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Date: 7/27/03 12:11PM
Subject: Talking Points for Monday Call on ANO-2 BMV Relaxation

Tom,

Attached are some detailed talking notes from our draft response. They have not completed internal review, but will provide a general idea of what our response will consist of. Provide to Al Hiser and Bob Davis in preperation for the call at 2:00 PM EST on Monday.

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Talking Points on Draft ANO-2 BMV RAI Relaxation Response

The following are draft summaries/excerpts of what is currently proposed in the submittal for the RAI response on the ANO-2 BMV relaxation:

Response to RAI 1 (a)(c)(d)(e), RAI 2 (a) – Details for testing and mockups for augmented examinations

Three Wesdyne reports being enclosed (~ 20 pages each)

1. Detection of Reactor Head Base Metal Loss from Inside the CRDM
2. Triple Point Inspection using TOFD Ultrasonic Methods (including excerpts from "MRP Inspection Demonstration Program" Updated December 11, 2002).
3. UT of Interference Fit Samples for Leak Path

Wastage Detection - Enclosure 1 describes the low frequency eddy current test method for wastage detection in the RPV head behind the nozzle. A rotating eddy current pancake coil is used to detect the presence or absence of carbon steel behind the nozzle. This technique detects the volume of missing metal up to a point in which the signal response becomes asymptotic.

A series of mockups with various axial and circumferential grooves and various wall loss geometries were fabricated. In addition, the reactor vessel head at the Westinghouse Waltz Mill Service Center was inspected to determine the ability to detect the upper counter bore (0.015" on the radius). The results from the mock up tests shows that a machined flaw 0.25" x 0.125" deep (0.03 sq in) and the upper counter bore 1.5" (assumed maximum coil field extent) x 0.015" deep (0.022 sq in) were detectable. If this is extrapolated to a 0.375" wide wastage zone which has been seen during inspections in the field, the detectable depth would be 0.06".

Triple Point Inspection - *Enclosure 2 reports the results of the ultrasonic inspections performed on blind* mockups for the MRP/EPRI Inspection Demonstration Program. As part of these demonstrations, the ability to detect flaws in the weld that extended to or near the triple point was included in the blind test sample. The majority of flaws in these mockups were in the nozzle base metal, however, there were some flaws in the J-weld only. During the mock up testing, WesDyne was able to detect the 4 flat-bottomed holes in the J-weld of the Entergy mockup, the 3 standalone *circumferential flaws in the EPRI Phase II mockup*, and the one standalone axial flaw in the Phase II demonstration. In addition, the ability of detecting flaws that extended to near the triple point region was demonstrated on available samples.

MRP Demonstrations - MRP has conducted inspection demonstrations in two phases which supports:

- Quantify detection limits of (ID) and (OD) connected flaws from the ID of the penetration tube,
- Document sizing capabilities of ID and OD connected flaws from the ID of the penetration tube,
- Evaluate capabilities to detect defects on the wetted surface of the RVHP attachment weld, and
- Investigate the capability to detect flaws approaching the weld-to-tube interface (triple point flaws)

Phase I Demonstrations - Mock-ups for the first phase (base metal inspection only) included field-removed tube specimens and a full-scale mock-up of the tube, weld and vessel head. The full-scale mock-up contained electro-discharge machined (EDM) notches and was used to evaluate the influence of component geometry since defect detection and sizing capabilities are influenced by the presence of the attachment weld and the configuration of the component. Wesdyne conducted demonstrations of inspection equipment and procedures for inspection with thermal sleeves in place and open-tube UT equipment for inspection with thermal sleeves removed. During this phase, Wesdyne successfully demonstrated the ability to detect 2-3 mm OD-initiated PWSCC and determined flaw position with an accuracy of 6 mm.

Phase II Demonstrations - The second phase of demonstrations added additional mock-ups containing manufactured flaws. These flaws are appropriate for quantifying the performance of UT and eddy current (ET) techniques for the tube and weld volume, and for the use of surface methods (i.e. ET) on the wetted surface of the attachment J-groove weld. The morphology of the manufactured flaws in the second phase of demonstrations is based on metallurgical investigations of tube and weld flaws removed from Oconee Nuclear Plant, Units 1 and 3. The UT and ET responses of these manufactured flaws have been shown to be comparable to responses from service-induced PWSCC. Wide ranges of flaw sizes are included in the mock-ups to quantify the performance of demonstrated inspection techniques.

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RVHP tube flaws were manufactured using the cold-isostatic processing (CIP) technique. The technique uses extremely high pressure to compress EDM notches, thereby reducing the volume and sharpening the notch tips. Studies show they deliver UT and ET responses closely representative of PWSCC. A CIP flaw can be implanted with exact size, shape, orientation, and location as required to quantify inspection performance.

Leak Path Detection - Enclosure 3 describes the ultrasonic technique used to determine if a leak path exists above the J-weld. The basis for this inspection is the difference between the ultrasonic reflection from an interface that is in interference fit versus a free surface. In theory, sound will partially transmit through a metal to metal interface with an interference fit while an interface with a free surface will be virtually 100% reflective.

The mockups were built using a carbon steel collar that was heated and shrunk fit onto a nozzle section. Prior to assembly, two grooves were cut along the length of the collar, 0.06" and 0.12" wide nominally (approximately 0.06" deep, however the depth is irrelevant for the purpose of this test). The results showed that the 0.12" wide groove is clearly detectable using the ultrasonic inspection methods intended for ANO-2. The narrower groove (0.06") was only detectable over 50% of its length. In actual field inspections where leak path grooving has been reported in conjunction with bare metal visual detection of boron, the ultrasonic responses were greater than 0.25" wide, so the detection limit is considered conservative for the intended purpose. A second mockup was built with similar grooves, but with no interference fit. As expected, the leak path simulation grooves were not detectable.

