

Callaway Energy Center Steam Generator Tube Inspection Report

28 pages follow this cover sheet

1.0 PURPOSE

The purpose of this report is to document that the Callaway Unit 1 steam generator tube integrity performance criteria have been met for operating cycles 22, 23, 24, and 25 (April 2016 to April 2022 of up to 4.655 EFPY duration) and to also demonstrate that there is reasonable assurance that the performance criteria will be met for the upcoming 5-cycle operating period, consisting of cycles 26, 27, 28, 29 and 30, not to exceed 7.2 EFPY.

2.0 REPORTING REQUIREMENTS

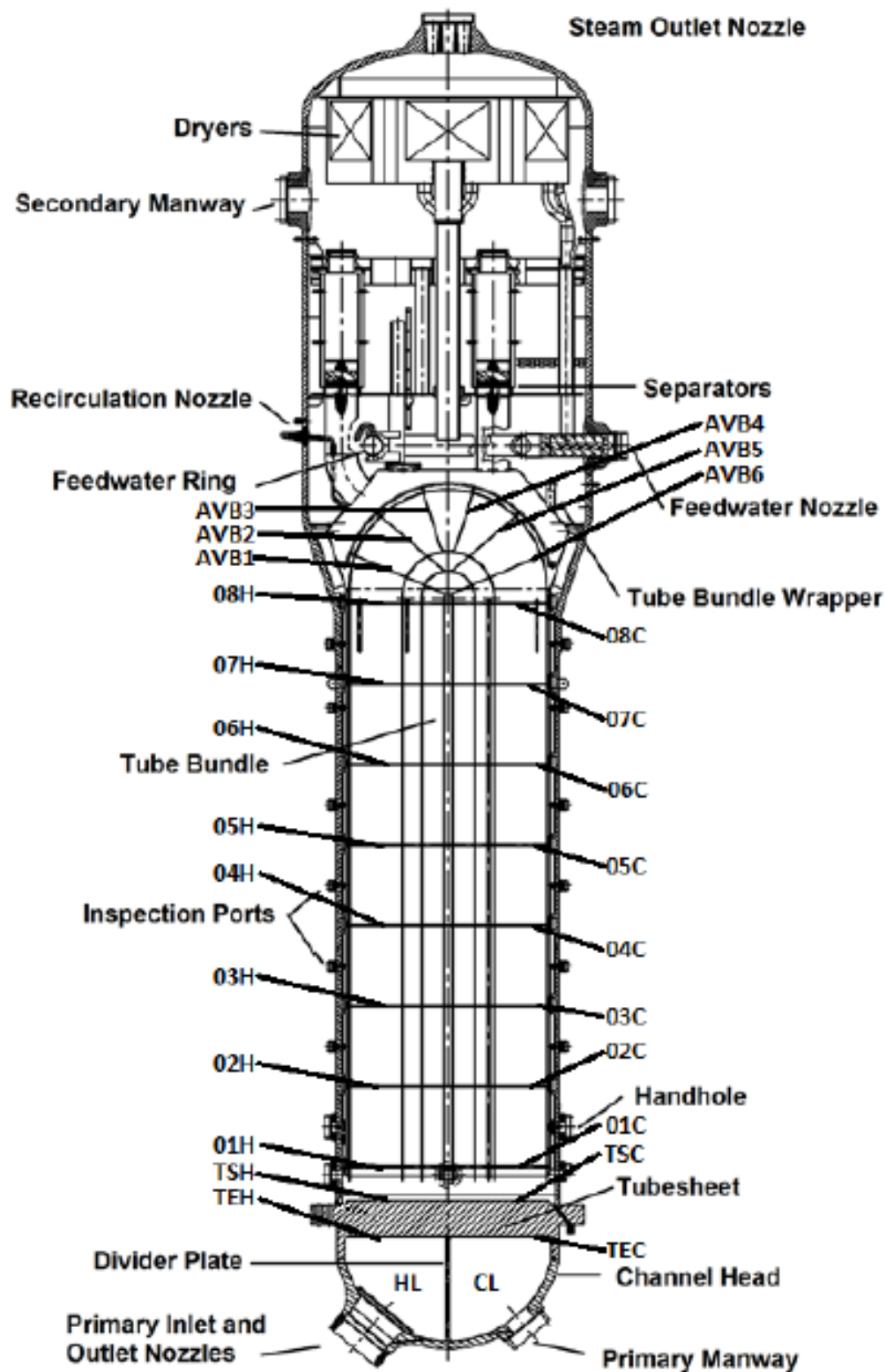
Technical Specification (TS) 5.6.10 requires that "A report shall be submitted within 180 days after the initial entry into MODE 4 following completion of an inspection performed in accordance with TS 5.5.9, 'Steam Generator (SG) Program.'" The report was prepared such that it will meet the requirements of revised TS 5.6.10 (i.e., revised per TSTF-577 as proposed per license amendment request letters ULNRC-06744 and ULNRC-06766). The report shall include:

- a) The scope of inspections performed on each SG;
- b) The nondestructive examination techniques utilized for tubes with increased degradation susceptibility;
- c) For each degradation mechanism found:
 - 1. The nondestructive examination techniques utilized;
 - 2. The location, orientation (if linear), measured size (if available), and voltage response for each indication. For tube wear at support structures less than 20 percent through-wall, only the total number of indications needs to be reported;
 - 3. A description of the condition monitoring assessment and results, including the margin to the tube integrity performance criteria and comparison with the margin predicted to exist at the inspection by the previous forward-looking tube integrity assessment; and
 - 4. The number of tubes plugged during the inspection outage;
- d) An analysis summary of the tube integrity conditions predicted to exist at the next scheduled inspection (the forward-looking tube integrity assessment) relative to the applicable performance criteria, including the analysis methodology, inputs, and results;
- e) The number and percentage of tubes plugged to date, and the effective percentage in each steam generator; and
- f) The results of any SG secondary side inspections.

3.0 DESIGN AND OPERATING PARAMETERS

Steam Generator Design and Operating Parameters	
SG Model / Tube Material / # SGs per unit	Framatome 73/19 / Alloy 690TT / 4
# of tubes per SG / Nominal Tube Dia. / tube thickness	5872 / 0.75 in / 0.043 in
Support Plate Style / Material	Broached Trefoil / SA-508
Last Inspection Date	April 2016
EFPM since the last inspection	55.859
Total cumulative SG EFPY	15.242
Mode 4 initial entry	May 23, 2022
Observed P/S Leak Rate since the last inspection and how it trended with time	None
Nominal indicated value of Thot during Cycle X at full power	615 degrees F (This value could change slightly depending on where and when the measurement is taken)
Loose Parts Strainer	<p>The feedwater distribution system composed of a feedwater ring equipped with 30 inverted J-tubes and an anti-stratification device (helix). The tee of the feedwater ring containing the helix is seal welded onto the feedwater nozzle</p> <p>Callaway's replacement SGs have a loose parts trapping system (LPTS). The LPTS installed at the top of the downcomer is composed of twelve cells of fine mesh stainless steel bolted onto a flange welded on the bundle wrapper outer wall.</p>
Deviations from SGMP guidelines since the last inspection	None
Steam Generator Schematic	See below Figure

Figure 1 - Callaway-1 Framatome 73/19T General Arrangement



4.0 SUMMARY

The steam generator tube in-service inspections were completed by Framatome Inc. during the Refuel 25 outage. An in-service inspection was performed on all four steam generators, primary and secondary side including 100% of the in-service tubes in each SG. The scope of inspections performed is described in the following inspection report. The service-related degradation mechanisms identified by eddy current inspection (primary side) were 459 anti-vibration bar (AVB) wear indications and 183 tube support plate (TSP) wear indications in total from all four steam generators. Callaway's TS plugging limit was set at 40% through wall (TW) to maintain tube integrity for cycles 26, 27, 28, 29 and 30. In total, 9 tubes were removed from service due to AVB wear. TSP wear had no impact on RF-25 tube plugging. This equates to a total of 0.270% of tubes, from all four steam generators removed from service to date.

Sludge Lancing (secondary side) was performed on all 4 steam generators. A combined total of 20.5 pounds of sludge was collected by Framatome. The steam generator tubes and the top of tubesheet were clean with exception of a small sludge pile located near the center of the hot and cold legs on each steam generator's top of tubesheet.

Steam Drum (secondary side) inspections were performed on three steam generators, SG-A, SG-B and SG-C. The original scope was the inspection of SG-B and SG-C steam drums, however, with the presence of foreign objects in the steam drums it was determined to expand the scope to the SG-A steam drum. Bolts and washers were found lying on the loose parts trapping screens and were retrieved. These foreign objects were a result of equipment degradation of the feedwater isolation valves (FWIV) upstream of the steam generators. A total of 17 bolts and 15 washers were retrieved from the three steam generators' steam drums. One washer was retrieved during FOSAR activities after sludge lancing SG-C. One washer was evaluated as a potential loose part in the steam generators during the upcoming cycles since it was not retrieved from the system. Finally, the Condition Monitoring Report concluded that the Callaway steam generator tubes satisfied the structural integrity performance criterion, accident induced leakage criterion and operational leakage criterion.

