From: Steven Bloom) NPP
To: Long, Steven
Date: 9/11/02 11:06AM
Subject: Fwd. Sample Plan Phase 3 Update

Here it is.

6/139

From: Jon Hopkins NRR
To: Bateman, Bill; Bloom, Steven; Coffin, Stephanie; Cullen, William; Dean, William; Hiser, Allen; Lee, Andrea; Wichman, Keith
Date: 9/10/02 4:05PM
Subject: Fwd Sample Plan Phase 3 Update

FYI, mat'l to be discussed at telecon Wed. morn at 10 am

From: <mkleisure@firstenergycorp com>
To: <jbh1@nrc gov> J. Hopkins, NRR
Date: 9/10/02 4:03PM
Subject: Sample Plan Phase 3 Update

Attached is an update of the lab work associated with Sample Plan Phase 3 This update describes the cracking discovered in the exposed cladding in the Nozzle 3 cavity, and provides a recommendation for further investigation of the cracking. We plan to discuss this recommendation during the conference call scheduled for 10am on Sept 11.

(See attached file: Sample Phase 3 Sept 10 doc)

Mike Leisure
Davis-Besse Licensing
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Davis-Besse Reactor Head Sample Characterization

Phase 3

Status Report, 09/10/02

New Phase 3 items or detailed test plans proposed, but have not been approved, are highlighted in Blue.
NRC/FENOC actions requested are highlighted in Red
Every Phase 3 status report supersedes the previous one. Please read the entire document.

The Phase 3 Sample Plan detailed herein reflects

1. Discussions held at the June 17, 2002 meeting in Lynchburg, Virginia between the NRC, FENOC, Framatome ANP, and BWXT.
2. Telephone conference between NRC, FENOC and Framatome ANP on July 15, 2002.

Sample Analyses

Analyses will be performed on the following Sample IDs:

Sample ID
Nozzle 2
Nozzle 3
Nozzle 3 Corrosion Area

The task sequences for each individual piece are listed below in a logical fashion; however, tasks may be performed in parallel provided that the designated HOLD POINTS are complied with. With the exception of the tests bounded by the HOLD POINTS, no tasks require additional NRC or FENOC personnel concurrence to proceed.

1. Nozzle 2 (work completed)

(a) Perform a visual inspection and document with photographs.

Completed on 8/23/02; no obvious evidence of cracking observed. Photos were taken to document nozzle condition. Based on measurement, it was estimated that ~7-5/8" was sectioned off the bottom of the nozzle during the removal at Davis-Besse site.

(b) If necessary, decontaminate the nozzle and flange; collect loose corrosion products in a traceable plastic bag(s).

Decontamination was not necessary

(c) Perform a visual inspection of the nozzle and document with macro photographs.

Performed - see (a) above.

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2. Nozzle 3

(a) Perform a visual inspection and document with photographs.

Completed on 8/21/02; photographs were taken to document condition of the nozzle. It was determined that 4-1/2" was sectioned off the bottom of the nozzle during removal.

(b) If necessary, decontaminate the nozzle and flange; collect loose corrosion products in a traceable plastic bag(s).

Completed on 8/22/02.

(c) Make two transverse cuts through the nozzle at the 1" and 3.5" distances from the bottom of the nozzle (near the J-groove weld end). The remainder of the nozzle is to be stored in the original shipping container. Additional work on the two rings, hereinafter referred to (by length) as the 1" ring and 2.5" ring, is described below.

Completed on 8/23/02; NOTE: Prior to sectioning, a PT exam was performed on the nozzle OD in the reduced area. No indications were found.

(d) Document the 2.5" ring with photographs.

Completed on 8/28/02.

NOTE

The shipping of the 2.5" ring to ANL releases it from the Davis-Besse Quarantine List.

(e) Ship the 2.5" ring to Argonne National Laboratory (ANL) for additional testing (shipping information to be provided by NRC personnel). The ANL testing is not part of the work scope described herein.

NRC and FENOC shipment authorization and ANL contact information received on 09/03/02. Shipment is being arranged with the following ANL contact:
John R. McDade
(630)252-5168
Fax (630)252-7367
jmcdade@anl.gov

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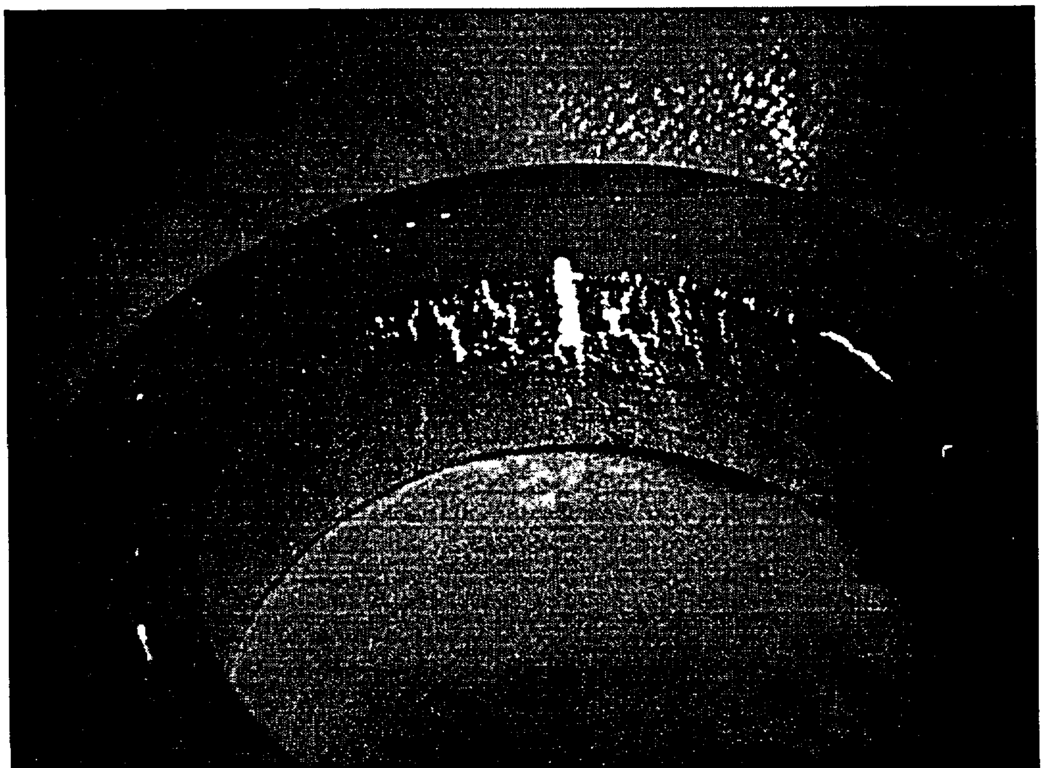
(f) Perform fluorescent penetrant testing (PT) on the 1" ring.

