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PG&E Letter DCL-16-056

U.S. Nuclear Regulatory Commission
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Docket No. 50-275, OL-DPR-80
Diablo Canyon Unit 1
<u>One Hundred Eighty-Day Steam Generator Report for Diablo Canyon Power Plant Unit 1 Nineteenth Refueling Outage</u>

Dear Commissioners and Staff:

Diablo Canyon Power Plant (DCPP) Technical Specification (TS) 5.6.10, "Steam Generator (SG) Tube Inspection Report," requires a report to be submitted within 180 days after initial entry into Mode 4 (Hot Shutdown) following completion of SG inspections performed in accordance with TS 5.5.9, "Steam Generator (SG) Tube Inspection Program." The enclosure provides the subject report for SG inspections performed during the DCPP Unit 1 Nineteenth Refueling Outage.

Pacific Gas & Electric Company makes no new or revised regulatory commitments (as defined by NEI 99-04) in this letter.

If there are any questions or if additional information is needed, please contact Mr. John Arhar at 805-545-4629.

Sincerely,

James M. Welsch

bnsm/4540/64018681
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ONE HUNDRED EIGHTY-DAY STEAM GENERATOR REPORT FOR DIABLO CANYON POWER PLANT UNIT 1 NINETEENTH REFUELING OUTAGE

ONE HUNDRED EIGHTY-DAY STEAM GENERATOR REPORT FOR DIABLO CANYON POWER PLANT UNIT 1 NINETEENTH REFUELING OUTAGE

Pacific Gas and Electric Company (PG&E) performed eddy current testing (ECT) inspections of the Diablo Canyon Power Plant (DCPP) Unit 1 steam generators (SGs) during the DCPP Unit 1 Nineteenth Refueling Outage (1R19) in October 2015. The inspections were conducted in accordance with DCPP Technical Specification (TS) 5.5.9. These were the second inservice inspections conducted on the Unit 1 SGs since they were replaced in the DCPP Unit 1 Fifteenth Refueling Outage (1R15) in 2009. The first inservice inspection was conducted in the DCPP Unit 1 Sixteenth Refueling Outage (1R16) in 2010.

The condition monitoring (CM) assessment concludes that, based on the results of the 1R19 inspections, none of the SG performance criteria were exceeded since the last ECT inspection in 1R16, that is, the three cycle operating period between the start of Unit 1 Cycle 17 and the end of Unit 1 Cycle 19. The operational assessment (OA) concludes that operation of the DCPP Unit 1 SGs until the next scheduled ECT inspection in DCPP Unit 1 Twenty Second Refueling Outage (1R22), three operating cycles, in 2020 will not cause any of the SG performance criteria to be exceeded.

- Section 1.0 provides background information including SG design features, Electric Power Research Institute (EPRI) guidelines, DCPP TS periods, and cycle lengths.
- Section 2.0 provides the SG tube integrity performance criteria.
- Section 3.0 provides the scope of inspections performed.
- Section 4.0 provides the results of condition monitoring.
- Section 5.0 provides an assessment of SG secondary side integrity.

Pursuant to TS 5.6.10, a report shall be submitted within 180 days after initial entry into MODE 4 (Hot Shutdown) following completion of an inspection performed in accordance with TS 5.5.9. DCPP Unit 1 entered Mode 4 on November 3, 2015.

The report shall include:

a. The scope of inspections performed on each SG.

   See Section 3.0 for the scope of inspections performed.

b. Active degradation mechanisms found.

   See Section 4.0 for active degradation mechanisms identified.

c. Nondestructive examination techniques utilized for each degradation mechanism.

   See Section 4.0 for nondestructive examination techniques utilized.

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

   See Tables 4 and 5 for location and measured depths of service-induced indications detected in 1R19.

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

   See Section 4.0. Eight tubes were plugged in 1R19 due to tube to structure wear: one in SG 1-1, five in SG 1-2, and two in SG 1-3. No tubes were plugged in SG 1-4.

f. Total number and percentage of tubes plugged to date.

   The percentage plugging to date is 0.02 percent in SG 1-1, 0.11 percent in SG 1-2, 0.04 percent in SG 1-3, and 0.00 percent in SG 1-4.

g. The results of CM, including the results of tube pulls and in situ testing.

