Entergy

Entergy Operations, Inc.
1340 Echelon Parkway
Jackson, MS 39213-8298
Tel 601 368 5758

Michael A. Krupa
Director
Nuclear Safety & Licensing

CNRO-2003-00058

October 24, 2003

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

SUBJECT: Entergy Operations, Inc.
Relaxation Request to NRC Order EA-03-009 for In-Core Instrumentation Nozzles

Waterford Steam Electric Station, Unit 3
Docket No. 50-382
License No. NPF-38

REFERENCE:

1. Entergy Operations, Inc. Letter CNRO-2003-00045, "Relaxation Request to NRC Order EA-03-009 for In-Core Instrumentation Nozzles," dated September 24, 2003
2. Entergy Operations, Inc. Letter CNRO-2003-00048 to the NRC, "Response to Requests for Additional Information Pertaining to Relaxation Requests to NRC Order EA 03-009 for In-Core Instrumentation Nozzles," dated September 26, 2003
3. Entergy Operations, Inc. Letter CNRO-2003-00050, "Supplemental Information Pertaining to NRC Order EA-03-009," dated October 2, 2003
4. Entergy Operations, Inc. Letter CNRO-2003-00052, "Relaxation Request to NRC Order EA-03-009 for In-Core Instrumentation Nozzles," dated September 24, 2003

In Reference 1, Entergy Operations, Inc. (Entergy) requested relaxation from Section IV.C(1)(b) of NRC Order EA-03-009 for Waterford Steam Electric Station, Unit 3 (Waterford 3). Specifically, Entergy requested that a combination of techniques and supplementary analysis be allowed for determining the condition of the In-Core Instrumentation (ICI) nozzles in lieu of the requirements of Section IV.C(1)(b) of the Order. References 2 through 4 provided supplemental clarifications with respect to that request.

In telephone calls held on October 21 and 23, 2003 representatives of the NRC staff and Entergy discussed the relaxation request for the ICI nozzles. The NRC indicated they would not approve the use of analysis to preclude examination of the counterbore region of these

A101

nozzles. Based on those discussions, Entergy is withdrawing the previous version of the relaxation request and submits a revised Waterford 3 Relaxation Request #3, which is provided in Enclosure 1.

The enclosed relaxation request updates that of Reference 1 and incorporates the information provided in References 2 through 4 and supercedes all of those letters. The commitment summary provided in Enclosure 2 reflects the current commitment applicable to this request and supersedes those of Reference 1.

Should you have any questions, please contact Guy Davant at (601) 368-5756.

Sincerely,

MAK/GHD/bal

Enclosure: 1. Waterford Steam Electric Station, Unit 3 Relaxation Request #3
2. Licensee-Identified Commitments

cc: Mr. W. A. Eaton (ECH)
Mr. J. E. Venable (W3)
Mr. G. A. Williams (ECH)

Mr. M. C. Hay, NRC Senior Resident Inspector (W3)
Mr. N. Kalyanam, NRR Project Manager (W3)
Mr. B. S. Mallett, NRC Region IV Regional Administrator

ENCLOSURE 1

CNRO-2003-00058

WATERFORD STEAM ELECTRIC STATION, UNIT 3
RELAXATION REQUEST #3

ENTERGY OPERATIONS, INC.
WATERFORD STEAM ELECTRIC STATION, UNIT 3

RELAXATION REQUEST #3 TO NRC ORDER EA-03-009

I. ASME COMPONENTS AFFECTED

Waterford Steam Electric Station, Unit 3 (Waterford 3) has one hundred-two (102) ASME Class 1 reactor pressure vessel (RPV) head penetration nozzles comprised of ninety-one (91) Control Element Drive Mechanism (CEDM) nozzles, ten (10) In-Core Instrument (ICI) nozzles, and one (1) vent line nozzle.

This request pertains to the ICI nozzles only. The locations of RPV head penetrations are provided in Figure 1.

II. REQUIREMENTS

The NRC issued Order EA-03-009 (the Order) that modified the current licenses at nuclear facilities utilizing pressurized water reactors (PWRs), which includes Waterford 3. The NRC Order establishes inspection requirements for RPV head penetration nozzles. In accordance with Section IV.A of NRC Order EA-03-009, the Waterford 3 susceptibility category is "high" based on a calculated value of 16.9 effective degradation years (EDY) at the beginning of the upcoming fall refueling outage.

Section IV.C of the Order states in part:

"All Licensees shall perform inspections of the RPV head using the following techniques and frequencies:

(1) For those plants in the High category, RPV head and head penetration nozzle inspections shall be performed using the following techniques every refueling outage.

   (a) Bare metal visual 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."

III. REASON FOR REQUEST

Section IV.F of the Order states:

"Licensees proposing to deviate from the requirements of this Order shall seek relaxation of this Order pursuant to the procedure specified below. The Director, Office of Nuclear Reactor Regulation, may, in writing, relax or rescind any of the above conditions upon demonstration by the Licensee of good cause. A request for relaxation regarding inspection of specific nozzles shall also 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.

