

Docket Nos. 50-266 and
50-301

February 14, 1994

LICENSEE: Wisconsin Electric Power Company
FACILITY: Point Beach Nuclear Power Plant, Units 1 and 2
SUBJECT: REACTOR VESSEL HEAD PENETRATION INSPECTION

On November 3, 1993, the staff met with representatives of the licensee at One White Flint North, Rockville, Maryland. The purpose of the meeting was to discuss the upcoming inspection of the control rod drive vessel head penetrations at the Point Beach Nuclear Plant. Enclosure 1 lists the meeting participants.

Following introductions and a brief summary of the purpose of the meeting, the licensee staff and their consultants presented details of their plans for the upcoming inspections (Enclosure 2 provides copies of the meeting handouts). Issues discussed included schedule, inspection scope, techniques to be employed, evaluation methods and criteria, and repair methodology.

A key issue identified during the presentation was the dispositioning of circumferential flaws. The licensee stated that NRC and WEPCo must agree on the acceptance criteria for these flaws (to leave in place as found, or to repair by an approved method) before the inspections begin. The staff stated that current analysis techniques and completed inspections at other plants indicate that there should not be any circumferential flaws, implying that if these flaws were found then the analysis could be deficient for not identifying them. The licensee then clarified that the analysis techniques can indeed be used for prediction of circumferential cracking, though this requires viewing the data from above the penetration. The licensee also stated that any circumferential cracks identified during the inspection could have been there since original construction, and not a result of operations. At the end of this part of the discussions, the staff agreed that the NRC position would be formalized before the inspections began.

A five day window in the upcoming Unit 1 refueling outage has been identified for the inspections. The inspections will encompass all 49 penetrations if time allows. If there are schedule problems, the licensee may alter the inspection scope and/or sequence.

ORIGINAL SIGNED BY
Allen G. Hansen, Project Manager
Project Directorate III-3
Division of Reactor Projects III/IV/V

170045

Enclosures:
As stated

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cc: See next page

OFFICE	LA:PDIII-3	PM:PDIII-3	D:PDIII-3
NAME	MRushbrook	AHansen	JHannon
DATE	2/14/94	2/14/94	2/14/94

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SVarga, Acting ADP

JRoe

JZwolinski

JHannon

MRushbrook

AHansen

RHermann

JHannon

LBanic

JDavis

WKoo

JStrosnider

OGC

EJordan

ACRS (10)

WDean 17 G 21

EGreenman

Mr. Robert E. Link
Wisconsin Electric Power Company

Point Beach Nuclear Plant
Unit Nos. 1 and 2

cc:

Mr. Robert E. Link, Vice President
Nuclear Power Department
Wisconsin Electric Power Company
231 West Michigan Street, Room P379
Milwaukee, Wisconsin 53201

Ernest L. Blake, Jr.
Shaw, Pittman, Potts & Trowbridge
2300 N Street, N.W.
Washington, DC 20037

Mr. Gregory J. Maxfield, Manager
Point Beach Nuclear Plant
Wisconsin Electric Power Company
6610 Nuclear Road
Two Rivers, Wisconsin 54241

Town Chairman
Town of Two Creeks
Route 3
Two Rivers, Wisconsin 54241

Chairman
Public Service Commission
of Wisconsin
Hills Farms State Office Building
Madison, Wisconsin 53702

Regional Administrator, Region III
U.S. Nuclear Regulatory Commission
801 Warrenville Road
Lisle, Illinois 60532-4351

Resident Inspector's Office
U.S. Nuclear Regulatory Commission
6612 Nuclear Road
Two Rivers, Wisconsin 54241