Response to RAI 1 (b) address both BMV functions of leakage detection and head corrosion detection

Leakage Detection – The primary leakage assessment determination uses the UT probe for changes in the interference fit to indicate an apparent flow path within the annulus. However, leakage into the annulus would first have to come through a flaw in the ID of the nozzle wall, along the OD of the nozzle between the nozzle and the J-weld, or through the J-weld itself. Flaws that originate in the nozzle wall will be identified by the UT scan of the nozzle. The UT scan also has the capability to observe flaws at the interface of the J-weld interface with the OD of the nozzle wall and in most cases flaws that originate in the J-weld itself. The detectible flaw depth into the J-weld adjoining the nozzle wall has been demonstrated to be up to 0.060 of an inch. This ability to see 0.060" along the J-weld including the triple point of the J-weld also provides leakage detection capability. At this point, it is expected that the flaw will go throughweld at or near the triple point. Therefore, at this point it is expected all or most flaws would be detected at the triple point of the weld, which provides an additional consideration for leakage detection. The low frequency ECT can also be used to measure any wall loss that is below the surface of the annulus.

RPV Head Wastage Detection –The primary means that will be used for wastage detection will be the low frequency ECT technique. This technique will be able to determine wastage at or below the top of the nozzle to head annulus. The process has been shown to have a sensitivity that will detect and measure small amounts of carbon steel wastage. In addition, the UT scan can also determine a loss of contact of the nozzle to the base metal of the head. If a leak path is detected, the UT scan can be extended to the top of the annulus to further confirm the presence or absence of interference fit at or near the top of the annulus.

RAI 2 (b) - Acceptance criteria decision matrix for determining additional NDE

Flaw Identified by UT Exam In Nozzle Wall - Any flaw identified in the nozzle wall will be repaired. If it determined or suspected that the flaw has extended through the pressure boundary, then Entergy will examine the leak path and low frequency ECT data to determine if leakage has seeped into the annulus region of the nozzle to RPV head interface. Absent any data that would indicate a loss of contact of the nozzle to the carbon steel (UT leakage assessment) or from a loss of metal (LF ECT), no additional action will be taken to evaluate the condition of the RPV head. If there is an apparent "riverbed affect" from the UT, a close comparison of information for loss of metal from the LF ECT will be performed. This may require scanning the nozzle in both directions using the LF ECT to provide the best characterization of condition of the RPV head annulus region. If there is no indication of any loss of metal, then, no additional action is considered necessary. If loss of metal is apparent, an evaluation will be performed on the extent of damage to the nozzle annulus. If it is determined that only minor damage to the carbon steel has occurred, no additional action will be required. If gross damage to

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the RPV head is suspected, Entergy will take additional action to remove all or a portion of the cooling shroud/insulation package to perform visual examination and repairs, if needed.

Flaw Identified in J-weld by UT Exam of the Triple Point - If a flaw is identified in the J-weld as well as in the nozzle, additional data will be obtained. This will likely be a wetted surface exam (dye penetrant or ECT) of the J-weld and the OD of the nozzle wall. The secondary affects of the flaw will be determined if the flaw has appeared to extend through the pressure boundary.

If an indication is detected only in the J-weld, Entergy will also compare the data from the previous outage examination to determine whether it was pre-existing. If the indication was previously recorded and has not changed, then no other action will be necessary. Entergy will also interrogate the indication in order to determine linear or circular extent. If the indication does not have any crack-like characteristics, and none of the other NDE techniques identify indications, then the indication will be considered to be a weld inclusion. No other action will be necessary. If the indication appears to have grown from previous data, or is seen to approach the triple point, then it will be categorized as a "special interest" indication. A supplemental surface examination, such as a dye penetrant examination (PT) will applied in the area of a special interest.

Riverbed Identified by UT Leak Path - If no flaws are identified in either the nozzle wall or in the J-weld, but there appears to be a loss of interference fit in the annulus that would indicate a potential flow path of boric acid, additional information will be investigated to confirm the leak path. A reevaluation of the primary UT data from the nozzle and the J-weld triple point will be conducted. The open housing ECT probe data will also be investigated to determine that no ID surface flaws exist in the nozzle. Data from the LF ECT of the upper annulus will be evaluated to determine whether there has been any indication of loss of carbon steel at the location of the leak path. If no further data indicates that there has been an actual leak, it would generally be concluded that the loss of contact is more indicative of changes in ovality of the nozzle and not leakage. If additional indications that a leak path does exist, then additional wetted surface examinations would be conducted to confirm that no flaws exist.

RPV Head Carbon Steel Loss Identified by LF ECT - If there is no indication from the UT examination, the open housing ECT examination, the UT leakage assessment, and the triple point results that a flaw exists, but an indication from the LF ECT examination indicates a potential loss of RPV head carbon steel, further evaluation will be performed to disposition the data. Given no other indication in the potential for a leaking nozzle, it would be expected that the findings may be indicative of a change in the design and ovality of the nozzle and bore. Significant depths and unexplained changes in characteristics of carbon steel head loss would likely indicate an active degradation mechanism is present. A wetted surface examination would be conducted on the J-weld to determine a potential flaw in the J-weld.