

Typical targets are walls, cables, cable trays and instrumentation. Jet impingement loads on these potential targets are determined and, if necessary, barriers or other protection is installed to reduce the forces on the targets. Calculations show that the functions of cables and cable trays are not affected by jet forces of 2 psi or less (Reference 9.14). The instrumentation and cables associated with the equipment required to bring the reactor to cold shutdown after a high energy line break are qualified for the resultant environment in accordance with the plant's EQ program. When the temperature of a high energy jet exceeds their qualification, jet impingement barriers are installed to protect them or they are relocated.

For each of the five identified high energy piping systems, pressure and temperature were calculated at various distances from postulated pipe breaks and cracks. Examples of the resulting curves appear in Figures I.5.4-1 through I.5.4-20.

I.5.5 Flooding [Ref. 9.12]

In support of original plant licensing, PINGP was required to review the effects of flooding for two types of pipe failure events. These event types are: 1) breaks and leakage cracks in high energy piping systems, and 2) leakage cracks in non-high energy, non-Class I systems that are capable of providing high flooding rates or which have an unlimited water supply. Henceforth, these flooding event types are termed HELB and non-HELB, respectively.

For convenience, the results of flooding reviews for non-HELB events in the auxiliary building were included in Appendix I of the original FSAR. That precedence continues to be followed.

I.5.5.1 HELB Flooding Review Basis

The requirement to determine the flooding effects of high energy line breaks was specified in the original HELB requirements letter, A Giambusso (AEC) to AV Dienhart (NSP), "Request for Additional Information Concerning a Postulated Steam Pipe Break Outside of Containment", December 12, 1972. (Ref. 1) Paragraph 9.29.15 in the letter's attachment states, "A discussion should be provided of the potential for flooding safety related equipment in the event of failure of a feedwater line or any other high energy fluid line."

To obtain clarification on several aspects of the December 12, 1972 letter, a meeting was held with the AEC staff on January 4, 1973. Meeting minutes were transmitted in letter, A Giambusso (AEC) to AV Dienhart (NSP), January 11, 1973. The AEC response to Request 9.29.7b(3) concerning cracks in high energy pipes reads in part, "The critical size is taken to be one half the pipe diameter in length and one half the wall thickness in width." (Ref. 2)

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PINGP's later commitment to implementing the high energy pipe break and leakage crack criteria in NRC Branch Technical Position MEB 3-1, as attached to NRC Generic Letter 87-11, Relaxation in Arbitrary Intermediate Pipe Rupture Requirements, (Ref. 4) is discussed in Sections I.1 and I.2. When adopting the relief offered by Generic Letter 87-11, PINGP used only the applicable equations in MEB 3-1 and nothing more.

I.5.5.2 Non-HELB Flooding Review Basis

The requirement to perform reviews for flooding effects resulting from non-high energy piping failures was specified in letter, DJ Skovholt (AEC) to AV Dienhart (NSP), "Flooding of Critical Equipment", August 3, 1972. (Ref. 26) The letter requested, "...review your facilities to determine (1) whether failure of any equipment which does not meet the criteria of Class I seismic construction, particularly the circulating water system, could cause flooding sufficient to adversely affect the performance of engineered safety systems, and (2) whether failure of any equipment could cause flooding such that common mode failure of redundant safety related equipment would result. The integrity of barriers to protect critical equipment from flood waters should be assumed only when the barrier meets the seismic requirements for Class I structures. If your review determines that engineered safety features could be so affected, provide your plans and schedule for corrective action together with the justification for continued operation of your facility pending completion of the corrective actions."

Follow-up letter, RC DeYoung (AEC) to AV Dienhart (NSP), September 26, 1972, restated the review request and extended the due date to October 26, 1972. (Ref. 27) Results of the PINGP flooding review for the auxiliary and turbine buildings was provided in letter, AV Dienhart (NSP) to RC DeYoung (AEC), October 23, 1972. (Ref. 28)

The AEC meeting minutes letter dated January 11, 1973 (Ref. 2) was the first time crack size criterion appeared in regulatory correspondence. The criterion applies to cracks in high energy pipes.