5.0 INSPECTION SCOPE REPORT

The Callaway Plant was shut down on April 4, 2022 for its 25th refueling outage. During the refueling outage an in-service inspection was performed on all four steam generators. The inspection scope was as follows:

- **Bobbin Coil ECT Examinations**
 - 100% of all in-service tubes, full length tube-end to tube-end
 - All probes were run through a deposit mapping standard
- **Array Coil ECT Examinations**
 - Hot Leg and Cold Leg Examination
 - The hot leg/cold leg tubesheet and 1st span in tubes located in the periphery region were examined with a 0.610 array probe (610XP). Acquisition examined from TEH +0.00 to 01H +1.00 and TEC +0.00 to 01C +1.00 while analysis analyzed from TEH +0.00 to 01H+1.00 (Hot Leg), TEC +0.00 to 01C+1.00 (Cold Leg). The periphery tube region is defined as the three outermost tubes adjacent to the annulus, and all tubes in rows 1 through 6 along the tube free lane.
 - 20% of tubes identified as having non-nominal tubesheet drill hole diameters were inspected with the 610XP array probe.
 - Hot Leg Only Examination
 - One hundred percent (100%) of tubes with sludge indications from the 1R21 sludge analysis in the hot leg tubesheet were inspected with the 610XP array probe.
- **+Point™ Coil ECT Examinations**
 - Inspected all Appui locations with +Point™
- **Special Interest Examinations with either Array or +Point™ probes:**
 - Bobbin “I” codes (ADI, DFI, DSI, DTI, LPI and NQI Indications)
 - New Bobbin BLG, IDC, PVN, GEO, and DNT Indications or change in voltage > 2 Volts from 1R21
 - New is defined as there not being any bobbin signal present in any historical data from the PSI
 - Samples of AVB and TSP wear.
 - New AVB wear >16%TW
 - AVB wear with a change >13%TW from 1R21
 - TSP wear with a change >10% from 1R21 Bobbin re-sized depths using the fixed curve
 - All new TSP wear indications.
 - Sample of tubes from SGA shown in [Table 3-3, Ref [3.a]] with array HL+U bend only for deposit mapping purposes to characterize potential TSP broach blockage.
 - Bobbin PLP Indications and one tube bounding exams for all Array/+Point™ confirmed PLP indications.
 - All potential foreign object wear

- Bobbin PVN for +Point™ Mag Bias
- Tubes subsequently identified with Possible Loose Part (PLP) Indications with array bounded by 1-Tube with the 610XP array probe.
- Additional indications at the discretion of analysis or Integrity Engineering.
- **Secondary Side Inspections:**
 - Top of Tubesheet (TTS) water lancing in all four SGs
 - Prior to water lancing a pre-look visual inspection was performed to examine the sludge pile in the C Steam Generator.
 - Foreign Object Search and Retrieval (FOSAR) performed in all four SGs
 - As required based on ECT
 - TTS annulus area in all four SGs
 - No-tube lane in all four SGs
 - Inner bundle passes
 - Visual Inspections of steam drums in SGB, SGC, and SGA (expanded scope)
 - Inspections included the loose parts trapping system, the feedring components, and the moisture separating components. Inspections of these areas focused on adverse conditions such as:
 - Loose/missing hardware/bolting
 - Signs of Flow Accelerated Corrosion
 - Structural deficiencies including welds
 - Conditions that would pose a risk to tube integrity
- **Visual Examinations**
 - As-found and as-left visual examinations of primary channel heads (both Hot Leg and Cold Leg)
 - NSAL 12-1 (and IN 2013-20) primary bowl inspections in all four SGs (both Hot Leg and Cold Leg)
 - Visual inspections of all plugs installed in the Callaway SGs both prior and during 1R25

5.1 Primary Side Inspection

The bobbin probe (ETSS 96004.3 and ETSS I-96043.4) is used for depth sizing AVB and TSP wear, respectively. The +Point™ and Array probes were primarily used as a diagnostic tool to resolve ambiguous bobbin probe indications, and to supplement SSI and bobbin inspections for potential loose parts.

Callaway Energy Center | 2022

Steam Generator Inspection Report

5.1.1 Eddy Current Inspections

Figure 2 - RF25 Eddy Current Inspection Scope Summary

Scope Description				SG A				SG B			
Exam Description	Leg	Probe	Extent	Planned	Acquired	Resolved	% Complete Resolved	Planned	Acquired	Resolved	% Complete Resolved
Bobbin Exams											
Full Length Rows >= 8	HOT	610HS	TECTEH	5516	5516	5516	100.00%	5530	5530	5530	100.00%
H/L CandyCane Rows 1-5	HOT	590UC	08CTEH	336	336	336	100.00%	336	336	336	100.00%
C/L Straight R1-5	COLD	610HS	08CTEC	336	336	336	100.00%	336	336	336	100.00%
Array Exams											
H/L Array	HOT	610XP	01HTEH	960	960	960	100.00%	965	965	965	100.00%
H/L Array - Sludge Pile sample	HOT	610XP	01HTEH	117	117	117	100.00%	129	129	129	100.00%
H/L Array - TS Drill Signals	HOT	610XP	01HTEH	N/A	N/A	N/A	N/A	1	1	1	100.00%
C/L Array	COLD	610XP	01CTEC	960	960	960	100.00%	965	965	965	100.00%
C/L Array - TS Drill Signals	COLD	610XP	01CTEC	2	2	2	100.00%	N/A	N/A	N/A	N/A
H/L PLP/FO Bounding	HOT	610XP	01HTEH								
C/L PLP/FO Bounding	COLD	610XP	01CTEC								
+Point Exams											
Appui Tubes AVBs	BOTH	5601P	AV1,AV2,AV3,AV4,AV5,AV6	156	156	156	100.00%	156	156	156	100.00%
Special Interest Array											
Hot Leg Indications	HOT	610XP	Various	8	8	8	100.00%	25	25	25	100.00%
Cold Leg Indications	COLD	610XP	Various	11	11	11	100.00%	12	12	12	100.00%
U-Bend Indications	BOTH	610XP	Various	4	4	4	100.00%	5	5	5	100.00%
Plug Visual Exams											
Hot Leg Plugs	HOT		TEHTEH	20	20	20	100.00%	6	6	6	100.00%
Cold Leg Plugs	COLD		TECTEC	20	20	20	100.00%	6	6	6	100.00%
Tubes to be Plugged				3				3			
Total - All Exams				8406	8406	8406	100.00%	8460	8460	8460	100.00%

Scope Description				SG C				SG D			
Exam Description	Leg	Probe	Extent	Planned	Acquired	Resolved	% Complete Resolved	Planned	Acquired	Resolved	% Complete Resolved
Bobbin Exams											
Full Length Rows >= 8	HOT	610HS	TECTEH	5510	5510	5510	100.00%	5533	5533	5533	100.00%
H/L CandyCane Rows 1-5	HOT	590UC	08CTEH	336	336	336	100.00%	336	336	336	100.00%
C/L Straight R1-5	COLD	610HS	08CTEC	336	336	336	100.00%	336	336	336	100.00%
Array Exams											
H/L Array	HOT	610XP	01HTEH	964	964	964	100.00%	965	965	965	100.00%
H/L Array - Sludge Pile sample	HOT	610XP	01HTEH	189	189	189	100.00%	84	84	84	100.00%
H/L Array - TS Drill Signals	HOT	610XP	01HTEH	2	2	2	100.00%	2	2	2	100.00%
C/L Array	COLD	610XP	01CTEC	964	964	964	100.00%	965	965	965	100.00%
C/L Array - TS Drill Signals	COLD	610XP	01CTEC	N/A	N/A	N/A	N/A	1	1	1	100.00%
H/L PLP/FO Bounding	HOT	610XP	01HTEH	9	9	9	100.00%				
C/L PLP/FO Bounding	COLD	610XP	01CTEC	6	6	6	100.00%	2	2	2	100.00%
+Point Exams											
Appui Tubes AVBs	BOTH	5601P	AV1,AV2,AV3,AV4,AV5,AV6	156	156	156	100.00%	156	156	156	100.00%
Special Interest Array											
Hot Leg Indications	HOT	610XP	Various	7	7	7	100.00%	11	11	11	100.00%
Cold Leg Indications	COLD	610XP	Various	8	8	8	100.00%	8	8	8	100.00%
U-Bend Indications	BOTH	610XP	Various	5	5	5	100.00%	5	5	5	100.00%
Plug Visual Exams											
Hot Leg Plugs	HOT		TEHTEH	26	26	26	100.00%	3	3	3	100.00%
Cold Leg Plugs	COLD		TECTEC	26	26	26	100.00%	3	3	3	100.00%
Tubes to be Plugged				3				0			
Total - All Exams				8492	8492	8492	100.00%	8404	8404	8404	100.00%

Figure 3 - RF25 Summary of Wear Indications

Indication Code	SGA	SGB	SGC	SGD	Total
	Indications	Indications	Indications	Indications	Indications
DNT	0	1	0	0	1
DNG	0	13	4	6	23
MBM	2	1	4	3	10
TWD (AVB)	128	100	190	41	459
TWD (TSP)	66	57	33	27	183
PLP	0	0	0	0	0

Callaway plugged 9 tubes due to AVB wear during refuel 25. The total number of tubes repaired to date is 64 (1 plugged during manufacturing). This is 0.270% total tubes plugged to date.

5.1.2 Primary Side Visual Examination

Remote visual examinations of the primary channel heads (hot leg and cold leg in each SG) were performed upon removal of the primary manways (i.e., as-found) and immediately prior to re-installation of the manways (i.e., as-left). Visual inspections were also performed to the NSAL 12-1 requirements. No degradation of the cladding, welds, or structures was identified within the channel heads, and no foreign objects were identified. All previously installed plugs in both channel heads of each SG were visually examined. No plug deficiencies were identified.

5.2 Secondary Side Inspection

This is discussed in detail below in Section 10 of this report.

6. NDE TECHNIQUES WITH INCREASED DEGRADATION

The bobbin probe (ETSS 96004.3 and ETSS I-96043.4) is used for depth sizing AVB and TSP wear, respectively. The +Point™ and Array probes were primarily used as a diagnostic tool to resolve ambiguous bobbin probe indications, and to supplement SSI and bobbin inspections for potential loose parts.

