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For Div of Compliance

Jersey Central Power & Light Company

MADISON AVENUE AT PUNCH BOWL ROAD • MORRISTOWN, N. J. 07960 • 539-6111

February 9, 1968

Dr. Peter A. Morris, Director
Division of Reactor Licensing
United States Atomic Energy Commission
Washington, D. C. 20545

Subject: Oyster Creek Reactor Vessel Repair Program

Dear Dr. Morris:

We have, throughout the past several weeks, discussed on several occasions with you and your staff, as well as the ACRS, the problems associated with the reactor vessel at Oyster Creek. These discussions, which have been in the nature of interim status reports, supplemented by Amendment 29, Status Report on Reactor Vessel Repair Program, have been aimed at maintaining communication with the Commission and its consultants relative to this problem.

Our contractor, the General Electric Company, has developed a repair program along the lines set forth in the attached summary report which, you will note, General Electric states will be amplified by its detailed report submitted within about one month. We have advised General Electric that we have no objection to their proceeding with the repair program, and we understand that initial activities have begun.

We and our consultants plan to review very carefully the detailed implementation of that repair program, including the quality control, inspection and test procedures employed by General Electric Company. We plan to submit, in the form of an amendment to the Oyster Creek operating license application, the detailed report submitted by General Electric Company.

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Sincerely,

J. E. Logan
Vice President

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Enclosure

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GENERAL ELECTRIC COMPANY

NUCLEAR ENERGY DIVISION

175 CURTNER AVE., SAN JOSE, CALIF. 95125 . . AREA CODE 408, TEL. 297-3000, TWX NO. 910-338-0116

February 2, 1968

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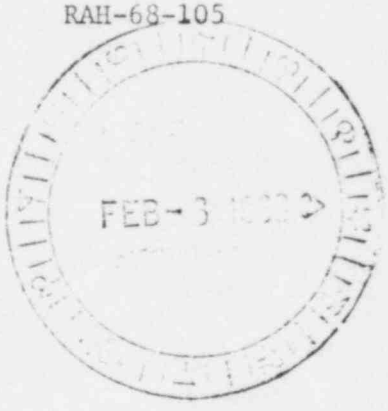

Jersey Central Project: Req. 303-91700
Subject: Oyster Creek Reactor Vessel Repair Program

Mr. G. H. Ritter, Vice President
Jersey Central Power & Light Company
Madison Avenue at Punch Bowl Road
Morristown, New Jersey

Dear Mr. Ritter:

General Electric investigation of the Oyster Creek reactor vessel problem has now developed to a point where we have completed the evaluation phases and are embarking on actual repair activities based upon the findings from such earlier activity. Our investigations conclude that the problem is, in fact, in the nature of that stated in earlier reports to you; namely, chemical activation of the surface of sensitized stainless steel stub tube material contained generally within high stress areas of the stub tube, the presence of defect containing field welds between the stub tubes and control rod housings, and minor defects contained within the welds between several of the in-core instrument tubes and the vessel.

Investigations

Careful and extensive examination of all areas of the reactor vessel have been carried out using liquid dye penetrant, ultrasonic and visual techniques. The scope and result of these examinations are summarized as follows:

1. Performance of carefully controlled dye penetrant examinations have revealed localized intergranular cracking in 123 stub tubes at the point of maximum stress, which is adjacent to the shop weld between the pressure vessel wall and the stub tube. Preliminary tests reported in Amendment 29 identified crack indications in 108 stub tubes at this location; the additional indications were minor in nature and were located near the center of the vessel where inspection is difficult and were of the type previously detected and reported.

2. Indications of shallow linear and non-linear rounded type defects have been found on the surfaces of 43 stub tubes by careful dye penetrant examination. These indications do not correlate with stress profiles, do reveal grain boundary attack, penetrate to a 5/32 inch depth in the maximum case and are extremely fine.

3. The field welds joining the stub tube and the control rod drive housings have been thoroughly surveyed using both dye penetrant and ultrasonic techniques. These studies indicate some level of defect--either porosity or localized lack of complete fusion--in each of the 137 field welds.

4. While not a major problem, slag inclusions were detected in a number of the welds attaching the flux monitor tubes to the reactor vessel bottom head through dye penetrant examinations and probe-grinding operations.

5. Subsequent to investigation of the aforementioned problem areas in the reactor vessel, further investigation of highly stressed areas or locations in which contaminants could potentially collect were initiated. These areas, which included recirculation suction piping, instrument nozzles, head spray welds, and various areas in the shroud support cone to the vessel welds, displayed no indications of defects through dye penetrant and ultrasonic examinations with the exception of three (3) minor surface indications located on internal surfaces of the vessel recirculation suction nozzle transition weld which were removed by shallow surface grinding. No defects were found in any other areas of the reactor vessel, with the exception of some minor localized weld lap indications at the intersection of the stub tube shop weld and the cladding which will be removed.

Evaluations

Based upon the facts set forth above, intensive evaluation of the reactor vessel defect problem was initiated by General Electric, its technical consultants, and Combustion Engineering, the reactor vessel supplier. These evaluations were broken down into specific functional phases aimed at investigation of metallurgical factors and performance of chemical and design analyses.

