CAUSE ANALYSIS

NOP-LP-2001-03

CR Number
06-01122

Category / Eval Code: SR

Condition Description and Cause Basis:

■ Hardware / Degraded Condition Resolution Required? ☑ Yes ☐ No

If Yes, select one
☑ Repair ☐ Scrap
☐ Rework ☐ Use-As-Is

Process Code	Trend Codes						
HDW			(If cause is T or W)				
Activity Code		Cause Code		Component Code Type	ID#	Cause Org	
0575	Primary	T19	Corrosion	M	102	NONE	NONE
	Secondary						
	Tertiary						

Completed By:

Date:

00-01102

BEAVER VALLEY UNIT 1 SGR PROJECT - JOB NO. 24828
NONCONFORMANCE REPORT

1. NCR No. 044
2. PAGE 1 OF

3. DRAWING / SPECIFICATION ITEM NO.	4. REV.	5. ITEM DESCRIPTION	6. SAFETY RELATED
SK-E03-199-S-05-01	1	U1 EXTERIOR LINER PLATE	YES ☒ NO ☐

7. ITEM LOCATION	8. SYSTEM NO.	9. ITEM TRACE NO.	10. ASME III ITEM
U1 CONSTRUCTION OPENING	N/A	N/A	YES ☒ NO ☐

11. PURCHASE ORDER NO	12. SUPPLIER / SUBCONTRACTOR	13. WPIR / MRI No.
N/A	BECHTEL	C-LPR-111

14. NONCONFORMANCE CONDITION: APPARENT CAUSE/CODE: E GEMS CODE: MA ☒ KB ☐ RB ☐ SB ☐

A) 3 AREAS OF WHAT APPEARS TO BE CORROSION NOTED ON THE EXTERIOR SURFACE OF THE LINER PLATE. AREA (1) IS APPROXIMATELY 2' X 2' LOCATED NEAR THE CENTER OF THE CONSTRUCTION OPENING WITH A MAXIMUM DEPTH OF 3/16". AREA (2) IS APPROXIMATELY 1 1/2' X 2' LOCATED NEAR THE LOWER RIGHT HAND CORNER OF THE CONSTRUCTION OPENING WITH A MAXIMUM DEPTH OF 3/16". AREA (3) IS APPROXIMATELY 1' X 8" LOCATED NEXT TO SHEAR STUD 28-5 (UPPER LEFT DOOR SHEET LIFTING LUG) WITH A MAXIMUM DEPTH OF 1/8".

B) SHEAR STUD S 18-6 WAS REMOVED TO FACILITATE CUTTING OF THE LINER PLATE PER THE WPIR, A LINEAR INDICATION WAS DETECTED BY MT AND REMOVED BY MECHANICAL MEANS. RESULTING AREA WAS MEASURED AT 1 ½" L X ¾" W X 1/16" D, THIS AREA WILL BE COVERED BY LIFTING LUG NOTED AS FW-3. MT INSPECTION WAS ACCEPTABLE. AFTER SURFACE PREP DEZ 2/21/06

C) SURFACE GOUGES WERE NOTED IN THE GENERAL AREA AROUND SHEAR STUDS S 16-2 AND S 12-14 WITH A MAXIMUM DEPTH OF 1/32".

STUD LOCATIONS ARE MARKED ON THE EXTERIOR LINER PLATE. DEZ 2/21/06

THE (2) LOWER AREAS OF CORROSION WERE NOTED ON FENOC CR# 06-01122.

15. REPORTED BY/DATE:	16. REVIEWED BY/DATE:	17. VALIDATED BY/DATE:	18. NO. OF HOLD TAGS ISSUED:
[signature] 02/21/06	[signature] 2/21/06	D.E. Town 2/21/06	-1-

19. RECOMMENDED DISPOSITION: ___ REPAIR ___ REWORK ___ USE AS IS ___ REJECT ___ OTHER

ROUTE TO RESIDENT ENGINEERING FOR DISPOSITION. REQUEST INTERIM DISPOSITION FOR ITEM A. TO ALLOW FOR LIFT.

20. RECOMMENDED BY/DATE:	21. PE CONCURRENCE/DATE:
[signature] 2/21/06	Richard L. Pierce. [signature] 2-21-06

22. PROJECT ENGINEERING DISPOSITION: ___ REPAIR ___ REWORK ___ USE AS IS ___ REJECT ___ OTHER

SEE PAGES 4 AND 5 FOR INTERIM DISPOSITION OF BLOCK 14, PARTS A AND B. DATED 21FEB06

23. DISPOSITIONED BY/DATE:	24. CHECKED BY/DATE:	25. PE CONCURRENCE/DATE:	26. DESIGN CHANGE REQ'D. YES ☐ NO ☐
27. PPE CONCURRENCE/DATE:	28. PPQCE CONCURRDATE:	29. FENOC SGRP MANAGER CONCURRDATE	30. ANI CONCURRDATE

31. DISPOSITION IMPLEMENTATION:	32. REINSPECTION RESULTS:
33. IMPLEMENTED BY / DATE:	34. REINSPECTED BY / DATE:

35. PPQCE REVIEW / DATE:	36. ANI / DATE:	37. NO. OF HOLD TAGS REMOVED:

Page 2 of ____

NONDESTRUCTIVE EXAMINATION REPORT
MAGNETIC PARTICLE EXAMINATION

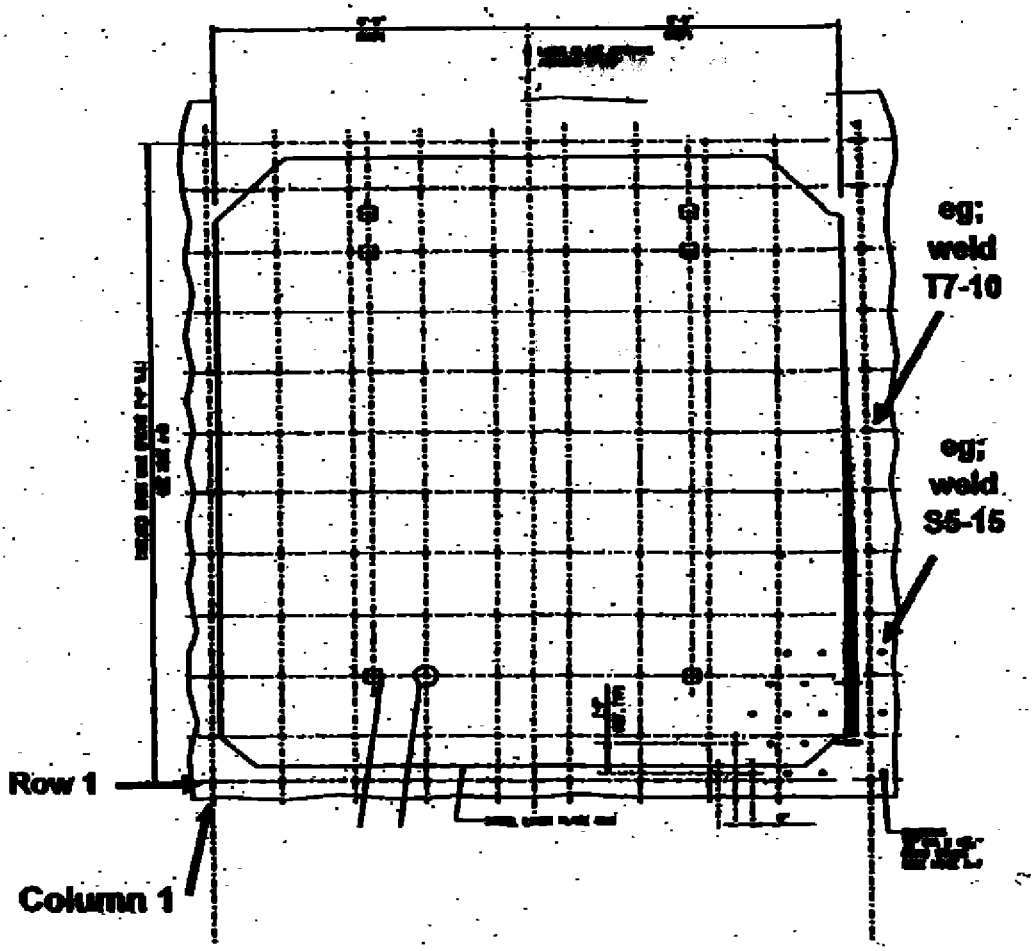
WP & IR C-LPR-111	BEAVER VALLEY U1 STEAM GENERATOR REPLACEMENT PROJECT		REPORT # 24928-MT-002
JOB # 24928	JOB NAME BEAVER VALLEY U1 SGRP	SURFACE CONDITION ☒ GROUND ☐ AS WELDED	DATE 2-21-06
ISO / DWG # SK-0199-S-05-01	ITEM / COMP ID EXTERIOR LINER PLATE STUD REMOVAL AREAS	TIME OF EXAM ☒ N/A ☐ PRE-PWHT ☐ POST-PWHT	COMPONENT TEMP < 600° F
CODE / WELD CLASS AMSE III 1989CL B	COMPONENT CONFIGURATION 3/8" LINER PLATE	MATL TYPE ☒ CARBON STEEL	PROCEDURE & REVISION MT-ASMEA/BAS R/0
EQUIPMENT ☒ YOKE ☒ AC ☐ DC ☒ CALIBRATION VERIFIED ☒ 10 LBS ☐ 40 LBS S/N YCB-25	EXAM MEDIUM ☒ DRY ☐ WET ☒ VISIBLE ☐ FLUORESCENT Manufacturer Magnaflux DRY / color RA RED Batch [illegible]		

INDICATION CODE: ROUND=ROUNDED INDICATION NI = NO INDICATION LINEAR=LINEAR INDICATION

PART OR WELD #	ACC	REJ	IND CODE	REMARKS
S 23-7	XX		NI	
S 20-6	XX		NI	
S 18-6	XX		NI	
S 6-6	XX		NI	
S 23-18	XX		NI	

Sketch / Comments YOKE MODEL B 310 SN 3588

Bechtel Glenn Cabral	Level II	Date 2-21-06
Reviewer	Level II	Date 2-21-06



Stud Weld numbers shall be based upon:
the type stud, 'T' for 1/2" diameter threaded
and 'S' for 5/8" headed shear studs
which vertical row it is in and
what horizontal column it is in.
See examples given above

VIEW – OUTSIDE LOOKING INTO CTMT

Reference WP& IR C-LPR-111 and C-LPR-112
Dwg. : 1-RV-0001GA-E03-0199-02

CONTROLLED COPY

ST-2

REV.	DATE	DESCRIPTION	DRAWN	CKD	PFE
1	1/26/06	Added references	[illegible]	[illegible]	JK
0	1/21/06	ISSUED FOR US E	[illegible]	[illegible]	JK

BECHTEL FREDERICK, MARYLAND	LINER PLATE STUD WELD MAP
BEAVER VALLEY UNIT 1 STEAM GENERATOR REPLACEMENT PROJECT	JOB NO. 24928 / SCALE: NTS
	FSK-C-114 / SHEET 1 OF 1

Project Engineering Disposition (Block 22):

Interim Disposition Dated 21FEB06:

Acceptance for rigging and handling cut section of liner plate with corrosion areas / linear indications

According to Block 14, Parts A and B, three (3) corrosion areas and one (1) linear indication have been identified during initial inspection of the liner plate exterior surface within the plate area to be cut and temporarily removed.

Part A (1): The identified 2-ft x 2-ft area has sporadic pitting with maximum identified depth of pit equal to 3/16" resulting in a reduced plate section at the center of door sheet. The FEM results and associated FEM stress plots contained in Bechtel Calculation 24928-C-301 document that for the intact plate, the minimum factor of safety against elastic buckling is 4.49 and the maximum plate stress at any location is 10.59 ksi providing a significant level of margin. Therefore, the small reduction in plate section will have a negligible effect on the overall plate stress and plate buckling behavior.

Part A (2): The identified 1-1/2-ft x 2-ft area has sporadic pitting with maximum identified depth of pit equal to 3/16" resulting in a reduced plate section near the lower right-hand corner of the door sheet. Since this area is located outside any high stress areas (area bounded by the rigging points), the overall plate behavior during the removal process is not adversely impacted by the localized reduced plate section.

Part A (3): The identified 1-ft x 8-in area has sporadic pitting with maximum identified depth of pit equal to 1/8" resulting in a reduced plate section in the vicinity of a lifting lug attachment plate at the top, left-hand side of the door sheet. The FEM results and associated FEM stress plots contained in Bechtel Calculation 24928-C-301 document that during the rigging process, plate stress is concentrated near the rigging point and is localized. Provided the rigging attachment plate is welded to sound liner plate material, the liner plate and rigging attachment will behave as evaluated. As the subject area is located outside an area bounded by the rigging points, buckling is not a concern. Considering the reduced liner plate thickness of ¼" for punching shear area at the rigging attachment perimeter, 4(6")(1/4") = 6 sq in, and the maximum sling tension of 5.67 kip, the punching shear stress in the door sheet is 0.95 ksi, which is negligible.

Part B: The identified linear indication was found after removing a nelson stud interference for a PL1.5"x6"x6" rigging attachment plate. As noted, the indication was removed by mechanical means and a follow-up MT examination was acceptable. Therefore, concern for crack propagation is eliminated. The current installation location for the rigging attachment plate will cover the identified indication. Since the indication was an existing condition that after mechanical removal has resulted in a reduced liner plate thickness, the area will require further evaluation by FENOC and possibly additional repair. Therefore, for the purpose of door sheet removal, the subject rigging attachment plate shall be moved vertically by 3-inches to leave the indication area exposed. The minor location adjustment for the rigging attachment plate has a negligible impact on the evaluations performed in Calculation 24928-C-301 for global liner plate behavior and stress. The minimum liner plate thickness near the rigging point is 5/16-inch. Considering this reduced liner plate thickness of 5/16" for punching shear area at the rigging attachment perimeter, 4(6")(5/16") = 7.5 sq in, and the maximum sling tension of 5.67 kip, the punching shear stress in the door sheet is 0.76 ksi, which is negligible.

(continued on Page 5)

NONCONFORMANCE REPORT CONTINUATION BEAVER VALLEY UNIT 1 SGR PROJECT - JOB NO. 24628	1. NCR No. 044 2. PAGE 6 OF

Project Engineering Disposition (Block 22):

Interim Disposition Dated 21FEB06 (continued):

Work may proceed with the following direction:

1) Removal of the door sheet from within the construction opening and movement to its designated lay down area may proceed.

