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PSEG
Nuclear LLC

United States Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

FIRST REVISED NRC ORDER EA-03-009:
REACTOR PRESSURE VESSEL HEAD AND VESSEL HEAD PENETRATION NOZZLE POST OUTAGE INSPECTION RESULTS
SALEM GENERATING STATION UNIT 1
FACILITY OPERATING LICENSE NO. DPR-70
DOCKET NO. 50-272

Reference: (1) NRC SER, Relief Request S1-RR-13-B22 requesting relaxation from the NDE requirements of the revised Order for the Salem Nuclear Generating Station (Salem), Unit No. 1, reactor vessel head vent nozzle penetration, dated April 23, 2004.

(2) NRC SER, Relaxation Request S1-RR-I3-B21 requesting relaxation from the NDE requirements specified in Sections IV.C.(5)(b)(i) and IV.C.(5)(b)(ii) of the First Revised Order for the Salem Nuclear, dated May 5, 2004.

The First Revised NRC Order EA-03-0091 was issued on February 20, 2004, establishing interim inspection requirements for reactor pressure vessel (RPV) heads of pressurized water reactors. In section IV.E. of the NRC Order, the NRC required that the results of the inspection be provided within 60 days of the plant being returned to operation. PSEG Nuclear LLC (PSEG) hereby submits the inspection results for Salem Unit 1 for the spring 2004 (1R16) refueling outage.

In accordance with section IV.C. of the NRC order and relaxations approved per References 1 and 2, PSEG conducted non-destructive examinations of the Salem Unit 1 RPV head penetration nozzles and a bare-metal visual examination of the upper surface the RPV head. Attachment 1 provides the Westinghouse report of the non-destructive examination of the RPV head penetration nozzles. Attachment 2 provides the report of the bare-metal visual examination of the RPV head upper surface.

A047

Should you have any questions regarding this response, please contact Michael Mosier at (856) 339-5434.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on 7/30/04 Sincerely,

D. F. Garchow

D. F. Garchow
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Attachments

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Attachment 1

Westinghouse Report WDI-PJF-1302611-FSR-001

Salem Unit 1-1R16 Reactor Vessel Head Penetration Examination

Dated May 17, 2004

Salem Unit 1–1R16 Reactor Vessel Head Penetration Examination

April 2004

Final NDE Report

WDI-PJF-1302611-FSR-001

May 17, 2004

Westinghouse Electric Company
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1.0 INTRODUCTION

During the Salem Unit 1 1R16 outage in April 2004, Westinghouse performed nondestructive examinations (NDE) of the reactor vessel head penetration tubes.
The purpose of the examination program was to identify evidence of primary water stress corrosion cracking (PWSCC) that might be present on the OD and ID surfaces of the head penetration tubes. Examinations of the CRDM penetration tubes also included the application of techniques to identify evidence of CRDM leakage in the shrink-fit region at the tube-to-head interface. Examinations were performed using procedures and techniques demonstrated through the EPRI/MRP protocol, and/or Westinghouse internal demonstration programs, and applied in a manner acceptable within the context of the February 20, 2004, USNRC Order EA-03-009, "Establishing Interim Inspection Requirements for Reactor Vessel Heads at Pressurized Water Reactors.

The reactor vessel head at Salem Unit 1 is a Westinghouse design and manufactured by Combustion Engineering (CE). The head contains 79 alloy 600 penetration tubes that are shrunk fit in the reactor vessel head and attached with alloy 182/82 partial penetration J-groove welds. The head also contains one carbon steel full penetration nozzle which was the original head vent and was not inspected.

The service history of the heats for the penetration tubes in the Salem Unit 1 reactor vessel head are presented below.

Heat #'s	Vendor	# Tubes	Heat Treatment	Penetrations
NX-5983 NX-5411 NX-7280 NX-4882 NX-8069 NX-5965 NX-5981	Huntington Alloys USA	79	1725F 1.5 hr –Air Cooled	#1through # 79

There are a variety of configurations for the 79 penetration tubes, each configuration requiring special consideration for examination. The penetration tubes measure 4.0" on the OD and have an ID dimension of 2.75". The wall thickness is 0.625". The penetration tube configurations are as follows:

- 53 penetration tubes with thermal sleeves installed
- 19 open thermocouple column penetration tubes
- 7 penetration tubes with part length drive shafts

The Salem Unit 1 reactor vessel head is in the "high susceptibility" category. For a reactor vessel head in the high category, Section IV.C. (5) of USNRC Order EA-03-009 revision 1 dated February 20, 2004 specifies:

"Bare metal visual examination of 100% of the RPV head surface (including 360° around each RPV head penetration nozzle)"

and

"Either

i *Ultrasonic testing of the RPV head penetration nozzle volume (i.e., nozzle base material) from 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 2 inches below the lowest point at the toe of the J-groove weld on a horizontal plane perpendicular to the nozzle axis (or the bottom of the nozzle if less than 2 inches; OR from 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 1.0-inch below the lowest point at the toe of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) and including all RPV head penetration nozzle surfaces below the J-groove weld that have an operating stress level (including all residual and normal operation stresses) of 20 ksi tension and greater. In addition, an assessment shall be made to determine if leakage has occurred into the annulus between the RPV head penetration nozzle and the RPV head low-alloy steel.*

or

ii *Eddy current testing or dye penetrant testing of the entire wetted surface of the J-groove weld and the wetted surface of the RPV head penetration nozzle base material from at least 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 2 inches below the lowest point at the toe of the J-groove weld on a horizontal plane perpendicular to the nozzle axis (or the bottom of the nozzle if less than 2 inches OR from 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 1.0-inch below the lowest point at the toe of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) and including all RPV head penetration nozzle surfaces below the J-groove weld that have an operating stress level (including all residual and normal operation stresses) of 20 ksi tension and greater.*

...shall be performed at every refueling outage. "

The examination program selected for Salem Unit 1 included ultrasonic examinations of the 79 CRDM penetration nozzles with leakage assessment in accordance with Section IV.C.(5) (b) (i) of the Order.

In anticipation that a combination of volumetric and surface examination techniques might be necessary to complete the reactor vessel head penetration inspection program, the following Westinghouse field service procedures and associated field change notices (FCNs) were approved for use at Salem Unit 1. All of the procedures have been demonstrated through the EPRI/MRP protocol.

- WDI-ET-002, Rev. 4 with FCN-01
  "Eddy Current Inspection of J-Groove Welds in Vessel Head Penetrations"

- WDI-ET-003, Rev. 6 with FCN-01 and FCN-02
  "IntraSpect Eddy Current Imaging Procedure for Inspection of Reactor Vessel Head Penetrations"

- WDI-ET-004, Rev. 5 with FCN-01 and FCN-02
  "IntraSpect Eddy Current Analysis Guidelines Inspection of Reactor Vessel Head Penetrations"

- WDI-ET-008, Rev. 3 with FCN-01
  "IntraSpect Eddy Current Imaging Procedure for Inspection of Reactor Vessel Head Penetrations With Gap Scanner"

- WDI-UT-010, Rev 7 with FCN-01and FCN-02
  "IntraSpect Ultrasonic Procedure for Inspection of Reactor Vessel Head Penetrations, Time of Flight Ultrasonic & Longitudinal Wave"

- WDI-UT-013, Rev. 5 with FCN-01 and FCN-02
  "CRDM/ICI UT Analysis Guidelines"

- WCAL-002, Rev. 3
  "Pulser/Receiver Linearity Procedure"

The vessel head penetrations were dispositioned based on an assessment of results from the nondestructive examinations presented herein and results from visual examinations performed from the top of the reactor vessel head.

2.0 SCOPE OF WORK

The reactor vessel head penetration nondestructive examination scope at Salem Unit 1 included all 79 CRDM penetration tubes.

- Examinations of the CRDM penetration tubes were performed from the inside diameter (ID) surfaces using two examination systems. The system selected for each penetration was dependent upon the penetration tube configuration and penetration-specific conditions:

  1) Nineteen (19) penetration tubes without thermal sleeves were examined from the ID using the Westinghouse 7010 Open Housing Scanner which performs; 1) TOFD ultrasonic examinations, 2) 0° straight beam examinations to identify evidence of a leak path in the shrink fit area, and 3) supplementary eddy current examinations.

  2) Fifty-three (53) penetration tubes containing thermal sleeves were inspected from the ID using the Westinghouse Gap Scanner and "Trinity" blade probes which perform 1) TOFD ultrasonic examinations, 2) 0° straight beam examinations to identify evidence of a leak path in the shrink fit area, and 3) supplementary eddy current examinations.

  3) Seven (7) penetration tubes sleeves containing part length drive shafts were inspected from the ID using the Westinghouse Gap Scanner and "Trinity" blade probes which perform 1) TOFD ultrasonic examinations, 2) 0° straight beam examinations to identify evidence of a leak path in the shrink fit area, and 3) supplementary eddy current examinations.

The delivery system used for the CRDM examinations at Salem Unit 1 was the Westinghouse DERI 700 manipulator.

The DERI 700 is a multi-purpose robot that can access all head penetrations and provides a common platform for all CRDM examination end effectors. The manipulator consists of a central leg, mounted on a carriage, which in turn is mounted onto a guide rail. The manipulator arm, with elbow and removable wrist, is mounted onto the carriage, which travels vertically along the manipulator leg.

The DERI 700 was used to deliver 1) the Westinghouse 7010 Open Housing Scanner for ultrasonic and supplementary eddy current examinations of penetration locations without thermal sleeves and 2) the Westinghouse Gap Scanner end effector for ultrasonic and supplementary eddy current examinations of penetration locations containing thermal sleeves.

