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Patric W. Conroy
Director Nuclear Safety Assurance
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March 23, 2009

Re: Indian Point Unit 3
Docket No. 50-286

NL-09-037

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

SUBJECT: Response to Request For Information Regarding Request For Relief 3-48 Supporting the Unit 3 Refuel Outage 15 Inservice Inspection Program (TAC ME0414)

REFERENCE:

1. Entergy Nuclear Operations letter to U.S. Nuclear Regulatory Commission, "Requests For Relief 3-45, 3-46, 3-47(I) and 3-48 to Support the Unit 3 Refuel Outage 15 Inservice Inspection Program," dated January 22, 2009

2. Entergy Nuclear Operations letter to U.S. Nuclear Regulatory Commission, "Supplement to Request For Relief 3-48 and 3-47(I) to Support the Unit 3 Refuel Outage 15 Inservice Inspection Problem," dated February 6, 2009

3. Entergy Nuclear Operations letter to U.S. Nuclear Regulatory Commission, "Response to Request For Information Regarding Request For Relief 3-48 Supporting the Unit 3 Refuel Outage 15 Inservice Inspection Program," dated March 9, 2009

Dear Sir or Madam:

Entergy Nuclear Operations, Inc. (Entergy) submitted Relief Request No. 3-48 (RR-3-48) for Indian Point Unit No. 3 (IP3) in Reference 1, supplemented this request in Reference 2, and responded to a request for additional information in Reference 3. This letter supersedes Reference 3 with clarified responses to address NRC comments received during a telecom which occurred on March 13, 2009. The revised responses are contained in Attachment 1.

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NRR

There are no new commitments identified in this submittal. If you have any questions or require additional information, please contact Mr. Robert Walpole, Licensing Manager at 914-734-6710.

Very truly yours,

Patric W. Conroy
Director Nuclear Safety Assurance
Indian Point Energy Center

Attachment: 1. Relief Request 3-48 Response to Request For Additional Information

cc: Mr. John P. Boska, Senior Project Manager, NRC NRR DORL
Mr. Samuel J. Collins, Regional Administrator, NRC Region I
NRC Resident Inspector's Office Indian Point
Mr. Paul Eddy, New York State Department of Public Service
Mr. Robert Callender, Vice President NYSERDA

ATTACHMENT 1 TO NL-09-037

RELIEF REQUEST 3-48

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

ENTERGY NUCLEAR OPERATIONS, INC.
INDIAN POINT NUCLEAR GENERATING UNIT NO. 3
DOCKET NO. 50-286

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION FOR RELIEF REQUEST 3-48 PROPOSED ALTERNATIVE EXAMINATIONS OF RPV BOTTOM MOUNTED INSTRUMENTATION PENETRATIONS

Entergy letters dated January 22, 2009 and February 6, 2009 submitted Request For Relief 3-48 to Support the Unit 3 Refuel Outage 15 Inservice Inspection Program. Entergy's letter dated March 9, 2009 responded to an NRC request for additional information. Entergy discussed the March 9, 2009 letter with the NRC in a telecom that occurred on March 13, 2009. This submittal supersedes the March 9, 2009 letter with a clarified response to the NRC request for additional information. The NRC questions and the Entergy responses are as follows:

A. The following questions relate to the Electric Power Research Instititute's Technical Report MRP-166, "Demonstration of Equipment and Procedures for the Inspection of Alloy 600 Bottom Mounted Instrumentation (BMI) Head Penetrations," dated March 2006

Question 1

What are the critical flaw locations and orientations? How have these critical flaws been incorporated in the demonstration?

Response

The critical flaw locations and orientations are above, below, and over the partial penetration weld in the circumferential orientation. From MRP-166 page A-4: Axial / radial and circumferential / radial flaws are located in the tube above, below, and/or over the attachment weld area (a circumferential flaw is defined as the weld-to-vessel intersection line). Radial and circumferential flaws are also located on the wetted surface of the attachment weld.

Question 2

Relief Request 3-48 indicates that the "proposed alternative of performing automated ultrasonic examinations ... from the inside surface using procedures, personnel, and equipment that have been demonstrated and qualified in accordance with MRP-166 ... as supplemented by technical justification WDI-TJ-1014 ..." MRP-166 is a capability demonstration for equipment and procedures not a qualification report on BMI examinations. In light of this, please clarify your use of MRP-166 in RR-3-48.

Response

Relief is requested for IPEC to examine the RPV bottom mounted instrument penetrations using ultrasonic (volumetric) and eddy current (surface) techniques in lieu of an external visual examination. Code Case 722-1 Table 1 Footnote (5) accepts an ultrasonic exam performed from the component's inside surface provided that the examination is in accordance with the requirements of ASME Section XI Table IWB-2500-1 and Appendix VIII. Relief Request 3-48 references MRP-166 for demonstrating the capability of the ultrasonic (volumetric) and eddy current (surface) techniques. Neither technique is qualified to Appendix VIII.

