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Subject: Responses to the NRC questions related to Relief Requests 01-0002-RR and 01-0003-RR
Creation Date: 10/14/01 1:43PM
From: "Cecilia, Loretta V." <Loretta.Cecilia@pgnmail.com>

Created By: Loretta.Cecilia@pgnmail.com

Recipients
nrc.gov
owf2_po.OWFN_DO
TLC (Terence Chan)

nrc.gov
owf4_po.OWFN_DO
JMG4 (John Goshen)
RPC (Richard Correia)

pgnmail.com
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Questions-Final Relief Request 01-0002-RR1.doc	64512	
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Expiration Date:	None
Priority:	Standard
Reply Requested:	No
Return Notification:	None
Concealed Subject:	No
Security:	Standard

Attached are the responses to the NRC questions related to Relief Requests 01-0002-RR and 01-0003-RR posed during our teleconference on October 11, 2001. During that discussion the NRC stated that the questions represented points of clarification as distinct from technical issues with the intended RPV head nozzle repair process. Accordingly, FPC representatives stated that repair welding would continue as planned. There was no indication from the NRC staff that proceeding with the repair held any regulatory risk.

FPC had initiated the repair process in accordance with our outage schedule and critical path progress based on the verbal approval of the Relief Requests. Verbal approval was provided in a telephone conversation between Sid Powell, CR-3 Licensing and Regulatory Programs Supervisor and Rich Correia, NRR Section Chief, Project Directorate II and John Goshen, NRR Project Manager for CR-3 on October 4, 2001. FPC has now completed the repair weld as described in Relief Request 01-0002-RR and is in the 48 hour hold period prior to final NDE acceptance of the weld.

We trust that the responses in the attachment will provide the clarification required and that written approval of the Relief Requests will be forthcoming. Not having written approval of the Relief Requests is a restraint to ascending from Refueling (Mode 6) to Cold Shutdown (Mode 5). If you have any questions, please contact Sid Powell at (352) 563-4883 or Sherry Bernhoft at (352) 563-4566.

<<Questions-Final Relief Request 01-0002-RR1.doc>> <<Questions-Final Relief Request 01-0003-RR1.doc>>

Ambient Temperature Temper Bead Weld Repair
Comparison of Section III/Section XI Code Reqirements to 01-0002-RR Methodology

Response to a & b:

IWA-4120(a) requires that repairs be made in accordance with the Owner's Design Specification and the original Construction Code of the component or system. Later Editions and Addenda of the Construction Code or of Section III, either in their entirety or portions thereof, and Code Cases may be used. In the event that repair welding cannot be performed in accordance with these requirements, the applicable alternative requirements of IWA-4500 and IWB-4000 may be used for Class I components.

This particular repair method reattaches a shortened nozzle to the reactor vessel closure head. Normally, the CR3 Section XI Repair and replacement program would require such a repair to be performed in accordance with ASME Section III, 1989 Edition, no Addenda, hereafter referred to as "Section III".
The primary difference between Section III requirements and the selected repair method is the use of an ambient temperature temper bead method with 50 degrees F minimum preheat and no post-weld heat treatment. However, the unusual geometry of the repair, accessibility and the impracticalities associated with hydrotesting necessitate further deviations from Section III requirements.

The repair has been presented as an alternative to IWA-4120(a) in that it does not conform to the definition of a weld repair as required by that paragraph and subsequent related paragraphs. In lieu of Section III requirements, the alternative follows the methodology of Code Case N-638, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique". It is important to note that the use of N-638 methodology does not imply that the Code Case has been invoked in its entirety. The Code Case was written specifically for instances in which welding is performed on components which cannot be drained because it is impractical, either for operational or radiological reasons. This is not the case for a reactor vessel closure head removed from the reactor vessel and placed on a remote head stand. In addition, the Code Case as written contains requirements relevant to full penetration rather than partial penetration welds. However, the fact that the Code Case does not have direct application to the circumstances of this repair does not diminish its value as an acceptable repair method. By closely following the methodology of N-638, and providing justification for instances where substitutions have been made for the as-written requirements, it is anticipated that NRC may draw on previous SERs associated with the use of Code Case N-638 in approving the CR3 methodology on its own merits as an acceptable alternative to Section III.

