From: Robert Tregoning , RES
To: Jeannette Torres
Date: 11/27/02 8:18AM
Subject: Fwd: Permanent set "Measured" in DB Clad

First of many

H-46

From: Mark Kirk
To: Bass, Richard - ORNL
Date: 10/29/02 9:28AM
Subject: Permanent set "Measured" in DB Clad

Richard -

Attached is a file with the measurements that you requested last week (& i forgot to send). The info you are looking for is on p. 19-20 ... by my very coarse interpretation of these data i'd say a permanent set of 0.18-in. was measured. I'd be interested to hear how well this number compares with the results of Paul's FE analysis. Since we have argued that the analysis is "intentionally conservative" (i.e. larger wastage area than actual modelled, reinforcing effect of J-groove weld not modelled) i'm hoping that the FE analysis predicts more set than 0.18-in. .... but let's see.

Thanks

Mark

CC: Nilesh Chokshi; Robert Tregoning; Williams, Paul - ORNL

Davis-Besse Reactor Head Sample Characterization

Phase 3 Status Report, 9/19/02

- ✓ Every Phase 3 status report supersedes the previous one. Please read the entire document.
- ✓ From this status update (9/12/02), the descriptions of the test items or steps are deleted. Please refer to the latest Phase 3 revision on the top left corner, which will always be attached in the same email message with the update.
- ✓ Test plan(s) proposed will continue to be included in the status report. However, once the proposed test plan is finalized and approved by FENOC/NRC, it will be included in the revised Phase 3 test plan.

Step 1. Nozzle 2 (Work has been completed)

(a) 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) Decontamination was not necessary

(c) Performed - see (a) above.

Step 2. Nozzle 3

(a) 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) Completed on 8/22/02.

(c) 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) Completed on 8/28/02, see photo below.

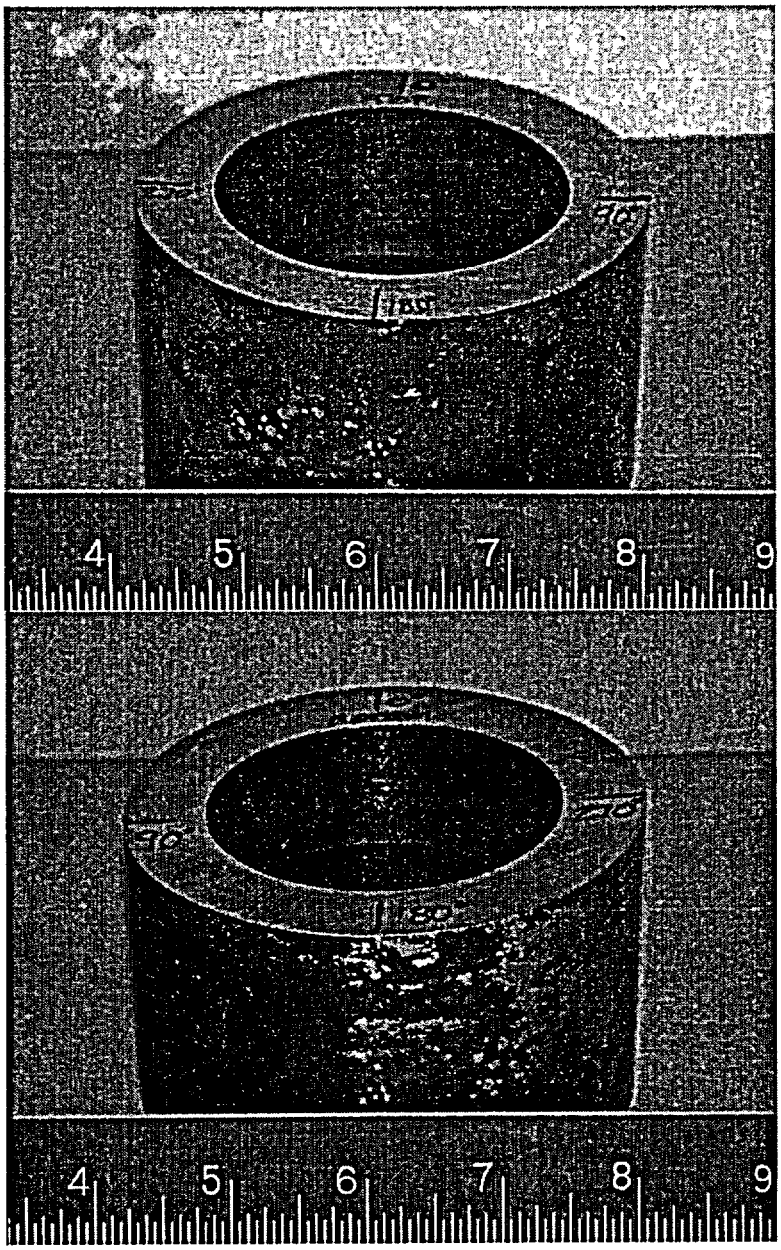


Figure 2(d). 2.5" long ring cut from Nozzle 3. Top face (from the 3.5" cut) and Bottom Face (from the 1" cut). The 0, 90, 180, and 270° markings are approximate.

(e) NRC and FENOC shipment authorization and ANL contact information received on 09/03/02. Shipment was received by ANL on 09/17/02. contact: John R. McDade, (630)252-5168, Fax (630)252-7367, jmcdade@anl.gov

(f) 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).

