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AUTH.NAME AUTHOR AFFILIATION
HAMPTON,J.W. Duke Power Co.
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SUBJECT: Forwards response to request for addl info on HPI sys. Attached responses supersedes previous leak-before-break analyses submitted on 970502 & 09.

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Duke Power Company
Oconee Nuclear Site
P.O. Box 1439
Seneca, SC 29679

J. W. HAMPTON
Vice President
(864)885-3499 Office
(864)885-3564 Fax

DUKE POWER

May 13, 1997

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Subject: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287
Response to Request for Additional Information
on the High Pressure Injection (HPI) System
NRC TAC No. M98454

In a letter dated May 5, 1997, the staff requested additional information to support its evaluation of the recent HPI System weld crack on Oconee Unit 2. Responses to the NRC questions were provided in Duke letters dated May 7, 1997 and May 8, 1997. Supplemental information regarding a revised leak-before-break analysis was submitted to the staff in a letter dated May 9, 1997. The May 9, 1997, submittal did not reflect the latest revision to the leak-before-break analysis. Please find attached a complete response to Question 4f of the May 5, 1997, staff request for additional information. The attached response supersedes the previous leak-before-break analyses submitted on May 2, 1997 and May 9, 1997.

Please address any questions to J. E. Burchfield, Jr. at (864) 885-3292.

Very Truly Yours,

J. W. Hampton
Site Vice President

A009

xc: L. A. Reyes, Region II
Regional Administrator

D. E. LaBarge, NRR
Project Manager

M. A. Scott, Region II
Senior Resident Inspector

Attachment 1
Supplemental Information Regarding Question 4 in May 5, 1997 NRC Request for Additional Information

Question 4f:

Provide a revised leak-before-break analysis based on the complex flaw geometry as found in the cracked and leaking pipe/safe end weld.

Response:

Leak-before-break analysis for the pipe/safe end has been performed using the PICEP Code developed by EPRI for finite-length, through-wall circumferential flaws using normal operating loads. Crack models are not available to perform leak-before-break analysis for the complex flaw geometry identified for the Oconee-2 leaking nozzle. As an alternative, PICEP-based leak-before-break analysis has been repeated for varying pipe wall thickness to approximate the geometry of the Oconee-2 flaw. In addition, the sensitivity of the leak-before-break results to pipe loads has been investigated by performing the analysis with minimum normal operating loads. The normal operating conditions and geometry are presented in Table 1 and the material properties are presented in Table 2. The maximum and minimum normal operating loads are found in Tables 3 and 4, respectively. The results of these leak-before-break analyses are presented in Tables 5 and 6.

Table 1 Normal Operating Conditions and Geometry

Temperature	= 100 F
Pressure	= 2300 psi
Outside Diameter	= 2.875 in
Thickness	= 0.375 in
Material	= 316 Stainless Steel

Table 2 Material Properties

Material	: A-376 TP316
Yield Stress	: 30 ksi
Ultimate Stress	: 75 ksi
Flow Stress	: 52.5 ksi ((Yield + Ultimate)/2)
Young's Modulus	: 28.3E6 psi
Ramberg-Osgood Parameters	
alpha	: 3.46
n	: 5.68

Table 3 Maximum Applied Loads at HPI Nozzle

Loading Condition	Ma (ft-lbs)	Mb (ft-lbs)	Mc (ft-lbs)	Mr (ft-lbs)
Weight	191	53	1016	
Thermal	72	-1349	2824	
Maximum Normal Operating	263	-1296	3840	4061

Table 4 Minimum Applied Loads at HPI Nozzle

Loading Condition	Ma (ft-lbs)	Mb (ft-lbs)	Mc (ft-lbs)	Mr (ft-lbs)
Weight	145	61	-269	
Thermal	288	225	-1035	
Minimum Normal Operating	433	286	-1304	1403

The following leakage size cracks and critical flaw sizes may be seen with decreasing thickness assuming the normal operating external loads.

Table 5 Maximum Normal Operating Load Results

Thickness (in)	Leakage Size Crack (in) @ 10 gpm	Critical Crack Length (in)	Margin Ratio
0.375	1.29	2.56	2.0
0.25	0.73	1.90	2.6
0.2	0.46	1.34	2.9

Table 6 Minimum Normal Operating Load Results

Thickness (in)	Leakage Size Crack (in) @ 10 gpm	Critical Crack Length (in)	Margin Ratio
0.375	2.73	3.94	1.4
0.25	2.29	3.54	1.6
0.2	2.03	3.21	1.6

To investigate the sensitivity of critical crack length results for the weld metal, TIG weld properties were used with one case from above (minimum normal operating and 0.375 in. thickness). The critical crack length found for that case is 4.44 in. compared to 3.94 in. calculated for the base metal with the same loads. The material properties used for the TIG weld are shown in Table 7 below.

Table 7 Material Properties

Material	:TIG Weld
Yield Stress	: 68.9 ksi
Ultimate Stress	: 79.7 ksi
Young's Modulus	: 28.3E6 psi
Ramberg-Osgood Parameters	
alpha	: 6.25
n	: 6.8