A BNFL Group company

Embedded Flaw Repair SER Discussion and Comments August 7, 2003

Warren Bamford

Jack Lareau

Nuclear Services

Purpose of Meeting

- Clarification of SER on embedded flaw repairs
- Present Westinghouse inspection plan to comply with SER
- Request expedited issuance of SER
- Request NRC letter confirming clarifications

SER on Embedded Flaw Repairs

- Technical Basis submitted via WCAP 15987
- SER issued July 3, 2003
- Approved a non-structural (seal) weld repair
- Three layers of weld required on attachment weld repairs, unspecified # of layers for the tube ID or OD
- SER acceptance was based on Westinghouse application of current ASME Code fracture mechanics methods
- The SER states that the embedded flaw repair is approved for application to CE and Westinghouse designs

SER on Embedded Flaw Repairs

- At or Above the Weld
  - The repair can be used for any flaws in the tube (ID or OD) that meet the ASME Section XI acceptance criteria, which was endorsed by the NRC by letter to NEI on April 11, 2003.
  - Larger flaws on the tube ID, are to be dealt with on a plant specific basis
  - Circumferential flaws in the tube above the weld, regardless of size are treated on a plant-specific basis, consistent with previous NRC approaches
- Below the weld
  - Flaws on the tube below the weld are approved, regardless of size, provided their upper extremity does not reach the bottom of the weld
- In the Weld Itself
  - The repair can be used for flaws of any type in the attachment weld

ASME Code Acceptance Criteria

Table IWB 3663-1: Summary of R.V. Head Penetration Acceptance Criteria				
Location	Axial a_f	l_f	Circ a_f	l_f
Below Weld (ID) (2)	t	No Limit	t	.75 Circ.
At and Above Weld (ID)	0.75 t	No Limit	(3)	(3)
Below Weld (OD) (2)	t	No Limit	t	.75 Circ.
Above Weld (OD)	(3)	(3)	(3)	*(3)

2004 edition of code. = to April 11 letter.

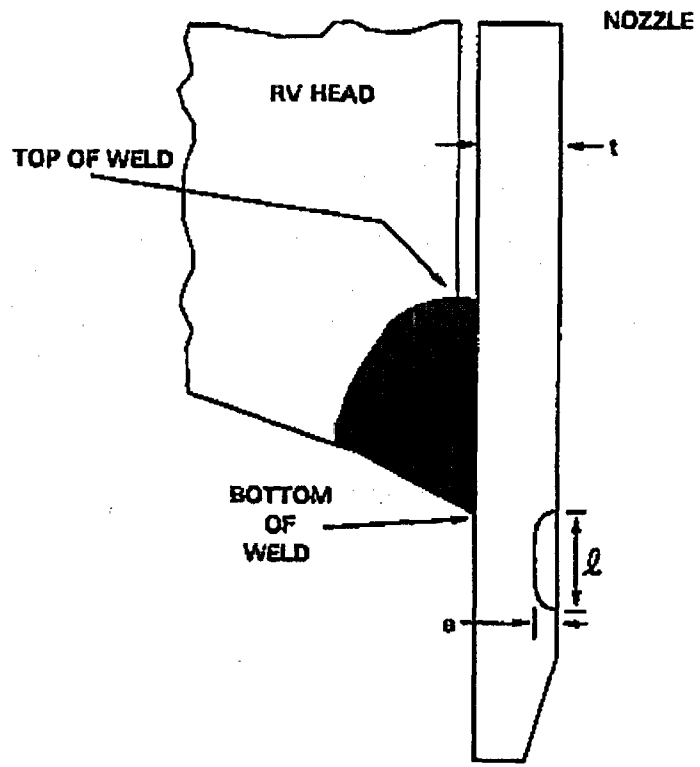
Notes:
(a) Surface flaws of any size in the attachment weld are not acceptable.
(2) Intersecting axial and circumferential flaws in the nozzle are not acceptable.
(3) Requires case-by-case evaluation and discussion with regulatory authority.

a_f = Flaw Depth as Defined in IWB 3600

l_f = Flaw Length

t = Wall Thickness of Head Penetration Nozzle

Head Penetration Geometry



SER Requirements

- Inspections are consistent with those for a structural weld, requiring both UT and surface exams in most cases --we had requested UT or Surface

- Inspections must be performed by qualified inspectors

- Licensees must demonstrate that a plant-specific application is bounded by the WCAP, including the ASME Code fracture mechanics evaluation contained in Appendix C of the WCAP (see SER paragraph 3.6)

SER Inspection Requirements

Repair Location	Flaw Orientation	Repair Weld	Repair NDE	ISI NDE of the repair, Note 2
VHP Nozzle ID	Axial	Seal	UT and Surface	UT or Surface
VHP Nozzle ID	Circumferential	Note 1	Note 1	Note 1
VHP Nozzle OD above j-groove weld	Axial or Circumferential	Note 1	Note 1	Note 1
VHP Nozzle OD below j-groove weld	Axial or Circumferential	Seal	UT or Surface	UT or Surface
j-groove weld	Axial	Seal	UT and Surface, Note 3	UT and Surface, Note 3
j-groove weld	Circumferential	Seal	UT and Surface, Note 3	UT and Surface, Note 3

Notes:

1. Repairs must be reviewed and approved separately by the NRC.
2. Inspection consistent with the NRC Order EA-03-009 dated February 11, 2003 and any subsequent changes.
3. Inspect with personnel and procedures qualified with UT performance-based criteria. Examine the accessible portion of the repaired region. The UT coverage plus surface coverage must equal 100 percent.

