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Chief Nuclear Officer

May 16, 1996
JPN-96-022

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
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SUBJECT: James A. FitzPatrick Nuclear Power Plant
Docket No. 50-333
Feedwater Nozzle Inspection Program

Reference: BWR Owners Group letter (BWROG-95092) to NRC, transmitting General Electric Report GE-NE-523-A71-0594, "Alternate BWR Feedwater Nozzle Inspection Requirements," dated October 30, 1995.

Dear Sir:

This letter requests NRC approval of proposed changes to the inspection program for the reactor vessel feedwater (FW) nozzles at the James A. FitzPatrick Nuclear Power Plant. The inspection program addresses the FW nozzle cracking potential discussed in NUREG-0619. The proposed changes would (1) increase the inspection interval of the ultrasonic (UT) examination of the feedwater nozzles to every ten years, and (2) eliminate a diagnostic system (Leakage Monitoring System), that monitors bypass leakage across the FW sparger thermal sleeve seals.

The proposed changes ensure adequate protection of the reactor pressure vessel while minimizing personnel exposure levels. The technical bases for the proposed changes are: (1) the effectiveness of the past and current UT examination program for detecting FW nozzle cracks, (2) the effectiveness of the improved thermal sleeve design in minimizing bypass leakage based on the results of the FitzPatrick Leakage Monitoring System over the past two operating cycles, (3) the absence of reportable FW nozzle indications after more than twenty years of service, and (4) the results of a fracture mechanics analysis of the FW nozzle. The Attachment provides additional information regarding these proposed changes.

The proposed FW nozzle inspection program conforms with the recommendations of the referenced BWR Owners Group report. The Authority requests NRC review of the proposed changes to the FW nozzle inspection program by August 30, 1996. This will permit the Authority to finalize plans for the upcoming refueling outage scheduled to start in the fall of 1996.

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If you have any questions, please contact Ms. C. D. Faison.

Very truly yours,

William J. Cahill, Jr.
Chief Nuclear Officer

Attachment: Proposed Changes to the Feedwater Nozzles Inspection Program

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James A. FitzPatrick Nuclear Power Plant
Docket 50-333

ATTACHMENT TO JPN-96-022

Proposed Changes to the Feedwater Nozzle Inspection Program

Current Inspection Program:

An augmented inspection program is performed on the FitzPatrick reactor vessel feedwater nozzles in response to the cracking problem experienced at other plants as described in NUREG-0619. The current inspection program is as follows:

1. External ultrasonic examination (UT) of all feedwater (FW) nozzle bore areas susceptible to fatigue cracking, every third refueling outage (next inspection scheduled for fall 1996 refuel outage).

2. Visual inspection (VT) of the FW spargers every fourth refueling outage.

3. An on-going diagnostic system monitors for FW bypass leakage across the FW sparger thermal sleeve seals.

Background:

FW flow enters the reactor vessel through four nozzle penetrations, and is directed by the FW spargers to mix with the downcomer flow from the steam separators before it contacts the vessel walls. Inspections of BWR feedwater nozzles at other plants revealed cracking of the nozzle internal bore and nozzle-to-vessel blend radius regions. Analysis revealed that the source of the crack initiation was high cycle fatigue due to feedwater leaking past the sparger thermal sleeve seals. The NRC issued guidelines for addressing this potential for cracking in NUREG-0619 (Reference 1). The normal full power FW inlet temperature at the FitzPatrick plant is approximately 418°F, which is significantly higher than FW inlet temperatures at many other plants. This minimizes the thermal fatigue on the nozzles due to both normal FW temperature changes and thermal sleeve bypass leakage, and minimizes the potential for FW nozzle cracking at FitzPatrick.

The FitzPatrick plant conformed to NUREG-0619 by: (1) removing the stainless steel cladding from the FW nozzles; (2) installing triple thermal sleeve, double piston-ring seal spargers; (3) cutting and capping the control rod drive return line; (4) changing the internal valve trim in the low flow feedwater control valve; and (5) implementing an augmented inspection program. The Authority demonstrated to the satisfaction of the NRC staff (Reference 2) that rerouting the Reactor Water Cleanup System return flow to all FW lines, and installing new low flow FW controllers, was not necessary.

