UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO MECHANICAL NOZZLE SEAL ASSEMBLIES

ENTERGY OPERATIONS, INC.

WATERFORD STEAM ELECTRIC STATION, UNIT 3

DOCKET NO. 50-382

1.0 INTRODUCTION AND BACKGROUND

By letter dated March 10, 1999, as supplemented by letters dated March 12 and March 23, 1999, Entergy Operations, Inc. (EOI, the licensee), requested relief from Title 10 of the Code of Federal Regulations (10 CFR) Section 50.55a repair requirements as implemented through the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) to permit installation of Mechanical Nozzle Seal Assemblies (MNSAs) as an alternative repair for leaking nozzles on primary portions (ASME Code Class 1 portions) of the reactor coolant system (RCS) hot legs at the Waterford Steam Electric Station, Unit 3 (Waterford 3).

Prior to the submittal of March 10, 1999, members of the Nuclear Regulatory Commission (NRC) staff held a telephone conversation with EOI to discuss EOI's corrective action plans for the leaks detected in the pressurizer and RCS hot leg instrument nozzles (Ref. 1). During the telephone conversation, the staff informed EOI that the following items would have to be included with the submittal of the alternative program for the MNSA designs:

- Pursuant to 10 CFR 50.55a(a)(3)(i), EOI's basis for installing MNSAs at Waterford 3.
- Summary of ABB-Combustion Engineering's (CE's) design of the MNSA prototype that was previously used by the Southern California Edison Company in support of its request to install MNSAs at the San Onofre Nuclear Station, Units 2 and 3, and a summary of the qualification tests that were performed on the prototype to support EOI's request to install MNSAs on the RCS hot legs at Waterford 3.
- Information on the EOI's design calculations and evaluations for the MNSAs in support of the alternative program.

In its letter of March 12, 1999, EOI confirmed that it would review the CE analysis for use of MNSAs at Waterford 3 to ensure that the results of the CE analysis are acceptable to support operation of the unit above a temperature of 286 °F prior to operating above 286 °F, and EOI would submit the analysis results to the staff for review. In its letter of March 23, 1999, EOI submitted the plant-specific design calculations for the NRC staff's review. The following

Enclosure

section provides the staff's evaluation of EOI's request to install MNSAs on the Waterford 3 RCS hot legs.

2.0 EVALUATION

2.1 Alternative Program Proposal

EOI is requesting approval to install the MNSAs as the basis for maintaining the structural integrity of leaking instrumentation and sampling line nozzles in the RCS hot legs of the Waterford 3.

2.2 Applicable Requirements

Technical Specification (TS) 3.4.5.2.a for Waterford 3 does not allow leakage from the Reactor Coolant Pressure Boundary (RCPB) when the unit is in the power operation (Mode 1), startup (Mode 2), hot standby (Mode 3), or hot shutdown (Mode 4) modes of operation. TS 3.4.5.2.a requires EOI to stop any RCPB leakage that is detected as a result of scheduled inservice inspections prior to reentering the plant into the hot shutdown/hot standby modes of operation during a plant startup.

Section 50.55a requires, in part, that all inservice examinations and system pressure tests conducted during the first 10-year interval and subsequent intervals on ASME Code Class 1, 2, and 3 components must comply with the requirements in the latest edition and addenda of Section XI incorporated by reference in 10 CFR 50.55a(b) on the date 12 months prior to the start of the 10-year interval. By reference to and implementation of Paragraphs IWB-3132 or IWB-3142 to Section XI of the ASME Code, 10 CFR 50.55a also requires that existing flaws in ASME Code Class components be removed by mechanical means, or else the components be repaired or replaced to the extent necessary to meet the acceptance standards in Article IWB-3000 of Section XI to the Code. Detection of leaks in the structural portion of an ASME Code Class 1, 2, or 3 component is direct evidence of a flaw in the component.

Paragraph IWA-4170 of Section XI of the ASME Code requires that repairs and the installation of replacements to the RCPB be performed and reconciled in accordance with the Owner's Design Specifications and Original Code of Construction for the component or system. The hot legs of the Waterford 3 RCS were designed and constructed to the rules of the 1971 Edition of Section III to the ASME Code, inclusive of the Winter 1971 Addenda. EOI has stated that the rules for installing MNSAs on the hot leg of the RCPB are not clearly defined in the 1971 Edition of Section III to the ASME Code.