NAME	AFFILIATION
Robert Hermann	USNRC/NRR/DE
John Hannon	USNRC/NRR/DRPW
Lee Banic	USNRC/NRR/DE
Jim Davis	USNRC/NRR/DE
William Koo	USNRC/NRR/DE
Jack Strosnider	USNRC/NRR/DE
Allen Hansen	USNRC/NRR/DE
Steve Hunt	Dominion Engineering
Dick Cyburon	ABB - Combustion Engineering
Kevin Fleming	BWNT
Melvin Arey	Duke Power
David Whitaker	Duke Power
John Galembush	Westinghouse
Rick Rishel	Westinghouse
David Howell	Westinghouse
Warren Bamford	Westinghouse
Dave Boyle	Westinghouse
Steve Brewer	American Electric Power
Jim Benes	American Electric Power
Dom Bemis	Consumers Power
Sid Burns	W(SI) ²
E. Kietzman	EPRI NDE Center
Frank Ammirato	EPRI NDE Center
Morris Schreim	NUMARC
Tom Spry	Commonwealth Edison
Tom Malanowski	Wisconsin Electric
Greg Maxfield	Wisconsin Electric
Roger Newton	Wisconsin Electric
Craig Prothero	Wisconsin Electric

WISCONSIN ELECTRIC POWER CO.

POINT BEACH MEETING

WITH NRC

**REACTOR VESSEL HEAD
PENETRATION INSPECTION**

January 31, 1994

NRC MEETING AGENDA

- 1) Introduction - Roger Newton
- 2) WE Schedule - Craig Prothero
 - a) Preparation
 - b) EPRI Mock-up Qualification
 - c) Outage
- 3) Scope of WE Inspection - Craig Prothero
- 4) Techniques to be Employed - Dave Howell
 - a) Detection
 - b) Sizing
- 5) Evaluation of Indications - Warren Bamford
 - a) Crack growth rate methodology
 - b) Acceptance Criteria
 - (1) Axial Flaws
 - (2) Circumferential Flaws
- 6) Repair Methodology - Dave Howell
- 7) Questions Closing - Roger Newton

JAN 25 1994

SCHEDULE

INDUSTRY EFFORT

Support WOG Activities	Ongoing
Support AHAC Activities	Ongoing

INSPECTION PREPARATION SCHEDULE

Decision to plan for inspection	03/03/93
Specification complete	03/24/93
Performed visual inspection of head penetrations from underneath	04/18/93
Performed scoping of job in containment	05/05/93
Received bids	05/21/93
Evaluated bids	09/02/93
Contract awarded	09/10/93
EPRI Mockup demonstration	02/09/94
Mockup of inspection end effectors with R-θ manipulator	02/14/94
Mockup of repair tooling end effectors with R-θ manipulator	02/21/94
Perform plant specific engineering analysis for flaw evaluation	03/10/94
Design head stand modification	03/15/94
Design head shield ring alteration	03/15/94
Design temporary lead shielding	03/15/94

OUTAGE SCHEDULE

Modify shield ring	04/03/94
Inspection equipment to arrive onsite	04/03/94
Install RV head stand modification	04/04/94
Install temporary lead shielding	04/05/94
Stage inspection equipment	04/08/94
Set RV head	04/09/94
Start head penetration inspection	04/10/94
Complete head penetration inspection	04/15/94
Replace RV head	04/17/94

WE INSPECTION SCOPE

INSPECTION SEQUENCE LOGIC

- 1) Start with outer row penetrations that do not have thermal sleeves and work towards the ID on non-sleeved penetrations (12 total).
- 2) Upon completion of non-sleeved penetrations, proceed with inspection of the sleeved penetrations starting with the outer most penetrations and working in (33 total).
- 3) Upon completion of unsleeved penetrations proceed with inspection of the penetrations with part-length control rods (4 total).

Inspection sequence will be very flexible. If problems are encountered on any particular penetration(s) then sequence may be altered to allow continued production.

If, for any reason, a 100% inspection cannot be conducted (e.g. equipment breakdown, access problems, critical path impact, etc.) then the particular situation will be assessed and a decision will be made on the course of action to be taken. Based on the inspection data to date, if the outer two rows (11 penetrations) are inspected, in accordance with the Westinghouse Owners Group Inspection Guidelines, and no flaws are identified, probabilistic analysis shows that there is a 94% confidence factor that no defects will exist.