7. NDE FOR EACH DEGRADATION MECHANISM

Parameter	AVB Wear	TSP Wear
ECT Probe	Bobbin	Bobbin
ETSS	I-96041.1 Rev. 6	I-96043.4 Rev. 0
NDE depth sizing regression	Depth = 1.01*NDE + 0.99	Depth = 1.01*NDE + 1.89
NDE depth sizing technique uncertainty	Sy,x = 3.29 %TW	Sy,x = 2.47 %TW

Callaway Energy Center 2022

Steam Generator Inspection Report

Degradation Mechanism(s)	Probe	EPRI ETSS	Demonstrated/ Extended Applicability	Detection	Sizing Applicability	Actual %TW vs. NDE %TW	Technique Uncertainty (Sy,x) %T W	Total Uncertainty @ 95/50 %T W
AVB wear	Bobbin	96004.3 Rev. 13 Note 2	AVB & TSP	Detection of AVB wear in the crossover regions	CMOA @ AVB crossover regions	$Y=0.97x+2.50$	3.10	5.1
		I-96041.1 Rev. 6 Note 1	AVB	All	CMOA: AVB &TSP	$Y=1.01x+0.99$	3.29	5.41
	Array	I-17909.1 Rev. 1	AVB (axial sensitive coils)	All	CMOA @ AVB	$Y=1.00x-0.22$	2.21	3.64
		I-17909.4 Rev. 1	AVB (circ sensitive coils)	All	CMOA @ AVB	$Y=1.01x-0.15$	3.74	6.15
	+Point™	I-10908.5 Rev.0	AVB	All	CMOA @ AVB	$Y=0.99x-0.23$	1.82	3.0
APPUI wear	Bobbin	96004.1 Rev. 13 Note 1	Appui Wear,TSP,AVB	All	CMOA @ Appui	$Y=0.98x+2.89$	4.19	6.89
	+Point™	Ref. [3.m]	Appui Wear	All	CMOA @ Appui			
TSP Wear	Bobbin	I-96043.4 Rev. 0	Single land (flat) and tapered wear broached TSPs	All	CMOA @ TSP	$Y=1.01x+1.89$	2.47	4.06
	Array	I-11956.3 Rev 3	Broached TSP (axial sensitive)	All	CMOA @ TSP	$Y=1.03x-1.22$	2.42	3.98
		I-11956.4 Rev 3	Broached TSP (circ sensitive)	All	CMOA @ TSP	$Y=0.97x+2.09$	4.60	7.57
	+Point™	96910.1 Rev. 11	Broached TSPs	All	CMOA @ TSP	$Y=0.95+6.70$	5.36	8.82

Callaway Energy Center 2022 Steam Generator Inspection Report

Degradation Mechanism(s)	Probe	EPRI ETSS	Demonstrated / Extended Applicability	Detection	Sizing Applicability	Actual %TW vs. NDE %TW	Technique Uncertainty (Sy,x) %TW	Total Uncertainty @ 95/50 %TW
Pitting	Bobbin	96005.1 Rev. 9	Presence of Copper Sludge Pile/Freespan	All	See Note 5	$Y=0.14x+33.34$	13.53	22.26
	Array	24998.1 Rev. 1	Freespan/ Detection of PLP Wear w/out part	All	Yes	N/A	N/A	N/A
Foreign objects/wear	Bobbin	27091.2 Rev 2	LPW (Part not present)/LPW (Part Present)	All	N/A			
	Array	17901.1 Rev. 0	LPW (part not present) /LPW (part present) See ETSS for flaw morphology (Note 3)	All	Yes	$Y=1.01x-0.17$	2.24	3.68
		17901.3 Rev. 0				$Y=0.97x+2.38$	3.76	6.19
		17902.1 Rev. 0				$Y=0.99x+0.74$	2.16	3.55
		17902.3 Rev. 0				$Y=1.00x+0.67$	4.63	7.62
		17903.1 Rev. 0				$Y=0.96x+2.30$	2.52	4.15
		17903.3 Rev. 0				$Y=0.96+2.53$	3.66	6.02
		17904.1 Rev. 0				$Y=0.99x+1.20$	2.07	3.41
		17904.3 Rev. 0				$Y=0.98x+1.89$	3.06	5.03
		17905.1 Rev. 0				$Y=0.98x+0.76$	2.22	3.65
		17905.3 Rev. 0				$Y=0.96x+2.12$	4.72	7.76
		17906.1 Rev. 0				$Y=1.01x-.22$	2.76	4.45
		17906.3 Rev. 0				$Y=0.98x+1.55$	4.95	8.14

Callaway Energy Center 2022

Steam Generator Inspection Report

Degradation Mechanism(s)	Probe	EPRI ETSS	Demonstrated / Extended Applicability	Detection	Sizing Applicability	Actual %TW vs. NDE %TW	Technique Uncertainty (Sy,x) %TW	Total Uncertainty @ 95/50 %TW
	+Point™	27901.1 Rev 1 27902.1 Rev 2 27903.1 Rev 1 27904.1 Rev 2 27905.1 Rev 2 27906.1 Rev 1 27907.1 Rev 2	LPW (part not present) /LPW (part present) See ETSS for flaw morphology (Note 3)	All	CMOA Freespan, expansion transitions, and at structures (Part not present)	See ETSS (Note 2)	See ETSS (Note 2)	See ETSS (Note 2)
Various	Bobbin Array +Point™	Various	All Locations	N/A (Note 4)				

Notes:

1. EPRI Appendix H technique 96004.1 and EPRI MAPOD Appendix I techniques 96041.1 R6 are both qualified for the detection and sizing of AVB wear. Technique 96004.1 was extended to the detection of APPUI wear per Reference [28]. The calibration requirements are different between these two techniques HOWEVER the site ETSS calibration requirements meet or exceed both. The decision to list both techniques for AVB wear detection and sizing is conservatively based on two factors; 1) The EPRI ETSS calibration requirements are different for the two techniques (even though the site ETSS meet or exceed both) and 2) EPRI ETSS 96004.1 is specifically discussed and extended for APPUI wear in Reference [28].
2. EPRI Appendix H technique 96004.3 is used for detection and sizing (if required) of AVB wear in the u-bend apex region also referred to as crossover tubes.
3. The applicable 279xx series +Point™ technique or 1790x series Array technique will be used for sizing based on analyst review and morphology of the flaw
4. For the purposes of this document, diagnostic techniques are actually EPRI Appendix H and/or I qualified techniques that fall outside of the site validation process. The specific applications where diagnostic techniques will be utilized have been evaluated and determined to be consistent with industry practice. In addition, the data analysis instructions provided in the site Guidelines/ETSS provide the requisite assurance that unexpected degradation mechanisms will be detected and reported.
5. Use Array or +Point™ technique over Bobbin technique for sizing

Callaway Energy Center **2022**

Steam Generator Inspection Report

7.1 The location, orientation (if linear), measured size, and voltage responses of each indication.

See attachment 1 of this report for all indications over 20% TW for each SG. There were no indications greater than or equal to 40%TW in all four SGs.

Table 4
RF25 Summary of AVB Wear Bobbin Indications

SG	Number of Indications		New and Repeat Depths			
			(%TW)			
	New	Repeat	Average	Upper 95 th	Max New	Max (New and Repeat)
A	8	120	16.1	29.7	19.0	35.0
B	5	95	17.1	32.0	14.0	36.0
C	7	183	15.8	29.0	21.0	36.0
D	3	38	13.2	25.0	12.0	29.0
All SGs	23	436	15.9	30.0	21.0	36.0

AVB wear was reported in each of the four steam generators. A total of 459 AVB wear indications were detected. The maximum reported AVB wear depth was 36%TW. There are 91 indications in 61 tubes of <20% TW in SG-A, 66 indications in 42 tubes of <20% TW in SG-B, 136 indications in 84 tubes of <20% TW in SG-C, and 35 indications in 21 tubes of <20% TW in SG-D.

Table 5
RF25 Summary of TSP Wear Indications

SG	Number of Indications		New and Repeat Depths			
			(%TW)			
	New	Repeat	Average	Upper 95 th	Max New	Maxi (New and Repeat)
A	16	50	10.9	15.0	14.0	19.0
B	33	24	11.7	16.2	15.0	20.0
C	12	21	11.8	17.8	12.0	23.0
D	17	10	10.7	14.0	14.0	15.0
All SGs	78	105	11.3	15.9	15.0	23.0

TSP wear was reported in each of the four steam generators. A total of 183 TSP wear indications were detected. The maximum reported TSP wear depth was 23%TW. There are 66 indications in 55 tubes of <20% TW in SG-A, 56 indications in 50 tubes of <20% TW in SG-B, 32 indications in 28 tubes of <20% TW in SG-C, and 27 indications in 25 tubes of <20% TW in SG-D.

7.2 Condition Monitoring

The Condition Monitoring report concluded that the Callaway steam generator tubes satisfied the structural integrity performance criterion, accident induced leakage criterion and operational leakage performance criterion specified in Technical Specification 5.5.9 and LCO 3.4.13, respectively. There was no degradation identified in RF25 in any of the SGs that was not bounded by the previous operational assessment (OA). Callaway did not perform any tube pulls or in-situ testing. The figure below shows a comparison to the most recent operational assessment completed for Callaway's SG inspection deferral from RF24 to RF25 to the actual RF25 results. As shown below, the RF24 OA was conservative in its predictions and bounded RF25 results in number of indications, growth rate, and the max depth measured for both AVB and TSP wear.