   Section 4.0 provides the results of CM for tube degradation that was detected. No tubes required removal or in situ testing.

1.0 Background Information

1.1 SG Description

Table 1 provides a description of pertinent DCPP SG design features. There are 4 SGs in DCPP Unit 1, and each SG has 4,444 tubes. Figure 1 provides the Westinghouse Delta 54 SG tubesheet map depicting the row and column numbers. Figure 2 provides the Westinghouse Delta 54 SG sketch depicting the tube support plate naming convention.

1.2 EPRI Steam Generator Integrity Assessment Guidelines

The EPRI Steam Generator Integrity Assessment Guidelines (SGIAGL), Revision 3, contains the following requirements:

- A CM report shall be completed prior to MODE 4 after a SG inspection.
- When SGs pass CM, an OA shall be completed for the next inspection interval within 90 days after MODE 4.

Consistent with the requirements of the SGIAGL, PG&E developed a report prior to MODE 4 to document the 1R19 DCPP Unit 1 SG CM and OA, thus satisfying the MODE 4 requirements for CM and the 90 day OA requirements. The 180-day TS 5.5.9 report requires the results of the CM assessment, but not the OA. As such, only the CM assessment is provided in this report.

1.4 DCPP TS Periods and Cycle Lengths

The DCPP Unit 1 cycle lengths are nominally 20 months, ranging from 19 to 21 months. Following the first ECT inspections in 1R16, Unit 1 Cycle 17 initiated the first ECT sequential period as defined in TS 5.5.9.d.2. The first sequential period is 144 effective full power months (EFPM). TS 5.5.9 allows SG operation without inspections up to 72 EFPM or three refueling outages, whichever is less.

54 EFPM, or 4.51 effective full power year (EFPY), have occurred since the last ECT inspection in 1R16, three cycles ago. 54 EFPM is much less than 72 EFPM and, therefore, 3 cycles establishes the period between ECT inspections.

A conservative projection for operational run time for the next three cycles between 1R19 and 1R22 is 4.68 EFPY. The next inservice inspection may be conducted after three cycles (at 1R22), based on the satisfactory OA.

DCPP TS 5.5.9 requires that 100 percent of the tubes be inspected in each sequential period, and to inspect 50 percent of the tubes by the refueling outage nearest the midpoint of the period and the remaining 50 percent by the refueling outage nearest the end of the period. 1R19 is the refueling outage nearest the midpoint of the period. Therefore, at least 50 percent of the tubes were required to be inspected in 1R19. However, 100 percent of the tubes were inspected as a conservative measure.

2.0 SG Performance Criteria

Structural Integrity Performance Criteria (SIPC) and Accident Induced Leakage Performance Criterion (AILPC) were developed in accordance with the SGIAGL and DCPP TS 5.5.9.b for SG tube integrity. The probability for satisfying the limit requirements shall be at least 0.95 at 50 percent confidence level (95/50).

2.1 DCPP SIPC Limits

The 95/50 CM limits for antivibration bar (AVB) wear and tube support plate (TSP) wear were calculated and are provided in Table 6. For development of the CM limit, burst pressure relationship and DCPP-specific tube material property uncertainties were applied, plus ECT sizing uncertainties. The uncertainties were combined via a Monte Carlo process. The Monte Carlo process involves randomly selecting uncertainties for the applicable parameters to remove excessive conservatism as allowed by the EPRI SGIAGL. The burst pressure applied is 3 times the normal operating pressure differential pressure (3NOdP).

2.2 DCPP AILPC Limits

The accident-induced leak rate for indications in an individual SG, combined with operational primary-to-secondary leakage in an individual SG, cannot exceed 0.05 gallons per minute (gpm) (room temperature condition) at main steam line break (MSLB) differential pressure.

The total accident-induced leak rate from indications in all SGs, combined with operational primary-to-secondary leakage in all SGs, cannot exceed 0.2 gpm (room temperature condition) at MSLB differential pressure.

3.0 1R19 Inspections

The 1R19 Degradation Assessment (DA) evaluated the condition of the SGs in advance of the 1R19 SG inspections. Per TS 5.5.9, "an assessment of degradation shall be performed to determine the type and location of flaws to which the tubes may be susceptible and, based on this assessment, to determine which inspection methods need to be employed and at what locations." The DA identified the appropriate eddy current inspection scope, probes to be utilized, and appropriate detection and sizing information for potential degradation mechanisms for the proposed inspection scope.

