

**BVPS 1R15  
NRC Outage Phonecall**

1. Discuss whether any primary to secondary leakage existed in this unit prior to shutdown. Include values of any calculated leakage and trends relative to previous outages.

Maximum leakage of 0.05 gpd in SGB was reported during the cycle. The value remained relatively constant, with fluctuation between 0.03 and 0.05 gpd. During cycle 13 primary to secondary leakage of a maximum of 0.3 gpd in SG B had been reported. After a mid-cycle trip, the leakage was not reported.

2. Discuss the results of secondary side pressure tests.

None were performed.

3. For each SG examined, provide a general description of areas examined, including the expansion criteria utilized and type of probe used in each area. Also, please be prepared to discuss your inspection of the tubesheet area.

See attached Table

All hot leg tubes were tested from 6" above to nominally 8" below the top of hot leg tubesheet. Prior to the outage, a reanalysis of 1R14 bobbin data was performed to determine the bottom of WEXTEx transition. These values were used to ensure that all tubes were tested to a minimum distance to ensure structural integrity based on the W\* analysis provided in WCAP-14797 Rev 1.

4. Discuss any exceptions taken to the industry guidelines.
  - Bobbin coil is being used for detection of significant axial PWSCC flaws within tubesheet region. Bobbin coil has no EPRI qualification for detection of axial degradation within this area.
  - BVPS does intend to supply the CM/OA if a C-3 condition is reported as NRC has indicated it does not wish to receive all of the industry's assessments. FENOC will supply the CM/OA if a C-3 condition is observed and CM/OA is requested by NRC
  - Not all Alloy 690 roll plugs will be inspected within a 60 EFPM window. There have been no industry events involving degradation of Alloy 690 roll plugs. BVPS has performed a 20% RPC sample of Alloy 690 roll plugs for the past 3 outages. Alloy 690 roll plugs were not sampled at the 1R15 outage.

5. Provide a summary of the number of indications identified to date of each degradation mode and SG tube location. Also, provide information such as voltages, and estimated depths and length of the most significant indications.

TTS and historic sludge pile region:

SGA: 3 axial PWSCC, 16 axial ODSCC, 6 circ ODSCC, 1 volumetric (wear)

SGB: 5 axial PWSCC, 23 axial ODSCC, 2 circ ODSCC

SGC: 10 axial PWSCC, 6 axial ODSCC

Total: 18 axial PWSCC, 45 axial ODSCC, 8 circ ODSCC

At 1R14, 13 axial PWSCC, 78 axial ODSCC, and 3 circ ODSCC tubes were reported. The large number of axial OSCC reports at 1R14 is attributed to increased detection capabilities resultant from chemical cleaning.

**Axial PWSCC:** 1.89 volts maximum, longest length 0.34", deepest depth from phase 93%, deepest depth from amplitude 72%.

**Axial ODSCC:** 0.31 volts maximum, longest length 0.95", deepest depth from phase 99%, deepest depth from amplitude 57%

**Circ ODSCC:** 0.24 volts, longest length 121° arc, deepest depth from phase 97%, deepest depth from amplitude 74%

U-bend Region:

SGA: 1 circ PWSCC Row1, 1 axial PWSCC >Row 2 (R42 C28)

SGB: 1 axial PWSCC >Row 2 (R13 C10)

SGC: 2 axial PWSCC >Row 2 (R17 C22, R13 C61)

Largest amplitude: 2.52 volts circ, 1.2 volts axial, longest length 49° circ, 2.9" axial (reported flaw length believed to be affected by coincident scratch), deepest depth circ 60% phase, 83% amplitude, deepest depth axial 80% phase, 59% amplitude.

TSP ODSCC:

Very similar to 1R14 distributions. Max DSI voltage reported was 4.59 volts in SGA. Max DSI voltage reported in SGB was 2.26 volt, SGC max DSI voltage was 2.5 volts. Total number of indications >2V is 11 in SGA, 6 in SGB, 5 in SGC. The maximum reported DSI amplitude at 1R14 was 5.3 volts in SGC.

Freespan:

No ODSCC reported other than 1 ding crack. (see question #8)

One tube reported with a volumetric, believed to be a possible lap indication from original tube drawing.

AVB: One repairable indication reported at 40%TW

CLT: Three repairable indications, 42%, 43%, and 51%

6. Describe repair/plugging plans for the SG tubes that meet the repair/plugging criteria.

All crack-like and volumetric (foreign object wear) indications located in the freespan and tubesheet regions are repaired by plugging. Any PWSCC indication located at TSP intersections are repaired by plugging (none found). TSP ODSCC indications are repaired per GL 95-05. AVB wear and cold leg thinning indications are repaired according to the technical specification 40% depth criteria.

7. Discuss the previous history of SG tube inspection results, including any look backs performed; specifically for significant indications where look backs are used in support of dispositioning (e.g., MBMs).

Most hot leg top of tubesheet indications contain precursor signals. Bobbin signals identified in the freespan region were reviewed against the 1R11 (1995) bobbin data to ensure that if slow growing ODSCC mechanisms are present that a change in the signal would be identified.