The bottom mounted nozzle (BMN) demonstration results documented in MRP-166 were conducted without using a pass / fail criteria. Entergy has reviewed the results and determined that the performance of the procedures and equipment are acceptable for implementation at Indian Point.

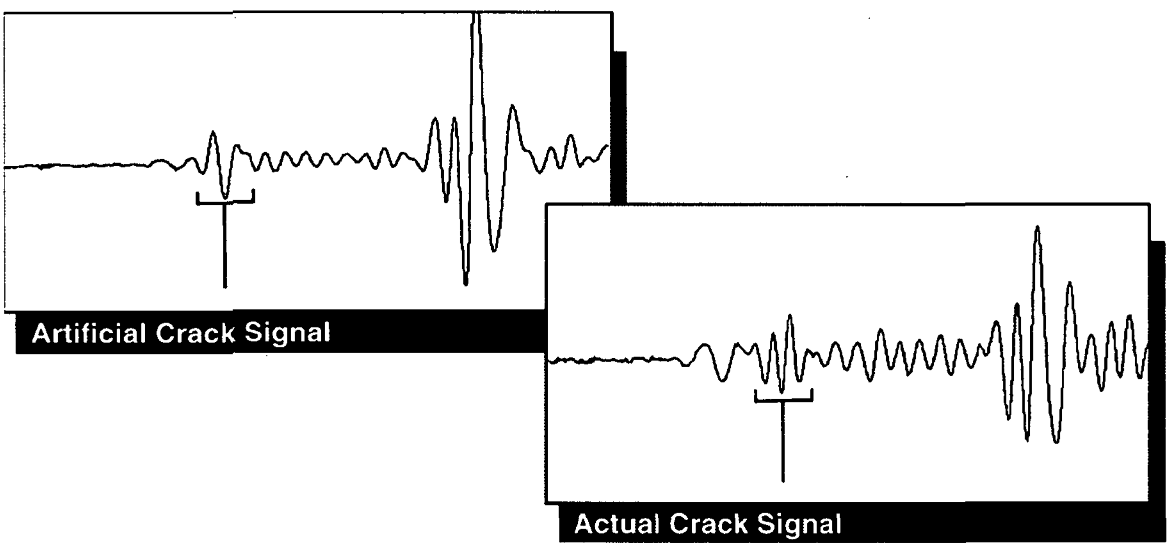
Question 3

For the Westinghouse 3 and 4 loop design:
(a) Please characterize the flaw population distribution for the mockups (i.e., range of flaw length and depth, orientation, and types)?
(b) What types of implants were used to generate flaws?
(c) Do the mockups include a LOF at the weld/tube interface?

Response

a. To keep the mockups blind, the range of flaw sizes cannot be discussed individually. Additional information was provided to the NRC staff the week of March 9, 2009 when they visited the EPRI offices in Charlotte. However, as can be seen in MRP-166, the regression analysis plot on page 3-10 indicates that the flaw lengths did not exceed 55 mm (2.17") and on page 3-5, the flaw depths ranged up to 100% of the wall thickness (e.g. 0.45"). In MRP-166, page 2-2 explains that the flaws are aligned both axially and circumferentially. The flaws are made with electro-discharge-machined (EDM) notches (not implants), which have been squeezed via the cold isostatic pressing (CIP) process. Typically the radius of the squeezed CIP EDM notch tips used in CRDM and BMN flawed mockups are 10 microns, which is smaller than that required by Section XI, Appendix VIII. Additionally, the ultrasonic CIP squeezed EDM notch responses have been compared to a PWSCC flaw from Bugey and they were found to give similar UT responses (the ultrasonic amplitude and echo-dynamic features were also similar), as shown in Figure 1 below and documented in a publicly available report; "Demonstration of Inspection Technology for Alloy 600 CRDM Head Penetrations", EPRI TR-106260, October 1996, Palo Alto, CA.

Figure 1. Comparison of Signal-to-Noise Ratio on Actual versus Manufactured Flaws.



b. As discussed above, the mockup flaws are CIP squeezed EDM notches in the tube. Fabrication defects were not intentionally introduced into the mockups. The vendors' ultrasonic procedures included instructions for differentiating service induced flaws from fabrication defects. See the response to Question 5. Material shared with the vendors to assist them with their procedure improvements and differentiation between fabrication flaws and cracking is located in Chapter 6 of EPRI report "Nondestructive Evaluation: Comparison of Field and Manufactured Flaw Data in Austenitic Materials", EPRI, Palo Alto, CA: 2007. 1015143. A copy of this report will be provided under separate cover.

c. No, "lack of fusion" flaw (LOF) was not intentionally placed at the weld / tube interface. However, some unintentional LOF was detected during the demonstration but the characterization of these LOF indications cannot be verified because true LOF measurements are not available.

<u>Question 4</u>

What is the tolerance for false calls? The information provided does not identify how the capability to detect all the laboratory flaws will translate to the field (that is the translation to actual field qualification for field inspectors). The question of qualification as opposed to capability will need to be addressed if the utility decides to rely on UT/ET examination in lieu of visual for a longer interval than two refuel cycles.