The following primary side inspections were performed on the DCPP SGs:

- A full-length (tube end to tube end) bobbin coil probe inspection was performed on 100 percent of the in-service tubes in each SG.
- +Point rotating probe inspection was performed on:
    - 100 percent of bobbin "I" codes.
    - 100 percent of AVB wear indications detected by bobbin.
    - 100 percent of bobbin possible loose part (PLP) codes, including bounding tubes.
    - 100 percent of greater than or equal to 1.0 volt dents or dings that were not examined with +Point in 1R16, or were previously unreported.
    - 100 percent of tube U-bend regions with proximity (PRO) indications.
    - Precautionary inspections in light of AVB wear being reported:

    - Full length of the U-bends in the 16 tubes with wear at AVB structures.
    - Selected AVB intersections in tubes that surround the tubes containing AVB wear.
- Visual inspection of each SG channel head in accordance of Westinghouse Nuclear Safety Advisory letter (NSAL-12-1) recommendations.

The following secondary side inspections and maintenance were performed on the DCPP SGs:

- Pre-lancing visual inspection of the top-of-tubesheet (TTS) to determine the as-found condition.
- Sludge lancing of the TTS.
- Post-lancing Foreign Object Search and Retrieval (FOSAR) visual inspections to determine effect of lancing, and retrieval of foreign objects.

4.0 Condition Monitoring

A CM evaluation of the SG tube bundles is performed to verify that the condition of the tubes, as reflected in the inspection results, is in compliance with the structural and leakage integrity requirements.

Tube wear degradation at AVB structures and at TSP structures was detected in 1R19, as described below. Tube to tube wear was not detected.

4.1 Anti-Vibration Bar Wear

During 1R19, tube wear degradation at AVB intersections was detected in 15 tubes in SGs 1-1, 1-2, and 1-3. One AVB wear indication, 5 percent through-wall (TW), was detected in the prior inspection in 1R16. The close contact between the AVBs and the tube surface provides a potential for tube wear during plant operation.

AVB wear was detected and depth-sized with the bobbin probe per EPRI examination technique specification sheet (ETSS) 96004.1, and these depths are applied in CM. All AVB wear was also inspected with +Point probe and sized per ETSS 10904.8, to confirm the bobbin indication, to determine if the wear was double-sided, and to allow structural profiling (length and depth).

Table 2 provides a summary of AVB wear indications per SG. Table 4 provides a list of all tubes and indications with AVB wear, their location and percent TW depth reported by bobbin, and identifies the plugged/stabilized tubes.

A total of 62 AVB wear indications in 15 different tubes were reported by +Point, broken down as follows: +Point confirmed 39 bobbin indications as wear; +Point identified 14 indications as double-sided wear; +Point reported 9 new indications

that were not detected by bobbin. Most of the deeper AVB wear indications tended to have double-sided wear.

All of the tubes with AVB wear indications are in higher rows (larger U-bend radius) with the maximum 6 AVB supports, with the majority in rows 86 and higher. The deepest indications reported by bobbin coil were 42 percent TW, in two tubes. All wear indications greater than or equal to 40 percent TW (DCPP TS plugging criteria) were plugged. To ensure a 3 cycle OA, additional tubes were plugged, such that a total of 8 tubes (containing 48 AVB wear indications) were plugged. All plugged tubes were also stabilized with a U-bend stabilizer. 14 AVB wear indications (in 7 tubes) were returned to service; the largest AVB wear indication returned to service was 10 percent TW.

Precautionary +Point inspections were conducted in light of the reported AVB wear. +Point inspections were conducted on the full length of the U-bends in the 16 tubes that had reported AVB wear were inspected by +Point. The full length exams confirmed that tube-to-tube wear did not occur. In the course of collecting these exams, nine small (deepest was 9 percent TW) wear indications were reported by +Point at some AVB intersections that were no detectable degradation (NDD) by the bobbin probe. +Point inspections were also conducted on selected AVB intersections in tubes that surround the tubes containing AVB wear. No wear was reported by +Point in these surrounding tubes.