NRC Branch Technical Position MEB 3-1, attached to NRC Generic Letter 87-11, Relaxation in Arbitrary Intermediate Pipe Rupture Requirements (Ref. 4), includes in Section B.3.c(3) the same high energy pipe leakage crack size criterion as originally provided in Reference 2. However, in Section B.3.c(4) additional review criteria were delineated.

MEB 3-1 Section B.3.c, Subparagraph (3) states, "Fluid flow from a leakage crack should be based on a circular opening of area equal to that of a rectangle one-half pipe diameter in length and one-half pipe wall thickness in width."

MEB 3-1 Section B.3.c, Subparagraph (4) states, "The flow from the leakage crack should be assumed to result in an environment that wets all unprotected components within the compartment, with consequent flooding in the compartment and communicating compartments. Flooding effects should be determined on the basis of a conservatively estimated time period required to effect corrective actions."

PINGP is not formally committed to any leakage crack size criterion for non-high energy non-Class I piping systems failures. PINGP's licensing basis does not specify criteria for this type of break. The MEB 3-1 criteria of Sections B.3.c.(3) and B.3.c.(4) is presented here to quantify a break size that would be reasonable, from a more current licensing viewpoint, for studying flooding vulnerability.

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I.5.5.3 Flooding Review Results (Ref. 9.12)

Piping systems in the Design Class I area of the Auxiliary Building were reviewed for the effects of flooding due to HELB and Non-HELB events. Failures in main steam, feedwater, blowdown, containment & auxiliary building chilled water and fire protection lines were selected for analysis.

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The analysis determined the times flooding would reach critical flood levels in the Auxiliary Building for each of the postulated pipe failures. Due to the high flow rates from a pipe break in the steam generator blowdown system, the shortest of the required response times for any HELB event was 52.7 minutes. Due to its large size and unlimited water supply if lined up to the cooling water system, a leakage crack in the containment & auxiliary building chilled water system yielded the shortest required response time for any non-high energy, non-Class I piping system failure; 296 minutes to detect, identify and isolate the leak. The required response times from failures in any other non-Class I piping system are bounded by these results.

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In addition, the auxiliary building was evaluated for potential damage to required equipment due to cascading water as it passes through floor openings (stairwells, pipe chases, floor drains, etc.) on its way to elevation 695' and for damage due to water spray. Most of the required equipment is located on elevation 695', which is a steam exclusion area; all penetrations from elevation 715' are sealed. Water from the upper elevations would be directed through the floor drain system and not cascade on required equipment located on elevation 695'. Due to the physical separation of the opposite-trained equipment, water spray from any leakage crack can only affect the operability of one train of any required equipment. This satisfies the required review criteria of the August 3, 1972 letter (Ref. 26).

The routing and pipe rupture evaluation of the feedwater line, as described in Section I.3.2.2, revealed no design basis break or leakage crack locations in the main piping in the Auxiliary Building. The Unit 2 feedwater flow control by-pass lines (4") have several leakage crack locations as identified on Figure I.3.2-4.

The routing and pipe rupture evaluation of the steam generator blowdown line is described in Section I.3.2.4. Each 2" line has terminal end design basis break locations in the Auxiliary Building. These locations are identified on Figures I.3.2-7 and I.3.2-8.

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For #21 feedwater flow control valve by-pass line leakage cracks, the water would flow down to elevation 723'-4" and spill over the fuel transfer canal into the steam generator blowdown flash tank and filter/demineralizer areas. Fire doors separating these areas from the remainder of the Auxiliary Building were conservatively assumed closed and any leakage was contained inside these areas before flowing through the floor drain system to the building sump. For #22 feedwater flow control by-pass line leakage cracks, the water would flow through floor openings and floor drains to the building sump.

Steam generator blowdown line design basis breaks occur in areas similar to those feedwater flow control by-pass line leakage cracks discussed above and flow to the building sump in a similar manner.

The cooling water supply to the containment & auxiliary building chilled water system is through 14" piping located in the component cooling heat exchanger area.

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