Xcel Energy®

Prairie Island Nuclear Generating Plant
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U. S. Nuclear Regulatory Commission
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Prairie Island Nuclear Generating Plant Unit 2
Docket 50-306
Renewed Facility Operating License No. DPR-60

2015 Unit 2 180-Day Steam Generator Tube Inspection Report

In accordance with Prairie Island Nuclear Generating Plant, Unit 2, Technical Specification 5.6.7, "Steam Generator Tube Inspection Report," Northern States Power Company, a Minnesota corporation, doing business as Xcel Energy (hereafter "NSPM") submits the enclosed report of steam generator tube inspections performed during the 2015 refueling and maintenance outage on Unit 2.

Summary of Commitments

This letter contains no new commitment and no revision to an existing commitment.

Scott Northard
Acting Site Vice President - Prairie Island Nuclear Generating Plant
Northern States Power Company - Minnesota

Enclosure (1)

cc: Administrator, Region III, USNRC
Project Manager, Prairie Island, USNRC
Resident Inspector, Prairie Island, USNRC

Enclosure 1

Prairie Island Nuclear Generating Plant – Unit 2
2015 Steam Generator Tube Inspection Report

(17 pages follow)

ENCLOSURE 1

Prairie Island Nuclear Generating Plant – Unit 2
2015 Steam Generator Tube Inspection Report

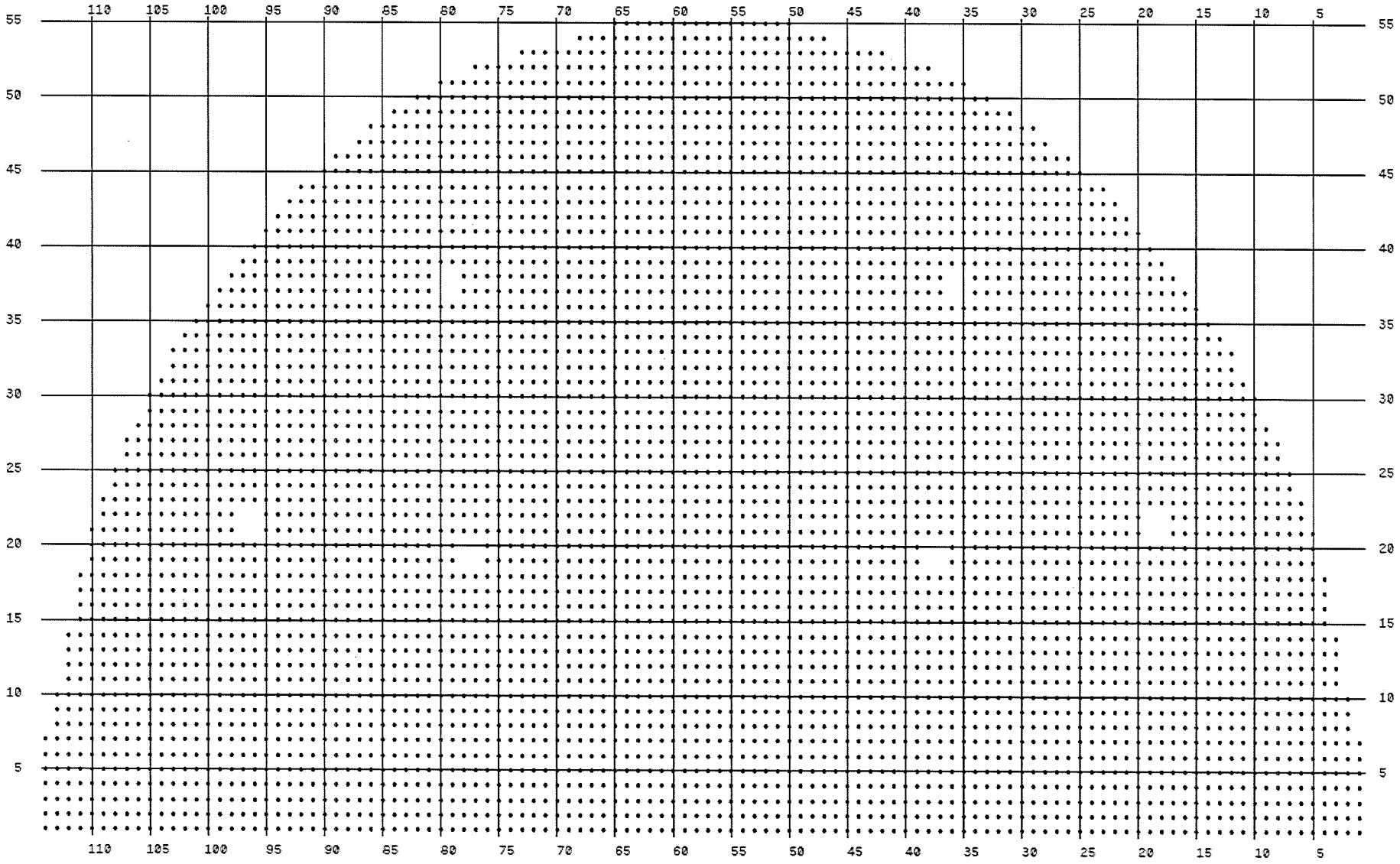
In accordance with Prairie Island Nuclear Generating Plant (PINGP), Unit 2 Technical Specification 5.6.7, Xcel Energy Nuclear Department submits this report of steam generator tube inspections performed during the 2015 refueling and maintenance outage for Unit 2 (2R29).

