SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELAXATION REQUEST FROM ORDER EA-03-009 REGARDING THE

EXAMINATION COVERAGE FOR REACTOR PRESSURE VESSEL HEAD

INCORE INSTRUMENTATION PENETRATION NOZZLES

FACILITY OPERATING LICENSE NO. NPF-38

ENTERGY OPERATIONS, INC.

WATERFORD STEAM ELECTRIC STATION, UNIT 3

DOCKET NO. 50-382

1.0 INTRODUCTION

Order EA-03-009, issued on February 11, 2003, requires specific examinations of the reactor pressure vessel (RPV) head and vessel head penetration (VHP) nozzles of all pressurized water reactor plants. Section IV, Paragraph F, of the Order states that the Director, Office of Nuclear Reactor Regulation, may, in writing, relax or rescind any of the conditions set forth in Section IV.C of the Order upon demonstration by the licensee of good cause. Section IV, Paragraph F, of the Order states that a request for relaxation regarding inspection of specific nozzles shall address the following criteria: (1) the proposed alternative(s) for inspection of specific nozzles will provide an acceptable level of quality and safety, or (2) compliance with this Order for specific nozzles would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. In addition, Section IV, Paragraph F, of the Order states that requests for relaxation of the Order associated with specific penetration nozzles will be evaluated by the Nuclear Regulatory Commission (NRC) staff using the procedure for evaluating proposed alternatives to the American Society of Mechanical Engineers Boiler and Pressure Vessel Code in accordance with Title 10 of the *Code of Federal Regulations* (10 CFR) 50.55a(a)(3).

By letter dated October 24, 2003, which superceded letters dated September 18, 24 and 26, and October 2 and 8, 2003, Entergy Operations, Inc. (Entergy, the licensee) requested relaxation to implement an alternative to the requirements of Section IV, Paragraph C.(1)(b), of the Order for all incore instrumentation (ICI) nozzles at Waterford 3.

2.0 RELAXATION REQUESTS FOR EXAMINATION COVERAGE FOR RPV HEAD ICI PENETRATION NOZZLES, ORDER EA-03-009

2.1 Order Requirements for which Relaxation is Requested

Section IV.C.(1) of Order EA-03-009 requires, in part, that the following inspections be performed every refueling outage for high susceptibility plants similar to Waterford 3:

(a) Bare metal visual (BMV) examination of 100% of the RPV head surface (including 360° around each RPV head penetration nozzle), AND

(b) Either:

(i) Ultrasonic testing of each RPV head penetration nozzle (i.e., nozzle base material) from two (2) inches above the J-groove weld to the bottom of the nozzle and an assessment to determine if leakage has occurred into the interference fit zone, OR

(ii) Eddy current testing or dye penetrant testing of the wetted surface of each J-Groove weld and RPV head penetration nozzle base material to at least two (2) inches above the J-groove weld.

The licensee has requested relaxation from Section IV.C.(1)(b)(i) of the Order to perform ultrasonic testing (UT) of the RPV head penetration inside the tube from 2 inches above the J-groove weld to the bottom of the penetration on all 10 ICI nozzles. Specifically, the relaxation is related to UT examination of the bottom portion of the nozzles as well as a portion of the counterbore region above the J-groove weld.

Relaxation was requested for the upcoming Waterford 3 refueling outage in the fall of 2003.

2.2 Licensee's Proposed Alternative Method

The licensee stated that it will perform a UT examination from the inside diameter (ID) of each ICI nozzle (i.e., nozzle base material) in accordance with Section IV.C(1)(b)(i) of the Order, with the exception of the blind zone at the bottom of each ICI nozzle, and the blind zone in the counterbore region above the J-groove weld of each ICI nozzle. For illustration purposes, Figure 1 shows the ICI nozzle configuration and Figure 2 shows the location of the blind zones. Figure 1 was taken from the licensee's October 24, 2003, letter, and Figure 2 was taken from the licensee's presentation that it gave at NRC headquarters on August 14, 2003.

The licensee states that because meaningful UT data cannot be collected at the bottom of the ICI nozzle, Entergy will augment the UT inspection with a surface examination of the nozzle ID surface, outside diameter (OD) surface, and J-groove weld that falls within the blind zone at the end of all 10 of the ICI nozzles. The licensee also states that the nozzle end blind zone varies in length from 0.2 inch to 0.7 inch depending on probe location.

For the counterbore blind zone, the licensee proposes that the portion of the ICI counterbore blind zone that is contained within the examination area 2 inches above the J-groove weld will receive an ID surface examination.