The Westinghouse 7010 Open Housing Scanner delivers an examination wand containing ultrasonic and eddy current probes to the ID surface of open reactor vessel head penetrations. The scanning motion is in a vertical direction moving from a specified height above the weld, in this case at least 2.0", to the ID chamfer at the bottom of each penetration. The probe is indexed in the circumferential direction. With the open housing Scanner, four examinations are conducted simultaneously. These include:

1) Time-of-flight diffraction ultrasonic examination optimized for identification of circumferentially oriented degradation on the penetration tube OD surfaces

2) Time-of-flight diffraction ultrasonic examination optimized for identification of axially oriented degradation on the penetration tube OD surfaces

3) Straight beam ultrasonic examination to identify variations in the penetration tube-to-reactor vessel head shrink fit area that might indicate a leak path

4) Supplementary eddy current examination for identification of circumferential and axial degradation on the ID surfaces of the penetration tubes

The Gap Scanner end effector delivers "Trinity" blade probes which include a cross wound eddy current coil, a TOFD UT transducer pair and a 0°ultrasonic transducer into the annulus between the ID surface of the reactor vessel head penetration tube and the OD surface of the thermal sleeve. The typical annulus size is 0.125". The blade probe design utilizes a flexible metal "blade" on which ultrasonic and/or eddy current probes are mounted in a spring configuration that enables the probes to ride on the ID surface of the penetration tubes. The scanning motion is in a vertical direction moving from a specified height above the weld, in this case at least 2.0", to the ID chamfer at the bottom of each penetration. The probes are indexed in the circumferential direction. The Gap Scanner end effector also has a probe tilt and drive unit to advance and reverse the probe in the tube/thermal sleeve annulus, a turntable to rotate the probe drive around the axis of the penetration, a lifting cylinder to raise and lower the tilt and drive unit and a centering device consisting of two clamping arms. With the Gap Scanner, three examinations are conducted simultaneously. These include:

1) Time-of-flight diffraction ultrasonic examination optimized for identification of circumferentially oriented degradation on the penetration tube OD surfaces

2) Straight beam ultrasonic examination to identify variations in the penetration tube-to-reactor vessel head shrink fit area that might indicate a leak path

3) Supplementary eddy current examination for identification of circumferential and axial degradation on the ID surfaces of the penetration tubes

2.1 7010 Open Housing Scanner Ultrasonic and Eddy Current Examinations

7010 Open Housing Scanner examinations were conducted on nineteen (19) reactor vessel head penetrations without thermal sleeves.

Examinations of the vessel head penetrations included:

1) TOFD ultrasonic techniques demonstrated capable of detecting axial and circumferential reflectors on the penetration tube OD surfaces with PCS24 probes in accordance with WDI-UT-010, Rev. 7 with FCN-01, and FCN-02 "IntraSpect Ultrasonic Procedure for Inspection of Reactor Vessel Head Penetrations, Time of Flight Ultrasonic Longitudinal Wave" & Shear Wave"

2) straight beam ultrasonic techniques at 2.25 MHz and 5.0 MHz to identify possible leak paths in the shrink fit region between the head penetrations and the reactor vessel head, and

3) supplementary eddy current examinations demonstrated capable of detecting axial and circumferential degradation on the penetration tube ID surfaces in accordance with and WDI-ET-003, Rev. 6 with FCN-01 and FCN-02 - "IntraSpect Eddy Current Imaging Procedure for Inspection of Reactor Vessel Head Penetrations".

2.2 Gap Scanner Penetration Tube Examinations using Trinity Blade Probe

Examinations were performed with the Gap Scanner end effector from the penetration ID surfaces on 53 penetration tubes containing thermal sleeves and seven (7) penetrations containing part lengths. These 60 penetration tubes were inspected from the ID using "Trinity" blade probes capable of performing TOFD ultrasonic examinations, leak path assessment, and supplementary eddy current examinations simultaneously. These examinations were performed in accordance with:

1) WDI-UT-010, Rev. 7 with FCN-01, and FCN-02 – "IntraSpect Ultrasonic Procedure for Inspection of Reactor Vessel Head Penetrations, Time of Flight Ultrasonic Longitudinal Wave" & Shear Wave"

2) WDI-ET-008, Rev. 3 with FCN 01 – "IntraSpect Eddy Current Imaging Procedure for Inspection of Reactor Vessel Head Penetrations With Gap Scanner".

3.0 EXAMINATION RESULTS

3.1 7010 Open Housing Scanner Ultrasonic and Eddy Current Examinations

The following table provides a summary of all 7010 Open Housing Scanner RVHP nondestructive examinations performed at Salem Unit 1 during the 1R16 March 2004 refueling outage.

Nineteen (19) penetrations without thermal sleeves were inspected from the ID using the Westinghouse Open Housing Scanner. The final disposition of the examination results is provided in the table below.