"Requests for relaxation associated with specific penetration nozzles will be evaluated by the NRC staff using its procedure for evaluating proposed alternatives to the ASME Code in accordance with 10 CFR 50.55a(a)(3)."

Pursuant to Section IV.F(2) of the Order, Entergy Operations, Inc. (Entergy) requests relaxation from the requirements of Section IV.C(1)(b). Entergy plans to inspect RPV head ICI penetration nozzles at Waterford 3 using the ultrasonic testing (UT) examination method in accordance with Section IV.C(1)(b)(i) of the Order to the maximum extent possible. However, limitations due to nozzle configuration cause reduced UT inspection coverage of each nozzle. In addition, the design of the UT inspection probe introduces a limitation impacting the amount of coverage that can be obtained. Entergy believes that to resolve these limitations would result in hardships without a compensating increase in the level of quality or safety. These limitations and their associated hardships are discussed below.

A. Counterbore Blind Zone

ICI nozzles are manufactured with a counterbore as shown in Figure 2. Due to lift-off of the UT transducers at the counterbore, a UT blind zone exists at the upper hillside location (180° azimuth) of each ICI nozzle. The axial length of the counterbore blind zone is estimated to be approximately 0.88 inch. Centered at the upper hillside location of each nozzle, the circumferential extent of the counterbore blind zone is estimated to be approximately 135° or less. See Figure 6 for additional details.

It should also be noted that the blind zone associated with the counterbore does not exist at any other azimuthal locations along the circumference of the ICI nozzle within the 2-inch area above the J-groove weld. Due to the RPV head angle at the ICI locations, the counterbore is significantly closer to the J-groove weld on the upper hillside location (180° azimuth) of the nozzle than on the lower hillside.

Resolving the UT limitations due to the counterbore would require eliminating the counterbore region through a physical modification of the nozzle itself. Entergy does not have the equipment necessary to perform such a modification.

B. Blind Zone at Nozzle Bottom End

A blind zone exists along the bottom of each ICI nozzle and varies from approximately 0.20 inch to 0.70 inch. This blind zone occurs due to loss of couplant as the transducers traverse across the bottom end of the nozzle. 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. See Figures 3, 4, and 5 for additional information.

Entergy knows of no UT equipment currently available that resolves this configuration limitation; therefore, new UT equipment would have to be developed and appropriately qualified. The time and resources required to develop and qualify this equipment is unknown.

C. Inspection Probe Design Limitation

The inspection probe to be used to inspect Waterford 3 ICI nozzles consists of seven (7) individual transducers. 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. This recess must be filled with water to provide coupling between the transducer and the nozzle wall. Because of this design, the complete diameter of the transducer must fully contact the inspection surface before ultrasonic information can be collected. Because 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, based on prior UT inspection experience and a review of UT data from previous inspections, the circumferential-shooting TOFD transducer pair only collects meaningful data down to a point 0.200 inch above inspectable area. Below this point, UT data cannot be collected.

Entergy knows of no UT equipment currently available that resolves this probe limitation; therefore, new UT equipment would have to be developed and appropriately qualified. The time and resources required to develop and qualify this equipment is unknown.

IV. PROPOSED ALTERNATIVE AND BASIS FOR USE

This request pertains only to the implementation of the Order during the Waterford 3 refueling outage RF12 during the fall of 2003.

Entergy understands that the Order requires the same technique, specified in Section IV.C(1)(b), be used to inspect the entire population of RPV head penetration nozzles; combining techniques on one nozzle or using one technique on one nozzle and a different technique on another nozzle is not permitted.

Paragraph IV.C(1)(b)(i) of the Order requires that the UT inspection of each RPV head penetration nozzle encompass "from two (2) inches above the J-groove weld to the bottom of the nozzle." Entergy plans to inspect the ICI nozzles to the extent possible using the UT inspection technique as specified in Section IV.C(1)(b)(i) of the Order. However, due to the reasons stated above, Entergy requests relaxation from this requirement for Waterford 3 ICI nozzles. Utilizing UT and surface examination methods, the proposed alternative is described below:

A. Proposed Alternative

1. UT Examination of ICI Nozzles

   Each ICI nozzle (i.e., nozzle base material) will be inspected to the maximum extent possible using the UT examination method in accordance with Section IV.C(1)(b)(i) of the Order. Where a UT blind zone exists in which meaningful UT data cannot be collected, augmented inspections shall be performed in accordance with Section IV.A.2, below.

   In addition to the UT examination, an assessment to determine if leakage has occurred into the interference fit zone will be performed, as currently specified in Section IV.C(1)(b)(i) of the Order.

2. Augmented Inspection Plan for ICI Nozzle Bottom End and Counterbore Blind Zone Regions

   Because meaningful UT data cannot be collected in the counterbore blind zone or at the bottom end of the ICI nozzle, Entergy will augment the UT inspection with a surface examination.

   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 inside diameter (ID) surface examination.

   At the bottom end, a surface examination of the nozzle ID, outside diameter (OD), and weld area that falls within the blind zone will be performed. As previously mentioned, the nozzle end blind zone varies in length from approximately 0.20 inch to 0.70 inch depending on probe location (see Figures 3, 4, and 5).

