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SUBJECT: Discusses linear indication identified on pipe-to-valve weld.Evaluation in accordance w/Generic 88-01 completed.Flaw acceptable for continued operation w/o repair.Summary encl.

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WASHINGTON PUBLIC POWER SUPPLY SYSTEM

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May 10, 1991
G02-91-096

Docket No. 50-397

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Gentlemen:

Subject: **NUCLEAR PLANT NO. 2, OPERATING LICENSE NPF-21 REPORT ON FLAW IN REACTOR RECIRCULATION PIPING (TAC No. 80358)**

References:

1) Letter, G02-88-164, GC Sorensen (SS) to NRC, "Supply System's Response to NRC's Generic Letter 88-01", dated July 26, 1988

2) Letter, G02-91-088, GC Sorensen (SS) to NRC, "Response to Generic Letter 88-01, Intergranular Stress Corrosion in Piping (TAC No. 69161)", dated May 3, 1991

3) Letter, G02-89-123, GC Sorensen (SS) to NRC, "Supply System's Response to Generic Letter 88-01 Request for Additional Information" dated July 20, 1989

During Inservice Inspection on the 20" shutdown cooling suction line of the reactor recirculation system, a linear indication was identified on pipe-to-valve weld 20RRC(6)-8. This weld is Category B per Generic Letter 88-01 (see Reference 3). The indication was detected and sized by personnel and procedures qualified for the detection and sizing of Intergranular Stress Corrosion Cracking (IGSCC) in stainless steel piping systems. The indication exceeded the acceptance criteria of the Code, ASME Section XI, IWB-3500. An evaluation in accordance with Generic Letter 88-01, Attachment A was completed. The indication is determined to be a flaw which is acceptable for continued operation without repair. A summary of the analysis performed is included as Attachment 1 to this letter.

In accordance with the Supply System's responses to Generic Letter 88-01 (References 1 and 2), the sample is being expanded to examine additional welds of the shutdown cooling system at this outage. Any unacceptable conditions will be reported to the NRC by the Supply System as required by Generic Letter 88-01. Results of these examinations will be included in the ISI Summary Report to be submitted to the NRC within 90 days after the end of the outage.

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At this time, to be conservative, the Supply System is assuming the flaw is due to IGSCC, even though this weld was treated with the Induction Heating Stress Improvement (IHSI) process prior to service. At the next refueling outage, April 1992, this weld will be reexamined to determine the crack growth rate. Whether IGSCC is the cause of the flaw should be established at that time. If it is found that the flaw size has not increased, this would point to a preexisting construction flaw. This is the first weld to show any potential for IGSCC at WNP-2. To date 67 of the 126 Category B welds have been examined for IGSCC.

Construction radiographs have been reviewed, with no unacceptable conditions apparent. The Supply System may attempt to have these radiographs enhanced to determine if a construction defect, such as lack of fusion, is a preexisting condition.

The ultrasonic preservice inspection records were also reviewed. Again no indications were present which suggests that the indication is caused by lack of fusion or root geometry.

The Supply System will consider weld 20RRC(6)-8 as an IGSCC Category F weld until the next outage when more data are available. It is our understanding that a planned supplement to Generic Letter 88-01 will provide for relaxation of Attachment A, item 3 of the Staff's Position on Leak Detection such that our existing Technical Specification action statement (3/4.4.3.1) remains appropriate.

It is also our understanding that per Generic Letter 88-01, the Supply System will not restart WNP-2 until the Staff has approved the crack evaluation of 20RRC(6)-8 as provided in Attachment 1. Restart is currently scheduled for June 4, 1991.

Very truly yours,

Alan Hosler for

G. C. Sorensen, Manager
Regulatory Programs

TFH/bk
Attachment

cc: JB Martin - NRC RV
NS Reynolds - Winston & Strawn
PL Eng - NRC
DL Williams - BPA/399
NRC Site Inspector - 901A

Attachment 1

WNP-2 R6 FLAW EVALUATION SUMMARY

INTRODUCTION

A fracture mechanics evaluation was performed to evaluate a linear indication found during in-service inspection of ISI weld number 20 RRC (6)-8. This particular weld consists of a SA-358 GR. 304 stainless steel pipe welded to a valve manufactured from SA-351 CF8M stainless steel. The indication was found on the upstream side of valve RHR-V-113. The defect is located in the 304 base metal at the top of the pipe centered at the 0° location (twelve o'clock position). The defect was sized at 0.15 inches deep and 4.5 inches long. The size of the defect exceeds the 1986 ASME Code Section XI Table IWB 3514-2 allowable and thus requires evaluation per paragraph IWB 3640 of the Code. The following discussion provides a comprehensive summary of the fracture mechanics model, applied loads (stresses), and Code evaluations that were performed.