Completed on 8/26/02; a patch of axial crack-like indications was observed on the lower end of the nozzle OD. The largest indication extended ~0.5" axially and ~1/8" into the nozzle wall. These indications were located on the uphill side of the nozzle (i.e., 180° or the side facing toward nozzle #1).



Cut #R3Cut #R2Cut #R1Cut #R4180°0°270°90°

~1 inch

Figure 2(f). Viewing orientation: looking at the Nozzle 3 lower end face.

The proposed sectioning plan requires FENOC/NRC approval. FENOC/NRC's immediate response to the proposed sectioning plan is requested.

Proposed sectioning plan for 1" ring from end of nozzle #3 (Dated 09/03/02).
The majority of cracks will be sectioned out of the ring (cuts #R1-3). Also, after Cuts #R1-2, the I.D. surface of the nozzle segment will be examined under SEM. Cut #R4, which is parallel to Cut #3, will be made transverse through the cracks (red line) and the two mirror surfaces will be mounted. This will permit observation of the cracks in two directions with further progressive grinding.

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HOLD POINT

Proceed with the following step only if no cracking indication is found. If cracking indication is found, STOP, obtain FENOC and NRC personnel concurrence for additional sectioning and testing plan for stereovisual inspections, Scanning Electron Microscopy and Energy Dispersive Spectroscopy (SEM/EDS), and metallography.

(g) Section the 1" ring and prepare a metallographic specimen containing the full wall thickness. Etch the specimen and take micrographs of representative microstructures. Perform microhardness traverse across the wall thickness.

See (f).

3. **Nozzle 3 Corrosion Area**

(a) The first mold of the cavity was successfully performed with FENOC and NRC personnel concurrence on June 14, 2002.

Complete on 06/14/02.

(b) The second mold of cavity (intended as a backup) was successfully performed with FENOC and NRC concurrence on June 27, 2002.

Complete on 06/27/02.

(c) A mold of the stainless cladding from the underside (RCS side) of the cavity was successfully performed with FENOC and NRC personnel concurrence on June 27, 2002.

Complete on 06/27/02.

(d) Make cuts #1, #2, and #3 as shown on Figure 1. All three cuts will be about 0.5" minimum outside the cavity walls. The resulting four pieces will be designated as Block A, B, C, and D. Block A contains the cavity; Blocks B and C are the "moon" pieces from cuts #1 and #2; Block D is from cut #3 and contains the CRDM Nozzle 11 bore and the remaining J-groove weld.

Completed on 8/23/02. NOTE: Cut #2 impinged approximately 1/16" into the side of the cavity, resulted in a small hole (½ to ¾" dia.) on the cavity side wall. This is a deviation from the planned cutting of 0.5" min. outside cavity walls. This was caused by deflection of the band saw blade. However, this is not expected to have any significant adverse impact on the investigation.

(e) Perform fluorescent PT (on the #1, #2, and #3 cutting faces on the side of Blocks B, C, and D. The objective is to look for de-bonding between the stainless steel cladding and the low alloy steel of the RV head.

Completed on 8/23/02; no evidence of disbond noted between the stainless steel clad and low alloy steel. One small void measuring ~1/8" in length was present near the nozzle #11 J-groove weld root. See photos below, before and after removing the PT dye and developer.

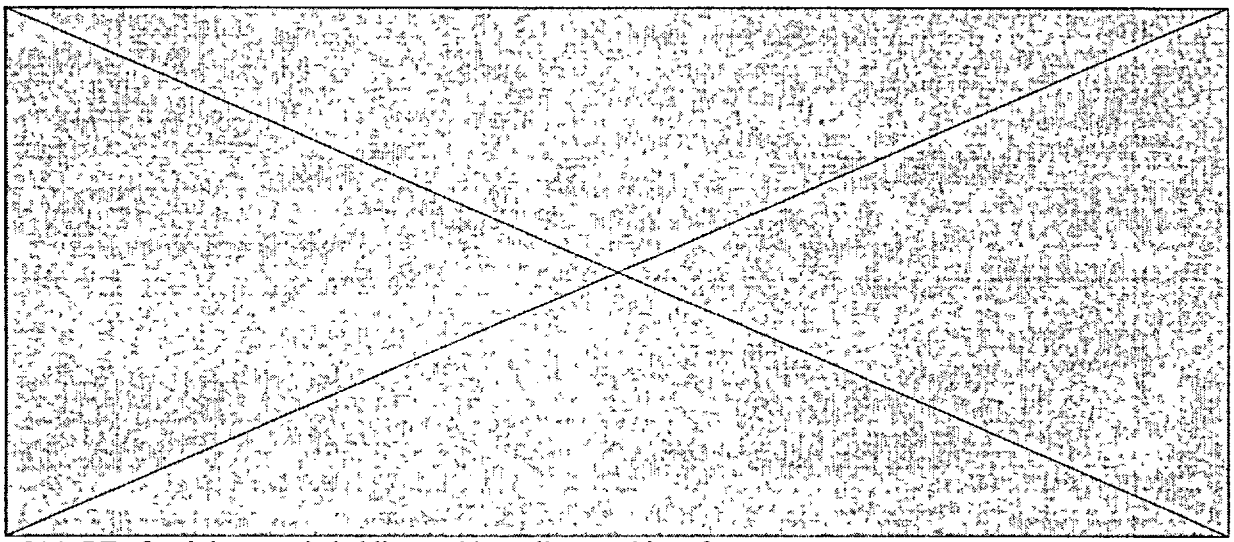

Figure 3(e). PT of stainless steel cladding and low alloy steel interface.