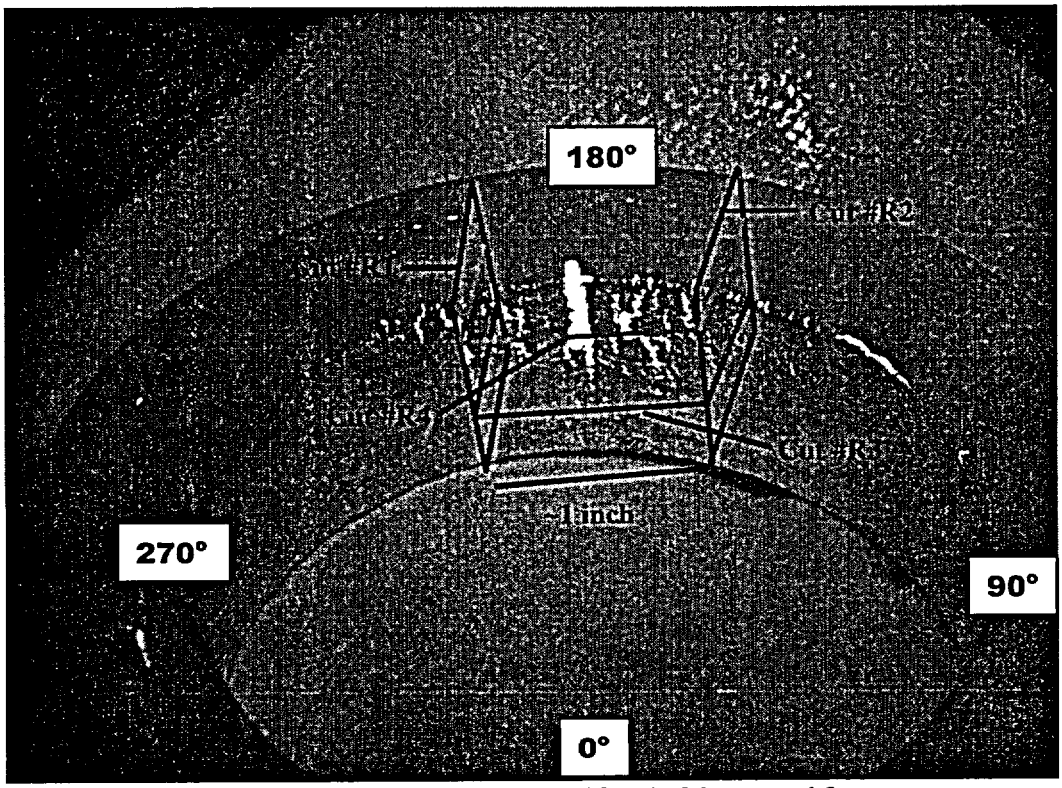


Figure 2(f). Viewing orientation: looking at the Nozzle 3 lower end face.

<u>Proposed sectioning plan for 1" ring from end of nozzle #3 (Dated 09/03/02).</u>
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.

Further testing of Nozzle 3 is currently on-hold, until the details of further sectioning and testing plan are finalized.

Step 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) 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) 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.

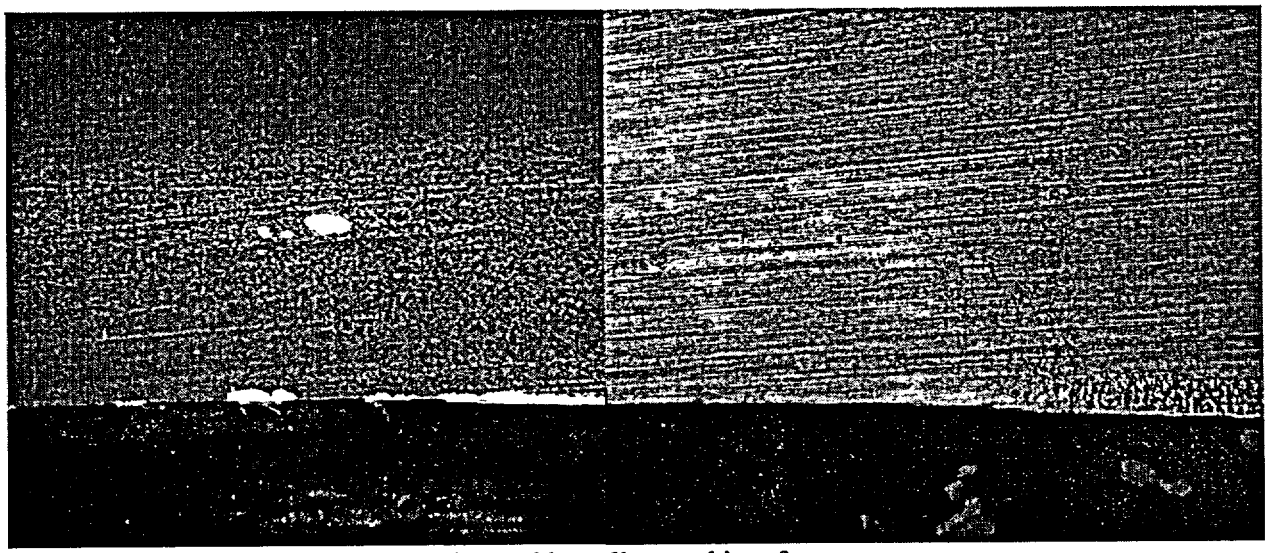
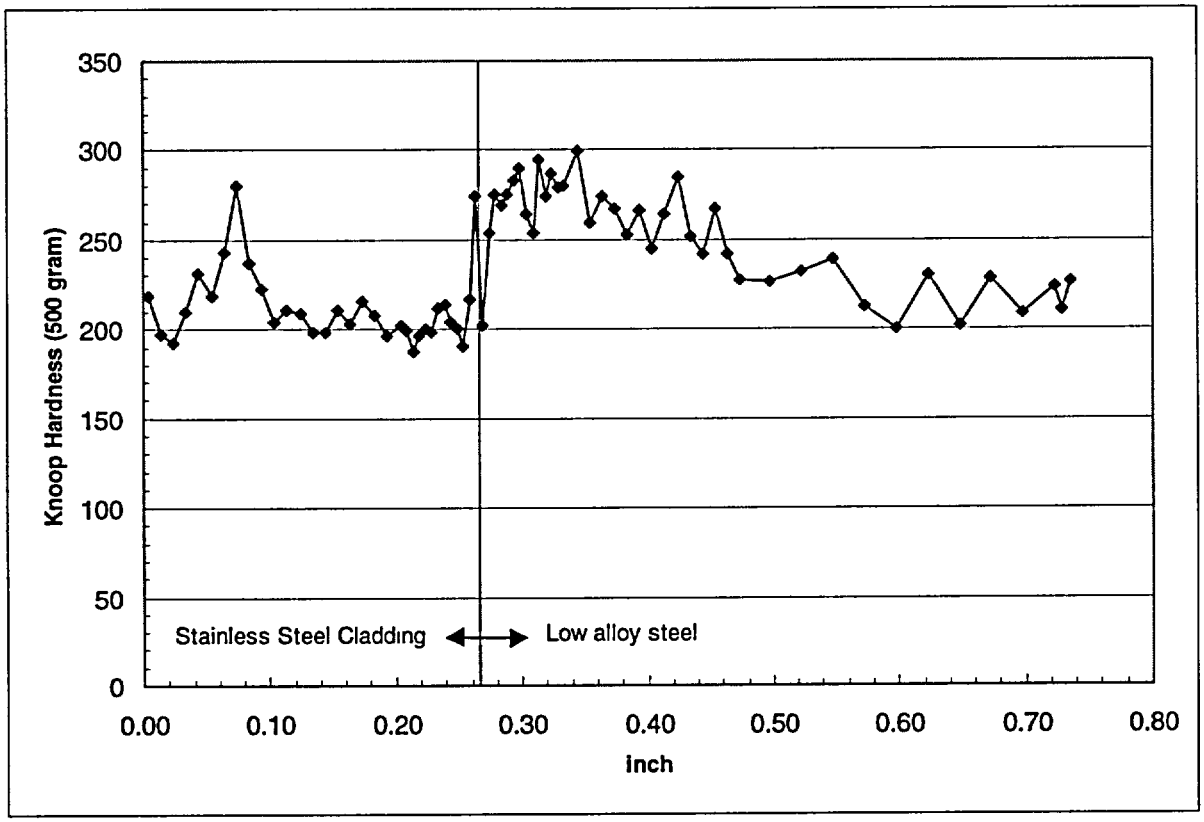


Figure 3(e). PT of stainless steel cladding and low alloy steel interface.