   The augmented inspections will be performed using the manual PT examination method as the primary technique. However, because the PT examination method cannot distinguish acceptable fabrication discontinuities from primary water stress corrosion cracking (PWSCC), PT indications are conservatively assumed to be PWSCC. Under these conditions, PT indications will be investigated by either:

   a) Supplemental inspection using the ECT examination method; or

   b) Grinding followed by additional PT or ECT examinations.

Entergy will include the results of the inspections in the 60-day report submitted to the NRC in accordance with Section IV.E of the Order.

B. Basis for Use

1. UT Examination

The ICI nozzles will be inspected to the maximum extent possible using the UT examination method in accordance with Section IV.C(1)(b)(i) of the Order. The UT inspection probe to be used to inspect the Waterford 3 ICI nozzles consists of seven (7) individual transducers. The configuration of the probe has been optimized for maximum coverage. UT inspection of ICI nozzles will be performed using a combination of TOFD and standard 0° pulse-echo techniques. The TOFD approach utilizes two pairs of 0.250-inch diameter, 55° refracted-longitudinal wave transducers aimed at each other. One of the transducers transmits sound into the inspection volume while the other receives the reflected and diffracted signals as they interact with the material. There will be one TOFD pair scanning in the axial direction of the penetration nozzle tube and one TOFD pair scanning in the circumferential direction of the tube. The TOFD technique is primarily used to detect and characterize planar-type defects within the full volume of the tube.

The standard 0° pulse-echo ultrasonic approach utilizes one 0.250-inch diameter straight beam transducer. The 0° technique is used to:

- Plot the penetration nozzle OD location and J-groove weld location,
- Locate and size any laminar-type defects that may be encountered, and
- Monitor the back-wall signal response to detect leakage that may occur in the interference regions of the RPV head penetration.

The UT inspection procedures and techniques to be utilized at Waterford 3 have been satisfactorily demonstrated under the EPRI Materials Reliability Program (MRP) Inspection Demonstration Program.

2. Augmented Inspection of the ICI Nozzle Bottom End and Counterbore Region Blind Zones

Augmenting UT of the ICI nozzle base material with surface examinations ensures that the ICI nozzles are adequately examined to determine their condition. The augmented inspection plan will only be used for those portions of the nozzles that could not be inspected by UT.

Entergy believes the use of a surface examination to augment UT is acceptable for ensuring that the required areas are inspected. The Order recognizes and allows the use of surface examinations (either PT or ECT) as acceptable for evaluating the condition of nozzle surfaces. Entergy will use the PT examination method as the primary surface examination technique. Augmenting the UT examination of the nozzle base material with a surface examination ensures the nozzle is adequately examined to determine its condition.

V. CONCLUSION

Section IV.F of NRC Order EA-03-009 states:

"Licensees proposing to deviate from the requirements of this Order shall seek relaxation of this Order pursuant to the procedure specified below. The Director, Office of Nuclear Reactor Regulation, may, in writing, relax or rescind any of the above conditions upon demonstration by the Licensee of good cause. A request for relaxation regarding inspection of specific nozzles shall also 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."

Section IV.C(1)(b) of the Order establishes a minimum set of RPV head penetration nozzle inspection requirements to identify the presence of cracks in penetration nozzles that could lead to leakage of reactor coolant and wastage of RPV head material.

Entergy believes the proposed alternative, described in Section IV above, provides an acceptable approach to determine the condition of the Waterford 3 ICI nozzles by utilizing UT and surface examination methods.

Entergy believes that compliance with the UT inspection provisions of Section IV.C(1)(b)(i) of the Order as described in Section II above would result in hardships and unusual difficulties, as discussed in Section III above, without a compensating increase in the level of quality and safety. Therefore, Entergy requests that this relaxation request be authorized pursuant to Section IV.F(2) of the Order for Waterford 3 refueling outage RF12.