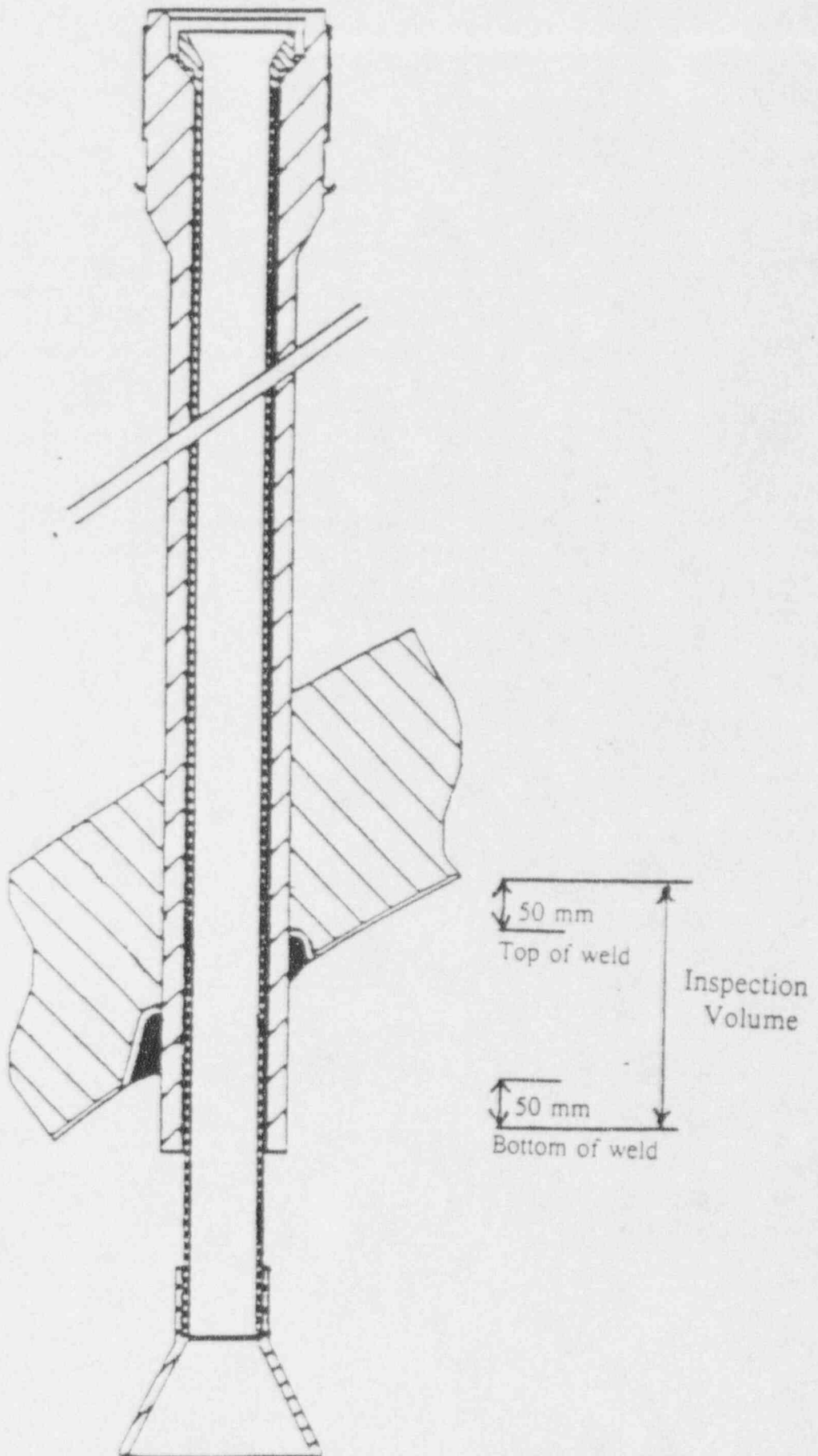
INSPECTION VOLUME

See Figure 1

PLAN

The objective of the CRDM inspection effort at PBNP is to conduct ECT of all 49 penetrations. The current outage schedule and estimated inspection rate allow for a 100% inspection.