The preceding discussion provides the reasoning for requesting broad relief from IWA-4120(a) rather than relief from each paragraph and subparagraph of Section III invoked by IWA-4120(a). However, it is recognized that this approach may make it difficult to draw parallels between the methodology described above and the paragraphs and subparagraphs that would have been applicable had IWA-4120(a) been followed. Consequently, the paragraphs of Section III and Section XI describing requirements that differ from those in Relief Request 01-0002-RR have been identified, and a

discussion has been provided to show how the intent of each has been satisfied by the proposed

repair method.

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Paragraph or Subparagraph	Requirement	Alternative, including Reference for Justification
*IWA-4120(a) *IWA-4530 *NB-4622.11	ASME Section XI, IWA-4120(a) requires that repairs be performed in accordance with ASME Section III or ASME Section XI. ASME Section III, NB-4622.11 is a temper bead weld process whenever post weld heat treatment is impractical or impossible. ASME Section XI, IWA-4530 is a half bead weld technique with specified post weld heat treatment.	Perform the repair in accordance with the requirements outlined in the Relief Request which are presented as a template from Code Case N-638 and altered to represent the specific repair method.
*IWA-4330(b)	"Where repair welding is required, the cavity shall be ground smooth and clean with beveled sides and edges rounded to provide suitable accessibility for welding."	Machining accomplishes an equal or better surface to that accomplished by grinding.
IWA-4700(a) IWA-5211(d)	"After repairs by welding on the pressure retaining boundary, a system hydrostatic test shall be performed in accordance with IWA-5000." System hydrostatic test conducted during plant shutdown at a pressure above nominal operating pressure or system pressure for which overpressure protection is provided.	System leakage test will be performed in lieu of a hydrostatic test in accordance with Code Case N416-1. This does not require a relief request.
*NB3357 *NB-4622	"All vessels and vessel parts shall be given the appropriate postweld heat treatment prescribed in NB-4620." PWHT Time and Temperature Requirement.	No postweld heat treatment will be performed, based on Code Case N-638 methodology, Ref. RR IV(j). Ambient temperature temper bead welding method will be used based on the overall relief request justification.

*NB-5245	Partial Penetration Welded Joints. "…shall be examined progressively using either the magnetic particle or liquid penetrant methods."	Final PT and UT will be performed on the finished weld. Progressive PT will not be performed. UT will be performed in accordance with Section XI Appendix I-2400 and Section III NB-5000. PT will be performed in accordance with NB-5000. PT acceptance criteria per NB-5350. UT acceptance criteria per NB-5330. Ref. III 4.0(e).

* Relief is requested from this paragraph or subparagraph.

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Response to c:

ASME Section III, NB-4310, 4330, NB-4331, NB-4333, NB-4334 NB-4335, & NB-4336 covers the requirements for welding procedure qualifications. As an alternative, Relief Request Section III, 2.0 will be followed versus ASME Section III NB-4310, 4330, NB-4331, NB-4333, NB-4334, NB-4335, & NB-4336.

The bases for the proposed alternative is provided in Section IV of the relief request.

Response to d:

ASME Section III, NB-4622.11 covers the requirements for temper bead weld repairs to dissimilar metal welds or buttering without post weld heat treatment. ASME Section XI, IWA-4530 covers the requirements for a half bead weld technique when the repair is within 1/8 inch of the ferritic base material. As an alternative, Relief Request Section III, 3.0 will be followed versus NB-4622.11 and IWA-4530.

The bases for the proposed alternative is provided in Section IV of the relief request.