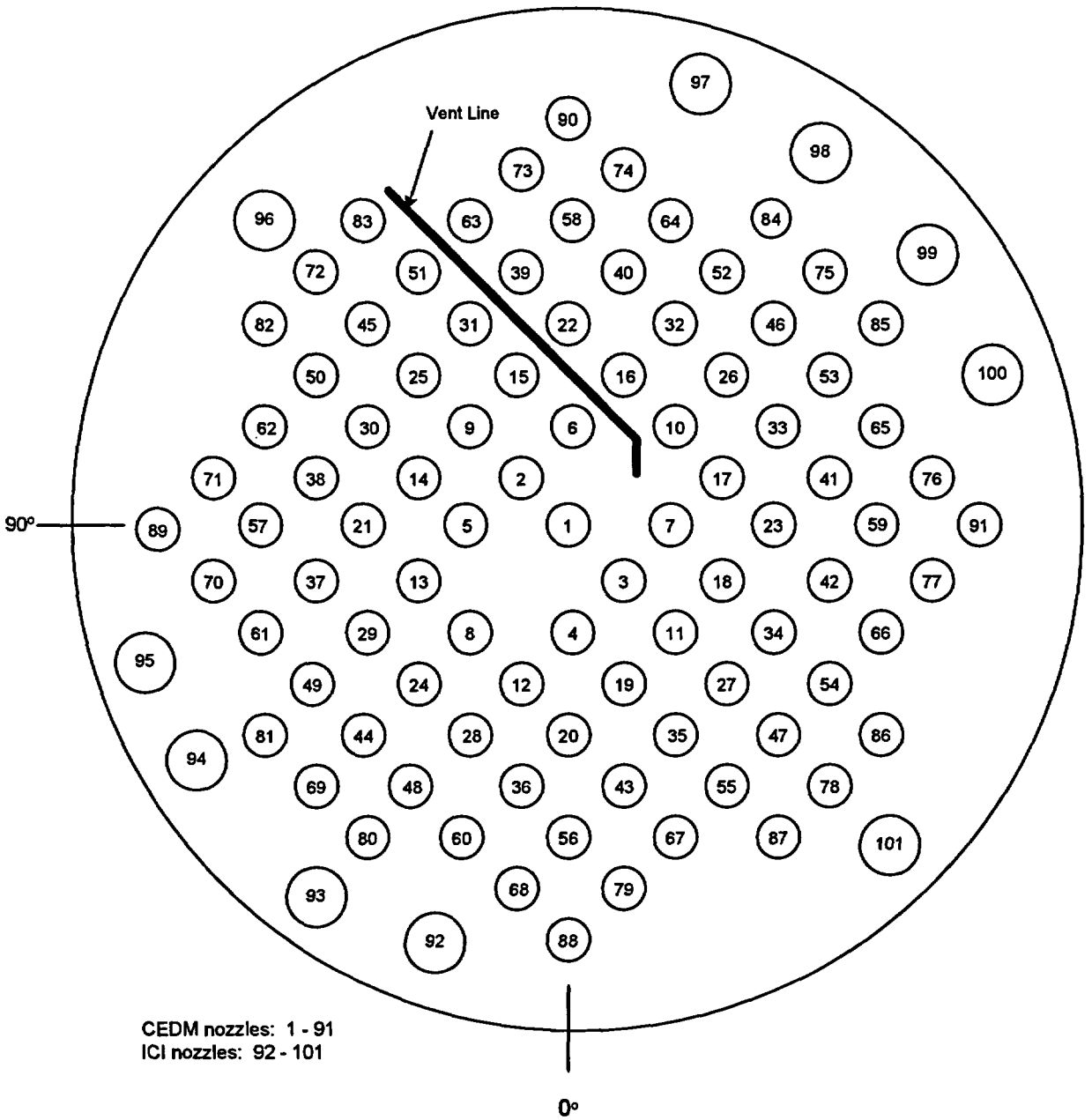
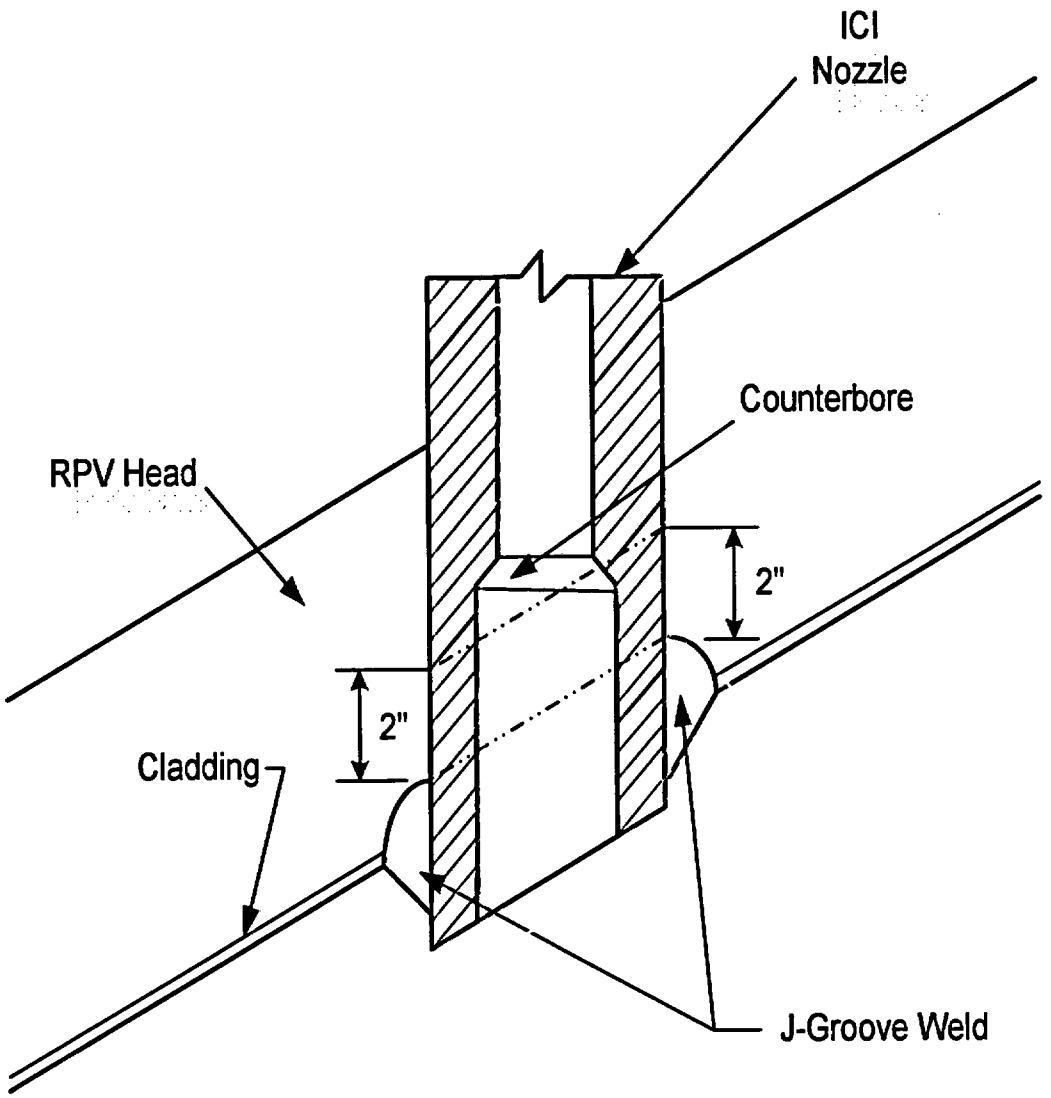