CM is satisfied for AVB wear by applying the bobbin results. The 95/50 CM limit for a 0.80 inch long (bounding contact length for rows 39 through 96) AVB wear scar is 52.4 percent TW, applying bobbin ETSS 96004.1. The deepest AVB wear depth (42 percent TW) is below this CM limit, thereby demonstrating margin to the SIPC.

For volumetric degradation such as tube wear, satisfying the SIPC will also satisfy the AILPC. For pressure loading of volumetric degradation that is predominantly axial in character with a circumferential extent that is less than 135 degrees (which is the case for AVB wear), the onset of pop-through and burst is coincident. Therefore, since the AVB wear passes SIPC at 3NOdP differential pressure, leakage integrity at lower accident differential pressures (MSLB) is also demonstrated. Therefore, CM is satisfied for both SIPC and AILPC.

4.2 Tube Support Plate Wear

During 1R19, tube wear degradation at TSP intersections was detected in 69 tubes in SGs 1-1, 1-2, 1-3, and 1-4. No TSP wear was detected in the prior ECT inspection in 1R16. Each trefoil broached TSP contains three lands, each about 0.1 inch wide, and these lands are in close contact to the tube surface thus providing a potential for tube wear during plant operation.

TSP wear was detected with a bobbin probe and reported as a distorted support indication (DSI). All DSI were then inspected with a +Point probe, using a TSP wear standard, to confirm if the bobbin DSI was tube wear, to depth size the wear per ETSS 96910.1, to determine if the wear was at multiple TSP lands, and to allow structural profiling (length and depth).

Table 3 provides a summary of TSP wear per SG. Table 5 provides a list of all tubes and indications with TSP wear, their location and percent TW depth reported by +Point, and identifies the plugged/stabilized tubes.

A total of 86 TSP wear indications in 69 tubes were reported by +Point. +Point confirmed 74 bobbin DSI as wear at TSP intersections, of which 9 TSP intersections had wear at multiple TSP lands (8 had wear at two TSP lands, and 1 had wear at all three TSP lands). In the course of collecting +Point data on the full U-bend lengths of tubes with AVB wear, two small (4 percent TW) TSP wear indications at TSP 8C were reported by +Point that were not detected by the bobbin probe.

Most of the TSP wear indications are located at upper TSPs (TSPs 5 through 8) and in outer periphery tubes. The deepest TSP wear indication was 12 percent TW. Most of the indications are less than or equal to 6 percent TW. None of the TSP wear indications exceeded the DCPP TS plugging criteria of 40 percent TW. However, because 6 of the 8 tubes that were plugged because of AVB wear indications also contained TSP wear indications, a total of 10 TSP wear indications in 6 tubes were plugged and stabilized. 76 TSP wear indications (in 63 tubes) were returned to service; the largest TSP wear indication returned to service was 11 percent TW.

CM is satisfied for TSP wear by applying the +Point results. The 95/50 CM limit for a 1.125 inch long TSP wear scar is 44.9 percent TW. The deepest TSP wear depth, 12 percent TW, is below this CM limit, thereby demonstrating margin to the SIPC.

For volumetric degradation such as tube wear, satisfying the SIPC will also satisfy the AILPC. For pressure loading of volumetric degradation that is predominantly axial in character with a circumferential extent that is less than 135 degrees (which is the case for TSP wear), the onset of pop-through and burst is coincident. Therefore, since the TSP wear passes SIPC at 3NOdP differential pressure, leakage integrity at lower accident differential pressures (MSLB) is also demonstrated. Therefore, CM is satisfied for both SIPC and AILPC.

4.3 Other Inspection Results

4.3.1 Proximity Indications

During the preservice inspection (PSI) of the DCPP Unit 1 SGs, 4 tubes with tube proximity signals were reported during the bobbin coil inspection. +Point examination was conducted in the PSI on these signals, which confirmed the signals, and no degradation was detected. These signals in the U-bend were attributed to the proximity of a given tube to another tube. Signals were reported in pairs of adjacent tubes in high rows in the same column at nearly the same axial location along the tube and are several inches in length. This confirms that the signal pairs were related to each other in that each tube contributed to the signal in the other.