Penetration #	Axial TOFD Channel 1	Circ TOFD Channel 2	0° 2.25 Mhz	0° 5.0 Mhz	Tube ID ECT Supplement)	Exam Extent	
						Lower	Upper
2	NDD	NDD	NDD	NDD	MAI	1.08	3.00
3	NDD	NDD	NDD	NDD	NDD	1.28	3.16
4	NDD	NDD	NDD	NDD	NDD	0.92	3.16
5	NDD	NDD	NDD	NDD	NDD	0.68	3.00
15	NDD	NDD	NDD	NDD	NDD	0.92	3.56
17	NDD	NDD	NDD	NDD	NDD	0.92	3.48
19	NDD	PTI(ID 0.047")	NDD	NDD	MAI	0.84	3.56
21	NDD	NDD	NDD	NDD	MAI	1.00	3.32
26	NDD	NDD	NDD	NDD	NDD	0.60	3.48
27	NDD	NDD	NDD	NDD	NDD	0.88	3.04
28	NDD	NDD	NDD	NDD	NDD	1.00	2.52
29	NDD	NDD	NDD	NDD	MAI	0.64	3.60
34	NDD	NDD	NDD	NDD	MAI	0.76	3.80
74	NDD	NDD	NDD	NDD	NDD	0.64	2.96
75**	NDD	NDD	NDD	NDD	NDD	0.74	2.20
76**	NDD	NDD	NDD	NDD	NDD	0.94	2.20
77**	NDD	NDD	NDD	NDD	NDD	0.54	2.08
78**	NDD	NDD	NDD	NDD	NDD	0.28	2.64
79**	NDD	NDD	NDD	NDD	NDD	0.90	2.52

Note **: Penetrations 75 through 79 were re-scanned using a Trinity blade probe mounted on the 7010 tool. The additional scans were performed to improve the examination coverage below the weld and the data quality.

Of the 19 penetrations inspected with the 7010 Open Housing Scanner Eddy Current System, 5 showed indications characteristic of axial cluster cracking on the ID surface and 14 penetrations showed no detectable degradation.

There were no indications of leak paths identified in the shrink fit areas.

All penetrations where inspected from 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis).

Penetrations #2, 3, 21 and 28 have data collected at least 1 inch below the lowest point at the toe of the J-groove weld. The remaining penetrations have coverage less than 1 inch below the lowest point at the toe of the J-groove weld.

3.2 Gap Scanner Penetration Tube Trinity Blade Probe Examinations

The following table provides a summary of all Gap Scanner examinations performed at Salem Unit 1 during the 1R16 March 2004 refueling outage.

53 penetration tubes containing thermal sleeves and 7 tubes containing part length drive shafts were inspected from the ID using the Westinghouse Gap Scanner and "Trinity" blade probes.

The final disposition of the examination results is provided in the table below.

Penetration #	PCS24 TOFD	0° Leak Path	Supplementary ECT Tube ID	Exam Extent	
				Lower	Upper
1	NDD	NDD	NDD	1.30	2.24
6	NDD	NDD	NDD	1.22	2.52
7	NDD	NDD	NDD	1.22	2.72
8	NDD	NDD	NDD	1.10	2.72
9	NDD	NDD	NDD	0.86	2.72
10	NDD	NDD	NDD	1.10	2.60
11	NDD	NDD	NDD	1.06	2.36
12	NDD	NDD	NDD	1.18	2.64
13	NDD	NDD	NDD	0.70	2.28
14	NDD	NDD	NDD	0.90	2.88
16	NDD	NDD	MAI	1.26	2.36
18	NDD	NDD	NDD	0.62	2.56
20	NDD	NDD	NDD	0.74	3.04
22	NDD	NDD	NDD	0.94	2.64
23	NDD	NDD	NDD	0.98	2.64
24	NDD	NDD	NDD	0.90	2.48
25	NDD	NDD	NDD	0.50	2.84
30*	NDD	NDD	MAI	0.74	3.92
31*	NDD	NDD	MAI	0.86	3.96
32*	NDD	NDD	NDD	1.02	3.80
33*	NDD	NDD	NDD	0.82	3.48
35*	NDD	NDD	NDD	0.94	3.76
36*	NDD	NDD	NDD	0.78	3.92
37*	NDD	NDD	MAI	0.58	3.88
38	NDD	NDD	NDD	0.94	3.28
39	NDD	NDD	MAI	0.82	3.00
40	NDD	NDD	NDD	0.78	2.96
41	NDD	NDD	NDD	0.82	2.64
42	NDD	NDD	NDD	0.86	2.88
43	NDD	NDD	NDD	0.78	2.32
44	NDD	NDD	NDD	0.82	2.68
45	NDD	NDD	NDD	0.74	2.64
46	NDD	NDD	NDD	0.86	2.80
47	NDD	NDD	NDD	0.66	2.84
48	NDD	NDD	MAI	0.66	2.88
49	NDD	NDD	NDD	0.54	2.96
50	NDD	NDD	NDD	0.62	3.00
51	NDD	NDD	NDD	0.62	3.16