Inspection Volume



POINT BEACH R.V. HEAD PENETRATION INSPECTION

INSPECTION TECHNIQUES

- REMOTE DELIVERY TOOL WITH R - θ Z CAPABILITY.
- REMOTE END EFFECTOR/PROBE CHANGEOUT.
- PERFORM EDDY CURRENT SCAN ON ALL PENETRATIONS TO IDENTIFY DEFECTS.
- ANY PENETRATIONS WITH AN INDICATION WILL BE EVALUATED WITH T.O.F. U.T.
- SEPARATE SABRE PROBE FOR PENETRATIONS WITH THERMAL SLEEVES (EC & UT).
- ROTATING PROBE FOR NONSLEEVED (EC/UT) LOCATIONS.
- NO REMOVAL OF THERMAL SLEEVE WILL BE REQUIRED.

POINT BEACH R.V. HEAD PENETRATION INSPECTION

EDDY CURRENT CAPABILITIES

(Based on Westinghouse Qualification Results)

o PANCAKE COIL/ROTATING PROBE

MINIMUM DETECTABLE DEFECT

LENGTH

1.5MM

DEPTH

.5MM

PRECISION FOR LOCATION OF
ONE INDICATION

± 5MM

SEPARATION EFFECT BETWEEN
TWO INDICATIONS

5MM

PRECISION OF THE INDICATION
LENGTH

± 1MM

SCANNING FOR 1ST ANALYSIS

2° /
TRANSITION

SCANNING FOR 2ND ANALYSIS

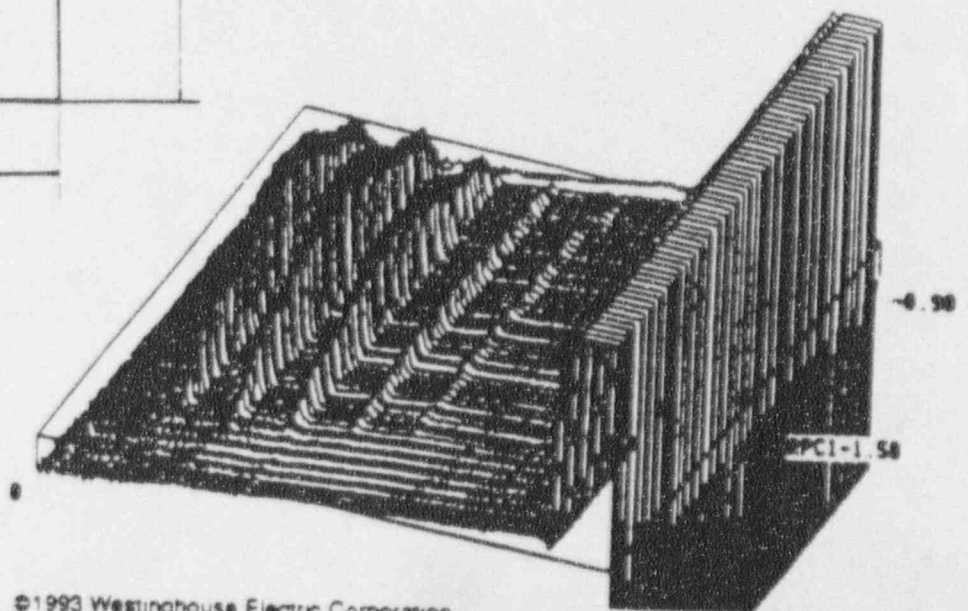
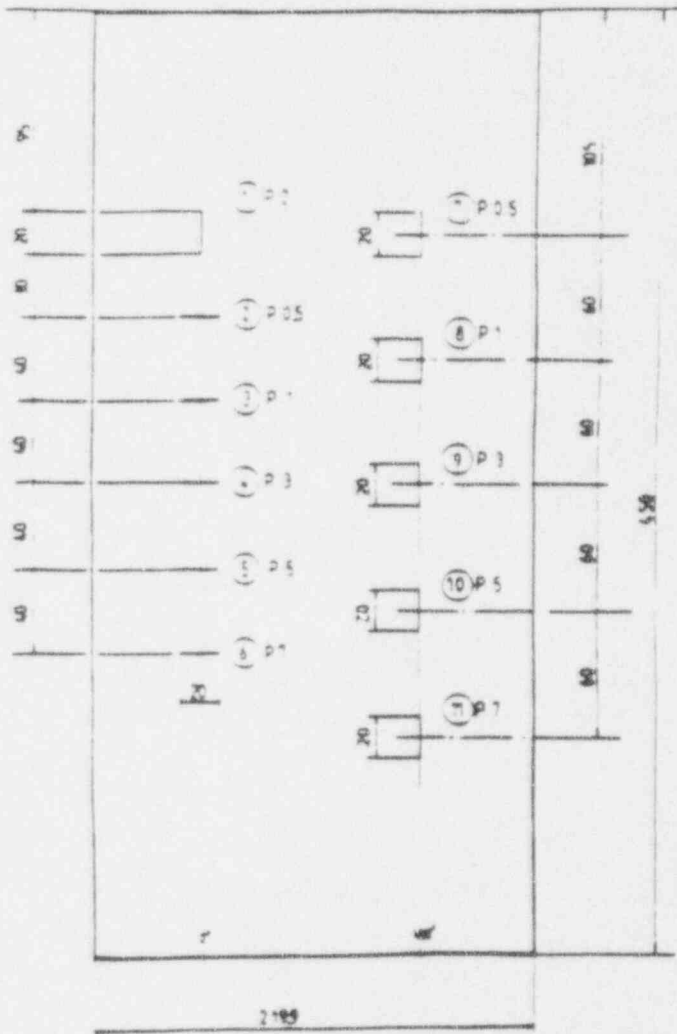
1° /
TRANSITION