Paragraph NB-3671.7 to Section III of the ASME Code, "Sleeve Coupled and Other Patented Joints," requires that ASME Code Class 1 joints be designed to meet the following criteria:

(1) provisions must be made to prevent separation of the joint under all service loading conditions,

(2) the joint must be designed to be accessible for maintenance, removal, and replacement activities, and

(3) the joint must either be designed in accordance with the rules of Section III to the ASME Code, Subarticle NB-3200, or else be evaluated using prototype of the joint that will be subjected to additional performance tests in order to determine the safety of the joint under simulated service conditions.[1]

2.3 Basis for Proposing the Alternative Program

Section 50.55a(a)(3) allows licensees to use alternatives to the requirements of the ASME Code when authorized by the Director of the Office of Nuclear Reactor Regulation. However, for approval, the licensee must demonstrate that, pursuant to the requirements of 10 CFR 50.55a(a)(3)(i), the alternatives would provide an acceptable level of quality and safety in lieu of meeting the requirements, or that, pursuant to the requirements of 10 CFR 50.55a(a)(3)(ii), complying with the requirements of 10 CFR 50.55a would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

EOI is requesting approval to install MNSAs over the leaking nozzles on the hot legs of the Waterford 3 RCS through to the end of the next operating cycle. EOI is proposing the alternative under the provisions of 10 CFR 50.55a(a)(3)(i), which would allow staff approval of the alternatives if installation of the MNSAs would demonstrate an acceptable level of quality and safety in lieu of performing the replacement activities required by the ASME Code.

2.4 Evaluation of Proposed Alternative

By letter of March 10, 1999, EOI informed the staff that it had performed required visual inspections of portions of the Waterford 3 RCS, and as a result of the examinations, it had identified five RCS nozzles in the ASME Code Class 1 portions of the RCS. These nozzles are located in the following areas:

- RCS hot leg No. 1 RTD (RC-ITE-112HC1)
- RCS hot leg No. 1 sampling line (RC-104)
- RCS hot leg No. 2 differential pressure instrument line (RC-DPT-9126-SMA)
- Pressurizer top head instrument tap (RC-310)
- Pressurizer top head instrument tap (RC-311)

These nozzles are welded to the pressurizer walls and RCS hot leg piping walls with J-groove welds. These welds have been found to be susceptible to stress corrosion. EOI has stated that it will replace the leaking nozzles on the pressurizer with partial nozzle replacements that meet the replacement criteria specified in Section XI of the ASME Code. However, EOI also stated that similar corrective measures on the RCS hot leg nozzles would require EOI to lower the water in the RCS sufficiently to enable them to perform the required replacement welding. EOI maintains that this process would significantly extend the refueling outage for the plant. EOI proposed the installation of MNSAs over the leaking RCS instrumentation and sampling nozzles as an alternative that would provide an acceptable level of quality and safety in lieu of performing the required replacement welding for the leaking RCS hot leg nozzles. EOI

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1 When it is anticipated that there will be effects from vibration, fatigue, cyclical loading, low temperature, thermal expansion, or hydraulic shock, the applicable conditions shall be incorporated into the tests. The prototype joints shall be required to be sufficiently leak tight to satisfy the requirements of the design specification.

therefore requested, pursuant to 10 CFR 50.55a(a)(3)(i), that the NRC approve the installation of the MNSAs for the leaking RCS hot leg nozzles for the next cycle of operation. In its letter of March 10, 1999, EOI also provided the following technical bases to support its conclusions that installation of MNSAs on the three identified hot leg nozzles would provide an acceptable level of quality and safety in lieu of performing Code-required replacements of the nozzles:

- The MNSAs are designed, fabricated, and constructed using approved ASME Code materials in accordance with the applicable rules of Section III of the ASME Code. The MNSAs are designed to prevent separation of the joint under all service loadings. This will be supported with demonstration by technical analyses and tests that meet the design criteria specified in Section III of the ASME Code.

- An MNSA prototype has been developed and has been subject to additional seismic, thermal, transient and hydrostatic pressure testing to demonstrate that the joint will remain leak tight under expected service conditions.

- The MNSAs are accessible for maintenance, removal, and replacement after installation.

An MNSA is a mechanical device consisting of a split gasket/flange assembly that is bolted around the instrument nozzles. The MNSA serves the following two safety-related functions: (1) it replaces the structural integrity function of the J-groove weld at the nozzle to RCS hot leg interface, and (2) it prevents leakage from any through-wall flaws in the nozzle's J-groove weld.

The MNSA is designed in a manner that prevents its installation from imparting any additional bending or axial loads to the J-groove weld of the nozzle. The MNSA seal is created by compressing a Grafoil packing material (which is a graphite gasket material) against the nozzles at the nozzle to RCS hot leg interface. The compression collar transmits the load to the Grafoil gasket while the gasket is retained with the seal retainer and compression collar. The compressive load is generated with hex head bolts that are threaded into the RCS piping and torqued. The installation of the hex head bolts does not violate the primary pressure boundary. The compressive load is then transmitted to the compression collar through the upper flange. The top plate is anchored to the upper flange through tie rods and secured in place by hex head nuts; securing the bolts in place with the nuts prevents ejection of the nozzle. The top plate is installed with a small gap between the nozzle and the plate's bottom surface to account for thermal expansion. The top plate will act as a restraint only if the nozzle's J-groove weld completely fails and other interferences are overcome; otherwise, the top plate is not subject to any loads during normal operation.

