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10 CFR 50.54(f)

January 7, 2002
5928-01-20362

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

THREE MILE ISLAND, UNIT 1 (TMI UNIT 1)
OPERATING LICENSE NO. DPR-50
NRC DOCKET NO. 50-289

SUBJECT: AmerGen Response to NRC Bulletin 2001-01, "Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles," Item No. 5

References:
1. NRC Bulletin 2001-01, ""Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles," dated August 3, 2001.
2. Exelon/AmerGen Letter to NRC (5928-01-20229), "Exelon/AmerGen Response to NRC Bulletin 2001-01, "Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles,"" dated August 31, 2001.

Pursuant to 10 CFR 50.54(f), AmerGen is hereby providing the information requested in Item 5 of NRC Bulletin 2001-01, "Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles"(Reference 1). Item 5 of the bulletin requests the following:

(a) A description of the extent of VHP (Vessel Head Penetration) nozzle leakage and cracking detected at your plant, including the number, location, size, and nature of each crack detected;

(b) If cracking is identified, a description of the inspections (type, scope, qualification requirements, and acceptance criteria), repairs, and other corrective actions you have taken to satisfy applicable regulatory requirements. This information is requested only if there are any changes from prior information submitted in accordance with this bulletin.

The Attachment contains the information described above and includes the results of the visual inspection of TMI Unit 1 Vessel Head Penetration (VHP) nozzles performed during the recently completed 1R14 Refueling Outage, and the corrective actions taken as a result of the visual inspections. As a result of these inspections, Licensee Event Report (LER No. 2001-002-00) was submitted on December 5, 2001. This information is being provided within 30 days following restart of TMI Unit 1 as stated in Reference 2.

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The visual inspection completed during Refueling Outage 1R14 meets the intent of a qualified visual inspection as defined in NRC Bulletin 2001-01. The most probable cause of the CRDM nozzle through-wall cracking is primary water stress corrosion cracking. The corrective actions taken by AmerGen support the conclusion that safety will be maintained during the planned operating cycle.

This letter establishes no new regulatory commitments and completes the AmerGen response to NRC Bulletin 2001-01 for TMI Unit 1.

I declare under penalty of perjury that the foregoing is true and correct. Executed on January 7, 2002.

Very truly yours,

Michael P. Gallagher
Director – Licensing and Regulatory Affairs
Mid-Atlantic Regional Operating Group

Attachment

cc: H. J. Miller, USNRC, Regional Administrator, Region I
T. G. Colburn, USNRC, Senior Project Manager, TMI Unit 1
J. D. Orr, USNRC, Senior Resident Inspector, TMI Unit 1
File No. 01062

Three Mile Island Unit 1 Response to
NRC Bulletin 2001-01, "Circumferential Cracking of Reactor
Pressure Vessel Head Penetration Nozzles," Item No. 5

REQUESTED ACTION:

5. Addressees are requested to provide the following information within 30 days after plant restart following the next refueling outage:

   a. a description of the extent of VHP (Vessel Head Penetration) nozzle leakage and cracking detected at your plant, including the number, location, size, and nature of each crack detected;

   b. if cracking is identified, a description of the inspections (type, scope, qualification requirements, and acceptance criteria), repairs, and other corrective actions you have taken to satisfy applicable regulatory requirements. This information is requested only if there are any changes from prior information submitted in accordance with this bulletin.

Additionally, the following commitment was made by AmerGen in response to NRC Bulletin 2001-01 (Attachment Reference 1):

> TMI Unit 1 will provide a report of the results of the visual inspections performed during the next refueling outage, and any corrective actions taken within 30 days following restart of the unit after the next refueling outage.

RESPONSE:

On October 9, 2001, TMI Unit 1 shut down in support of the planned Refueling Outage 1R14. TMI Unit 1 proceeded to implement the planned visual inspection and subsequent repair activities as committed to in the TMI Unit 1 response to NRC Bulletin 2001-01 (Attachment Reference 1). Repairs were performed in accordance with the ASME Section XI Code with relief from Code requirements as approved by the NRC (Attachment References 2 and 3).

Following entry into Cold Shutdown and removal of the Reactor Vessel Head insulation, a qualified bare metal visual inspection of the 69 Control Rod Drive Mechanism (CRDM) nozzle and 8 Thermocouple (TC) nozzle interfaces was performed. The inspection was performed in accordance with ES-NDE-07T, "Visual Inspection Of TMI-1 Reactor Vessel Head Penetrations," Revision 0. The inspectors were certified Level III visual and specifically trained on VHP leakage observations. The special training used industry operating experience and images of leaking nozzles to sensitize inspectors to the type and quantity of boric acid crystal deposits indicative of CRDM through-wall leaks experienced at Oconee Nuclear Station, Crystal River, and Arkansas Nuclear One.

