GPU Nuclear

GPU Nuclear Corporation
One Upper Pond Road
Parsippany, New Jersey 07054
201-316-7000
TELEX 136-482
Writer's Direct Dial Number

April 21, 1992
C321-92-2080
5000-92-3020

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

Gentlemen:

Subject: Oyster Creek Nuclear Generating Station
Facility License No. DPR-16
Docket No. 50-219
Deferral of Isolation Condenser Piping Stress Improvement

In order to resolve the remaining open issue under Systematic Evaluation Program Topic III-5.B, "Pipe Break Outside Containment," GPU Nuclear submitted an evaluation of the newly-replaced Isolation Condenser (IC) System piping outside containment by letter (C321-91-2260) dated October 28, 1991. The evaluation was based on the guidance in draft Standard Review Plan (SRP) Section 3.6.3 to demonstrate that the probability of rupture of this piping is extremely low. The draft SRP Section 3.6.3 guidelines required an assessment of the new piping's resistance to intergranular stress corrosion cracking (IGSCC). Consistent with the staff's guidance, we planned to implement residual stress improvement treatment to applicable weldments within two years of service. To meet this schedule, the stress improvement work would have to be completed by the end of the next (Cycle 14R) refueling outage.

In light of the very large number of candidate work tasks being considered for the 14R outage, it is clear that some adjustments to the planned workscope must be made in order to stay within established resource constraints. For that reason we recently reassessed the schedular importance of IC piping stress improvement. Our conclusion is that the combination of material composition of the new piping, welding processes which minimize sensitization and our good reactor water chemistry would ensure that the possibility of IGSCC initiation during an extended service period without stress improvement is remote. These IGSCC mitigating factors, when viewed in relation to current industry experience with resistant material and projected service periods without cracking, provide at least a 12 year period during which crack initiation would not be expected. On that basis, we propose to defer stress improvement of the new IC piping to the Cycle 15R outage. Any further schedular change will be based on our continuing review of industry studies and experience as well as our specific experience at Oyster Creek.

A001

ATTACHMENT
ISOLATION CONDENSER PIPING
BASES FOR STRESS IMPROVEMENT DEFERRAL

1.0 BACKGROUND

1.1 Intergranular Stress Corrosion Cracking (IGSCC)

The original isolation condenser (IC) piping material was Type 316 austenitic stainless steel with a carbon content of 0.05 to 0.07 percent. Welding procedures used during the construction phase were not controlled to minimize heat input. The absence of these controls sensitized the weld heat affected zone and introduced high residual stresses. Thus, the piping was susceptible to IGSCC. Oyster Creek began commercial operation in 1969. IGSCC was first observed in 1982 in the isolation condenser condensate return lines. It was detected via thru-wall leakage and ultrasonic examination. From 1982 until the 1991 Cycle 13R refueling outage IGSCC repairs to IC piping were made using pipe spool replacement or weld overlays.

1.2 Piping Replacement

During the 13R outage, the Isolation Condenser System steam supply and condensate return piping outside containment was replaced with piping fabricated from 316 Nuclear Grade stainless steel. This was done to avoid IGSCC so that the requirements of General Design Criterion 4 could be met as they pertain to the application of a leak-before-break analysis to eliminate from the design basis the dynamic effects of pipe rupture.

1.3 Piping Material

The alloy composition and fabrication processing requirements governing the piping used in the replacement effort conform with the EPRI guidelines established to ensure resistance to IGSCC. Carbon content was limited to a maximum of 0.02 percent which minimizes the possibility of IGSCC. The formation of a sensitized structure as a result of the welding process is significantly reduced.

1.4 Piping Installation

Welding heat input was controlled in accordance with the EPRI guidelines. Specifically, these controls recommend an energy density maximum of 2.0 MJ/in^3. Field installation records show that the actual heat input levels were lower. These practices are a significant improvement over the original piping installation where similar controls were not utilized.