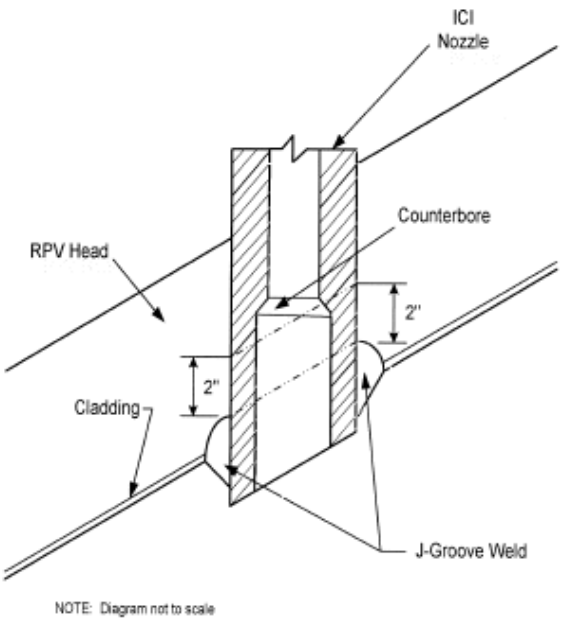

Figure 1

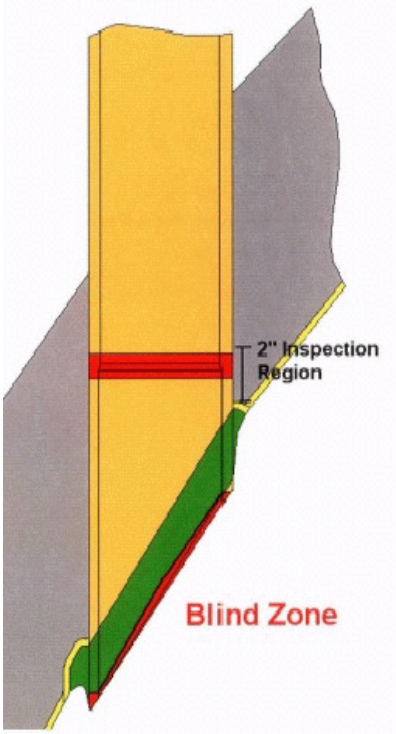

Figure 2

2.3 Licensee's Basis for Relaxation

Counterbore Blind Zone

The licensee states that the ICI nozzles are manufactured with a counterbore above the J-groove weld (Figure 1). According to the licensee, because of UT transducer liftoff at the counterbore, a UT blind zone exists at the upper hillside location (180° azimuth) of each ICI nozzle and the blind zone measures approximately 0.88 inch in axial length. The licensee states that the portion of the counterbore blind zone that lies within the required inspection zone of 2 inches above the J-groove weld is centered at the upper hillside location of each nozzle, and is estimated to have a circumferential extent of approximately 135° or less. The blind zone associated with the counterbore does not exist at any other azimuthal location along the circumference of the ICI nozzle within the required 2-inch inspection area above the J-groove weld. The licensee states that the counterbore is significantly closer to the J-groove weld on the upper hillside of the nozzle than on the lower hillside, due to the RPV head angle at the ICI locations. The licensee also states that no volumetric inspection equipment is available to inspect the counterbore region, and resolving the UT limitations due to the counterbore would require eliminating the counterbore region through a physical modification of the nozzle itself.

The licensee further states that it does not have the equipment necessary to perform such a modification.

Blind Zone at Nozzle Bottom End

Entergy states that a blind zone exists along the bottom of each ICI nozzle and varies from approximately 0.20 inch to 0.70 inch. According to the licensee, the blind zone at the end of the nozzle occurs due to loss of coupling as the transducers traverse across the bottom end of the nozzle. The licensee states that this problem is further compounded by the configuration of the ICI nozzle bottom end, which is cut to match the contour of the RPV head. The licensee further states that it is not aware of any equipment currently available that will resolve the configuration limitation.

Inspection Probe Design Limitation

The licensee states that the inspection probe to be used to inspect the Waterford 3 ICI nozzles consists of seven (7) individual transducers. The licensee further states that various probe configurations will be utilized to perform the UT inspections (e.g., UT time-of-flight diffraction (TOFD) and standard 0° scans). The inspection probe is designed so that the ultrasonic transducers are slightly recessed into the probe holder, and this recess must be filled with water to provide coupling between the transducer and the nozzle wall. The licensee contends that because of this design, the complete diameter of the transducer must fully contact the inspection surface before ultrasonic information can be collected, and since these UT probes have a diameter of 0.250 inch, these transducers should, in theory, be able to collect meaningful UT data down to a point approximately 0.125 inch (1/2 diameter) above the area to be inspected. However, the licensee states that this theory does not hold true based on its prior UT inspection experience. According to the licensee, a review of UT data from previous inspections shows that the circumferential-scanning TOFD transducer pair only collects meaningful data down to a point 0.200 inch above the bottom of the nozzle. The licensee states that below this point, UT data cannot be collected.