Response

The EPRI demonstration was a capability study that was conducted in a blind fashion so no pass / fail criteria were used. The bottom mounted instrument penetration capability study results are documented in MRP-166. The utilities decided if the NDE performance met their needs.

This is similar to the capability study for the CRDM. The mockups used for the CRDM capability study have more than 30 realistic flaws implanted in them, as documented in report "Demonstration of Inspection Technology for Alloy 600 CRDM Head Penetrations", EPRI TR-106260, October 1996, Palo Alto, CA. and report "Nondestructive Evaluation: Comparison of Field and Manufactured Flaw Data in Austenitic Materials", EPRI, Palo Alto, CA: 2007. 1015143. The mockups are full-scale with as-built weld geometries and have realistic distortion as caused by the J-groove weld.

The BMN capability studies have translated well to the field. WesDyne has examined approximately 700 BMNs at various plants and has not detected cracking in any of the inspected BMN. These inspection results correlate well with actual operating experience since there have been no visual indications of leaks at any of these locations inspected by WesDyne. The only visual indication of a BMN leak was at South Texas Project (STP) whose inspection was performed by another vendor. The STP leak was confirmed by detection with both the visual and non-visual techniques and this occurred prior to the EPRI BMN capability demonstrations. The examination results are a favorable affirmation of the reliability of the NDE procedures and effectiveness of the demonstration process and translation to the field. See the response to Question 5 on differentiating between service induced flaws and fabrication induced flaws. See also the response to Question 9 regarding procedural changes to reduce false calls.

This relief request applies to the ISI cycle which ends in July 2009. If a decision is made to rely on the UT/ET examination to extend the visual inspection then the required information would be submitted.

Question 5

Has acceptance criteria been developed? Has criteria for determining the need for corrective action (i.e., repair) been developed? Please provide more information, including the criteria that will be used to determine what is a recordable indication.

Response

Recordable indications are documented based on the following examination procedure.

- For Eddy Current Examination the procedures used are WDI-STD-133 Rev. 5 and WDI-STD-142 Rev. 2.
- For Ultrasonic Examination the procedure used is WDI-STD-141 Rev. 4

The procedures provide details with many examples of flaws and other defects. The procedures provide direction regarding Reporting Criteria and Result codes. Criteria include:

- ET Reporting Criteria: All flaw like indications (having expected phase response) with a peak magnitude equal to or greater than the reference notch (0.040") peak magnitude shall be reported. A flaw-like indication is defined as a vertical response in a linear pattern in the vertical C-Scan display.
- UT Reporting Criteria: RI: Recordable indication is considered service induced defect in the penetration tube. The criteria are below.

Recordable indications that are reportable are service induced flaws that are typically planar in nature (i.e., detected by either axial TOFD or circ TOFD transducers) and cannot be seen by 0^0 transducers. Recordable indications that are fabrication flaws, including LOF, are flaws that can be seen by both circ and axial TOFD and with the 0° transducer. They are classified as fabrication flaws by the procedure. Fabrication flaws are not considered reportable but are characterized to allow comparison in future examinations.

During the demonstration process for MRP-166, WesDyne reported several fabrication flaws that were not considered False Calls. The WesDyne analysis procedure addressed these flaws as not reportable.

The ASME, Section XI IWB-3000 will be used as the acceptance criteria to determine the need for corrective action (i.e. repairs). This section requires that flaws which are predicted to exceed the acceptance criteria of IWB-3000 prior to the next inspection will be repaired prior to returning the penetration to service.

Question 6

What are the criteria for addressing sizing error in any flaw evaluation?

Response

Typically there is no sizing (instrumentation) error included in the WesDyne flaw evaluation. When a flaw is detected, the sizing information provided is directly used in the IWB-3000 evaluation. This is consistent with the best estimate philosophy of ASME, Section XI.

Question 7

In general, is there any particular flaw type/orientation/size/location that may be missed? More specifically, time-of-flight diffraction (TOFD) ultrasonic examination (UT) has a known limitation for near surface inspection in that the presence of the lateral wave may obscure the detection of small flaws near the scan surface. Is this a concern for these inspections? Why/why not?

Response

The Westinghouse 3 and 4 loop demonstration missed no flaws from the ID or OD (paragraph 3.1.2.1 of MRP-166). The TOFD UT limitation is not a concern since the disruption of the lateral wave is an indication of an ID connected flaw that is generally seen. A supplemental Eddy Current examination is performed. While a deep OD initiated flaw may not have a resolvable tip from the ID, TOFD can find this by looking for shadowing of the backwall / weld interface.

Question 8

MRP-166 notes that the vendor's procedure will identify responsibilities and qualification requirements for personnel carrying out several functions including documenting minimum personnel training requirements and qualifications for acquisition and analysis. In light of the fact that a high degree of operator skill is required to correctly interpret TOFD UT inspection results, what are the training and qualification requirements for personnel to carry out the TOFD UT data acquisition and analysis? Where is this documented?