DCPP Unit 2 SGs also have proximity signals. As discussed in PG&E letter DCL-10-149 dated November 24, 2010, "Response to NRC Request for Additional Information Regarding the 180-Day Steam Generator Report for Diablo Canyon Power Plant Unit 2 Fifteenth Refueling Outage," the logical cause of the proximity indications is a reduced tube-to-tube gap condition. A proximity signal can be generated on the bobbin coil if two tubes experience such a condition. A potential cause of a reduced tube-to-tube gap condition is manufacturing tolerances on a tube-to-tube basis, such as tolerances on U-bend profile and tube overall height. A tolerance stack-up indicates that a reduced gap may occur but tube-to-tube contact is not possible. Manufacturing tolerances on the U-bend profile are slightly larger in higher radius U-bend tubes.

During 1R16 and 1R19, the existing PRO indications from PSI were examined with bobbin coil and the PRO signals were again identified. Single coil +Point inspections were conducted on these PRO locations in 1R16 and 1R19, and no degradation was detected. Because no degradation was detected by +Point probe, and since there is no active degradation mechanism in tubes that have the proximity condition, CM is inherently met.

4.3.2 Channel Head Inspection Results

Visual exams of each channel head were conducted and recorded in support of NSAL-12-1 recommendations to perform a channel head bowl scan in a dry condition (during plant shutdown) of the low lying areas (e.g., areas where a pool of primary water with concentrated boric acid could remain in the drained SGs) of both the hot and cold legs of the inside surface of the channel head. Areas of the inspection included the channel head cladding and the divider plate-to-channel head weld. (Note: There is no drain tube in the channel head in these replacement SGs.) No areas of defects or unusual discolorations were noted.

5.0 Assessment of SG Secondary Side Integrity

The EPRI SGIAGL contains the following CM requirements with respect to secondary side integrity: CM shall include aspects of the secondary side inspection that affect tube integrity such as secondary side inspections performed, foreign material removed, and foreign material remaining in the SGs.

The following describes the 1R19 SG top of tubesheet secondary side cleaning, top of tubesheet visual inspections including FOSAR, and results achieved. The handhole covers (4) on each SG were removed to facilitate this maintenance. The secondary manways were not removed and no upper internals inspections were conducted.

5.1 Pre-Lance Visual Inspection

In all SGs, a pre-sludge lance visual inspection was performed to determine the as-found conditions at the TTS. Pre-lance inspections consisted of video probe inspections of the no tube lane, periphery trough, and selected in-bundle locations.

With regard to the as-found conditions, all four SGs were clean except for nearly-identical sludge piles on all four hot leg tubesheets, in the region of column 62 to column 68 and from approximately row 29 to approximately row 37. One small wire (0.016 inch diameter, 1.5 inch long in curled position) was discovered during the pre-lance exam of SG 1-4. The object was removed immediately after it was identified. The bounding tubes were programmed for +Point inspection. +Point examination of these bounding tubes revealed no indications of wear.

5.2 Sludge Lancing

Sludge lancing was performed in each SG after the pre-lance visual exams. 23 pounds of sludge was removed from the top of the tubesheet (5, 8, 4, and 6 lbs of sludge removed from SG 1 through 4, respectively).

5.3 FOSAR Exam

After sludge lancing in each SG, a FOSAR exam was performed. The post-lance inspection consisted of video probe inspections of the no tube lane and selected in-bundle locations, and a periphery inspection using a crawler with integrated camera. The sludge pile areas noted in the pre-lance visual exams were removed from between all columns.

One small wire (0.007 inch diameter, 0.6 inch long in curled position) was discovered during the post-lance exam of SG 1-4. The object was removed immediately after it was identified.

5.4 Foreign Material in Sludge Lance Filter Strainer

Foreign material that was collected in the sludge lance filter strainer was assessed. Each strainer contents had some minor debris including some small pieces of perforated gasket metal (stainless steel), some flexible

strapping/backing pieces, and a small number of machining remnants/curls and weld slag. All foreign material was of small dimension and insignificant mass.