Penetration #	PCS24 TOFD	0° Leak Path	Supplementary ECT Tube ID	Exam Extent	
				Lower	Upper
52	NDD	NDD	NDD	1.14	2.88
53	NDD	NDD	NDD	0.58	2.92
54	NDD	NDD	NDD	0.94	2.74
55	NDD	NDD	NDD	0.74	3.00
56	NDD	NDD	NDD	0.78	3.12
57	NDD	NDD	NDD	0.74	3.12
58	NDD	NDD	NDD	0.62	2.96
59	NDD	NDD	NDD	1.10	3.00
60	NDD	NDD	NDD	1.18	2.80
61	NDD	NDD	NDD	0.82	2.72
62	NDD	NDD	NDD	0.66	2.36
63	NDD	NDD	MAI	0.74	3.08
64	NDD	NDD	NDD	0.78	2.92
65	NDD	NDD	NDD	0.58	2.84
66	NDD	NDD	NDD	0.74	2.80
67	NDD	NDD	NDD	0.50	2.64
68	NDD	NDD	NDD	0.70	2.80
69	NDD	NDD	MAI	0.78	3.08
70	PTI(<0.04")	NDD	MAI	0.86	2.96
71	NDD	NDD	NDD	0.98	2.48
72	NDD	NDD	NDD	0.62	2.80
73	PTI(<0.04")	NDD	MAI	0.50	3.00

Note: * Indicates Part Length Drive Shafts

Of the sixty penetrations inspected with the Gap Scanner Eddy Current System, 10 showed indications characteristic of axial cluster cracking on the ID surface and 50 penetrations showed no detectable degradation.

There were no indications of leak paths identified in the shrink fit areas.

All penetrations where inspected from 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis).

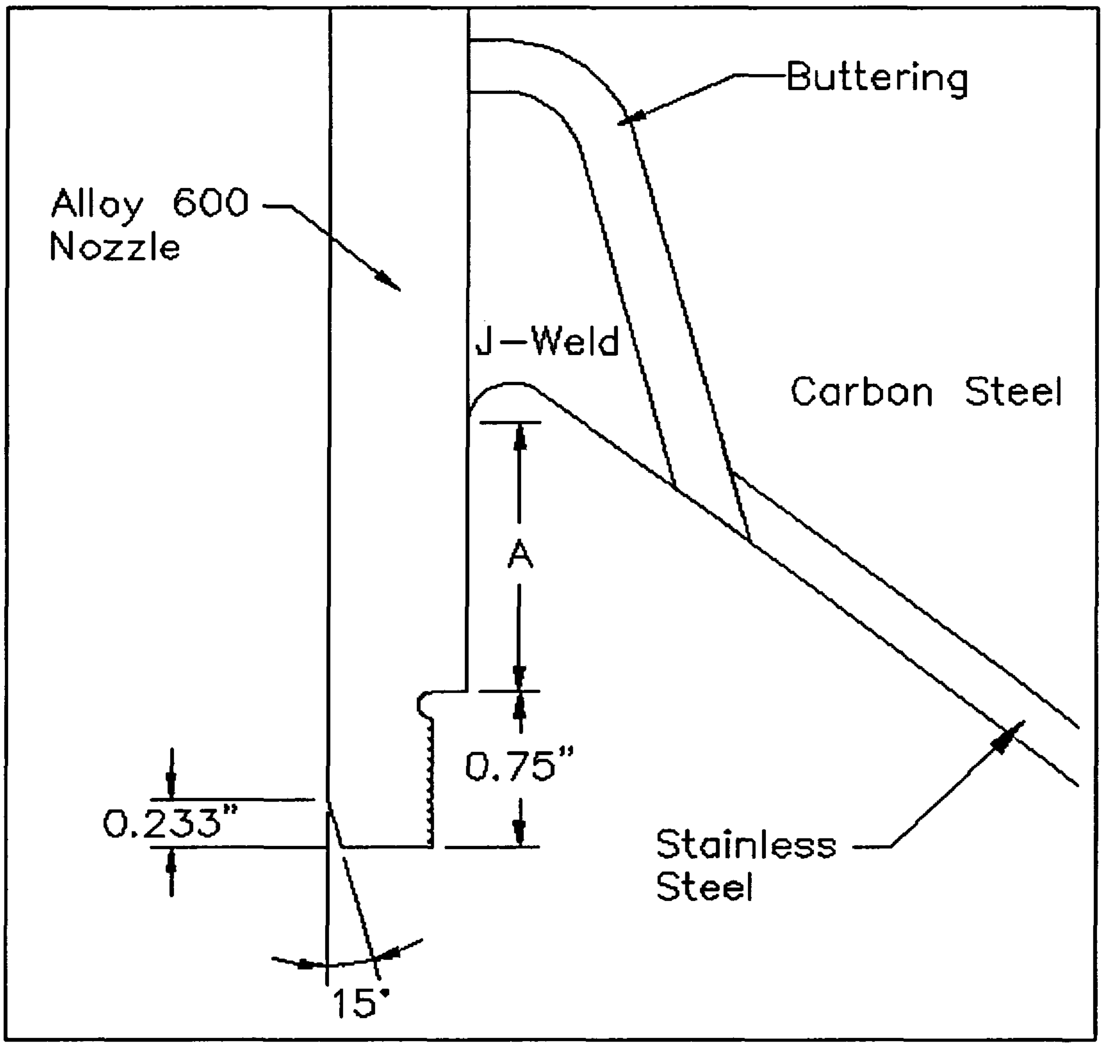
Penetrations #1, 6, 7, 8, 10, 11, 12, 16, 21, 32, 52, 59 and 60 have data collected at least 1 inch below the lowest point at the toe of the J-groove weld. The remaining penetrations have coverage less than 1 inch below the lowest point at the toe of the J-groove weld.