FIGURE 1
Penetration Locations in the Waterford 3 RPV Head



NOTE: Diagram not to scale

FIGURE 2
ICI NOZZLE CONFIGURATION

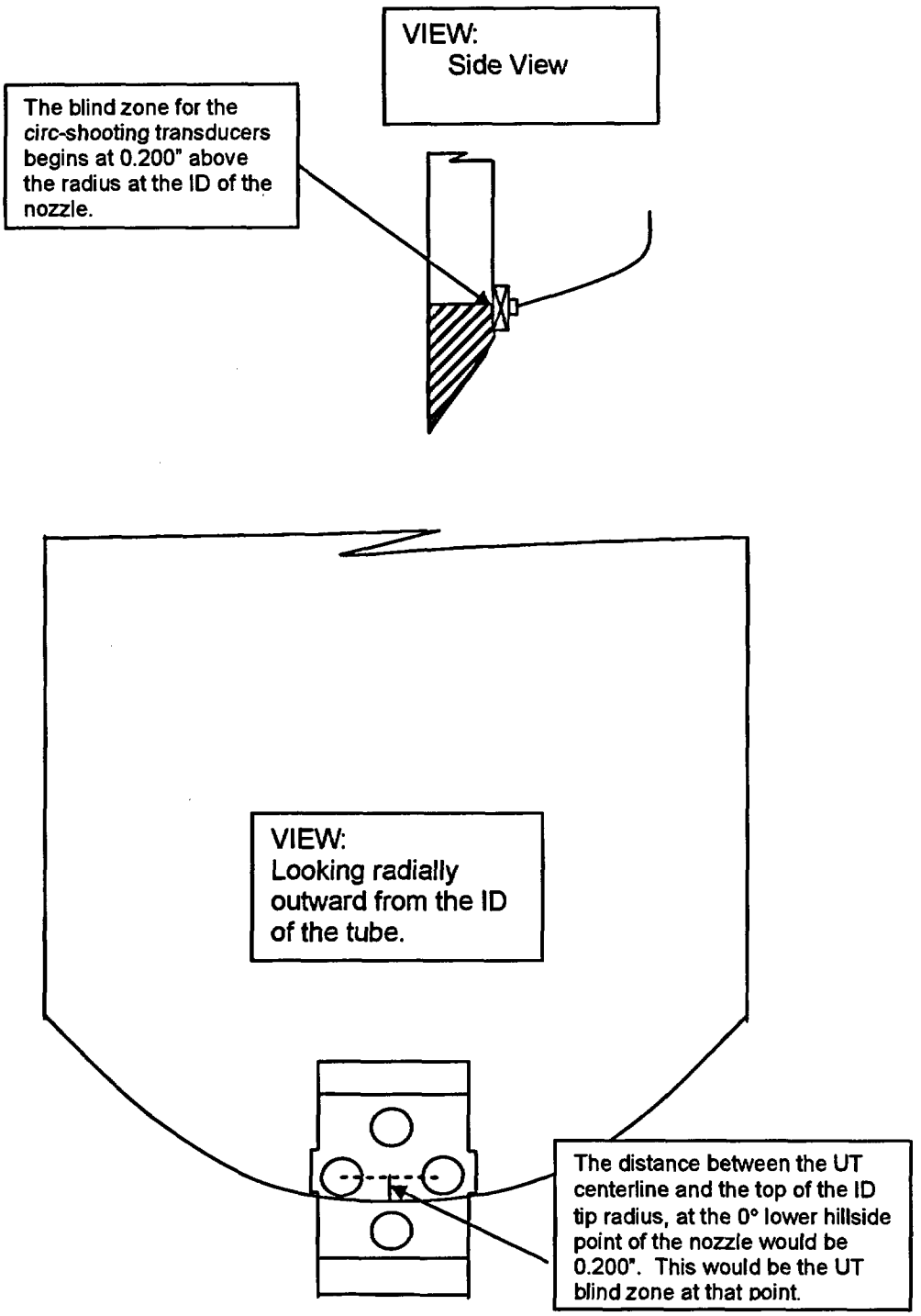


FIGURE 3
UT INSPECTION PROBE
END OF NOZZLE – LOWER HILLSIDE POSITION