2) All rigging attachment plates shall be welded to sound liner plate material.

3) For the rigging attachment plate identified in Block 14, Part B, the rigging attachment plate shall be re-located in the vertical direction by 3-inches (mm) each that the noted linear indication remains exposed.

This NCR will be forwarded to FENOC Engineering for further evaluation to address final acceptability of the identified nonconforming areas.

DISPOSITIONED BY/DATE:		/ 2-21-06
CHECKED BY/DATE		/ 21FEB06
PE CONCURRENCE/DATE		/ 21 Feb 06
PFE CONCURRENCE/DATE		/ 21 Feb 06
PFQCE CONCUR/DATE	D.E. Town	/ 2-21-06
FENOC SGRP MGR CONCUR/DATE	for Kenneth E. Halliday	/ 21st FEBRUARY 2006
ANII CONCUR/DATE:	per telecon w/ D Nizuk 9310	/ 2-21-06

James Roemer/CONTRACTORS/FirstEnergy

02/22/2006 04:03 PM

To Mary Ann Gillooly/FirstEnergy

cc Glenn S Ritz/FirstEnergy, Joann R Young/FirstEnergy, Theodore A Sockaci/FirstEnergy

bcc

Subject Attachments to CR 06-01122 Hard Mailed Today

NCR-044 has been sent to you today in an inter-office mailer. Please scan in as an attachment to CR 06-01122. Note that the NCR scope is larger than the initiat scope of this CR. As the plate exterior is prepared for reinstallation, other discrepancies and surface irregularities may be found. For that reason I'd like this single CR to represent the investigation into ALL discrepancies on the liner plate exterior, and ultimately dispositon them all.

Similarly, CR 06-01061 will represent the investigation into ALL discrepancies on the liner plate interior, and ultimately dispositon those. Associated NCR-040 has already been sent for scanning, according to Joann.

Attachment 5

NDE VT Reports

(7 pages)

FENOC Visual Exam of Equipment and Components (General)

FirstEnergy Nuclear Operating Company

Site/Unit:	BV / 1	Procedure:	VT-500 / VT-509	Outage No.:	N/A
Summary No.:	CA 06-01122-04	Procedure Rev.:	11 / 6	Report No.:	BOP-VT-06-040
Workscope:	BOP-1	Work Order No.:	Bechtel WPIR	Page:	1 of 2

Code: NA Cat./Item: NA/NA Location: Unit 1 Containment

Drawing No.: NA Description: VT of removed Reinforcing Bars

System ID: Concrete Containment

Component ID: Rebar at Opening

Limitations: Removed rebar - on trailers - only sampling (approx 50%) was inspected.

Resolution: 1/32" Line Surface Condition: AS FOUND

Light Meter Mfg.: N/A Serial No.: N/A Illumination: NA

Visual Equipment/Aids: FLASHLIGHT, CAMERA

Lo Location: End of Rebar Wo Location: NA

Loc L	Loc W	Loc U/D	Ind. R/L	Size D/L	Remarks
89"	N/A	N/A	N/A	N/A	See page 2 for details.

Comments:

See page 2 for image - Rebar strapped to flatbed and covered with plastic - approx 50% of surfaces are visible.

Results: Sat ☐ Unsat ☐ Info ☑

Percent Of Coverage Obtained > 90%: N/A Reviewed Previous Data: N/A

Examiner Dugan, Michael	Level III	Signature	Date 2/25/2006	Reviewer N/A		Signature	Date
Examiner N/A	Level N/A	Signature	Date	Site Review Kocher, Terry R. L- II		Signature	Date 2/27/2006
Other N/A	Level N/A	Signature	Date	ANII Review DEAN WIZNIK		Signature	Date 2-27-06

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FENOC

Supplemental Report

Report No.: BOP-VT-06-040

Summary No.:	CA 06-01122-04						
Examiner:	Dugan, Michael	Level:	III	Reviewer:	N/A	Date:	
Examiner:	N/A	Level:	N/A	Site Review:	Kocher, Terry R. L- II	Date:	2/27/2006
Other:	N/A	Level:	N/A	ANII Review:		Date:	

Comments: 1 area of corrosion and pitting 89" from end of rebar to CL of pitted area. The area is approx. 9" long x 1-1/2" wide. Rebar # 8-D4B

Sketch or Photo: S:\AII\NDE\IMAGES\BOP-VT-06-040.jpg

FENOC
FirstEnergy Nuclear Operating Company

Visual Examination of Component Supports and Snubbers (VT-3)

Site/Unit:	BV / 1	Procedure:	VT-500 / VT-503	Outage No.:	N/A
Summary No.:	CA 06-01122-05	Procedure Rev.:	11 / 21	Report No.:	BOP-VT-06-041
Workscope:	BOP-1	Work Order No.:	Bechtel WPIR	Page:	1 of 5

Code: GENERAL INSPECTION Cat./Item: NA/NA Location: Paint Shop

Drawing No.: NA Description: Areas #1 & 2 prior to paint removal for autoscans

System ID: Containment Liner

Component ID: Removed liner Plate

Limitations: None

Light Meter Mfg.: N/A Serial No.: N/A Illumination: N/A

Temp. Tool Mfg.: N/A Serial No.: N/A Surface Temp.: NA °F

Resolution: 1/32" Line Surface Condition: PAINTED

Visual Equipment/Aids: FLASHLIGHT AND CAMERA (DIGITAL)

All Components	Sat	Unsat	N/A	See Comments
1) External Obstruction			✓	
2) Cracks or Linear Ind.			✓	
3) Loose Parts			✓	
4) Missing Parts			✓	
5) Obstr. To Moving Parts			✓	
6) Wear			✓	
7) Corrosion/Coating			✓	
8) Contaminants			✓	
9) Improper Weld Reinfor.			✓	
10) Physical Deformation			✓	
11) Misuse			✓	
12) Slipped Clamps			✓	
13) Other (Describe)			✓	
14) Correct Settings	Yes	No	✓	N/A
15) Actual Setting	N/A			
16) Serial No.	N/A			
Constant Load Supports				
17) Travel Stops in Place			✓	
18) Housing Damage			✓	

Spring Supports	Sat	Unsat	N/A	See Comments
19) Off Scale High			✓	
20) Off Scale Low			✓	
21) Locking Device In Place			✓	
22) Spring Degraded			✓	
23) Gross Misalignment			✓	
Mechanical Snubbers				
24) Swing Clearance			✓	
25) Bent Extension Rod			✓	
26) Housing Damage			✓	
Hydraulic Snubbers				
27) Reservoir Level			✓	
28) Leakage			✓	
29) Piston Fully Extended			✓	
30) Piston Fully Retracted			✓	
31) Reservoir Inverted			✓	
32) Piston Damage			✓	

Comments:

See attachements for images and conditions observed. This activity to support the paint removal to enable UT autoscans of the designated areas.

Results: Sat ☐ Unsat ☐ Info ☑

Percent Of Coverage Obtained > 90%: Yes Reviewed Previous Data: N/A

Examiner	Level III	Signature	Date	Reviewer		Signature	Date
Dugan, Michael			2/25/2006	N/A			
Examiner	Level N/A	Signature	Date	Site Review		Signature	Date
N/A				Buck, George L. L-III			2/27/2006
Other	Level N/A	Signature	Date	ANII Review		Signature	Date
N/A				DEAN WIZNIK			2-28-06

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FENOC

FirstEnergy Nuclear Operating Company

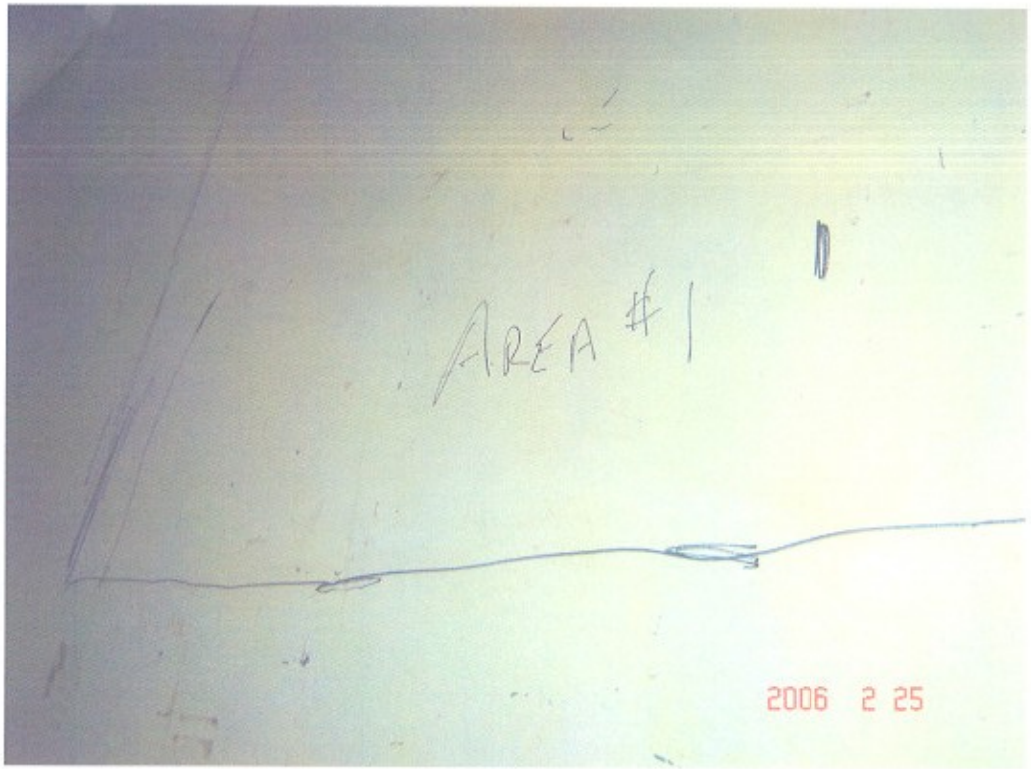
Supplemental Report

Summary No.: CA 06-01122-05

Examiner:	Dugan, Michael	Level:	III	Reviewer:	N/A	Date:	
Examiner:	N/A	Level:	N/A	Site Review:	Buck, George L. L-III	Date:	2/27/2006
Other:	N/A	Level:	N/A	ANII Review:	Dean Nizvik	Date:	2-28-06

Comments: **Area #1 Painted surface prior to paint removal. Some minor coating damage present - there is no substrate damage. Damage appears to have been caused by handling during removal and transport. No other indications observed.**

Sketch or Photo: S:\AII\NDE\IMAGES\BOP-VT-06-041-1.jpg



FENOC
FirstEnergy Nuclear Operating Company

Supplemental Report

Summary No.: CA 06-01122-05

Examiner:	Dugan, Michael	Level:	III	Reviewer:	N/A	Date:	
Examiner:	N/A	Level:	N/A	Site Review:	Buck, George L. L-III	Date:	2/27/2006
Other:	N/A	Level:	N/A	ANII Review:	DEAN NIZNIK	Date:	2-28-06

Comments: **Area #1 corroded surface shown for reference.**

Sketch or Photo: S:\AII\NDE\IMAGES\BOP-VT-06-041-2.jpg

FENOC
FirstEnergy Nuclear Operating Company

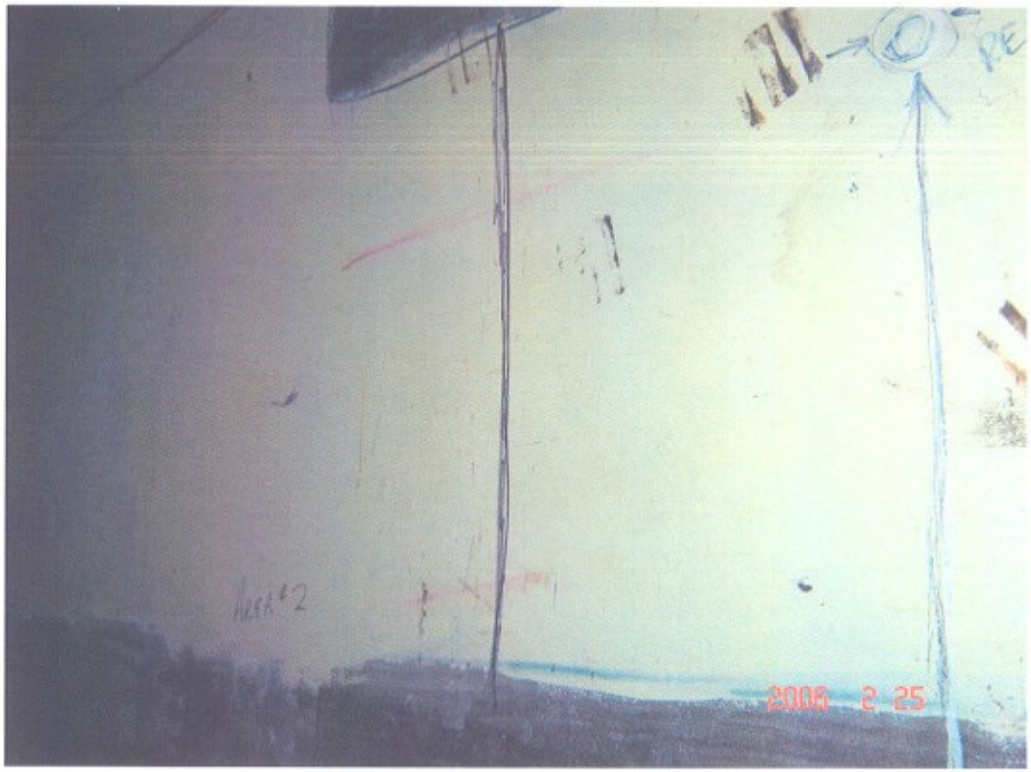
Supplemental Report

Summary No.: CA 06-01122-05

Examiner:	Dugan, Michael	Level:	III	Reviewer:	N/A	Date:	
Examiner:	N/A	Level:	N/A	Site Review:	Buck, George L. L-III	Date:	2/27/2006
Other:	N/A	Level:	N/A	ANII Review:	DEAN NIZNIK	Date:	2-28-06

Comments: **Area #2 painted surface prior to paint removal. Some minor coating damage present - there is no substrate damage. Damage appears to have been caused by handling during removal and transport. No other indications observed.**

