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2CAN060308

June 26, 2003

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

SUBJECT: Arkansas Nuclear One, Unit 2
Docket No. 50-368
Response to Request for Additional Information on the ANO-2 Relaxation from Performing a Bare Metal Visual Inspection from the February 11, 2003 Reactor Pressure Vessel Head Order

REFERENCES:

1. NRC letter dated February 11, 2003, *Issuance of Order Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors* (0CNA020302)
2. Entergy letter dated May 8, 2003, *Request for Relaxation from Section IV.C(1)(a) of the Order Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads* (2CAN050301)
3. NRC Notice dated June 4, 2003, *Forthcoming Meeting with Entergy Operations, In.c* (2CNA060301)
4. Entergy letter dated June 11, 2003, *Relaxation Requests to NRC Order EA-03-009* (CNRO-2003-00020)
5. Entergy NRC Meeting of June 17, 2003, on ANO-2 Bare Metal Visual Inspection Relaxation (Adams Accession ML031690190)
6. Entergy letter dated June 3, 2002, *30 Day Post Outage Response to NRC Bulletins 2001-01 and 2002-01 for ANO-2 and Follow-up Response to Bulletin 2002-01 for ANO-1 and ANO-2* (0CAN060203)
7. Entergy letter dated June 17, 2002, *Submittal of Demonstration Report for Volumetric Examination of Vessel Head Penetration Nozzles* (0CAN060201)

Dear Sir or Madam:

On February 11, 2003, the Nuclear Regulatory Commission (NRC) issued an Order addressing interim inspection requirements for reactor pressure vessel (RPV) heads at pressurized water reactors (Reference 1). The NRC stated that the actions in the Order are interim measures, necessary to ensure that licensees implement and maintain appropriate

A101

measures to inspect and, as necessary, repair RPV heads and associated penetration nozzles. On May 8, 2003, Entergy Operations Inc. (Entergy) requested relaxation from Section IV.C(1)(a) of the Order (Reference 2) to perform a bare metal visual (BMV) inspection of 100 percent of the RPV head surface for Arkansas Nuclear One, Unit 2 (ANO-2).

The NRC staff reviewed Entergy's relaxation request and provided a request for additional information (RAI) for complying with the intent of the Order to gain relaxation. This RAI was formally issued to Entergy on June 4, 2003 (Reference 3). Based on this request, Entergy and the NRC staff conducted a teleconference on June 5, 2003, that discussed the intent of the NRC's request. In light of the additional perspective raised by the RAI, Entergy discussed additional non-destructive examination (NDE) techniques that have been under development which could better satisfy the "diverse and complementary" expectations for gaining relaxation from the Order. Entergy proposed a low frequency eddy current technique that can examine the loss of carbon steel if wastage of the reactor vessel head were to occur. A public meeting was conducted with the NRC on June 17, 2003, where further details were discussed regarding Entergy's hardship for conducting a BMV inspection and Entergy's outage inspection plans. As a result, Entergy is proposing to supplement our initial relaxation request consistent with the details presented in this meeting. The response contained in Attachment 1 addresses the NRC request for additional information.

Therefore, Entergy is further committing to perform additional diverse and complementary examinations and inspections in this letter beyond that initially made by Entergy in the original relaxation request of May 8, 2003. Entergy believes that the additional examinations and inspections provide an acceptable level of quality and safety. In addition, Entergy has also provided a discussion of the other Order relaxations proposed for ANO-2 for the next outage. Entergy believes that sufficient basis exists for the NRC to grant relaxation of the requirements contained in Section IV.C(1)(a) of the Order.

The proposed relaxation request involves new commitments as summarized in Attachment 2. Entergy requests expedited review and approval of this request by July 25, 2003, to support planning for the Fall 2003 refueling outage. Entergy is requesting a deferral from performing the BMV inspection for the upcoming ANO-2 refueling outage in the fall of 2003.

If you have any questions or require additional information, please contact Steve Bennett at 479-858-4626.

