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NINE MILE POINT NUCLEAR STATION UNIT #1

INSERVICE INSPECTION PROGRAM FOR

CONTROL ROD DRIVE PENETRATIONS

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NINE MILE POINT NUCLEAR STATION UNIT #1

INSERVICE INSPECTION PROGRAM FOR

CONTROL ROD DRIVE PENETRATIONS

1.0 Introduction

1.1 On March 27, 1984, water was observed dripping from a Control Rod Drive (CRD) penetration on the Nine Mile Point Unit #1 reactor vessel. More detailed inspection using closed circuit television identified the cause of the leak to be cracks in the reactor pressure vessel stub tubes. A leakage path was formed through the cracks in the stub tubes, into the annular gap between the CRD housing and the vessel bore, continuing along the housing until it collected at the CRD flange. Subsequent inspections identified an additional leaking penetration and seven penetrations which showed evidence of prior leakage. Remote closed circuit TV inspections of 12 penetrations revealed cracks in six stub tubes. The cracks were limited to the furnace sensitized 304 stainless steel stub tube material in the area near the J-weld between the top of the stub tube and the housing. These cracks were believed to be typical of Intergranular Stress Corrosion Cracking (IGSCC) found in other operating boiling water reactors.

Repairs were performed to only those CRD penetrations which leaked or showed evidence of possible prior leakage. Repairs were performed by roll expanding the CRD housing into the wall of the

reactor pressure vessel. This rolling results in high contact pressure between the outside diameter of the housing and the bore of the reactor pressure vessel, thereby eliminating or limiting leakage to a very small amount. During the system hydrostatic test, an additional leaking CRD penetration was found and repaired by the rolling process.

Prior to rolling, the area to be rolled and the stub tube to housing weld areas were ultrasonically inspected for integrity. These same areas were also examined after rolling to ensure integrity was maintained. The determination of penetrations to be rolled was based solely on visual inspections performed from underneath the vessel. The closed circuit TV inspections were performed in order to determine and verify the source of the leakage. Also, these closed circuit TV inspections provided assurance that the cracking was consistent with our understanding of the problem, and occurrences in other operating boiling water reactors.

Based on our understanding of the cracking mechanism, inspection performed during the Spring 1984 Refueling Outage and experience from other operating boiling water reactors; Niagara Mohawk has developed this CRD penetration inspection program.

2.0 Scope

2.1 This inspection program covers future inspection of CRD penetrations at the Nine Mile Point Unit #1 nuclear power generating station.

3.0 Purpose

3.1 This inspection program is designed to perform the following functions:

3.1.1 Verify the integrity of the CRD penetration pressure boundary and identify any leakage from new sources or degradation of previous repairs.

3.1.2 Monitor the weld heat affected portions of the CRD housing to ensure that the IGSCC observed in 1984 remains confined to the furnace sensitized 304 stainless steel stub tubes.

3.1.3 Monitor the CRD housing in the rolled area for any deleterious affects caused by the rolling process.

3.2 This inspection program shall meet or exceed the requirements of ASME Boiler and Pressure Vessel Code, Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components (Table IWB-2500-1, Categories B-E and B-N-2.

4.0 Inspection Program

4.1 The inspections to be performed include the following:

4.1.1 Continued visual examination of the CRD penetrations for leakage and/or evidence of prior leakage during and after the performance of leakage or hydrostatic tests of the reactor coolant system. These examinations are performed to satisfy the requirements specified in Section XI of the American Society of Mechanical Engineers Boiler & Pressure Vessel Code (ASME Code).

4.1.2 Continued visual inspections of the CRD penetration assemblies and welds using remote closed circuit television or other visual aids from inside the reactor vessel to identify the location and extent of any cracks in the CRD stub tubes, housings and welds. The CRD weld inspection is performed to satisfy the requirements specified in Section XI of the ASME Code. These visual inspections will be performed only when these areas become accessible during normal maintenance activities.

4.1.3 Ultrasonic inspections from the inside of the CRD housings to confirm their structural integrity and the integrity of the stub tube-to-housing weld. These examinations will be performed for information only.

4.2 The following is a description of each inspection to be performed as well as the identification of the extent and frequency.

4.2.1 Visual Examination for Leakage During Leakage or Hydrostatic Tests

These examinations are intended to meet present Nine Mile Point Unit #1 technical specification Inservice Inspection (ISI) requirements and are based on Table IWB-2500-1, Category B-E of Section XI of the ASME Code.

4.2.1.1 Description of Inspection

Perform checks of all CRD penetrations for evidence of leakage (e.g., by looking for drops at the CRD housing flange), and if any leakage is observed, perform visual examination of the leaking CRD housings at the vicinity of the lower reactor vessel head to confirm the location of the leaking penetration and to observe any evidence of prior leakage (e.g., water streaks, discoloration or corrosion products). These examinations are to be performed during pressure testing of the reactor coolant system with the system pressurized to the system leakage test or system hydrostatic test pressure specified in Section XI of the ASME Code. A hold time of four hours is recommended for all tests to provide sufficient time for accumulation of any leakage at the CRD housing flange elevation.

4.2.1.2 Frequency and Extent of Inspection

Perform the visual examination of each CRD penetration during each system leakage test following each refueling outage and during each system hydrostatic test conducted at or near the end of each inspection interface as specified in Table IWB-2500-1 Section XI of the ASME Code.

4.2.2 Visual Examination From Inside the Reactor Vessel

These examinations are intended to meet present Nine Mile Point Unit #1 technical specification ISI requirements and are based on Table IWB-2500-1, Category B-N-2 of Section XI of ASME Boiler and Pressure Vessel Code.