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



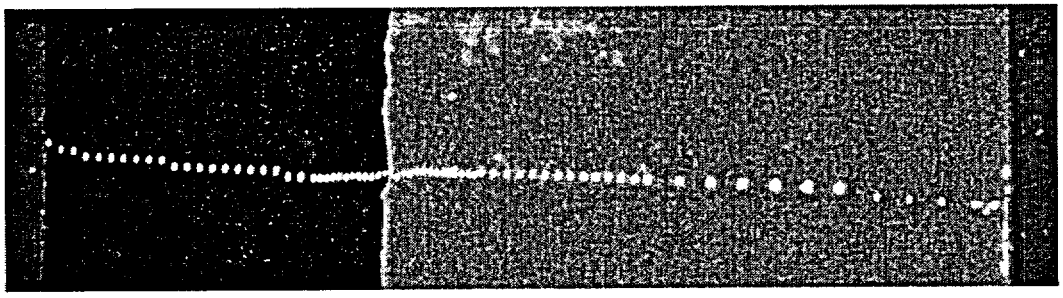
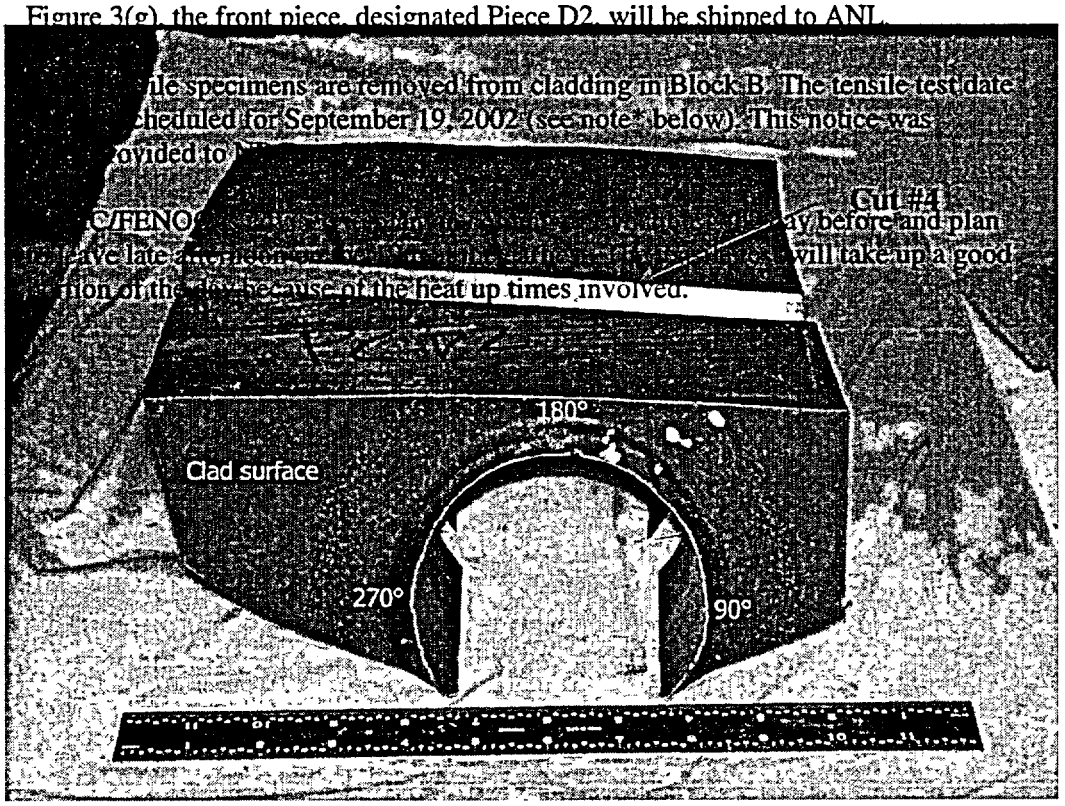


Figure 3(f). Microhardness traverse across stainless steel cladding and into low alloy steel

*The micrographs of low alloy steels and stainless steel cladding microstructures are documented in a separate Microsoft Word file, "Supplement 1, Microstructure of Low Alloy Steel and Stainless Steel Cladding, Rev 9/11/02." This is to limit the status report file size (make it easy on email systems and computer ram).

(g) Cut #4 completed on 8/26/02 (see photo below); NRC and FENOC shipment authorization and ANL contact information received on 09/03/02. Shipment was received by ANL on 09/17/02, contact: John R. McDade, (630)252-5168, Fax (630)252-7367, jmcdade@anl.gov.

Figure 3(g), the front piece, designated Piece D2, will be shipped to ANL.



ule specimens are removed from cladding in Block B. The tensile test date
cheduled for September 19, 2002 (see note * below). This notice was
ovided to
C/FENO
ay before and plan
have late afternoon
will take up a good
tion of the
because of the heat up times involved.

(i) 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.