Legend:

NDD No Detectable Defect
MAI Multiple Axial Indication
PTI Penetration Tube Indication

4.0 EXAMINATION COVERAGE

The configuration of the Salem Unit 1 CRDM penetration tubes is shown in the figure below. This figure represents the tube-to-head geometry on the "downhill" side of the tube (0° azimuth of the penetration). The bottom ends of all seventy-nine penetration tubes are threaded on the OD surface and have a 15° chamfer on the ID surface.



The threads on the OD surfaces extend from the bottom of the tube to an elevation of approximately 0.6875" where there a thread relief is machined. The top of the thread relief is 0.75" above the bottom of the tube. The distance from the top of the thread relief to the bottom of the fillet of the J-groove weld (identified as "A" in the figure) varies based on location of the penetration in the head. These distances are longer for penetrations at "inboard" locations and become progressively shorter for penetrations located further away from the center of the head.

The ID surfaces of the penetration tubes are chamfered at a 15° angle from the bottom of the tube to an elevation of 0.233".

The threads on the tube OD surfaces and chamfer on the ID surfaces represent geometric conditions which limit examination coverage near the bottoms of the tubes.

For ID examinations of all 79 penetration tubes the TOFD PCS24 examination coverage extended from the uppermost elevation of the chamfer (0.233" from the bottom of the tube plus half of the PCS) to elevations at least 2.0" above the weld. Supplementary eddy current examination coverage extended from the uppermost elevation of the chamfer (0.233" from the bottom of the tube plus half of the probe diameter) to elevations at least 2.0" above the weld except for penetrations #28, 76, 77 and 79. The extent of coverage was verified for each penetration by confirmation that: 1) tube entry signals were evident and 2) scan coverage elevations were in excess of 2.0" above the uppermost elevation of each weld.

For OD examinations of all 79 penetration tubes, the TOFD PCS24 transducer coverage extended from 0.851" (for Gap Scanner examination) and 0.831" (for Open Housing Scanner examination) above the end of the tube to elevations at least 2.0" above the uppermost elevation of each weld. The extent of coverage was verified for each penetration by confirmation that: 1) TOFD ultrasonic signals from the thread relief were evident and 2) scan coverage elevations were in excess of 2.0" above the uppermost elevation of each weld.

5.0 DISCUSSION OF RESULTS

All of the penetration tube ultrasonic examination data was analyzed in accordance with WDI-UT-013, Rev. 5 with FCN-01 and FCN-02 – "CRDM/ICI UT Analysis Guidelines". The penetration tube eddy current data was analyzed in accordance with WDI-ET-004, Rev. 5 with FCN-01 and FCN-02 – "IntraSpect Eddy Current Analysis Guidelines Inspection of Reactor Vessel Head Penetrations".

Data sheets and printouts of the results of each examination performed on each penetration are found in Volume 2.

Eddy Current results from tube ID surface examinations showed 15 penetration tubes with indications characteristic of axial cluster cracking. With the exception of penetration #19 these indications were determined with the TOFD inspection to have a depth less than 0.040". Penetration #19 had indications characteristic of axial cluster cracking as described above. One indication in the cluster area had a reflector which produced a measurement of 0.047" with the TOFD inspection channel.

Results from the TOFD ultrasonic and eddy current examinations of the sixty-nine reactor vessel head penetrations identified no indications characteristic of PWSCC. The straight beam ultrasonic examinations of the shrink-fit regions of the seventy nine penetration tubes showed no evidence of leak paths.