Response to e:

4.0.b: ASME Section III, NB-5245 "Partial Penetration Welds" covers the NDE requirements for a partial penetration weld. Relief is requested to examine the final weld, using surface and ultrasonic methods as outlined in the RR Section III.4.0. FPC is also using Code Case N-416-1 "Alternative Pressure Test Requirement for Welded Repairs or Installation of Replacement Items by Welding, Class 1, 2, and 3 Section XI, Division 1" to perform a pressure test. The Code Case allows an alternative to hydrostatic pressure testing required by IWA-4700(a). The Code Case requires the NDE of the weld to be in accordance with ASME Section III, 1992 Edition.

The bases for the proposed alternative is provided in Section IV of the relief request.

4.0.c: No relief from ASME Section III is required. This is a comparison of CC N-638 requirements versus FPC repair plan.

4.0.e: No relief from ASME Section III is required. This is a comparison of CC N-638 requirements versus FPC repair plan.

e.1. Ultrasonic examination of partial penetration welds in accordance with ASME Section XI, Appendix I is addressed in paragraph I-2400. I-2400 requires ultrasonic examinations be performed in accordance with the requirements of Article 4 or 5 of ASME Section V, as applicable. The applicable Article for performing ultrasonic examinations in this application is Article 5 Ultrasonic Examination Methods for Materials and Fabrication. ASME Section III, NB-5111 also requires ultrasonic examinations be performed in accordance with ASME Section V, Article 5. The Framatome ANP NDE Procedure Number 54-ISI-178 for Ultrasonic Examination of CRDM Nozzle Temperbead Weld Repairs meets the requirements of ASME Section V, Article 5, through the 1992 Edition for the detection of fabrication flaws.

The effectiveness of the UT techniques to examine the ID temperbead (IDTB) repair weld have been qualified by demonstration on a mockup of the IDTB involving the same materials used for repair. Notches were machined into the mockup at the triple point region of depths of 0.10 inch, 0.15 inch, and 0.25 inch in order to quantify the ability to characterize the depth of penetration into the nozzle. This is illustrated in Figure 1. The depth characterization is done using tip diffraction UT techniques that have the ability to measure the depth of a reflector relative to the nozzle bore. Each of the notches in the mockup could be measured using the 45-degree transducer. During the examination longitudinal wave angle beams of 45 degrees and 70 degrees are used (refer to Figure 2). These beams are directed along the nozzle axis looking up and down. The downward looking beams are effective at detecting the anomaly because of the impedance change at the triple point. The 45-degree transducer is effective at depth characterization by measuring the time interval to the tip of the reflector relative to the transducer contact surface. This provides the ability to determine if the anomaly is within the limits of the analyzed 0.10 inch flaw size. The 70-degree longitudinal wave provides additional qualitative data to support information obtained with the 45-degree transducer. Together, these transducers provide good characterization of the solidification anomaly. These techniques are routinely used for examination of austenitic welds in the nuclear industry for flaw detection and sizing.

Detection of the solidification anomaly has also been demonstrated on mockups fabricated during the welding qualification activities. The techniques detected the anomaly and were subsequently sectioned. The anomaly was generally less than 0.03 inch for the samples sectioned.

In addition to the 45 and 70-degree beam angles described above the weld is also examined in the circumferential direction using 45-degree longitudinal waves in both the clockwise and counterclockwise directions to look for transverse fabrication flaws (refer to Figure 3). A 0-degree transducer is also used to look radially outward to examine the weld and adjacent material for laminar type flaws and evidence of underbead cracking (refer to Figure 4).