In response to a proposed change (Reference 3), the NRC, on September 13, 1988, approved (Reference 4) a change in the UT inspection frequency for the FW nozzles from every other refueling outage to every third refueling outage. The NUREG-0619 UT examination of the FW nozzles was performed in 1982, 1985, 1990, and an ASME XI Code UT examination of the vessel to nozzle weld was performed in 1995.

Proposed Changes to the FW Nozzle Inspection Program:

The following changes are proposed to the FitzPatrick FW Nozzle Inspection Program:

1. Increase the inspection interval of the external UT examination of all feedwater nozzle bore areas susceptible to fatigue cracking from "every third refueling outage" to "every ten years." The change is consistent with the recommendation of the BWR Owners Group report, "Alternate BWR Feedwater Nozzle Inspection Requirements" (Reference 5), and would defer the next UT examination until the year 2000. The increase in the inspection interval to every ten years is conditional on using UT examination techniques that conform to Methods 3 or 4 as described in the referenced BWROG report. The proposed schedule change ensures adequate protection of the reactor pressure vessel while minimizing personnel exposure levels.

2. Eliminate the commitment to monitor bypass leakage across the FW sparger thermal sleeve seals, effective at the end of the current operating cycle. The Leakage Monitoring System (LMS) utilizes local temperature sensors mounted on each of the four FW nozzles, and a data collection recorder located outside the drywell. Discontinuing the monitoring of leakage is justified by the past results of the monitoring system, and removes a significant calibration, maintenance,and ALARA burden associated with the operation of this system.

The proposed changes would reduce personnel exposure levels by approximately 7.5 person-rem for the upcoming operating cycle. UT examinations, including support activities, of all four FW nozzles will result in approximately 7 person-rem; and approximately 0.5 person-rem per operating cycle is expected for repairs and calibration of the leakage monitoring system.

Technical Bases for the Change:

The technical bases for the proposed changes are: (1) the effectiveness of the past and current UT examination for detecting FW nozzle cracks; (2) the effectiveness of the improved thermal sleeve design in minimizing the bypass leakage based on the results of the Leakage Monitoring System over the past two operating cycles; (3) the absence of reportable FW nozzle indications during previous nondestructive examinations; and (4) the results of a fracture mechanics analysis of the FW nozzle.

1. <u>UT Examination Techniques</u>

   Since NUREG-0619 was issued, significant improvements in UT technology have been made. Automated UT techniques, such as used by the Authority during the 1990 UT examination of the FW nozzle, are capable of detecting small (0.25 inch deep or smaller) fatigue cracks.

The General Electric GERIS automated UT system was used to perform NUREG-0619 examinations on the four FW nozzles during the 1990 FitzPatrick refueling outage. FW nozzle zones 1 through 3 (Figure 1), which is the expected area of cracking, were examined using the following techniques.

Zone 1: From vessel wall with shear waves
Zone 2A & 2B: From nozzle OD quarter point with shear waves
Zone 2A & 2B: From nozzle OD mid point with shear waves
Zone 2A & 2B: From nozzle OD three quarter point with shear waves
Zone 3: From nozzle OD with shear waves

General Electric demonstrated the capability of the GERIS system in a 1991 qualification test (Reference 6). The qualification tests, as proven on Electromagnetic Discharge Machining (EDM) notches, confirmed that the techniques used during the 1990 FitzPatrick inspections are capable of detecting a 0.250 inch deep flaw in the blend radius and bore regions of the FW nozzles. The modifications performed to the GERIS system between the 1990 FitzPatrick examinations and the 1991 qualification tests do not impact this conclusion. The modifications involve the addition of an A-scan digitizer that stores the A-scan data on optical disks, and the use of a new UT technique that scans the Zone 2A region from the nozzle OD blend radius.

This UT method is equivalent to Method 3 described in the BWROG report, "Alternate BWR Feedwater Nozzle Inspection Requirements," (Reference 5). In accordance with the proposed ten year inspection frequency, the Authority will use UT examinations that conform with Method 3 (automated, full radio frequency recording - no threshold) or Method 4 (phased array - no threshold).