PINGP Unit 2 has two Areva Model 56/19 Replacement Steam Generators (RSGs) with approximately 5,600 square meters of heat transfer area utilizing tubes with 19 millimeter outside diameter. Each RSG has 4,868 thermally-treated Alloy 690 u-tubes manufactured by Sandvik which have an outside diameter of 0.750 inch and a nominal wall thickness of 0.043 inch. The tubes are configured in a square pitch of 1.0425 inches with 55 rows and 114 columns (see Figure 1). The tube u-bends vary in radius from 2.7000 inches for a row 1 tube to 58.9950 inches for a row 55 tube. The tubes vary in length from 738.16 inches for row 1 tubes to 923.04 inches for row 55 tubes. Row 1 through row 9 tubes were subject to stress relieving following the bending process using the thermal treatment process for an additional 2 hour minimum soak time. The tubes were hydraulically expanded at each end for the full depth of the tubesheet with the expansion transition being between 0.079 inches and 0.236 inches below the secondary tubesheet face.

The tubesheet is low alloy steel 21.46 inches thick with alloys 82 and 182 cladding 0.375" thick for an overall thickness of 21.835 inches. The tubes are supported by eight tube support plates (TSPs) and five anti-vibration bars (AVBs) intersecting tubes between 1, 3, 5, 7 and 9 times (see Figure 2). There is one straight bar that intersects all rows at the center of each bend, two 57 degree bars that intersect rows 13 through 55 and two 14 degree bars that intersect rows 25 through 55. In addition there are 24 peripheral tubes with nine staples (one at each AVB location) that carry the entire load of the complete AVB assembly. All TSPs are constructed from Type 410 stainless steel. The TSPs have a minimum thickness of 1.18 inch and have quatrefoil-shaped holes through which the tubes pass. The AVBs are constructed from Type 405 stainless steel and are rectangular in cross section (nominally 0.5 inch by 0.3 inch).

Each RSG is equipped with a Loose Parts Trapping Systems (LPTS), which is composed of screens at the top of the downcomer and at the top of the primary (cyclone) separators. These screens (0.14" square mesh formed from 0.031" diameter wire), prevent foreign material from entering the steam generator tube area from the main feedwater and auxiliary feedwater systems (see Figure 2).

Figure 1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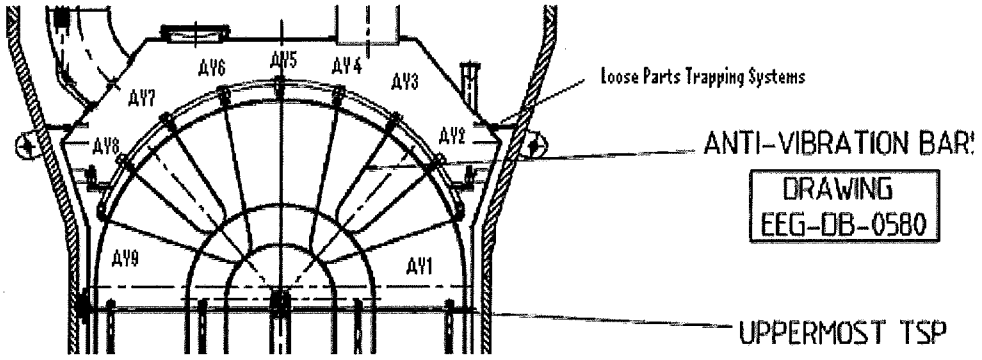

Figure 2

The original Westinghouse Model 51 Steam Generators (SGs) were replaced during the 2013 refueling outage after 33.56 EFPY of operation. During the 2015 refueling outage the first in-service inspection (ISI) was conducted on the RSGs after accumulating the initial 1.66 EFPY of RSG operation.

NOTE:	*Italicized* text represents technical specification excerpts. Each excerpt is followed by the appropriate information intended to address each specific requirement and also includes additional details based on benchmarking previous submittals and Staff requests for additional information of peer Licensees. A legend of codes and field names is included at the end of the report.

5.6 Reporting Requirements

5.6.7 Steam Generator Tube Inspection Report

A report shall be submitted within 180 days after initial entry into MODE 4 following completion of an inspection performed in accordance with the Specification 5.5.8, Steam Generator (SG) Program.

Initial entry into MODE 4 occurred on November 27, 2015, dictating submittal of this report on or before May 25, 2016.

The report shall include:

a. *The scope of inspections performed on each SG,*

Table 1 and the notes that follow, provides the scope of inspections performed during 2R29.