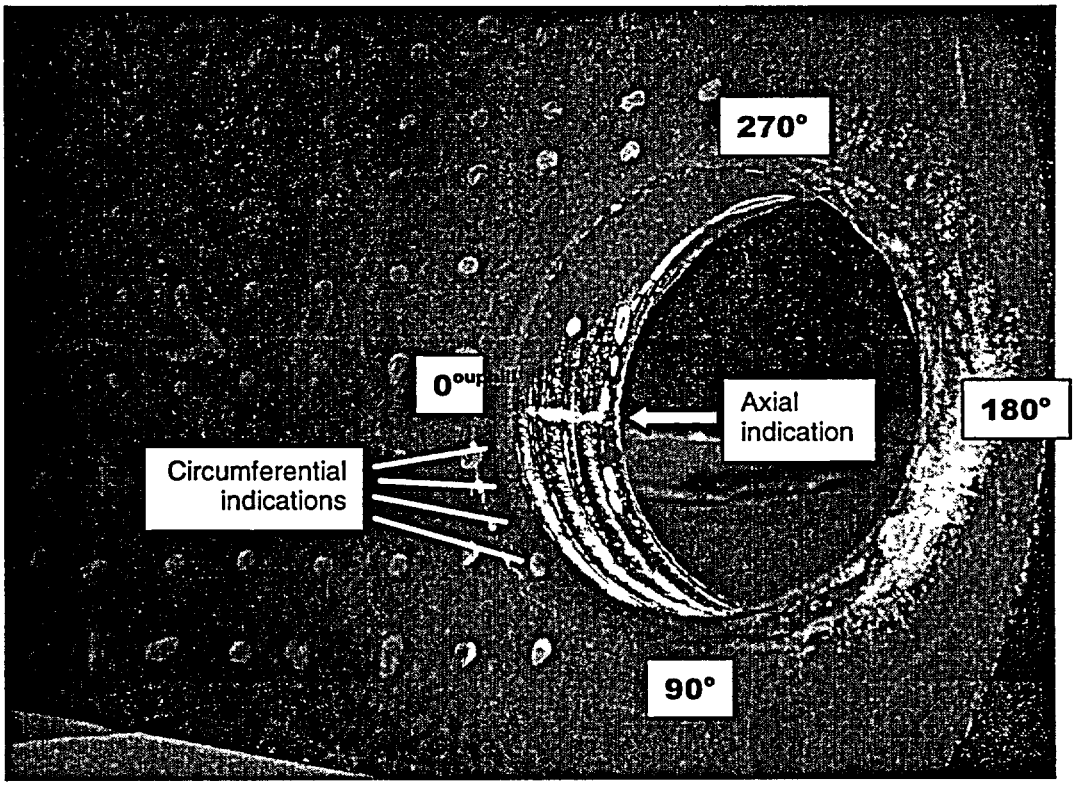


Figure 3(i)-1. PT results for nozzle #3 J-groove weld. Orientation: looking at stainless steel clad surface (or underside, i.e., RCS side). 0° is downhill side facing the cavity, and 180° is uphill side. A crack-like indication measuring ~1.4" long was present at ~10 degrees on the J-groove weld bore (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.

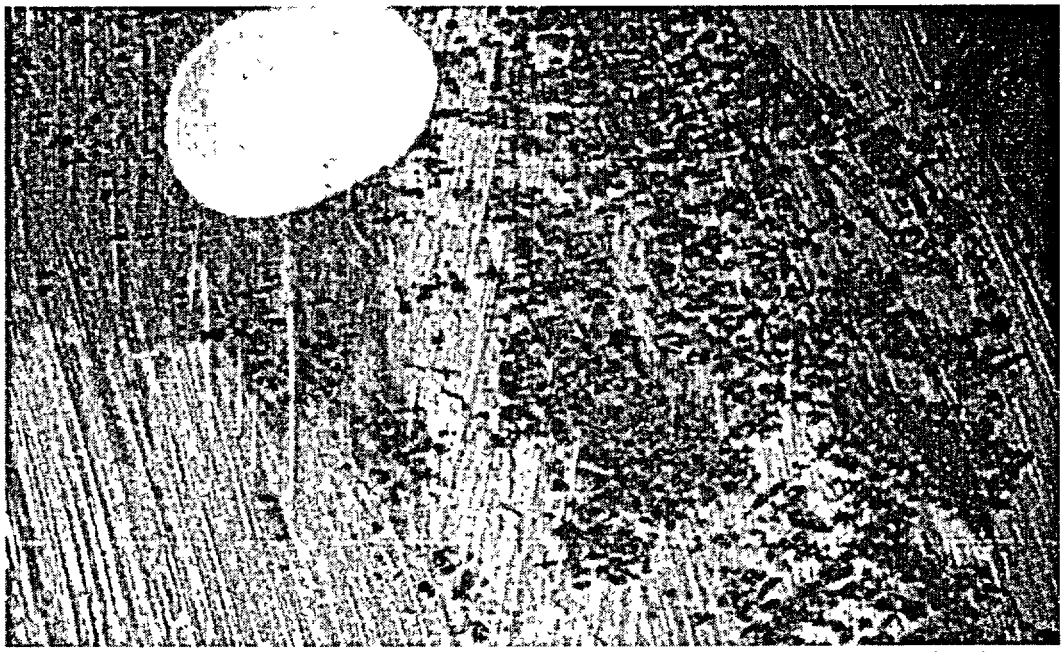


Figure 3(i)-2. Circumferential cracking on the J -groove weld underside or RCS side (6X). The yellow spot at the top of the photo is a grid marking for the UT thickness measurement performed at the Davis-Besse site.

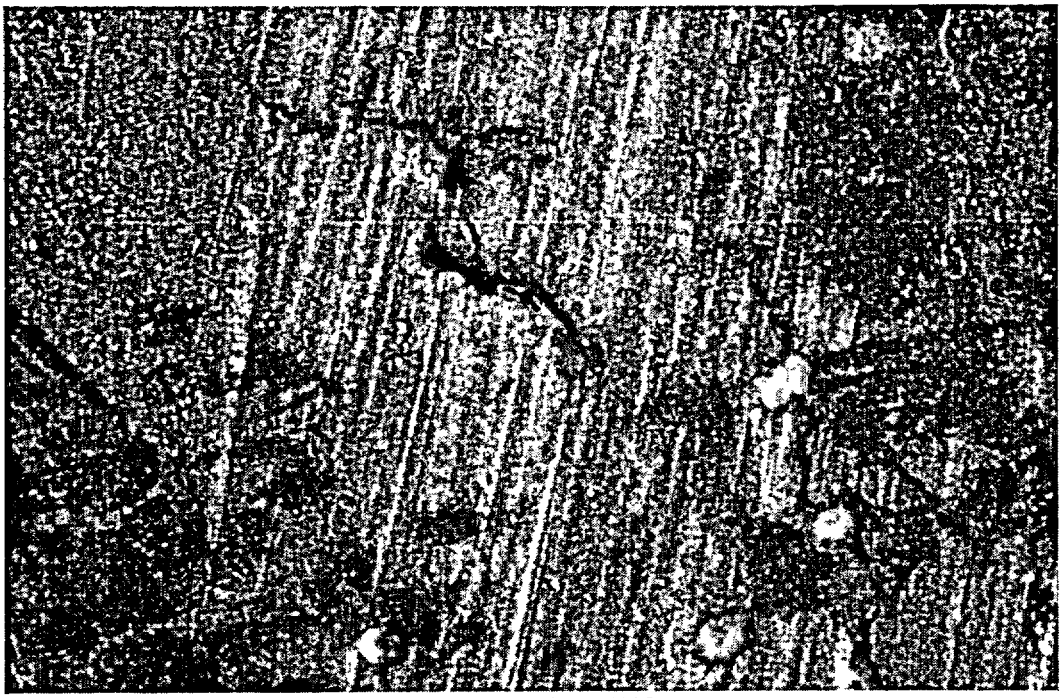


Figure 3(i)-3. Detail of circumferential cracking (40X).

