-HRC-45RL2-6	C	R-RC-45RL2-R-1	±y	Hard
←(EC-8439, R307)					

NOTE: C - Circumferential Break L - Slot Break

→(EC-8439, R307)
1 Pipe Break R-HRC-45RL2-7 and pipe whip restraint function of R-RC-45RL2-R-4 deleted by EC8439.
←(EC-8439, R307)

TABLE 3.6A-4

CHEMICAL AND VOLUME CONTROL (LETDOWN) - PIPE WHIP RESTRAINTS
INSIDE CONTAINMENT

Line Designation	Pipe Break No.	Type of Break	Pipe Whip Restraint Identification No.	Protection Direction	Type of* Restraint
1RC2-43A/B	R-HRC-43 A/B-1	C	R-RC-43A/B-R-1	-y	Hard
1RC2-49RL2B	R-HRC-49RL2 B-2	C	No Restraint	-	-
1CH2-58A/B	R-HCH-58A/B-3	C	R-RC-43A/B-R-2	+x	Soft
			R-CH-59A/B-R-3	-x	Soft
2CH2-59A/B	R-HCH-59A/B-4	C	R-CH-59A/B-R-4	-y	Hard
2CH2-189A/B	R-HCH-189A/B-5	C	R-CH-189A/B-R-5	-y	Hard
2CH2-189A/B	R-HCH-189A/B-6	C }	R-CH-189A/B-R-6	-z	Hard
2CH2-189A/B	R-HCH-189A/B-7	C }	R-CH-188A/B-R-7	+z	Hard
2CH3-188A/B	R-HCH-188A/B-8	C	R-CH-188A/B-R-8 Anchor at Pen. #26	-z;+x	Hard

NOTE: C- Circumferential Break L- Slot Break

TABLE 3.6A-5 (1 of 2)

CHEMICAL AND VOLUME CONTROL - (CHARGING) - PIPE WHIP RESTRAINTS
INSIDE CONTAINMENT

Line Designation	Pipe Break No.	Type of Break	Pipe Whip Restraint Identification No.	Protection Direction	Type of* Restraint
2CH2-53A/B	R-HCH-190 A/B-1	C	R-CH-190A/B R-1	-y	Hard
2CH2-191A/B	R-HCH-191 A/B-2	C	R-CH-191A/B R-2	+x	Hard
2CH2-191A/B	R-HCH-191 A/B-3	C	R-CH-191A/B-R-2	+x	Hard
2CH2-191A/B	R-HCH-191 A/B-4	C	R-CH-191A/B-R-2	+x	Hard
2CH2-55A/B	R-HCH-55 A/B-5	C	R-CH-55A/B-R-3	-x	Hard
2CH2-56A	R-HCH-56-7	C			
1CH2-57A	R-HCH-57A-7	C			
2CH2-77A	R-HCH-77A-8	C	R-CH-55A/B-R-5	-x	Hard
1CH2-78A	R-HCH-77A-9	C	R-RC-41RL1-R-7	+x	Hard
1CH2-78A	R-HCH-78A-10	C	R-CH-55A/B-R-4	-y	Hard
1CH2-78A	R-HCH-78A-11	C			
1CH2-57A	R-HCH-57A-12	C	R-CH-57A-R-6	+z	Hard
1RC2-41RL1	R-HRC-41RL1-13	C	R-RC-41RL1-R-8	-z	Hard
1RC2-41RL1	R-HRC-41RL1-15	C	R-RC-41RL1-R-9	+z	Hard
2CH2-56B	R-HCH-56B-16	C			
1CH2-57B	R-HCH-57B-17	C	R-CH-55A/B-R-10	±x	Hard
1CH2-57B	R-HCH-57B-18	C	R-RC-42RL2-R-11	+x	Hard
1RC2-42RL2	R-HRC-42RL2-19	C			
1RC2-42RL2	R-HRC-42RL2-25	C	R-HRC-42RL2-R-13	+y	Hard

NOTE: C - Circumferential L - Slot Break

TABLE 3.6A-5 (2 of 2)

CHEMICAL AND VOLUME CONTROL - (CHARGING) - PIPE WHIP RESTRAINTS INSIDE CONTAINMENT

Line Designation	Pipe Break No.	Type of Break	Pipe Whip Restraint Identification No.	Protection Direction	Type of* Restraint
2CH2-56A/B	R-HCH-56 A/B-23	C			
1CH2-57A/B	R-HCH-57 A/B-22	C	R-RC-55A/B-R-12	-x	Hard
1CH2-57A/B	R-HCH-57 A/B-21	C	R-CH-55A/B-R-10	±x	Hard
1RC2-55A/B	R-HRC-55 A/B-20	C			
1RC2-55A/B	R-HRC-55A/B-10	C	No Restraint	---	---
1RC2-55A/B	R-HRC-55A/B-11	C	No Restraint	---	---
1RC2-55A/B	R-HRC-55A/B-12	C	No Restraint	---	---