Figure 4 - 1R25 Results Comparison to 1R24 OA Projections

Degradation		1R24 OA Deferral Projections(Note 1)	1R25 Results
AVB Wear	# Indications	543 (in limiting SGC)	190 (in limiting SGC)
	Upper 95 th Growth Rate (%TW/EFPY)	4.49 (See Note 1)	1.9 (combined growth rate from all SGs)
	Maximum Depth (%TW)	69 (See Note 2)	36
TSP Wear	# Indications	478	183
	Upper 95 th Growth Rate (%TW/EFPY)	4.59 (See Note 1)	1.3
	Maximum Depth (%TW)	62 (See Note 2)	23
NOTES 1. 1R24 projections from 1R24 Deferral OA MathCAD Full Bundle Model Run for AVB and TSP wear 2. Based on applying maximum growth rate from AVB and TSP Kunin and applying it to maximum depth flaw that was returned to service in 1R21 over the actual 1R22-1R25 cycle length.			

7.3 Tubes Plugged during RF25

There were no tubes that met the Technical Specification plugging limit of $\geq 40\%$ TW in any of the SGs. To improve margin for a 5-cycle OA, the following preventative tube plugging (PTP) criteria was additionally implemented at 1R25

1. SGA, SGB, SGC, SGD
 - a. Tubes with a maximum AVB wear indication $\geq 35\%$
 - b. Any tube with a Wear Index > 100
 - i. Wear index is the sum of all AVB wear indication %TW values in the tube
 - c. Any tube with AVB wear growth $\geq 18\%$

Callaway Energy Center 2022

Steam Generator Inspection Report

Figure 5 - SG-A Tube Plug Summary

SG	Row	Col	Hot Leg	Cold Leg	Reason for Tube Repair	Tube Qty.	Stab	PTP Criterion
Callaway1AR	75	83	Rolled	Rolled	PTP 29% @ AV5-0.02	1	No	(c)
Callaway1AR					PTP 34% @ AV4+0.00			
Callaway1AR					PTP 30% @ AV3+0.00			
Callaway1AR					PTP 13% @ AV2+0.00			
Callaway1AR	109	61	Rolled	Rolled	PTP 35% @ AV6-0.07	1	No	(a)
Callaway1AR	111	71	Rolled	Rolled	PTP 25% @ AV6+0.02	1	No	
Callaway1AR					PTP 26% @ AV5-0.02			(b)

Figure 6 - SG-B Tube Plug Summary

SG	Row	Col	Hot Leg	Cold Leg	Reason for Tube Repair	Tube Qty.	Stab	PTP Criterion
Callaway1BR	76	68	Rolled	Rolled	PTP 13% @ AV6+0.02	1	No	(c)
Callaway1BR					PTP 14% @ AV5-0.02			
Callaway1BR					PTP 24% @ AV4-0.02			
Callaway1BR					PTP 27% @ AV3-0.05			
Callaway1BR					PTP 26% @ AV2-0.05			
Callaway1BR	88	88	Rolled	Rolled	PTP 36% @ AV4+0.00	1	No	(a)
Callaway1BR	95	57	Rolled	Rolled	PTP 35% @ AV4+0.02	1	No	(a)

Figure 7 - SG-C Tube Plug Summary

SG	Row	Col	Hot Leg	Cold Leg	Reason for Tube Repair	Tube Qty.	Stab	PTP Criterion
Callaway1CR	94	66	Rolled	Rolled	PTP 18% @ AV6+0.00	1	No	(c)
Callaway1CR					PTP 29% @ AV5-0.02			
Callaway1CR					PTP 27% @ AV4+0.00			
Callaway1CR					PTP 31% @ AV3-0.02			
Callaway1CR					PTP 6% @ AV2+0.14			
Callaway1CR	97	69	Rolled	Rolled	PTP 36% @ AV4+0.02	1	No	(a)
Callaway1CR					PTP 36% @ AV5-0.02			
Callaway1CR	110	72	Rolled	Rolled	PTP 35% @ AV6+0.00	1	No	(a)

Figure 8 - SG-D Tube Plug Summary

SG	Row	Col	Hot Leg	Cold Leg	Reason for Tube Repair	Tube Qty.	Stab	PTP Criterion
Callaway1DR	N/A	N/A	N/A	N/A	N/A	1	N/A	N/A

Figure 9 - RF25 Repairable Tube Summary

Location	Tube Degradation	SGA	SGB	SGC	SGD	Total
AVB	Wear	3	3	3	0	9
TSP	Wear	0	0	0	0	0
Total Tubes Plugged		3	3	3	0	9

8.0 An analysis summary of the tube integrity conditions

The operational assessment performed during RF25 provides reasonable assurance that the performance criteria will be met over the next five operating cycles (cycles 26, 27, 28, 29 and 30) which includes conservative assumptions for growth rate distributions, cycle length, new indication initiation, and differential pressure ($3\Delta P$). The analysis of five operating cycles assumes that Callaway's license amendment request will be approved for the implementation of TSTF-577 to change the inspection interval to a maximum allowable 96 EFPM period.

8.1 AVB Wear

The OA for AVB wear was implemented using the Framatome MathCAD SG Full Bundle, Fully Probabilistic Operational Assessment model. The OA methodology utilizes a probabilistic full bundle approach that samples from a distribution of structural effective lengths and depths, for each individual flaw depth returned to service, to arrive at the overall bundle probability of survival for a given steam generator. This follows the fundamental definition of the projected OA worst case flaw as stated in the EPRI Integrity Assessment Guidelines. The per-bundle approach (which considers each flaw depth returned to service) is the fundamental OA requirement. It is more responsive to extreme value growth rates because it explicitly captures the fact that if more deep flaws are returned to service, there is an increasing probability that large growth rates will be matched with large beginning-of-cycle (BOC) depths, making deep end-of-cycle (EOC) flaws more likely. Hence, this approach will yield a lower repair limit for a SG which has a large population of flaws.

The full bundle analysis treats AVB wear indications as Axial Partial Through-wall Degradation less than 135° in circumferential extent. The OA methodology was based on using the probability of burst, namely $3\Delta P$, of 3885 psid as outlined in the Degradation Assessment over 7.2 EFY. A Kunin fit was used to model the 1R25 NDE growth rate distribution. This distribution was formed by combining the growth rates from all four SGs.

As part of the OA full bundle analysis, all pertinent uncertainties were considered including material properties, NDE technique, burst equation, and growth allowances. The excellent probability of detection (POD) associated with ETSS I-96041.1 regarding tube wear at AVB locations causes little concern for undetected wear scars.

Callaway Energy Center | 2022

Steam Generator Inspection Report

Figure 10 - Probability of Meeting 3ΔP at 50% Confidence after 7.2 EFPY (AVB Wear)

SG	POS	Minimum Required POS
A	0.997	0.95
B	0.998	0.95
C	0.997	0.95
D	0.999	0.95

Figure 11 - RF30 OA AVB Projections

1R30 OA Projections		
AVB Wear	# Indications	542 (in limiting SGC)
	Upper 95 th Growth Rate (%TW/EFPY)	2.48 (See Note 1)
	Maximum Depth (%TW)	52 (See Note 2)
NOTES 1. Determined from Kunin growth rate used in AVB Full Bundle Model. 2. Based on applying upper 95th growth rate from AVB Kunin and applying it to maximum depth flaw that was returned to service in 1R25 over the projected 1R26-1R30 cycle length.		

8.2 TSP Wear

The OA for TSP wear was implemented using the Framatome fully probabilistic operational assessment model following the same methodology as the AVB wear OA. Due to the smaller number of TSP indications found during the outage all flaws were conservatively grouped into one steam generator.

The results SGA are provided in Figure 12. The POS for SG-A is greater than the SG Program minimum allowable of 95%; therefore, continued operation will not result in TSP wear that challenges tube integrity prior to the next SG inspection (1R30).

Callaway Energy Center | 2022

Steam Generator Inspection Report

Figure 12 - Probability of Meeting $3\Delta P$ at 50% Confidence after 7.2 EFPY (TSP Wear)

SG	POS	Minimum Required POS
All	0.998	0.95
Notes 1. TSP flaws from all generators were included in SGA		

Figure 13 - R30 OA TSP Projections

1R30 OA Projections		
TSP Wear	# Indications	581 (Total)
	Upper 95 th Growth Rate (%TW/EFPY)	2.03 (See Note 1)
	Maximum Depth (%TW)	38 (See Note 2)
NOTES 1. Upper 95 th from Kunin of TSP growth rate data. 2. Based on applying bounding upper 95 th growth rate from TSP Bundle model with all flaws combined to largest TSP flaw returned to service over the projected 1R26-1R30 cycle length.		

8.3 Foreign Object Wear

8.3.1 ECT PLPs and Post Lancing FOSAR Results

The historical performance of the Callaway SGs with respect to foreign object wear, the results of outage 1R25 FOSAR, bobbin probe examinations, and array probe examinations provide reasonable assurance that foreign object wear will not challenge tube integrity prior to the next tube examination (1R30).

8.3.2 Unrecovered FWIV Washer

The results of the analysis performed for the unrecovered washer shows that this washer will not create tube wear that is greater than the high probability structural limit of 59%TW for a bounding 1.0-inch length flaw. This result provides reasonable assurance that tube integrity will not be impacted by this unrecovered washer over cycles 26, 27, 28, 29, and 30.

