UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION

BY THE OFFICE OF NUCLEAR REACTOR REGULATION

MATERIAL TESTING PROGRAM FOR HOT-ROLLED XM-19 MATERIAL

GPU NUCLEAR CORPORATION

OYSTER CREEK NUCLEAR GENERATING STATION

DOCKET NO. 50-219

1.0 INTRODUCTION AND BACKGROUND

By letter dated August 24, 1994 (Ref. 1), GPU Nuclear Corporation (GPUN) submitted its response to GL 94-03, "Intergranular Stress Corrosion Cracking of Core Shrouds in Boiling Water Reactors." GPUN inspected the Oyster Creek Nuclear Generating Station (OCNGS) core shroud during the unit's fall 1994 refueling outage (RFO 15R, September 10, 1994). GPUN's examinations of the OCNGS core shroud indicated that significant cracking was evident in the core shroud's H4 weld. As a result of this cracking, GPUN decided to implement a modification of the OCNGS core shroud prior to returning the OCNGS reactor to service. The modification of the core shroud was to be designed to assure the structural integrity of the OCNGS shroud during subsequent operating cycles of the plant.

GPUN submitted the OCNGS core shroud stabilizer design to the NRC on October 25, 1994 (Ref. 2.). The staff reviewed GPUN's core shroud modification design and accepted the design for implementation on November 25, 1994 (Ref. 3). However, the NRC requested in the SE that GPUN submit a material testing program for hot rolled XM-19 material used in the core shroud stabilizer design, which was placed in service prior to the conclusion of refueling outage (RFO) 15R. The material testing program was to demonstrate the resistance of the XM-19 materials to intergranular stress corrosion cracking (IGSCC) under creviced Boiling Water Reactor (BWR) environmental conditions. By letter dated June 7, 1995, GPUN submitted its proposed material testing program for hot rolled XM-19 materials to the NRC (Ref. 4). The following evaluation provides the staff's assessment of GPUN's proposed testing program for hot rolled XM-19.

In its June 7, 1995, letter GPUN also submitted its augmented inservice program for the tie rod assemblies. The staff has not completed its evaluation of the augmented inservice program for the rod assemblies. Upon completion of the staff's review the staff will present the results in a safety evaluation.

Enclosure

2.0 EVALUATION AND CONCLUSION

GPUN's material testing program for hot-rolled XM-19 materials is summarized below:

1. Testing will be accomplished utilizing cylindrical CERT type specimens containing a threaded section cut to the same geometry as that utilized in the core shroud tie rods. A crevice geometry will be established around the threaded section to simulate the condition existing at the condition existing at the tie rod ends. Materials will be archive specimens from the same heats of material utilized in the core shroud tie rods installed at Oyster Creek (GPUN) and FitzPatrick (NYPA) Nuclear Power Plants.

2. The test medium will be simulated BWR reactor coolant at 550°F with a minimum 8 ppm oxygen. Contaminant levels will be controlled to maintain conductivity of the test medium in the range of 0.3 - 0.5 μS/Cm.

3. Test acceleration will be accomplished by subjecting the specimens to slow strain rate testing at a low strain rate (approx. $5x10^{-7}$ sec^{-1}) until failure. Prior to straining, specimens will be preconditioned for approximately seven days in the elevated temperature test environment.

4. Two specimens each of GPUN and NYPA heats of hot-rolled XM-19 will be tested in the BWR coolant environment and one specimen each will be tested in air as a control. In addition, one specimen of sensitized Type 304 stainless steel will be tested in the test environment as a control to assure adequacy of the test environment to produce IGSCC.

5. Following the test, specimens will be examined using conventional light microscopy and scanning light microscopy. The specimens will be examined for indications of stress corrosion cracking on the fracture surface and along the gauge section. A minimum of two metallographic mounts will be evaluated for each specimen.

The staff has reviewed GPUN's proposed material testing program and has determined the proposed program will simulate the chemistry environment in the OCNGS reactor coolant by using a high oxygen content in the environment, and by maintaining the conductivity of the test environment at levels which simulates the levels at the industry where significant cracking has been discovered. The staff has also determined that the testing conditions are designed to simulate the creviced environment of the hot-rolled XM-19 tie rod assembly components. Therefore, the staff concludes that GPUN's proposed material testing program for hot-rolled XM-19 materials is acceptable for implementation, provided the following conditions are incorporated into GPUN's test program:

1. Fabrication of test and control specimens of hot-rolled XM-19 should be done as to bound the degree of cold work in the fabricated hot-rolled XM-19 tie rod assembly components. This should include the method of fabricating the threads in the test and control specimens.

2. The creviced conditions of the test and control specimens should duplicate as closely as possible the creviced conditions around the tie rod assembly hot-rolled XM-19 components.

3. The staff recommends that control and test specimens be tested in an autoclave environment to simulate both the pressures and temperatures of the BWR operating environment at OCNGS.

4. The control specimens should include at least one sensitized XM-19 specimen from each heat of hot-rolled XM-19 to ensure that the testing conditions will produce IGSCC.

5. GPUN should justify why chloride and sulfate impurities are not considered in the BWR testing environment.

3.0 REFERENCES

1. Letter from R. W. Keaten, Vice President and Director of Technical Functions, GPU Nuclear Corporation, to the NRC, dated August 24, 1994, "Oyster Creek Nuclear Generating Station (OCNGS), Docket No. 50-219, NRC Generic Letter 94-03, 'Intergranular Stress Corrosion Cracking of Core Shrouds in Boiling Water Reactors.'"

2. Letter from R. W. Keaten, Vice President and Director of Technical Functions, GPU Nuclear Corporation, to the NRC, dated October 25, 1994, "Oyster Creek Nuclear Generation Station Core Shroud Repair - Design Report, Rev. 0."

3. Letter from the NRC to J. J. Barton, Vice President and Director, GPU Nuclear Corporation, dated November 25, 1994, "Safety Evaluation Regarding the Oyster Creek Core Shroud Repair (TAC No. M90104)."

4. Letter from R. W. Keaten, Vice President and Director of Technical Functions, GPU Nuclear Corporation, to the NRC, dated June 7, 1995, "Oyster Creek Nuclear Generation Station (OCNGS), Docket No. 50-219, Facility Operating License No. DPR-16, Core Shroud Enhancement - Inservice Inspection and XM-19 Material Testing Program."

Principal Contributors: W. Koo
J. Medoff

Date: September 25, 1995