Sketch or Photo: S:\AII\NDE\IMAGES\BOP-VT-06-041-3.jpg



FENOC
Firstenergy Nuclear Operating Company

Supplemental Report

Summary No.: CA 06-01122-05

Examiner:	Dugan, Michael	Level:	III	Reviewer:	N/A	Date:	
Examiner:	N/A	Level:	N/A	Site Review:	Buck, George L. L-III	Date:	2/27/2006
Other:	N/A	Level:	N/A	ANII Review:		Date:	

Comments: **Area #2 corroded surface shown for reference.**

Sketch or Photo: S:\AII\NDE\IMAGES\BOP-VT-06-041-4.jpg

Attachment 6

NDE UT Reports

(19 pages)

FENOC

UT Erosion/Corrosion Examination

Site/Unit:	BV / 1	Procedure:	UT-308	Outage No.:	N/A
Summary No.:	R&D Paint "t"	Procedure Rev.:	13	Report No.:	BOP-UT-06-024
Workscope:	BOP-1	Work Order No.:	R&D	Page:	1 of 3

Code: REPORT RESULTS Cat./Item: NA/NA Location: PAINT SHOP

Drawing No.: NA Description: 0.375 Containment liner plate

System ID: LINER PLATE

Component ID: CUT OUT LINER PLATE Size/Length: 1" DIA. AREA Thickness/Diameter: NA

Limitations: THROUGH PAINT Component File No.: Prior to paint removal Start Time: 1615 Finish Time: 1705

Calibration Information

Calibration Thickness (In)		Calibration Times / Initials		
.500	.500	Start:	1615	GFF
.376	.375	Verify:	NA	NA
.251	.250	Verify:	NA	NA
.126	.126	Verify:	1640	MD
NA	NA	Final:	1705	MD

Partitioning Information

Component	Begin/Col/Row	Ending/Col/Row
M. UPST Ext.	NA	NA
Main UPST.	NA	NA
Main	NA	NA
Main DNST.	NA	NA
M. DNST Ext.	NA	N/A
Branch	N/A	N/A
Branch Ext.	N/A	N/A

Component Information

Component Geometry:	0.375 NOM. PLATE		
Outside Diameter:	NA	Grid Size:	NA
Max. Thickness:	NA	Min. Thickness:	NA
Nominal Thickness:	NA	Tmin.:	NA
Min. Thickness Location:	N/A		
Max. Thickness Location:	N/A		

Instrument:
Manufacturer: K-KRAMER
Model: DMS
Serial No.: 008M99
Gain: 64
Range: 1.0"

Transducer:
Manufacturer: KBAEROTECH
Serial No.: G31936
Size: .380" DUAL Freq.: 7.5 MHz.
Model: FH2E
# of Elements: 2

Reference/Simulator Block:
Serial No.: BDTG0001
Type: C/S STEP
Ref./Simulator Block Temp.: 63.2 °F
Material/Component Temp.: 62.4 °F

Temp. Tool:
Manufacturer: FLUKE
Serial No.: I-II-2.7896

Couplant:
Type: ULTRAGEL II
Batch No.: 02125

Comments/Obstructions: ONE AREA TAKEN TO DETERMINE PLATE THICKNESS THROUGH PAINT.

Results: Sat ☐ Unsat ☐ Info ☑ A FOLLOW UP REPORT AFTER THE PAINT IS REMOVED WILL BE 2-25-06

Examiner Freeh, Gary F.	Level II	Signature Gary Freeh	Date 2/24/2006	Reviewer N/A		Signature	Date
Examiner Dugan, Michael	Level III	Signature	Date 2/24/2006	Site Review Buck, George L. L-III		Signature George Buck	Date 2/25/2006
Other N/A	Level N/A	Signature	Date	ANII Review Dean Nizwik		Signature Dean Nizwik	Date 2-27-06

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FENOC
FirstEnergy Nuclear Operating Company

Supplemental Report

Report No.: BOP-UT-06-024

Summary No.:	R&D Paint "t"						
Examiner:	Freeh, Gary F. GFF	Level:	II	Reviewer:	N/A	Date:	
Examiner:	Dugan, Michael SWM	Level:	III	Site Review:	Buck, George L. L-III GLB	Date:	2/25/2006
Other:	N/A	Level:	N/A	ANII Review:	Scannizuik	Date:	2-27-06

Comments:

Sketch or Photo: R:\AII\NDE\IMAGES\BOP-UT-06-024-1.jpg

FENOC
FirstEnergy Nuclear Operating Company

Supplemental Report

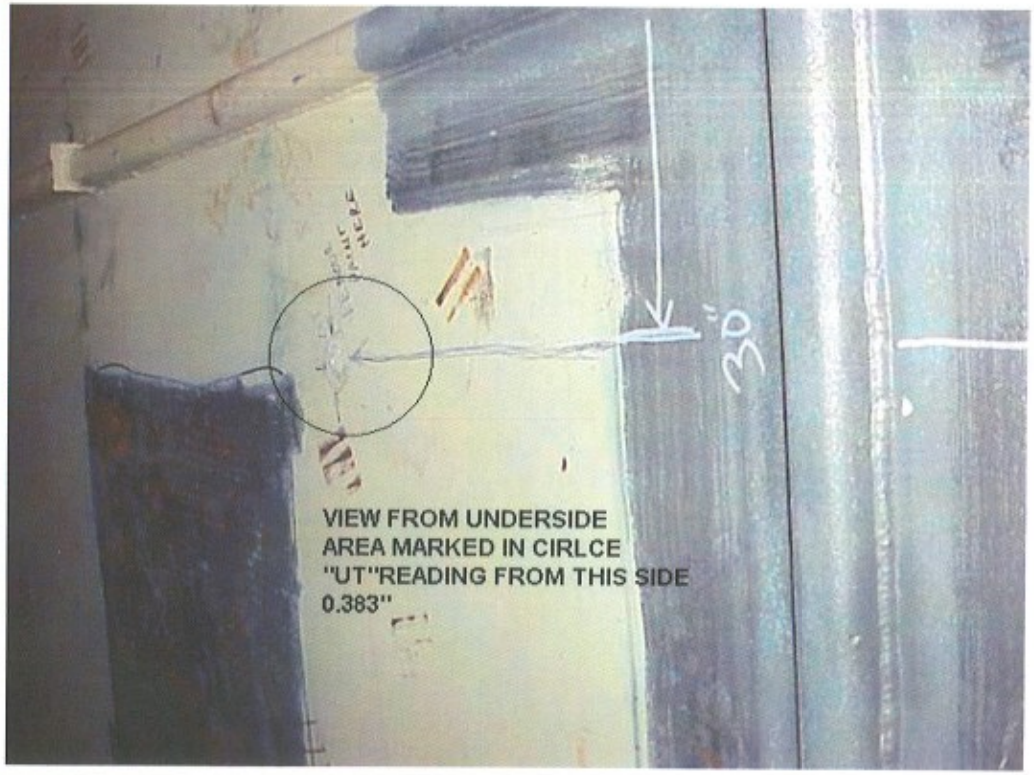
Report No.: BOP-UT-06-024

Summary No.: R&D Paint "t"

Examiner:	Freeh, Gary F. GAF	Level:	II	Reviewer:	N/A	Date:	
Examiner:	Dugan, Michael	Level:	III	Site Review:	Buck, George L. L-III	Date:	2/25/2006
Other:	N/A	Level:	N/A	ANII Review:	DEAN NIZWIK	Date:	2-27-06

Comments:

Sketch or Photo: R:\AI\NDE\IMAGES\BOP-UT-06-024-2.jpg



FENOC
FirstEnergy Nuclear Operating Company

UT Erosion/Corrosion Examination

Site/Unit:	BV / 1	Procedure:	UT-315	Outage No.:	N/A
Summary No.:	Liner Plate Auto1	Procedure Rev.:	4	Report No.:	BOP-UT-06-025
Workscope:	BOP-1	Work Order No.:	R&D	Page:	1 of ~~1~~ 4

Code: Report Results Cat./Item: NA/NA Location: Paint Shop TCH 2/26/06

Drawing No.: NA Description: Rusted Cont Liner Plate Area

System ID: Containment Liner

Component ID: Liner Plate Loc 1 Size/Length: NA Thickness/Diameter: 3/8" nominal

Limitations: None Component File No.: Liner_Plate_Area_1 Start Time: 1851 Finish Time: 1951

Calibration Information

Calibration Thickness (In)		Calibration Times / Initials		
0.139	0.138	Start:	1705	TCH
0.237	0.233	Verify:	NA	NA
0.339	0.332	Verify:	NA	NA
0.439	0.432	Verify:	NA	NA
0.539	0.539	Final:	1955	TCH

Partitioning Information

Component	Begin/Col/Row	Ending/Col/Row
M. UPST Ext.	NA	NA
Main UPST.	NA	NA
Main	NA	NA
Main DNST.	NA	NA
M. DNST Ext.	NA	NA
Branch	NA	NA
Branch Ext.	NA	NA

Component Information

Component Geometry: Liner Plate
Outside Diameter: NA Grid Size: NA
Max. Thickness: NA Min. Thickness: .225"
Nominal Thickness: 0.375" Tmin.: NA
Min. Thickness Location: X= 9.35", Y = 7.35"
Max. Thickness Location: NA

Instrument:
Manufacturer: WESDYNE AMDATA
Model: INTRASPECT LAPTOP
Serial No.: UTS-002
Gain: 60
Range: 0.500"

Transducer:
Manufacturer: KBAEROTECH
Serial No.: 00264C
Size: .375" DIA Freq.: 7.5 MHz.
Model: FH2E
# of Elements: 2

Reference/Simulator Block:
Serial No.: CS-1
Type: NOTCH BLOCK
Ref./Simulator Block Temp.: 70.2 °F
Material/Component Temp.: 69.2 °F

Temp. Tool:
Manufacturer: FLUKE
Serial No.: I-II-2.7896

Couplant:
Type: DEMIN. WATER
Batch No.: DEMIN. WATER

Comments/Obstructions: Designated Location #1 - start point 67" from Left edge; 83" from Bottom edge Scan area 13" x 18"

Results: Sat ☐ Unsat ☐ Info ☑ 253.6 square inches - 101,441 data points (.05 x .05 index in both axes)

Examiner Level III Heimel, Timothy C.	Signature Timothy C Heimel	Date 2/25/2006		Reviewer N/A	Signature	Date	
Examiner Level III Dugan, Michael	Signature Shl Dug	Date 2/25/2006		Site Review Buck, George L. L-III	Signature George Buck	Date 2/27/2006	
Other Level N/A N/A	Signature	Date		ANII Review	Signature	Date	

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BOP-UT-06-025
P. 2 of 4

Print at: Sunday, February 26, 2006 12:09:28 PM
Host: FIRST_ENERGY
User: Intraspect

C-Scan Statistics

C-Scan Depth/Thickness Statistics
File: Liner_Plate_Area_1 Channel 1 Gate SW1

Select Area in C-Scan then press 'Process'

Search Criteria

Amplitude Threshold	10	% FSH
Depth Threshold	0.328	in

Search Area

X Axis	0.000	to	18.000	in
Y Axis	0.000	to	14.000	in

Area Information

Total Area	253.602	sq in	101441	pts		
Above Depth Threshold	211.792	sq in	84717	pts	84	%
Below Depth Threshold	5.457	sq in	2183	pts	2	%
Not Considered	36.352	sq in	14541	pts	14	%

Depth/Thickness Statistics

Non-Relevent	9	pts		X Axis		Y Axis	
Minimum	0.225	in	at	9.350	in	7.350	in
Maximum	0.456	in	at	10.500	in	1.850	in
Mean	0.383	in					
Median	0.387	in					
Std Dev	0.016	in					

Process Close Save to Notes

BOP-UT-06-025
P. 3 of 4

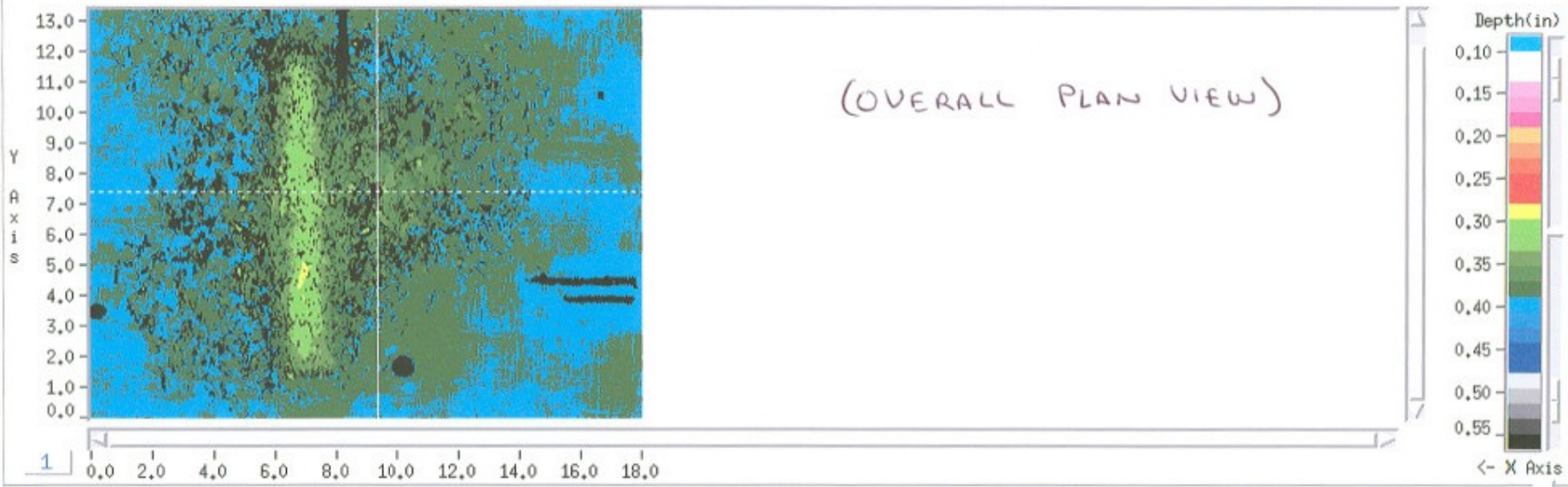
Print at: Sunday, February 26, 2006 12:02:01 PM
Host: FIRST_ENERGY
User: Intraspect