9.0 Tubes Plugged to Date

Figure 14 - Callaway Tube Cumulative Plugging Status

Outage	SGA	SGB	SGC	SGD	Total
Pre-Service	1	0	0	0	1
1R15	0	0	0	0	0
1R18	10	6	12	1	29
1R21	9	0	14	2	25
1R25	3	3	3	0	9
Total Tubes Plugged	23	9	29	3	64
Total Tubes	5872	5872	5872	5872	23488
Total Percentage	0.39%	0.15%	0.49%	0.05%	0.27%
Limit (%)	10.00%	10.00%	10.00%	10.00%	10.00%

10. Results of Secondary Side Inspection

The planned FOSAR (annulus, no-tube lane, and inner bundle passes) examinations were performed in each of the four SGs following water lancing. One washer from the FWIV was retrieved on TTS in the periphery adjacent to the NTL. Visual inspections of the steam drums in SG-B and SG-C were performed as planned with expanded scope inspection SG-A due to FWIV equipment deficiencies.

10.1 Steam Drum Inspections

During inspections of the SGB and SGC steam drums, no degradation was noted in the loose parts trapping system (LPTS), feeding, and moisture separating components. However, bolts and washers were found laying on the loose parts trapping screens and were retrieved after site notification. In response to this foreign material intrusion issue, an inspection of the main feedwater isolation valve (FWIV) for each SG was performed and verified that only the valves for SGs A, B, and C were missing bolts and washers. Therefore, the steam drum visual inspections were expanded to include SGA where bolts and washers were also found on the loose parts trapping screen. Below is a tally of the bolts/washers found in the steam drums of A, B, and C versus what was reported missing in the FWIV for each steam generator.

- During the inspection of SGA steam drum 9 bolts and 8 washers were found and retrieved by SSI/FOSAR (CR 202202654). Site verified that 9 bolts and 9 washers were found missing from Alpha FWIV. Therefore, 1 washer is still missing.

Callaway Energy Center | 2022

Steam Generator Inspection Report

- Note: The loose parts trapping screens were also found damaged in the steam drum (CR 202202265). Specifically, a portion of the wire mesh screen was noted missing and a dented screen that resulted in a gap between two adjacent screens was noted. Recommended actions from the CR evaluation were to perform FOSAR for the remaining missing FWIV bolts and washers, perform an extent of condition review for all steam generator steam drums and loose parts trapping screens, remove any loose wire remnants from the stainless-steel mesh that could potentially become foreign material and evaluate replacement of the damaged LPTS segment during a future outage.
- During inspection of the SGB steam drum 1 bolt and 1 washer was found and retrieved by SSI FOSAR (CR 202202455). Site verified that 1 bolt and 1 washer were found missing from Bravo FWIV.
- During inspection of the SGC steam drum 7 bolts and 6 washers were found and retrieved by SSI FOSAR (CR 20222432). Site verified that 8 bolts and 8 washers were found missing from Charlie FWIV. However, borescope inspections found the one missing bolt in a drain line and post lance inspection in SGC found one of the missing washers on TTS in the periphery adjacent to NTL (CR 202202730). Disassembly of the C FWIV also found a missing washer. Therefore, all of the C FWIV hardware that was missing was accounted for by the site.
- In summary, all bolts/washers reported missing from the feedwater isolation valves are accounted for except for one washer. One washer from FWIV A is still missing. The potential for the washer, including the missing wire mesh piece, to enter the tube bundle and cause wear on tubes over the next five cycles (up to 7.2 EFPY) is evaluated in the CMOA.

10.2 Sludge Lancing

Sludge Lancing was performed on all 4 steam generators. A combined total of 20.5 pounds of sludge was collected by Framatome. The steam generator tubes and the top of tubesheet were clean, with exception of a small sludge pile located near the center of each steam generator's top of tubesheet. Overall, it is evident that the sludge pile region in SGA, SGC, and SGD has shown only marginal increase in size (i.e., number of affected tubes) since 1R21. The sludge pile region in SGB has decreased in size since 1R21. The average height of the sludge pile region in each SG has noticeably increased since 1R21. The deposit mapping study determined that the heaviest deposits are located on the hot leg, between the 6th and 8th TSP of each SG. The tube support analysis indicates that the flow restriction is not present in the flow regions for the tube support intersections.

Table 6
RF25 Sludge Lancing Results

	SGA	SGB	SGC	SGD	TOTAL
Sludge Removed (lbs)	4.5	9.0	4.0	3.0	20.5

ATTACHMENT 1

This attachment shows the details of the indications observed on all four SGs with a 20-39%TW indication. See the below figures for each generator.

Ameren - Callaway Unit 1
1R25 - 04/22

AVB Wear 20% - 39%

GROUP	TUBES
Previously Plugged	20
AVB TWD 20-39%	27

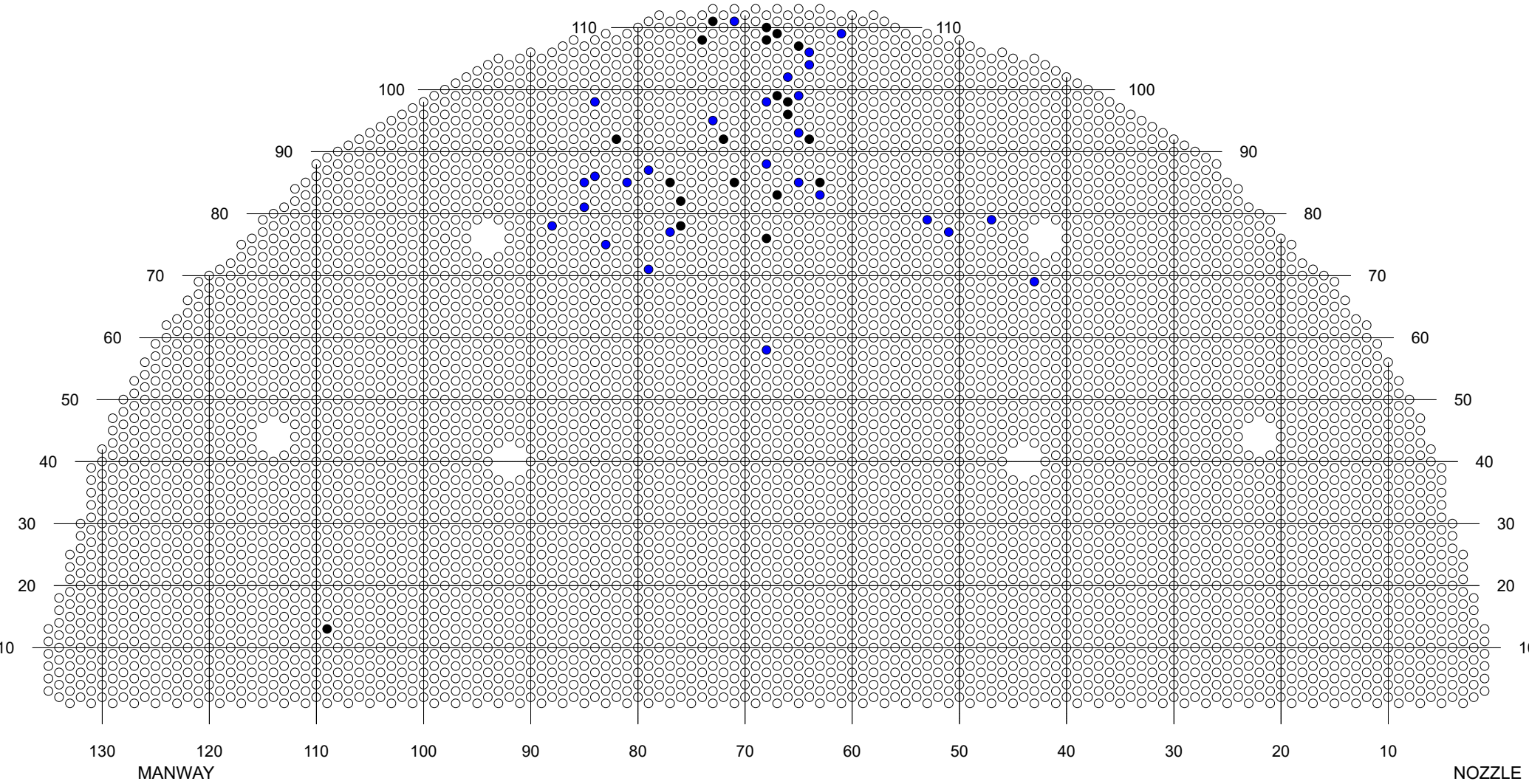
Framatome - FDMS map module Version 16.0

S/G A
HOT
PRIMARY FACE

TOTAL TUBES: 5872
SELECTED TUBES: 47
OUT OF SERVICE (#): NA

SCALE: 0.084494 X
Wed May 04 08:54:51 2022

Ameren: S/G A HOT AREVA



AVB Wear 20% - 39%

QUERY: QueryM1[1]