TABLE 1

SCOPE	LEG	EXTENT	TECHNIQUE	SG 21	SG 22
Row 7 through 55①	H/C	F/L	X-Probe™	100%(4184)	100%(4184)
Row 3 through 6	H	AV5TEH	X-Probe™	100%(456)	100%(456)
Row 1 through 2	H	08HTEH	X-Probe™	100%(228)	100%(228)
Row 1 through 2	H	08CTEH	Bobbin	N/A	100%(228)
Row 1 through 2	C	08HTEC	Bobbin	100%(228)	N/A
Row 1 through 2	C	08CTEC	X-Probe™	100%(228)	100%(228)
Row 3 through 6	C	AV5TEC	X-Probe™	100%(456)	100%(456)
Special Interest②	H/C	Various	MRPC®	0.3%(17)	0.6%(30)
Post Plugging③	H/C	N/A	Visual	100%(4)	100%(14)
Upper Internals④	N/A	N/A	Visual	100%	100%
Top of Tubesheet⑤	H/C	N/A	Visual	100%	100%
In-bundle⑥	H/C	N/A	Visual	~17%	~17%
PLP⑦ FOSAR	H/C	N/A	Visual	N/A	N/A

Notes:

- The X-Probe™ deployed contained both a standard bobbin coil and a 16 coil array of transmit/receive coils.
- The scope of inspections is provided as a percentage of the open tubes (or plugs) followed by the total number of tests parenthetically (where practical).
- No tubes were plugged during the RSG manufacturing or prior to service.

① The Row 7 through 55 inspections were completed from both legs (either hot or cold) over the full length (F/L) of each tube (TEHTEC or TECTEH).

② Special Interest MRPC® testing is intended to bridge the array coil technology with the previously employed (pre-service inspection (PSI)) +Point™ technology. The selection and percentage (number) of tubes was based on both the PSI results and the current inspection results.

③ Post tube plugging visual inspections were conducted by Engineering to validate the tube plug location and proper insertion.

④ Inspections of the upper internals included the visual inspections of all bolted closures (manways and camera ports), Feedwater Ring (including J-tubes and antistratification (helix) device), Primary (Moisture) Separators, Loose Parts Trapping screens, Downcomer Loose Parts Trapping System (LPTS) and wrapper position per NRC Generic Letter 97-06 and Prairie Island Unit 2 56/19 Replacement Steam Generator Operation and Maintenance Manual.

⑤ Tube lane and periphery of the tube bundle inspected using a camera transport system.

⑥ Random fiber-optic inspection of one out of every six columns.

⑦ Foreign Object Search and Retrieval of possible loose part (PLP) indications for evaluation and possible removal based on eddy current results (not necessary – no PLP's detected in either SG).

b. *Degradation mechanisms found,*

Primary Side Inspections - AVB wear and TSP wear were the only degradation mechanisms found in both SGs during 2R29.

For AVB wear the inspection results indicate an improved performance relative to the Unit 1 experience. Only three tubes were identified that contained AVB wear indications, with the largest depth reported at 20%TW. The growth rate experienced by these indications is not abnormally large when compared to industry operating experience (OE) for first cycle AVB wear.

For TSP wear the number of indications in both SGs is increased from that of the Unit 1 experience at the first inspection. There are two facts that can account for this. The first is the amount of run time that Unit 2 had during its first cycle, which allowed for more indications to initiate and grow. Unit 1 first cycle of operation was 1.36 EFPY versus 1.66 EFPY for Unit 2. As expected, the depth distributions for the wear were also slightly higher for Unit 2 compared to that of Unit 1. In addition, a compelling argument for the increase in numbers is the sensitivity of the eddy current methods employed at the Unit 2 inspection. In 2R29, the tubes were inspected with a combination bobbin/array probe over their entire length. The X-Probe™ has increased sensitivity, as well as the ability to help clarify bobbin signals. In the data provided (Tables 3 through 6), there are 59 indications that were detectable by the array coils that were not detectable using the bobbin coil. These indications inflate the total number when compared to the Unit 1 first inspection where only bobbin coil was utilized for full length inspections. Even considering this difference, the number, orientation and depth distributions are not outside either the expectations or the industry OE for other RSGs in terms of wear in the first cycle of operation.

Secondary Side Inspections – No secondary side degradation was found. A total of 12 small (all $\leq$ 0.25 sq. in.) pieces (five in SG 21 and seven in SG 22) of foreign material (FM) were discovered during the upper bundle inspection on the downcomer LPTS which were subsequently removed. The top of tubesheet and in bundle FOSAR inspections found no FM and no eddy current PLP indications were detected.

c. *Nondestructive examination techniques utilized for each degradation mechanism,*

Table 2 and the notes that follow, provide the Electric Power Research Institute (EPRI) Examination Technique Specification Sheet (ETSS) (techniques) utilized during 2R29 for existing and potential degradation.

TABLE 2

CLASSIFICATION①	MECHANISM	LOCATION	PROBE	TECHNIQUE②
Potential	Wear	TSP	Bobbin	96004.1 Rev. 13
			X-Probe™	11956.1 Rev. 2
			+Point™	96910.1 Rev. 10
Potential	Wear	AVB and Staple	Bobbin	M96041.1 Rev. 4③
			X-Probe™	11956.1 Rev. 2
			+Point™	10908.3 Rev. 1
Potential	Wear	PLP	Bobbin	27091.2 Rev.1
			X-Probe™	20400.1 Rev. 5
			+Point™	2790X.1 Rev. 1④
Potential	Wear	Tube-to-Tube	Bobbin	13091.1 Rev. 0
			X-Probe™	13902.1 Rev. 0
			+Point™	13901.1 Rev. 1

Notes:

① Existing or Potential degradation as defined in the EPRI SGMP: Steam Generator Integrity Assessment Guidelines, Revision 3.