Analysis - Liner_Plate_Area_1 - Unlocked

File Mode Channel Gate C-Scan B-Scan A-Scan Tools Display Settings Help

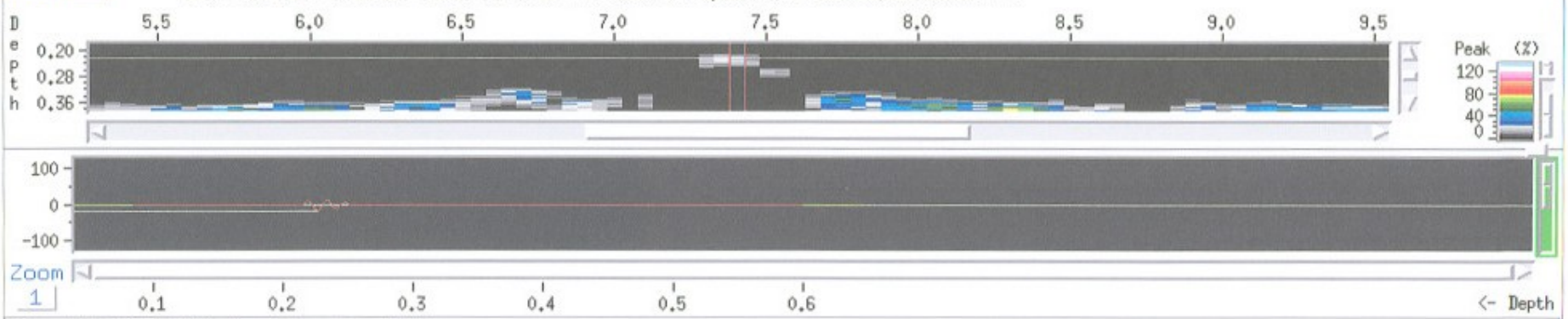
File: Liner_Plate_Area_1 Exam Date: 02/25/2006 Time: 18:51 - 19:51 WP: N/A M
Channel: 1 Gate: SW 1 Mode: Thresh Video Mode: Off Video Filter: 2
Gain: 60.0 dB Dac: ON Offset: 6.0 db Pulser Voltage: 400

Y Axis: 7.400, X Axis: 9.350 Depth: 0.225 in



Zoom 10:0.25

Y Axis: 7.400 X Axis: 9.350 DTOF: 1.580 us Meas: NA C
SY Axis: 7.400 SX Axis: 9.350 Soft Gain: 0.0
AMP: -20% TOF: 8.780 us TOF2: 7.200 us MP: 0.225 in Dpth: 0.225 Thcknss: 22.46% @ 1/2 V



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P. 4 of 4

Print at: Monday, February 27, 2006 07:44:29 AM
Host: FIRST_ENERGY
User: Intraspect

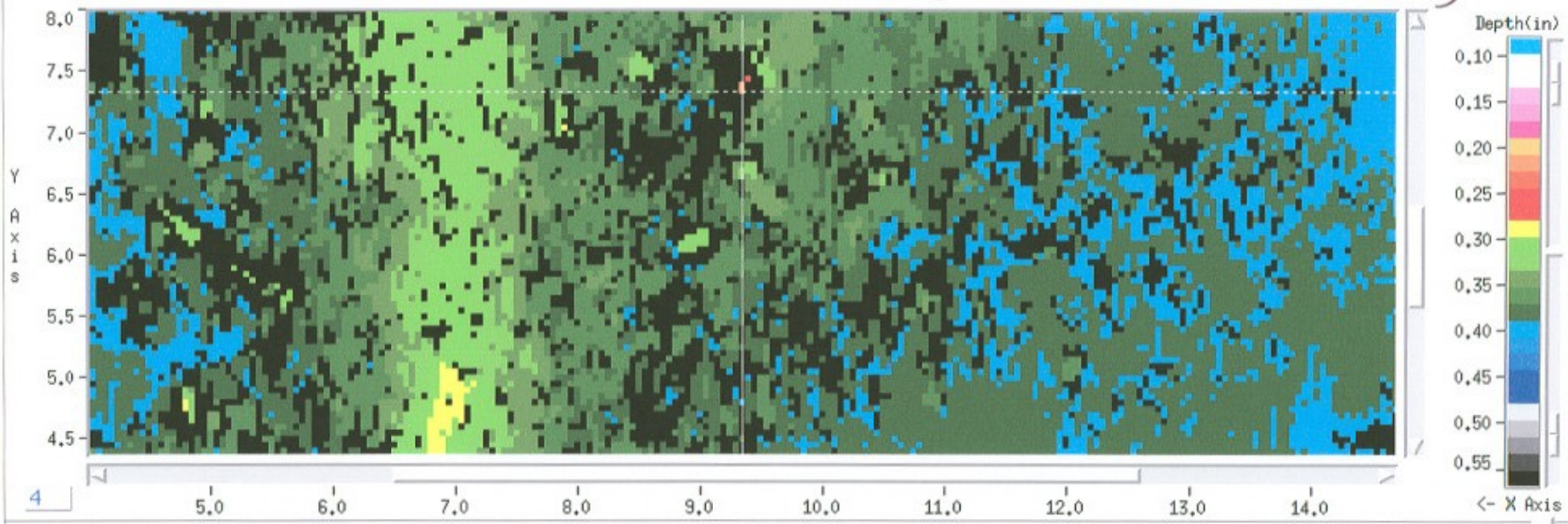
Analysis - Liner_Plate_Area_1 - Unlocked

File Mode Channel Gate C-Scan B-Scan A-Scan Tools Display Settings Help

File: Liner_Plate_Area_1 Exam Date: 02/25/2006 Time: 18:51 - 19:51 WP: N/A M
Channel: 1 Gate: SW 1 Mode: Thresh Video Mode: Off Video Filter: 2
Gain: 60.0 dB Dac: ON Offset: 6.0 db Pulser Voltage: 400

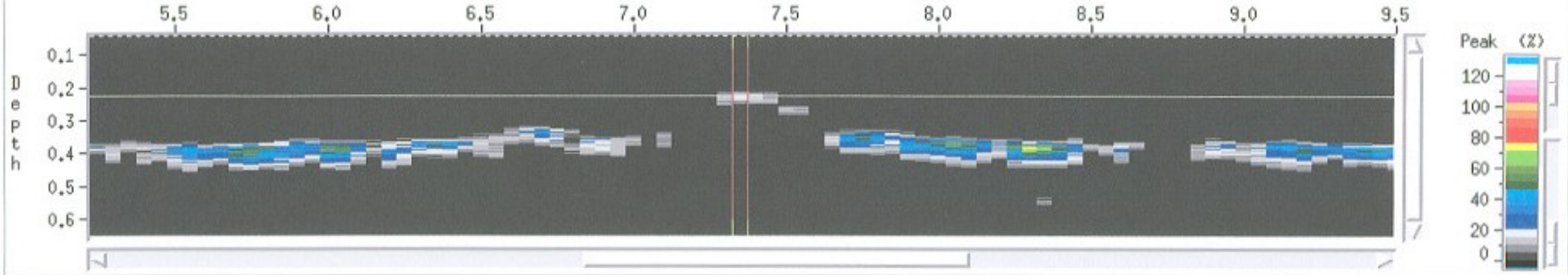
Y Axis: 7.350, X Axis: 9.350 Depth: 0.225 in

(DETAIL OF DEEPEST PIT)



Zoom
10:0.25

Y Axis: 7.350 X Axis: 9.350 DTOF: 1.580 us Meas: NA C
SY Axis: 7.350 SX Axis: 9.350 Soft Gain: 0.0
AMP: -22% TOF: 8.780 us TOF2: 7.200 us MP: 0.225 in Dpth: 0.225 Thcknss: 22.46% @ 1/2 V



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FENOC
FirstEnergy Nuclear Operating Company

UT Erosion/Corrosion Examination

Site/Unit:	BV / 1	Procedure:	UT-315	Outage No.:	N/A
Summary No.:	Liner Plate Auto 2	Procedure Rev.:	4	Report No.:	BOP-UT-06-026
Workscope:	BOP-1	Work Order No.:	R&D	Page:	1 of ~~2~~ 6

TCH 2-27-06

Code:	Report Results	Cat./Item:	NA/NA	Location:	Paint Shop
Drawing No.:	NA	Description:	Rusted Cont Liner Plate Area		
System ID:	Containment Liner				
Component ID:	Liner Plate Loc 2	Size/Length:	NA	Thickness/Diameter:	3/8" nominal
Limitations:	None	Component File No.:	BV1_Liner_Area_2	Start Time: 1732	Finish Time: 1752

Calibration Information

Calibration Thickness (In)		Calibration Times / Initials		
0.139	0.138	Start:	1705	TCH
0.237	0.233	Verify:	NA	NA
0.339	0.332	Verify:	NA	NA
0.449	0.432	Verify:	NA	NA
0.539	0.539	Final:	1955	TCH

Partitioning Information

Component	Begin/Col/Row	Ending/Col/Row
M. UPST Ext.	NA	NA
Main UPST.	NA	NA
Main	NA	NA
Main DNST.	NA	NA
M. DNST Ext.	NA	NA
Branch	NA	NA
Branch Ext.	NA	NA

Component Information

Component Geometry:	Liner Plate		
Outside Diameter:	NA	Grid Size:	NA
Max. Thickness:	NA	Min. Thickness:	0.151"
Nominal Thickness:	0.375"	Tmin.:	NA
Min. Thickness Location:	X=5.9", Y=7.3"		
Max. Thickness Location:	NA		

Instrument:

Manufacturer:	WESDYNE AMDATA
Model:	INTRASPECT LAPTOP
Serial No.:	UTS-002
Gain:	60
Range:	0.500

Transducer:

Manufacturer:	KBAEROTECH		
Serial No.:	00264C		
Size:	.375" DIA	Freq.:	7.5 MHz.
Model:	FH2E		
# of Elements:	2		

Reference/Simulator Block:

Serial No.:	CS-1
Type:	NOTCH BLOCK
Ref./Simulator Block Temp.:	70.2 °F
Material/Component Temp.:	69.2 °F

Temp. Tool:

Manufacturer:	FLUKE
Serial No.:	I-II-2.7896

Couplant:

Type:	DEMIN. WATER
Batch No.:	DEMIN. WATER

Comments/Obstructions: Designated Location #2 - start point 27" from right edge; 59-1/2" from bottom edge; scan area 12" x 18

Results: Sat ☐ Unsat ☐ Info ☑ 219 square inches - 21,901 data popints (0.1" x 0.1" index in both axes)

Examiner Level III Heimel, Timothy C.	Signature Timothy C Heimel	Date 2/25/2006		Reviewer N/A	Signature	Date	
Examiner Level III Dugan, Michael	Signature Michael Dugan	Date 2/25/2006		Site Review Buck, George L. L-III	Signature George Buck	Date 2/27/2006	
Other Level N/A N/A	Signature	Date		ANII Review	Signature	Date	

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FENOC
FirstEnergy Nuclear Operating Company

Supplemental Report

Report No.: BOP-UT-06-026

Page: 2 of ~~2~~ 6

TCH 2-27-06

Summary No.: Liner Plate Auto 2

Examiner:	Heimel, Timothy C. TCH	Level:	III	Reviewer:	N/A	Date:	
Examiner:	Dugan, Michael	Level:	III	Site Review:	Buck, George L. L-III GLB	Date:	2/27/2006
Other:	N/A	Level:	N/A	ANII Review:		Date:	

Comments:

A second scan of the most severe rusted area was performed using a .05 x .05 index in both axes to provide clearer definition of the degraded area. The lowest reported thickness in both scans was 0.151" at the deepest pit that is visible on the exterior surface.

Print at: Monday, February 27, 2006 08:03:22 AM
Host: FIRST_ENERGY
User: Intraspect

C-Scan Statistics

C-Scan Depth/Thickness Statistics
File: BV1_Liner_Area_2 Channel 1 Gate SW1

Select Area in C-Scan then press 'Process'

Search Criteria

Amplitude Threshold	10	% FSH
Depth Threshold	0.328	in

Search Area

X Axis	0.000	to	18.000	in
Y Axis	0.000	to	12.000	in

Area Information

Total Area	219.010	sq in	21901	pts		
Above Depth Threshold	189.510	sq in	18951	pts	87	%
Below Depth Threshold	3.940	sq in	394	pts	2	%
Not Considered	25.560	sq in	2556	pts	11	%

Depth/Thickness Statistics

Non-Relevent	1	pts		X Axis		Y Axis	
Minimum	0.151	in	at	5.900	in	7.300	in
Maximum	0.548	in	at	12.000	in	7.300	in
Mean	0.376	in					
Median	0.380	in					
Std Dev	0.015	in					

Process Close Save to Notes

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P. 4 of 6

Print at: Sunday, February 26, 2006 12:19:09 PM
Host: FIRST_ENERGY
User: Intraspect

