

September 28, 1987

Docket Nos. 50-387/388

Mr. Harold W. Keiser  
Vice President  
Nuclear Operations  
Pennsylvania Power and Light Company  
2 North Ninth Street  
Allentown, Pennsylvania 18101

Dear Mr. Keiser:

SUBJECT: DYNAMIC EFFECTS OF POSTULATED PIPE RUPTURES

RE: SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2

In a letter dated October 17, 1986, you requested an exemption from the requirements of the General Design Criterion 4 (GDC-4) of Appendix A to 10 CFR 50, related to the dynamic effects of postulated pipe ruptures in the reactor recirculation piping. The requested exemption would permit you to apply the fracture mechanics "leak-before-break" technology as an alternative to providing physical protection against dynamic loads due to jet impingement following postulated pipe ruptures.

The staff has reviewed your supporting analysis provided in MPR Associated report MPR-949, "Susquehanna Steam Electric Station, Leak Before Break Evaluation of Postulated Recirculation System Pipe Cracks", Revision 1, dated October, 1986. As a result of our review, we have prepared the enclosed request for additional information which is needed to assure that the underlying purpose of GDC-4 is satisfied by the alternative analysis provided in your request. Please provide your response to the enclosed questions within 60 days from the receipt of this letter.

Sincerely,

/s/

Mohan Thadani, Project Manager  
Project Directorate I-2  
Division of Reactor Projects I/II

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Enclosures:  
As stated

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UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

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Mohan Thadani, Project Manager  
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Enclosures:  
As stated

cc w/enclosures:  
See next page



Mr. Harold W. Keiser  
Pennsylvania Power & Light Company

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Units 1 & 2

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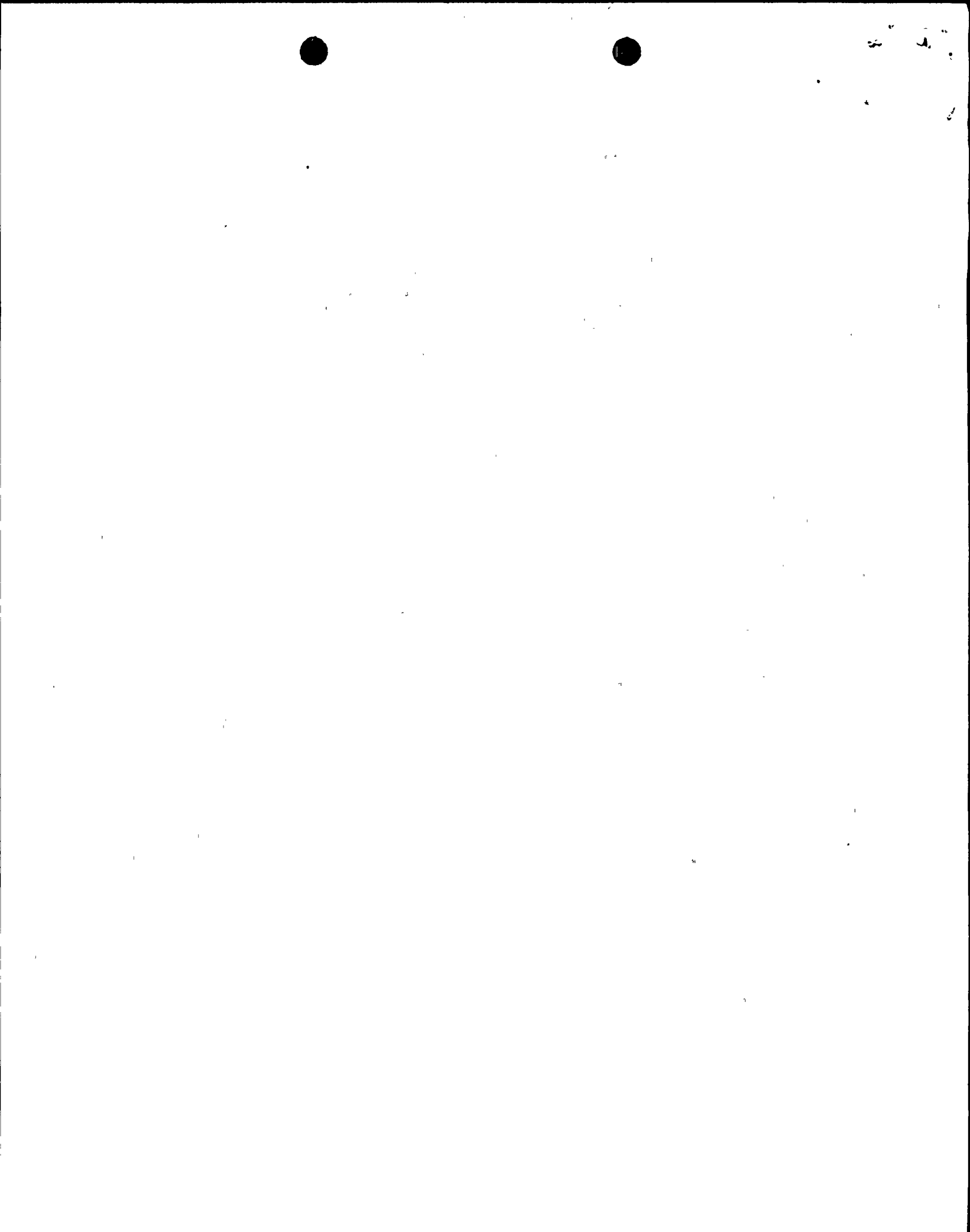
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ENCLOSURE