.qry

ROW	COL	VOLTS	DEG	CHAN	IND	%TW	LOCATION	EXT	EXT	UTIL 1	UTIL 2	UTIL 3	CAL	LEG	PROBE	IDX
===	===	=====	===	=====	===	===	=====	===	===	=====	=====	=====	=====	=====	=====	=====
58	68	0.46	126	P2	TWD	20	AV5 +0.00	TEC	TEH				3	HOT	610HS	I331
69	43	0.59	120	P2	TWD	23	AV3 -0.02	TEC	TEH				2	HOT	610HS	I309
71	79	0.48	100	P2	TWD	21	AV3 +0.00	TEC	TEH				5	HOT	610HS	I081
75	83	0.94	111	P2	TWD	29	AV5 -0.02	TEC	TEH				5	HOT	610HS	I140
		1.41	114	P2	TWD	34	AV4 +0.00	TEC	TEH				5	HOT	610HS	I140
		1.04	115	P2	TWD	30	AV3 +0.00	TEC	TEH				5	HOT	610HS	I140
77	51	0.56	129	P2	TWD	22	AV3 -0.02	TEC	TEH				2	HOT	610HS	I424
77	77	0.90	117	P2	TWD	29	AV4 +0.00	TEC	TEH				6	HOT	610HS	I056
78	88	0.61	114	P2	TWD	24	AV4 -0.05	TEC	TEH				6	HOT	610HS	I226
79	47	0.62	120	P2	TWD	24	AV4 +0.02	TEC	TEH				1	HOT	610HS	I357
		0.62	126	P2	TWD	24	AV3 -0.05	TEC	TEH				1	HOT	610HS	I357
79	53	0.80	108	P2	TWD	27	AV3 +0.00	TEC	TEH				1	HOT	610HS	I441
81	85	0.83	121	P2	TWD	27	AV3 -0.05	TEC	TEH				6	HOT	610HS	I181
		0.52	116	P2	TWD	21	AV2 +0.00	TEC	TEH				6	HOT	610HS	I181
83	63	0.54	119	P2	TWD	22	AV5 -0.02	TEC	TEH				1	HOT	610HS	I594
85	65	0.63	116	P2	TWD	24	AV3 -0.02	TEC	TEH				2	HOT	610HS	I644
		0.47	107	P2	TWD	20	AV2 -0.07	TEC	TEH				2	HOT	610HS	I644
85	81	0.48	118	P2	TWD	20	AV3 -0.02	TEC	TEH				6	HOT	610HS	I120
85	85	0.45	123	P2	TWD	20	AV3 -0.05	TEC	TEH				6	HOT	610HS	I182
86	84	0.86	118	P2	TWD	28	AV3 -0.02	TEC	TEH				5	HOT	610HS	I154
		1.02	118	P2	TWD	30	AV4 +0.00	TEC	TEH				5	HOT	610HS	I154
87	79	0.52	112	P2	TWD	22	AV3 -0.02	TEC	TEH				5	HOT	610HS	I085
88	68	0.52	123	P2	TWD	22	AV3 -0.02	TEC	TEH				3	HOT	610HS	I323
93	65	0.51	118	P2	TWD	21	AV4 +0.05	TEC	TEH				2	HOT	610HS	I646
95	73	0.52	121	P2	TWD	21	AV3 +0.00	TEC	TEH				3	HOT	610HS	I405
98	68	1.03	123	P2	TWD	30	AV5 +0.00	TEC	TEH				4	HOT	610HS	I322
		0.94	118	P2	TWD	29	AV4 +0.00	TEC	TEH				4	HOT	610HS	I322
98	84	0.83	116	P2	TWD	27	AV2 -0.05	TEC	TEH				5	HOT	610HS	I151
99	65	1.33	120	P2	TWD	33	AV5 -0.05	TEC	TEH				1	HOT	610HS	I629
102	66	0.46	122	P2	TWD	20	AV5 -0.02	TEC	TEH				1	HOT	610HS	I634
104	64	0.80	112	P2	TWD	27	AV6 -0.02	TEC	TEH				2	HOT	610HS	I623
		1.46	119	P2	TWD	34	AV5 -0.02	TEC	TEH				2	HOT	610HS	I623
106	64	0.68	118	P2	TWD	25	AV5 -0.02	TEC	TEH				1	HOT	610HS	I603
109	61	1.55	111	P2	TWD	35	AV6 -0.07	TEC	TEH				2	HOT	610HS	I588
		0.71	123	P2	TWD	26	AV5 -0.02	TEC	TEH				2	HOT	610HS	I588
111	71	0.67	111	P2	TWD	25	AV6 +0.02	TEC	TEH				3	HOT	610HS	I378
		0.74	119	P2	TWD	26	AV5 -0.02	TEC	TEH				3	HOT	610HS	I378

Total Tubes : 27
Total Records: 37

Ameren - Callaway Unit 1
1R25 - 04/22

AVB Wear 20% - 39%

GROUP	TUBES
Previously Plugged	6
AVB TWD 20-39%	17

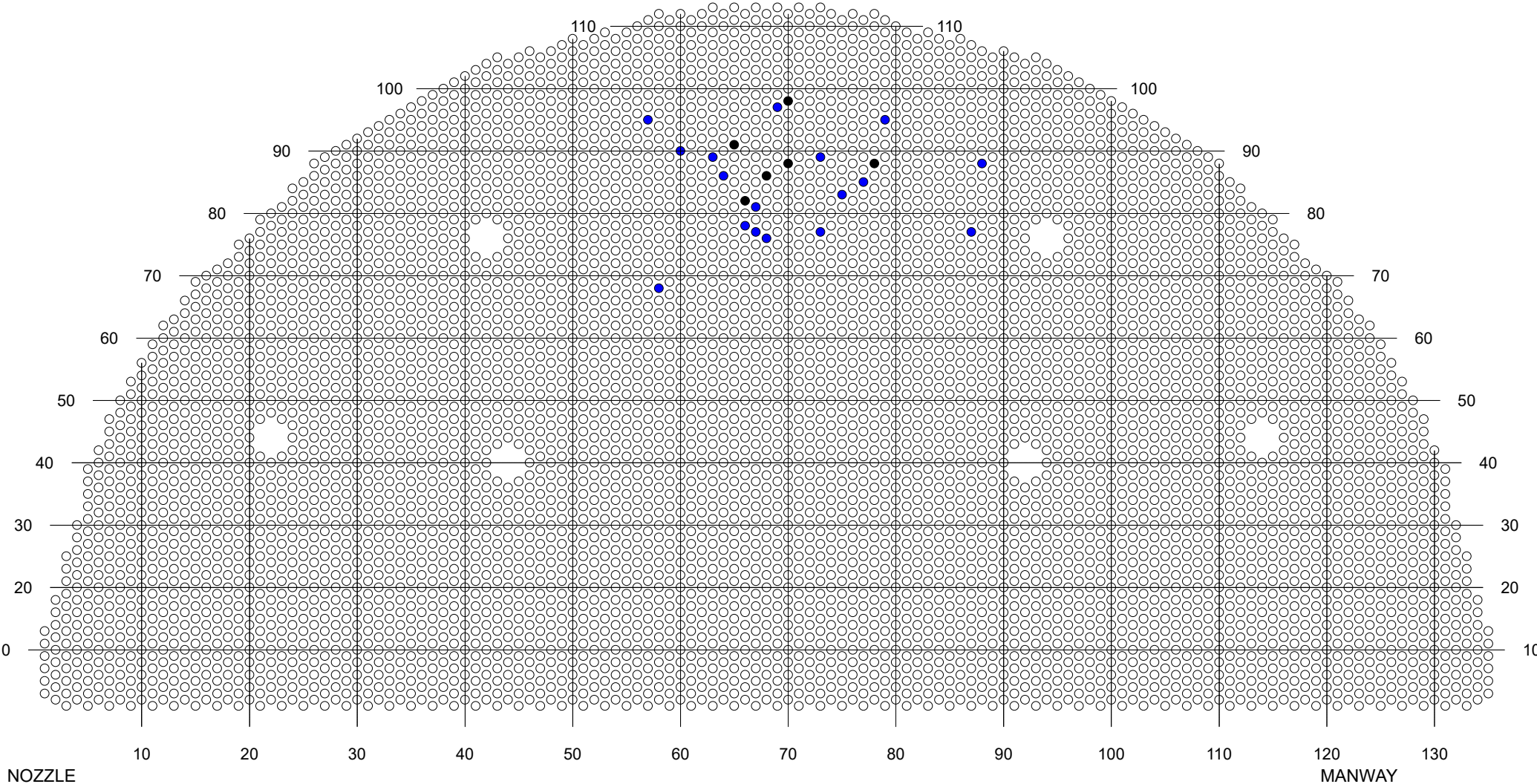
Framatome - FDMS map module Version 16.0

S/G B
HOT
PRIMARY FACE

TOTAL TUBES: 5872
SELECTED TUBES: 23
OUT OF SERVICE (#): NA

SCALE: 0.084494 X
Wed May 04 08:56:54 2022

Ameren: S/G B HOT AREVA



AVB Wear 20% - 39%

QUERY: QueryM1[1]