Figure 5-1 - Penetration Tube ID Flaw Evaluation

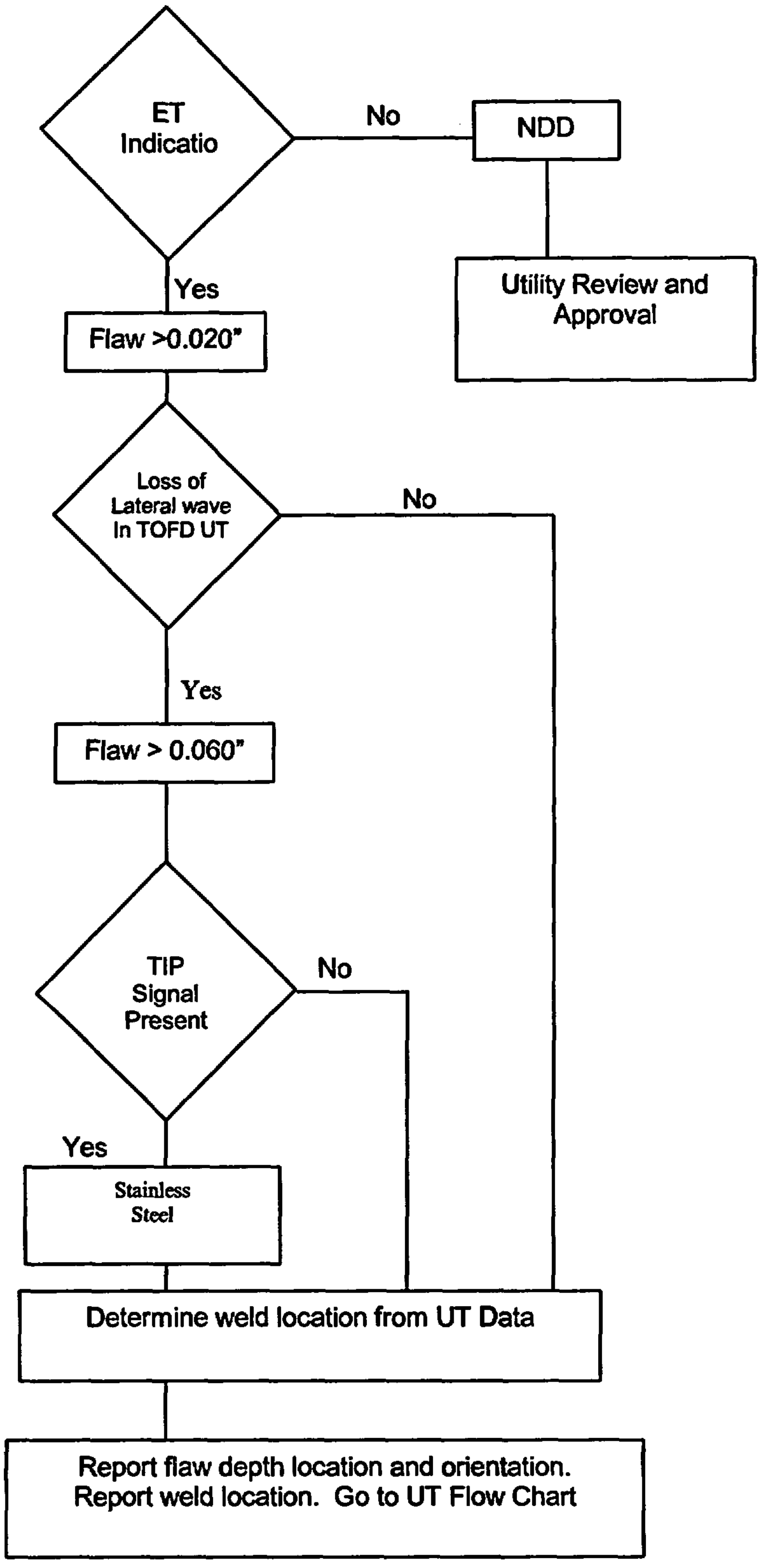
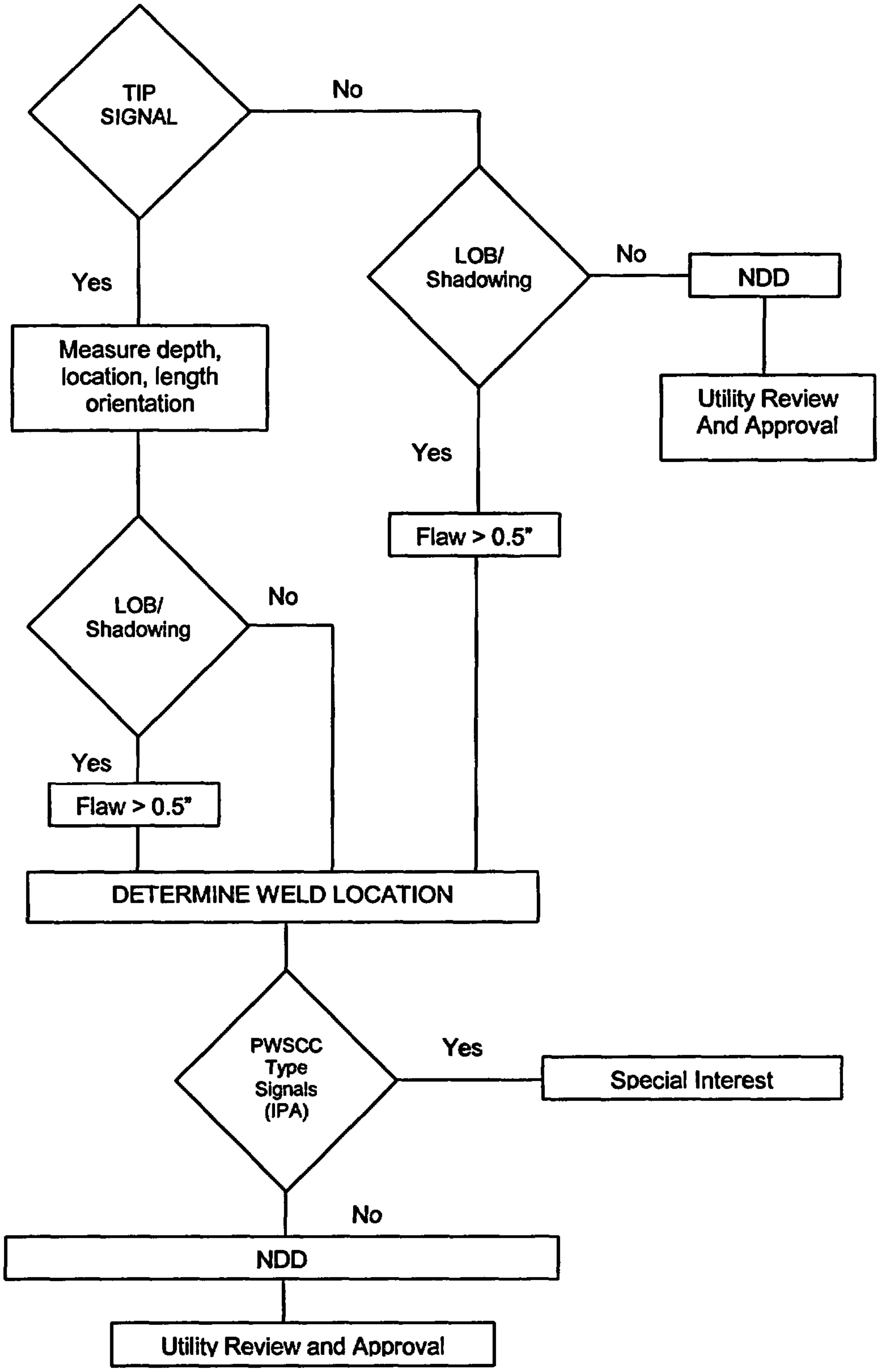