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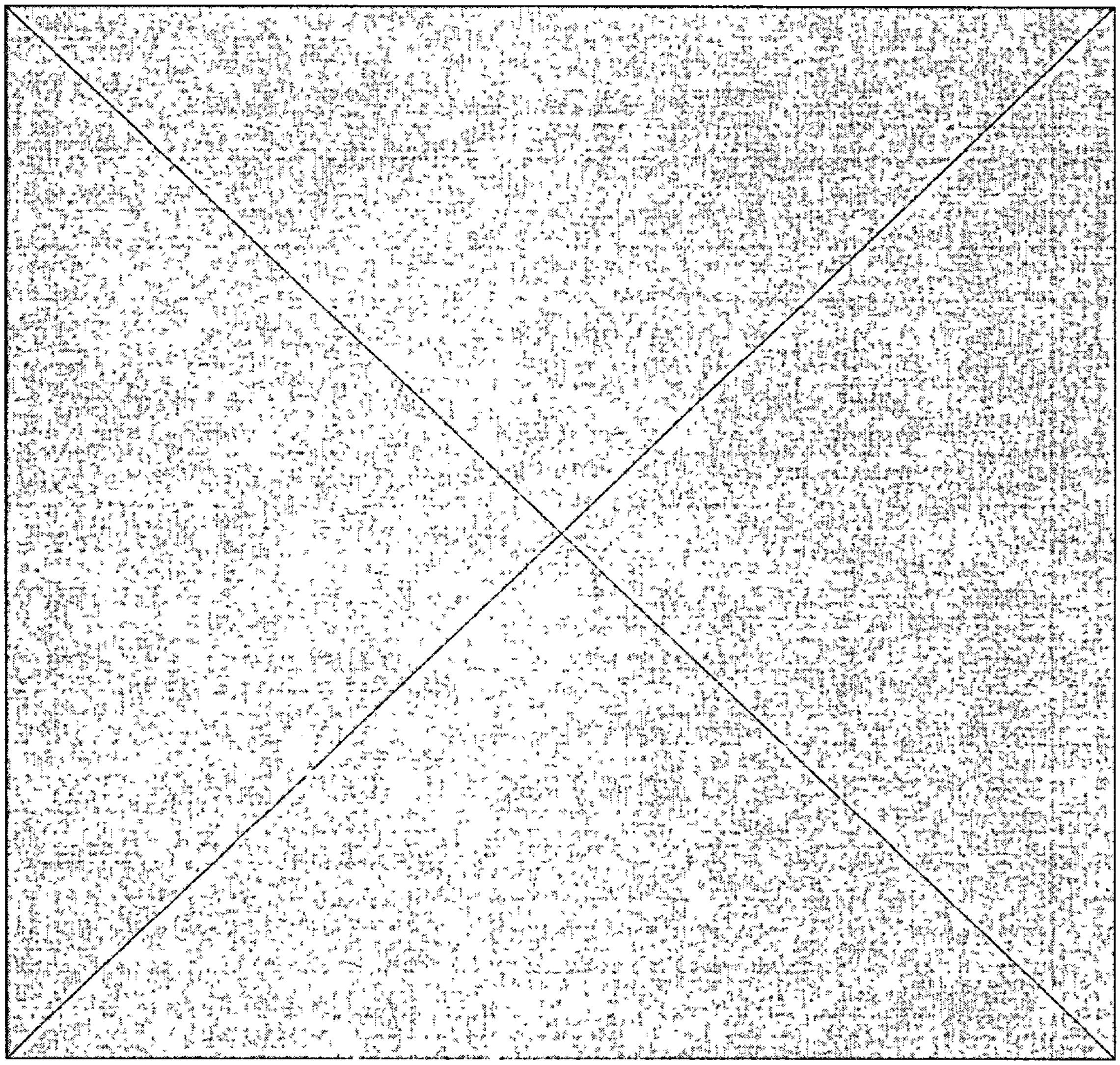
(f) Perform microhardness tests on one of the "moon" pieces (Block B or C). The microhardness tests are to traverse across the stainless steel cladding thickness, into the low alloy steel heat affected zone (HAZ), and the unaffected base metal in a line perpendicular to the stainless steel cladding.



Microhardness (Knoop 500gram) traverse on Block B completed on 9/6/02. See plot below.

Figure 3(f). Microhardness traverse across stainless steel cladding and into low alloy steel

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NOTE

The shipping of the portion of Block D to ANL releases it from the Davis-Besse Quarantine List.

(g) Make cut #4 approximately 0.5" above the J-groove weld on Block D (containing the CRDM Nozzle 11 bore). Ship the portion of Block D containing the J-groove weld to ANL for additional testing (shipping information to be provided by NRC personnel). The ANL testing is not part of the work scope described herein.

Cut #4 completed on 8/26/02;

NRC and FENOC shipment authorization and ANL contact information received on 09/03/02. Shipment is being arranged with the following ANL contact:
John R. McDade
(630)252-5168
Fax (630)252-7367
jmcdade@anl.gov

(h) Perform two tension tests on the stainless cladding removed from either "moon" piece (Block B or C). Remove both specimens from the same area, with one specimen being machined from the cladding near the carbon steel interface (top specimen), and the other specimen from the cladding near the surface in contact with RCS (bottom specimen). The cuts for both specimens shall be made perpendicular to the direction of travel of the cladding weld machine. Nominal specimen dimensions in reduced area are 0.080" x 0.200" and are approximately 1.5" to 2.0" long. Perform both tensile tests at 600 °F.

Tensile specimens are removed from cladding in Block B. The tensile test date is scheduled for September 19, 2002 (see note* below). This notice is in accordance with notifying NRC/FENOC at least 5 business days in advance of the test date.

* NRC/FENOC is advised to plan on coming to Lynchburg the day before and plan to leave late afternoon on the 19th at the earliest. The tensile test will take up a good portion of the day because of the heat up times involved.

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(i) Prepare the CRDM Nozzle 3 J-groove weld surface and perform fluorescent PT of all accessible surfaces of the J-groove weld for cracking.

Completed on 8/28/02; linear crack-like indication present on ID surface; circumferential cracking present on the J-groove weld's underside surface (RSC side, the same as stainless steel cladding surface); linear voids present in J-groove weld. See the following three photos.