NOTE: C - Circumferential Break L - Longitudinal Slot Break

TABLE 3.6A-6

PRESSURIZER RELIEF SYSTEM - PIPE WHIP RESTRAINTS

Line Designation	Pipe Break No.	Type of Break	Pipe Whip Restraint Identification No.	Protection Direction	Type of* Restraint
1RC3-18A	R-HRC-18A-8	C	No Restraints Required		
1RC3-18A	R-HRC-18A-9	C	No Restraints Required		
1RC3-18B	R-HRC-18B-1	C	No Restraints Required		
1RC3-18B	R-HRC-18B-2	C	No Restraints Required		

NOTE: Circumferential Break L - Slot Break

TABLE 3.6A-7

PRESSURIZER SPRAY SYSTEM - PIPE WHIP RESTRAINTS
INSIDE CONTAINMENT

Line Designation	Pipe Break No.	Type of Break	Pipe Whip Restraint Identification No.	Protection Direction	Type of* Restraint
1RC4-16A/B	R-HRC-16A/B-1	C	R-RC-16A/B-R-1	+y	Hard
1RC4-16A/B	R-HRC-16A/B-2	C	R-RC-16A/B-R-3	-y	Soft
1RC4-16A/B	R-HRC-16A/B-2	L	R-RC-16A/B-R-2	±x	Hard
1RC3-14A	R-HRC-14A-7	C	R-RC-12A-R-4	+z	Soft
			R-RC-12A-R-10	+z	Soft
			No Restraint in -z direction	-	-
1RC3-12A	R-HRC-12A-8	C	R-RC-12A-R-5	-y	Soft
			No Restraint in +y direction	-	-
1RC3-12A	R-HRC-12A-9	C	R-RC-12A-R-9	+y	Hard
1RC3-15B	R-HRC-15B-3	C }	R-RC-13B-R-6	-x	Soft
	R-HRC-15B-4	C }	No Restraint in +x direction	-	-
1RC3-13B	R-HRC-13B-5	C	R-RC-13B-R-7	-y	Hard
1RC3-13B	R-HRC-13B-6 at RCS nozzle	C	R-RC-13B-R-8	+y	Hard

NOTE: C - Circumferential L - Slot Break

TABLE 3.6A-8 Revision 307 (07/13)

PRESSURIZER SURGE - PIPE WHIP RESTRAINTS - INSIDE CONTAINMENT

Line Designation	Pipe Break No.	Type of Break	Pipe Whip Restraint Identification No.	Protection Direction	Type of* Restraint
1RC12-11A/B	R-HRC-11A/B-1 @ RCS Loop Nozzle	C	R-RC-11A/B-R-1	±y	Soft
1RC12-11A/B	R-HRC-11A/B-2	L	R-RC-11A/B-R-1	±y	Soft
1RC12-11A/B	R-HRC-11A/B-2	C	R-RC-11A/B-R-3	+z;±y	Hard
1RC12-11A/B	R-HRC-11A/B-3	L	R-RC-11A/B-R-2	±y	Soft and Hard
1RC12-11A/B	R-HRC-11A/B-3	C	R-RC-11A/B-R-3	+z	Hard
1RC12-11A/B	R-HRC-11A/B-4	C	R-RC-11A/B-R-2	+x	Soft and Hard
			R-RC-11A/B-R-5	-x	Soft
1RC12-11A/B →(EC-8439, R307)	R-HRC-11A/B-4	L	R-RC-11A/B-R-3	±y	Hard
1RC12-11A/B ←(EC-8439, R307)	R-HRC-11A/B-5	L	R-RC-11A/B-R-4 (Note 1)	±y	Soft
1RC12-11A/B	R-HRC-11A/B-5	C	R-RC-11A/B-R-2	+x	Soft and Hard
			R-RC-11A/B-R-5	-x	Soft
1RC12-11A/B →(EC-8439, R307)	R-HRC-11A/B-6	L	R-RC-11A/B-R-5	±y	Soft
1RC12-11A/B ←(EC-8439, R307)	R-HRC-11A/B-6	C	R-RC-11A/B-R-4 (Note 1)	-z	Soft
			R-RC-11A/B-R-7	+z	Hard
1RC12-11A/B →(EC-8439, R307)	R-HRC-11A/B-7	L	R-RC-11A/B-R-6	±y	Soft
1RC12-11A/B ←(EC-8439, R307)	R-HRC-11A/B-7	C	R-RC-11A/B-R-4 (Note 1)	-z	Soft
			R-RC-11A/B-R-7	+z	Hard
1RC12-11A/B	R-HRC-11A/B-8	L }	R-RC-11A/B-R-7	±y	Hard
1RC12-11A/B	R-HRC-11A/B-8	C }	R-RC-11A/B-R-6	-x	Soft
1RC12-11A/B	R-HRC-11A/B-9	C }	No Restraint in +x Direction		
1RC12-11A/B	R-HRC-11A/B-9	L	R-RC-11A/B-R-8	±y	Hard
1RC12-11A/B	R-HRC-11A/B-10	L	R-RC-11A/B-R-8	±y	Hard
1RC12-11A/B	R-HRC-11A/B-10	C	R-RC-11A/B-R-8	-z	Hard
			No Restraint in +z Direction		
1RC12-11A/B	R-HRC-11A/B-11	L	R-RC-11A/B-R-10	±y	Soft
1RC12-11A/B	R-HRC-11A/B-11	C	R-RC-11A/B-R-8	-z	Hard
			No Restraint +z Direction		
1RC12-11A/B	R-HRC-11A/B-12	L	Pressurizer Nozzle		
1RC12-11A/B	R-HRC-11A/B-12	C	R-RC-11A/B-R-10	-y	Soft
			To Pressurizer Nozzle		
1RC12-11A/B	R-HRC-11A/B-13 @ Pressurizer Nozzle	C	R-RC-11A/B-R-10	-y	Soft