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.

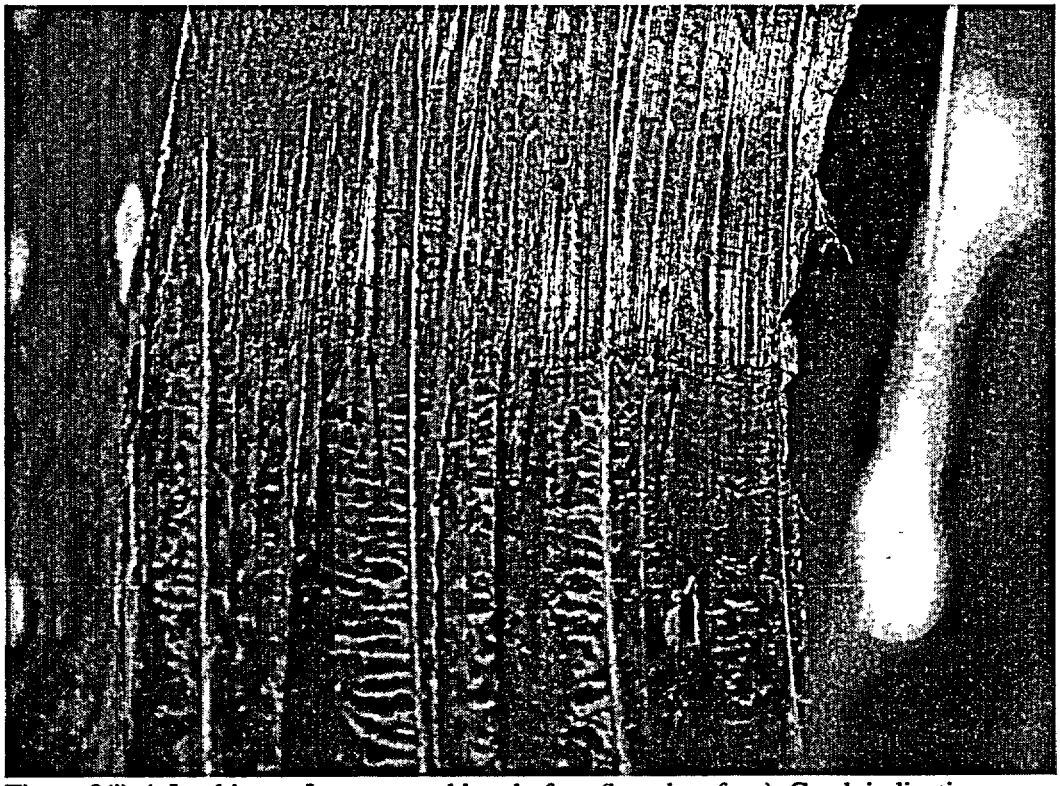


Figure 3(i)-4. Looking at J-groove weld underface (bored surface). Crack indication corresponds to axial crack (near 0°) indication in Figure 3(i)-1.

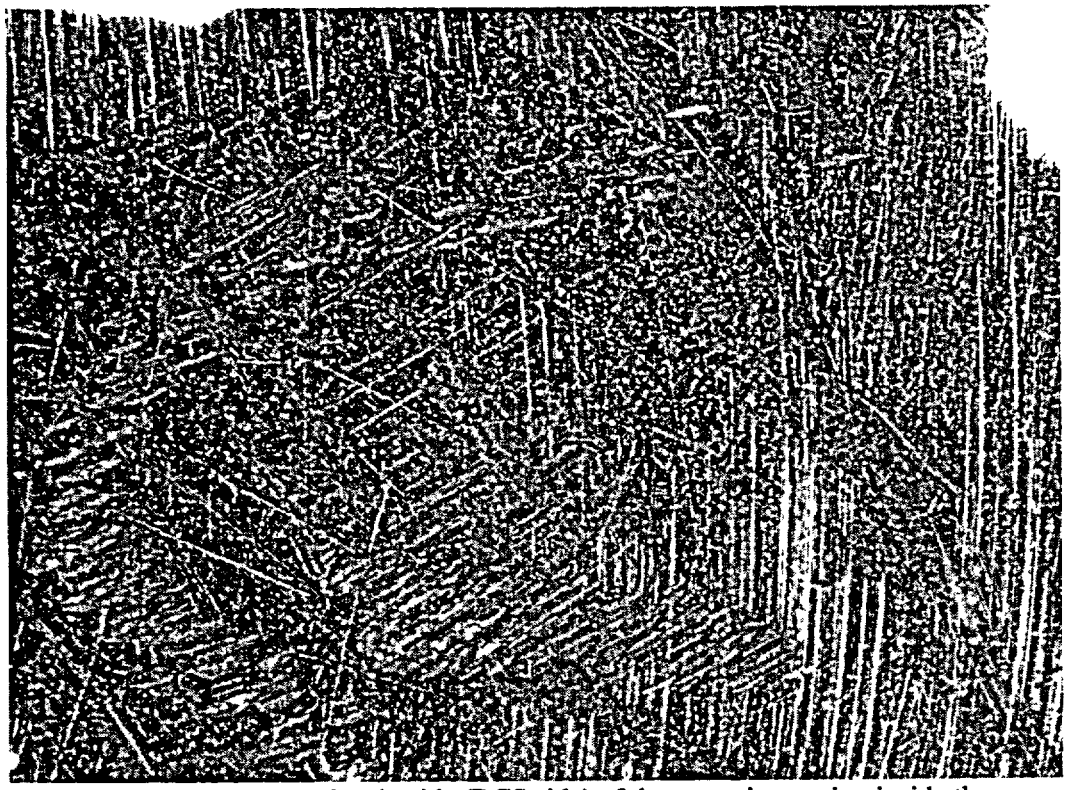


Figure 3(i)-11. Close-up of underside (RCS side) of the corrosion cavity, inside the maximum deflection 6X. No indication of cracking is found on the underside with stereo microscope scanning.

(j) 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"

*Note, the area of the exposed stainless steel cladding captured by the molding of the cavity was twice measured at BWXT. On the first occasion (8/7/02), the image analysis was performed on a photograph of the cavity molding and yielded 17.3 sq. inch. On the second occasion (8/9/02), the image analysis was performed on a grid paper which had

traced the outline (the outline shown in Figure 3(j)-1) of the exposed cladding area captured by the molding. By preventing inaccuracy arising form a slight cladding curvature and/or perspective distortion in the photograph, the second method is considered to be slightly more accurate. The second measurement resulted in 16.5 sq. inch of exposed cladding area.