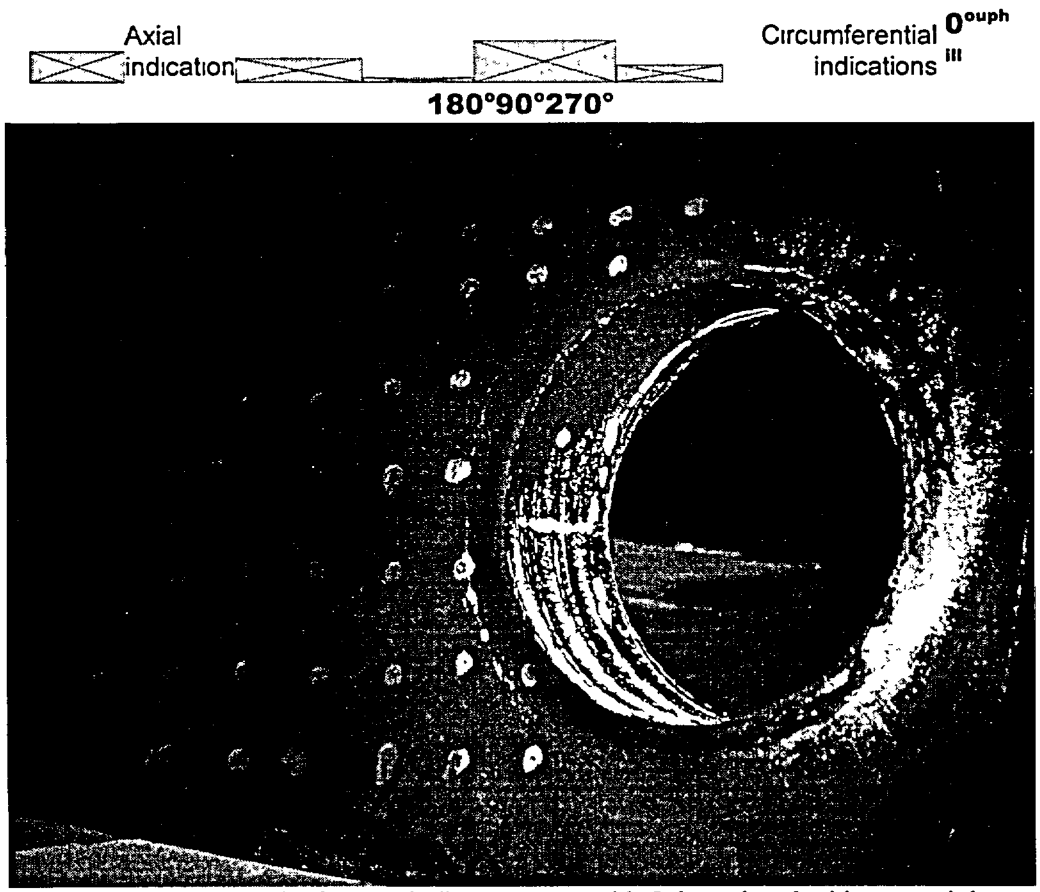

Figure 3(i)-1. PT results for nozzle #3 J-groove weld. Orientation: looking at stainless steel clad surface (or underside, i.e., RCS side). 0° is downhill side facing the cavity, and 180° is uphill side. A crack-like indication measuring ~1.4" long was present at ~10 degrees on the J-groove weld bore (arrow). This crack was visible on the top of the J-groove weld and was aligned with the deepest portion of the cavity. Circumferential cracking was observed on the J-groove weld's underside surface (same as stainless steel cladding surface). These circumferential cracks are located ~3/4" radially from the penetration bore and between 0° and 45° (higher magnification photos follow). Linearly aligned voids were also present on the J-groove weld bore

~0.3" below the top surface of the J-groove weld. These voids extended from 240 degrees to 30 degrees (through 0 degrees) and measured a maximum ~0.1" wide and ~1.4" in length. These voids likely formed during original welding.

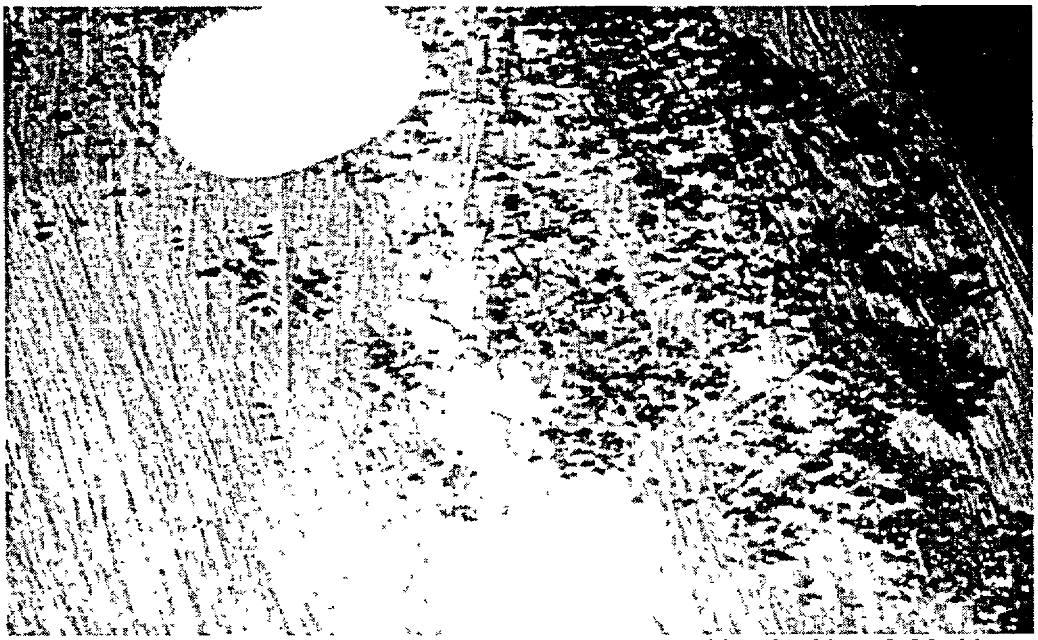

Figure 3(i)-2. Circumferential cracking on the J -groove weld underside or RCS side (6X). The yellow spot at the top of the photo is a grid marking for the UT thickness measurement performed at the Davis-Besse site.

Figure 3(i)-3. Detail of circumferential cracking (40X).

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Additional Stereomicroscope Inspections of Nozzle 3 J-groove Weld Area
(Performed between 09/06/02 – 09/09/02).

The PT performed did reveal one axial crack indication on the J-groove weld bore surface (180°) and some circumferential crack indications on the J-groove weld un-machined undersurface (0-45°) see above. However, the surface condition of the J-groove weld, especially the upper surface and the machined bore of the J-groove weld are not conducive to PT. Hence, it was decided to use the stereo microscope (up to X50) to completely scan the J-groove weld area. This led to the following new information to the PT indication, cracking indications not revealed by the PT, and cracking in the exposed stainless steel cladding top surface.

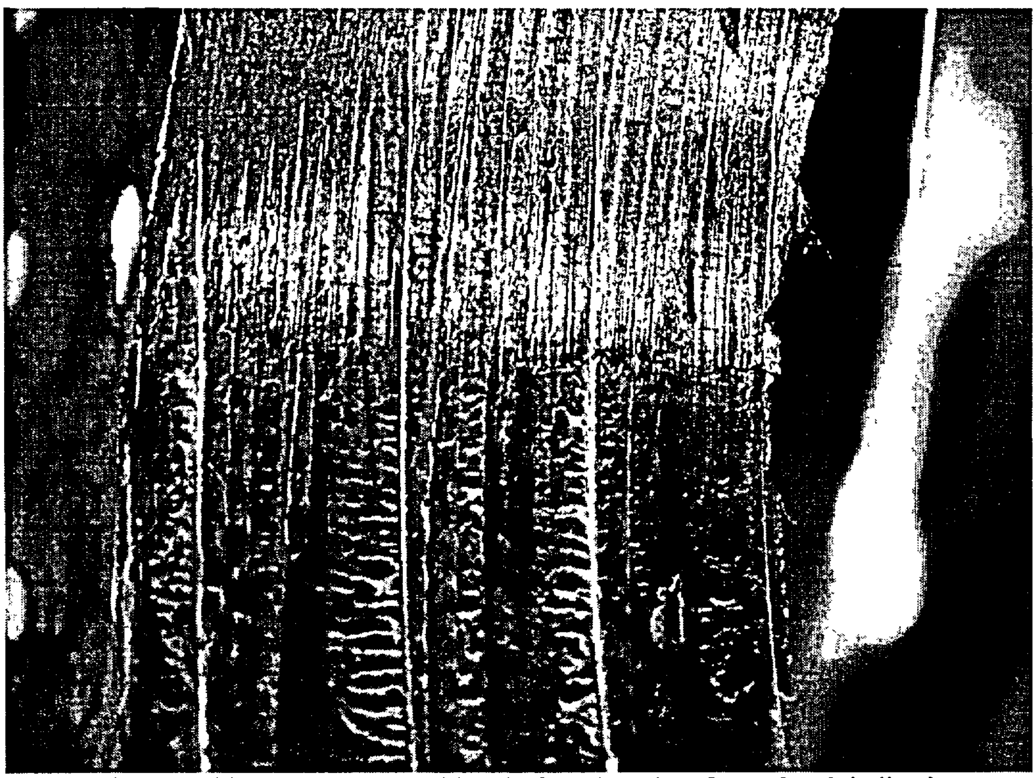

Figure 3(i)-4. Looking at J-groove weld underface (bored surface). Crack indication corresponds to axial crack (near 0°) indication in Figure 3(i)-1.