② Each listed technique was site validated for both detection and sizing except for PLP wear with the X-Probe™ which utilized the above listed technique for detection while sizing would have been based on ETSS 11956.1 Rev. 2 had PLP wear been detected. In addition, bobbin ETSS's 96010.1 Rev. 7, 24013.1 Rev. 2 and 96007.1 Rev. 12 were site validated for use on non-degradation (MBMs, DNGs, PDSs and cold laps).

③ M indicates the cited ETSS is an Appendix I qualified technique with system performance quantified using Model Assisted Probability of Detection (MAPOD).

④ X represents 1 through 7 where the user selects the best EPRI ETSS based on the as found wear scar shape and applies the published performance indices for that ETSS.

d. *Location, orientation (if linear), and measured sizes (if available) of service induced indications,*

Tables 3 and 4 provide the location, orientation and measured size of each reported TSP wear indication in each steam generator respectively for the degradation found during 2R29. All the tubes in these two tables were returned to service.

Tables 5 and 6 provide the location, orientation and measured sizes of AVB and TSP wear indications in each steam generator respectively for tubes preventively plugged during 2R29. The preventive tube plugging criteria implemented during 2R29 was: 1) any AVB wear $\geq$ 8% through wall as measured by the array coils, 2) any TSP wear $\geq$ 20% through wall as measured by the array coils, 3) any TSP wear $\geq$ 18% through wall as measured by the bobbin coil and 4) any TSP wear with a FLT code (flat non-tapered wear).

Within Table 3, two tubes with a UTIL2 NCA code were detected by the bobbin coil and not confirmed by the array coil. Within Tables 3 through 6, no tubes were reported with multiple VOL calls at the same ROW/COL/LOC/PROBE which would confirm indications of double sided AVB wear or multiple wear location sites on multiple land contact points of a Quatrefoil TSP. Conversely, all VOL calls at the same ROW/COL/LOC/PROBE confirm only single sided wear sites at all AVB and TSP locations.

A legend of fields and codes with brief explanations is provided at the end of this enclosure for clarification purposes.

TABLE 3
Steam Generator 21 TSP Wear

TUBE #	IND #	ROW	COL	VOLTS	IND	PCT	LOC	ELEV	PROBE	UTIL1	UTIL2
1	1	2	2	0.28	VOL	13	04C	-0.46	Array	TPR	NBC
2	2	3	2	0.27	VOL	13	04C	-0.47	Array	TPR	NBC
3	3	5	2	0.29	VOL	13	04C	-0.66	Array	TPR	NBC
4	4	2	5	0.28	VOL	13	04C	-0.65	Array	TPR	NBC
5	5	5	5	0.21	VOL	12	04C	-0.82	Array	TPR	NBC
6	6	27	11	0.15	WAR	13	02C	0.52	Bobbin		CBA
6	6	27	11	0.18	VOL	11	02C	0.35	Array	WAR	TPR
7	7	37	16	0.15	WAR	13	02C	0.49	Bobbin		CBA
7	7	37	16	0.29	VOL	13	02C	0.29	Array	WAR	TPR
8	8	43	23	0.2	WAR	16	02C	0.52	Bobbin		CBA
8	8	43	23	0.54	VOL	17	02C	0.12	Array	WAR	TPR
9	9	11	39	0.16	WAR	13	03H	0.4	Bobbin		CBA
9	9	11	39	0.33	VOL	14	03H	0.49	Array	WAR	TPR
10	10	46	39	0.22	VOL	12	04H	-0.9	Array	TPR	NBC
11	11	51	41	0.4	VOL	15	04H	-0.9	Array	TPR	NBC
12	12	52	45	0.21	WAR	17	02C	0.69	Bobbin		CBA
12	12	52	45	0.33	VOL	14	02C	0.26	Array	WAR	TPR
12	13	52	45	0.33	VOL	14	04H	-0.87	Array	TPR	NBC
13	14	48	48	0.34	VOL	14	06C	-0.96	Array	TPR	NBC
14	15	53	49	0.11	WAR	10	04H	-0.67	Bobbin		CBA
14	15	53	49	0.37	VOL	15	04H	-0.87	Array	WAR	TPR
15	16	54	49	0.49	VOL	16	06H	-1.01	Array	TPR	NBC
16	17	53	51	0.49	VOL	16	07H	-1.07	Array	TPR	NBC
17	18	54	52	0.2	VOL	11	03H	-0.87	Array	TPR	NBC
17	19	54	52	0.25	VOL	12	04H	-0.82	Array	TPR	NBC
17	20	54	52	0.37	VOL	15	07H	-0.93	Array	TPR	NBC
18	21	52	53	0.38	VOL	15	04C	-1.03	Array	TPR	NBC
19	22	53	53	0.3	VOL	13	03H	-0.84	Array	TPR	NBC
19	23	53	53	0.37	VOL	15	05H	-0.9	Array	TPR	NBC
20	24	54	53	0.1	WAR	9	06H	-0.81	Bobbin		CBA
20	24	54	53	0.37	VOL	15	06H	-0.92	Array	WAR	TPR
20	25	54	53	0.32	VOL	14	07H	-0.85	Array	TPR	NBC
21	26	53	54	0.27	VOL	13	06H	-0.92	Array	TPR	NBC
22	27	54	54	0.11	WAR	10	05H	0.35	Bobbin		CBA
22	27	54	54	0.32	VOL	14	05H	0.38	Array	WAR	TPR
23	28	55	54	0.31	VOL	14	06C	-0.92	Array	TPR	NBC
23	29	55	54	0.12	WAR	10	08C	-0.7	Bobbin		CBA
23	29	55	54	0.44	VOL	16	08C	-1.07	Array	WAR	TPR