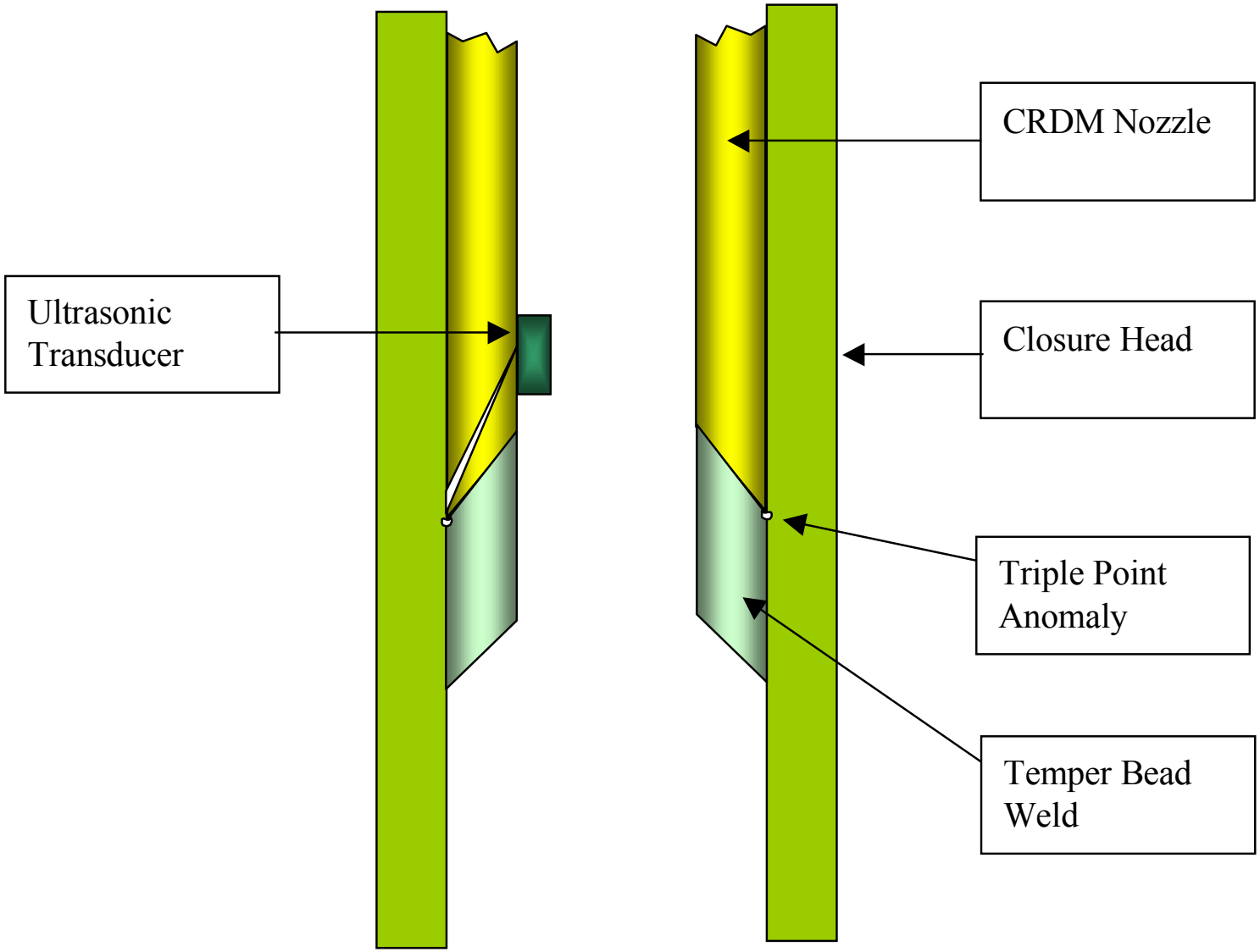

Figure 1

Typical IDTB Weld Configuration with Weld Solidification Anomaly

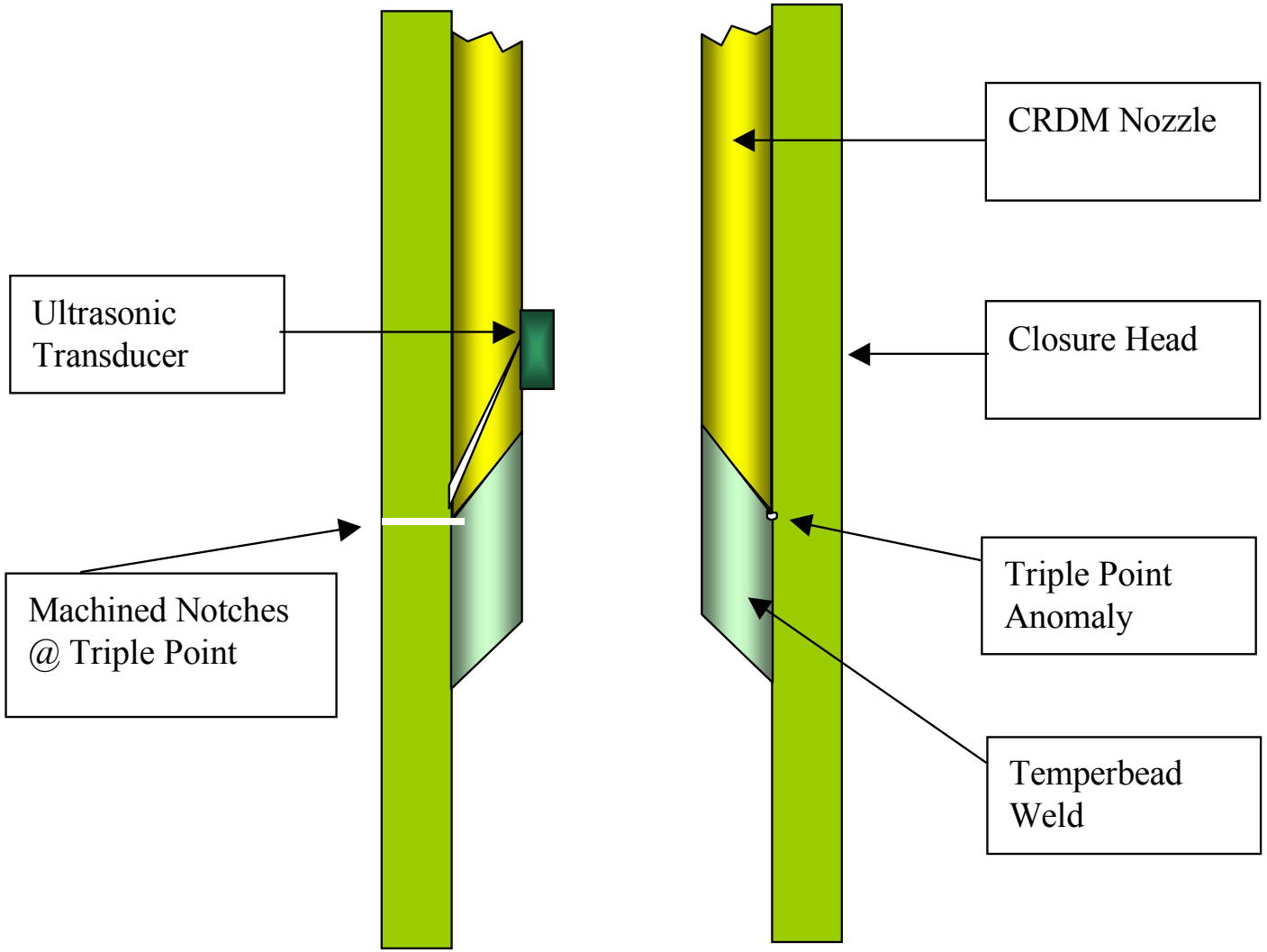

Figure 2

Mockup for Characterization of Weld Solidification Anomaly at the Triple point. Contains notches of 0.10 inch, 0.15 inch, and 0.25 inch depth relative to the OD of the CRDM nozzle. Beam angles of 45 and 70 degrees looking up and down are used.