ATTACHMENT (CONTINUED)
ISOLATION CONDENSER PIPING
BASES FOR STRESS IMPROVEMENT DEFERRAL

Reference 3 shows the calculated probabilities of leaks in 304SS and 316NG piping material as a function of time. These results were generated using the PRAISE computer code which is based on a probabilistic fracture mechanics model using Monte Carlo simulation techniques. In these calculations worst case stress conditions were assumed and no credit for any mitigating measures was taken. Therefore, these results are considered conservative. The results of calculations are summarized below:

1) The time required to reach a given leak probability is about six times as long in 316NG as it is in 304.

2) Where failure in 304 piping is always dominated by initiated cracks (i.e., resulting from stress corrosion), in 316NG the initiated cracks dominate the probability of leak only after about 12 years.

3) The probability of a leak in the 304SS weldment exceeds 1E-4 after approximately three years, while this value is reached only after 15 years with 316NG.

Therefore, it is concluded that 316NG material owes its resistance to the fact that fewer cracks initiate than in 304SS and when they do initiate, it is later in plant life. These results, even with the cited conservatism, support deferring stress improvement for an additional fuel cycle and does not subject the isolation condenser piping to the risk of crack initiation.

In addition, of three other nuclear generating stations with replacement nuclear grade material in service without stress improvement, one has a service period of approximately 7 years with no evidence of IGSCC. The field evidence alone supports the performance projection.

3.0 CONCLUSION

GPU Nuclear believes it is very unlikely corrosion damage would occur to the extent of flaw initiation within a 12 year service period. From this assessment it is concluded that stress improvement can be deferred at least to the Cycle 15R refueling outage as the current piping without stress improvement already provides substantial resistance to crack initiation resulting from stress corrosion.

4.0 REFERENCES

1) EPRI Report NP-2671-LD, October 1982, "Alternative Alloys for BWR Pipe Applications"

2) GPU Nuclear Topical Report No. 050, Revision 3, Section 3.2

3) NUREG/CR-5486, "Application of Reliability Techniques to Prioritize BWR Recirculation Loop Welds for In-Service Inspection"

ATTACHMENT (CONTINUED)
ISOLATION CONDENSER PIPING
BASES FOR STRESS IMPROVEMENT DEFERRAL

With the implementation of heat input controls, it is unlikely that residual tensile welding stresses or sensitization would occur to the extent where they would adversely effect the material's inherent resistance to IGSCC. These practices are consistent with those implemented at other utilities for pipe replacement programs.

2.0 DISCUSSION

2.1 Mitigative Measures

As discussed on the previous page, material composition and welding controls significantly reduce the possibility of IGSCC. The carbon content limit of the material provides about a four-fold improvement in resistance to IGSCC (Reference I). Since 1985 reactor water chemistry controls have been tightened allowing additional margin against the occurrence of IGSCC. Currently, water conductivity is controlled to less than 0.2μS/cm which yields a factor of 4 improvement in crack growth (Reference 2).

2.2 Expected Functional Performance

During installation of the original isolation condenser piping there was an absence of IGSCC mitigation measures. In fact, factors promoting IGSCC were present, i.e., high residual stresses, a sensitized material and a more aggressive environment. Under this combination of factors, it took approximately 13 years for cracks to initiate and propagate to the extent they were readily detected.

Since crack growth is significantly faster than initiation, it is estimated that initiation occurred after 8 to 10 years of service. The crack growth rate of greater than 90 mils/yr discussed in our previously submitted Topical Report 050 supports the premise that cracks can extend from initiation to leakage within 3-4 years in the absence of preventative measures. The new piping, installed in the 13R outage along with improved water chemistry is expected to have a much longer time frame, compared with that of the old piping, for IGSCC to initiate.

The attachment to this letter is a more detailed summary of the bases of this proposal. We request the NRC staff's concurrence that our leak-before-break evaluation of the IC piping outside containment is not impacted since IGSCC mitigating factors are already in place and stress improvement will be implemented at an appropriate time.

Very truly yours,

J. C. DeVine, Jr.
Vice President and Director,
Technical Functions

JCD/PFC/amk
Attachment

cc: Administrator, Region 1
NRC Resident Inspector
Oyster Creek NRC Project Manager