TABLE 3
Steam Generator 21 TSP Wear

TUBE #	IND #	ROW	COL	VOLTS	IND	PCT	LOC	ELEV	PROBE	UTIL1	UTIL2
24	30	47	56	0.07	WAR	6	04H	-0.66	Bobbin		CBA
24	30	47	56	0.3	VOL	13	04H	-0.86	Array	WAR	TPR
25	31	53	56	0.31	VOL	14	04H	-0.96	Array	TPR	NBC
26	32	54	56	0.32	VOL	14	04H	-0.87	Array	TPR	NBC
26	33	54	56	0.4	VOL	15	07H	-1.01	Array	TPR	NBC
27	34	42	58	0.22	WAR	17	05H	0.43	Bobbin		CBA
27	34	42	58	0.4	VOL	15	05H	0.29	Array	WAR	TPR
28	35	52	58	0.09	WAR	8	05H	-0.66	Bobbin		CBA
28	35	52	58	0.25	VOL	12	05H	-0.84	Array	WAR	TPR
29	36	55	59	0.1	WAR	9	04C	-0.87	Bobbin		CBA
29	36	55	59	0.22	VOL	12	04C	-0.9	Array	WAR	TPR
29	37	55	59	0.26	VOL	13	08C	-0.95	Array	TPR	NBC
30	38	53	60	0.27	VOL	13	04C	-0.93	Array	TPR	NBC
31	39	54	60	0.12	WAR	10	06C	-0.78	Bobbin		CBA
31	39	54	60	0.39	VOL	15	06C	-0.84	Array	WAR	TPR
31	39	54	60	0.12	VOL	6	06C	-0.77	+Point™	WAR	TPR
32	40	55	60	0.11	WAR	10	02C	-0.63	Bobbin		CBA
32	40	55	60	0.36	VOL	14	02C	-0.84	Array	WAR	TPR
33	41	55	61	0.11	WAR	10	04C	0.32	Bobbin		CBA
33	41	55	61	0.35	VOL	14	04C	0.12	Array	WAR	TPR
34	42	26	62	0.14	WAR	12	04H	0.46	Bobbin		NCA
35	43	54	66	0.12	WAR	10	05C	0.41	Bobbin		CBA
35	43	54	66	0.24	VOL	12	05C	0.46	Array	WAR	TPR
36	44	49	69	0.12	WAR	10	07H	-0.75	Bobbin		CBA
36	44	49	69	0.34	VOL	14	07H	-1.01	Array	WAR	TPR
37	45	35	70	0.07	WAR	6	04H	-0.67	Bobbin		CBA
37	45	35	70	0.28	VOL	13	04H	-0.87	Array	WAR	TPR
38	46	53	70	0.11	WAR	10	03H	-0.55	Bobbin		CBA
38	46	53	70	0.33	VOL	14	03H	-0.87	Array	WAR	TPR
39	47	50	72	0.07	WAR	7	05C	-0.84	Bobbin		CBA
39	47	50	72	0.4	VOL	15	05C	-0.87	Array	WAR	TPR
40	48	48	74	0.13	WAR	11	05C	0.4	Bobbin		CBA
40	48	48	74	0.31	VOL	14	05C	0.38	Array	WAR	TPR
41	49	48	79	0.34	VOL	14	06C	-1.08	Array	TPR	NBC
42	50	39	88	0.13	WAR	11	03H	0.4	Bobbin		CBA
42	50	39	88	0.36	VOL	14	03H	0.4	Array	WAR	TPR
43	51	40	90	0.09	WAR	8	05H	0.35	Bobbin		CBA
43	51	40	90	0.28	VOL	13	05H	0.32	Array	WAR	TPR
44	52	42	91	0.27	VOL	13	04H	-0.87	Array	TPR	NBC

TABLE 3
Steam Generator 21 TSP Wear

TUBE #	IND #	ROW	COL	VOLTS	IND	PCT	LOC	ELEV	PROBE	UTIL1	UTIL2
45	53	1	95	0.17	WAR	14	08H	0.29	Bobbin		NCA
46	54	39	95	0.21	VOL	12	06H	-0.87	Array	TPR	NBC
47	55	15	103	0.11	WAR	10	08C	0.67	Bobbin		CBA
47	55	15	103	0.39	VOL	15	08C	0.64	Array	WAR	TPR