MNSAs have previously been approved for temporary installation at the San Onofre Nuclear Generating Station (Ref. 2). The MNSAs for use at Waterford 3 have been designed, fabricated, and constructed by ABB-CE as ASME Code Class 1 components to comply with the design criteria of the 1989 Edition of Section III to the ASME Code. The MNSAs are designed using ASME-approved materials. In order to meet the requirements of NB-3717.7 of Section III, CE developed a prototype of the MNSA design in order to test the safety of the design under appropriate simulated loading conditions.[2] The design and testing of the MNSA has been

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2 The tests for the MNSA prototype included hydrostatic testing, seismic testing, and thermal cycling.

previously reviewed by the staff and accepted as providing a reasonable demonstration of the response of the MNSA design to anticipated service conditions. The review of the design of the prototype also indicated that the MNSA designs would be accessible for any maintenance, repairs, or replacements that might be necessary to ensure the integrity of the joint designs. The staff, therefore, concluded that MNSA designs could be used as a temporary repair of leaking Class 1 nozzles that were welded to the San Onofre steam generators, pressurizers, and RCS hot legs. The staff's evaluation of the design and testing of the MNSA prototype is documented in the staff's safety evaluation of February 17, 1998 (Ref. 2). The review for installation of MNSAs at San Onofre included a review and approval of the plant-specific design calculations for MNSAs.

The MNSAs proposed by EOI for use at Waterford 3 have been designed in accordance with the same CE prototype design that was used to qualify the MNSAs for use at San Onofre Nuclear Generating Station. Any minor deviations in the MNSA designs for applications at Waterford 3 will be accounted for in EOI's plant-specific design calculations for the MNSAs. By letter of March 23, 1999, EOI submitted the plant-specific design calculations (e.g., the CE analysis) for installation of the MNSAs at Waterford 3. The EOI reviewed and approved the plant-specific design calculations for use at Waterford 3. Although the staff has not yet reviewed these plant-specific calculations, because the licensee stated that the design calculations were to be performed in accordance with the applicable rules for joint designs in Section III of the ASME Code, the staff concludes that the MNSAs can be installed for the intended applications at Waterford 3. However, the NRC staff will perform a confirmatory review of the plant-specific design calculations, and should the staff's confirmatory review show that EOI's design calculations are not acceptable, EOI will take appropriate action, including potentially shutting the unit down, as specified in its March 12, 1999, letter. Therefore, this relief is contingent upon the acceptability of the design calculations, as determined by the staff in its confirmatory review.

3.0 CONCLUSIONS

EOI has demonstrated the applicability of MNSAs as a temporary alternative repair of leaking instrumentation and sampling nozzles in the hot legs at the Waterford 3 RCS. The MNSAs proposed by EOI for use at Waterford 3 have been designed in accordance with the same prototypes that were used to qualify them for use at the San Onofre Nuclear Generating Station (Ref. 2). Since Waterford 3 is also a CE-designed facility, the staff has determined that the testing of the prototype design may be used as the basis for approving EOI's request to install MNSAs over the leaking RCS hot leg nozzles. Therefore, the staff concludes, pursuant to 10 CFR 50.55a(a)(3)(i), that the proposed alternative will provide an acceptable level of quality and safety. EOI may install the MNSAs over the leaking nozzles during the current refueling outage, and the MNSAs may remain in service for the next operating cycle for Waterford 3. However, the NRC staff will perform a confirmatory review of the plant-specific design calculations, and should the staff's confirmatory review show that EOI's design calculations are not acceptable, EOI will take appropriate action, including potentially shutting the unit down, as specified in its March 12, 1999, letter. Therefore, this relief is contingent upon the acceptability of the design calculations, as determined by the staff in its confirmatory review.

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Date: March 25, 1999

REFERENCES

1. March 5, 1999 - Telephone conference call between C. P. Patel, Project Manager for Waterford 3, U.S. Nuclear Regulatory Commission, and Charles DeDeaux and S. Lewis, Entergy Operations, Inc.

2. February 17, 1998 - Letter from W. H. Bateman, Project Director, Project Directorate-IV-2, Division of Reactor Projects-III/IV, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, to H. B. Ray, Executive Vice President, Southern California Edison Company, "Use of the Mechanical Nozzle Seal Assembly for the San Onofre Nuclear Generating Station, Units 2 and 3..."