8. Discuss in general, new inspection findings.

One ding ODSCC indication was reported in SGB at 01H +3.2". The ding amplitude was 6.39 volts, thus the bobbin screening technique could not be applied. This indication was found during the 20% >5V ding program. Expansion to 100% of all dings >5V in SGB was performed.

Three tubes have been reported with signals suggestive of axial PWSCC in large radius U-bends. Two appear to be associated with dents at AVB locations. The third is slightly above the hot leg tangent point. Additional inspection techniques are being considered.

One tube was reported with two small signals suggestive of circumferential ODSCC at the 07H support. These signals are very similar to signals observed just above the top of tubesheet in 1R15 and 1R14 that were judged to be possible anomalies due to SG assembly. These tubes were repaired by plugging. Additional inspection techniques are being considered to help to determine the validity of these indications.

Axial ODSCC was reported at a dented intersection on the hot leg (2.91 volts). Estimated ODSCC depth is 46%TW. Expansion to 100% of all dents  $\geq 2$  volts was performed. Two additional indications were reported in 3.1 and 2.5 volt dents. Estimated ODSCC depth is 60% and 51%TW, respectively.

Parent tube anomalies were reported within the tube original hardroll region of 28 sleeved tubes. The area of the tube where the anomalies are reported is adjacent to the

sleeve hardroll region. These sleeved tubes will be plugged. It is suspected the cause of the anomaly is due to a heat affected zone or possible permeability variation since all tubes had TIG relaxed plugs prior to sleeving.

The blowdown pipe support bracket was found to be separated from the weld that secures the bracket to the tubesheet. Visual examination indicates that the bracket experienced limited bonding with the weld. Dynamic analysis indicates that the free end of the blowdown pipe will not contain adjacent active tubes and will remain structurally intact for remainder of SG service period.

9. If SGs contain Alloy 600 thermally treated tubing.....

Alloy 600 thermally treated tubing is not used in the BVPS Unit 1 SGs.

10. Discuss use or reliance on inspection probes other than bobbin and typical rotating probes.

None are used as part of the base eddy current program. The Ghent3/4 probe is being considered to help to validate some of the flaw reports.

11. Describe in situ pressure test plans and results, including selection criteria.

Selection criteria follows the EPRI in situ guideline recommendations. All indications requiring testing are tested. In addition, all new degradation mechanisms with the exception of the reported axial ODSCC at a dented TSP intersection will be pressure tested.

12. Describe tube pull plans.

None scheduled.

13. Discuss the assessment of tube integrity for the previous operating cycle (i.e., condition monitoring).

The EPRI tube integrity guideline and in situ pressure test guidelines were used. All indications at 1R14 were shown to provide margin against the performance criteria. Benchmarking of previous results indicate that the predicted limiting flaws for 1R15 are conservative compared to the observed flaw-like indications.

14. Discuss the assessment of tube integrity for the next operating cycle.

The EPRI tube integrity guidelines will be used for evaluation of tube integrity at EOC 16. No indications have been reported at 1R15 that suggest that structural or leakage integrity would be challenged at EOC 16.

Additional Questions:

1. Collapsed sleeves, how was weld and roll integrity verified? Has potential for sleeve collapse been considered in T/H evaluations.

Four sleeves were found to be collapsed at 1R14. Visual examination indicated that sleeve had experienced a localized dimpling that progresses no further than the sleeve axis. A structural evaluation was performed that concluded that based on tube to sleeve internal pressures sufficient to cause collapse, combined with sleeve strain effects, would not cause the weld to be stressed past yield, nor would axial loads exceed the hardroll joint breakaway load.

One additional sleeve was found to be collapsed at 1R15.

This phenomenon has been previously reported in the industry. It has been associated with typically the first ISI after sleeve installation. The BVPS results are consistent with industry experience. Current tube plugging analysis supports 30% plugged. Historical information, as well as BVPS 1R14 and 1R15 data suggest that no further collapsed sleeves will be identified at 1R16.

2. Clarify how mixed residuals are dispositioned.

The BVPS mixed residual reporting level is 1.5 volts, which is substantially more conservative compared to other 7/8" OD plants. The 100 largest mixed residual signals that could mask a flaw are RPC tested, along with all mixed residual signals with a phase angle of  $\leq 50^\circ$ . All mixed residuals that have been confirmed to contain axial ODSCC have been able to have a mix channel DSI amplitude extracted using the 200 kHz bobbin channel. As a DSI signal can be extracted, mixed residuals that are confirmed to contain axial ODSCC are changed to a DSI code and included in the GL 95-05 analysis. To date, 86 SPRs have been confirmed to contain axial ODSCC. Over 400 SPRs have been +Pt tested. Using the +Pt volts vs DSI voltage correlation, <10 SPRs contain > 1 volt flaw signals.

3. Differentiate between a DSI and a PSI.

DSI is a distorted support plate signal that could represent axial ODSCC at a TSP intersection. PSI is a possible support indication that could represent a flow hole misdrilling that results in either a locally thinned tube hole ligament or partially missing ligament. RPC is used to estimate the amount of "missing" ligament arc length. If missing material is found by RPC, the PSI is changed to CSI. The RPC value is compared against a threshold limit determined by analysis that considers the amount of material that is required to be removed to permit the tube to escape from the tube hole. All PSI/CSI indications are excluded from ARC application.