TABLE 4
Steam Generator 22 TSP Wear

TUBE #	IND #	ROW	COL	VOLTS	IND	PCT	LOC	ELEV	PROBE	UTIL1	UTIL2
1	1	5	2	0.14	WAR	12	04C	-0.51	Bobbin		CBA
1	1	5	2	0.23	VOL	12	04C	-0.84	Array	WAR	TPR
2	2	1	4	0.24	VOL	12	06C	-0.79	Array	TPR	NBC
3	3	30	16	0.09	WAR	8	04H	-0.71	Bobbin		CBA
3	3	30	16	0.36	VOL	14	04H	-0.9	Array	WAR	TPR
4	4	37	16	0.15	WAR	13	04H	-0.76	Bobbin		CBA
4	4	37	16	0.37	VOL	15	04H	-0.93	Array	WAR	TPR
4	5	37	16	0.3	VOL	13	05C	-0.85	Array	TPR	NBC
5	6	37	17	0.13	WAR	11	04H	-0.79	Bobbin		CBA
5	6	37	17	0.31	VOL	14	04H	-0.9	Array	WAR	TPR
6	7	33	18	0.31	VOL	13	05C	-0.76	Array	TPR	NBC
7	8	45	29	0.31	VOL	14	05C	-0.91	Array	TPR	NBC
8	9	47	30	0.37	VOL	15	05C	-0.82	Array	TPR	NBC
9	10	48	32	0.14	WAR	12	05H	-0.76	Bobbin		CBA
9	10	48	32	0.61	VOL	18	05H	-0.93	Array	WAR	TPR
9	10	48	32	0.08	VOL	4	05H	-0.85	+Point™	WAR	TPR
10	11	51	35	0.09	WAR	8	04H	-0.73	Bobbin		CBA
10	11	51	35	0.26	VOL	13	04H	-0.9	Array	WAR	TPR
11	12	51	36	0.07	WAR	6	05H	-0.82	Bobbin		CBA
11	12	51	36	0.42	VOL	15	05H	-0.79	Array	WAR	TPR
12	13	45	39	0.23	VOL	12	04H	-0.88	Array	TPR	NBC
13	14	48	39	0.3	VOL	13	04H	-0.88	Array	TPR	NBC
14	15	52	39	0.35	VOL	14	04H	-0.96	Array	TPR	NBC
15	16	52	41	0.16	WAR	13	05H	-0.74	Bobbin		CBA
15	16	52	41	0.51	VOL	17	05H	-0.88	Array	WAR	TPR
15	16	52	41	0.11	VOL	5	05H	-0.87	+Point™	WAR	TPR
15	17	52	41	0.32	VOL	14	07H	-0.88	Array	TPR	NBC
16	18	52	42	0.37	VOL	15	04H	-0.9	Array	TPR	NBC
17	19	53	44	0.34	VOL	14	04H	-0.9	Array	TPR	NBC
18	20	54	47	0.15	WAR	13	04H	-0.75	Bobbin		CBA
18	20	54	47	0.42	VOL	15	04H	-0.95	Array	WAR	TPR
19	21	52	48	0.36	VOL	14	07H	-0.9	Array	TPR	NBC
20	22	53	48	0.26	VOL	13	07H	-0.87	Array	TPR	NBC
21	23	51	49	0.13	WAR	11	07H	-0.72	Bobbin		CBA
21	23	51	49	0.35	VOL	14	07H	-0.95	Array	WAR	TPR
22	24	54	54	0.12	WAR	11	07H	-1.01	Bobbin		CBA
22	24	54	54	0.45	VOL	16	07H	-0.9	Array	WAR	TPR
22	24	54	54	0.1	VOL	5	07H	-0.82	+Point™	WAR	TPR
22	25	54	54	0.39	VOL	15	08H	-0.98	Array	TPR	NBC