The licensee states that because of the blind zone at the end of the ICI nozzles, UT examinations will be augmented by performing a dye penetrant testing (PT) examination of the nozzle ID and OD surfaces, and the weld area that falls within the blind zone at the nozzle bottom end. The licensee states that augmented inspections will be performed on the bottom ends of the ICI nozzles and the blind zone in the counterbore region using the manual PT examination method as the primary technique. The licensee also states that because the PT examination method cannot distinguish acceptable fabrication discontinuities from PWSCC, PT indications are conservatively assumed to be PWSCC. The licensee further states that PT indications will be investigated by either supplemental inspection using the eddy current testing (ECT) examination method or grinding followed by additional PT or ECT examinations.

Entergy states that it believes that the hardships associated with inspection activities required by the Order, as discussed in its submittal, are not commensurate with the increased level of safety or quality that would be obtained by complying with the Order.

3.0 STAFF EVALUATION

Counterbore Blind Zone

The NRC staff's review of the portion of this request regarding the counterbore blind zone region was based on Criterion (2) of Paragraph F of Section IV of the Order, which states:

> Compliance with this Order for specific nozzles would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Within the context of the licensee's proposed alternative examination of the RPV penetration nozzles, the licensee has demonstrated that hardship would result from implementing UT examinations to the counterbore region of the ICI nozzles, associated with modifying the region to allow access by the UT probe to collect data in the counterbore region. The staff finds that the nozzles' counterbore area makes inspection of these nozzles in accordance with Order EA-03-009 difficult and would involve a hardship or unusual difficulty. The licensee proposes to perform a surface examination of the nozzle ID surface 2 inches above the J-groove weld that falls within the blind zone in the counterbore region of all 10 of the ICI nozzles. This evaluation focuses on the issue of whether there is a compensating increase in the level of quality and safety such that these nozzles should be UT inspected despite this hardship.

The staff finds that the licensee's proposed alternative examination of the 10 ICI RPV head penetration nozzles which includes performing a surface examination on the area of material that is not receiving a UT examination per the requirements of Section IV.C.(1)(b)(i) of the Order, i.e., the "blind zone" in the counterbore region, is sufficient to detect the PWSCC phenomenon and therefore provides reasonable assurance of structural integrity of the RPV head, VHP nozzles, and welds. Further inspection of the ICI nozzle counterbore region in accordance with Section IV.C.(1)(b)(i) of Order EA-03-009, would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Bottom-of-Nozzle Blind Zone

The NRC staff's review of the portion of this request regarding the blind zone at the end of the ICI nozzles was based on Criterion (1) of Paragraph F of Section IV of the Order, which states:

> The proposed alternative(s) for inspection of specific nozzles will provide an acceptable level of quality and safety.

The staff finds that the geometry and configuration of the end of the ICI nozzles makes them very difficult to inspect using a volumetric examination technique. The licensee states that the nozzle end blind zone varies in length from 0.2 inch to 0.7 inch, depending on probe location. The licensee proposes to perform a surface examination of the nozzle ID and OD surfaces, and the J-groove weld surfaces that fall within the blind zone at the end of all 10 of the ICI nozzles.

The staff finds that by performing a surface examination on the area of material that is not receiving a UT examination per the requirements of Section IV.C.(1)(b)(i) of the Order, i.e., the "blind zone" at the end of nozzle, the licensee is performing an examination that is sufficient to detect the PWSCC phenomenon. The staff also notes that the augmented inspection covers the entire wetted surface of the volume of material at the bottom of the nozzle that is not

receiving a UT examination. Therefore, this alternative examination provides reasonable assurance of structural integrity of the ICI nozzles, and, thus provides an acceptable level of quality and safety.

4.0 CONCLUSION

The staff concludes that the licensee's proposed alternative augmented surface examination of the ICI RPV head penetration nozzles in the counterbore blind zone region above the J-groove weld, provides reasonable assurance of the structural integrity of the RPV head, VHP nozzles, and welds. Further inspection of the ICI nozzle counterbore region in accordance with Section IV.C.(1)(b)(i) of Order EA-03-009 would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The staff also concludes that the licensee's proposed alternative examination of the ICI RPV head penetration nozzles, to perform a surface examination of the blind zone at the bottom of the ICI nozzles, provides reasonable assurance of structural integrity of the ICI nozzles and, thus, provides an acceptable level of quality and safety consistent with Criterion (1) of Section IV, Paragraph F, of Order EA-03-009.

Therefore, good cause has been shown for relaxation of the Order and pursuant to Section IV, Paragraph F, of Order EA-03-009 and 10 CFR 50.55a(a)(3), the staff authorizes, for one operating cycle commencing with the startup from the fall 2003 refueling outage, the proposed alternative inspections for all 10 ICI head penetration nozzles at Waterford 3.

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Date: November 7, 2003