.qry

ROW	COL	VOLTS	DEG	CHAN	IND	%TW	LOCATION	EXT	EXT	UTIL 1	UTIL 2	UTIL 3	CAL	LEG	PROBE	IDX
===	===	=====	===	=====	===	===	=====	===	===	=====	=====	=====	=====	=====	=====	=====
68	58	0.58	126	P2	TWD	23	AV3 -0.02	TEC	TEH				6	HOT	610HS	I127
		0.52	118	P2	TWD	21	AV4 -0.02	TEC	TEH				6	HOT	610HS	I127
76	68	0.62	126	P2	TWD	24	AV4 -0.02	TEC	TEH				7	HOT	610HS	I402
		0.80	126	P2	TWD	27	AV3 -0.05	TEC	TEH				7	HOT	610HS	I402
		0.77	120	P2	TWD	26	AV2 -0.05	TEC	TEH				7	HOT	610HS	I402
77	67	0.45	127	P2	TWD	20	AV6 -0.12	TEC	TEH				6	HOT	610HS	I265
		1.23	121	P2	TWD	32	AV4 +0.05	TEC	TEH				6	HOT	610HS	I265
		0.69	122	P2	TWD	25	AV3 -0.05	TEC	TEH				6	HOT	610HS	I265
77	73	0.45	122	P2	TWD	20	AV4 +0.02	TEC	TEH				10	HOT	610HS	I033
		0.89	126	P2	TWD	28	AV3 +0.00	TEC	TEH				10	HOT	610HS	I033
77	87	0.54	127	P2	TWD	22	AV4 -0.02	TEC	TEH				9	HOT	610HS	I236
		0.77	127	P2	TWD	26	AV3 -0.02	TEC	TEH				9	HOT	610HS	I236
78	66	0.74	91	P2	TWD	26	AV3 -0.05	TEC	TEH				5	HOT	610HS	I246
81	67	0.73	126	P2	TWD	26	AV5 -0.02	TEC	TEH				6	HOT	610HS	I266
		0.89	115	P2	TWD	28	AV4 -0.02	TEC	TEH				6	HOT	610HS	I266
		0.69	105	P2	TWD	25	AV3 -0.05	TEC	TEH				6	HOT	610HS	I266
83	75	0.44	95	P2	TWD	20	AV3 -0.02	TEC	TEH				10	HOT	610HS	I063
85	77	0.51	108	P2	TWD	21	AV4 -0.02	TEC	TEH				9	HOT	610HS	I089
		1.35	115	P2	TWD	33	AV3 -0.02	TEC	TEH				9	HOT	610HS	I089
		0.52	69	P2	TWD	22	AV2 -0.05	TEC	TEH				9	HOT	610HS	I089
86	64	0.92	126	P2	TWD	29	AV4 +0.02	TEC	TEH				6	HOT	610HS	I011
		0.99	119	P2	TWD	30	AV3 -0.02	TEC	TEH				6	HOT	610HS	I011
88	88	1.72	123	P2	TWD	36	AV4 +0.00	TEC	TEH				10	HOT	610HS	I273
		1.18	122	P2	TWD	32	AV3 -0.05	TEC	TEH				10	HOT	610HS	I273
		0.45	123	P2	TWD	20	AV2 -0.07	TEC	TEH				10	HOT	610HS	I273
89	63	1.22	134	P2	TWD	32	AV3 -0.07	TEC	TEH				6	HOT	610HS	I205
		0.53	141	P2	TWD	22	AV2 -0.02	TEC	TEH				6	HOT	610HS	I205
89	73	0.54	107	P2	TWD	22	AV4 -0.02	TEC	TEH				10	HOT	610HS	I030
90	60	0.58	119	P2	TWD	23	AV3 -0.02	TEC	TEH				5	HOT	610HS	I154
95	57	0.99	129	P2	TWD	30	AV5 -0.07	TEC	TEH				6	HOT	610HS	I110
		1.53	124	P2	TWD	35	AV4 +0.02	TEC	TEH				6	HOT	610HS	I110
		0.66	140	P2	TWD	24	AV3 -0.07	TEC	TEH				6	HOT	610HS	I110
95	79	0.47	143	P2	TWD	20	AV3 +0.02	TEC	TEH				10	HOT	610HS	I127
97	69	0.73	99	P2	TWD	26	AV3 -0.07	TEC	TEH				8	HOT	610HS	I417

Total Tubes : 17
Total Records: 34

Ameren - Callaway Unit 1
1R25 - 04/22

AVB Wear 20% - 39%

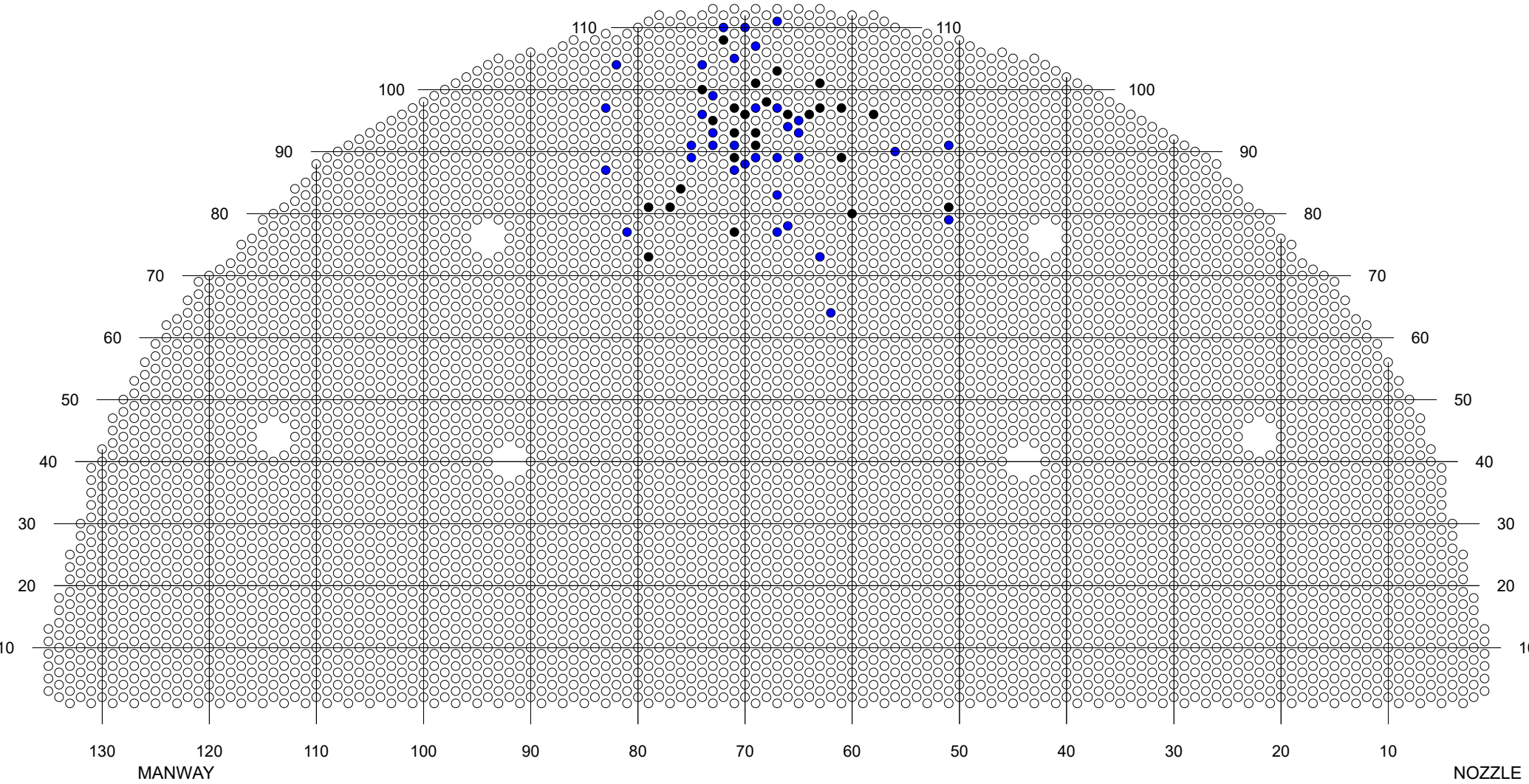
GROUP	TUBES
Previously Plugged	26
AVB TWD 20-39%	35

Framatome - FDMS map module Version 16.0

S/G C
HOT
PRIMARY FACE

TOTAL TUBES: 5872
SELECTED TUBES: 61
OUT OF SERVICE (#): NA

SCALE: 0.084494 X
Wed May 04 08:58:44 2022
Ameren: S/G C HOT AREVA



AVB Wear 20% - 39%

QUERY: QueryM1[1]