TABLE 4
Steam Generator 22 TSP Wear

TUBE #	IND #	ROW	COL	VOLTS	IND	PCT	LOC	ELEV	PROBE	UTIL1	UTIL2
23	26	55	55	0.14	WAR	12	04C	-0.63	Bobbin		CBA
23	26	55	55	0.5	VOL	16	04C	-0.83	Array	WAR	TPR
23	27	55	55	0.1	WAR	9	07H	-0.72	Bobbin		CBA
23	27	55	55	0.39	VOL	15	07H	-0.89	Array	WAR	TPR
24	28	54	56	0.28	VOL	13	07H	-0.87	Array	TPR	NBC
25	29	55	56	0.16	WAR	13	07H	-0.81	Bobbin		CBA
25	29	55	56	0.58	VOL	17	07H	-0.9	Array	WAR	TPR
26	30	21	57	0.14	WAR	12	08H	0.69	Bobbin		CBA
26	30	21	57	0.28	VOL	13	08H	0.61	Array	WAR	TPR
27	31	55	57	0.19	WAR	15	01H	-0.61	Bobbin		CBA
27	31	55	57	0.27	VOL	13	01H	-0.84	Array	WAR	TPR
27	32	55	57	0.22	WAR	17	07H	-0.75	Bobbin		CBA
27	32	55	57	0.73	VOL	19	07H	-0.92	Array	WAR	TPR
27	32	55	57	0.21	VOL	10	07H	-0.87	+Point™	WAR	TPR
28	33	55	61	0.17	WAR	14	02C	0.42	Bobbin		CBA
28	33	55	61	0.47	VOL	16	02C	0.31	Array	WAR	TPR
29	34	54	62	0.19	WAR	15	02C	0.39	Bobbin		CBA
29	34	54	62	0.69	VOL	19	02C	0.17	Array	WAR	TPR
29	34	54	62	0.3	VOL	13	02C	-0.2	+Point™	WAR	TPR
29	35	54	62	0.08	WAR	7	07C	-0.65	Bobbin		CBA
29	35	54	62	0.42	VOL	15	07C	-0.87	Array	WAR	TPR
30	36	49	64	0.32	VOL	14	07H	-0.91	Array	TPR	NBC
31	37	54	64	0.13	WAR	11	05H	-0.62	Bobbin		CBA
31	37	54	64	0.31	VOL	14	05H	-0.85	Array	WAR	TPR
32	38	53	68	0.12	WAR	10	04H	-0.65	Bobbin		CBA
32	38	53	68	0.42	VOL	15	04H	-0.9	Array	WAR	TPR
32	39	53	68	0.33	VOL	14	08C	-0.98	Array	TPR	NBC
33	40	52	69	0.11	WAR	10	04H	-0.64	Bobbin		CBA
33	40	52	69	0.31	VOL	14	04H	-0.9	Array	WAR	TPR
34	41	53	70	0.34	VOL	14	04C	-0.9	Array	TPR	NBC
35	42	39	75	0.15	WAR	13	06C	-0.84	Bobbin		CBA
35	42	39	75	0.32	VOL	14	06C	-1.04	Array	WAR	TPR
36	43	14	76	0.17	VOL	11	03H	0.64	Array	TPR	NBC
37	44	38	76	0.22	WAR	17	03C	0.42	Bobbin		CBA
37	44	38	76	0.39	VOL	15	03C	0.37	Array	WAR	TPR
38	45	50	78	0.33	VOL	14	07H	-1	Array	TPR	NBC
39	46	47	86	0.13	WAR	11	02C	0.45	Bobbin		CBA
39	46	47	86	0.32	VOL	14	02C	0.31	Array	WAR	TPR
40	47	24	87	0.19	VOL	11	01C	-0.89	Array	TPR	NBC

TABLE 4
Steam Generator 22 TSP Wear

TUBE #	IND #	ROW	COL	VOLTS	IND	PCT	LOC	ELEV	PROBE	UTIL1	UTIL2
41	48	45	87	0.22	VOL	12	08C	-1.02	Array	TPR	NBC
42	49	46	88	0.28	VOL	13	04H	-0.82	Array	TPR	NBC
43	50	45	90	0.15	WAR	13	05H	-0.65	Bobbin		CBA
43	50	45	90	0.33	VOL	14	05H	-0.93	Array	WAR	TPR
44	51	44	91	0.25	VOL	12	05H	-0.93	Array	TPR	NBC
45	52	41	93	0.58	VOL	17	05H	-0.93	Array	TPR	NBC
46	53	41	94	0.14	WAR	12	04H	-0.65	Bobbin		CBA
46	53	41	94	0.48	VOL	16	04H	-0.87	Array	WAR	TPR
47	54	38	97	0.15	WAR	13	04H	-0.65	Bobbin		CBA
47	54	38	97	0.24	VOL	12	04H	-0.48	Array	WAR	TPR
48	55	8	100	0.15	WAR	13	03H	-0.7	Bobbin		CBA
48	55	8	100	0.34	VOL	14	03H	-0.87	Array	WAR	TPR
49	56	30	102	0.16	WAR	13	04H	-0.65	Bobbin		CBA
49	56	30	102	0.24	VOL	12	04H	-0.93	Array	WAR	TPR
50	57	27	106	0.22	VOL	12	05C	-1.07	Array	TPR	NBC
51	58	22	107	0.13	WAR	11	05H	-0.74	Bobbin		CBA
51	58	22	107	0.45	VOL	16	05H	-0.96	Array	WAR	TPR
52	59	26	107	0.23	VOL	12	05C	-0.93	Array	TPR	NBC
53	60	13	108	0.26	VOL	13	04C	-0.99	Array	TPR	NBC
54	61	16	111	0.54	VOL	15	05H	-0.93	Array	TPR	NBC
55	62	6	112	0.32	VOL	14	04C	-0.9	Array	TPR	NBC
56	63	6	113	0.14	WAR	12	04H	-0.48	Bobbin		CBA
56	63	6	113	0.47	VOL	16	04H	-0.96	Array	WAR	TPR

TABLE 5
Steam Generator 21 Tube Plugging

TUBE #	IND #	ROW	COL	VOLTS	IND	PCT	LOC	ELEV	PROBE	UTIL1	UTIL2
1	1	53	45	0.24	VOL	12	AV9	-0.11	Array	FLT	NBC
1	1	53	45	0.09	VOL	5	AV9	-0.04	+Point™	WAR	TPR
2	2	45	61	0.19	AVB	6	AV7	0	Bobbin		CBA
2	2	45	61	0.86	VOL	20	AV7	-0.35	Array	WAR	FLT
2	2	45	61	0.24	VOL	12	AV7	-0.29	+Point™	WAR	FLT