→(EC-19087, R305; EC-8439, R307)

Note 1: Except for pipe whip restraint R-RC-11A/B-R-4 which is removed by EC8439, the above listed restraints are no longer required as approved by LBB analysis (EC-19087). The remaining above-listed restraints are retained since these restraints still exist in the plant.

←(EC-19087, R305)

Note 2: C - Circumferential Break L- Slot Break

←(EC-8439, R307)

TABLE 3.6A-9 Revision 4 (12/90)

SUMMARY OF DESIGN BASIS BREAKS

MAIN STEAM PIPING - INSIDE CONTAINMENT
MAIN STEAM LINE A

NODE	LOCATION TYPE	REASON FOR SELECTION
10	Anchor at Nozzle	Terminal Point
30	Elbow	High Combined Stresses
40	Elbow	High Combined Stresses
110	Elbow	High Combined Stresses
1100	Elbow	High Combined Stresses
150	Anchor at Containment	Terminal Point

TABLE 3.6A-10

SUMMARY OF DESIGN BASIS BREAKS

MAIN STEAM PIPING - INSIDE CONTAINMENT
MAIN STEAM LINE B

NODE	LOCATION TYPE	REASON FOR SELECTION
2230	Anchor at Nozzle	Terminal Point
2210	Elbow	High Combined Stresses
2200	Elbow	High Combined Stresses
2130	Elbow	High Combined Stresses
2120	Elbow	High Combined Stresses
2090	Anchor at Containment	Terminal Point

TABLE 3.6A-11

SUMMARY OF DESIGN BASIS BREAKS

FEEDWATER PIPING - INSIDE CONTAINMENT
FEEDWATER LINE A

NODE	LOCATION TYPE	REASON FOR SELECTION
10	Anchor at Nozzle	Terminal Point
80	Elbow	High Combined Stresses
800	Elbow	High Combined Stresses
150	Elbow	High Combined Stresses
160	Elbow	High Combined Stresses
190	Anchor at Containment	Terminal Point

TABLE 3.6A-12

SUMMARY OF DESIGN BASIS BREAKS

FEEDWATER PIPING - INSIDE CONTAINMENT
FEEDWATER LINE B

NODE	LOCATION TYPE	REASON FOR SELECTION
9180	Anchor at Nozzle	Terminal Point
9105	Elbow	High Combined Stresses
9100	Elbow	High Combined Stresses
9040	Elbow	High Combined Stresses
9030	Elbow	High Combined Stresses
9000	Anchor at Containment	Terminal Point

TABLE 3.6A-13

MAIN STEAM - PIPE WHIP RESTRAINTS - INSIDE CONTAINMENT

Line Designation	Pipe Whip Restraint Identification No.	Protection Direction
MS Line A	Node # 25	+x, -z
MS Line A	45	+y
MS Line A	55	+y
MS Line A	75	-x, +z
MS Line A	105	-x, +z
MS Line A	105	+x, -z
MS Line A	125	-y
MS Line B	Node # 2225	-x, -z
MS Line B	2195	+y
MS Line B	2185	+y
MS Line B	2165	+x, +z
MS Line B	2135	+x, +z
MS Line B	2135	-x, -z
MS Line B	2115	-y
MS Line B	2092*	-y, +z

* Guard Pipe

TABLE 3.6A-14 Revision 15 (03/07)

FEEDWATER - PIPE WHIP RESTRAINTS - INSIDE CONTAINMENT

Line Designation	Pipe Whip Restraint Identification No.	Protection Direction
FW Line A	Node # 15	+z
FW Line A	100	-x, +y
FW Line A	31	-x
FW Line A	41	-y
→(DRN 06-734, R15)		
FW Line A	6005	+x, -x
FW Line A	6005	+z,-z
←(DRN 06-734, R15)		
FW Line A	700	-z
FW Line A	9	+y
FW Line A	101	-x
FW Line A	101	+y
FW Line A	120	+z
FW Line A	141	-x, -z
FW Line A	161	-y
FW Line B	Node # 9175	+z
FW Line B	9170	+x, +y
FW Line B	9156	+x
FW Line B	9141	-y
FW Line B	9130	-x
FW Line B	9130	-z
FW Line B	9110	-z
FW Line B	910	+y
FW Line B	9081	+x
FW Line B	9081	+y
FW Line B	9060	+z
FW Line B	9041	-x, -z
FW Line B	9021	-y