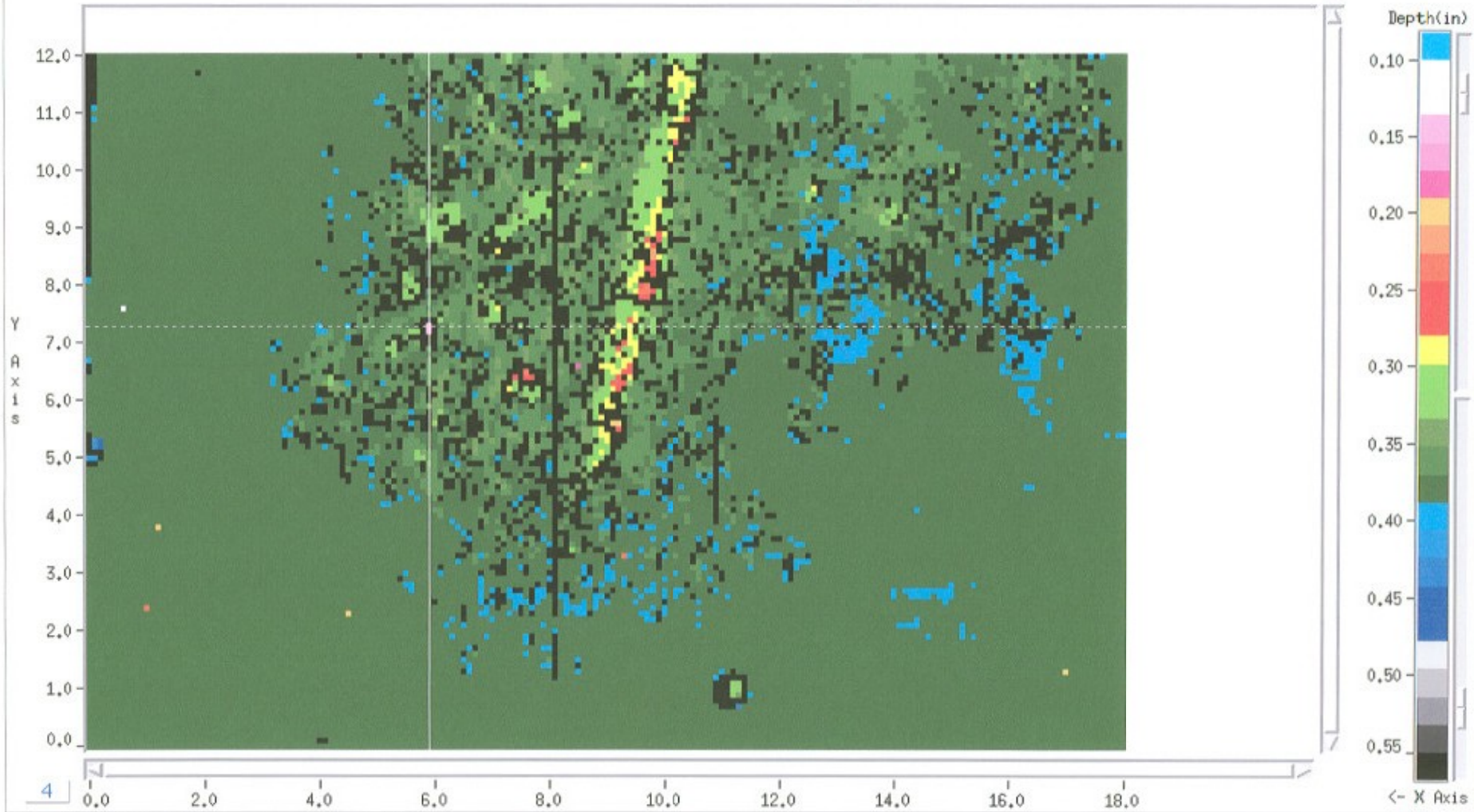
Analysis - BV1_Liner_Area_2 - Unlocked

File Mode Channel Gate C-Scan B-Scan A-Scan Tools Display Settings Help

File: BV1_Liner_Area_2 Exam Date: 02/25/2006 Time: 17:32 - 17:52 WP: N/A MT:
Channel: 1 Gate: SW 1 Mode: Thresh Video Mode: Off Video Filter: 2
Gain: 60.0 dB Dac: ON Offset: 6.0 db Pulser Voltage: 400

Y Axis: 7.300, X Axis: 5.900 Depth: 0.151 in

(OVERALL AREA PLAN VIEW)



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P. 5 of 6

Print at: Sunday, February 26, 2006 12:27:06 PM
Host: FIRST_ENERGY
User: Intraspect

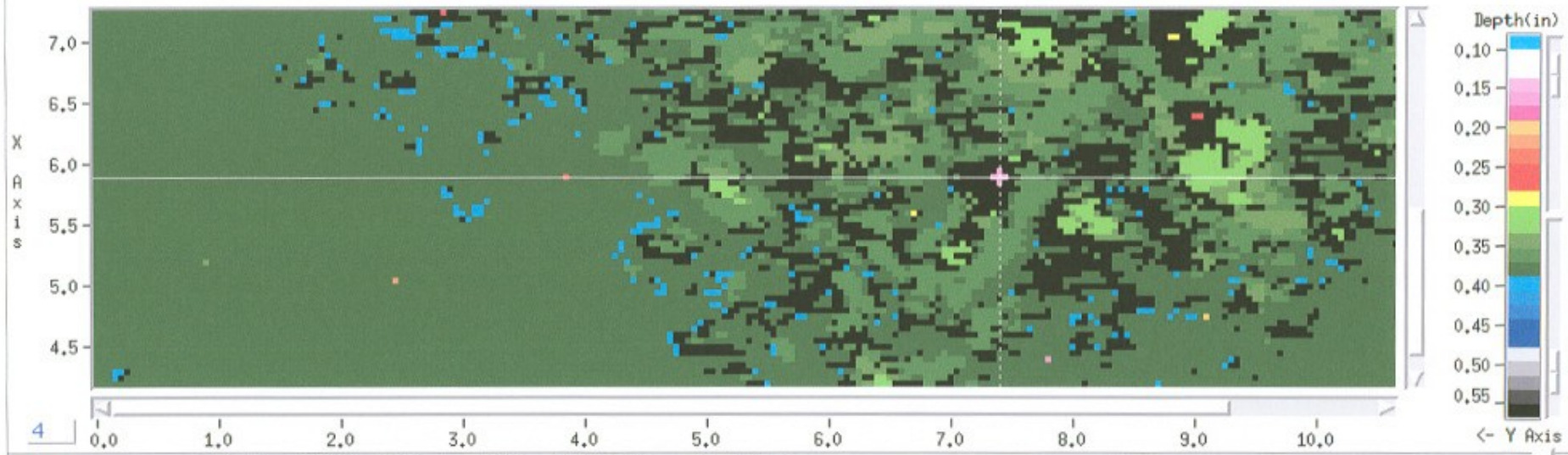
Analysis - Liner_area_2_detail - Locked

File Mode Channel Gate C-Scan B-Scan A-Scan Tools Display Settings Help

File: Liner_area_2_detail Exam Date: 02/25/2006 Time: 18:08 - 18:29 WP: N/A
Channel: 1 Gate: SW 1 Mode: Thresh Video Mode: Off Video Filter: 2
Gain: 60.0 dB Dac: ON Offset: 6.0 db Pulser Voltage: 400

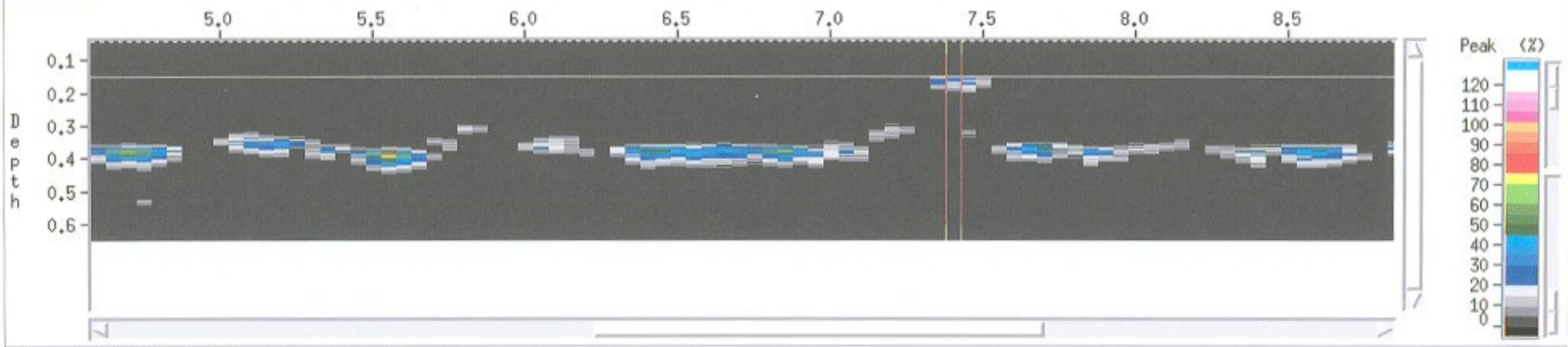
(DETAIL OF THINNEST AREA)

Y Axis: 7.400, X Axis: 5.900 Depth: 0.151 in



Zoom
10:0.25

Y Axis: 7.400 X Axis: 5.900 DTOF: 0.950 us Meas: NA C
SY Axis: 7.400 SX Axis: 5.900 Soft Gain: 0.0
AMP: 21% TOF: 8.150 us TOF2: 7.200 us MP: 0.151 in Dpth: 0.151 Thcknss: 15.09% @ 1/2 V



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P. 6 of 6

Print at: Sunday, February 26, 2006 12:39:32 PM
Host: FIRST_ENERGY
User: Intraspect

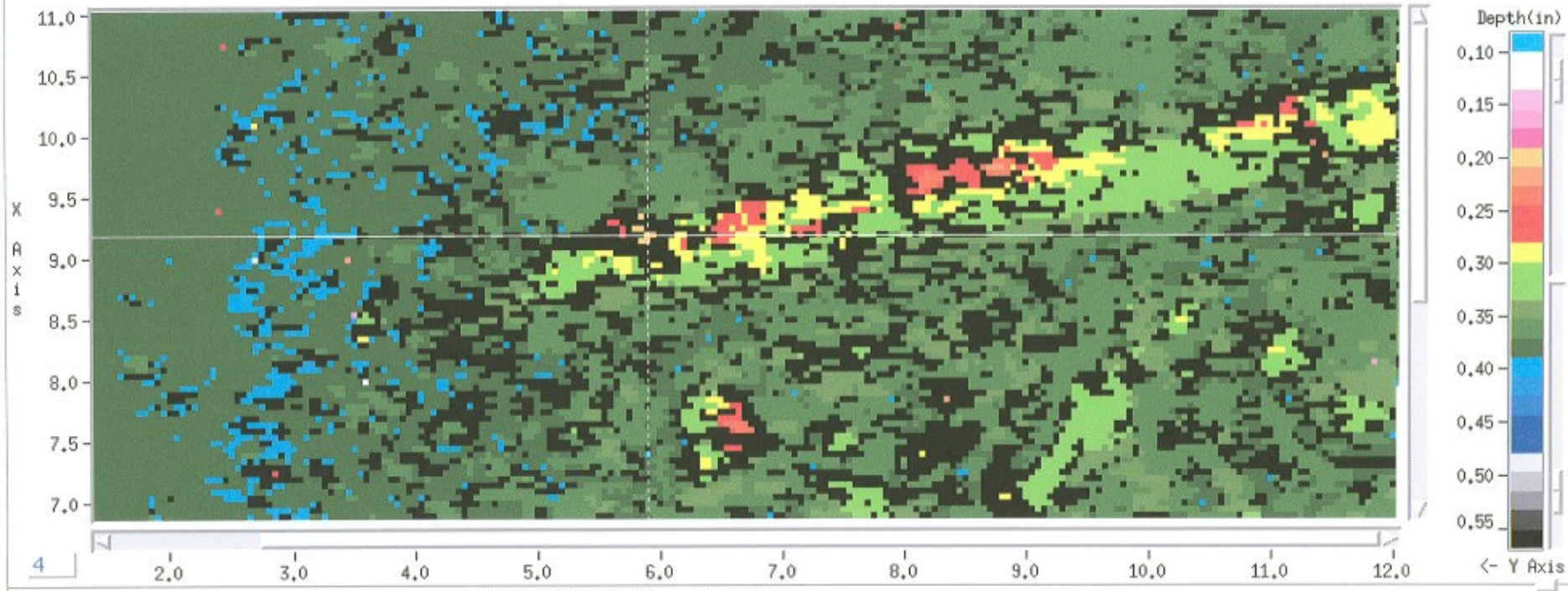
Analysis - Liner_area_2_detail - Locked

File Mode Channel Gate C-Scan B-Scan A-Scan Tools Display Settings Help

File: Liner_area_2_detail Exam Date: 02/25/2006 Time: 18:08 - 18:29 WP: N/A
Channel: 1 Gate: SW 1 Mode: Thresh Video Mode: Off Video Filter: 2
Gain: 60.0 dB Dac: ON Offset: 6.0 db Pulser Voltage: 400

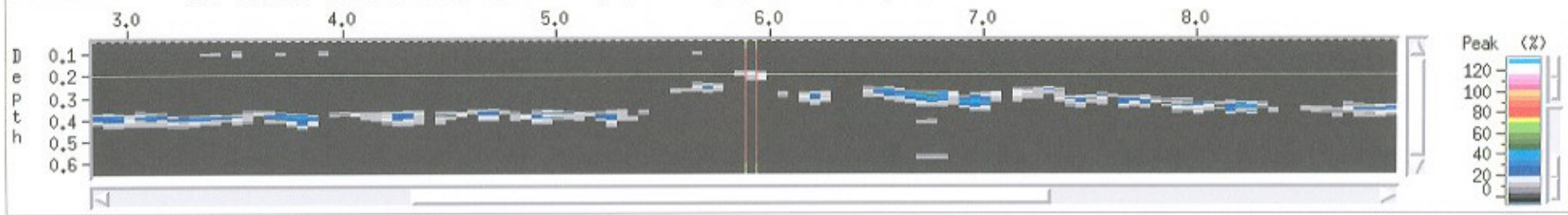
(DETAIL OF 2ND THINNEST AREA)

Y Axis: 5.900, X Axis: 9.200 Depth: 0.194 in



Zoom
7:0.17

Y Axis: 5.900 X Axis: 9.200 DTOF: 1.320 us Meas: NA C
SY Axis: 5.900 SX Axis: 9.200 Soft Gain: 0.0
AMP: -23% TOF: 8.520 us TOF2: 7.200 us MP: 0.194 in Dpth: 0.194 Thcknss: 19.42% @ 1/2 V



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FENOC
FirstEnergy Nuclear Operating Company

UT Erosion/Corrosion Examination

Site/Unit:	BV / 1	Procedure:	UT-308	Outage No.:	N/A
Summary No.:	R&D Paint "t" After	Procedure Rev.:	13	Report No.:	BOP-UT-06-027
Workscope:	BOP-1	Work Order No.:	R&D	Page:	1 of 1

Code: REPORT RESULTS Cat./Item: NA/NA Location: PAINT SHOP

Drawing No.: NA Description: 0.375 Containment liner plate

System ID: LINER PLATE

Component ID: CUT OUT LINER PLATE Size/Length: 1" DIA. AREA Thickness/Diameter: NA

Limitations: None Component File No.: After Paint Removal Start Time: Finish Time:

Calibration Information

Calibration Thickness (In)		Calibration Times / Initials		
.500	.500	Start:	1630	MPD
.376	.375	Verify:	NA	NA
.251	.250	Verify:	NA	NA
.126	.126	Verify:	NA	NA
NA	NA	Final:	1800	MPD

Partitioning Information

Component	Begin/Col/Row	Ending/Col/Row
M. UPST Ext.	NA	NA
Main UPST.	NA	NA
Main	NA	NA
Main DNST.	NA	NA
M. DNST Ext.	NA	NA
Branch	NA	NA
Branch Ext.	NA	NA