TABLE 6
Steam Generator 22 Tube Plugging

TUBE #	IND #	ROW	COL	VOLTS	IND	PCT	LOC	ELEV	PROBE	UTIL1	UTIL2
1	1	39	57	0.38	VOL	15	AV7	-0.43	Array	TPR	NBC
1	1	39	57	0.13	VOL	5	AV7	-0.22	+Point™	WAR	FLT
2	2	54	58	0.26	WAR	19	02C	0.39	Bobbin		CBA
2	2	54	58	0.58	VOL	17	02C	0.22	Array	WAR	TPR
2	2	54	58	0.24	VOL	10	02C	-0.09	+Point™	WAR	TPR
3	3	54	59	0.26	WAR	19	02C	0.39	Bobbin		CBA
3	3	54	59	0.73	VOL	19	02C	0.06	Array	WAR	TPR
3	3	54	59	0.32	VOL	13	02C	-0.11	+Point™	WAR	TPR
3	4	54	59	0.12	WAR	10	03C	-0.82	Bobbin		CBA
3	4	54	59	0.55	VOL	17	03C	-0.87	Array	WAR	TPR
3	4	54	59	0.15	VOL	7	03C	-0.82	+Point™	WAR	TPR
4	5	55	59	0.26	WAR	19	02C	0.39	Bobbin		CBA
4	5	55	59	0.56	VOL	17	02C	0.11	Array	WAR	TPR
4	5	55	59	0.22	VOL	10	02C	-0.07	+Point™	WAR	TPR
4	6	55	59	0.22	WAR	17	04C	0.37	Bobbin		CBA
4	6	55	59	0.79	VOL	20	04C	-0.08	Array	WAR	TPR
4	6	55	59	0.22	VOL	10	04C	-0.54	+Point™	WAR	TPR
5	7	54	61	0.53	WAR	31	01C	-0.11	Bobbin		CBA
5	7	54	61	1.48	VOL	25	01C	-0.73	Array	WAR	FLT
5	7	54	61	0.4	VOL	17	01C	-0.57	+Point™	WAR	FLT
5	8	54	61	0.21	WAR	16	02C	0.42	Bobbin		CBA
5	8	54	61	0.66	VOL	18	02C	0.11	Array	WAR	TPR
6	9	54	63	0.27	WAR	20	02C	0.42	Bobbin		CBA
6	9	54	63	0.77	VOL	20	02C	0.11	Array	WAR	TPR
6	9	54	63	0.24	VOL	11	02C	-0.2	+Point™	WAR	TPR
7	10	31	104	0.23	WAR	18	05H	0.42	Bobbin		CBA
7	10	31	104	0.44	VOL	16	05H	0.25	Array	WAR	TPR
7	10	31	104	0.22	VOL	10	05H	0.18	+Point™	WAR	TPR

e. *Number of tubes plugged during the inspection outage for each degradation mechanism,*

Table 7 provides the number of tubes plugged during 2R29.

TABLE 7

MECHANISM	SG 21	SG 22
AVB Wear	2	1
TSP Wear	0	6

f. *The number and percentage of tubes plugged to date, and the effective plugging percentage in each steam generator, and*

Table 8 provides the total number and percentage of tubes plugged to date.

TABLE 8

PLUGGING	SG 21	SG 22
TOTAL	2	7
PERCENT	0.04%	0.14%

g. *The results of condition monitoring, including the results of tube pulls and in-situ testing.*

The deepest AVB wear indication reported during 2R29 was 20%TW as reported from the X-Probe™. The condition monitoring (CM) limit for flat (uniformly deep) AVB wear is 47.2%TW. As the deepest indication is of lesser depth than the CM limit, CM is satisfied.

The deepest TSP wear indication reported during 2R29 was 25%TW as reported from X-Probe™, and is the only TSP wear indication with a flat profile. The flat wear TSP CM limit is 49.5%TW. As the deepest indication is of lesser depth than the CM limit, CM is satisfied.

The deepest TSP wear indication with a tapered profile was 20%TW as reported from X-Probe™. The tapered wear TSP CM limit is 60%TW. As the deepest indication is of lesser depth than the CM limit, CM is satisfied.

Additionally, an operation assessment (OA) was performed that provides reasonable assurance that the performance criteria will not be exceeded during the upcoming operating cycles 29 and 30 until the next planned SG inspection.

LEGEND OF FIELDS AND CODES

FIELD	EXPLANATION
TUBE #	Distinct ROW/COL combination within each Table
IND #	Distinct ROW/COL/LOCATION combination within each Table
ROW	Row number of tube location
COL	Column number of tube location
VOLTS	Measured Voltage
IND	Three Digit Code - see below
PCT	Measured percent through wall
LOC	Location of landmark - see below
ELEV	Measurement in inches from the center of the landmark to the center of the indication
PROBE	Probe Coil Type – Array, Bobbin or +Point™
UTIL1	Clarifying Codes – see below
UTIL2	Clarifying Codes – see below

FIELD	CODE	EXPLANATION
IND	AVB	Anti-Vibration Bar
	VOL	Volumetric
	WAR	Wear
LOC	0?H	? = First through Eighth tube support plate on hot leg side
	AV?	? = First through Ninth anti-vibration bar
	0?C	? = First through Eighth tube support plate on cold leg side
UTIL1 or UTIL2	CBA	Confirmed By Array coil
	FLT	Flat (non-tapered) wear
	NBC	No Bobbin Call
	NCA	Not Confirmed by Array coil
	TPR	Tapered wear
	WAR	Wear