4. Clarify cold leg top of tubesheet indications from 1R14.

All cold leg top of tubesheet indications were associated with loose part wear or wear due to sludge lance rail interaction. The sludge lance equipment used at 1R13 and 1R14 was not used at 1R15. No cold leg indications have been reported at 1R15.

**Table 2-2 Detection Inspection/Expansion Plan: Beaver Valley Unit 1, 1R15 Inspection**

Degradation Mechanism	Location	Probe Type	Detection Inspection/Expansion Plan	
			Inspection Sample Plan	Expansion Plan
<b>Active Degradation Mechanisms</b>				
Axial ODSCC	Non-Dented TSP Intersections	Bobbin	100% full length bobbin (except Row 1 and 2 U-bend regions)	None
	Non-Dented TSP Intersections (confirmation only)	Plus Point	100% bobbin indications >2 volts, 100 largest mixed residuals > 1.5 volts per SG	100 additional mixed residuals $\geq 1.5$ volts if DSI > 1 volt reported in MRI >1.5 but < 2 volts per SG
Axial ODSCC	Hot leg sludge pile and freespan	Bobbin	100% full length bobbin	None
		Plus Point	100% HL TTS 6" above TTS to 8" below TTS nominal	20% cold leg TTS from +6 to -8" at either 1R15 or 1R16 if C-3
Axial PWSCC	Row 1 and 2 U-bends	Plus Point	100% Row 1 and 2 U-bends, 20% Row 3 U-bends	100% Row 3 in SGs with Row 3 indications
Axial and Circ. ODSCC	HL TTS expansion transition	Plus Point	100% HL TTS 6" above TTS to 8" below TTS nominal	20% cold leg TTS from +6 to -8" at either 1R15 or 1R16 if C-3
Axial PWSCC	Hot Leg TTS expansion transition and within tubesheet	Plus Point	100% HL TTS from 6" above to 8" below TTS nominal	20% cold leg TTS from +6 to -8" at either 1R15 or 1R16 if C-3
Thinning	Cold Leg TSP intersections	Bobbin	100% full length bobbin all SGs	None
<b>Resolution for Classification of Indications</b>				
Freespan Differential	Freespan	Bobbin	100% full length, all SGs	Historical review; RPC if no history or changed
Potential MBMs	All	Bobbin	100% full length, all SGs	Historical review; RPC if no history or changed
<b>Relevant Degradation Mechanisms</b>				
Axial ODSCC	Freespan	Bobbin	100% full length bobbin all SGs	None
Axial PWSCC	Dented TSP intersections, freespan dings	Plus Point	20% dented hot leg intersections and freespan dings $\geq 2$ volts between TTS and 03H	100% dented hot leg intersections and freespan dings $\geq 2$ volts between TTS and 03H
Axial ODSCC	Dented TSP Intersections $\geq 5$ volt	Plus Point	100% intersections $\geq 5$ volt	None

**Table 2-2 Detection Inspection/Expansion Plan: Beaver Valley Unit 1, 1R15 Inspection**

Degradation Mechanism	Location	Probe Type	Detection Inspection/Expansion Plan	
			Inspection Sample Plan	Expansion Plan
Circumferential ODSCC	CL TTS expansion transition	Plus Point	20% cold leg TTS from 6" above to 8" below TTS nominal in SGA concentrated within historic sludge pile region	100% in SGA, 20% SGs B and C
Axial PWSCC	Within Tubesheet (below transition)	Bobbin	100% full length bobbin all SGs	None
Pitting	Cold leg TTS	Bobbin	100% full length bobbin all SGs	None
		Plus Point	20% cold leg TTS from 6" above to 8" below TTS in SGA	Per Table 3-3 of EPRI Rev. 5 ISI guidelines
Tube Wear	AVB intersections	Bobbin	100% full length bobbin all SGs	None
Tube Wear (loose parts)	TTS periphery, tube lane	Bobbin	100% full length bobbin +FOSAR	None
		Plus Point	100% hot leg TTS from 6" above to 8" below TTS	None unless FOSAR identifies objects on CL
Axial ODSCC	Freespan dings	Bobbin	100% full length, all SGs	None
		Plus Point	20% FS dings > 5volts, flaw confirmation of bobbin indications	100% freespan dings > 5 volts in SGs with indications
Oblique PWSCC	U-bend of Rows 3 to 10	Plus Point	100% U-bends Rows 3 thru 46	None
<b>Potential Degradation Mechanisms</b>				
Axial ODSCC	Expanded CL TSP intersections	3-coil Plus Point	100% expanded intersections in SG A	None (expanded tubes found in SG A only)
General SCC or wastage	Sleeves	Bobbin 0.640"	100% all sleeves	None
Circ. PWSCC	Parent tube of LWS joints and Laser Welds	Plus Point	100% all LWS joints	None
Undefined	Parent tube in sleeve roll region (1)	Plus Point	20% LWS roll expansion joints	100% LWS roll expansion joints if indications detected