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June 30, 1979
GQL 0865

Mr. B. H. Grier, Director
Region I
Office of Inspection and Enforcement
631 Park Avenue
King of Prussia, PA 19406

Dear Sir:

Three Mile Island Nuclear Station, Unit 1
Operating License No. DPR-50
Docket No. 50-289
LER 79-011/03X-1

LER 79-011/03L-0 reported abnormal degradation of spent fuel cooling system piping and outlined certain followup action to further identify the cause of the pipe cracking. Since that report dated 5-16-79, investigative efforts have been initiated to resolve this problem and are presently continuing. This report is intended to update the status of these efforts.

1) Radiograph Inspections.

LER 79-011/03L-0 indicated that the highly stressed areas of the Spent Fuel Cooling system piping would be radiographed. Although radiographs of the leaking area of piping detected the cracking, blind testing of the same piping by a special ultrasonic method proved to be more sensitive to the full extent of the cracking. The capability of the ultrasonic testing was subsequently confirmed by visual and metallurgical inspections of an area of leaking pipe removed from the Spent Fuel Cooling System near valve SF-V17. Because of its greater sensitivity to the cracking and its greater practicality for extensive pipe weld examinations, the ultrasonic testing technique was used as the principal examination method for the survey of the system welds.

2) Ultrasonic Inspections

Using an ultrasonic technique recently developed to detect intergranular stress corrosion cracks in austenitic stainless steel, inspections of the Spent Fuel Cooling System were performed to determine the extent of the cracking. Results of these inspections are summarized in Table 1. The inspection results were analyzed on-site to determine any common characteristics which might be identified as a contributing cause of the intergranular stress corrosion cracks.

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Review of the data analysis for the Spent Fuel Cooling System inspections produced significant concerns for cracking of Type 304 stainless steel piping in stagnant or intermittently stagnant, oxygenated, boric acid environments in other plant systems. In response to these concerns, ultrasonic inspections of the Decay Heat Removal, Makeup & Purification and Reactor Building Spray system piping were initiated and are still in progress. Current inspection results are summarized in Table 1. Additional ULT equipment & technicians are being assembled to pursue the expanded inspection program.

3) Visual Inspections.

Visual walk-through inspections of the accessible Spent Fuel Cooling, Decay Heat Removal, & Reactor Building Spray systems piping have been conducted. These inspections located several areas of boric acid buildup and the results by system are tabulated in Table 1. A program for visual inspection of the accessible portions of other borated water systems is being implemented.

4) Metallurgical Analysis.

Metallurgical analysis was performed on a section of cracked and leaking piping welded to Spent Fuel Cooling System valve SF-V17. The conclusion of this analysis was that the cracking was due to intergranular stress corrosion cracking originating on the pipe I.D. The cracking was localized to the weld heat affected zone where the Type 304 stainless steel is sensitized. In addition to the main through-wall cracks, incipient cracks were noted at several locations in the weld heat affected zone. Sensitization of the weld heat affected zone is evidenced by precipitation of carbides in the grain boundaries and is believed to be caused by welding. The stresses responsible for cracking are believed to be primarily residual welding stresses, as the calculated applied stresses are below 15,000 psi.

Preparations are being made to remove an additional Spent Fuel Cooling System pipe section approximately 20 feet in length for further metallurgical analysis. Portions of this pipe length will be made available to the NRC and EPRI for independent analysis. A portion will also be supplied to Battelle Northwest Laboratory to perform a surface chemical analysis.

5) Chemistry Review.

A review of the chemistry logs for the Spent Fuel Cooling System from November, 1975 through May, 1979 indicated that chloride concentration was generally <0.1 ppm. The only exceptions were four samples between 0.1 and 0.2 ppm and one sample recorded at 1.4 ppm. Fluoride concentration was always <0.1 ppm. Therefore, there is no conclusive evidence at this time to identify any aggressive chemical species which could promote intergranular stress corrosion attack. If chemical attack does contribute to this corrosion phenomenon, then the Battelle Northwest Laboratory surface chemical analysis described above should be able to detect the aggressive chemical.

6) Piping Stress Analysis.

GPU Service Corporation conducted a review of the piping stress analysis for the areas of leakage in the Spent Fuel Cooling System. This review included the seismic, dead load, internal pressure, and thermal stresses. Stresses were found to be less than code design limits.

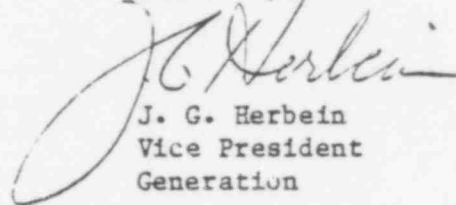
7) Repair Plans.

Present plans include replacing cracked sections of the 304 stainless steel piping in the affected systems with 304L stainless steel piping (having low carbon and nitrogen impurity levels). Type 304L stainless steel has shown increased resistance to intergranular stress corrosion in testing by General Electric Co. To avoid weld heat affected zone sensitization, only low heat input welding procedures will be used. These repair plans are under review and are subject to change as the full extent of the cracking becomes known.

8) Followup Report.

The next followup report will be submitted by August 15, 1979 and will include an update of the results of the piping inspections and the schedule for repair and/or replacement of the cracked piping. This report is also considered to serve as a followup report to LER 79-13/1P.

Sincerely,



J. G. Herbein
Vice President
Generation

JGH:ROB:jfg

Attachment

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TABLE #1

PIPING INSPECTION RESULTS
(current through 6/27/79)

<u>SYSTEM</u>	<u>NO. OF WELDS UT INSPECTED</u>	<u>NO. OF CRACK INDICATIONS BY UT</u>	<u>VISUAL LEAKS</u>
Spent Fuel Cooling (Dwg. 302-630)	270	66	7
Decay Heat Removal (Dwg. 302-640)	78	30	6
Reactor Building Spray (Dwg. 302-712)	0	0	2
Makeup & Purification (Dwg. 302-660 & 302-661)	<u>0</u>	<u>0</u>	<u>0</u>
Total	348	96	15

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