In accordance with ES-NDE-07T, the initial results of the visual inspection classified the "as-found" condition of the VHP nozzle penetrations into three categories:

1. Acceptable: Those in the Acceptable category showed no evidence of leakage at the base of the nozzle and the outer Reactor Pressure Vessel (RPV) head surface.

2. Masked: This was an interim category. Those in the Masked category had loose debris or obstructions around the nozzle that prevented an entire 360 degree inspection. The obstruction or loose debris was vacuumed (while videotaping the area) to allow for complete inspection. The boric acid residue from leaking RPV nozzle penetrations at other stations was characterized as tightly adhering to the nozzle/head interface area. Vacuuming would not remove this type of boric acid residue. After vacuuming, the nozzle was classified as either Acceptable or Suspect. Any nozzle that remained "masked" in the area of interest (annular gap) was classified as Suspect and subject to subsequent UT and PT inspections.

3. Suspect: Those in the Suspect category showed signs of boric acid residue at the nozzle base.

The Suspect CRDM locations were examined using a visible dye penetrant (PT) method at the surface of the J-groove weld, the OD of the CRDM nozzle protruding into the RPV, and at the end of the CRDM nozzle. All Suspect CRDMs had the drives removed and a top-down ultrasonic examination was performed utilizing the Babcock & Wilcox Owners Group (B&WOG) Top-down tooling. The ultrasonic examination consisted of two complete scans of each Suspect nozzle. One axial scan was used to identify circumferential flaws, and one circumferential scan to identify any axial flaws.

Boric acid deposits were located at the base of all eight TC nozzles. After reviewing tapes of the last TC nozzle inspection, all TC nozzles were deemed to be leaking and were repaired.

The initial visual inspection categorized two CRDM nozzles as Suspect; and forty-five were categorized as Masked. The masked locations were videotaped as the loose debris was vacuumed to allow for complete inspection of the base of the CRDM nozzles. Subsequently, ten additional CRDM nozzles were deemed Suspect. This brought the total number of Suspect CRDM nozzles requiring additional PT and UT examinations to twelve. The twelve CRDM nozzles identified for PT and UT examinations were TMI CRDM Nozzles #11, #20, #29, #32, #35, #37, #41, #44, #48, #51, #64, and #65.

PT and UT examinations were performed after the RPV head was removed and placed on the storage stand. The final engineering evaluation of the visual inspection, PT and UT data identified that five of the CRDM nozzles were leaking. The five leaking nozzles were TMI nozzles #29, #35, #37, #44, and #64. One additional nozzle, TMI CRDM Nozzle #51, was analyzed by fracture mechanics to be unacceptable for the next operating cycle. This brought the total number of CRDM nozzles requiring repair to six (See Figure 1).

PT Examinations:
The results of the PT examination identified four CRDM locations with indications. All CRDM locations with PT indications were repaired. The other eight nozzles did not exhibit any PT indication.

The PT indications are described as follows:

1. CRDM Nozzle #35 had two (2) axial indications in the weld and one circumferential indication approximately 23 degrees long in the weld.

2. CRDM Nozzle #37 had one axial indication in the weld and one circumferential indication approximately 100 degrees long in the weld.

3. CRDM Nozzle #44 had four (4) axial indications (one in the weld and 3 at the end of the nozzle) and one circumferential indication 23 degrees long in the weld.

4. CRDM Nozzle #64 had one circumferential indication approximately 60 degrees long in the toe of the weld at the RPV cladding interface.

UT Examinations:
Five of the twelve nozzles (TMI CRDM Nozzles #20, #32, #37, #41, and #48) exhibited no flaws based on UT. The results of the UT examinations identified seven (7) CRDM nozzles with indications. No circumferential flaws were detected in the nozzles either above or below the J-groove weld. Three of the CRDM nozzles were determined to require repair. Flaws in the other four CRDM nozzles were evaluated as acceptable in accordance with the flaw acceptance criteria contained in the September 24, 2001 draft NRC letter from J. Strosnider to A. Marion of NEI (Attachment Reference 4).

The UT indications are described as follows:

1. CRDM Nozzle #11 had one ID axial indication in the nozzle. The flaw was 0.12 inch in depth and 0.36 inch long. The flaw was located 1.91 inch below the J-groove weld. The flaw was analyzed as acceptable for at least one additional cycle of operation.