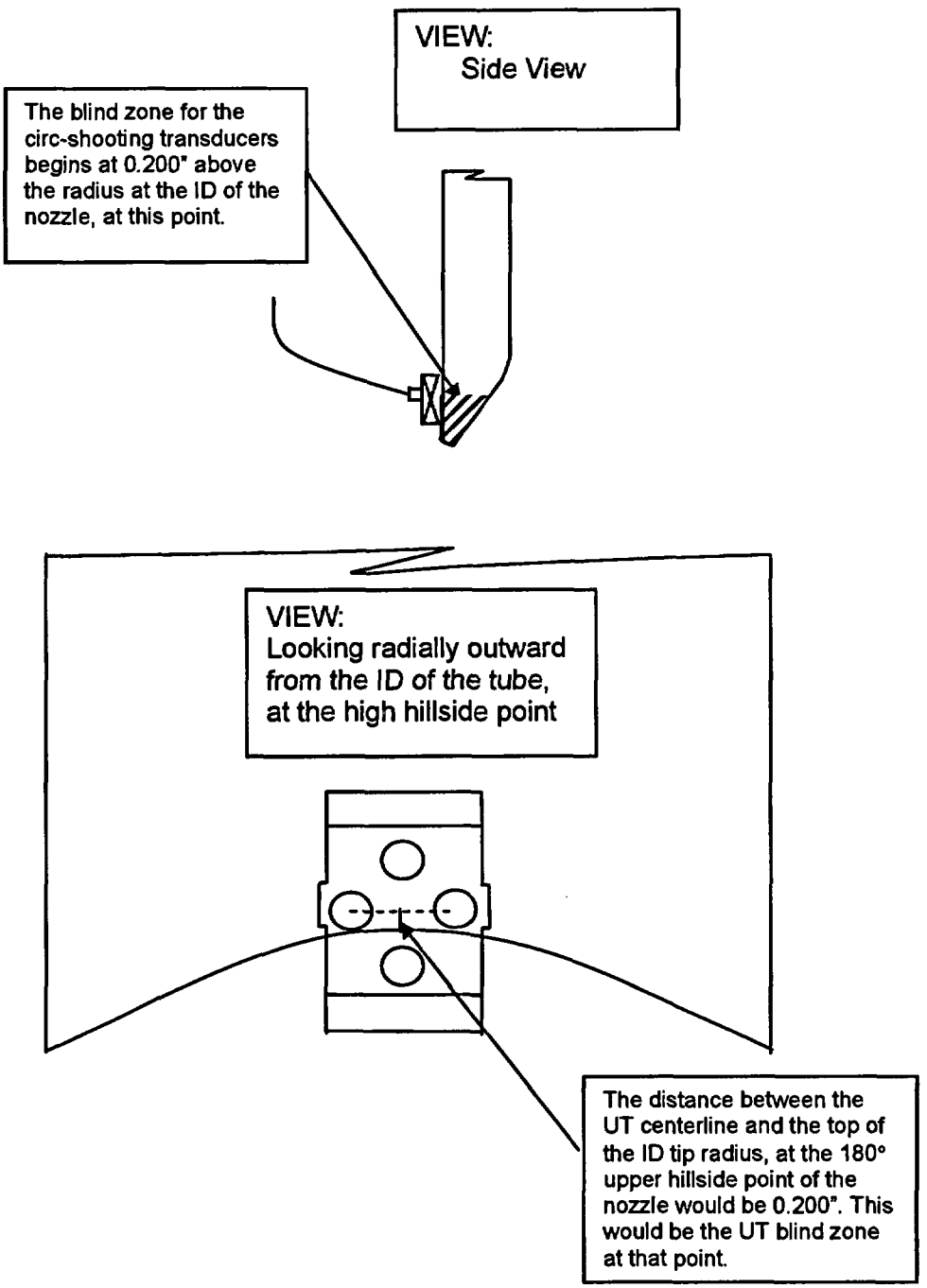


FIGURE 4
UT INSPECTION PROBE
END OF NOZZLE- UPPER HILLSIDE POSITION

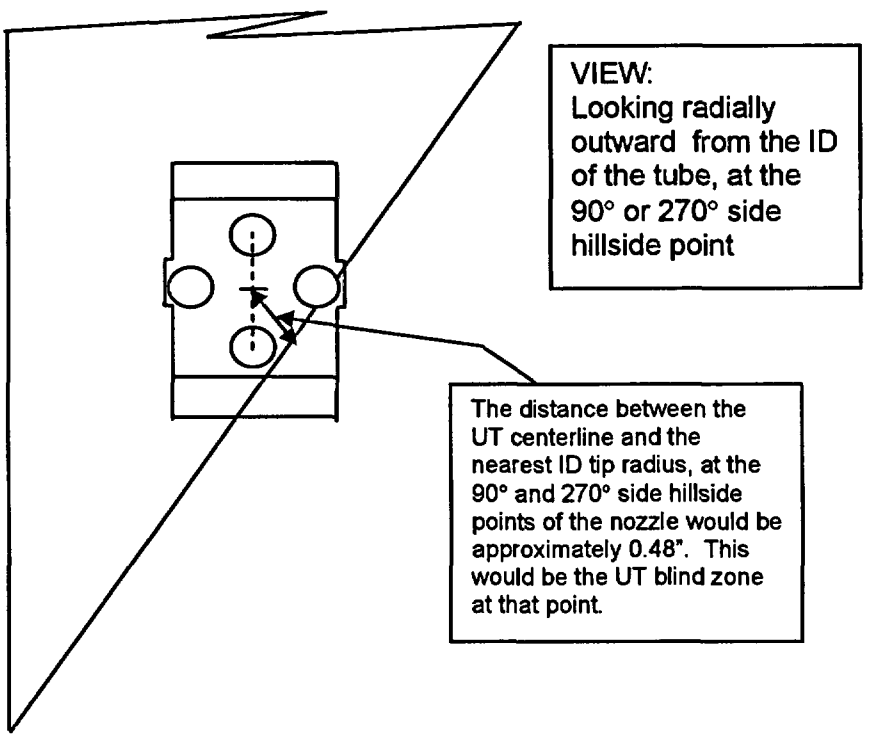


FIGURE 5
UT INSPECTION PROBE
END OF NOZZLE – SIDE VIEW @ 90° and 270°

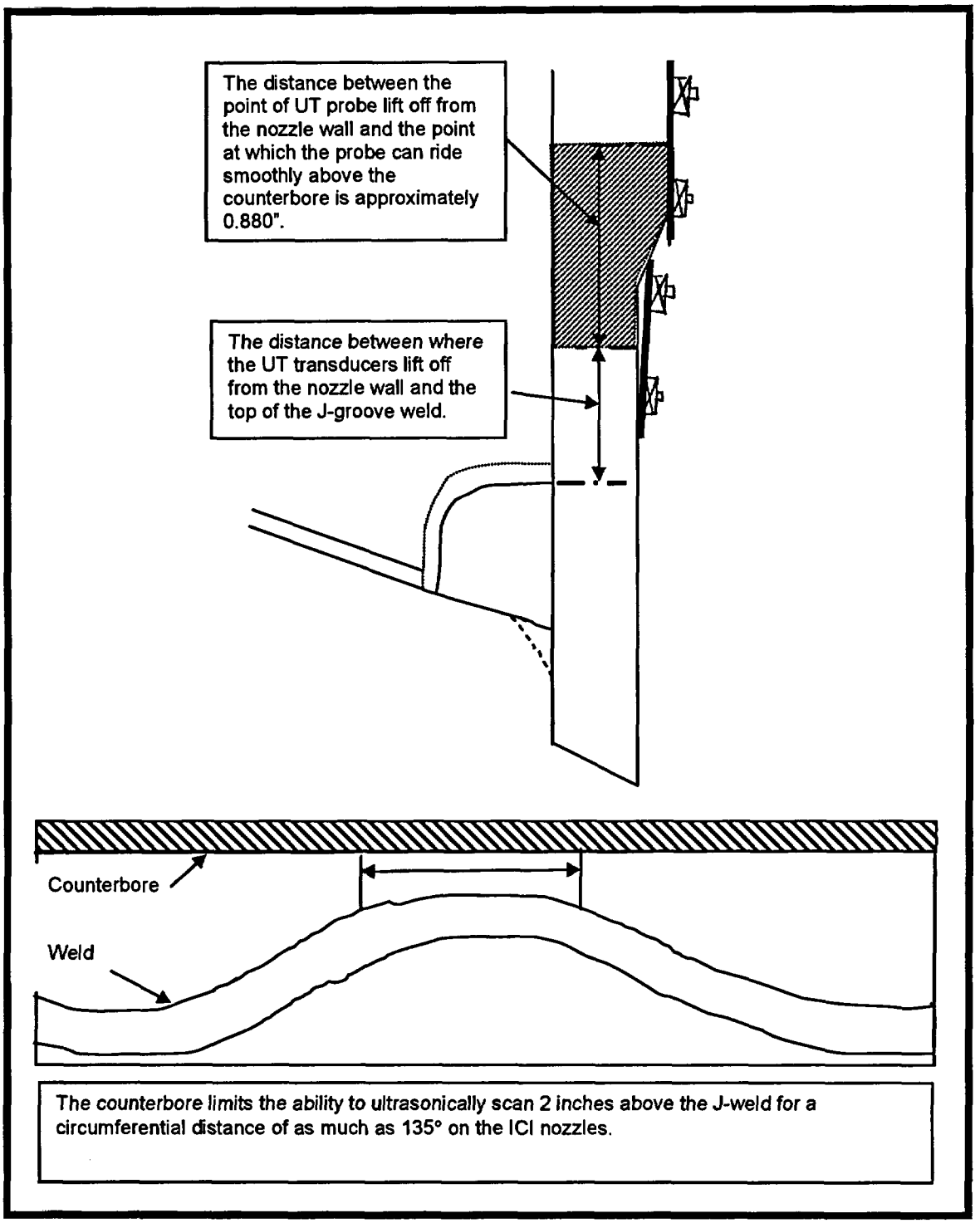


FIGURE 6
