UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SAFETY EVALUATION OF REDUCED SCOPE OF IGSCC INSPECTION

OYSTER CREEK NUCLEAR GENERATING STATION

GPU NUCLEAR, INC.

DOCKET NO. 50-219

1.0 INTRODUCTION

By letter dated July 29, 1998, as supplemented by e-mail received September 21, 1998, GPU Nuclear, Inc., (the licensee) submitted a request for NRC approval to perform a reduced scope of intergranular stress corrosion cracking (IGSCC) inspection in the upcoming refueling outage 17 (17R) (September 1998) at Oyster Creek Nuclear Generating Station (OCNGS). The licensee proposed to inspect 15 welds instead of 94 welds as originally scheduled for 17R outage (September 1998) in accordance with Generic Letter (GL) 88-01. Due to financial uncertainties, the licensee is planning decommissioning of OCNGS after operation of one more fuel cycle. Therefore, the licensee's activities during the 17R outage will focus on modifications, inspections and testing required to support safe operation of the plant through the next fuel cycle (fall 2000), and all other activities designed for long-term safe operation through the licensed life will be deferred for one fuel cycle. The licensee indicated that in the event that the early closure of OCNGS is not carried out, the original IGSCC inspection scope scheduled for 17R will be performed in 18R.

The IGSCC inspection in accordance with GL 88-01 started since the 12R outage. So far, cracks were found in 42 welds. Nine of these cracked welds were overlay repaired (four welds in each of the core spray and recirculation system piping and one weld in the shutdown cooling system piping). Two welds in the recirculation piping system found cracks after treatment by induction heating stress improvement (IHSI) in 11R. These welds were closely monitored and there are essentially no changes in the flaw sizes. One weld found leaking in a piping component that connects the reactor head cooling line to the closure head was replaced. Thirty welds in the isolation condenser system outside the drywell showed crack indications and all these welds were replaced. The licensee stated that inspections performed in the last three refueling outages did not find any crack indications.

The full cycle of hydrogen water chemistry (HWC) was implemented at OCNGS since cycle 13. Electro-chemical potential (ECP) used to control the HWC program was monitored in an external autoclave fed by flow from the "A" recirculation loop. The ECP measurements were discontinued near the end of cycle 15 to cut down the personnel radiation exposure, and the control of HWC performance was based on adjustment of hydrogen injection to limit the recirculation dissolved oxygen to a maximum of 2 ppb. The relationship of ECP versus dissolved oxygen content was established by measurements made during the previous operating cycles. During cycles 14 and 15 the availability of HWC was calculated to be very close to 90%, and in cycle 16, the HWC availability has been greater than 95% based on measured oxygen concentrations. The average

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conductivity since 15R was reported to be 0.09 uS/cm. The licensee indicated that HWC EPRI BWR water chemistry guidelines will continue to be implemented during the next fuel cycle.

The original scope and the licensee's proposed reduced scope of IGSCC inspection at 17R are summarized in Table 1. The inspection scope consists of ultrasonic examination of various numbers of piping welds in reactor head cooling, reactor water clean up, core spray, isolation condenser, shutdown cooling and recirculation systems. The staff's evaluation of the licensee's proposed reduced scope of IGSCC inspection at 17R outage is presented below.

2.0 EVALUATION

As shown in Table 1, the licensee proposed to defer inspection of 79 welds for one fuel cycle with 44 welds in the RWCU system, 6 welds in the core spray system, 26 welds in the isolation condenser system, 2 welds in the shutdown cooling system and 1 weld in the recirculation system. Of the affected welds, 35 are Category C welds (stress improved), 35 are Category D welds (nonresistant welds) and 9 are Category G welds (nonresistant, not inspected welds). The bases of the licensee's request are briefly summarized below:

(a) The water chemistry at Oyster Creek has been good in recent cycles. The average conductivity since 15R is about 0.09 uS/cm which is much better than the level 1 conductivity control requirement of 0.3 uS/cm in EPRI water chemistry guidelines.

(b) The HWC program was initiated in cycle 12. The availability of HWC is about 90% since 15R. HWC will continue to be implemented during the upcoming cycle 17R.

(c) During the last three refueling outages (14R, 15R and 16R), a total of 299 welds were UT inspected, no IGSCC indications were found.

(d) The licensee performed a sample crack growth calculation for the affected piping systems, using crack growth equation from the BWRVIP-14. The average operating stress is assumed to be 7.5 ksi. In the BWRVIP-14 equation, the crack growth rate is related to stress intensity factor, conductivity, electro-chemical potential (ECP) and the temperature. The results of the calculations have shown that the structural integrity of the affected piping welds will be maintained even if a small flaw (0.001 inch in depth and 360 degrees around) is assumed to be present since the last inspection. For larger piping (larger or equal to 12 inches in diameter), a 10% flaw can be tolerated.

(e) All the affected piping welds have been ultrasonically inspected two to three times since cycle 11R, using EPRI qualified personnel and procedures.

