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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REGULATION

GPU NUCLEAR CORPORATION - FEEDWATER CONTROL LINE DRIVE RETURN LINE

NOZZLES UT INSPECTION PROGRAM FOR OYSTER CREEK NUCLEAR GENERATING STATION

DOCKET NO. 50-219

1.0 INTRODUCTION

By letters dated January 18, 1990, and July 12, 1990, GPU Nuclear Corporation (licensee/GPUN) proposed to replace routine internal dye penetrant (PT) examination of the feedwater (FW) nozzles and control rod drive return line (CRDRL) nozzle with external ultrasonic (UT) during the Oyster Creek Nuclear Generating Station (OCNGS) 13R refueling outage (1st quarter 1991). In addition, the licensee said, that based on satisfactory UT results during 13R of its FW and CRDRL nozzle inspection it will propose to defer future PT of the CRDRL nozzle. Furthermore, information was provided by a meeting between the staff and its contractor, Battelle, Pacific Northwest Laboratories, licensee, and Universal Testing Laboratories (UTL) (licensee's contractor) on September 19, 1990, and a phone call between the staff and licensee on October 22, 1990.

NUREG-0619 "BWR Feedwater Nozzle and Control Rod Drive Return Line Nozzle Cracking" dated November 1980, implements intervals for various feedwater nozzle configurations and CRDRL nozzles. In Table 2 of NUREG-0619 OCNGS's FW nozzles fall under single-sleeve, single-piston-ring seal, cladding removed and modified spargers, and requires the FW nozzles to be PT every 6 Inspection Interval-Refueling Cycles or 90 Start-up/Shutdown Cycles.

The original feedwater spargers were replaced with an improved design that considered thermal cycling and that was acceptable to the NRC. Other improvements to OCNGS have been considered or implemented for feedwater nozzle requirements as specified in Section 4.0 and Section 7.0 of NUREG-0619. For example:

1. Cladding was removed from the FW nozzles blend radius and bore regions during the spring 1977 OCNGS refueling outage.

2. During the 12R (1988) the licensee installed on the FW nozzles and pipe a Thermal Transient Monitoring System (TTMS), a modified version of EPRI "Fatigue-Pro", that has the capability for leakage monitoring, records actual transients encountered in service, and provides real time update of the remaining fatigue resistance of the nozzles.

3. The licensee reviewed the FW low-flow controller recommendations in NUREG-0619 and determined that the controller meets the intent of NUREG-0619, by minimizing feedwater on-off events at low power levels. The NRC reviewed the licensee's position and agreed with it by NRC letter dated July 20, 1981.

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4. The licensee reviewed its FW operating procedures against the recommendations in NUREG-0619 and found they meet the intent of Section 3.4.4.3 of NUREG-0619. The NRC reviewed the licensee's position and agreed with it by NRC letter dated July 20, 1981.

5. The licensee reviewed the NUREG-0619 recommendation to reroute the reactor water cleanup (RWCU) system to all feedwater nozzles. The licensee found that a marginal improvement would have been achieved by rerouting the RWCU piping. The NRC reviewed the licensee's position and agreed with it by NRC letter dated July 20, 1981.

The Oyster Creek Nuclear Generating Station had experienced between the previous FW nozzle inspection (7R) and the most recent (by UT) inspection (12R) 73 start-up/shut-down cycles and has accumulated up to the 12R outage a total of 157 start-up/shut-down cycles. During the 7R (1977) inspection of the FW nozzles the licensee found 54 unacceptable indications and subsequently upon the removal of the clad and polishing of the affected areas all indications were removed. The final examination of the affected areas indicated that the deepest grind-out was 7/32 inch in the 315 degree nozzle. During the 12R (1988) inspection by UT no indications were interpreted to be cracks in FW nozzles A, B, C, and D.

Various solutions to the CRDRL nozzle cracking problem had been presented in Section 7.2 and Appendix D of NUREG-0619. According to NUREG-0619, Paragraph 8.2(5), Page 34, the licensee chose to retain the upstream end of the OCNGS thermal sleeve, which was rolled into the nozzle safe end and tack-welded in three positions. The downstream end of the thermal sleeve was cut-off to permit PT of the nozzle blend radius. It was replaced by a removable insert deemed to be as good as the original sleeve. The 13R inspection requirements of the CRDRL nozzle is under Paragraph 8.2(5) of NUREG-0619, that specifically requires that the licensee remove the removable insert sleeve from the nozzle and PT be performed at the time of FW nozzle PT in accordance with Table 2 of NUREG-0619. Furthermore, this inspection requirement includes PT of the reactor vessel wall area beneath the CRDRL nozzle. During the 7R (1977) inspection of the CRDRL nozzle; the thermal sleeve was removed and PT was performed on the inside diameter of the nozzle. No indication of cracking was observed. In addition, the licensee by letter dated August 25, 1981, committed to a PT examination of the CRDRL nozzle during the 13R (1st quarter 1991) outage.

