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**SUBJECT: Provides response to NRC RAI re GL 97-01, "Degradation of CRDM/CEDM Nozzle & Other Vessel Closure Head Penetrations."**

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June 11, 1999

AEP:NRC:1218F

Docket Nos.: 50-315  
50-316

U. S. Nuclear Regulatory Commission  
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Donald C. Cook Nuclear Plant Units 1 and 2  
GENERIC LETTER 97-01: DEGRADATION OF CRDM/CEDM NOZZLE AND  
OTHER VESSEL CLOSURE HEAD PENETRATIONS  
REQUEST FOR ADDITIONAL INFORMATION  
(TAC NOS. M98559 AND M98560)

- Reference: (1) Letter, John F. Stang, Jr. to Robert P. Powers,  
GENERIC LETTER (GL) 97-01, 'DEGRADATION OF  
CRDM/CEDM NOZZLE AND OTHER VESSEL CLOSURE HEAD  
PENETRATIONS' REQUEST FOR ADDITIONAL  
INFORMATION FOR DONALD C. COOK NUCLEAR PLANT,  
UNITS 1 AND 2 (TAC NOS. M98559 AND M98560),  
dated November 16, 1998.
- (2) Letter, David J. Modeen to Gus C. Lainas,  
"Responses to NRC Requests for Additional  
Information on Generic Letter 97-01", dated  
December 11, 1998.
- (3) Letter, Jack R. Strosnider to David J. Modeen,  
"REVIEW OF GENERIC RESPONSE TO THE NRC REQUESTS  
FOR ADDITIONAL INFORMATION REGARDING GENERIC  
LETTER 97-01", dated March 21, 1999.

Gentlemen:

In accordance with 10 CFR 50.54(f), Indiana Michigan Power  
Company (I&M) hereby provides the response to the NRC's request  
for additional information (RAI) regarding Generic Letter (GL)  
97-01 (Reference 1). I&M's RAI responses are contained in  
attachment 1 to this letter.

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I&M is participating in the Westinghouse Owners Group/Nuclear Energy Institute (WOG/NEI) integrated inspection program. As a part of this program, generic answers to the RAIs sent to all licensees were developed and submitted to the NRC (Reference 2). The NRC, by letter dated March 21, 1999 (Reference 3), found the generic responses to be acceptable. The I&M responses to the Cook Plant specific questions have been extracted from the NEI generic responses.

Sincerely,



M. W. Rencheck  
Vice President Nuclear Engineering

Attachments

SWORN TO AND SUBSCRIBED BEFORE ME

THIS 11<sup>th</sup> DAY OF JUNE 1999

  
\_\_\_\_\_  
NOTARY PUBLIC

My Commission Expires: 2/10/2003

**JAN WATSON**  
NOTARY PUBLIC, BERRIEN COUNTY, MI  
MY COMMISSION EXPIRES FEB. 10, 2003

c: J. E. Dyer, w/attachment  
MDEQ - DW & RPD  
NRC Resident Inspector, w/attachment  
R. Whale

JAN WATSON  
NOTARY PUBLIC, BERRIEN COUNTY, MI  
MY COMMISSION EXPIRES FEB. 10, 2003



Attachment 1 to AEP:NRC:1218F

RESPONSES TO NRC'S REQUEST FOR ADDITIONAL INFORMATION

On November 16, 1998, the Nuclear Regulatory Commission (NRC) requested further information with respect to Indiana Michigan Power Company's (I&M) Generic Letter (GL) 97-01 responses dated April 29, 1997 (Reference 1), August 1, 1997 (Reference 2), and November 4, 1997 (Reference 3) to complete its review of the responses as they relate to the Westinghouse Owners Group's (WOG) integrated program for assessing the Vessel Head Penetration (VHP) nozzles for the WOG member plants, and to the contents of Topical Report Number WCAP-14901.

The I&M response has been prepared in accordance with the integrated WOG and the Nuclear Energy Institute (NEI) response provided to the NRC on December 11, 1998. The specific responses to the NRC's request for additional information (RAI) are addressed below.