REACTOR VESSEL ALLOY 600

WESTINGHOUSE INSPECTION SUPPORT

R.V. HEAD INSPECTION STRATEGY

TESTING RESULTS



POINT BEACH R.V. HEAD PENETRATION INSPECTION

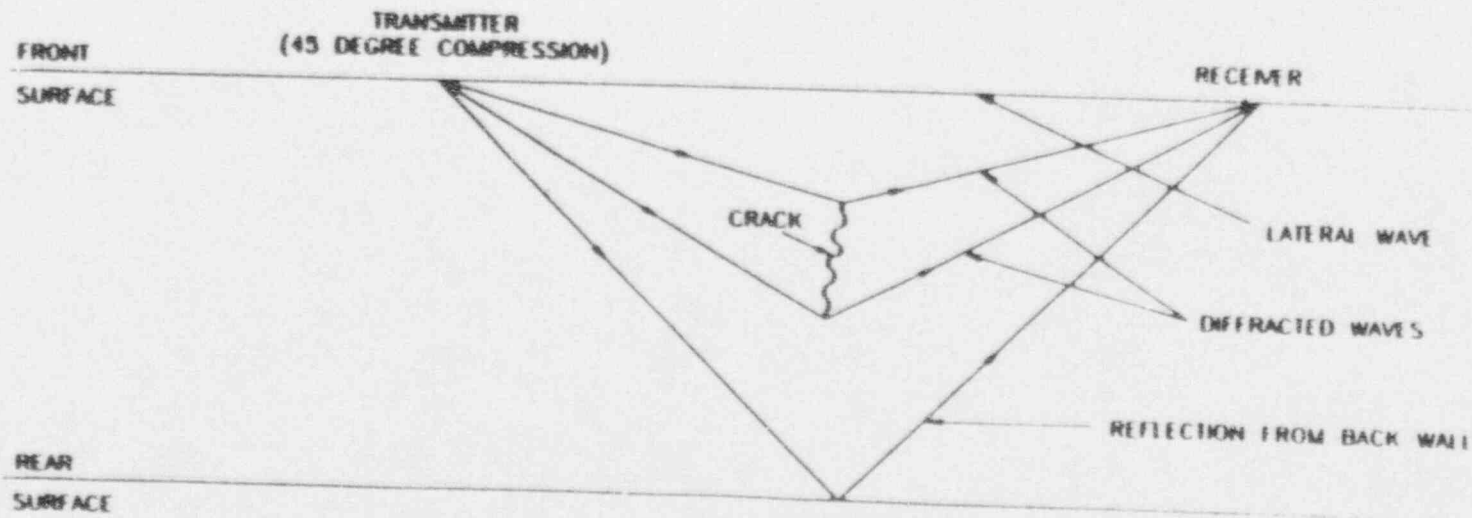
U.T. SIZING CAPABILITIES

(Based on Testing Performed in France)