Response

The WesDyne written practice meets the requirements of ASME Section XI, IWA-2300 and Appendix VII for Ultrasonic Examiner Certification. Additional training for the BMI specific application is as follows:

- For BMI Acquisition – The requirement is for 80 Hours of Paragon Operator Training for Reactor Vessel Exams. Included in this course is training on the Basic TOFD theory, BMI Acquisition Procedure Review, Paragon TOFD display setup, and acquisition responses from BMI tubes.

- For BMI Analysis – The Basic Paragon Operator Training is a pre-requisite for BMI analysis. The requirement for a BMI analyst is for a 40 hour BMI specific course. The course covers additional BMI Theory, TOFD Calibration, Data Quality, Acquisition and Analysis Procedure Reviews and Hands on with Recent Field Inspection data.

Question 9

MRP-166 is dated March 2006; however, most of the information it contains dates back to 2004. Is the same equipment being used today as that used in 2004? If not, what has been done since 2004? Has this equipment been demonstrated on mockups?

Response

Spring 2004

During the 2004 MRP demonstration, axial and circumferentially oriented TOFD, 0 degree, 45 degree transducers and an X-point Eddy Current probes were demonstrated with the Paragon system. Following the demonstration, the 0 degree transducer was modified to obtain a better signal to noise ratio. The size and frequency of the 0 degree transducer was optimized, and the transducer material was changed to a composite. No further demonstration has been performed with the modified transducer.

Fall 2004

In the fall of 2004 the data was reanalyzed using the Paragon system with an analysis procedure that had been revised to incorporate lessons learned from the initial demonstration and field application of this procedure. The purpose of the re-analysis was to reduce the number of false calls. The procedure enhancements improved the ability to characterize the fabrication defects which reduced the number of false calls to one.

Spring 2006

MRP-166 issued.

Fall 2007

EPRI conducted no additional demonstrations for data acquisition. Previously collected data was reanalyzed with the Intraspect system (another WesDyne remote data acquisition and collection system) in 2007. The procedure used for data analysis with Intraspect was based on the Paragon data analysis procedure which had been improved by the lessons from the 2004 Paragon data re-analysis and further Paragon field experience. This Intraspect re-analysis resulted in improved sizing capabilities and eliminated false calls in the 3 and 4-Loop Westinghouse data. Both fabrication flaws (volumetric or L.O.F.) and manufactured planar flaws were found in the demonstration samples. Since the fabrication flaws were not intentionally inserted in the demonstration specimens these flaws were graded as "false calls" by EPRI if they were reported as service induced flaws (planar flaws). However, LOF indications detected during actual field inspections are evaluated and recorded if they exceed the recording guidelines provided in the WesDyne evaluation procedures. As in the response to question 5, the logic of characterization of valid (planar, crack-like) versus false (volumetric or L.O.F.) indications is described. The procedure was revised to include the following:

Service induced flaws are typically planar in nature (i.e., detected by either axial TOFD or circ TOFD transducers) and can not be seen by 0^0 transducers. Flaws that can be seen by both circ and axial TOFD and the 0° transducer are classified as fabrication flaws by the procedure. Fabrication flaws are not considered reportable.

Question 10

The equipment from two vendors was evaluated in MRP-166. The regression analyses presented in MRP-166 seem to indicate that the Vendor A system significantly out-performed the Vendor B system for length and depth measurements for the Westinghouse 3- and 4-Loop Design. Why is that? Can the Vendor B system today perform as well as the Vendor A system?

Response

The answer to this question is unknown since EPRI has performed no additional demonstrations since the original Spring 2004 demonstration. As discussed in question 9, there have been improvements made to WesDyne's data analysis procedures and these improvements have resulted in improved sizing capabilities and a reduction in false calls.

Question 11

What is the implication of the Vendor B system's significant undersizing of length and depth measurements as shown in the regression analyses in MRP-166?

Response

The implications are unknown. As stated in the response to question 6 above, if a crack is detected in a BMN the flaw will be evaluated in accordance with the ASME Section XI, IWB-3000 procedures using nominal flaws dimensions to establish its acceptability for continued service.

Question 12

MRP-166 notes in Attachment 1 that it is possible that inspection vendors will be provided confidential information on the flaw characteristics of a limited set of flaws contained in the mockups in cases where vendor weaknesses were identified. Per this statement, confirm whether the examinations used to demonstrate this technique were conducted only on the blind mockups.

Response

Blind mockups were used and if weaknesses were identified in their procedure they were guided to improve their analysis to better characterize flaws, but were not given any flaw truth information.

Question 13

Per the introduction section of MRP-166, it is noted that both Vendor A and Vendor B are still developing eddy current (ET) equipment for inspecting the wetted surface of the attachment weld. Additionally, there is little information in MRP-166 reporting on the ET portion of the examination. Please clarify what criteria were or are being used to qualify the ET examination technique? Please elaborate on the results, limitations, status, etc. of the ET examinations. Do the regression analyses include results obtained via ET examination?