Figure 5-2 - Penetration Tube OD Flaw Evaluation



6.0 REFERENCES

[1] EPRI/MRP89 Technical Report, "Materials Reliability Program: Demonstrations of Vendor Equipment and Procedures for the Inspection of Control Rod Drive Mechanism Head Penetrations (MRP-89)", EPRI, Palo Alto, CA: July, 2003.

[2] USNRC Letter EA-03-009, "Issuance of First Revised NRC Order (EA-03-009) Establishing Interim Inspection Requirements for Reactor Vessel Heads at Pressurized Water Reactors", February 20, 2004.

Attachment 2

Report of the Bare-Metal Visual Examination of the Salem Unit 1 Reactor Pressure Vessel Head

A bare-metal visual (BMV) examination of the Salem Unit 1 reactor pressure vessel (RPV) head top surface, including 360° around each penetration nozzle, was performed as identified in section IV.C.(5)(a) of the First Revised NRC Order EA-03-009. To facilitate the examination, the reflective mirror insulation was completely removed from the RPV head, providing a 360-degree, 100% visual access to all penetrations. The inspection was not inhibited or masked by the presence of insulation, any deposits or debris, or other factors that could interfere with the detection of boric acid leakage; therefore, the capability of detecting and discriminating small amounts of boric acid deposits, if present, was afforded to the certified examiners

The overall condition of the Salem Unit 1 RPV head surface was clean with no evidence of leakage. The intersections of 100% of each nozzle and the head vent were easily observed 360 degrees and there was no indication of the presence of boric acid deposits. The intersections between the penetration nozzles and the reactor head were well defined and clean of any indication of boric acid deposits that have taken the physical appearance of "popcorn", or evidence of any boric acid crystal growth extruding up from the head, on the outside surface of the nozzle. There was no evidence of boric acid leakage from sources above the head, such as canopy seal welds that could leak downward onto the head.

In summary, a 100% BMV examination of the Salem Unit 1 RPV head was performed. There was no evidence of boric acid leakage.