- WELD PROFILE T.O.F. PROBES IN P/E MODE.
- DEFECT SIZING UTILIZING TIME OF FLIGHT TECHNIQUE.
- MULTIPLE SPACING BETWEEN PROBES TO ASSURE FULL COVERAGE OF WALL THICKNESS.
- ACCURATELY SIZE DEFECTS GREATER THAN 2-3MM DEEP.
- ACCURACY \pm .5MM ON DEPTH AND \pm 2MM ON LENGTH.
- ABILITY TO DIFFERENTIATE BETWEEN 16MM THROUGH WALL DEFECT AND A 15MM PARTIAL DEPTH DEFECT.
- SEPARATION BETWEEN DEFECTS = 8MM - 10MM.

WESTINGHOUSE / AEA O'DONNELL
REACTOR VESSEL ALLOY 600 PENETRATION INSPECTION

TIME-OF-FLIGHT DIFFRACTION



"TIME-OF-FLIGHT" ULTRASOUND PATHS

POINT BEACH R.V. HEAD PENETRATION INSPECTION

TESTING PROGRAMS/FIELD EXPERIENCE

- ALL EQUIPMENT TESTED AND QUALIFIED BY WESTINGHOUSE PRIOR TO FIELD USE.
- E.C. SYSTEM HAS BEEN SUCCESSFULLY UTILIZED ON THE FOLLOWING PLANTS:
 - o DOEL 1 (BELGIUM) - 49 PENETRATIONS
 - o ANGRA (BRAZIL) - 40 PENETRATIONS
- U.T. SYSTEM HAS BEEN SUCCESSFULLY USED AT CATTENOM IN FRANCE - 2 PENETRATIONS.

POINT BEACH R.V. HEAD PENETRATION INSPECTION

EPRI PERFORMANCE DEMONSTRATION

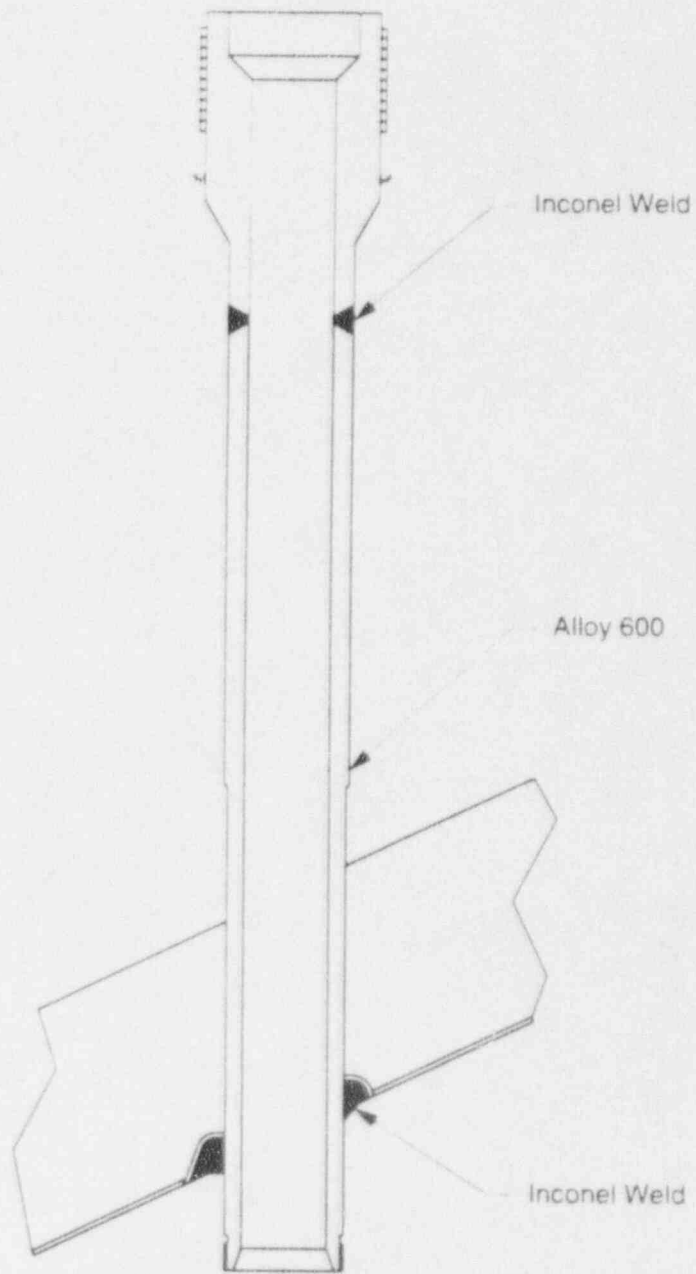
- o FULL PERFORMANCE DEMONSTRATION CONDUCTED BY EPRI IS SCHEDULED FOR WEEK OF 2/7/94.
- o BOTH E.C. AND U.T. TECHNIQUES WILL BE VERIFIED ON EPRI MOCKUP.
- o PROCEDURES WILL BE REVIEWED BY WESTINGHOUSE, EPRI AND PT. BEACH.