5.5 Assessment

The small dimensions of the foreign material found in the sludge lance strainer and observed during tubesheet visual exams is similar to foreign material observed in previous SG visual exams. The foreign material likely originated from upstream systems and entered the SGs through the 0.27 inch diameter holes in the feedring spray nozzles. None of the foreign material found in the strainers and in the tubesheet visual exams is capable of causing SG tube wear because of their small mass and small dimensions; these dimensions are bounded by previous Westinghouse loose parts evaluations.

No tube wear from loose parts was detected during 100 percent bobbin SG tube eddy current inspections in 1R19, thus validating this conclusion. Primary analysis (manual) and Secondary analysis (automated) analyzed the bobbin low frequency data for PLPs and for loose part tube wear, as part of the regular analysis process. (Note: Bobbin analysis resulted in one PLP indication in the U-bend region of SG 1-1 R96 C54 at AV3; subsequent +Point exam of the area detected no degradation, with no further action required.) Designated analysts on the primary analysis team also performed a separate in-depth PLP analysis in the three outer peripheral tubes, which are subject to high secondary water fluid velocity and are typically the most susceptible to flow induced foreign object wear. Also, the top of tubesheet signals in all tubes were examined using a “turbo mix” designed to detect potential loose part wear that could be missed by the normal analysis process.

Tube wear continues to be a non-relevant tube degradation mechanism for the DCPP SGs.

In conclusion, CM for secondary side integrity was satisfied.

6.0 Conclusions

SG tube ECT, tubesheet cleaning and inspections, and channel head visual inspections were conducted in 1R19. The CM assessment concludes that, based on the results of the 1R19 inspections, none of the SG performance criteria were exceeded since the last SG ECT inspection in 1R16.

Table 1
Pertinent DCPP SG Design Features

SG Designer	Westinghouse
SG Model Number	Westinghouse Delta 54 (W-D54)
SG Fabricator	ENSA
SG Tube Manufacturer	Sandvik
Tube Material	Alloy I-690 Thermally Treated
Number of Tubes per SG	4444
Tube Outside Diameter (in)	0.75
Tube Nominal Wall Thickness (in)	0.043
Tube Pattern	Triangular / 96 Rows, 119 Columns
Tube Pitch	1.144 / Triangular
Number of TSPs	8
TSP Material	Type 405 SS
TSP Thickness (in)	1.125
TSP Design	Trefoil broached holes
TSP Flow Design Characteristics	In the no tube lane, TSPs 1 through 7 have flow slots and TSP 8 has flow holes.
U-bend Support Design	"V" Shaped AVBs
Number of AVBs	3 sets
Tube Rows Supported by AVBs	Rows 8 through 96 (one AVB set) Rows 22 through 96 (two AVB sets) Rows 43 through 96 (three AVB sets)
AVB Material	Type 405 SS
Tubesheet Thickness (in)	23.55 (includes 0.30 inch cladding)
Tube Expansion Process	Full depth hydraulically expanded. Tube end tack expanded using urethane plug expansion process. Tube ends are sealed with a flush autogenous weld which is analyzed for pressure boundary in accordance with ASME Code Section III NB-3000 stress analysis.
U-bend minimum radius (in)	3.25 (Row 1)
Stress Relieved Tubes	Rows 1 through 16 were full-length stress relieved following bending.

Table 2
AVB Wear Summary per SG

Number	SG 1-1	SG 1-2	SG 1-3	SG 1-4	Total
AVB Wear Indications – percent TW Bobbin calls confirmed by Plus Point	12	21	6	0	39
AVB Wear Indications - Plus Point that are NDD by Bobbin	3	6	0	0	9
AVB Wear Indications - Double Sided by Plus Point	5	8	1	0	14
AVB Wear Indications - Total Plus Point	20	35	7	0	62
AVB Wear Tubes Affected	6	7	2	0	15
AVB Wear Indications, Plus Point - Plugged	11	30	7	0	48
AVB Wear Tubes Plugged	1	5	2	0	8
AVB Wear Indications, Plus Point - Returned to Service	9	5	0	0	14
Tubes Returned to Service with AVB Wear Indications	5	2	0	0	7