The licensee proposes to use an UT technique called Phased-Array instead of PT examination during the 13R (1st quarter 1991) outage inspection of the FW nozzles, the CRDRL nozzle and 8 inches of the reactor vessel wall below the CRDRL nozzle. A technical review meeting was held on September 19, 1990, at Chattanooga, Tennessee between the NRC, Battelle, Pacific Northwest Laboratories (NRC contractor), licensee, Kraftwerk Union (KWU)(developer of the phased-array technique) and Universal Testing Laboratories (UTL) (licensee's contractor and subsidiary of KWU) in which the Phased-Array technique was demonstrated. The staff found that the proposed phased array system to examine the OCGNS FW nozzles and CRDRL nozzle consists of hardware and software for performing a remote UT examination of the subject nozzles from the O.D. and three-dimensional computer modeling software aids in determining UT parameters used for inspection of nozzles. The demonstration also provided data to support the conclusion that the smallest notch that might not be detected is 0.172 inch. Sizing capability has been demonstrated effective only on notches; however, the performance on actual cracks is not known. Thermal fatigue cracks have been found in the feedwater nozzle, and the phased array system should demonstrate capability to detect and size thermal fatigue cracks.

The effectiveness of the techniques developed by KWU and UTL were demonstrated to the licensee in a blind test. The blind test was performed on a FW nozzle mock up prepared by the licensee that contained similar geometric conditions as those in the FW to be examined. Cracks had been found by a previous inspection (7R) and removed by grinding. The blind test accounted for this condition by grinding areas to simulate the original components. This portion of the blind test demonstrated the capability of the phased array system to discriminate between ground areas and cracks. The phased array system detected 33 out of 33 notches used in the performance demonstration to the licensee. For detail information on the phased-array UT system see attached Battelle, Pacific Northwest Laboratories' report dated October 3, 1990.

UTL Procedure No. UTL-AUT-04.01, Rev. 3 "Automated Phased Array Ultrasonic Inspection of RPV Nozzles" dated October 19, 1988, was reviewed to determine if inspection procedures were available for the phased array technique. The staff found that in addition to UTL's generic procedures, a plant specific procedure is written for use at each plant inspected with the phased array system. The phased array system and amplitude calibration is provided for by various calibration reference blocks and nozzle mock-ups that contain notches. The notches are used to set up the examination system parameters. The exception to this is the sweep, or time/distance calibration which is conducted manually. Couplant used for the examination will be Ultragel II or demineralized water. In addition, data evaluation is performed by personnel responsible for the examination system design and personnel who evaluate data from the examination technique qualifications. All personnel responsible for UT data acquisition and evaluation are qualified and certified in accordance with requirements of the ASME Code, Section XI.

2.0 EVALUATION

An UT examination will not be as sensitive for detection of surface connected defects as a PT examination. However, a PT examination does not provide any information on defect depth (a PT examination can only be used to determine defect length). The objective of an inservice examination is the detection of defects that may affect the structural integrity of the nozzle. The three-dimensional computer modeling developed for the UT of nozzles is an excellent analytic tool for developing parameters for the UT nozzles. Therefore, based on the licensee's experiences during the past 73 startup/shutdown cycles and five refueling outages, modifications, results of various FW and CRDRL nozzles NUREG-0619 requirement reviews by the licensee and NRC, and the effectiveness of the proposed phased array system's qualification method, the staff has found the licensee's proposed FW and CRDRL nozzle UT inspection to be acceptable for the 13R outage provided:

1. Any surface indication detected by the phased array system and not proven to be geometric in nature will require that a liquid penetrant examination be performed that meets the requirements Section XI.

2. The phased array system should demonstrate the capability to detect thermal fatigue cracks that are 0.172 inch in depth. The demonstration need not be a blind demonstration, as an example if data is available from other test (such as PISC II or past inservice inspection examinations) could be used to illustrate crack detection capability.

3.0 CONCLUSIONS

The staff and its contractor, Battelle, Pacific Northwest National Laboratories concluded that the licensee's proposed FW and CRDRL nozzle inspection program for OCNGS is acceptable provided that the licensee follows the requirements as discussed above. The staff also concludes that the proposed UT inspection of the subject nozzles will provide reasonable assurance of maintaining the structural integrity of the FW and CRDRL nozzles in OCNGS. A copy of the staff's contractor's report is enclosed.

Dated:

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