TABLE 3.6A-15 (Sheet 1 of 2)

CVCS - CHARGING - PIPE WHIP RESTRAINTS - OUTSIDE CONTAINMENT

Line Designation	Pipe Break No.	Type of Break	Pipe Whip Restraint Identification No.	Protection Direction	Type of Restraint
2CH2-51A/B	A-HCH-51A/B-1	C	A-CH-51A/B-R-25	+x ; +z	Hard
	@ Pump A/B Nozzle				
	& A-HCH-51a/b-2	C	A-CH-51A/B-R-25	+x ; +z	Hard
2CH1 1/2-	A-HCH-154A/B-3	C	A-CH-51A/B-R-24	-y	Hard
154A/B	& A-HCH-154A/B-4	C	A-CH-153A/B-R-26	+y	Hard
2CH2-51A/B	A-HCH-51A/B-5	C	A-CH-51A/B-R-23	+y	Hard
			A-CH-51A/B-R-21	-y	Hard
2CH2-51A/B	A-HCH-51A/B-6	C	CHRR-93	+y	Hard*
			A-CH-51A/B-R-19	-y	Hard
2CH2-51A/B	A-HCH-51A/B-7	C	A-CH-51A/B-R-19	-y	Hard
			CHRR-93	+y	Hard*
2CH2-51A	A-HCH-51A-17	C	CHRR-400	+x ; +z	Hard*
	@ Nozzle Pump A				
2CH11/2-154A	A-HCH-154A-15	C	A-CH-51A-R-16	-y	Hard
	A-HCH-154A-16	C	A-CH-153A-R-18	+y	Hard
2CH2-51A	A-HCH-51A-14	C	A-CH-51A-R-15	+x	Hard
			A-CH-51A-R-13	-z	Hard
2CH2-51A	A-HCH-51A-13	C	A-CH-51A-R-14	+x ; -z	Hard
			A-CH-51A-R-12	-x ; +y	Hard
2CH2-51A	A-HCH-51A-12	C	A-CH-51A-R-11	-x ; +y	Hard
	& A-HCH-51A-11	C	A-CH-44A/B-R-8	-y	Hard
2CH2-44A/B	A-HCH-52A/B-10	C	A-CH-52A/B-R-6	+x	Hard
			A-CH-51A-R-10	±x	Hard
2CH2-52A/B	A-HCH-52A/B-9	C	A-CH-52A/B-R-7	-z	Hard
			A-CH-53A/B-R-4	+z	Hard
2CH2-52A/B	A-HCH-52A/B-8	C	A-CH-52A/B-R-5	-x	Hard
			A-CH-51A/B-R-20	+x	Hard
2CH2-53A/B	A-HCH-53A/B-18	C	A-CH-53A/B-R-3	-z	Hard
			A-CH-53A/B-R-1	+z	Hard
2CH2-53A/B	A-HCH-53A/B-19	C	A-CH-53A/B-R-2	-y	Hard
			A-CH-53A/B-R-56	+y	Hard

Note: C - Circumferential Break
L - Slot Break
* - Pipe Support Also

TABLE 3.6A-15 (Sheet 2 of 2)

CVCS - CHARGING - PIPE WHIP RESTRAINTS - OUTSIDE CONTAINMENT

Line Designation	Pipe Break No.	Type of Break	Pipe Whip Restraint Identification No.	Protection Direction	Type of Restraint
2CH2-44A/B	A-HCH-44A/B-20	C	A-CH-44A/B-R-9 A-CH-51A-R-10	-y	Hard
2CH2-53A/B	A-HCH-53A/B-21	C	No Restraint	----	----
2CH2-53A/B	A-HCH-53A/B	C	No Restraint	----	----
2CH2-53A/B	A-HCH-53A/B-23 at Penetration	C	A-CH-53A/B-R-67	+x ; +z	Hard
2CH2-51B	A-HCH-51B-24	C	A-CH-51B-R-27 CHRR-87	-y -x ; +y	Hard Hard*
2-CH2-51B	A-HCH-51B-25	C	A-CH-51B-R-28 A-CH-51B-R-30	-x +y	Hard Hard
2CH1 1/2-154B	A-HCH-154B-26 & A-HCH-154B-27	C C	A-CH-153B-R-33 A-CH-51B-R-31	+y -y	Hard Hard
2CH2-51B	A-HCH-51B-28 @ Pump B Nozzle	C	A-CH-51B-R-32	+x ; +z	Hard

