ATTACHMENT 1

Consumers Power Company
Palisades Plant
Docket 50-255

REPLY TO NRC REQUEST FOR INFORMATION
REGARDING THE PRESSURIZER SAFE END CRACK CRITICAL FLAW SIZE
AND MARGIN TO FAILURE ANALYSIS

Response to Items 10 and 11 of the NRC's
October 8, 1993 Information Request

November 30, 1993

4 Pages

Request for additional information regarding Consumer's Power's engineering analysis and root cause evaluation report dated October 7, 1993 for the pressurizer safe-end crack at Palisades plant.

NRC request:

10. What was the margin-to-failure for the cracked PORV nozzle safe-end?

CPCo response:

A limit load analysis was performed using the cracked PORV nozzle safe-end crack dimensions. A collapse moment loading of 320 in-kips was calculated based on a measured circumferential crack size taken at the inner radius of 2.5 inches. A comparison to the design basis moment loading of 58.3 in-kips, for faulted loads, results in a margin-to-failure of about 5. (Attachment 2 provides supporting calculation P-ME-C-011.)

NRC request:

11.a. What are the critical through-wall crack lengths for field welds in the pressurizer PORV line safe-end, the pressurizer spray line safe-end, and the surge line safe-end under normal and faulted loading conditions?

CPCo response:

Based on the design basis moment loading for normal operating and faulted loads, for each of these lines, a limit load analysis was performed. The design basis loadings were assumed equal to the limit loading resulting in the following critical crack sizes calculated for each of the three pipe geometries. (Attachment 2 provides supporting calculation P-ME-C-011.)

LINE	LOADING	CRACK LENGTH (in)
PORV	Normal Operating	7.5
	Faulted	6.8
SPRAY LINE	Normal Operating	6.7
	Faulted	5.2
SURGE LINE	Normal Operating	22.1
	Faulted	18.6

NRC request:

11.b. What leakage rate could be reliably detected from the pressurizer PORV line safe-end, the pressurizer spray line safe-end and the surge line safe-end under normal operating conditions, and how do these leakage rates compare to the leakage rates that would be associated with the critical through-wall flaws for each of these lines under normal operating conditions.

CPCo response:

The presence of the crack in the PORV nozzle was discovered through the use of the leak detection system. Based on changes noted in the collection rate, a visual inspection was made of the pressurizer during which the leaking PORV nozzle was noted. Calculations of the collection rate indicated a leakage rate of about .20 gpm from the PORV nozzle.

Leakage rates from critical through-wall flaws, listed below, were based on results of a PICEP analysis performed for the three lines using normal operating loads and critical crack size for normal operation documented in the response to Question 11a. (Attachment 2 provides supporting calculation P-ME-C-011.) These predicted leakage rates are much greater than the leakage detected from the PORV nozzle. Based on our experience, critical flaw size pipe leakage at these three locations would be readily identified at Palisades.

LINE	LEAKAGE RATE
PORV	12.4 gpm
SPRAY	77.3 gpm
SURGE	110.1 gpm

NRC request:

11.c. Guidance on how to perform these calculations is provided in draft NRC Standard Review Plan 3.6.3. Compare the results of your analysis with the factors of safety on load, crack size and leak detection specified in the SRP.

CPCo response:

The safety factor (SF) is defined as the ratio of calculated values based on application of the Leak-Before-Break technology, divided by either the design basis or measured values. These results for the PORV line are compared to the safety factors defined in SRP 3.6.3 in the following table. (Attachment 2 provides supporting calculation P-ME-C-011.)

PARAMETER	SAFETY FACTOR	
	SRP 3.6.3	CALCULATED
LEAKAGE RATE	10	62[a]
CRACK LENGTH	2	2.39[b]
LOAD	1.4	5.5[c]

Notes: a: Based on measured leak rate of .2 gpm
b: Based on measured crack size, scaled to the mean radius, as 2.848 inches
c: Based on design basis faulted load of 58.3 in-kips

NRC request:

11.d. Discuss the symmetry or asymmetry of the stress distributions in the subject lines and the potential for symmetric versus asymmetric crack growth.

CPCo response:

Preliminary evaluations have been performed which determined unintensified axial stress levels occurring at the top (safe end-pipe juncture) of each of the nozzles. These loads include deadweight and normal operating thermal expansion and pressure loads. Additionally, axial stresses were determined for the PORV based upon a postulated thermally stratified condition at temperature. The results of the evaluation indicate that:

For the PORV Nozzle:

The loads due to deadweight, pressure, and normal thermal expansion produce asymmetric axial stresses on the inside surface. These stresses vary from a minimum of about -1.0 ksi (compression) to a maximum of about 7.5 ksi (tension). For the crack location, total stresses are near zero. The asymmetric nature of the stress distribution is due to the asymmetric pipe loads (bending moments).

The loads due to deadweight, pressure, and the postulated thermal stratification condition with an assumed top-to-bottom difference in wall temperature of 200°F, produce asymmetric axial stress on the inside surface. These stresses vary from a minimum of about -12 ksi (compression) to a maximum of about 18 ksi (tension). For the crack location total stresses range from -4.0 ksi (compression) to about 16 ksi (tension). The asymmetric nature of the stress distribution is due to the asymmetric pipe loads (bending moments).

For the Pressurizer Spray Nozzle:

The loads due to deadweight, pressure, and normal thermal expansion produce asymmetric axial stresses on the inside surface. These stresses vary from a minimum of about -3.0 ksi (compression) to a maximum of about 10 ksi (tension). The asymmetric nature of the stress distribution is due to the asymmetric pipe loads (bending moments).

For the Pressurizer Surge Nozzle:

The loads due to deadweight, pressure, and normal thermal expansion produce axial stresses on the inside surface that are generally uniform, on the order of 4.0 ksi (tension). While the pipe loads are asymmetric, their contribution to overall stress is minimal.

Attachment 3 provides the calculation C-MECH-CALC-019 supporting the above conclusions.