Component Information

Component Geometry: 0.375" NOM PLATE
Outside Diameter: NA Grid Size: NA
Max. Thickness: NA Min. Thickness: NA
Nominal Thickness: NA Tmin.: NA
Min. Thickness Location: NA
Max. Thickness Location: NA

Instrument:
Manufacturer: K-KRAMER
Model: DMS
Serial No.: 008M99
Gain: 64
Range: 1.0"

Transducer:
Manufacturer: KBAEROTECH
Serial No.: G31936
Size: .380" DUAL Freq.: 7.5 MHz.
Model: FH2E
# of Elements: 2

Reference/Simulator Block:
Serial No.: BDTG0001
Type: C/S STEP
Ref./Simulator Block Temp.: 64.5 °F
Material/Component Temp.: 69.2 °F

Temp. Tool:
Manufacturer: FLUKE
Serial No.: I-II-2.7896

Couplant:
Type: ULTRAGEL II
Batch No.: 02125

Comments/Obstructions: UT MEASURED THICKNESS AFTER PAINT REMOVAL = 0.386" (FROM BOTH SIDES OF PLATE)

Results: Sat ☐ Unsat ☐ Info ☑ REFERENCE REPORT BOP-UT-06-024 FOR LOCATION DETAIL

Examiner Dugan, Michael	Level III	Signature	Date 2/25/2006	Reviewer N/A		Signature	Date
Examiner N/A	Level N/A	Signature	Date	Site Review Heimel, Timothy C. L-III		Signature	Date 2/27/2006
Other N/A	Level N/A	Signature	Date	ANII Review DEAN WIZNIK		Signature	Date 2-27-06

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FENOC
FirstEnergy Nuclear Operating Company

UT Erosion/Corrosion Examination

Site/Unit:	BV / 1	Procedure:	UT-308	Outage No.:	N/A
Summary No.:	N/A	Procedure Rev.:	13	Report No.:	BOP-UT-06-035
Workscope:	BOP-1	Work Order No.:	N/A	Page:	1 of 15

Code: Report Results Cat./Item: NA/NA Location: N/A MBB 3/1/06

Drawing No.: N/A Description: Containment Liner plate area #3

System ID: N/A

Component ID: Liner plate area #3 Size/Length: 7" - 23" Thickness/Diameter: 0.400"

Limitations: None Component File No.: N/A Start Time: 0030 Finish Time: 0200

Calibration Information

Calibration Thickness (In)		Calibration Times / Initials		
0.100"	0.100"	Start:	0030	TK
0.200"	0.200"	Verify:		
0.300"	0.300"	Verify:		
0.400"	0.400"	Verify:		
0.500"	0.500"	Final:	0200	TK

Partitioning Information

Component	Begin/Col/Row	Ending/Col/Row
M. UPST Ext.	N/A	N/A
Main UPST.	N/A	N/A
Main	N/A	N/A
Main DNST.	N/A	N/A
M. DNST Ext.	N/A	N/A
Branch	N/A	N/A
Branch Ext.	N/A	N/A

Component Information

Component Geometry: Plate
Outside Diameter: N/A Grid Size: N/A
Max. Thickness: 0.400' Min. Thickness: 0.330"
Nominal Thickness: N/A Tmin.: N/A
Min. Thickness Location: N/A
Max. Thickness Location: N/A

Instrument:
Manufacturer: K-KRAMER
Model: DMS2E
Serial No.: 00YHVR
Gain: 64
Range: 0.600"

Transducer:
Manufacturer: KBAEROTECH
Serial No.: 0043J4
Size: .375" DIA Freq.: 7.5 MHz.
Model: FH2E
# of Elements: 2

Reference/Simulator Block:
Serial No.: A13835
Type: STEP WEDGE C/S
Ref./Simulator Block Temp.: 63 °F
Material/Component Temp.: 63 °F

Temp. Tool:
Manufacturer: FLUKE
Serial No.: I-II-2.7896

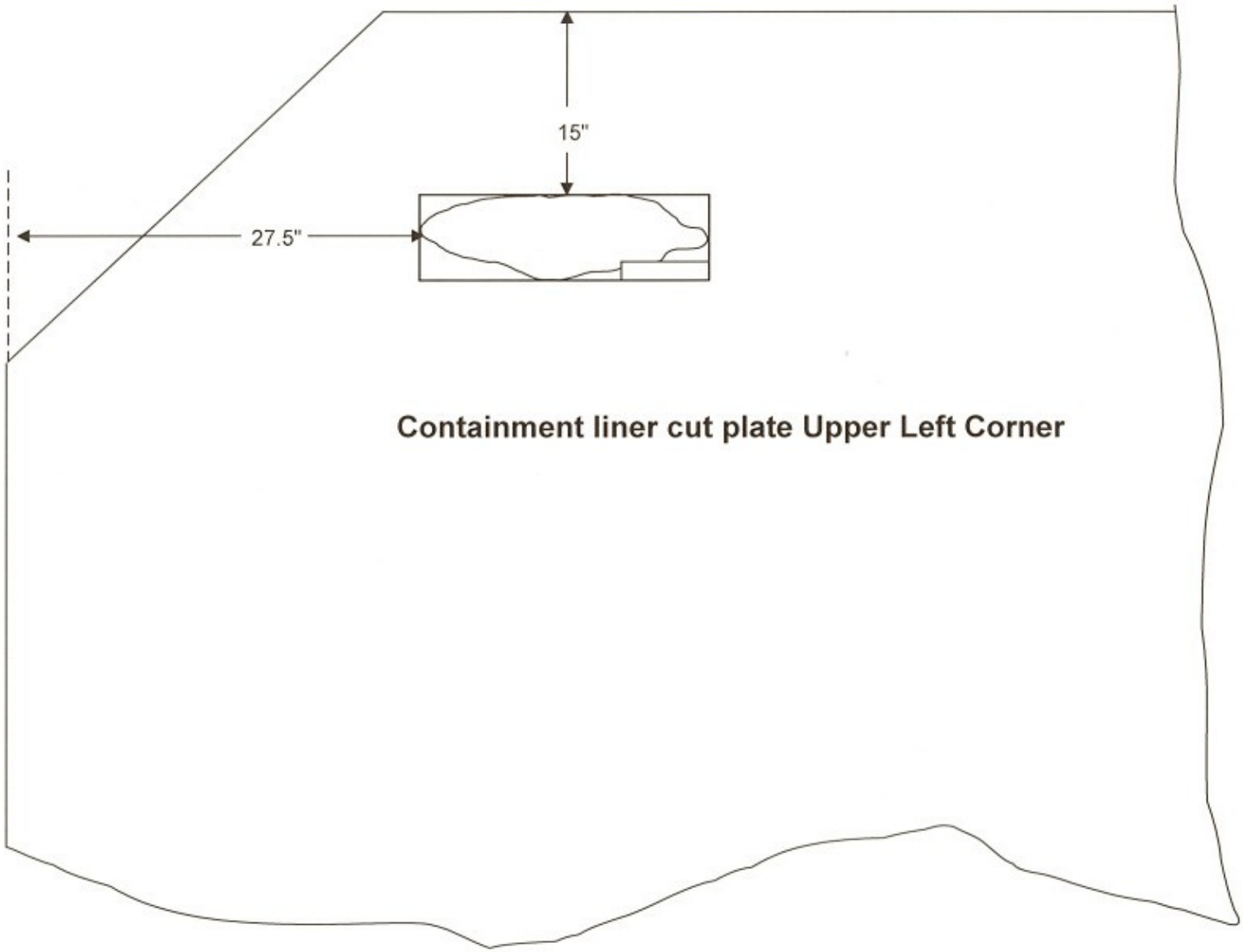
Couplant:
Type: ULTRAGEL II
Batch No.: 02125

Comments/Obstructions: No notable low readings in the painted section

Results: Sat ☐ Unsat ☐ Info ☑

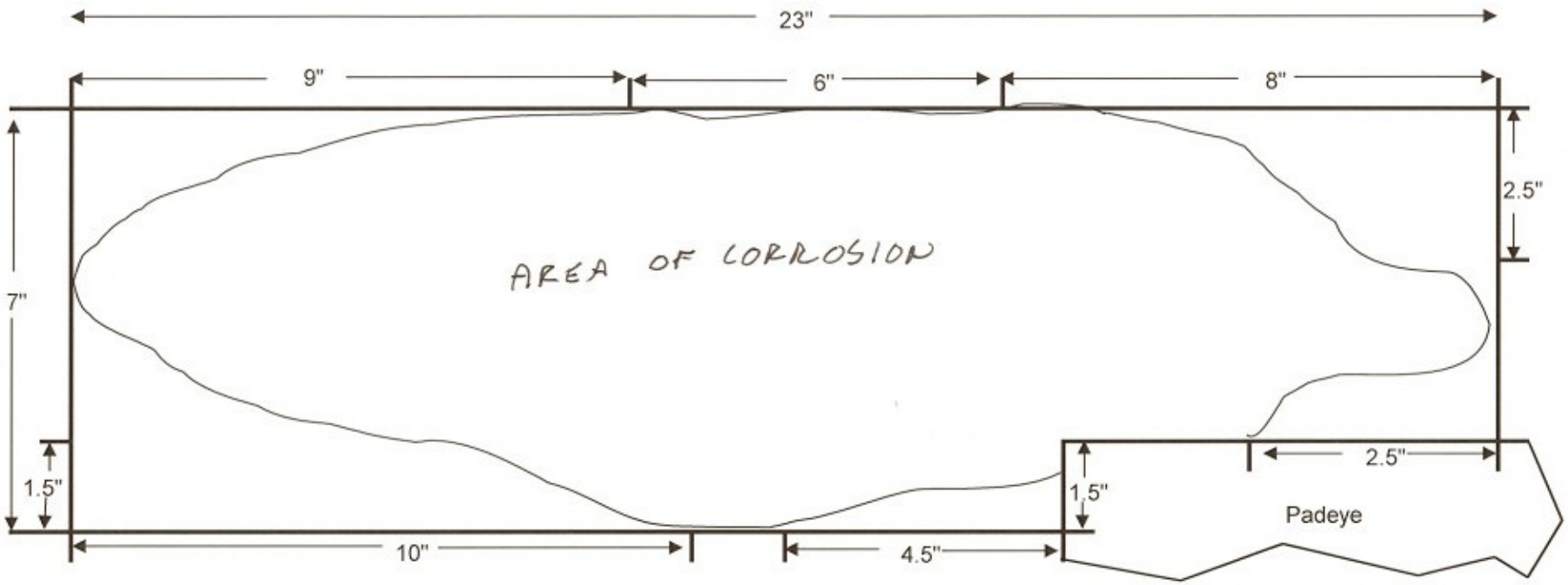
Examiner	Level	Signature	Date	Reviewer	Signature	Date
Knauth, Timothy P.	II-L		3/1/2006	N/A		
Examiner	Level	Signature	Date	Site Review	Signature	Date
N/A	N/A			Buck, George L. L-III	George Buck	3/1/2006
Other	Level	Signature	Date	ANII Review	Signature	Date
N/A	N/A					