Response

The wetted surface ET tool for the attaching weld is still in the development stage. Therefore elaboration on ET criteria for the attaching weld is premature. Examination of the wetted surface of the attaching weld was not within the scope of the EPRI demonstration and is not part of the existing WesDyne capabilities.

For the ET examinations of the base material I.D. surface (BMI penetration tube), Vendor A (WesDyne) included an ET probe in their BMI ID inspection probe. No specific limitations were noted during the demonstration.

The Eddy current probe used for this inspection is an "X" point probe. It is similar to the "+" point probe used for the steam generator inspections. The probe used was a cross-wound driver pickup design capable of operating at frequencies between 75 and 500 KHz. The primary ET test frequency for the demonstration was 400 KHz. The ET probe was calibrated by optimizing the response from a 0.040" deep EDM notch oriented circumferentially and at the ID surface of the calibration standard. The probe was used for surface flaw detection, length sizing, flaw locations and orientations of both axial and circumferential flaws at the ID of the tube. The sensitivity of the ET technique, in combination with UT TOFD techniques, to I.D. surface flaws in the mockups is documented in MRP-166. As documented on page 3-4 of MRP-166, WesDyne used ET in combination with UT to detect surface breaking, ID flaws. In addition, page 3-5 of MRP-166 also states that all ID connected flaws were detected during the WesDyne demonstration. Based on this, it is concluded that the ET technique when used in combination with UT was effective in detecting 100% of the ID surface breaking flaws.

Eddy current is the primary tool for length sizing and orientation for the BMI penetration tube ID connected flaws. UT is the primary tool for flaw characterization information and thru-wall sizing. Both ET and UT are used in combination for detection of ID connected flaws. All base metal ID detection and sizing is a result of the two complimentary exams used in this demonstration.

For regression analysis performed by EPRI, ET data in combination with the UT data in detection and length sizing of flaws located on the ID surface of the tube was used.

Question 14

In section 3.1 of MRP-166, the discussion of the Vendor B Demonstration, a statement is made that the J-groove ET exam had an issue with being unable to examine the entire area of interest. Has this been addressed? What is the status of Vendor B's upgrade of their examination tool? Please address whether a new tool has been successfully demonstrated?

Response

The wetted surface ET tool for the J-groove weld is still in the development stage and has not been demonstrated with MRP.

Question 15

The NRC has accepted the qualification / demonstration of similar techniques for the inspection of control rod drive mechanism penetrations in the initial licensee responses to NRC order EA-03-009. Provide a detailed comparison of the demonstration for the lower head penetrations with the demonstration industry used to justify the UT and ET techniques for the CRDM inspections. Please provide the protocol or criteria used to qualify the UT/ET for the BMI inspections and how it compares to the protocol or criteria used for CRDMs. Please provide the MRP-89 report on the demonstration program for CRDM inspections.

Response

The demonstrations were done in a very similar fashion and protocol with similar flaw types. Due to the smaller size of the BMNs, fewer flaws were able to be placed in them and fewer flaws were available for the demonstration. The required CRDM inspection volume was from the bottom of the tube to 2" above the weld. There was no required inspection volume for the BMNs, but in the 4-loop mockup, flaws were placed within 1" above and below the weld as the weld causes distortion in the tube and this would be the most challenging to examine in the field. The CRDM demonstration was done from below the dry mockup while the BMN demonstration was done from above the submerged mockup (similar to how they would be inspected in the field). MRP-89 is not being used as a basis for the bottom mounted instrument (BMI) penetration inspection program.

B. The following questions relate to WesDyne's Technical Report WSI-TJ-1014, Revision 2, "BMI Examination of Indian Point Penetrations," dated April 18, 2006

Question 1

Though an eddy current probe is shown in the figure associated with Table 1 for the Westinghouse 3/4 Loop Probe, there is no descriptive information provided for this probe. Please provide this information along with a description of the flaws that this probe is sensitive to and how this was demonstrated.

Response

The Technical Justification was developed to show the equivalency of the probe diameter change from the demonstrated Westinghouse 2 Loop and 3/4 Loop plant BMI tube configurations to the Indian Point Units 2 and 3 specific configurations.

The Eddy current probe used for this inspection is an "X" point probe. It is similar to the "+" point probe used for the steam generator inspections. The probe used was a cross-wound driver pickup design capable of operating at frequencies between 75 and 500 KHz. The primary ET test frequency for the demonstration was 400 KHz. The ET probe was calibrated by optimizing the response from a 0.040" deep EDM notch oriented circumferentially and at the ID surface of the calibration standard. The probe was used for surface flaw detection, length sizing, flaw locations and orientations of both axial and circumferentially flaws at the ID of the tube.

The sensitivity of the ET technique, in combination with UT TOFD techniques, to I.D. surface flaws in the mockups is documented in MRP-166. Paragraph 7.0 of WesDyne's Technical Report WSI-TJ-1014, Revision 2 references the results of the demonstration in the EPRI draft "Summary of Demonstration Results" report dated February 10, 2005 which was later published as MRP-166 in March 2006.