RAI Question Number 1

1. In WCAP-14901 Westinghouse Electric Corporation (WEC) did not provide any conclusions as to what the probabilistic failure model would lead the WOG to conclude with respect to the assessment of PWSCC in WEC-designed vessel head penetrations. With respect to the probabilistic susceptibility model (e.g., probabilities failure model) provided in WCAP-14901:
  - a. Provide the susceptibility rankings compiled for the WOG member plants for which WCAP-14901 is applicable. In regard to other WOG member plants to which WCAP-14901 is applicable, include the basis for establishing the ranking of your plant(s) relative to the others.
  - b. Describe how the probabilistic failure model in WCAP-14901 for assessing postulated flaws in vessel head penetration nozzles was benchmarked, and provide a list and discussion of the standards the model was benchmarked against.
  - c. Provide additional information regarding how the probabilistic failure models in WCAP-14901 will be refined to allow the input of plant-specific inspection data into the model's analysis methodology.
  - d. Describe how the variability in product forms, material specifications, and heat treatments used to fabricate each CRDM penetration nozzle at the WOG member utilities are addressed in the probabilistic crack initiation and growth models described or referenced in Topical Report No. WCAP-14901.



Responses to Request Number 1

- a. For industry planning purposes, plants have been grouped into three categories based on the predicted time to reach the allowable flaw depth limit. These results are provided in the industry histogram provided in Enclosure 1 to the NEI December 11, 1998 letter (Attachment 2). Cook Nuclear Plant Unit 1 is in the 5-15 effective full power year (EFPY) group, and Unit 2 is in the less than 5 EFPY group.
- b. The Westinghouse model and software used for the probabilistic analysis of reactor vessel head penetration nozzles were developed using the structural reliability and risk assessment (SRRA) methodology. The application of this SRRA methodology to piping risk-informed ISI was extensively benchmarked against hand calculations, available failure data and alternative calculations as described in WCAP-14572, Revision 1, Supplement 1 (October 1997).

As described in Table 4-2 of WCAP-14901 (July 1997), the SRRA probabilities for Alloy 600 PWSCC compare very well with inspection observations at four plants where sufficient information existed to perform calculations for the worst head penetration nozzle at the time they were first inspected. While two of the plants (D. C. Cook 2 and Ringhals 2) with relatively high calculated probabilities had observed flaw indications, two other plants with lower calculated probabilities (Almaraz 1 and North Anna 1) did not. The initial WOG probabilistic model was revised as a result of the North Anna 1 inspection observations and an independent peer review by Alloy 600 PWSCC specialists at APTECH Engineering in the spring of 1997.

- c. There are two kinds of variations that are considered in the Westinghouse probabilistic analysis: random and systematic. The random variation is that due to localized material variability and other effects with insufficient information available to completely characterize them. This could include the effect of the variation in surface roughness on crack initiation and the variation in the actual weld size on the local stress. For these types of uncertainties, a Bayesian updating process has been developed by Westinghouse that could be used to combine the prior distribution on time to failure, which gives the initial calculated probability of failure with time, with the observations from the inspection. The updated posterior distribution that



is generated in this manner can then be used to generate an updated estimate of the probability of failure with time for each penetration that was inspected.

The systematic or mechanistic type variations, such as the time to crack initiation being inversely proportional to the stress to the 4<sup>th</sup> power, are included directly in the Westinghouse probabilistic model. If the observations from an inspection would differ significantly from what was calculated, then the basic model would need to be revised. This, in fact, has already occurred based upon the observations from the North Anna 1 inspections. The revised model now provides calculated probabilities that are consistent with the current inspection observations (see response to question 1b).

- d. Since the Westinghouse probabilistic analysis models are mechanistically based, uncertainties are provided to directly account for the variability in such fabrication related input parameters as nozzle wall thickness, material grain boundary carbide coverage, and monotonic yield strength. The Westinghouse mechanistic model also accounts for the variability in indirect fabrication related effects, such as the variation in surface roughness on crack initiation and the variation in the actual weld size on the local stress, where there is insufficient information to describe the causes and effects in a statistically significant manner. Specifically, the model input also includes the observed uncertainties on the coefficients used to calculate residual stress, initiation time and crack growth rate.