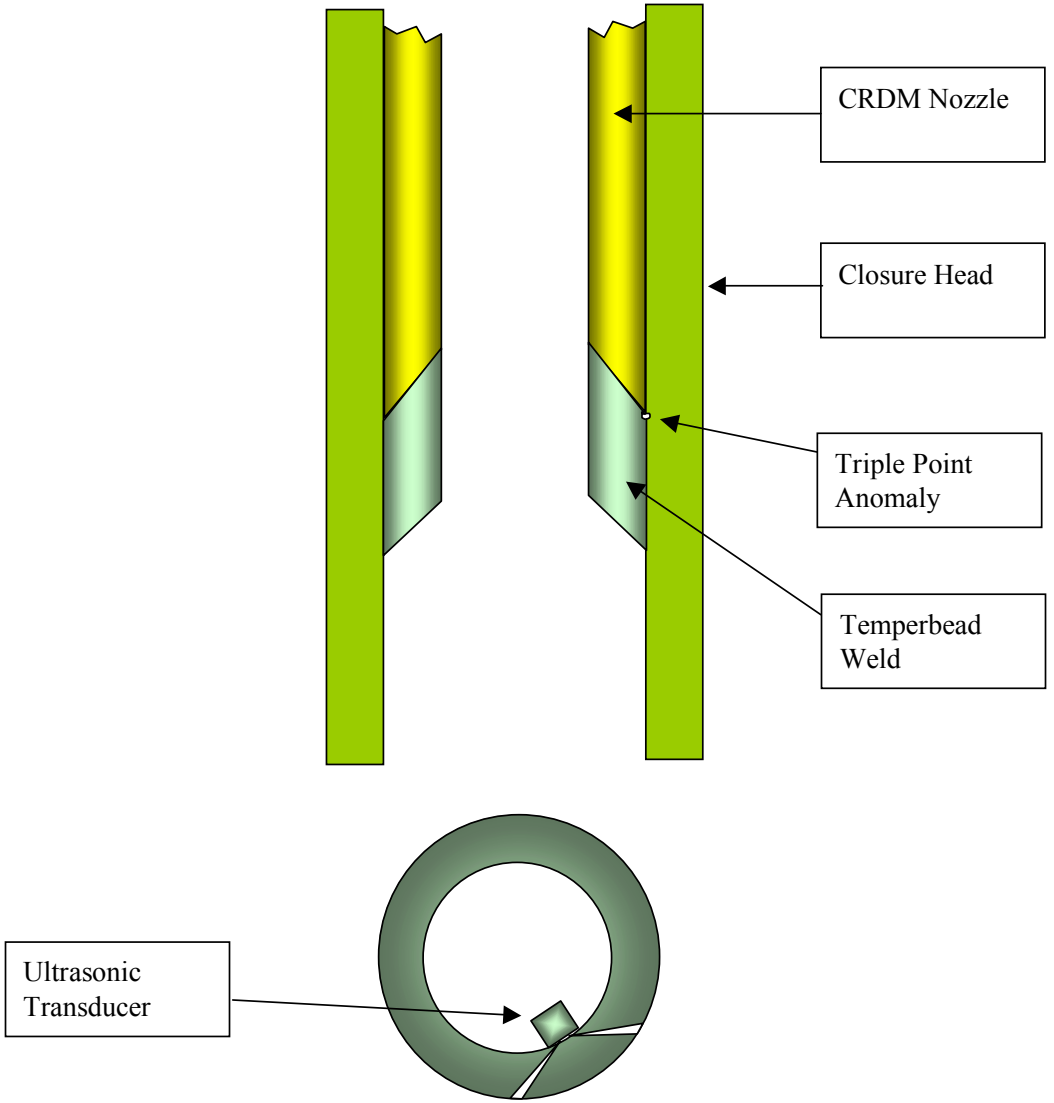

Figure 3

Circumferential Beam Directions (CW & CCW) with 45 degree

Ambient Temperature Temper Bead Weld Repair
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Longitudinal Wave