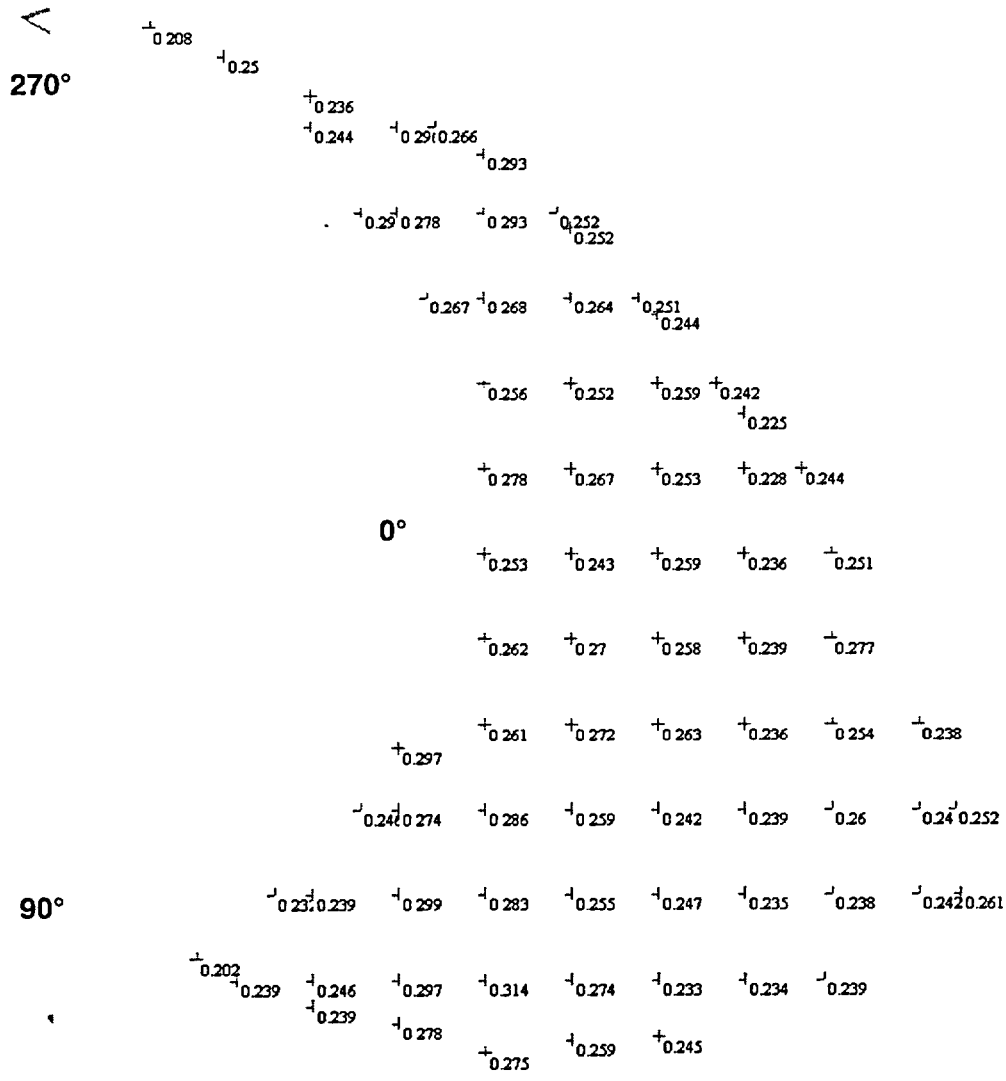


Figure 3(j)-1. Exposed stainless steel cladding thickness measurement.