2. CRDM Nozzle #29 had one Outer diameter (OD) axial indication in the nozzle. The flaw was 0.11 inch in depth and 0.91 inch long. The flaw was located 0.13 inch above the J-groove weld and extended to 0.34 inch above the face of the weld. It was determined that the flaw most likely entered the weld material and was too small to be seen as a PT indication. The flaw was determined to be unacceptable and the nozzle was repaired.

3. CRDM Nozzle #35 had three (3) ID axial indications in the nozzle. Flaw #1 was 0.35 inch in depth and 0.44 inch long. The flaw was located 1.49 inch below the J-groove weld. Flaw #2 was 0.21 inch in depth and 0.61 inch long. The flaw was located 1.08 inch below the J-groove weld. Flaw #3 was 0.21 inch in depth and 0.52 inch long. The flaw was located 1.32 inch below the J-groove weld. The three flaws were closely spaced and evaluated as a single combined flaw. The combined flaw was analyzed and found to be acceptable for an additional cycle of operation based on UT. (Note that CRDM #35 was repaired based on PT results.)

4. CRDM Nozzle #44 had one ID axial indication in the nozzle. The flaw was 0.34 inch in depth and 1.53 inch long. The flaw was located 0.33 inch below the J-groove weld. The flaw was determined to be unacceptable and the nozzle was repaired.

5. CRDM Nozzle #51 had five (5) ID axial indications in the nozzle. Flaw #1 was 0.35 inch in depth and 1.7 inch long. The flaw was located 0.97 inch below the J-groove weld. Flaw #2 was 0.43 inch in depth and 2.06 inch long. The flaw was located 0.48 inch below the J-groove weld. Flaw #3 was 0.15 inch in depth and 0.47 inch long. The flaw was located 1.99 inch below the J-groove weld. Flaw #4 was 0.17 inch in depth and 0.55 inch long. The flaw was located 0.75 inch above the J-groove weld. Flaw #5 was 0.12 inch in depth and 0.33 inch long. The flaw was located 1.1 inch above the J-groove weld. Flaws #1, #2, and #3 were closely spaced and evaluated as a single combined flaw. The combined flaw was determined to be unacceptable and the nozzle was repaired.

6. CRDM Nozzle #64 had one ID axial indication in the nozzle. The flaw was 0.24 inch in depth and 1.17 inch long. The flaw was located 1.03 inch below the J-groove weld. The flaw was analyzed as acceptable for an additional cycle of operation based on UT. (Note that CRDM #64 was repaired based on PT results.)

7. CRDM Nozzle #65 had one ID axial indication in the nozzle. The flaw was 0.12 inch in depth and 0.4 inch long. The flaw was located 0.89 inch below the J-groove weld. The flaw was determined to be acceptable for at least one additional cycle of operation.

UT detected no circumferential cracking above the J-groove weld in any CRDM nozzle. Therefore, no expansion of the UT inspection beyond the above listed CRDM nozzles was required (See Attachment Reference 1).

Six CRDM and eight TC nozzles were repaired. A video inspection of the RPV head surface was completed after cleaning activities to provide a baseline for future visual inspections. An in-service leakage test was performed in accordance with plant procedure 1303-8.1, "Reactor Coolant System." The plant conditions were nominal operating pressure and temperature. No evidence of leakage was noted following a four-hour hold. Operability of the CRDM was confirmed during plant start-up in accordance with plant procedures.

Corrective actions are in place to re-examine CRDM Nozzles #11 and #65 during the next refueling outage if they are to remain in service during the next operating cycle.

This submittal completes the AmerGen response to NRC Bulletin 2001-01.

References:

1. Exelon/AmerGen letter to U.S. NRC (5928-01-20229), "Exelon/AmerGen Response to NRC Bulletin 2001-01, 'Circumferential Cracking of Reactor Pressure Vessel Head Penetration Nozzles,'" dated August 31, 2001.

2. NRC letter to M.E. Warner (5928-01-30329), "Three Mile Island Nuclear Station, Unit 1 (TMI-1) – Safety Evaluation for the Third 10-Year ISI Interval Request for Relief Nos. RR-01-14 Through RR-01-17 (TAC No. MB2323)," dated November 7, 2001.
3. NRC letter to M.E. Warner (5928-01-30351), "Three Mile Island Nuclear Station, Unit 1 (TMI-1) – Safety Evaluation for the Third 10-Year Inservice Inspection (ISI) Interval Request for Relief No. RR-01-18 (TAC No. MB3177)," dated December 4, 2001.
4. NRC draft letter to A. Marion of NEI, "Flaw Evaluation Criteria," dated September 24, 2001.

Figure 1