Note: C - Circumferential Break
L - Slot Break
* - Pipe Support Also

TABLE 3.6A-16 (Sheet 1 of 2)

CVCS LETDOWN - PIPE WHIP RESTRAINTS - OUTSIDE CONTAINMENT

Line Designation	Pipe Break No.	Type of Break	Pipe Whip Restraint Identification No.	Protection Direction	Type of Restraint
2CH2-61A/B	A-HCH-61A/B-1	C	A-CH-61A/B-R-47	+y	Hard
2CH2-61A/B	A-HCH-61A/B-2	C	A-CH-61A/B-R-42 A-CH-61A/B-R-43	-x +x	Hard Hard
2CH2-61A/B	A-HCH-61A/B-3	C	A-CH-61A/B-R-47 A-CH-155A/B-R-50	+z -z	Hard Hard
2CH2-61A/B	A-HCH-61A/B-4	C	A-CH-155A/B-R-35 No Restraint in -x direction	+x	Hard
2CH3-155A/B	A-HCH-155A/B-5	C	A-CH-155A/B-R-51 CHRR--125	+y -y	Hard Hard*
2CH2-61A/B	A-HCH-61A/B-6	C	A-CH-155A/B-R-44 A-CH-61A/B-R-45	+y -y	Hard Hard
2CH2-118A/B	A-HCH-118A/B-7 & A-HCH-11A/B-8	C C	A-CH-61A/B-R-45 A-BM-353A/B-R-52	-y +y	Hard Hard
2CH2-102A/B	A-HCH-102A/B-9	C	No Restraints		
2CH2-101A/B	A-HCH-101A/B-10	C	A-CH-101A/B-R-55 A-CH-60A/B-R-54	-y +y	Hard Hard
2CH2-60A/B	A-HCH-60A/B-11	C	A-CH-6-A/B-R-57 A-CH-60A/B-R-59	-x +x	Hard Hard
2CH2-60A/B	A-HCH-60A/B-12	C	A-CH-60A/B-R-58 A-CH-60A/B-R-59A	-y +y	Hard Hard
2CH2-60A/B	A-HCH-60A/B-13	C	A-CH-60A/B-R-60 No Restraint	-x --	Hard --
2CH2-60A/B	A-HCH-60A/B-14	C	No Restraint A-CH-60A/B-R-66	-- -z	-- Hard
2CH2-60A/B	A-HCH-62A/B-15	C	A-CH-60A/B-R-65	+x ; +z	Hard
2CH2-62A/B	A-HCH-62A/B-18	C	A-CH-62A/B-R-49	-y	Hard
2CH2-62A/B	A-HCH-62A/B-19	C	A-CH-62A/B-R-48	-z	Hard

Note: C - Circumferential Break
L - Slot Break
* - Pipe Support Also

TABLE 3.6A-16 (Sheet 2 of 2)

CVCS LETDOWN - PIPE WHIP RESTRAINTS - OUTSIDE CONTAINMENT

Line Designation	Pipe Break No.	Type of Break	Pipe Whip Restraint Identification No.	Protection Direction	Type of Restraint
2CH2-62A/B	A-HCH-62A/B-20	C	A-CH-62A/B-R-38	-y	Hard
2CH2-62A/B	A-HCH-62A/B-19	C	A-CH-62A/B-R-39	+z	Hard
2CH2-195A/B	A-HCH-62A/B-20	C	A-CH-62A/B-R-40	+y	Hard
2CH2-195A/B	A-HCH-195A/B-22	C	A-CH-62A/B-R-46	+z	Hard
2CH2-195A/B	A-HCH-195A/B-21	C	A-CH-62A/B-R-34	+z	Hard
2CH2-195A/B	A-HCH-195A/B-22	C	A-CH-106A/B-R-41	-z	Hard
2CH2-106A/B	A-HCH-106A/B-17	C	A-CH-106A/B-R-53 A-CH-106A/B-R-37	+y +x	Hard Hard

Note: C - Circumferential Break
L - Slot Break

TABLE 3.6A-17

STEAM GENERATOR BLOWDOWN SYSTEM - PIPE WHIP RESTRAINTS

OUTSIDE CONTAINMENT

Line Designation	Pipe Break No.	Type of Break	Pipe Whip Restraint Identification No.	Protection Direction	Type Restraint
2BD4-2	A-HBD-4-21A	C	No Restraints	-	-
5BD4-4	A-HBD-4-21B	C	No Restraints	-	-
5BD4-4	A-HBD-41-21C	C	No Restraints	-	-
6BD8-48	A-HBD-48-21	C	A-BD-48-R-22	+z	Hard
6BD2-46	A-HBD-6-19	C	No Restraints	-	-
6BD2-46	A-HBD-6-20	C	No Restraints	-	-
5BD2-6	A-HBD-6-20A	C	No Restraints	-	-
5BD2-6	A-HBD-6-20B	C	No Restraints	-	-
2BD4-1	A-HBD-3-15A	C	No Restraints	-	-
5BD4-3	A-HBD-3-15B	C	No Restraints	-	-
5BD4-3	A-HBD-3-15	C	No Restraints	-	-
6BD8-47	A-HBD-47-18	C	A-BD-47-R-17	-z	Hard
6BD2-45	A-HBD-45-16	C	A-BD-47-R-17 A-BD-5-R-18	-x +x	Hard Hard
5BD2-5	A-HBD-5-16A	C	A-BD-3-R-14	+y	Hard