A9.730D



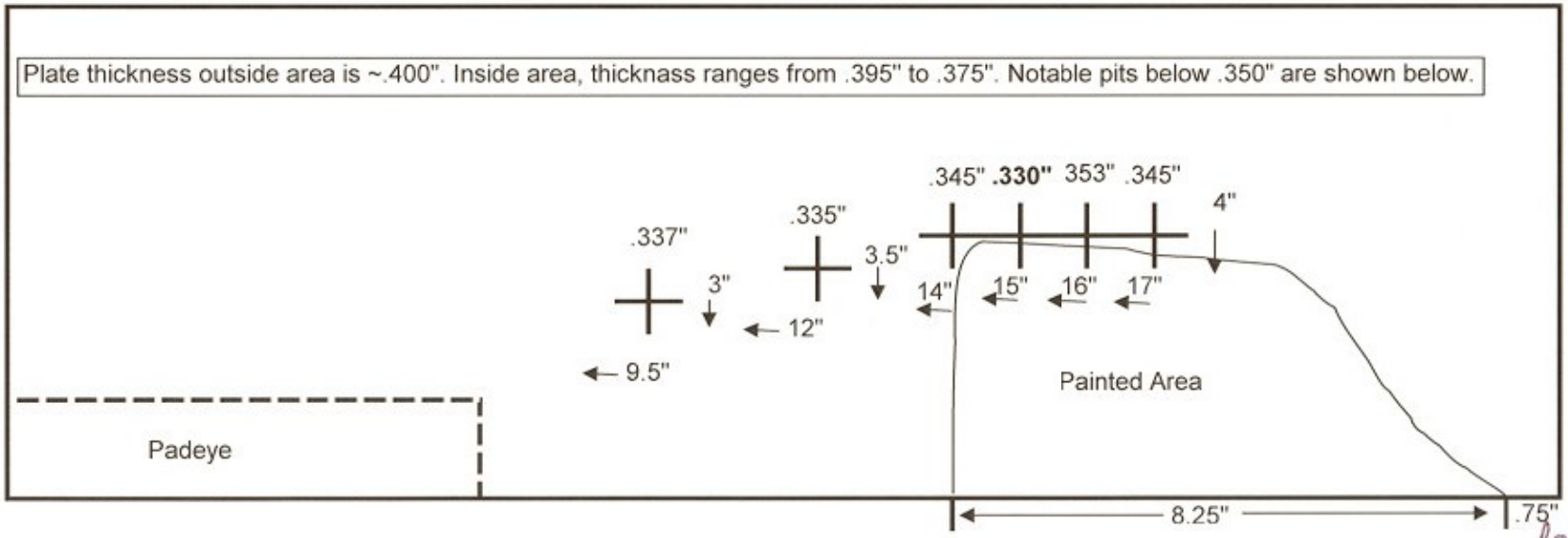
BOP-UT-06-035

Area #3 Shape and Dimensions - Outside Surface



Thickness Readings- Inside Surface

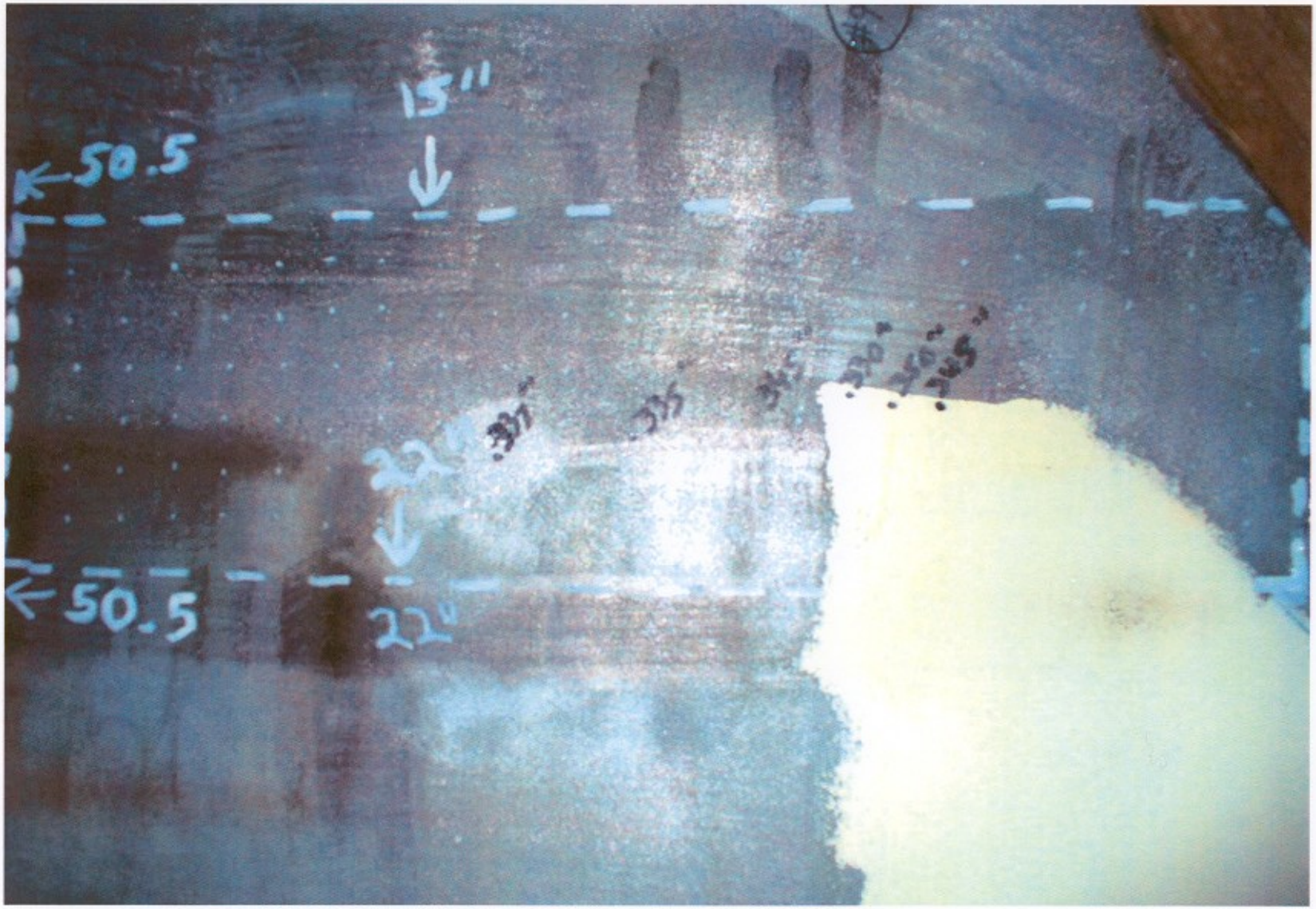
Plate thickness outside area is ~.400". Inside area, thicknass ranges from .395" to .375". Notable pits below .350" are shown below.



BOP-UT-06-035

OUTSIDE SURFACE

BoP-U1-06-035
4 of 5



INSIDE SURFACE

BOP-UT-06-035
5 OF 5

Attachment 7

CR 06-01519 – Degraded Reinforcing Bar from SGRP Access Opening

(6 pages)

CONDITION REPORT

CR Number 06-01519

TITLE: DEGRADED REINFORCING BAR FROM SGRP ACCESS OPENING

ORIGINATION

DISCOVERY DATE	TIME	EVENT DATE	TIME	SYSTEM / ASSET#
2/25/2006	1630	N/A	N/A	47 BV-1-RCBX

EQUIPMENT DESCRIPTION Reinforcing Bar from Reactor Containment Exterior Wall

DESCRIPTION OF CONDITION and PROBABLE CAUSE (if known) Summarize any attachments. Identify what, when, where, why, how.

During a general visual examination of reinforcing bars removed from the temporary containment opening a single bar was found to have damage and/or pitting. The general visual inspection of the reinforcing bars was to look for corrosion or pitting of the observable rebar. The general inspection was requested as part of the investigation of the corrosion pitting found on the containment liner plate, see CA 06-01122-04.
A single bar was found to have damage or pitting. The bar was tagged 8-D4B and is a #14 size rebar. The tag identifies the bar as a diagonal rebar from the eighth layer of reinforcing. This reinforcing layer is the closest to the outside surface of the concrete.
All removed reinforcing steel will be visually inspected by Bechtel as part of the SGRP prior to preparation of the bars for reinstallation in the wall. The applicable criteria is in Bechtel specification 24928-C-304(Q). The reinforcing bar defect will be dispositioned, repair, replace or accept as-is, at that time.

The following information was copied from CA 06-01122-04:
A general Visual Inspection of the reinforcing bars that were removed from the temporary containment opening was performed by a VT Level III on February 25, 2006. The removed bars are being stored on flatbed trailers under plastic in the PAF parking lot. Due to the storage conditions and physical size of the rebar, the visual examination encompassed approximately 50% of the surface areas of the bars.

Of the exposed rebar surfaces examined, only one rebar showed appreciable pitting - Rebar #8-D4B had one area of corrosion and pitting 89 inches from the end of the rebar to the centerline of the pitted area. The pitted area is approximately 9 inches long x 1-1/2" wide. A photograph of the condition is attached to NDE report BOP-VT-06-040.

The examination was documented on Visual Examination Report BOP-VT-06-040. A scanned color copy of the completed report has been placed in the following location:
S:\AI\ENG\1R17 CONT LINER CORROSION\REBAR VISUAL REPORTS

SPECIAL INSTRUCTIONS - THIS ISSUE IS A MODE RESTRAINT. A MODE HOLD RESOLUTION FORM IS REQUIRED TO BE COMPLETED.

IMMEDIATE ACTIONS TAKEN / SUPV COMMENTS (Discuss CORRECTIVE ACTIONS completed, basis for closure.)

Finding documented on NDE report BOP-VT-06-040 and CA 06-01122-04.

Supv Comments: The flawed reinforcing bar defect will be dispositioned, repaired, replaced or accepted as-is during the inspection of bars performed by Bechtel prior to reinstallation.

QUALITY ORGANIZATION USE ONLY	IDENTIFIED BY (Check one)	ATTACHMENTS
Quality Org. Initiated ☐ Yes	☑ Individual/Work Group ☐ Self-Revealed	
Quality Org. Follow-up ☐ Yes ☐ No	☐ Supervision/Management ☐ Internal Oversight ☐ External Oversight	☐ Yes ☑ No

ORIGINATOR	ORGANIZATION	DATE	SUPERVISOR	DATE	PHONE EXT.
WESTBROOK, GT	BVDM	3/1/2006	MANCUSO, C	3/2/2006	7740

CONDITION REPORT

CR Number 06-01519

TITLE: DEGRADED REINFORCING BAR FROM SGRP ACCESS OPENING

PLANT OPERATIONS

SRO REVIEW	EQUIPMENT OPERABLE	OPERABILITY ASSESSMENT REQUIRED	ORG. NOTIFIED	IMMEDIATE INVESTIGATION REQUIRED	ORG. NOTIFIED	MODE CHANGE RESTRAINT
☑ Yes ☐ No	☐ Yes ☐ No ☑ N/	☐ Yes ☑ No		☐ Yes ☑ No		☑ Yes ☐ No

MODE	ASSOCIATED TECH SPEC NUMBER(S)	ASSOCIATED LCO ACTION STATEMENT(S)
1-4	3.6.1.8	#1 N/A
		#2
		#3

DECLARED INOPERABLE (Date / Time)	REPORTABLE?		APPLICABLE UNIT(S)
N/A	☐ Yes ☑ No ☐ Eval Required	One Hour N/A Four Hour N/A Eight Hour N/A Other N/A	☑ U1 ☐ U2 ☐ Both

COMMENTS

Resolve prior to mode 4

Current Mode - Unit 1	Power Level - Unit 1	Current Mode - Unit 2	Power Level - Unit 2
6	0%	N/A	N/A

SRO - UNIT 1	SRO - UNIT 2	DATE
Green, R	N/A	3/2/2006

CRPA / SUPV / MRB

CATEGORY / EVAL	ASSIGNED ORGANIZATION	DUE DATE
CF	SGRP	4/15/2006

REGULATORY

REPORTABLE? ☐ Yes ☑ No ☐ LER No.

REPORTABILITY REVIEWER: Fedin, R

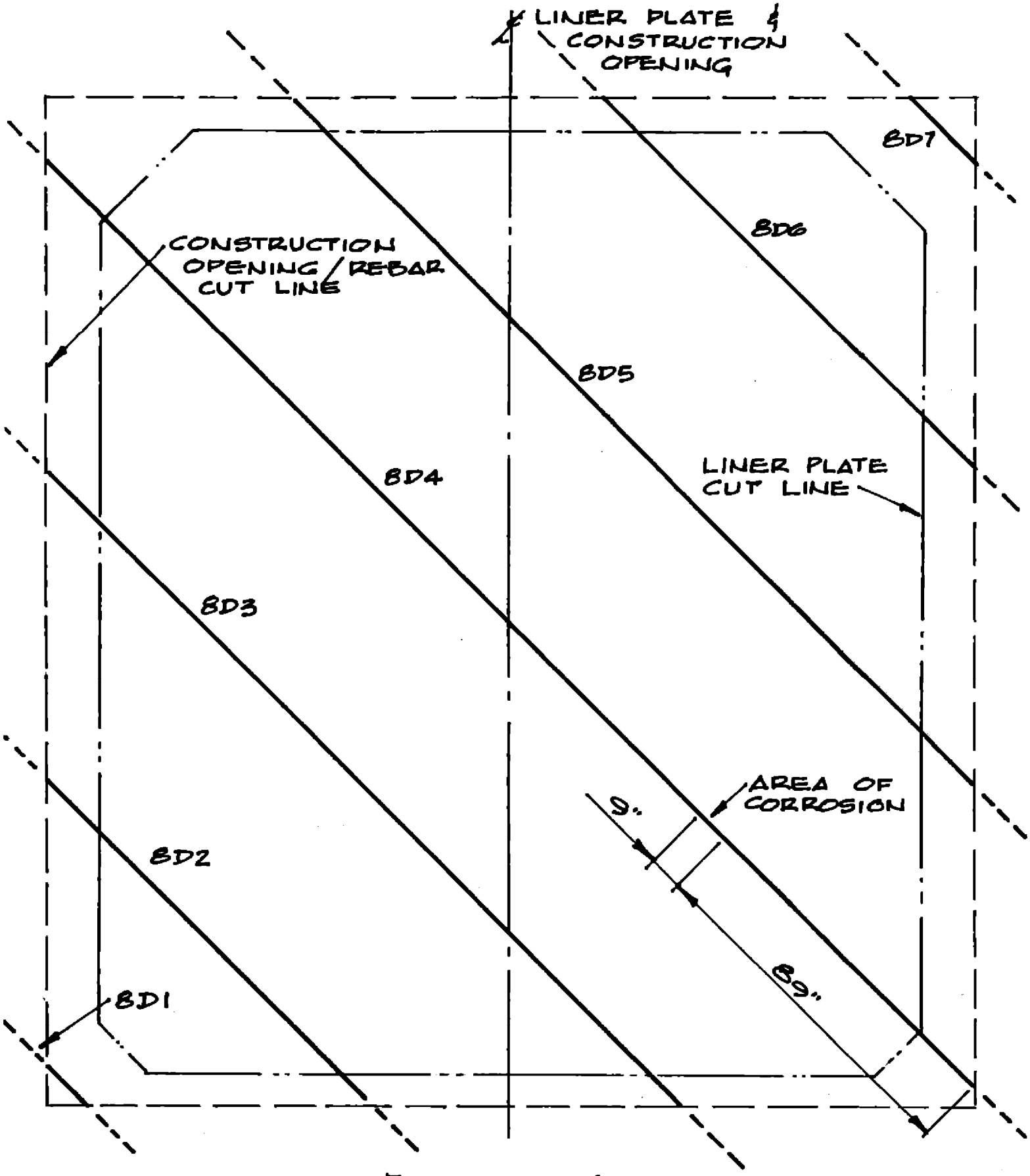
DATE: 03/02/06

TREND CODES Process / Activity / Cause Code(s)			Comp Type / ID (If Cause T or W)		Cause Org
HDW	0575	T08			

INVESTIGATION OPTIONS ☐ Maint.Rule ☐ OE Evaluation

CLOSED BY

DATE



ELEVATION
LAYER Nº 8 REBAR DIAGONALS
LOOKING NORTH FROM OUTSIDE CTMT
NOT TO SCALE

Typical Condition of Rebar

Damaged Area of Rebar 8-D48

Rebar Damage Close Up

Attachment 8

Beta Labs Report M06074

(78 pages)

LAB NO.: M06074	WORK TRACKING NO.: 14878	PAGE 1 OF 78
PLANT & UNIT: BEAVER VALLEY #1	PART: CONTAINMENT MATERIALS	DATE: 3/9/2006

MATERIAL ANALYSIS REPORT

CONTACT:	D. WEAKLAND
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REVIEWED BY (SIGNATURE ON FILE):	J. BLOUGH

REPORT ISSUED TO:

B. SIKORSKI	D. WEAKLAND

SAMPLE DESCRIPTION: Two (2) sample pieces of steel removed from the containment shell liner and assorted sample pieces of the associated concrete shell from Beaver Valley #1 Unit were forwarded for evaluation of external (OD, concrete side) corrosion distress of the steel liner seen visually during disassembly work in the 1R17 Outage, see Figures 1-3.