#### RAI Question Number 2

2. Table 1-2 in WCAP-14901 provides a summary of the key tasks in WEC's vessel head penetration nozzle assessment program. The table indicates that the tasks for (1) Evaluation of PWSCC Mitigation Methods, (2) Crack growth Data and Testing, and (3) Crack initiation Characterization Studies have not been completed and are still in progress. In light of the fact that the probabilistic susceptibility models appear to be dependent in part on PWSCC crack initiation and growth estimates, provide your best estimate when these tasks will be completed by WEC, and describe how these activities relate to and will be used to update the probabilistic susceptibility assessment of VHP nozzles at your plant(s).

Response to Request Number 2

The programs on crack growth testing and crack initiation have been essentially completed, and the program on mitigation is now under way and targeted for completion in mid-2000. These programs have thus far served to confirm the assumptions used in the original safety evaluations and models (Reference 4). As additional information becomes available from the referenced testing, the models will be reviewed and updated by Westinghouse as necessary.

RAI Question 3

3. In the NEI letters of January 29, 1998 and April 1, 1998, NEI indicated that inspection plans have been developed for the VHP nozzles at the Farley Unit 2 plant in the year 2002, and the Diablo Canyon Unit 2 plant in the year 2001, respectively. The staff has noted that although you have endorsed the probability susceptibility model described in WCAP-14901, Revision 0, other WOG member licenses have endorsed a probabilistic susceptibility model developed by an alternate vendor of choice. The WOG's proposal to inspect the VHP nozzles at the Farley Unit 2 and Diablo Canyon Unit 2 plants appears to be based on a composite assessment of the VHP nozzles at all WOG member plants. Verify that such a composite ranking assessment has been applied to the evaluation of the VHP Nozzles at your plant(s). If composite rankings of the VHP nozzles at WOG member plants have been obtained from the composite results of the two models, justify why application of the probabilistic susceptibility model described in WCAP-14901, Revision 0, would yield the same comparable relative rankings of the VHP nozzles for your plant(s) as would application of the alternate probabilistic susceptibility model used by the WOG member plants not subscribing to the susceptibility model used by the WOG member plants not subscribing to WCAP-14902, Revision 0. Comment on the susceptibility rankings of the VHP nozzles at your plant(s) relative to the susceptibility rankings of the VHP nozzles at the Farley Unit 2 and Diablo Canyon Unit 2 plants.

Response to Request Number 3

The announcement of inspection plans by individual WOG plants is the result of each individual plant's economic situation, along with their future operational plans. The individual plant results are compared in the histogram in Enclosure 1 to NEI's December 11, 1988 letter (Attachment 2). An individual plant's category in the histogram is one of the many considerations which must be evaluated in making inspection decisions.

Unit 1 is in the same group as the Diablo Canyon 2 plant,  
and Unit 2 is in the same group as the Farley 2 plant.

- References:
- (1) Letter AEP:NRC:1218B, "RESPONSE TO GENERIC LETTER NO. 97-01, DEGRADATION OF CONTROL ROD DRIVE MECHANISM NOZZLE AND OTHER VESSEL CLOSURE HEAD PENETRATIONS", dated April 29, 1997.
  - (2) Letter AEP:NRC:1218C, "GENERIC LETTER 97-01, 'DEGRADATION OF CONTROL ROD DRIVE MECHANISM NOZZLE AND OTHER VESSEL CLOSURE HEAD PENETRATIONS', 120 DAY RESPONSE", dated August 1, 1997.
  - (3) Letter AEP:NRC:1218D, "GENERIC LETTER 97-01, 'DEGRADATION OF CONTROL ROD DRIVE MECHANISM NOZZLE AND OTHER VESSEL CLOSURE HEAD PENETRATIONS, 120 DAY RESPONSE' - SUPPLEMENT", dated November 4, 1997.
  - (4) WCAP-13565, Revision 1, "Alloy 600 Reactor Vessel Adapter Tube Cracking Safety Evaluation," dated February 1993 (Proprietary).

Attachment 2 to AEP:NRC:1218F

NEI PROPOSED RESPONSE TO GENERIC LETTER 97-01  
REQUESTS FOR ADDITIONAL INFORMATION