Sincerely,

for Craig Anderson

CGA/sab

Attachments

1. Response to NRC Request for Additional Information Regarding the Entergy Relaxation Request for Performing a Bare Metal Visual Inspection of the Reactor Vessel Head
2. List of Regulatory Commitments

cc: Mr. Thomas P. Gwynn
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Attachment 1

2CAN060308

Response to NRC Request for Additional Information Regarding the Entergy Relaxation Request for Performing a Bare Metal Visual Inspection of the Reactor Vessel Head

Response to NRC Request for Additional Information (RAI) Regarding the Entergy Relaxation Request for Performing a Bare Metal Visual Inspection of the Reactor Vessel Head

NRC REQUEST FOR ADDITIONAL INFORMATION

The purposes of the bare metal visual (BMV) examination required by Order Section IV.C(1)(a) are to detect the presence of deposits (indicative of leakage) at the interface of the reactor pressure vessel (RPV) head and the vessel head penetration (VHP) nozzles and to provide positive assurance of the integrity of the RPV head, i.e., that no corrosion of the RPV head is occurring. For the purpose of detecting deposits indicative of leakage, BMV is a diverse and complementary examination to the UT measurements required by Order Section IV.C(1)(b)(i) or the surface examination requirements of Order Section IV.C(1)(b)(ii). Therefore, one function of the BMV is to provide a second opportunity to identify a leaking nozzle that may have eluded detection by the non-visual examination required by Order Section IV.C(1)(b). Absent a compensatory alternative (or alternatives) that supports this diverse and complementary function of the BMV for leakage detection and the function of providing assurance of integrity of the RPV head, approval of a relaxation request to not perform the BMV is unlikely.

The licensee needs to describe how its alternative examination(s) supports the functions of the BMV, in particular the diverse and complementary function of leakage detection to the non-visual examination requirements of Order Section IV.C(1)(b), such that an acceptable level of quality and safety is achieved, or how performance of a BMV results in hardship without a compensating increase in the level of quality and safety, that justifies their alternative.

ENTERGY RESPONSE TO RAI

As discussed in our May 8, 2003, submittal (Reference 2), Entergy proposed to perform inspections and non-destructive examinations (NDE) to meet the specific requirements of the Order and to provide compensatory actions in lieu of performing a BMV inspection of the top of the Arkansas Nuclear One, Unit 2 (ANO-2) RPV head. Entergy is committing to perform additional examinations and inspections in lieu of performing a BMV inspection for the control element drive mechanism (CEDM) and the vent line penetrations. The following summarizes the complete inspections and non-destructive examinations to meet the Order or to provide complementary actions to meet the intent of the Order.

Compliance with Section IV.C(1)(b) of the Order for Volumetric or Wetted Surface Examinations

ANO-2 Control Element Drive Mechanism and Incore Instrument Penetrations – As discussed in Entergy's May 8, 2003, relaxation request, Entergy will perform an ultrasonic (UT) examination of the ANO-2 RPV head CEDM and the incore instrument (ICI) penetrations during the fall 2003 refueling outage. The scope of the UT will include an examination of these RPV head penetrations 360 degrees around the nozzle. The examinations will scan two inches above the J-groove weld on the CEDM and ICI nozzles and into the interference fit region along the nozzle bore. However, compliance with the Order will require two separate Order relaxation requests. The first relaxation involves the inability to perform UT examination of the lower extent of the CEDM nozzles at the threaded

coupling to the nozzle alignment cones. This relaxation was submitted on June 11, 2003, (Reference 4) for both ANO-2 and Waterford-3 stations. Entergy is evaluating a second relaxation to this provision of the Order since the UT technology may not be able to effectively examine the upper 2" of the ICI nozzles due to the counter-bore and to the lower tip of the ICI nozzles due to loss of detector contact. This relaxation will be submitted in the near future for relaxation to this section of the Order, if determined necessary.