Table 6-1 of the referenced BWROG report recommends UT examination intervals for FW nozzle zones 1, 2, and 3. The intervals recommended by Table 6-1 are a function of the plant-specific FW sparger type, UT examination method performed, and the results of the fracture mechanics assessment. Applying the following plant-specific data for the FitzPatrick FW nozzles, the table recommends a UT interval of ten years for the FitzPatrick UT examinations.

- FitzPatrick has the triple sleeve, double piston ring, unclad nozzle design configuration.
- FitzPatrick utilized a UT technique for the last NUREG-0619 examination that is equivalent to method 3, as defined in the table.
- The fracture mechanics analysis concluded that the maximum crack growth (0.47 inch) was well within the one inch depth limit at the end-of-plant life, assuming an initial 0.25 inch crack.

The visual inspection of the spargers will remain at every fourth refueling outage as recommended in Table 6-1. The New York Power Authority is currently a participant in the BWR Owners Group Committee monitoring NUREG-0619 developments.

2. Results of the Leakage Monitoring System

A Leakage Monitoring System (LMS), that monitors for feedwater leakage past the sparger thermal sleeve seals, was installed on all four nozzles at Fitzpatrick in the spring of 1992. The leakage data covers a period of two operating cycles, and confirms acceptable bypass leakage levels, without any increasing trends, for all four FW nozzles. Thermal sleeves at other plants with leakage monitoring systems have also exhibit insignificant leakage (Reference 6). This confirms the effectiveness of the improved thermal sleeve design in minimizing bypass leakage. The nozzle temperature data from the A, B, and D nozzles confirm the absence of leakage. The data from the C nozzle correspond to a leakage rate of approximately 0.75 gpm. The predicted 40 year cumulative fatigue usage is unchanged from previous studies for the FW nozzles. Based on a leakage of 0.75 gpm, the resulting contribution to 40 year cumulative fatigue usage remains at about 0.28.

3. Inspection Results

Nondestructive examinations of the FW nozzles, in accordance with NUREG-0619, have not revealed any reportable indications to date. This includes the UT examinations performed in 1982, 1985, 1990, and 1995; and the VT examinations performed in 1985, 1987, 1990, and 1994.

4. FW Nozzle Fracture Mechanics Analysis

A fracture mechanics analysis of the FitzPatrick FW nozzle concluded that stress cycling from conservative temperature and flow profiles, when added to those resulting from other crack growth phenomena, such as startup and shutdown cycles, do not result in the growth of an initial 0.25 inch crack to greater than one inch during the remaining life of the plant (0.47 inches for the worst case). The analysis (Reference 7) conservatively assumed failure of the first seal on the triple thermal sleeve sparger, and remains valid for the FitzPatrick FW nozzle. The results of this analysis were previously approved by the NRC (Reference 2).

Conclusions:

The current UT examination program for the FW nozzles utilizes state-of-the-art inspection methods and equipment, and, along with the VT examination schedule, provides an inspection program that is effective for assuring the integrity of the FW nozzles. The LMS, in service for two operating cycles, confirms the effectiveness of the improved FW sparger thermal sleeve design and the absence of unacceptable fatigue usage due to rapid thermal cycling. Further, the higher FW inlet temperature minimizes the potential for thermal cycle fatigue usage even in the event of bypass leakage. For these reasons, and considering the absence of any anomalies associated with the present FW nozzle configuration, an increase in the UT examination interval, and elimination of the LMS, will not compromise plant safety.

References:

1. NRC NUREG-0619, "BWR Feedwater Nozzle and Control Rod Drive Return Line Nozzle Cracking," November 1980.

2. NRC letter, H. I. Abelson to J. C. Brons, dated July 21, 1986, "Feedwater Nozzle Cracking in BWRs."

3. NYPA letter, J. C. Brons to NRC (JPN-88-010), dated March 25, 1988, "NUREG-0619, Feedwater Nozzle Inspections."

4. NRC letter, H. I. Abelson to J. C. Brons (TAC 67829), dated September 13, 1988, "Relief From Augmented Inspection of Feedwater Nozzle/Sparger."

5. BWR Owners Group letter (BWROG-95092) to NRC, transmitting General Electric Report GE-NE-523-A71-0594, "Alternate BWR Feedwater Nozzle Inspection Requirements," dated October 30, 1995.