The steel liner sample pieces had been pre-labeled "A" and "B" and were marked with a grid pattern, as-received, designations that were retained strictly for tracking purposes in the Lab. The concrete samples, seen in Figure 4, were labeled #1 ("Large") and #2 ("Small"). The #1 sample (bag label only partly legible) was identified from "against the liner"; the #2 sample was from ~12" outside of the inner rebar layer.

NOTE: Plant personnel later confirmed that the steel liner sample marked "A" corresponds to Area 1; the sample marked "B" to the Area 2, in the Plant images provided.

SUMMARY: External "rust" corrosion of undetermined activity or vintage is confirmed on the steel liner. The "rust" corrosion is attributed to oxidation of the plain or mild steel, where oxygen and water would be required simultaneously; chlorides (Cl) could aggravate the corrosion if also present at the same time.

ATTRIBUTE	#SAMPLES TOTAL	#SAMPLES FOUND	DESCRIPTION	
LINER OD SURFACE COLD-WORK	15	3	TRACES SEEN IN "B" Q10-#1 AND "B" Q10-#4 AND WELD AREA	
LINER OD SURFACE PITS	15	5	SOME WITH UNDERCUT AND END-GRAIN IN WORST AREAS	
LINER OD CORROSION PRODUCT	15	15	"DEPOSIT/ SCALE" RESIDUES REMAINED ON ALL SAMPLES EXAMINED	
LINER ID SURFACE PITS	15	0	NONE IDENTIFIED AS SUCH	
LINER ID SURFACE COLD-WORK	15	15	ABUNDANT, ATTRIBUTED TO SURFACE CLEANING PROCESSES	
LINER MICROSTRUCTURE	15	15	FERRITE-PEARLITE AND STRINGERS, AS-ROLLED	
LINER CORROSION PRODUCTS IN-SITU	7	NA	UP TO 2.3% CA, 1.8% SI, 0.7% S; CL NOT DETECTED	
LINER COMPOSITION	3	NA	NOMINALLY 0.19% C, 0.76% MN, SI KILLED STEEL	
LINER HARDNESS	3	NA	RANGE 71.3-76.5 HRB	
LINER TYPICAL WALL THICKNESS	15	NA	~3/8" (0.375") NOMINAL; ~25/64" (0.390") MAXIMUM MEASURED	
LINER MINIMUM WALL THICKNESS	15	NA	~5/32" (0.156") LOCATED AT A PIT IN "B" Q10-#5	
STUD WELD	1	1	FULL CONTACT FUSION	
LINER WELD	1	1	CLEAN AND SOUND, MULTI-PASS FROM BOTH SIDES	
SEM-EDS ANALYSIS			AS-RECEIVED	WASHED IN DE-IONIZED WATER
BULK LINER OD SURFACE, CALCIUM	3	3	UP TO 26.4%	UP TO 5.9% IN BROWN SURFACE
BULK LINER OD SURFACE, SILICON	3	3	UP TO 3.7%	UP TO 1.4% IN BROWN SURFACE
BULK LINER OD SURFACE, SULFUR	3	3	UP TO 2.9%	0.2 % IN BROWN SURFACE
BULK LINER OD SURFACE, CHLORINE	3	2	UP TO 0.3%	NOT DETECTED
CONCRETE CALCIUM	3	3	20.2-38.5%	
CONCRETE SILICON	3	3	13.6-33.8%	
CONCRETE SULFUR	3	3	0.3-0.4%	
CONCRETE NEXT TO LINER,	3	1	0.1% FOUND BY EDS, PH 10.62, CL NOT DETECTED BY IC	
CONCRETE AWAY FROM LINER	1	1	10.67 PH, 0.56 PPM CL BY ION CHROMATOGRAPHY (IC)	

MATERIAL ANALYSIS REPORT

BACKGROUND: Plant personnel reported that the liner distress was seen when the liner plate was exposed by the removal of the concrete containment building shell to facilitate 1R17 Outage Work. Site Engineering identified the containment liner as a steel vapor barrier attached by "Nelson-Studs" to the reinforced concrete shell. The concrete was removed by high-pressure water-blasting. Filtered river water was used for the "hydro-demolition." No test results for chlorides on the water used during this work were reported, and chloride content of river water is not normally measured at the Plant. A filtered river water sample was taken by Plant personnel approximately two weeks after the hydro-demolition for analysis. The reported results were: 1) pH-7.54, 2), Chloride 50 ppm, and 3) Sulfate 68 ppm.

Plant personnel provided the following data concerning the liner plate and weld materials from material test reports in the BVPS site fabrication records. The liner plate material was ASTM A516 Grade 60 steel. The liner manufacturer's drawing identifies the welding procedures used to make the welds in the liner. Vertical welds were done with the shielded metal arc (SMAW) welding process with E-7018 electrodes."

TESTS PERFORMED: Visual examinations, chemical analysis via vacuum spectrometry, standardless SEM-EDS, hardness, microstructures, and pH and ion chromatography in the Beta Water Lab.

TEST RESULTS: Concrete, visual examinations found the heterogeneous sample pieces seen in Figures 5 and 6. The smaller sample was more irregular, reportedly having been recovered from ~12" from the inner rebar layer. The larger sample was removed by site engineering personnel. One surface of this piece was identified by Plant personnel as being in contact with the OD of the steel liner plate, and the opposite end was in contact with the first layer of reinforcing bar. The "flat" surface of this larger piece, reported to have been against the liner at the time of removal, was relatively smooth, except for spherical appearing voids. The estimated void size was approximately 1/16"-1/8" Ø, see Figure 7.

It should be noted that, reportedly, the larger concrete sample had to be foam-cleaned to allow its release from the Plant. Site personnel contacted the manufacturer of the "Syntech Touch-it-up Aerosol," the cleaning agent used, regarding the chemical contents of the product. The manufacturer provided a typical analysis that reported a "Total Halogens 38 ppm, as Cl" and "Total Sulfur 2 ppm. The MSDS form for the cleaner listed its chemical constituents as 2 butoxy ethanol; sodium metasilicate; octylphenol polyethoxylate; trisodium phosphate, and hydrocarbon propellant.)

Studs, visual examinations found "headed-studs", approximately 5/8"Ø X 6¼" long, had been stud-welded to the external (OD) surfaces of the containment liner; all appeared to be in good condition. One stud (1) had been removed from the sample "B" section prior to receipt at Beta. Other stud-welded pieces of round steel bar-stock, approximately 3/8"Ø X 12" long, were noted.

Steel Liner, sample grid patterns that were marked in white (as-received) on the OD were numbered as Quadrants ("Q"); #1-12 for sample "A" and #1-16 for sample "B", strictly for tracking purposes in the Lab. Visual examinations, see Figures 8 and 9, found that the external (OD, toward the concrete) surface conditions varied from locally rough and irregular with obvious pits to smooth and apparently unaffected.

The sample "B" section also contained a vertical weld joining two (2) sections of the liner; the corrosion of the external surfaces extended across (and included) this weld. Chemical analysis of a sample piece of each steel liner section, one (1) from "A" and two (2) from two (2) from "B" (one on each side of the weld), found similar compositions, nominally 0.19% C, 0.76% Mn and 0.26% Si, see Table 2 for all of the results.

Hardness tests of sample pieces from each of the three (3) steel liner sections included found similar values in the range of 71.3-76.5 HRB, see Table 3 for comparisons.
Sample "A" was sectioned to extract selected areas (Quadrant #11) for additional study, see Figures 10 and 11. Sample "B" was sectioned to extract selected areas (mainly Quadrant #10) for additional study, see Figures 12 and 13.

MATERIAL ANALYSIS REPORT

TEST RESULTS (continued): Steel Liner, several metallographic sections were prepared for examination from each sample, see Figures 14-17. These metallographic sections revealed that the visible pits in the liner were up to ~7/32" (0.218") deep; nearby intact areas contained remaining walls ~3/8" (0.375") thick. Corrosion, general, open pits and undercut pits, was evident on the external (OD, concrete side) surfaces in the metallographic sections from affected areas, see Figures 18-20.

Traces of cold-work distortion of the external (OD, concrete side) surfaces were seen in metallographic sections from sample "B", from areas that were both unaffected and affected by the corrosion, see typical appearances in Figure 21. The base microstructures through-out the steel liner metallographic sections examined consisted of ferrite-pearlite aggregates with stringer inclusions, which were considered indicative of the as-rolled (hot) condition, typical is seen in Figure 22.

All metallographic sections examined contained abundant cold-work distortion of the internal (ID, Plant side) surfaces, see a typical example in Figure 23, attributed to cleaning processes applied before the samples were received at Beta. A metallographic section through the sample "B" liner-weld found a sound multi-pass weld, made from both sides, see Figure 24.

A metallographic section taken through the sample "B" stud-weld found the features seen in Figure 25, including the coarse-grained fusion zone and flash typical of a stud-weld. Small (~1/64") crack-line features were seen in the stud material at the flash; a small (<1/64") fusion line pore or void was also noted, see Figure 26. The stud metal microstructure consisted of ferrite-pearlite aggregates with stringer inclusions, see Figure 27.

SEM-EDS, standardless chemical analysis via SEM-EDS was performed of selected areas of samples of the steel liner and the concrete samples, complete results are contained in Tables 4-6.

Liner, suspected residues of in-situ corrosion products were seen in the bottom of a pit in at least one metallographic section from each of the liner samples, see Figures 28-30 for an undercut pit and 31-34 for an open pit, in samples "A" and "B", respectively, for the appearances, and Table 4 for the results.

The material in the pits appeared to be predominantly oxides of iron with films of Al and Ca detected in the elemental dot-mapping, typical see Figure 33. The Si seen in this map representing the mold material used to encapsulate the sample. The Al seen may represent the aluminum oxide polishing media.

In-situ analysis of the "as-found" liner OD surface with suspected corrosion product containing areas on sample "A"-Quadrant #11 (Q11) found the major constituents detected on the smoother, brown, surfaces were 34.4% O, 31.7% Fe, and 26.4% Ca. Nearby red-orange surfaces were 58.2% Fe, 23.7% O, and 13.4% Ca. The material in a pit in the same area contained 39.3% Fe, 32.1% O and 24.0% Ca. See Table 5 for the complete results.

Additional metallographic sections were taken from "as-found" surface areas representing smoother (dark-brown) and corroded (orange-red) for SEM-EDS. The major constituents included, in the dark-brown "scale" 72.1% Fe, 23.4% O and 2.3% Ca; orange-red surfaces 81.7% Fe, 15.9% O and 1.6% Si, see Figures 35 and 36, respectively for the appearances and elemental dot-maps.

Cleaning another piece of the same "A"-Q11 liner sample section in de-ionized water and analyzing the in-situ surfaces found that the brown surface was mainly Fe (64.4%), 26.6% O, and 5.9% Ca. The adjacent white surfaces were 94.2% Fe, 4.2% O. See Figure 37-39 for the appearances and Table 5 for the complete results. It was noted that white surfaces flash-rusted to orange-red overnight.

MATERIAL ANALYSIS REPORT

TEST RESULTS (continued): Concrete, the results of chemical analysis of selected surfaces via standardless SEM-EDS of the concrete sample pieces are seen in Figures 40-47; although various species were identified, Cl was not detected in any of the elemental dot-mapping, see Figures 41 and 42 for the #1 ("Large Piece") sample examined and Figures 45 and 47 for the #2 ("Small Piece"). "Spot" analyses found 0.1% Cl in the #1 "flat" ("special") sample that had reportedly been foam-cleaned with "Syntech Touch-it-up Aerosol" at the Plant to allow its release, among the compositions listed in Table 6.

Beta Water-Lab, samples from (large piece #1 and small piece #2) pieces of the concrete were crushed, sieved and leached with de-ionized water for pH and ion chromatography analysis, see Attachment #2 for the Beta Water Lab Report, the pH was 10.63-10.67; the % water soluble was 2.58-2.59% and the chloride content was none detected in the "large piece #1 flat surface" and 0.56 ppm in "small piece #2".

CONCLUSIONS: External (OD, concrete side) "rust" corrosion of the steel liner, occurring via general wastage and pitting, was confirmed in the localized areas seen visually. The pits were up to ~7/32" deep, leaving a minimum wall of ~5/32" in the deepest pit studied. The nominal wall was approximately 3/8" thick; the thickest remaining wall measured was an estimated 25/64" (0.390").

It was apparent that the liner corrosion in Area 2 must have occurred *after* the weld was made, since the visible pattern of surface distress continued from one side to the other and included the weld itself. No preferential corrosion of the weld or the heat-affected zones (HAZ) was identified.

The liner samples appeared to represent a mild or plain carbon-manganese (C-Mn), silicon (Si) killed (de-oxidized) steel "as-rolled", closely resembling A516-90, Grade 60; since this was almost certainly rolled hot, the surface cold-work distortion seen is probably not from original plate manufacture. The weld in sample "B" (Area 2) had been made with multiple passes from both sides; the weld metal was clean an sound in the section examined. It appears that lower carbon, higher manganese and silicon filler metals, such as E7018, had been used in this welding.

The stud-weld sample section examined contained the flash and heat affected zones considered typical for the process. Small (<1/64") crack-like indications were seen in the stud sample near the flash. One small (<1/64") pore or void was seen at or near the fusion line.

The Water Lab concrete analyses found trace amounts of water-soluble chlorides, 0.56 parts per million (ppm), in the small piece (#2) away from the liner, the water extracted "leachate" tested had a pH 10.63-10.67, see Attachment #2 for the particular details of this work.

All of the surviving sample remains will be retained for a minimum of ninety days (90 days) for possible review or consultation, after which they will be discarded, unless otherwise requested.

DISCUSSION: Although it can be said with certainty that the simultaneous presence of oxygen and water are required for the "rusting" of steel, producing hydrated oxides, the exact cause of this condition in this instance, its vintage or current state of activity, could not be determined with any certainty at this time by metallurgical analysis alone. Chlorides could aggravate the corrosion if also present at the same time.

Attempts to characterize the surface oxides seen in areas that appeared relatively unaffected, either semi-quantitatively via SEM-EDS or morphologically, as either "rust", representing corrosion products, or mill-scale, appear inconclusive at this time. By definition, mill-scale*, is the "heavy oxide layer formed during hot fabrication or heat treatment of metals." Since the original surface conditions of the liner, or how mill-scale might behave in the in-situ environment over time, are not known, further evaluation here is precluded by the complexity, lack of data, and time constraints.

* American Society for Metals, "Glossary of Metallurgical Terms and Engineering Tables." ©1979, p. 48.

MATERIAL ANALYSIS REPORT

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