Note: C - Circumferential Break L - Slot Break

TABLE 3.6A-18 Revision 14 (12/05)

PIPE STRESSES VS. ALLOWABLES
AREA NEAR CONTAINMENT ISOLATION VALVES
OPERATING CONDITIONS

Main Steam Line A

Node	S_{press} (psi)	S_{dw} (psi)	$S_{eq + rv}$[1] (psi)	S_{th} (psi)	$S_{combined}$[2] (psi)	$.8(1.2S_h + S_a)$ (psi)
150	7393	94	2307	727	10521	37800
160	6979	90	1738	2063	10870	37800
170	6979	265	2137	2205	11586	37800
260	6979	276	2191	2841	12287	37800
280	6979	910	3224	2637	13750	37800
290	7393	641	1211	1104	10349	37800
310	7393	1190	710	872	10165	37800

Main Steam Line B

Node	S_{press} (psi)	S_{dw} (psi)	$S_{eq + rv}$[1] (psi)	S_{th} (psi)	$S_{combined}$[2] (psi)	$.8(1.2S_h + S_a)$ (psi)
2090	7393	252	2036	547	10228	37800
2080	6979	73	1078	1331	9461	37800
2070	6979	75	1245	1636	9935	37800
1980	6979	738	1232	2240	11189	37800
1930	6979	750	1057	2222	11008	37800
1920	7393	635	599	780	9407	37800
1890	7393	89	375	893	8750	37800

Notes:

1. Earthquake and relief valve transient forces are combined using square root sum-of-squares.

2. Combined stresses are the sum of Equations 9 and 10 of ASME Section III, Subarticle NC-3652.

→(DRN 03-2056, R14)

3. Values of stresses (pressure, dead weight, earthquake and relief valve transient, thermal, and combined) near the containment isolation valves(s) represent an historic summary of data developed to verify qualification of piping in the Break Exclusion Zone. For the current state of stress in the piping system, refer to the latest revision of the pipe stress analysis calculations.

←(DRN 03-2056, R14)

TABLE 3.6A-19 Revision 14 (12/05)

PIPE STRESSES VS. ALLOWABLES
AREA NEAR CONTAINMENT ISOLATION VALVES
PIPE RUPTURE CONDITION

Main Steam Line A

Node	S_{press} (psi)	S_{dw} (psi)	$S_{eq + rv}$[1] (psi)	S_{pr}[1] (psi)	$S_{combined}$[2] (psi)	1.8 S_h (psi)
150	7393	94	2307	22906	30509	31500
160	6979	90	1738	7332	20904	31500
170	6979	265	2137	6722	20344	31500
260	6979	276	2191	11259	28431	31500
280	6979	910	3224	11861	31088	31500
290	7393	641	1211	17777	25852	31500
310	7393	1190	710	21680	30275	31500

Main Steam Line B

Node	S_{press} (psi)	S_{dw} (psi)	$S_{eq + rv}$[1] (psi)	S_{pr}[1] (psi)	$S_{combined}$[2] (psi)	1.8S_h (psi)
2090	7393	252	2036	23630	31363	31500
2080	6979	73	1078	12708	21476	31500
2070	6979	75	1245	14934	24001	31500
1980	6979	738	1232	6607	20601	31500
1930	6979	750	1057	11127	28761	31500
1920	7393	635	599	14290	22331	31500
1890	7393	89	375	20030	27516	31500

Notes:

1. Earthquake, relief valve, and pipe rupture transient forces combined using square root sum-of-squares.

2. Stresses combined according to Equation 9 of ASME Section III, Subarticle NC-3652.

→(DRN 03-2056, R14)

3. Values of stresses (pressure, dead weight, earthquake and relief valve transient, thermal, and combined) near the containment isolation valves(s) represent an historic summary of data developed to verify qualification of piping in the Break Exclusion Zone. For the current state of stress in the piping system, refer to the latest revision of the pipe stress analysis calculations.