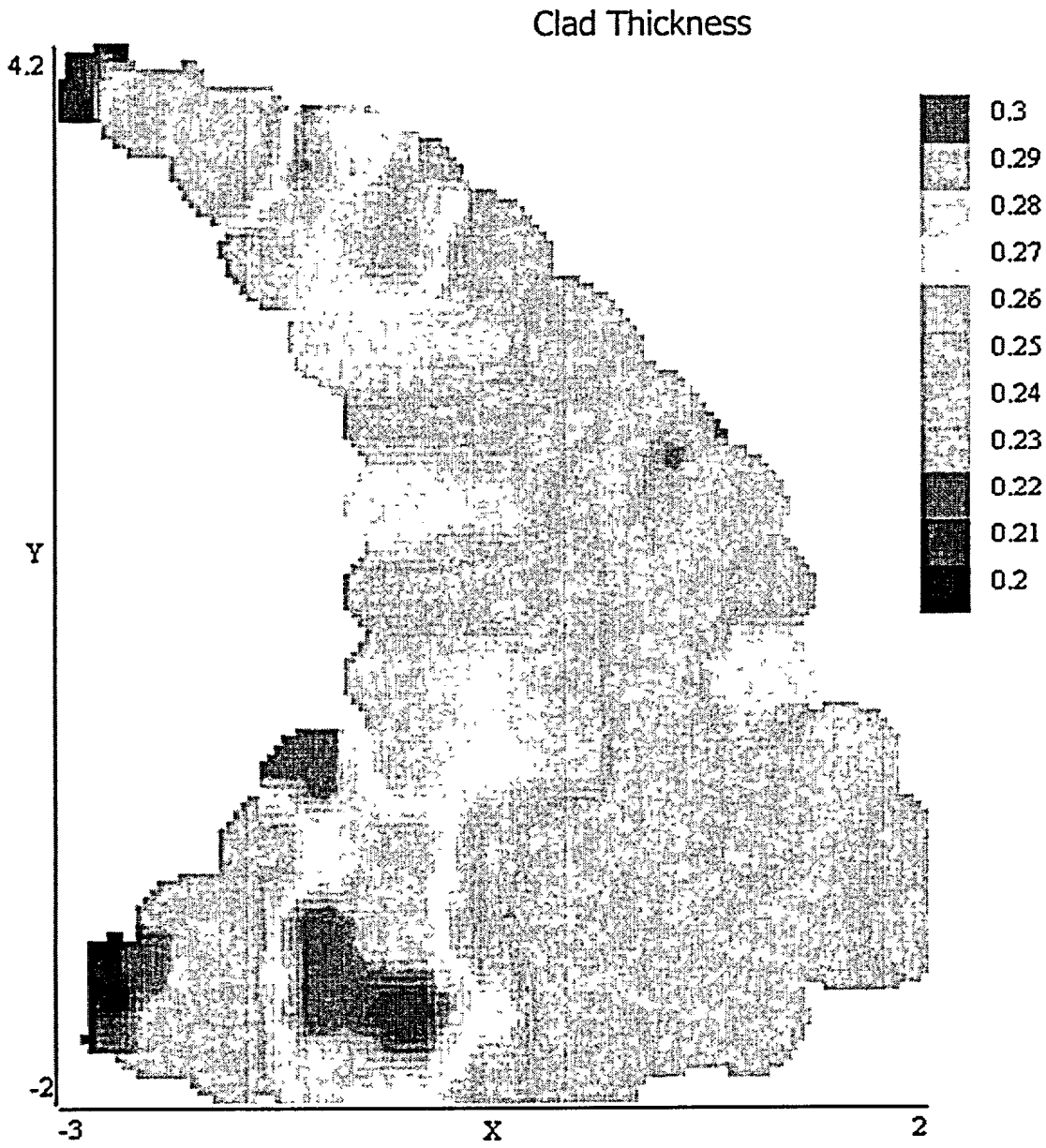


Figure 3(j)-2. Color representation of the exposed stainless steel cladding thickness based on Figure 3(j)-1 numbers.

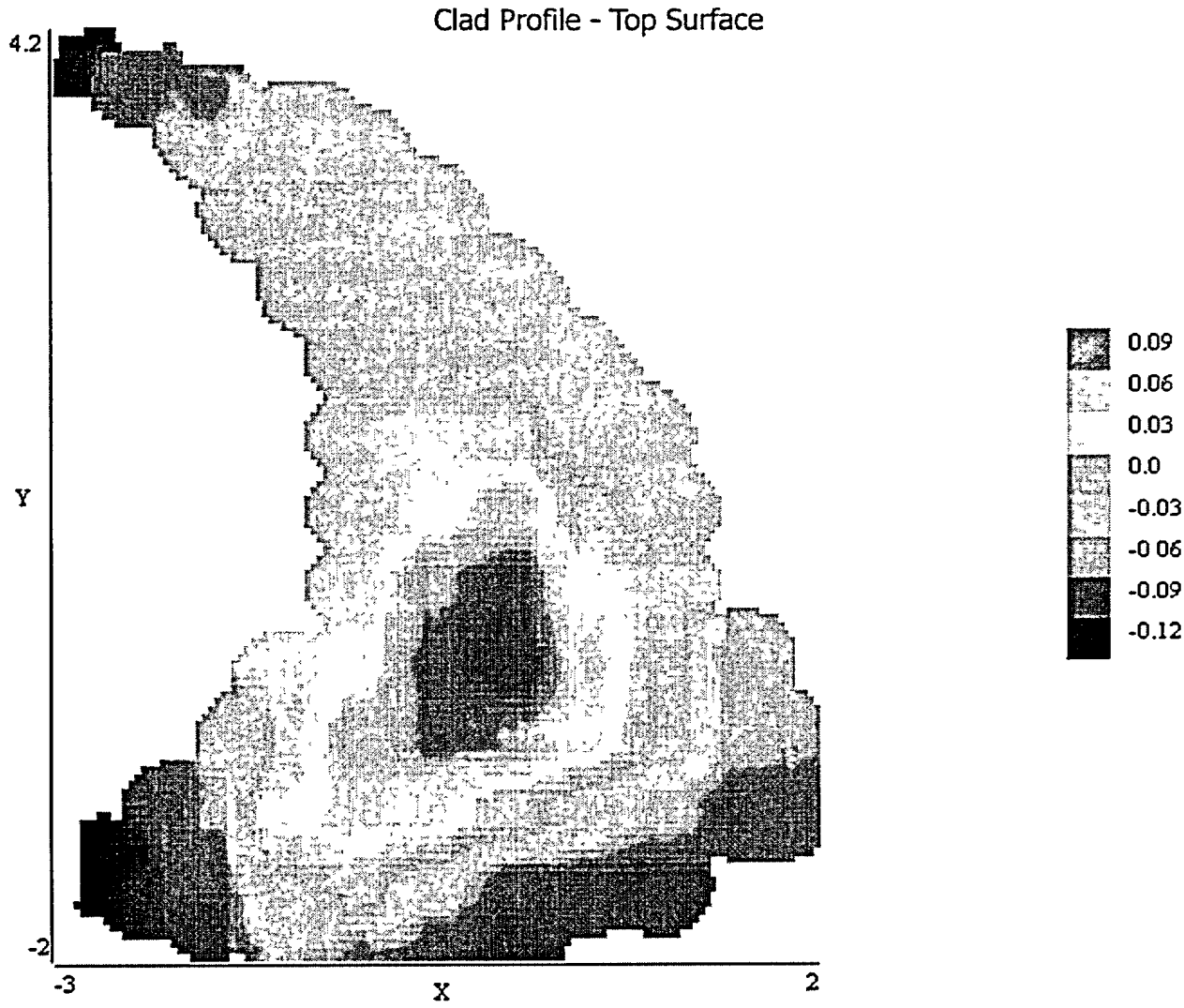


Figure 3(j)-3, Color representation of the elevation profile of the upper exposed cladding surface.