REQUEST FOR ADDITIONAL INFORMATION  
ON ELIMINATION OF POSTULATED REACTOR RECIRCULATION SYSTEM PIPE RUPTURES  
AS A DESIGN BASIS

PENNSYLVANIA POWER & LIGHT COMPANY  
SUSQUEHANNA STEAM ELECTRIC STATION UNITS 1 AND 2  
DOCKET NOS. 50-387 & 50-388

- (1) The leak-before-break (LBB) analysis must be performed for the functional piping system from anchor point to anchor point. A through-wall flaw should be postulated in each size of pipe comprising the functional system in the LBB analysis. However, the licensee indicated that LBB analyses were performed on the pipe-to-safe end welds for the 28-inch recirculation discharge nozzles and the 12-inch recirculation inlet nozzles. Although the licensee may only intend to eliminate the postulated pipe ruptures at these discrete locations for operational reasons, the LBB analysis must be performed for the entire piping system. For each pipe size, the limiting location for LBB analyses is the location having the least favorable combination of stress and material properties.
- (2) For application of LBB to piping that has a history of intergranular stress corrosion cracking (IGSCC), the piping must qualify for the standard Section XI of the ASME Code inspection schedule (i.e., no augmented inspection). The staff requires that (1) the piping be fabricated with IGSCC resistant material, or (2) the piping be treated with remedial stress improvement (within two years of operation) and an acceptable hydrogen water chemistry be implemented. Also, the application of LBB is not permitted in piping with any cracking or weld overlay. The licensee must discuss the compliance of the staff's requirements for the Susquehanna recirculation system piping.
- (3) Susquehanna, being a boiling water reactor (BWR), has a 5 gallon per minute (gpm) Technical Specification allowable unidentified leakage rate. Because Susquehanna can continue to operate without containment entry to identify the source of less than 5 gpm unidentified leakage, the staff considers it appropriate to use 5 gpm as the basis for the detectable leakage rate in LBB analyses. To account for uncertainties inherent in the analyses and leak detection capability, a margin of 10 on leakage is required. Furthermore, there are margins of 2 on the flaw size and 1.4 on the loads. The LBB margins are discussed in detail in NUREG-1061, Volume 3. Thus, in order to demonstrate LBB based on a 5 gpm leakage

rate, the stability of a 50 gpm leakage-size through-wall flaw has to be demonstrated. The licensee would have to perform a fracture mechanics analysis to show that a through-wall flaw at least twice the size of the 50 gpm leakage-size flaw will be stable under combined normal (pressure, deadweight, and thermal expansion) and safe shutdown earthquake (SSE) loads. Also, the licensee's fracture mechanics analysis would have to demonstrate that the 50 gpm leakage-size flaw will be stable if the loads are increased to at least 1.4 times the combination of normal and SSE loads.

- (4) The licensee indicated that the Susquehanna recirculation system piping and nozzle safe ends were fabricated from forged austenitic stainless steel and not from cast stainless steel. The weld properties were not discussed in the submitted report. However, the submitted report referenced toughness properties for cast stainless steel from the literature as representative of those for welds without providing justification. The licensee should identify the welding process of the recirculation system piping. The fracture toughness of the welds should be considered in the flaw stability analyses. The licensee should consider lower-bound weld toughness properties in LBB analyses. However, the fracture toughness of welds depends on the weld wire type, weld wire heat number, flux type, flux lot number, post-weld heat treatment, and welding procedures. Thus, when literature data are used, the number of material and weld procedures tested must be adequate to cover the range of properties at Susquehanna.
- (5) The licensee used both linear elastic fracture mechanics (LEFM) and elastic-plastic fracture mechanics (EPFM) procedures in the flaw stability analysis. However, the staff considers it inappropriate to use LEFM when the associated Irwin plane-stress plastic zone sizes are not small compared with the half-crack length. The licensee should clarify that the staff's requirement is satisfied when LEFM was used.