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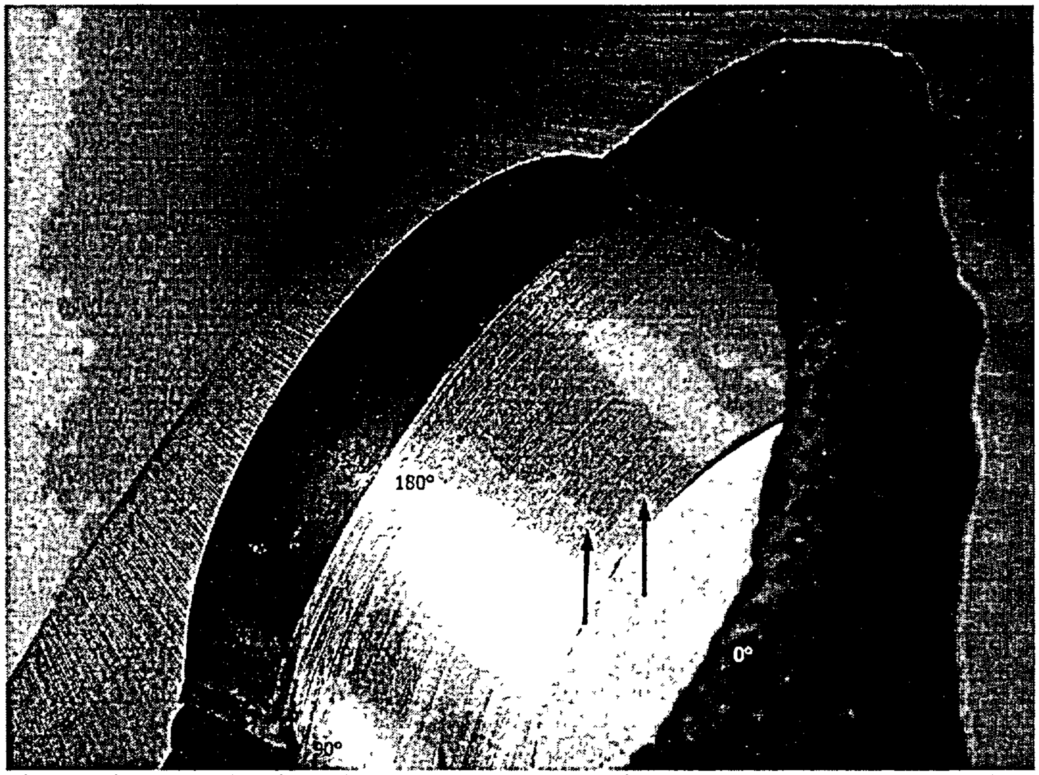

Figure 3(i)-5. Looking from the J-groove weld upper face (the J-groove beads exposed due to the removal of low alloy steel by boric acid corrosion can be seen near the 0°). Axial crack near 180° indications (not revealed by PT). Also see Figure 2(f) of 1" ring of Nozzle 3 axial cracking near 180°. These results suggest that axial cracking near 180° on the Nozzle 3 may be only through the nozzle wall within the length covered by J-groove weld (It is also possible for axial crack to be through the nozzle wall below the J-weld).

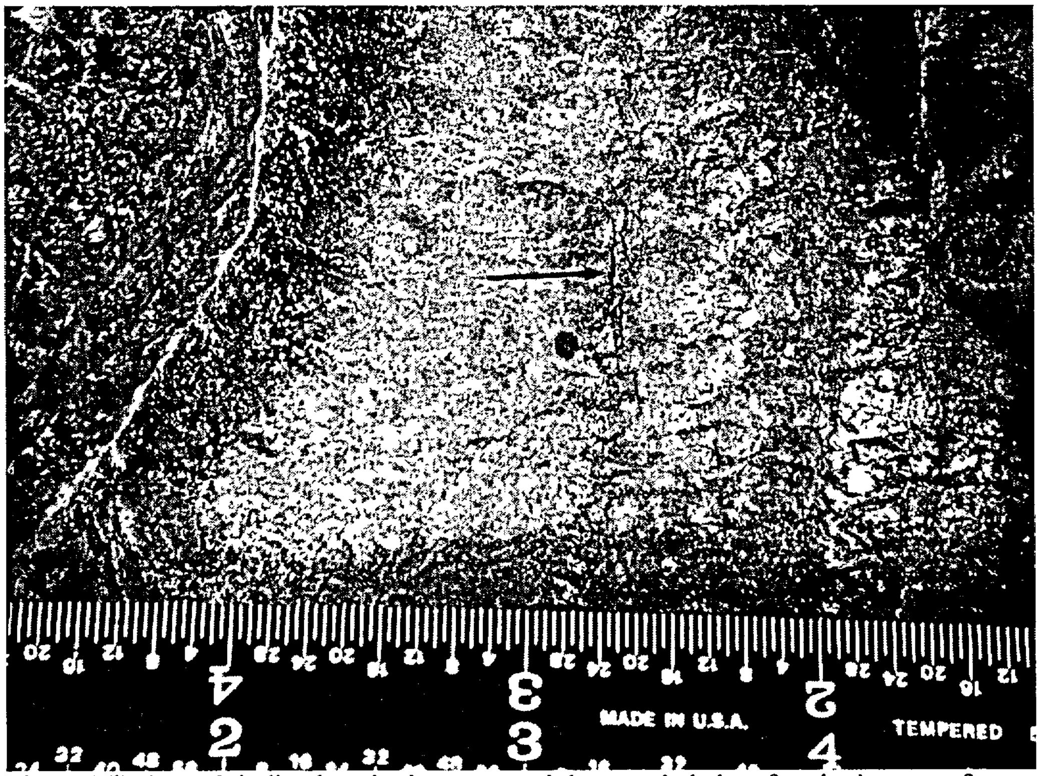

Figure 3(i)-6, crack indications in the upper stainless steel clad surface in the area of maximum upward deflection (also see Figure 3(f) below for orientation). These indications were mostly about 1.25" from the J-groove weld edge and do not appear to be associated with the circumferential cracking in the J-groove weld underface in Figure 3(i)-1.