EVALUATIONS OF INDICATIONS

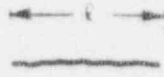
- Industry Acceptance Criteria will be used
 - Axial Flaws
 - Circumferential Flaws
- Point Beach specific evaluations are underway to determine the predicted growth for a range of indications.
- These evaluations will be complete before the inspection begins.

FLAW CHARACTERIZATION

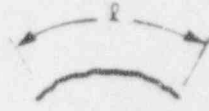
1. FLAWS DETECTED MUST BE CHARACTERIZED BY LENGTH AND PREFERABLY DEPTH
2. IF ONLY FLAW LENGTH IS CHARACTERIZED, ASSUME $A = 0.5 \times \text{LENGTH}$
3. FLAWS SHALL BE CONSIDERED SINGLE FLAWS PROVIDED THE SEPARATION DISTANCE BETWEEN FLAWS IS EQUAL TO OR LESS THAN THE DIMENSION S , WHERE S IS DETERMINED AS SHOWN IN SECTION XI,
4. FLAW LOCATION RELATIVE TO BOTH THE TOP AND BOTTOM OF THE PARTIAL PENETRATION ATTACHMENT WELD TO THE VESSEL HEAD SHALL BE DETERMINED. (SEE FIGURE 1)
5. FLAW PROJECTIONS SHOULD BE MADE IN BOTH THE AXIAL AND CIRCUMFERENTIAL DIRECTIONS IF THE FLAW IS ORIENTED AT AN ANGLE.



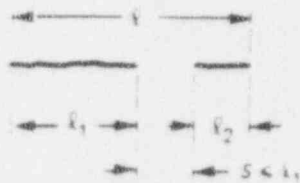
Westinghouse
CRDM Nozzle



(a) Single Linear Flow

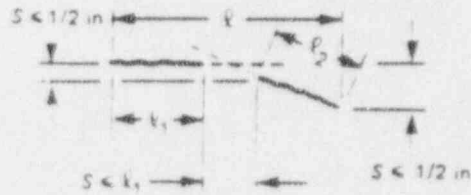


(b) Single Curvilinear Flow



(c) Aligned Linear Flaws

$$l_1 > l_2$$

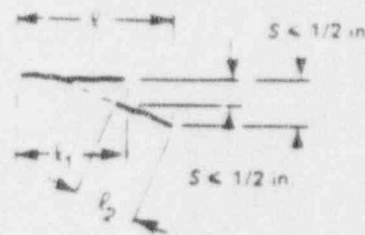


(d) Nonoverlapping Flaws

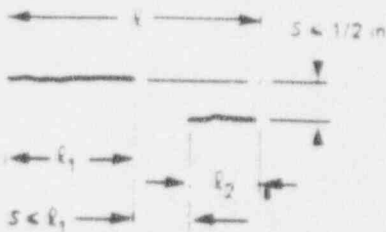
$$l_1 = l_2$$



(e) Overlapping Parallel Flaws

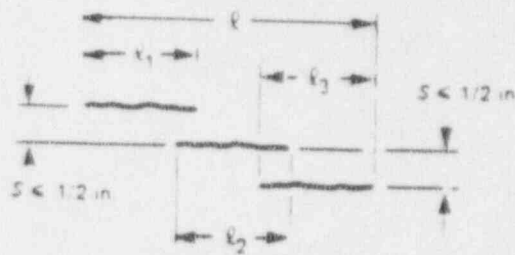


(f) Overlapping Flaws



(g) Nonaligned Parallel Flaws

$$l_1 > l_2$$



(h) Multiple Parallel Flaws

FLAW PROXIMITY RULES FROM SECTION XI (FIGURE IWA 3400-1)