The UT examination will be capable of performing leakage assessment for compliance with the volumetric examinations under IV.C(1)(b)(i) of the Order. The UT examination will detect the "riverbed" effect associated with leakage through the annulus region. This technique determines whether telltale signs of boric acid wastage exist from lack of contact between the carbon steel of the head and the outside diameter (OD) of the nozzle wall in the annulus region.

ANO-2 RPV Head Vent Line Examination – Even though not directly discussed in the original May 8, 2003 relaxation request, Entergy is proposing to perform a wetted surface examination of the vent line per section IV.C(1)(b)(ii) of the Order. The wetted surface examination is proposed to be an eddy current (ECT) inspection of the required coverage area of the vent nozzle inside diameter (ID) surface as well as the surface area of the end of the nozzle and the J-weld region. The inspection of the inside surface of the vent nozzle will be accomplished by one or more "plus point" type surface ECT transducers via a hand delivery process. The inspection of the outside surface of the J-groove weld is planned to be a manually controlled, multi-array ECT probe approach utilizing between 12 and 36 plus point transducers, depending on the radial distance of coverage needed. The spring-loaded ECT coil array will be offset in such a way to provide complete coverage of the end of the J-weld to nozzle interface.

Since section IV.C(1)(b) of the Order states that either a UT or wetted surface exam of the RPV penetrations is to be performed, the Order implies that a combination of processes would not be permitted. Therefore, Entergy will submit a relaxation request to the Order to allow both means of NDE for performing examinations on the ANO-2 RPV head penetrations.

Compliance with Section IV.C(1)(a) of the Order for Bare Metal Visual Inspections of the RPV Head

As discussed in the May 8, 2003, relaxation request, the design of the RPV Head cooling shroud and insulation package does not allow access to the top of the head to perform a BMV inspection without significant extenuating hardship. Further details of the ANO-2 concerns for performing a BMV were presented to the NRC Staff during the June 17, 2003 meeting (Reference 5). Based on our understanding of the Order and the NRC expectations for seeking relaxation, Entergy provided justification for relaxation and alternate inspection plans in lieu of performing a BMV inspection (Reference 2). Entergy proposed that ANO-2 would perform an examination of the interface of the J-weld as part of the examinations being conducted using the open housing UT probe for inspecting the nozzle wall. In addition, Entergy also proposed to perform a supplemental visual (non-BMV) inspection of the ICI and accessible CEDM nozzles through the doorways into the cooling shroud as well as crediting boric acid program inspections.

As also discussed in the May 8, 2003, relaxation request, the triple point examination method is capable of determining if there is a throughwall or throughweld crack by

interrogating the full thickness of the nozzle and at least 0.060" into the weld. Flaws that would result in leakage through the J-weld would pass through the triple point at a location around the circumference. In the event that there is not an interference fit between the nozzle and the RPV head carbon steel, the examination of the triple point will further confirm the existence or absence of flaws in the weld interface. The ability to examine the J-weld using the Westinghouse open housing probe was first discussed in our 30 day post outage response to NRC Bulletins 2001-01 and 2002-01 for ANO-2 (Reference 6). At that time the UT probe used by Westinghouse on ANO-2 had been demonstrated to be able to detect flaws through the wall thickness of the nozzle and at least 0.050 inches into the J-weld. This was documented in the demonstration report provided to the NRC on June 17, 2002 (Reference 7). This demonstration included a series of flat bottom holes created from the OD of the weld. Further demonstration of the capability to examine the nozzle-to-weld interface using the Westinghouse open housing probe was conducted in the spring of 2002 as part of the Phase II demonstrations. During this demonstration, a pure axial/radial squeezed notch flaw was added from the ID of the J-weld that extended thru-weld to the triple point of the J-weld. The flaw depth was approximately 0.060" which provided the additional basis for the capability of the open housing probe. The EPRI/MRP demonstration report documenting the latter testing has not been issued by EPRI, to date.