4.2.2.1 Description of Inspection

Perform a visual inspection of specified CRD penetrations from inside the reactor vessel lower head using a remote TV camera.

The following weld and heat affected zones should be inspected; the stub tube to reactor vessel weld, the stub tube to CRD housing J-weld, and adjacent areas of the reactor vessel, stub tube and CRD housing. All accessible surfaces of stub tubes should be examined.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

4.2.2.2 Frequency and Extent of Inspection

Examine CRD penetrations during refueling outages as required by the examination frequency identified in Table IWB-2500-1 of Section XI. This requires welds of interior attachments beyond the beltline region be examined as they become accessible during maintenance or refueling activities.

The purpose of this examination is to identify stub tube cracks or other defects which could potentially result in leakage during future plant operation and to monitor changes in the defect size and extent in those stub tubes which contain identified defects. The examination will provide additional information as to the extent of stub tube cracking.

4.2.3 Ultrasonic Inspection for CRD Housing Integrity

Remote ultrasonic examinations of the CRD and J-weld are developmental in nature and are performed in accordance with state-of-the-art techniques. They are performed for information only and are not covered by ASME Code requirements.

4.2.3.1 Description of Inspection

Perform ultrasonic inspections from the inside of the CRD housing to identify cracks or other defects in the housing or in the fusion zone of the housing to stub tube welds (J-welds). The inspection shall cover the length of the CRD housing from the outside diameter of the reactor vessel to just above (approximately 2 inches) the J-weld, and should include inspection of the CRD housing rolled area and the rolled to unrolled transition areas for evidence of cracks.

4.2.3.2 Frequency and Extent of Inspection

Perform ultrasonic examination of two or more CRD penetrations previously repaired by rolling during each refueling outage. Different housings should be examined during each refueling outage, as practical. If no defects are found during the first three inspection periods, the frequency of inspection will be re-evaluated.

4.3 Acceptance Criteria

The following is the acceptance criteria to be used in the evaluation of the examination results.

4.3.1 CRD Penetration Leakage Results

The plant technical specifications contain criteria to be used in evaluating the acceptability of CRD penetration leakage. Additional considerations are as follows:

4.3.1.1 During Hydrostatic Testing

There is no requirement for a leak tight joint since, based on the safety evaluation report, the plant can tolerate a significant leak. However, leakage detected during a hydrostatic test will be evaluated as part of the decision whether to repair by rolling. If it is judged that the leakage could (during subsequent plant operation) impair the ability to obtain an effective rolled joint repair in the future, a rolling repair of the leaking penetration will be performed.

4.3.1.2 During Plant Operation

Allowable leakage requirements are specified in the Nine Mile Point Unit #1 technical specifications. Also any leakage detected during plant operation will be evaluated in considering whether to repair by rolling or other means.

4.0 Inspection Program (Continued)

4.3.2 Inservice Inspection Results

4.3.2.1 For In-Vessel Visual Examinations by Closed Circuit TV

Any cracking or abnormal conditions will be evaluated on a case basis.

4.3.2.2 For Ultrasonic Inspection Results

Since there are no fixed criteria to be used in evaluating the acceptability of the ultrasonic inspection results, any indication which is found will be evaluated on a case basis.

4.4 Records and Reports

Records of all inspections shall be maintained and reports shall be prepared in accordance with the requirements of Article IWA-6000 of Section XI of the ASME Code.

5.0 Discussion

5.1 In preparing the inspection program, past experience from other operating boiling water reactors with CRD penetration leakage was reviewed. This inspection program is consistent with that experience.

5.0 Discussion (Continued)

5.2 The driving force for IGSCC in stub tubes is the residual stress resulting from field installation and straightening, since service stresses are compressive. Therefore, crack propagation through the stub tube wall may be very slow once the residual stresses are relieved during crack initiation.

5.3 The decision to roll repair a CRD penetration will continue to be based on leakage or evidence of prior leakage determined during the visual inspections performed during the pressure tests.

6.0 Conclusion

6.1 Previous safety evaluations have determined that stub tube cracking does not pose a safety issue. We believe IGSCC in furnace sensitized 304 stainless steel stub tubes is well understood. Extensive inspections to determine location and depth of cracks may not accurately predict propensity for leakage. Extensive inspection requires significant amounts of time and personnel exposure and does not provide any significant benefits. Based on these reasons, we believe the Nine Mile Point Unit #1 inspection program, detailed in Section 4.0, provides adequate margin for safety without undue personnel exposure.

NIAGARA MOHAWK

NIAGARA MOHAWK POWER CORPORATION/300 ERIE BOULEVARD WEST, SYRACUSE, N.Y. 13202/TELEPHONE (315) 474-1511

October 1, 1984

Director of Nuclear Reactor Regulation
Attention: Mr. Domenic B. Vassallo, Chief
Operating Reactors Branch No. 2
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Re: Nine Mile Point Unit 1
Docket No. 50-220
DPR-63

Dear Mr. Vassallo:

Our letter of May 25, 1984 indicated we were evaluating plans for future nondestructive examinations of our control rod drive housing assemblies. Our letter of May 31, 1984 indicated we would begin the examination during our next scheduled refueling outage. We further indicated we would provide our final plans by October 1, 1984. Contained herein are those plans.

Sincerely,

NIAGARA MOHAWK POWER CORPORATION

C. V. Mangan
Vice President
Nuclear Engineering and Licensing

RJP/bd
Enclosure

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