6. GE report NEDC-32019P (Class III), "Inspection and Monitoring of Feedwater Nozzles," dated May 1992.

7. GE report NEDE-30799P, "James A. FitzPatrick Nuclear Power Station Feedwater Nozzle Fracture Mechanics Analysis to Show Compliance with NUREG-0619," December 1984.

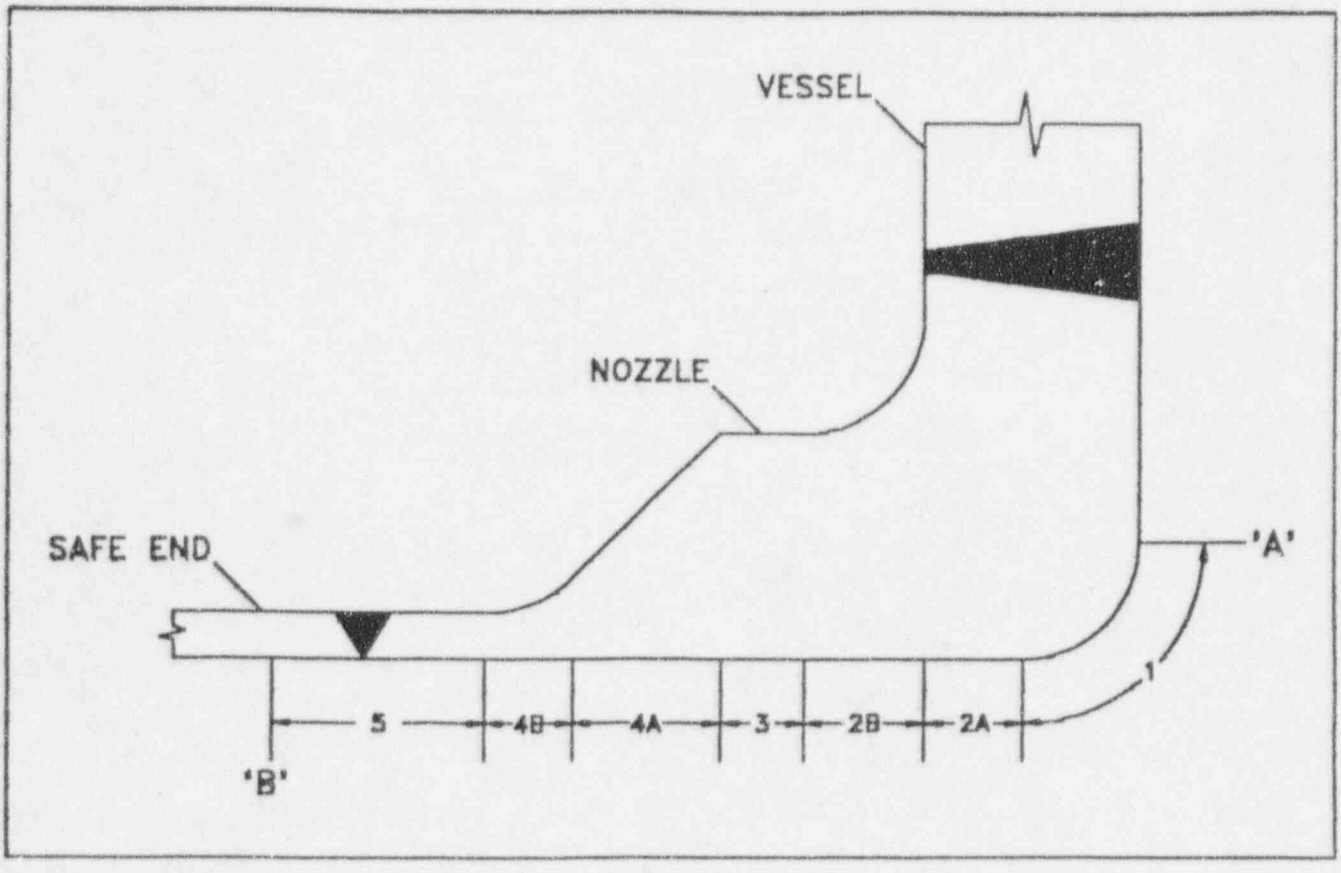

Figure 1 - Feedwater Nozzle Examination Zones