METHODOLOGY

Stress (Loads) Evaluation

The stress state at the location of the flaw is required to determine the driving force for crack propagation. Stresses for the applicable loading conditions were extracted from the ASME Class 1 Stress Report for the subject RHR piping (Calculation No. 8.14.107) to complete the RHR piping flaw evaluation.

The following load combinations were evaluated to determine if the crack would grow under the imposed loads. Two of the evaluations (fatigue and intergranular stress corrosion cracking (IGSCC)) encompass the requirements of IWB-3640. The third evaluation was done to evaluate the flaw growth under the relatively short duration applied load caused by the worst thermal transient experienced by the system, i.e. plant shutdown.

> The imposed load for fatigue evaluation consists of superimposing the pressure, deadweight bending, normal operating thermal bending stress and the weld residual stress to complete the evaluation of the minimum fracture stress intensity. Pressure, deadweight bending, and thermal bending stresses are conservatively combined with the worst case faulted dynamic bending stresses (without regard to the direction of the applied stress) to complete the evaluation of the maximum fracture stress intensity range. This methodology conservatively includes faulted dynamic stresses in the normal/upset evaluation and conservatively adds additional thermal stresses into the faulted evaluation. The number of dynamic loading cycles is based on the design basis main steam safety relief valve actuations which yield an equivalent 300 stress cycles per year. The peak

dynamic loading includes 300 cycles of the Safe Shutdown Earthquake event even though the plant design basis is 10 stress cycles.

The IGSCC evaluation was completed using the steady state deadweight pressure and bending stress and the normal plant operation thermal stress.

The thermal transient load evaluation superimposed the pressure and deadweight bending stresses on the thermal bending and thermal gradient stresses. The dynamic stress was not included due to the low probability of occurrence during the short duration of the peak thermal gradient stress.

In each loading condition the above stress states were then superimposed on the weld residual stress distribution to complete the respective flaw evaluations. The resulting flaw sizes were then evaluated against the end of evaluation period depth-to-thickness ratios from Tables IWB-3641-1 and IWB-3641-2.

Flaw Evaluation

The indication was evaluated using the NASCRAC computer code developed by Failure Analysis Associates. This code uses stress field influence functions as the basis for flaw propagation. The NASCRAC model selected is a shell element containing an elliptically shaped circumferential flaw. The model is identified as 703 in the NASCRAC manual. This particular model includes three crack growth degrees of freedom encompassing the respective circumferential and crack depth coordinates. The evaluation was performed using conservative linear elastic fracture mechanics principles.

The modeling applies the requirements identified in NRC Generic Letter 88-01. The flaw was evaluated as an intergranular stress corrosion crack using the crack growth rate equation provided in the generic letter. The weld residual stress distribution provided in the letter was also used even though the weld in question had induction heat stress improvement (IHSI) performed on it in 1983. The weld residual stresses are developed from room temperature yield for 304 material (30 ksi) as the normalization stress outlined in the generic letter. The flaw aspect ratio was reviewed and compared to the requirements of NUREG-0313, Rev. 2. The aspect ratio was determined to be 30:1 which exceeds the NRC requirements for maintaining the same aspect ratio during crack growth. Therefore the final crack growth aspect ratio was determined by the NASCRAC flaw model.

In performing the evaluation the flaw model was run to evaluate fatigue damage for a one year operating cycle. The crack was evaluated using both a da/dn curve

for BWR water environments and an air environment for austenitic stainless steel. The da/dn equation used for BWR environments was provided in the EPRI draft final report "Evaluation of Flaws in Austenitic Piping " dated October 1985, page 3-2, Equation 3-1. In this EPRI equation the F-factor selected for a BWR environment was taken as ten. The curve used for the air environment is that provided in ASME Code Section XI, Appendix C, Figure C-3210-1 for an R-ratio of 0.79.

Upon completion of the fatigue evaluation the NASCRAC flaw model was executed to complete the IGSCC evaluation. The crack dimensions for the evaluation period as determined by fatigue would normally be used as input for the initial crack dimensions for the IGSCC model. However the growth due to the 300 fatigue cycles did not yield a significant change in the initial crack size. Therefore the original flaw size was used as the input for the IGSCC model. The equation used for the IGSCC crack growth rate, as mentioned earlier, was that provided in the generic letter.

The above described flaw evaluation and computer outputs are documented in Supply System calculation ME-02-91-30.

CONCLUSION

Based on the flaw evaluation results it is determined that WNP-2 may operate for the single cycle evaluation period before reevaluation of the linear indication is again required. The evaluation demonstrates that under the worst imposed loading conditions the flaw meets the acceptance criteria of ASME Section XI Tables IWB-3641-1 and 3641-2. The Fatigue evaluation for the flaw propagation shows that growth due to the piping system mechanical loads is insignificant. The fracture mechanism which can propagate the flaw is intergranular stress corrosion cracking. If the IGSCC phenomena is active the crack will increase in depth to 0.29 inches in the next year which is less than the ASME Code allowable of 0.773 inches per Table IWB-3641-1 and 2.