Eddy current is the primary tool for length sizing and orientation of the BMI penetration tube ID connected flaws. UT is the primary tool for flaw characterization information and thru-wall sizing. Both ET and UT are used in combination for detection of ID connected flaws. All base metal ID detection and sizing is a result of the two complimentary exams used in this demonstration. Since ET is primarily used to detect ID surface flaws and all ID surface flaws were detected during the original EPRI demonstration (see page 3-5 of MRP-166), it confirms the effectiveness of the inspection technique.

For regression analysis performed by EPRI, ET data in combination with the UT data in detection and length sizing of flaws located on the ID surface of the tube was used.

<u>Question 2</u>

On page 13 of 17, a statement is made that "WesDyne has satisfactorily demonstrated techniques..." To what criteria were the WesDyne demonstrations evaluated against (i.e., what determines a "satisfactory" demonstration).

Response

The results of the 3/4 loop Westinghouse were very good with all flaws > 10% detected. The results of blind testing performed for flaw detection at EPRI on 2 mockups of the Westinghouse 3 / 4 loop style BMI are:
a) 10% to 100% TWE detected
b) All ID connected flaws detected
c) All OD connected flaws detected

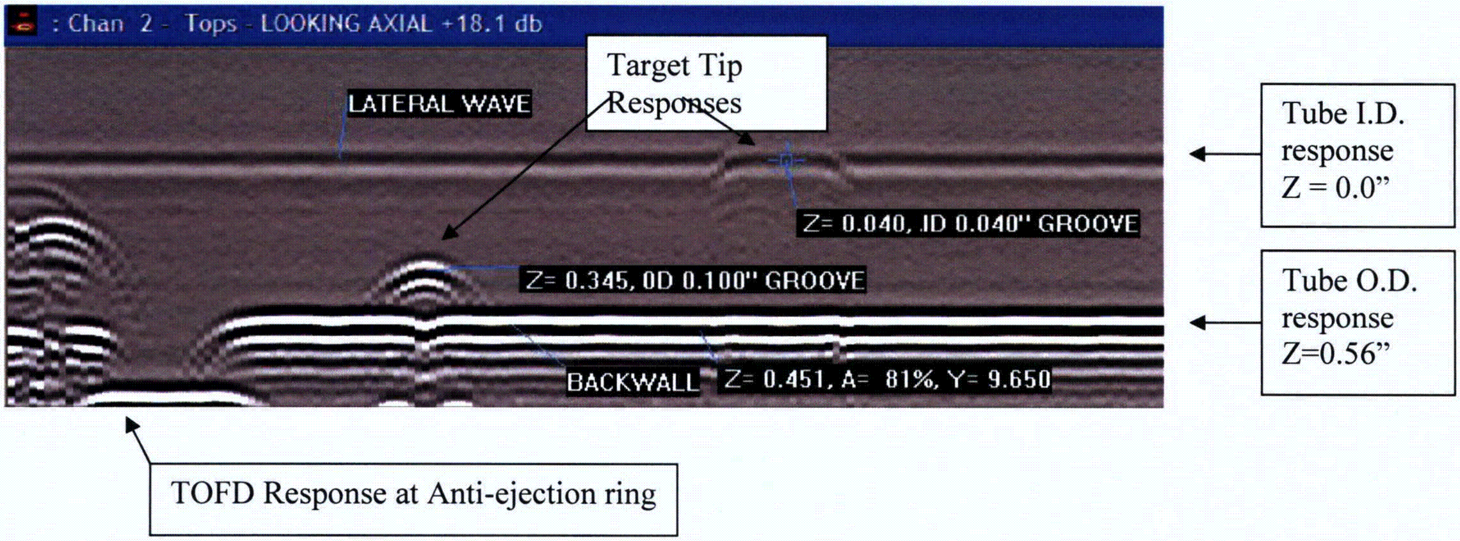
<u>Question 3</u>

The WesDyne report presents 3 examples of calibration scans using the Westinghouse 3/4 loop standard with only labels provided as explanations (and these labels are not clear as to what they are referring to). Please provide a more detailed description of what the scans are showing with each feature of the TOFD scan clearly labeled. Additionally, please provide examples of TOFD scan from the mockup flaws with the features of the scans clearly labeled.