FLAW ACCEPTANCE CRITERIA

1. MAXIMUM ALLOWABLE DEPTH AT OR ABOVE WELD IS $A/T = 0.75$ FOR BOTH AXIAL AND CIRCUMFERENTIAL FLAWS, WHERE A = FLAW DEPTH AND T = PENETRATION THICKNESS. THIS DEPTH IS A_F AS DEFINED IN IWB 3600.
2. AXIAL FLAWS FOUND BELOW THE WELD ARE ACCEPTABLE REGARDLESS OF DEPTH, PROVIDED THEIR UPPER END DOES NOT REACH THE BOTTOM OF THE WELD DURING THE PERIOD OF SERVICE UNTIL THE NEXT INSPECTION. AXIAL FLAWS ABOVE THE BOTTOM OF THE WELD ARE SUBJECT TO ITEM 1.
3. CIRCUMFERENTIAL FLAWS FOUND BELOW THE WELD ARE ACCEPTABLE REGARDLESS OF DEPTH, PROVIDED THE LENGTH IS LESS THAN 75% OF THE CIRCUMFERENCE.

4. AXIAL FLAWS EXTENDING THROUGH AND/OR ABOVE THE WELD REGION ARE NOT LIMITED IN LENGTH BUT DEPTH IS LIMITED BY ITEM 1.

5. CIRCUMFERENTIAL FLAWS AT AND ABOVE THE WELD ARE LIMITED TO A MEASURED LENGTH OF 50 PERCENT OF THE CIRCUMFERENCE AND THE DEPTH IS LIMITED BY ITEM 1.

6. FLAWS WHICH EXCEED THESE CRITERIA MUST BE REPAIRED, UNLESS ANALYTICALLY JUSTIFIED FOR FURTHER SERVICE WITHOUT REPAIR. THIS ANALYSIS SHALL BE SUBMITTED TO THE REGULATORY AUTHORITY HAVING JURISDICTION AT THE PLANT SITE.

Table 1: Summary of R.V. Head Penetration Acceptance Criteria

<u>LOCATION</u>	<u>AXIAL</u>		<u>CIRC</u>	
	a_r	l	a_r	l
BELOW WELD	t	no limit	t	.75 circ
AT AND ABOVE WELD	0.75t	no limit	0.75t	.50 circ

a_r = FLAW DEPTH AS DEFINED IN IWB 3600

l = FLAW LENGTH

t = WALL THICKNESS

POINT BEACH R.V. HEAD PENETRATION INSPECTION

REMEDIAL REPAIRS

- EXCAVATION - AVAILABLE FOR PT. BEACH
 - o WINDOW THRU SLEEVE
 - * 1" (25MM) WIDE X 7" (178MM) LONG
 - * STRUCTURALLY AND FUNCTIONALLY ACCEPTABLE.
 - o ACCEPTABLE STRESSES IN SLEEVE
 - o GUIDANCE FUNCTION OF SLEEVE/FUNNEL REMAINS
 - o ACCEPTABLE THERMAL EFFECTS ON CRDM
 - o REMOVAL OF LOCAL INDICATIONS - EDM EXCAVATION
 - o 360° SKIM CUT BY ROTATION OF SLEEVE
 - o ANALYSIS PERFORMED TO JUSTIFY:
 - * LOCAL EXCAVATION = 5/8" WIDE X 1/4" DEEP 4 TO 1 TAPER
 - * SKIM CUT = 3/16" REDUCTION IN WALL THICKNESS
- EXCAVATION WITH WELD REPAIR - AVAILABLE FOR PT. BEACH
 - o LOCAL REMOVAL OF INDICATIONS
 - o WELD REPAIR
- ALL WORK WILL BE PERFORMED IN COMPLIANCE TO ASME CODES
- NO REMOVAL OF THE THERMAL SLEEVE WILL BE REQUIRED