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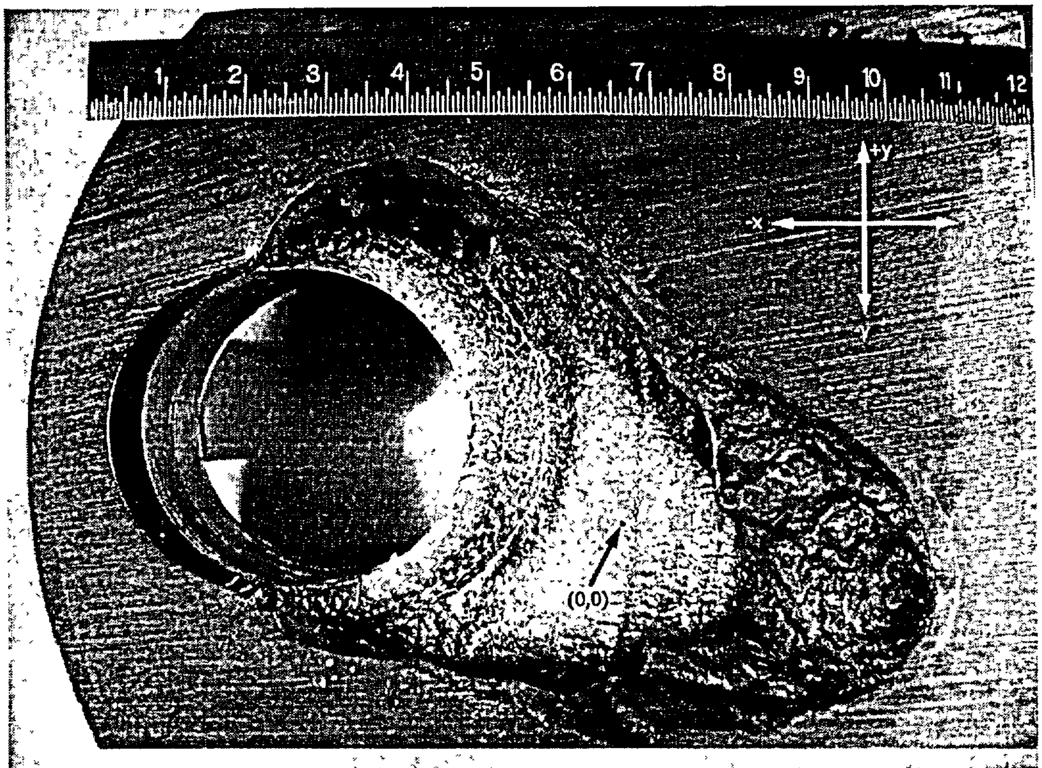

Figure 3(i)-7. Top view of the corrosion cavity after Cut #5. This lower part of Block A is designated "Block A2". The crack indications on the cladding surface, by coincident, are near the red dot (0,0) pointed by the arrow. The red dot (0, 0) was previously used for establishing the Cartesian coordinates for the exposed cladding thickness measurements shown in Figure 3(j).

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Figure 3(i)-8. Close-up of crack montage (scale, each photo is ~1" from left to right side).

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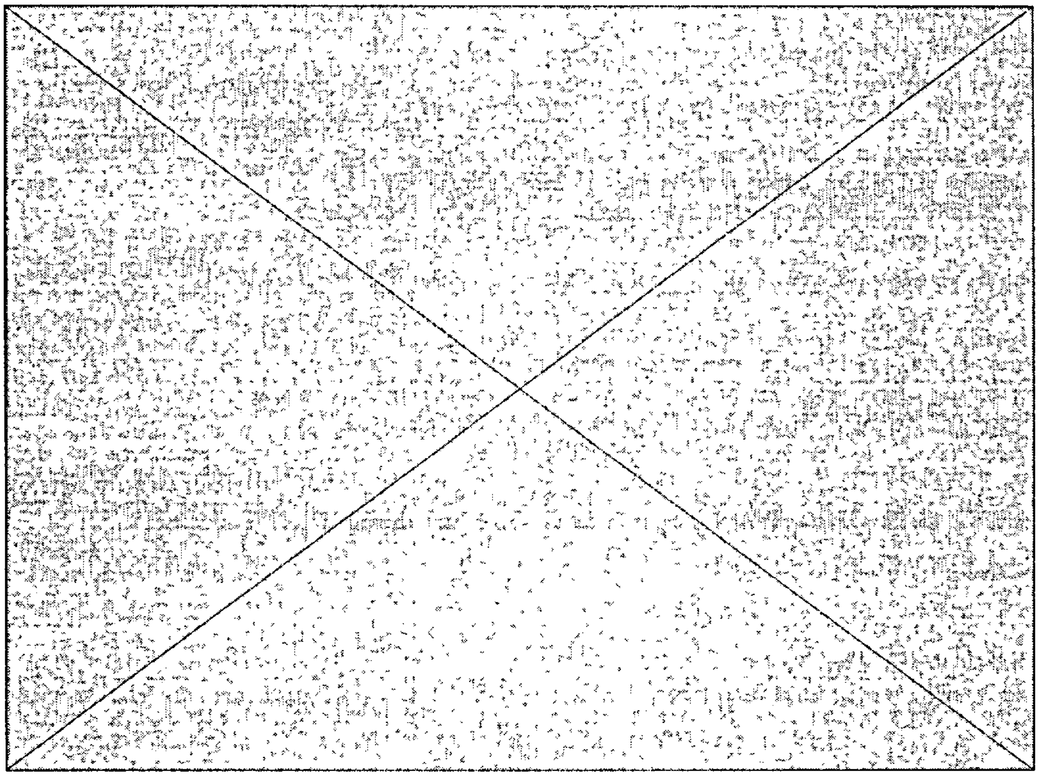

Figure 3(i)-9. Underside (RCS side) of the corrosion cavity. All the white dots were marked at the Davis-Besse site for UT thickness measurement. The two lines on the left are believe to indicate Nozzle 11, which is just outside the this photo on the left. The red circle superimposed on the photo indicates area of maximum deflection (bulging). This maximum bulging area is shown in the next two photos under higher magnification.