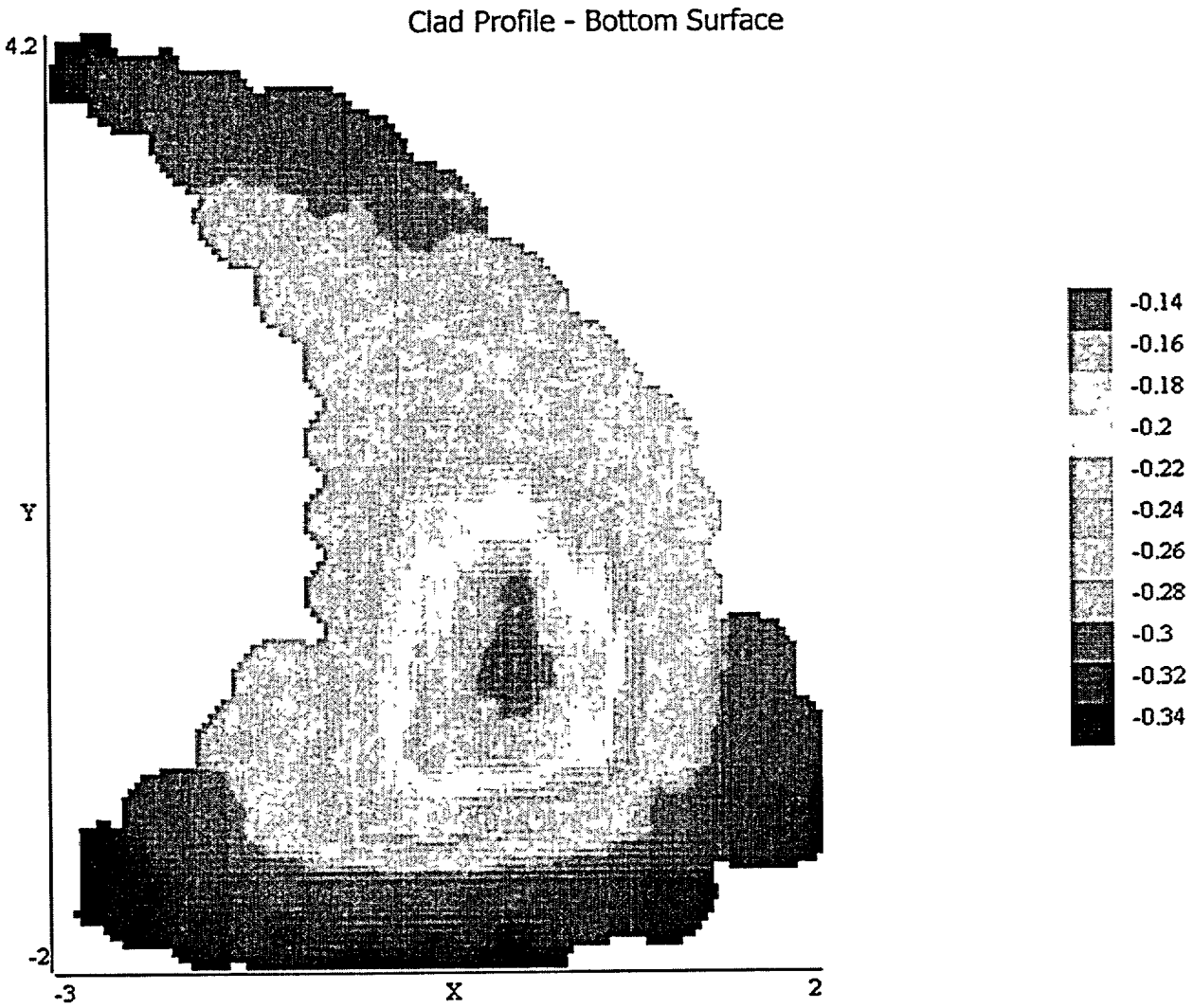
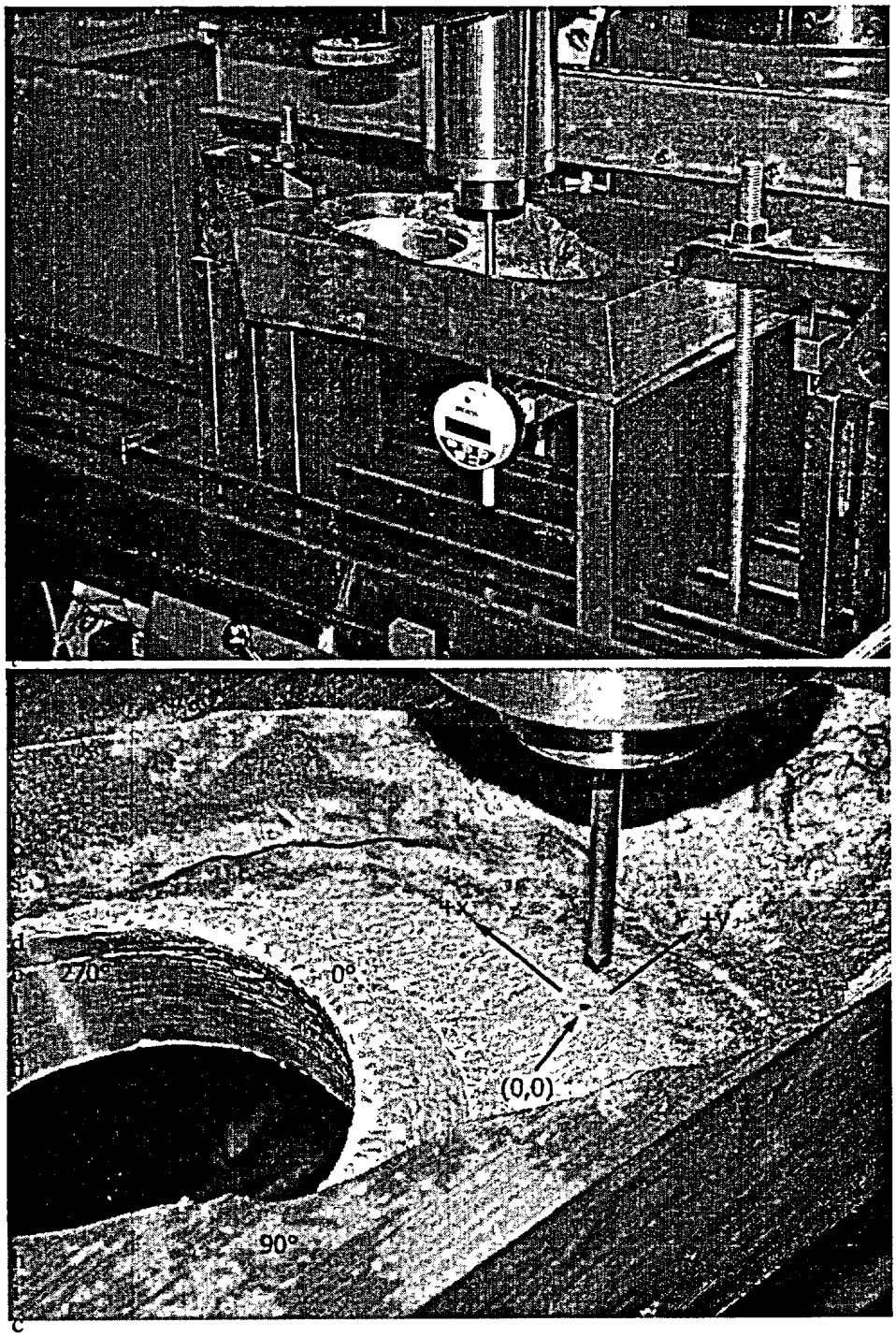


Figure 3(j)-4, Color representation of the elevation profile of area on the lower cladding surface corresponding to the exposed cladding on the upper side.



kness measurement. The two opposing dials are mechanicallly connected to ensure their identical X-Y positioning.

(k) Approved, but not performed yet.

(l) Approved, but not performed yet.

(m)Approved, but not performed yet.

Beside the above items already approved, all other testing of samples originated from Nozzle 3 Corrosion Area is currently on-hold, until the details of further sectioning and testing plan are finalized.