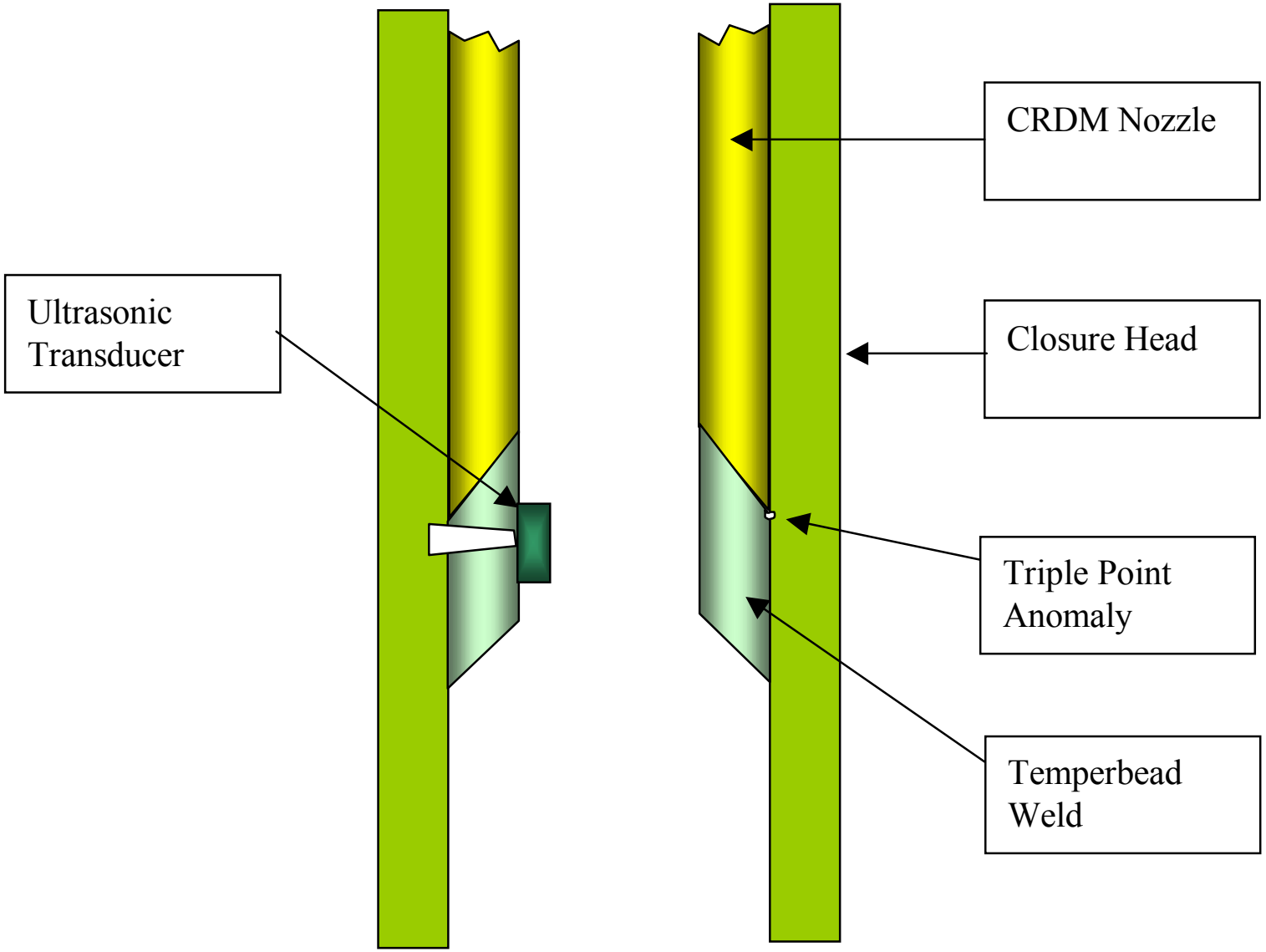

Figure 4

0-degree Transducer for Laminar Flaws and Underbead Cracking

e.2. The relevance of Code Case N-416-1 is that it provides relief from performance of an ASME Section XI hydrostatic pressure test. The Code Case allows a system leak test at nominal operating pressure in lieu of a hydrostatic pressure test provided the NDE methods and acceptance criteria are in accordance with ASME Section III, 1992 Edition.