Westinghouse NDE Demonstrations

Tube ID and OD — UNREPAIRED

- Depth Sizing demonstration was not completed at the time of the Relief Request submittal
- Flaw detection and sizing, both length and depth is now demonstrated (MRP Interim Report, Dec '02)

J-Groove Weld — UNREPAIRED

- Surface Flaw detection demonstrated with Grooveman, for the J-Groove weld (MRP Interim Report, Dec '02)
- Detection capability (4mm) better than PT - code acceptance criteria(4.5mm)
- Demonstrated UT detection of both axial and circumferential flaws at the triple point plus 0.06" into weld

Embedded Flaw Repair Weld Inspection

REPAIR CASES

Tube ID Repair

- Weld repair surface is finished, amenable to inspection, both UT and surface exams
- Flaw detection through the weld to the tube OD demonstrated
- Additional demonstration planned, but expectation is for success. Mockup being fabricated

Tube OD Repair

- Volumetric UT Inspection will be from the ID
- OD surface will be inspected by PT

Inspection Approach to Comply with SER Nozzle OD and ID Repairs

- Perform the same inspection as for non repaired condition (ET and UT)
- Mockup testing - consistent with previous slide
  - Previous testing used saw cut flaws
  - Use CIP flaws similar to MRP mockups

↳ EPRI WILL MAKE FLAWS.

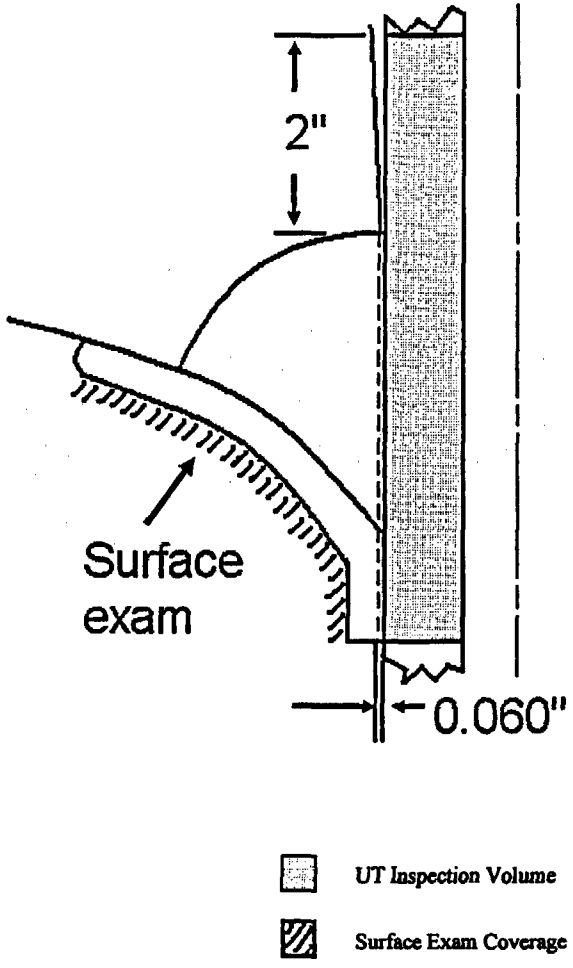
Inspection of Embedded Flaw Repair in J Groove Weld

- Inspection requirement per SER: UT plus surface exam coverage must equal 100 percent
- Weld OD repaired surface is considered not accessible for meaningful UT
- UT inspection is from the tube ID, looking at the triple point to detect flaw growth and/or leak path
- UT demonstration complete (MRP Interim Report,12/02)

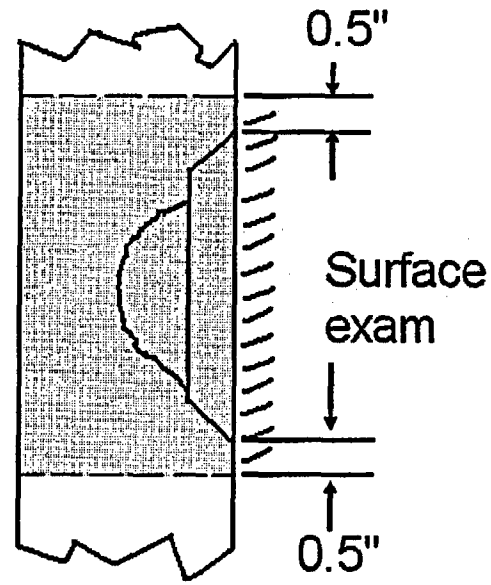
Approach to Comply with SER J Groove Weld Repairs

- Weld overlay is a non-structural corrosion resistant seal weld (cladding)
- PT after seal weld repair and for ISI
  - ASME requirement is PT plus VT for ISI
- Assumed flaw is entire cross section of weld
- Volumetric exam will be performed from the nozzle ID
  - Monitor for flaw growth beyond the maximum assumed (and analyzed) flaw in weld
  - Monitor for possible leak path

Exam Coverage: J-Groove Weld Repair



Exam Coverage: Tube ID or OD Repair



UT Inspection Volume

Surface Exam Coverage

Summary and Conclusions: Embedded Flaw Repair Welds

J-Groove Weld

- Inspection requirement per SER: UT plus surface exam coverage must equal 100 percent
- PT of repair weld for preservice and inservice exams
- UT inspection is from the tube ID, looking at the triple point to detect flaw growth and/or leak path

Nozzle OD and ID Repairs

- Same inspection as non-repair condition

Conclusion: Post repair exams are equivalent to pre-repair exams in coverage, as required by the NRC Order, Feb. 03

Comparison to Code Case 504-1 (and -2)

- Pipe repairs are structural welds.
  - CRDM repairs are corrosion resistant seal welds (cladding)
- Pipe flaw growth is toward weld repair
  - Potential J groove weld flaw growth is away from weld toward triple point
  - Potential ID repair flaw growth is similar to pipe repairs, although not a structural weld

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