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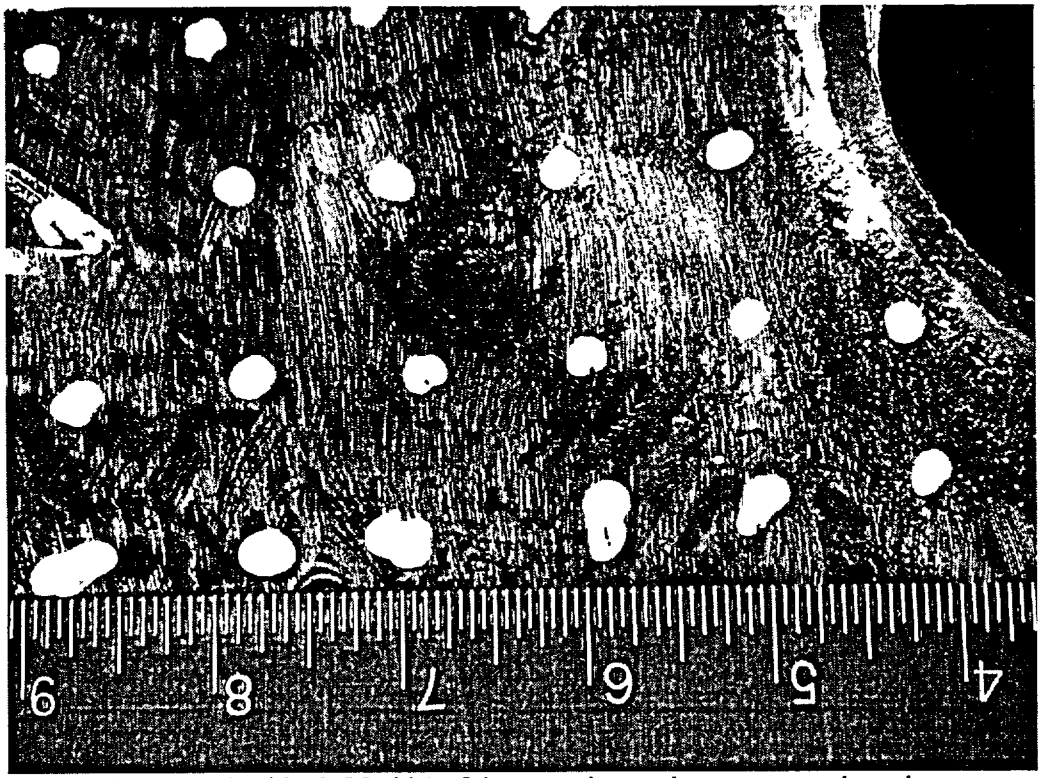

Figure 3(i)-10. Underside (RCS side) of the corrosion cavity, area around maximum deflection (bulging). No indication of cracking is found on the underside with stereomicroscope scanning.

Figure 3(i)-11. Close-up of underside (RCS side) of the corrosion cavity, inside the maximum deflection 6X. No indication of cracking is found on the underside with stereomicroscope scanning.

The following proposed PT requires NRC/FENOC authorization and FENOC funding before it will be performed. NRC/FENOC's immediate actions are requested.

Proposed date (09/10/02)

(1) PT the cladding underside (RCS side), covering the entire underside area corresponding to the exposed cladding on the upperside. This will look for signs of any cracking on the underside or if any cracks on the upperside extending to the underside, creating a leak path. The attempt will be made to remove the white dots/marking with chemical solvent. Mechanical means of removing these dots or surface preparation will Not be used.

(2) PT the upperside of the cladding around the area of maximum deflection and to PT as much area as possible. However, the cavity edge will be excluded due to remaining overhang. This is to capture the extent of the cracking on the top side. However, substantial PT background noise due to the surface condition is expected based on prior experience with the J-groove weld PT. No surface preparation by mechanical means will be performed prior to PT.

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(j) Make cut #5 on Block A (containing the cavity) at approximately 2" above and parallel to the stainless cladding. Perform thickness measurements of the exposed stainless steel cladding in a 0.5" grid pattern.

Cut #5 completed on 8/27/02;

Stainless clad thickness measurement completed on 9/5/02.
The Figure below shows the cladding thickness measurements superimposed on the exposed stainless steel cladding contour (taken from the cavity molding). It should be noted that some portion of the exposed cladding along its edge is inaccessible for measurement due to the undercutting close to the bottom. The #5 cut did not remove all the overhang above the exposed cladding surface.

Average thickness of all 78 readings: 0.256"
Minimum measured clad thickness: 0.202"
Maximum measured clad thickness: 0.314"

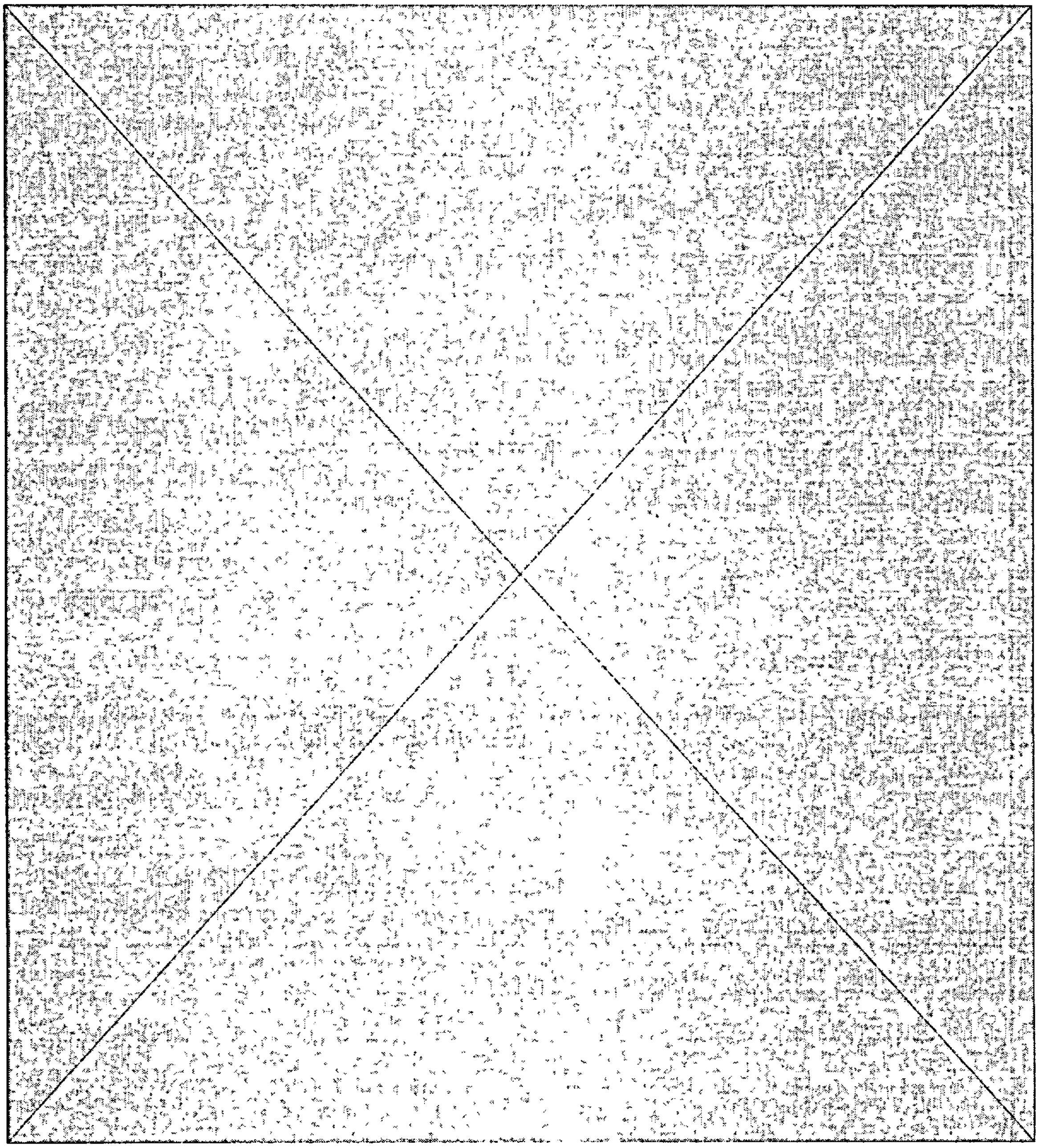

Figure 3(j). Exposed stainless steel cladding thickness measurement (also see Figure J).