ASME Section III, 1992 Edition paragraph NB-5245 states that the NDE requirement for a partial penetration weld is a progressive magnetic particle or liquid penetrant method. The increment of examination is the lesser of one-half of the maximum welded joint dimension measured parallel to the centerline of the connection or ½ inch. The surface of the finished welded joint shall also be examined by either method.

The finished weld will be examined using surface (liquid penetrant) and ultrasonic methods when the completed weld has been at ambient temperature for at least 48 hours. The ultrasonic method is an alternative to the incremental liquid penetrant examination. It is not practical to perform an incremental examination due to the complexity of the welding process. The ultrasonic examination provides a more detailed examination of the finished weld versus the incremental examination as it covers the full thickness of the finished weld.

ASME Section III, 1992 Edition paragraph NB-5350 provides the acceptance criteria for liquid penetration examinations and NB-5330 provides the acceptance criteria for ultrasonic examinations.

Relief Request 01-0003-RR

Response to Question (a)

ASME XI, IWA-3300 requires that flaws remaining in service be characterized by NDE and evaluated. FPC is requesting relief from ASME Section XI, Subsection IWA-3300(a) & (b). FPC will remove portions of the original weld to limit the size of flaws as allowed by IWA-4310. FPC is not requesting relief from IWA-4310. In lieu of fully characterizing the existing cracks, FPC proposes to utilize worst-case assumptions to conservatively estimate the crack extent and orientation as outlined in the relief request.

Response to Question (b)

The use of the term "evaluated" with respect to the rules of IWB-3500 may bemisleading. FPC proposes to allow potential flaws in the remaining J-groove weld to remain in place and evaluate and accept them in accordance with Section XI criteria as permitted by ASME Section XI 1992 Edition, IWA-4310.

The acceptance standards for flaws in Category B-E welds are described in IWB-3522, and are all based on visual inspection. However, as the reviewer points out, IWB-3600 contains criteria for the analytical evaluation of flaws, including acceptance criteria based on applied stress intensity factor (IWB-3612), which have been used here. Assuming a flaw extends through the entire depth of the chamfered J-groove weld, the evaluation shows that the flaw size in the combined J-groove weld and low alloy head resulting from continued service does not exceed the acceptable size and applied stress intensity factor limits. No relief is requested from IWB-3500 or IWB-3600.

Response to Question (c)

The worst-case assumption on flaw size is based on maximum crack growth by primary water stress corrosion cracking (PWSCC). Although a crack propagating through the J-groove weld by PWSCC would eventually grow to the low alloy steel reactor vessel head, continued growth by PWSCC into the low alloy steel is not expected to occur. Stress corrosion cracking (SCC) of carbon and low alloy steels is not a problem under BWR or PWR conditions. SCC of steels containing up to 5% chromium is most frequently observed in caustic and nitrate solutions and in media containing hydrogen sulfide. Based on this information, SCC is not expected to be a concern for low alloy steel exposed to primary water. Instead, an interdendritic crack propagating from the J-groove weld area is expected to blunt and cease propagation. This has been shown to be the case

for interdendritic SCC of stainless steel cladding cracks in charging pumps and by recent events with PWSCC of Alloy 600 weld materials at ONS-1 and VC Summer.

Response to Question (d)

IWB-3132.4(b) requires that flaws accepted by analytical evaluation be subsequently reexamined in accordance with IWB-2420(b) and (c). Inherent in the application of IWB-2420(b) and (c) is that the flaw has initially been characterized in accordance with IWA-3300, since this establishes the basis for comparison of subsequent examination results to those used to accept the original flaw in accordance with IWB-3600.

Since the proposed nozzle repair includes relief from the requirements of IWA-3300, no initial characterization data exists. Therefore, there is no basis for comparison to subsequent examination results.

In conclusion, if relief is granted from the requirements of IWA-3300, it follows that the subsequent examination requirements of IWB-2420(b) and (c), as invoked by IWB-3132.4(b), do not apply.

Accession Number ML013400193