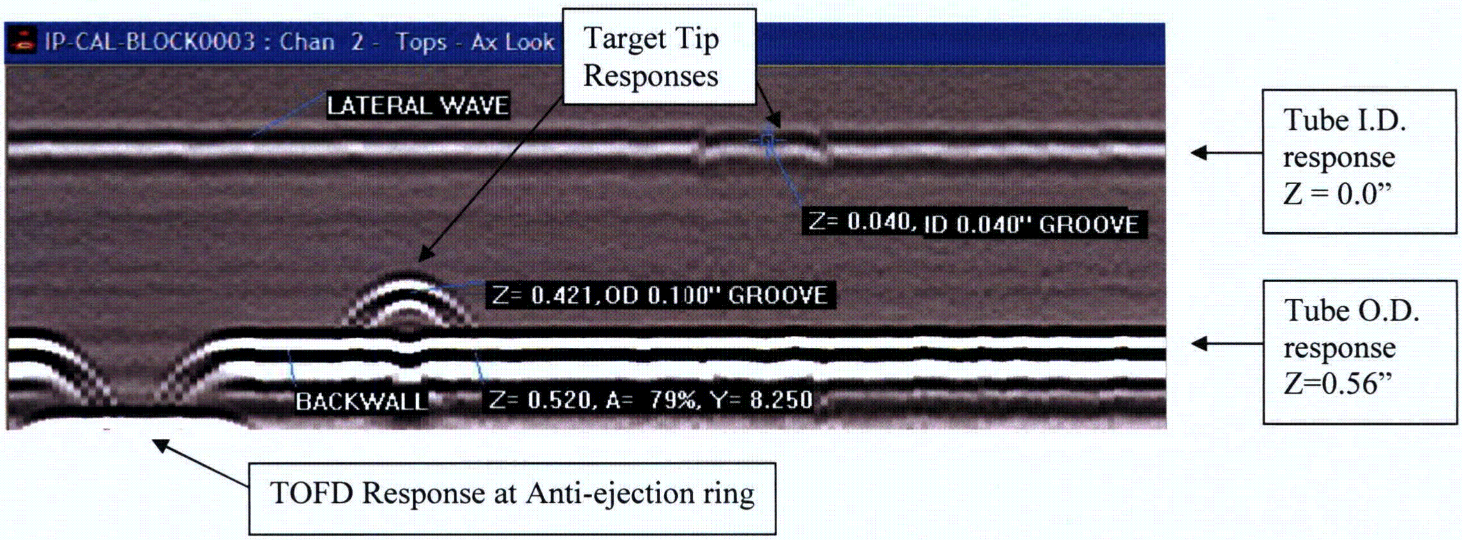
Response

The following are the examples of Calibrations using different size probes and calibration blocks. Each Axial looking TOFD calibration shows the ID surface (Lateral Wave), the 0.040" ID EDM notch, the 0.100" OD Groove, and the tube OD (Backwall response). In the following pictures the "Z" value shows depth from the tube I.D. surface.

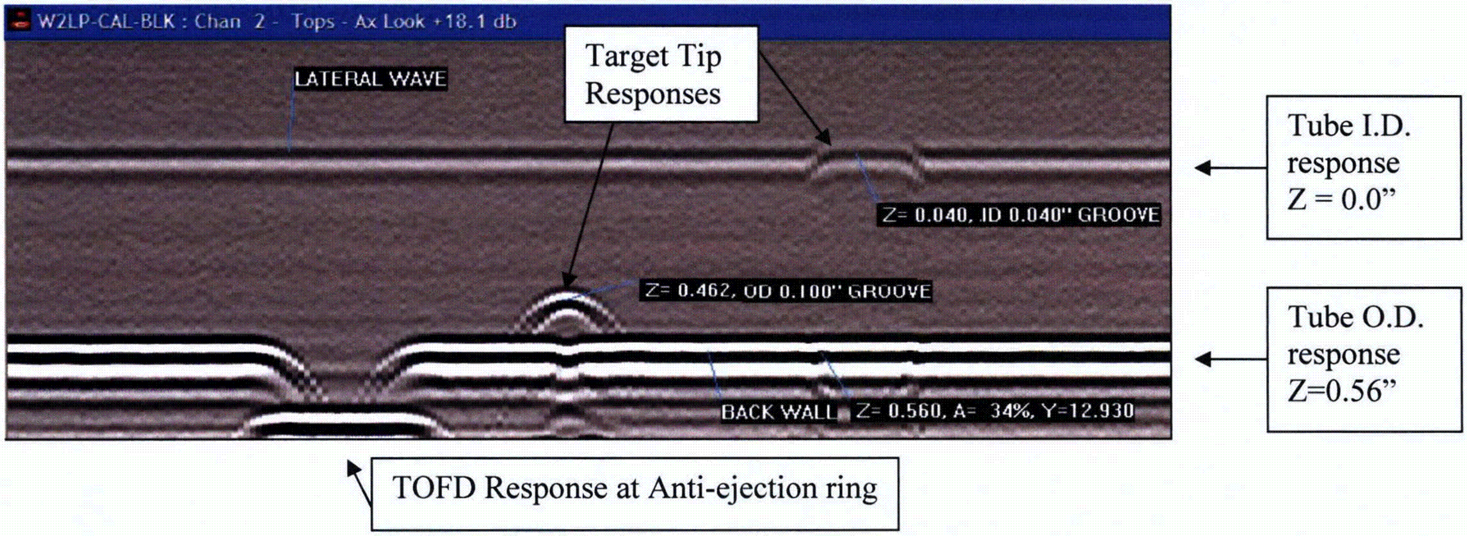
#1 Westinghouse 3/4 loop calibration block with 0.600" BMI Probe.