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Besides the above, no other work has been performed or scheduled at this point.

HOLD POINT

Obtain FENOC and NRC personnel concurrence before proceeding to the following items.

(k) Cut the upper portion of cavity in half by sectioning through the head in the Nozzle 3 bore to Nozzle 11 bore direction. Perform stereovisual inspections to determine locations for SEM/EDS and metallography samples.

(l) Cut the lower portion of the cavity (containing the exposed cladding) in half in the same manner as the previous step. Perform stereovisual inspections to determine locations for SEM/EDS, metallography and microhardness test samples.

Note: The cuts in Steps (k) and (l) will be numbered sequentially (such as Cuts #6 and #7) and illustrated in a sectioning plan (Phase 4?) for FENOC and NRC concurrence.

Control of Samples

Currently, the three Sample IDs, i.e., CRDM Nozzle 2, CRDM Nozzle 3 and the Nozzle 3 Corrosion Area cutout (which includes the Nozzle 11 bore), are being stored at BWXT.

Traceability of the Sample IDs, and portions thereof, will be maintained. Each sample will be identified either by placing the sample identification on the sample itself or on a container or a plastic bag. Only one sample will be allowed in a container or in a plastic bag. The inventory of the samples and the specific location of each sample will be documented in a project logbook maintained by the vendor test facility.

HOLD POINT

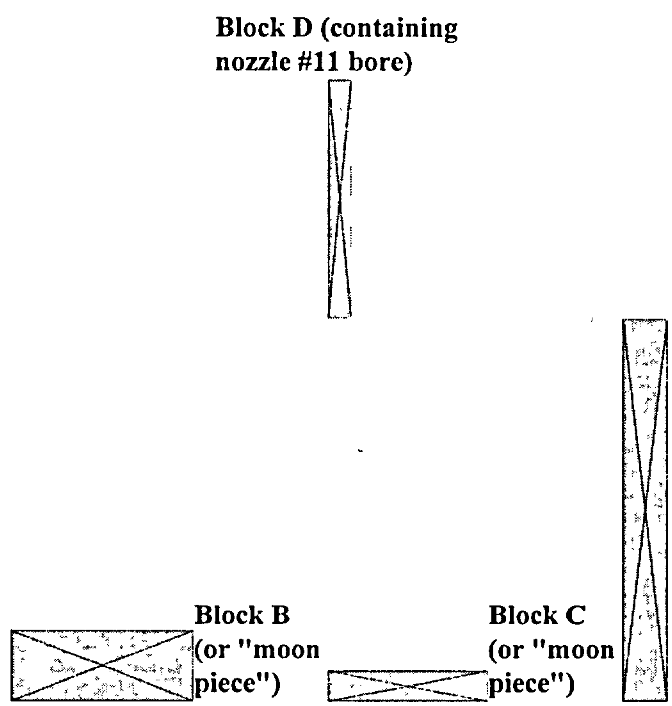
Prior to proceeding with the disposal of samples, the current status will be discussed with the NRC staff.

No samples or materials will be disposed of without FENOC authorization. Samples will be retained until released from quarantine.

Schedule

Upon request, reasonable advance notice will be provided to allow NRC or FENOC personnel to have the opportunity to witness the actual testing (site-specific radiological worker training may be required).

A final report will be provided to FENOC approximately four weeks following completion of the laboratory work. This report will provide a detailed description of the material samples, a detailed description of the analytical techniques utilized, and the results.



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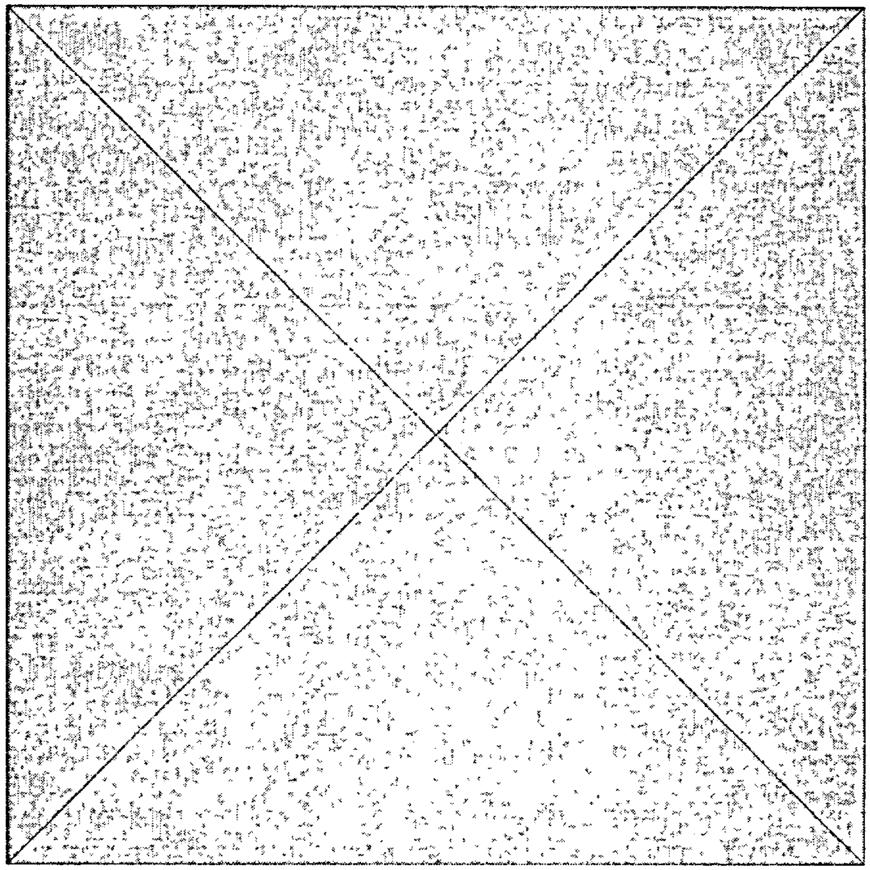

Block A (containing the cavity)

Figure 1. Section Plan for the Nozzle 3 Corrosion Area Cutout