In the area of metallurgy, physical samples were taken from representative reactor vessel stub tube shop welds, stub tubes proper, and field welds. These samples were taken in locations indicating major defects, as well as locations which were expected to be representative of general stub tube conditions. Metallography relating to these samples was evaluated by both General Electric and Combustion Engineering and their respective consultants. Results of this metallography indicated the presence of intergranular attack of the stub tube areas both adjacent to the shop weld locations and in localized areas of the stub tubes proper. Metallography of the field welds which join the stub tube to drive housings showed indication of lack of complete fusion and, in some cases, porosity within the weld proper.

The preliminary evaluation set forth in Amendment 29 which indicated that the subject problem appeared to be a combination of problems associated with welding of the field welds and stress assisted corrosion of the stub tubes has been fully verified by studies and evaluations conducted since issuance of the Amendment. A comprehensive survey has been conducted of the environment to which the vessel was subjected during its fabrication and field installation history. Although it has not been possible to establish a specific corrodant responsible for the problem, several chemicals which potentially have been in contact with the reactor vessel have been evaluated. Among these were those associated with shop fabrication operations, both shop and field hydrostatic testing, and field assembly and cleaning activities.

In order to evaluate as effectively as possible the potential chemical contaminants associated with the observed intergranular attack of the vessel stub tube material, control samples were taken of liquids collected in various local areas of the reactor vessel, as well as samples of the chemical solutions utilized in reactor vessel cleaning operations. Investigation was also made of materials utilized during shop fabrication operations and other environments to which the vessel was subjected throughout both its shop and on-site life.

Samples exposed to chemical cleaning solutions comparable to those actually utilized at Oyster Creek displayed no evidence of intergranular attack after a period of 160 hours at a temperature of 180°F.

All samples tested indicated freedom from attack with the exception of those sensitized 304 stainless steel material samples stressed above yield and subjected to aqueous solutions containing chlorides as low as ten parts per million at a temperature of 180°F. Such cracking was incurred in laboratory samples after exposure to the above conditions for forty-eight hours.

A careful evaluation of stress profiles has been conducted by General Electric, Combustion Engineering, and the Teledyne Corporation. In general, these evaluations conclude that:

1. The highest operating tensile stresses occur in the cold pressurized condition.

2. The stresses tend to be compressive in nature at the hot operating condition.

The shop weld between the stub tube and the vessel head included weld metal in excess of that required by design. Experience and measurements of the distortion indicate that the field weld between the stub tube and the CRD housing applied fabrication induced strains which exceed the elastic limit of the material on the "free" length of the "hill side" on the outer rows of the stub tubes. Experience also indicates that increasing the "free" length of the stub tube will reduce the fabrication strains. As a result of this conclusion, excess weld metal will be removed in selected areas.

Repair Action

Based upon the investigative and evaluation actions set forth above, decisions have been made to effect repair of the Oyster Creek reactor vessel as follows:

1. The stress-assisted intergranular cracks in the stub tube at the shop weld to stub tube juncture have been removed by grinding. Even though stress analyses indicate that only those ground configurations which exceed 3/16 inch in depth require deposition of weld metal, all ground configurations will be restored with 308L weld metal.

2. The fine cracks observed in the stub surfaces have been removed. However, these cracks are extremely fine in many cases and it is not possible to guarantee that all such cracks have been removed. While remote, it is also possible that remaining undetected cracks could bear a corrodant which in time could further propagate. To provide insurance against this remote eventuality, stub tube surfaces will be clad with a 308L weld metal overlay. This material is significantly more resistant than sensitized 304 stainless steel to stress-assisted corrosion attack.

3. As stated previously, the tensile strains resulting from fabrication or the cold pressurized condition are reduced as the "free" length of the stub tube is increased. The shop welds will be contour-machined to provide a minimum of 1/2 inch between the top of the shop weld and the bottom of the field weld.

4. Some level of defect, porosity or lack of complete fusion, is indicated in the field welds through the combination of dye penetrant and ultrasonic testing methods. It is difficult to establish with assurance the real significance of these findings in each instance. In the interest of advancing the Oyster Creek program, all field welds attaching the thimble to the stub tubes will be removed and replaced.

5. Slag inclusions in the flux monitor guide tube welds will be removed and the welds repaired with application of Inco 182 weld material.

In the composite, this program of modification and repair consistently, we believe, reflects a conservative approach to the integrity of the Oyster Creek pressure vessel and fully restores the pressure vessel to at least the original design and design intent.

We are initiating immediately the aforementioned repair action at Oyster Creek excepting those two specific stub tube locations which the Commission previously requested be retained in their original state. At an appropriate time when the repair schedule demands, these two stub tubes will also be repaired.

Preparation of procedures and plans in support of this program is nearing completion. These procedures and plans, as developed, will be available for review with AEC Compliance personnel on site as the work progresses. We will further provide to the Commission and to the ACRS a final report in detail of the information supplied above. This report will be filed with the Commission in the form of an amendment to the Oyster Creek operating license application.

Sincerely,

R. A. Huggins
Principal Project Engineer
Oyster Creek Project

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