Additional RPV Head Examinations and Inspections Being Performed for the 2R16 Refueling Outage

Even though Entergy had concluded that the initial proposed inspections and examinations proposed in the May 8, 2003 submittal met the relaxation requirements of the Order, the recent RAI and discussions with the NRC staff clarified that additional diverse and complementary means of confirming the integrity of the top of the ANO-2 RPV were necessary. As a result, Entergy is proposing to perform additional NDE that will confirm the integrity of the upper annulus of the RPV head by use of low frequency eddy current (ECT) technology. Additionally, Entergy has further investigated the ability to perform a BMV inspection of the ICI nozzles and believes that this examination can be performed even though tight tolerances will be experienced around the nozzles. Therefore, the following additional examinations are being proposed to further supplement the previously proposed BMV inspection alternatives.

ANO-2 RPV Head Low Frequency Eddy Current Annulus Degradation Examination – Entergy will perform a low frequency ECT examination of the annulus region of the CEDM and vent line reactor head penetrations. These ECT techniques will be used to map the upper annulus region of the carbon steel RPV head around the 81 CEDMs and the single vent line penetrations. The purpose of this examination will be to detect and characterize degradation that may be occurring in these regions of the reactor head.

The magnetic properties associated with the reactor head base metal offer a means to determine its congruity adjacent to a head penetration nozzle through the use of low frequency ECT techniques. These techniques rely on an electro-magnetic field generated by a coil to interact with the component under test. This applied field generates eddy current flow in the component (i.e. carbon steel head) which, in turn, alters the electrical impedance in the coil. For detection of a loss of base metal of the reactor head adjacent to an Alloy 600 head penetration, a coil configuration operating at a low frequency is required to assure that the coil's electro-magnetic field extends through the penetration tube.

For the vent line penetration, Entergy proposes to use a low frequency ECT scan with a full circumferential coil pair (bobbin coil), which operates at 2 KHz. Westinghouse has demonstrated this technique to be effective for detecting a radial step of 0.050" around the circumference of a sample penetration mock-up. The signal produced by this radial step was 14.61V, compared to a signal response of 19.93 V when the carbon steel base metal is in contact with the vent line nozzle. This relatively large signal difference (26%) from nominal provides adequate sensitivity to detect RPV head base metal loss around this penetration.

For the CEDM penetration examination, one or more 3/4" driver/pick-up coils will be used with their coincident axes placed such that they are oriented radially with respect to the penetration. Each coil is operated at an inspection frequency of 200 Hz. As these probes are scanned over the area of interest, a potential loss of base metal in the reactor head can be detected as a change in the response from the coil(s).

Westinghouse has demonstrated the capability of this technique to characterize changes in morphologies in the carbon steel surrounding a reactor head nozzle up to 0.250" in radial depth from the nozzle OD. Inspection results from reactor head penetrations in the cancelled Jamesport Head demonstrate this technique's ability to map the annulus geometry around an actual penetration, including a 0.015" change in radial depth created by the counter-bore near the reactor head OD. Figures 1 and 2 provide graphical results of the examinations performed as part of these demonstrations. A 0.015" change in the carbon steel RPV head counter-bore can be clearly distinguished on the graph.

When scanning across an indication that is essentially perpendicular to the scan pattern, small changes in radial depth can be detected, such as with the 0.015" counter-bore that was plotted during the demonstration process. Indications that are oriented perpendicular to the scan pattern are more easily detected than those that are parallel to the scan. During the demonstration process, an axial scan pattern was used to interrogate the test samples. The strength of the signal response received from different axially-oriented indications diminished relative to the circumferential extent, or width, of the indication. The smallest axial artifact that was demonstrated to be detectable was a 1/4" wide, 3/16" deep groove (Note: Westinghouse data shows that the minimum circumferential width measured on an actual leak path indication was approximately 3/8 inch). As the width of the artifacts increased, the signal responses were seen to increase as well. The major axis of a true indication of leakage in a reactor head penetration would be expected to be axially-oriented, with respect to the penetration tube. Entergy's inspection plan for the ANO-2 RPV head will apply a circumferential scan pattern for detection of potential carbon steel loss that would be indicative of pressure boundary leakage. If indications of potential material loss are detected, an axial scan would also be applied to further characterize the indication.