.qry

ROW	COL	VOLTS	DEG	CHAN	IND	%TW	LOCATION	EXT	EXT	UTIL 1	UTIL 2	UTIL 3	CAL	LEG	PROBE	IDX
64	62	0.51	123	P2	TWD	21	AV5 -0.05	TEC	TEH				1	HOT	610HS	I557
		1.15	122	P2	TWD	31	AV4 -0.02	TEC	TEH				1	HOT	610HS	I557
		0.56	122	P2	TWD	22	AV3 -0.05	TEC	TEH				1	HOT	610HS	I557
73	63	0.85	102	P2	TWD	28	AV5 +0.00	TEC	TEH				1	HOT	610HS	I577
		0.67	134	P2	TWD	25	AV4 +0.00	TEC	TEH				1	HOT	610HS	I577
77	67	0.89	133	P2	TWD	28	AV3 +0.00	TEC	TEH				2	HOT	610HS	I670
		0.54	133	P2	TWD	22	AV2 -0.05	TEC	TEH				2	HOT	610HS	I670
77	81	0.45	128	P2	TWD	20	AV2 +0.00	TEC	TEH				12	HOT	610HS	I044
78	66	0.50	145	P2	TWD	21	AV2 -0.05	TEC	TEH				2	HOT	610HS	I652
79	51	0.46	120	P2	TWD	20	AV3 -0.05	TEC	TEH				2	HOT	610HS	I423
83	67	0.65	88	P2	TWD	24	AV3 -0.02	TEC	TEH				1	HOT	610HS	I635
87	71	0.66	126	P2	TWD	24	AV5 +0.00	TEC	TEH				8	HOT	610HS	I090
		0.57	121	P2	TWD	23	AV3 -0.07	TEC	TEH				8	HOT	610HS	I090
87	83	0.73	129	P2	TWD	26	AV4 +0.00	TEC	TEH				12	HOT	610HS	I054
88	70	0.63	132	P2	TWD	24	AV5 -0.07	TEC	TEH				8	HOT	610HS	I050
89	65	0.47	143	P2	TWD	20	AV3 -0.02	TEC	TEH				2	HOT	610HS	I636
89	67	0.94	133	P2	TWD	29	AV5 -0.02	TEC	TEH				2	HOT	610HS	I667
		0.84	138	P2	TWD	28	AV4 +0.00	TEC	TEH				2	HOT	610HS	I667
		0.54	148	P2	TWD	22	AV3 -0.05	TEC	TEH				2	HOT	610HS	I667
89	69	0.61	132	P2	TWD	24	AV4 -0.05	TEC	TEH				8	HOT	610HS	I030
		1.26	122	P2	TWD	33	AV3 -0.02	TEC	TEH				8	HOT	610HS	I030
89	75	0.94	111	P2	TWD	29	AV3 +0.00	TEC	TEH				10	HOT	610HS	I066
90	56	1.05	114	P2	TWD	30	AV3 +0.00	TEC	TEH				2	HOT	610HS	I499
		0.53	116	P2	TWD	22	AV2 -0.02	TEC	TEH				2	HOT	610HS	I499
91	51	0.87	113	P2	TWD	28	AV3 -0.02	TEC	TEH				2	HOT	610HS	I420
91	71	0.48	130	P2	TWD	21	AV5 -0.02	TEC	TEH				8	HOT	610HS	I091
91	73	0.49	123	P2	TWD	21	AV3 -0.02	TEC	TEH				9	HOT	610HS	I025
91	75	0.77	125	P2	TWD	27	AV6 +0.00	TEC	TEH				9	HOT	610HS	I069
		0.49	113	P2	TWD	21	AV5 -0.02	TEC	TEH				9	HOT	610HS	I069
93	65	0.54	143	P2	TWD	22	AV2 -0.05	TEC	TEH				2	HOT	610HS	I635
93	73	0.48	114	P2	TWD	21	AV4 +0.05	TEC	TEH				10	HOT	610HS	I025
94	66	0.91	134	P2	TWD	29	AV5 -0.02	TEC	TEH				2	HOT	610HS	I656
		0.79	139	P2	TWD	27	AV4 +0.00	TEC	TEH				2	HOT	610HS	I656
		1.13	123	P2	TWD	31	AV3 -0.02	TEC	TEH				2	HOT	610HS	I656
95	65	0.48	98	P2	TWD	20	AV5 +0.00	TEC	TEH				1	HOT	610HS	I602
		0.63	123	P2	TWD	24	AV4 +0.05	TEC	TEH				1	HOT	610HS	I602
96	74	0.81	116	P2	TWD	27	AV2 -0.05	TEC	TEH				9	HOT	610HS	I031
97	67	0.84	130	P2	TWD	28	AV2 -0.05	TEC	TEH				2	HOT	610HS	I665
97	69	1.71	114	P2	TWD	36	AV5 -0.02	TEC	TEH				8	HOT	610HS	I032
		1.67	123	P2	TWD	36	AV4 +0.02	TEC	TEH				8	HOT	610HS	I032
97	83	0.45	133	P2	TWD	20	AV4 +0.00	TEC	TEH				9	HOT	610HS	I140
99	73	0.59	121	P2	TWD	23	AV3 +0.00	TEC	TEH				10	HOT	610HS	I026
		0.62	132	P2	TWD	24	AV5 +0.00	TEC	TEH				10	HOT	610HS	I026
		0.67	121	P2	TWD	25	AV4 +0.00	TEC	TEH				10	HOT	610HS	I026
104	74	0.48	122	P2	TWD	21	AV4 +0.02	TEC	TEH				10	HOT	610HS	I029
104	82	0.77	122	P2	TWD	27	AV4 +0.02	TEC	TEH				10	HOT	610HS	I132
105	71	0.46	122	P2	TWD	20	AV3 -0.02	TEC	TEH				8	HOT	610HS	I096
107	69	0.57	130	P2	TWD	23	AV6 +0.02	TEC	TEH				8	HOT	610HS	I036
		1.48	120	P2	TWD	34	AV5 +0.00	TEC	TEH				8	HOT	610HS	I036
		0.73	128	P2	TWD	26	AV4 +0.00	TEC	TEH				8	HOT	610HS	I036
110	70	1.00	119	P2	TWD	30	AV3 -0.02	TEC	TEH				8	HOT	610HS	I040
110	72	1.51	126	P2	TWD	35	AV6 +0.00	TEC	TEH				8	HOT	610HS	I102
		0.81	129	P2	TWD	27	AV5 +0.00	TEC	TEH				8	HOT	610HS	I102
111	67	0.46	102	P2	TWD	20	AV4 -0.05	TEC	TEH				1	HOT	610HS	I629

Total Tubes : 35

Total Records: 54

Ameren - Callaway Unit 1
1R25 - 04/22

AVB Wear 20% - 39%

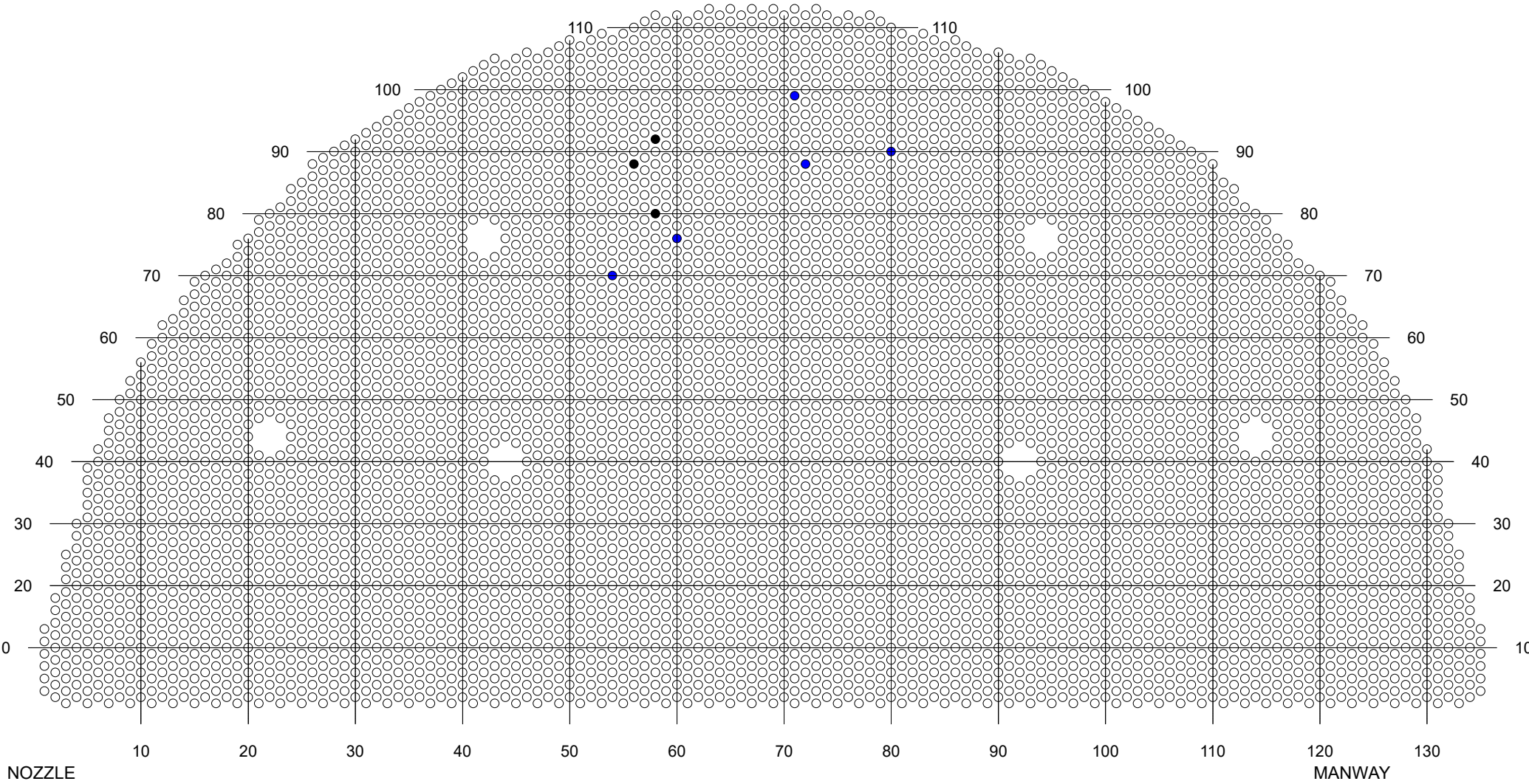
GROUP	TUBES
Previously Plugged	3
AVB TWD 20-39%	5

Framatome - FDMS map module Version 16.0

S/G D
HOT
PRIMARY FACE

TOTAL TUBES: 5872
SELECTED TUBES: 8
OUT OF SERVICE (#): NA

SCALE: 0.084494 X
Wed May 04 09:02:41 2022
Ameren: S/G D HOT AREVA



AVB Wear 20% - 39%

QUERY: QueryM1[1]

.qry

ROW	COL	VOLTS	DEG	CHAN	IND	%TW	LOCATION	EXT	EXT	UTIL 1	UTIL 2	UTIL 3	CAL	LEG	PROBE	IDX
===	===	=====	===	=====	===	===	=====	===	===	=====	=====	=====	=====	=====	=====	=====
70	54	0.60	127	P2	TWD	23	AV5 +0.00	TEC	TEH				15	HOT	610HS	I188
76	60	0.95	114	P2	TWD	29	AV5 -0.05	TEC	TEH				14	HOT	610HS	I273
		0.64	118	P2	TWD	24	AV4 -0.02	TEC	TEH				14	HOT	610HS	I273
88	72	0.67	102	P2	TWD	25	AV6 -0.02	TEC	TEH				5	HOT	610HS	I190
90	80	0.61	117	P2	TWD	24	AV5 -0.05	TEC	TEH				6	HOT	610HS	I018
99	71	0.68	96	P2	TWD	25	AV2 -0.05	TEC	TEH				5	HOT	610HS	I174

Total Tubes : 5

Total Records: 6