#2 Westinghouse Indian Point Unit 2 calibration block with 0.460" BMI Probe.



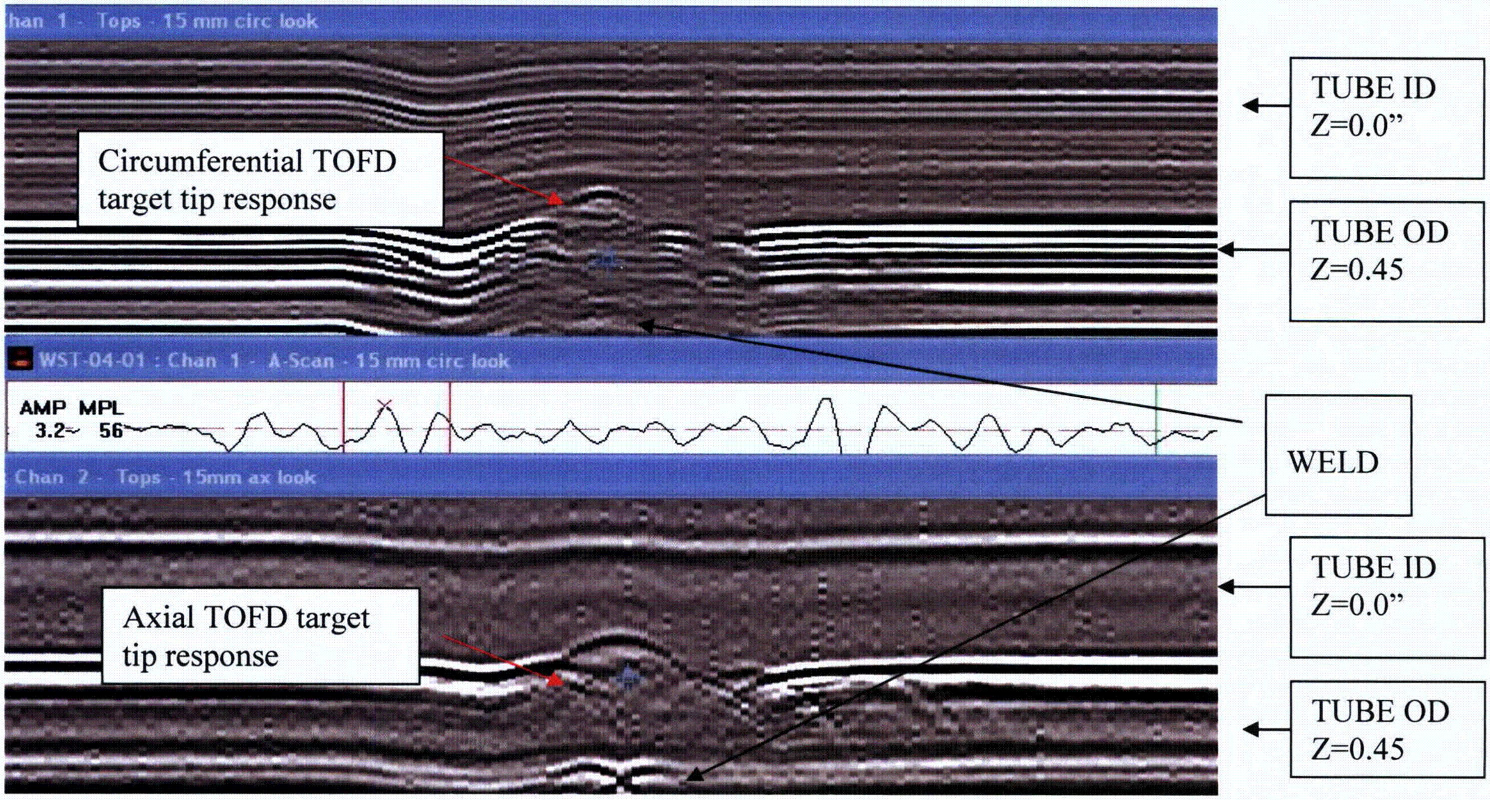
#3 Westinghouse 2 loop calibration block with 0.375" BMI Probe.



#4 Example of Fabrication Flaw (Lack of Fusion) at the toe of the weld

Fabrication Flaw (Lack of Fusion) at the weld interface as detected with TOFD probes is shown below. Characteristics of this type of indication are:

- Strong, high amplitude target signals.
- Long target signal response of similar amplitude as shown in both Axial and Circ TOFD channels.
- Target detected on both Axial and Circumferential channels for multiple sweeps.
- Confirmation and length sizing can be done using the 0 degree transducer.



#5 Example of Planar Flaw

Planar Flaw breaking the OD surfaces typically exhibit the following characteristics when detected with a TOFD transducer pair oriented perpendicular to the flaw length.

- a break, or perturbation of the backwall signal
- a diffracted arc-shaped signal located above the middle of the break, or perturbation, in the backwall signal.
- Target detected either Axial and Circumferential or channel
- No Confirmation can be done using the 0 degree transducer.