As shown in Table 2, the licensee-proposed inspection deferral of 79 welds for one fuel cycle at 17R outage consists of 35 Category C welds, 35 Category D welds and 9 Category G welds. The 9 Category G welds were RWCU welds located outside the second containment isolation valves (CIV). The inspection deferral of one fuel cycle for these 9 welds is acceptable because the licensee is committed to modify the 4 RWCU CIV at 17R outage to ensure that the subject valves can be closed during blow down conditions (such as LOCA outside the second CIV). Furthermore, 44% (38 welds) of the RWCU welds outside the second CIV were inspected and no IGSCC related flaws were found.

For the 35 Category C welds, 28 welds were stress improved by MSIP at 15R and seven welds by IHSI at 11R. In accordance with GL 88-01 the 28 welds improved by MSIP at 15R are required to be reinspected within two fuel cycles to ensure the stress improvement was properly applied and after that, the inspection frequency is once every 10 years. In view of the satisfactory service experience in the industry with the MSIP treated welds, the deferment of one fuel cycle to perform the confirmation inspection after the MSIP treatment is acceptable. However, the staff has some concerns regarding the effectiveness of mitigating IGSCC in IHSI treated welds. At the staff's request, the licensee reviewed the application data of the seven IHSI treated welds. The licensee indicated that with the exception of weld NZ-3-39, IHSI treatment was properly applied on these welds and met the processing specifications. Since the inspection requirement for the IHSI treated welds is once every 10 years, the inspection deferment of one fuel cycle is acceptable for those welds that were properly treated with IHSI. The licensee reported that, in IHSI treating the weld NZ-3-39, the actual through-wall temperature differential (263°C) did not meet the required magnitude of 273°C. Therefore, weld NZ-3-39 should be inspected during the upcoming refueling outage because IHSI mitigation may not be fully effective in this weld.

The 38 Category D welds in the RWCU system are small diameter (6 inches) piping welds. Per GL 88-01 Category D welds are welds susceptible to IGSCC and are required to be inspected every two fuel cycles. The licensee proposed to inspect three welds with recordable non-IGSCC indications at 17R outage and defer the inspection of the remaining 35 welds for one fuel cycle. These welds had been inspected two to three times since 11R outage; however, the staff has determined that the inspection of only three such welds at 17R outage would not provide an adequate sampling of these IGSCC susceptible welds. The staff recommends that three additional welds (ND-1-006, ND-1007 and ND-1-029) in the inlet line (ND-1) should be inspected at 17R outage. Welds ND-1-006, ND-1-007 and ND-1-029 are recommended for inspection because these welds are in the inlet line (off the recirculation system) and valve side of the wall thickness was not measured, indicating one side weld inspection. The RWCU welds in the inlet line are expected to be more susceptible to IGSCC than that in the return line (ND-10), because the temperature in the inlet line (520°F) is much higher than that in the return line (412° F). In addition, the staff recommends that weld ND-1-001 should be selected for inspection as one of the three welds with recordable indications. Weld ND-1-001 is located in the inlet line and is expected to be more susceptible to IGSCC than the other five welds with recordable indications which are located in the return line. Therefore, as shown in Table 1, of the 38 Category D welds in the RWCU piping system inside the CIV, six welds should be inspected at 17R outage. When cracks are found, sample expansion should follow the guidelines in GL 88-01.

In the evaluation of the reduced IGSCC inspection scope at 17R outage as discussed above, the staff also considered the situation that OCNGS may be decommissioned after 17R fuel cycle. Since the inspection scope per GL 88-01 is designed for long term safe operation of the plants, a reduced inspection scope can be granted for a short term plant operation such as one fuel cycle at OCNGS, when adequately justified. Based on the favorable inspection experience in the last three outages and the good coolant water chemistry resulting from implementing hydrogen water chemistry, the staff believes that extensive IGSCC is not likely to occur at OCNGS during the 17R fuel cycle. The staff has determined that the licensee has provided adequate justification to support its request of performing a reduced IGSCC inspection scope at 17R outage. However, the acceptable number of welds for inspection deferral of one fuel cycle is 75 welds instead of

79 welds as requested. Four additional welds (3 RWCU Category D welds (ND-1-006, ND-1-007 and ND-1-029) and 1 core spray Category C weld (NZ-3-39)) should be inspected at 17R as discussed above.

CONCLUSION

Based on the staff's evaluation, the licensee's request to defer inspection of 79 welds for one fuel cycle at 17R outage is acceptable, with the exception that four additional welds (3 RWCU Category D welds (ND-1-006, ND-1-007 and ND-1-029) and one core spray Category C weld (NZ-3-39)) should be inspected as discussed above. The staff has determined that because of favorable inspection experience in the last three outages and the good coolant water chemistry resulting from implementing hydrogen water chemistry, the safe operation of OCNGS for the 17R fuel cycle will not be compromised with the performance of the reduced scope of IGSCC inspection at 17R outage .

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