←(DRN 03-2056, R14)

TABLE 3.6A-20 Revision 14 (12/05)

PIPE STRESSES VS. ALLOWABLES
AREA NEAR CONTAINMENT ISOLATION VALVES
OPERATING CONDITIONS

Feedwater Line A

Node	S_{press} (psi)	S_{dw} (psi)	S_{eq} (psi)	S_{th} (psi)	$S_{combined}$[1] (psi)	$0.8(12S_h + S_a)$ (psi)
19	5391	3543	891	631	10546	37800
210	5213	521	174	1652	7560	37800
220	5213	1549	397	1306	8465	37800
24	5391	1350	487	1081	8309	37800

Feedwater Line B

Node	S_{press} (psi)	S_{dw} (psi)	S_{eq} (psi)	S_{th} (psi)	$S_{combined}$[1] (psi)	$0.8(12S_h + S_a)$ (psi)
900	5391	3562	894	2000	11851	37800
397	5213	517	174	850	6754	37800
2396	5213	1556	400	639	7808	37800
394	5391	1353	492	583	7819	37800

Notes:

1. Combined stresses are the sum of Equations 9 and 10 of ASME Section III, Subarticle NC-3652.

→(DRN 03-2056, R14)

2. Values of stresses (pressure, dead weight, earthquake, thermal, and combined) near the containment isolation valves(s) represent an historic summary of data developed to verify qualification of piping in the Break Exclusion Zone. For the current state of stress in the piping system, refer to the latest revision of the pipe stress analysis calculations.

←(DRN 03-2056, R14)

TABLE 3.6A-21 Revision 14 (12/05)

PIPE STRESSES VS. ALLOWABLES
AREA NEAR CONTAINMENT ISOLATION VALVES
PIPE RUPTURE CONDITION

Feedwater Line A

Node	S_{press} (psi)	S_{dw} (psi)	S_{eq}1 (psi)	S_{pr}1 (psi)	$S_{combined}$2 (psi)	1.8 S_h (psi)
19	5391	3543	891	15686	24645	31500
210	5213	521	174	8930	18187	31500
220	5213	1549	397	8244	18667	31500
24	5391	1350	487	9228	15982	31500

Feedwater Line B

Node	S_{press} (psi)	S_{dw} (psi)	S_{eq}1 (psi)	S_{pr}1 (psi)	$S_{combined}$2 (psi)	1.8 S_h (psi)
900	5391	3562	894	21844	30815	31500
397	5213	517	174	13577	24559	31500
2396	5213	1556	400	10839	22235	31500
394	5391	1353	492	10467	17223	31500

Notes:

1. Earthquake and pipe rupture transient forces combined using square root sum-of-squares.

2. Stresses combined according to Equation 9 of ASME Section III, Subarticle NC-3652.

→(DRN 03-2056, R14)

3. Values of stresses (pressure, dead weight, earthquake, thermal, and combined) near the containment isolation valves(s) represent an historic summary of data developed to verify qualification of piping in the Break Exclusion Zone. For the current state of stress in the piping system, refer to the latest revision of the pipe stress analysis calculations.

←(DRN 03-2056, R14)

TABLE 3.6A-22

SUMMARY OF DESIGN BASIS BREAKS

MAIN STEAM PIPING - OUTSIDE CONTAINMENT
MAIN STEAM LINE A

NODE	LOCATION TYPE	REASON FOR SELECTION
230	6 in. Branch Connection	Branch Point
540	Run Point	High Combined Stresses
600	Elbow	High Combined Stresses
610	Elbow	High Combined Stresses
630	Elbow	High Combined Stresses
640	Elbow	High Combined Stresses
660	Elbow	High Combined Stresses
670	Elbow	High Combined Stresses

TABLE 3.6A-23

SUMMARY OF DESIGN BASIS BREAKS

MAIN STEAM PIPING - OUTSIDE CONTAINMENT
MAIN STEAM LINE B

NODE	LOCATION TYPE	REASON FOR SELECTION
2010	6" Branch Connection	Branch Point
1680	Elbow	High Combined Stresses
1670	Elbow	High Combined Stresses
1490	Elbow	High Combined Stresses
1480	Elbow	High Combined Stresses

TABLE 3.6A-24

SUMMARY OF DESIGN BASIS BREAKS

FEEDWATER PIPING - OUTSIDE CONTAINMENT
FEEDWATER LINE A

NODE	LOCATION TYPE	REASON FOR SELECTION
23	4" Branch Connection	Branch Point
590	Elbow	High Combined Stresses
600	Elbow	High Combined Stresses
620	Elbow	High Combined Stresses
630	Elbow	High Combined Stresses
650	16" Branch Connection	High Combined Stresses and Branch
402	8" Branch Connection	Branch Point
408	8" Branch Connection	Branch Point
83	16" Branch Connection	Branch Point
96	20" Branch Connection	Branch Point
98	Anchor	Terminal Point

TABLE 3.6A-25

SUMMARY OF DESIGN BASIS BREAKS

FEEDWATER PIPING - OUTSIDE CONTAINMENT
FEEDWATER LINE B

NODE	LOCATION TYPE	REASON FOR SELECTION
395	4" Branch Connection	Branch Point
9363	Elbow	High Combined Stresses
9362	Elbow	High Combined Stresses
9353	16" Branch Connection	Branch Point
439	8" Branch Connection	Branch Point
469	Elbow	High Combined Stresses
468	Elbow	High Combined Stresses
445	8" Branch Connection	Branch Point
336	16" Branch Connection	Branch Point
9328	Elbow	High Combined Stresses
327	Elbow	High Combined Stresses
96	20" Branch Connection	Branch Point