Due to normal variations in nozzle thickness, and the potential for ovality of the nozzle bore, it is expected that changes in the distance of the carbon steel head from the ID of the nozzle can affect the way the RPV head is characterized. Gradual changes in the low frequency ECT results would be more indicative of these conditions, while more abrupt changes may be more indicative of loss of the carbon steel boundary. Therefore, the determination of potential RPV head leakage/wastage must take into consideration other aspects of the overall NDE results including the UT examinations. Entergy will determine the appropriate means of establishing detection criteria for the low frequency ECT examination prior to the 2R16 refueling outage.

Therefore, based on this technique, Entergy believes that leakage/wastage to the RPV head upper annulus from potential nozzle or J-weld leakage will be detected and meets the intent of section IV.C(1)(a) of the Order.

BMV Inspection of ICI Nozzles – As discussed in our May 8, 2003 relaxation request, the cooling shroud has doors that allow access to each of the eight ICI nozzles. The ICI nozzles are located in the outer periphery of the shroud while the CEDM nozzles exit the shroud through the orifice plate inside the cooling shroud. Therefore, the cooling shroud design allows greater access to the ICI nozzles. Even though these nozzles are more accessible, the top of the RPV head around the ICI nozzles may require removing the insulation collars at the base of the nozzle and inspecting below the widened ICI flange assembly. Therefore, Entergy will perform a bare metal visual inspection around the annulus of the ICI nozzles using a combination of optical inspections and boroscopics to inspect 360 degrees around the nozzle.

This BMV Inspection of the ICI nozzle penetrations will meet the requirements of section IV.C(1)(a) of the Order without relaxation. Therefore, relaxation from the Order for performing a BMV of the ICI nozzles as requested in our May 8, 2003, relaxation is no longer requested.

Conclusions

Entergy complies with the intent of section IV.C(1)(b) of the Order by performing either volumetric examinations of the nozzles including a leakage assessment or through wetted surface examinations. Entergy does have to seek relaxation due to nozzle configurations that do not allow examination to the full extent of the Order or as a result of the literal wording of the Order itself. These relaxations to the Order are being sought separately from this relaxation request.

Entergy is able to comply with section IV.C(1)(a) of the Order for the ANO-2 ICI nozzles since Entergy proposes to perform a BMV inspection for these nozzles. However, the specific requirements of this section of the Order for performing a bare metal visual inspection of the CEDM and vent line penetrations cannot be conducted without significant hardship to Entergy. The hardship is due to the original design of the associated cooling shroud and the insulation package. Entergy is proposing alternate diverse and complementary means for the CEDM and vent line penetrations to ensure the integrity of the head. Entergy will be conducting additional examinations into the J-weld to nozzle interface using the open housing UT probe, which provides additional assurance that leakage through the J-weld at the triple point will be detected. The low frequency ECT examination will provide a diverse and complementary means to ensure that potential wastage, if it were to occur, at the RPV head annulus will be detected to within 0.015 of an inch. Additionally, Entergy will continue to perform supplemental inspections on top of the cooling shroud and RPV head flange to identify boric acid deposits that could create wastage due to other sources of RCS water.

Therefore, Entergy concludes that appropriate diverse and complementary RPV head examinations have been provided to allow the NRC to grant relaxation to the requirements of the Order.