COUNTERBORE – UPPER HILLSIDE POSITION

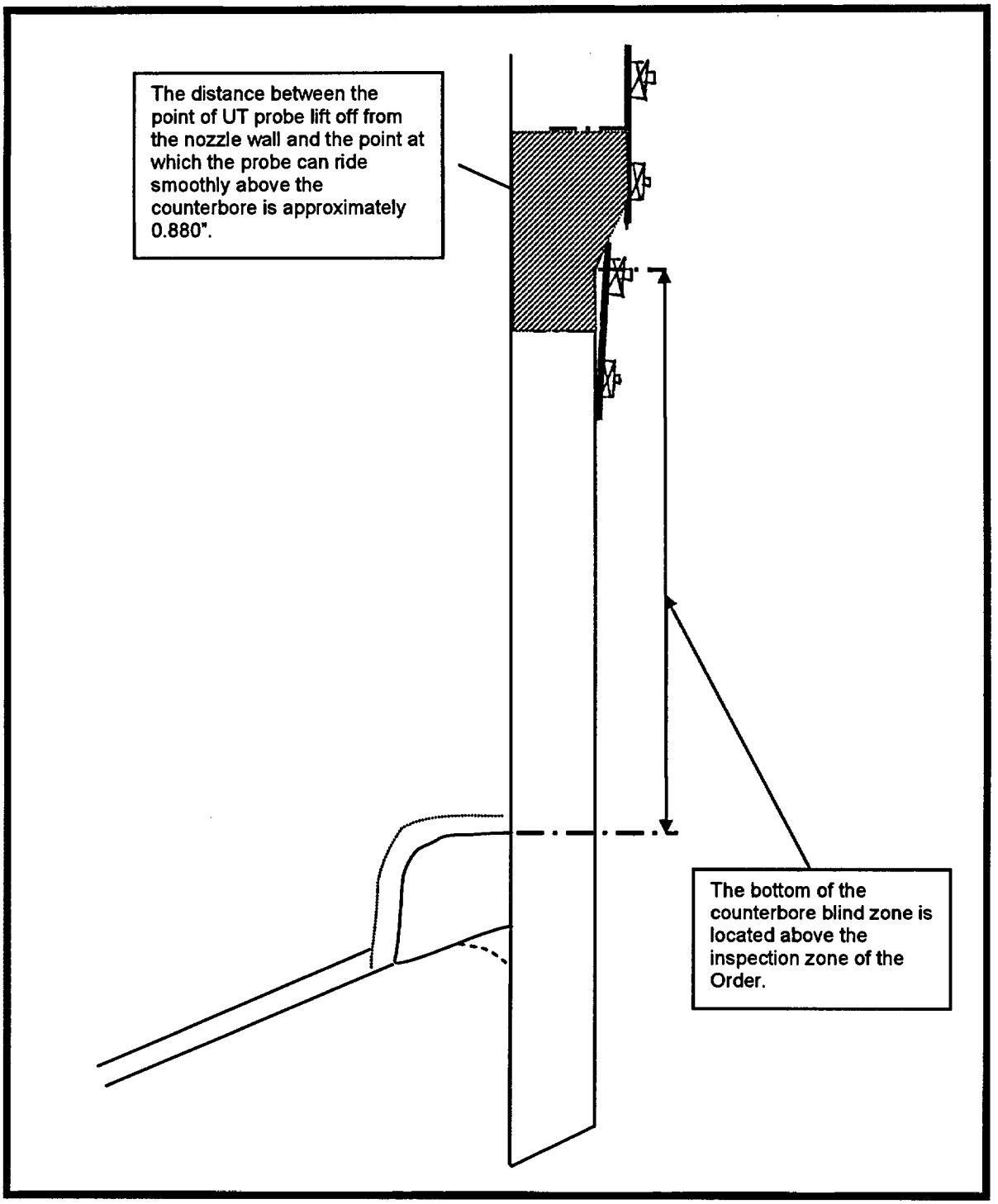


FIGURE 7
COUNTERBORE – LOWER HILLSIDE POSITION

ENCLOSURE 2

CNRO-2003-00058

LICENSEE-IDENTIFIED COMMITMENTS

LICENSEE-IDENTIFIED COMMITMENTS

COMMITMENT	TYPE (Check one)		SCHEDULED COMPLETION DATE
	ONE-TIME ACTION	CONTINUING COMPLIANCE	
1. Entergy will include the results of the inspections in the 60-day report submitted to the NRC in accordance with Section IV.E of the Order.	✓		60 days after startup from the next refueling outage