TABLE 3.6A-26 Revision 308 (11/14)

MAINSTEAM - PIPE WHIP RESTRAINTS - OUTSIDE CONTAINMENT

→(EC-45581, R308)

LINE DESIGNATION	PIPE WHIP RESTRAINT IDENTIFICATION NO.	PROTECTION DIRECTION[1]
←(EC-45581, R308)		
MS Line A	Node # 155	(-x, -z)
MS Line A	175	-x
MS Line A	255	± x;± y
MS Line A	375	± y;+z
→(EC-45581, R308)		
MS Line A	415	(-x, -z)
MS Line A	435	(+x,-z); (-x, +z)
MS Line A	505	(+x, -z);+y
←(EC-45581, R308)		
MS Line A	525	+x;-y
→(EC-45581, R308)		
MS Line A	595	±x; ±y
←(EC-45581, R308)		
MS Line A	615	± y;± z
MS Line A	645	± x;± z
MS Line A	655	± x;± z
MS Line A	675	± y;± z
MS Line A	795	± y;± z
MS Line A	815	± x;± y
→(EC-45581, R308)		
MS Line B	Node # 2085	(+x;-z)
←(EC-45581, R308)		
MS Line B	2075	+x
MS Line B	1985	-x;± y
MS Line B	1865	-y;+z
MS Line B	1830	+x;-z
→(EC-45581, R308)		
MS Line B	1825	(+x,-z)
MS Line B	1805	+y; (-x,-z)
MS Line B	1755	-y; (-x,-z)
MS Line B	1735	-x, +y
←(EC-45581, R308)		
MS Line B	1685	± x;± y
MS Line B	1655	± y;± z
MS Line B	1640	-z
MS Line B	1635	-x
MS Line B	1625	+x
MS Line B	1605	+z
MS Line B	1495	± y;± z
→(EC-45581, R308)		
MS Line B	1478[2]	-x
MS Line B	1475[3]	+x, ±y

Notes:
(1) Protection directions separated by semi-colon indicate separate restraints. Protection directions enclosed in parenthesis indicate a skewed restraint.
(2) Identified on drwg. G825A as 1475A.
(3) Identified on drwg. G825A as 1475B.

←(EC-45581, R308)

TABLE 3.6A-27 Revision 308 (11/14)

FEEDWATER - PIPE WHIP RESTRAINTS - OUTSIDE CONTAINMENT

→(EC-45581, R308)

LINE DESIGNATION	PIPE WHIP RESTRAINTS IDENTIFICATION NO.	PROTECTION DIRECTION[1]
FW Line A	Node # 22	-x
←(EC-45581, R308)		
FW Line A	37	+y
FW Line A	50	± y;-x
FW Line A	57	± x;-y
FW Line A	59	+y
→(EC-45581, R308)		
FW Line A	60	±x; +z
←(EC-45581, R308)		
FW Line A	62	+x
FW Line A	63	±y
→(EC-45581, R308)		
FW Line A	65	(+y, -z)
FW Line A	401	(-y, +z)
←(EC-45581, R308)		
FW Line A	406	+y
FW Line A	431	-y
FW Line A	414	-y
FW Line A	410	+z
→(EC-45581, R308)		
FW Line A	75	-x
←(EC-45581, R308)		
FW Line A	831	-z
FW Line A	91	-z
FW Line A	96	-y
FW Line B	Node # 323	+y
FW Line B	324	-z
FW Line B	326	+y
FW Line B	327	-x
→(EC-45581, R308)		
FW Line B	328	-y; -z
←(EC-45581, R308)		
FW Line B	335	+z
FW Line B	447	-z
→(EC-45581, R308)		
FW Line B	443	+y
←(EC-45581, R308)		
FW Line B	451	-y
FW Line B	466	+z
FW Line B	468	-y
→(EC-45581, R308)		
FW Line B	438	(-y, -z)
FW Line B	353	(+y, +z)
←(EC-45581, R308)		
FW Line B	342	+x
→(EC-45581, R308)		
FW Line B	358	-x; -z
←(EC-45581, R308)		
FW Line B	362	+z
FW Line B	363	± x
→(EC-45581, R308)		
FW Line B	370	-x; -y
FW Line B	371	(-x,-z)
FW Line B	382	(+x,+z) ; (+x,-z) ; (-x,+z)
←(EC-45581, R308)		
FW Line B	396	+x

→(EC-45581, R308)

Notes: (1) Protection directions separated by semi-colon indicate separate restraints.
Protection directions enclosed in parenthesis indicate a skewed restraint.

←(EC-45581, R308)