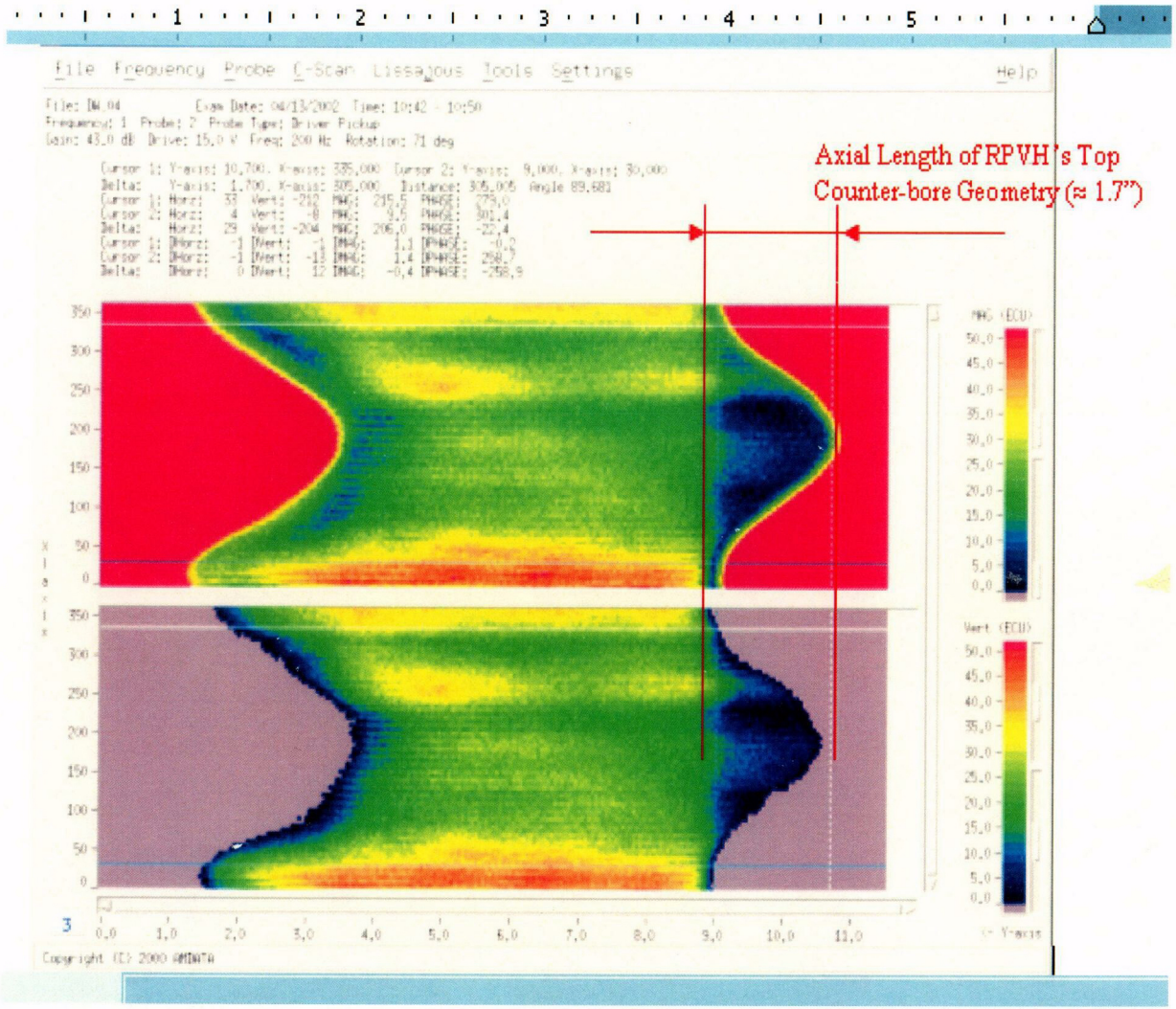

Figure 1
C-Scan of Jamesport RPV head using Low Frequency ECT

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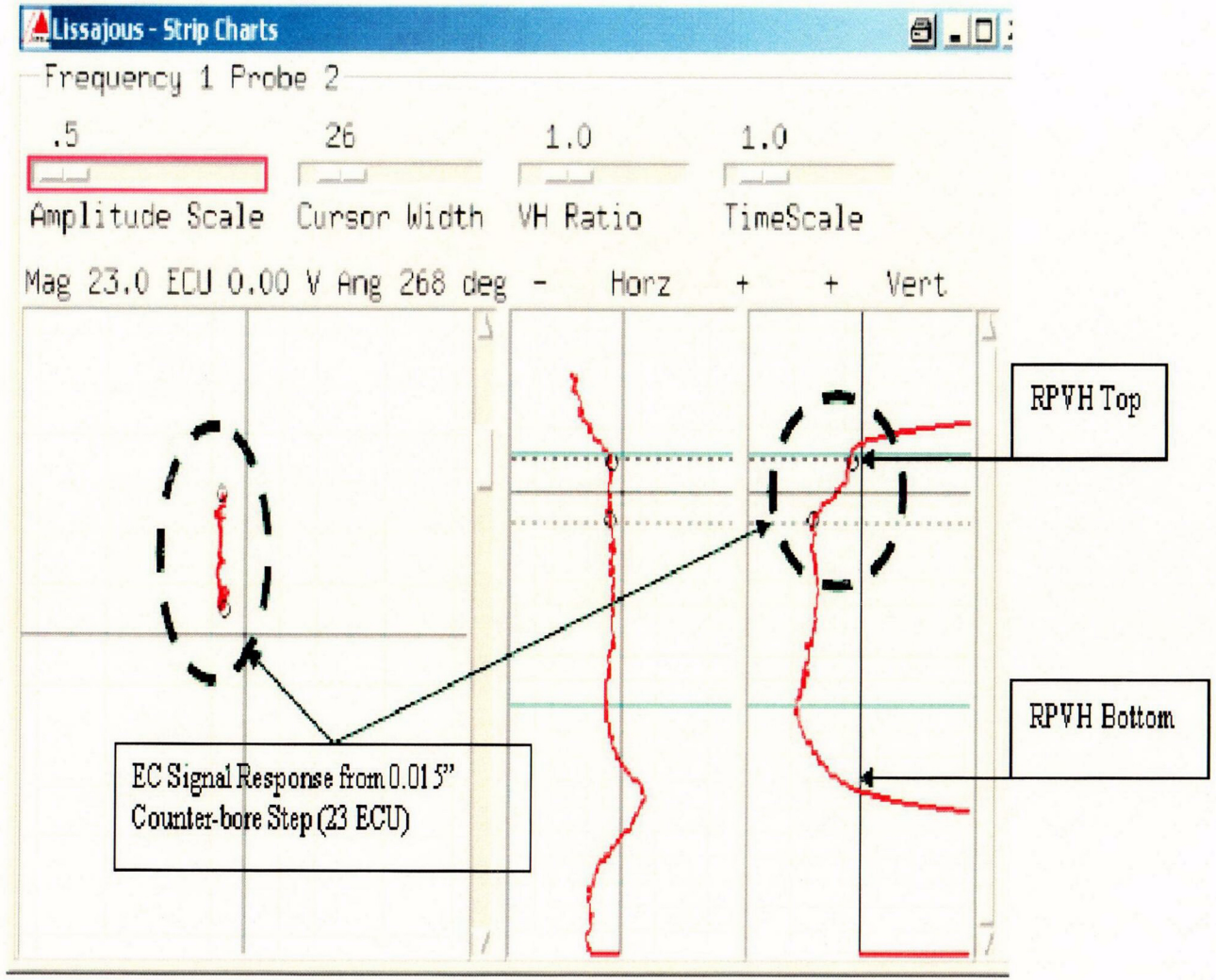

Figure 2
Strip Chart Display of Jamesport RPV head using Low Frequency ECT

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List of Regulatory Commitments

The following table identifies those actions committed to by Entergy in this document. Any other statements in this submittal are provided for information purposes and are not considered to be regulatory commitments.

COMMITMENT	TYPE (Check one)		SCHED COMP DATE
	ONE-TIME ACTION	CONT. COMP	
Entergy will perform a low frequency eddy current examination of the upper annulus region of the ANO-2 CEDM and vent line RPV head penetrations. Entergy will determine the appropriate means of establishing wastage criteria prior to the 2R16 refueling outage.	X		2R16 Fall 2003
Entergy will perform a bare metal visual inspection 360 degrees around the annulus of the ANO-2 ICI nozzles.	X		2R16 Fall 2003