Table 3
TSP Wear Summary per SG

Number	SG 1-1	SG 1-2	SG 1-3	SG 1-4	Total
TSP Wear Indications - DSI Bobbin calls confirmed by Plus Point	4	16	37	17	74
TSP Wear Indications - Plus Point that are NDD by Bobbin	2	0	0	0	2
TSP Wear Indications - Additional TSP Lands by Plus Point	1	3	6	0	10
TSP Wear Indications - Total Plus Point	7	19	43	17	86
TSP Wear Tubes Affected	6	15	33	15	69
TSP Wear Indications Plugged	2	7	1	0	10
TSP Wear Tubes Plugged	1	4	1	0	6
TSP Wear Indications, Plus Point - Returned to Service	5	12	42	17	76
Tubes Returned to Service with TSP Wear Indications	5	11	32	15	63

Table 4
1R19 SG Tube Locations with Wear at Antivibration Bar Intersections

SG	ROW	COL	AVB	%TW Bobbin	Plugged and Stabilized?	Not detected by Bobbin?	Double Sided?	Tube Count
11	78	66	AV4	6				1
11	83	57	AV2	6		Yes		2
11	83	57	AV5	10				
11	86	56	AV4	5				3
11	86	56	AV5	6		Yes		
11	87	45	AV3	6				4
11	93	55	AV1	5	Yes			5
11	93	55	AV2	14	Yes		Yes	
11	93	55	AV3	32	Yes		Yes	
11	93	55	AV4	39	Yes		Yes	
11	93	55	AV5	38	Yes		Yes	
11	93	55	AV6	29	Yes		Yes	
11	95	53	AV3	5		Yes		6
11	95	53	AV4	8				
11	95	53	AV5	8				
12	72	64	AV2	6				7
12	86	58	AV2	9	Yes			8
12	86	58	AV3	16	Yes			
12	86	58	AV4	19	Yes			
12	86	58	AV5	7	Yes			
12	86	58	AV6	7	Yes			
12	87	47	AV5	24	Yes			9
12	87	47	AV6	18	Yes		Yes	
12	89	79	AV2	3		Yes		10
12	89	79	AV3	4		Yes		
12	89	79	AV4	5				
12	89	79	AV6	9		Yes		
12	92	64	AV2	7	Yes			11
12	92	64	AV3	35	Yes		Yes	
12	92	64	AV4	42	Yes		Yes	
12	92	64	AV5	32	Yes		Yes	
12	92	64	AV6	10	Yes			
12	92	72	AV2	14	Yes			12
12	92	72	AV3	22	Yes			
12	92	72	AV4	8	Yes	Yes		
12	92	72	AV5	4	Yes	Yes		

SG	ROW	COL	AVB	%TW Bobbin	Plugged and Stabilized?	Not detected by Bobbin?	Double Sided?	Tube Count
12	96	66	AV1	4	Yes	Yes		
12	96	66	AV2	10	Yes			13
12	96	66	AV3	32	Yes		Yes	
12	96	66	AV4	39	Yes		Yes	
12	96	66	AV5	39	Yes		Yes	
12	96	66	AV6	13	Yes		Yes	
13	93	67	AV3	33	Yes			14
13	93	67	AV4	26	Yes			
13	95	57	AV2	22	Yes			15
13	95	57	AV3	42	Yes			
13	95	57	AV4	37	Yes		Yes	
13	95	57	AV5	25	Yes			

Note: %TW depth is from bobbin. If bobbin was NDD, %TW depth is from +Point.

Table 5
1R19 SG Tube Locations with Wear at Tube Support Plate Intersections

SG	ROW	COL	TSP	%TW +Point	Plugged and Stabilized?	Not detected by Bobbin?	Wear at multiple TSP Lands?	Tube Count
11	29	5	7C	8				1
11	74	22	6C	6				2
11	78	66	8C	4		Yes		3
11	83	57	8C	4		Yes		4
11	93	55	8C	12	Yes, due to AVB Wear		Yes	5
11	93	55	8C	6	Yes, due to AVB Wear		Yes	
11	95	73	6H	6				6
12	23	25	6C	5				7
12	54	12	7C	8				8
12	54	12	8C	3				
12	60	18	6H	4				9
12	66	18	6H	7				10
12	75	23	6H	5				11
12	79	79	5C	3				12
12	82	52	4H	5				13
12	84	82	6H	5				14
12	86	58	8C	10	Yes, due to AVB Wear		Yes	15
12	86	58	8C	6	Yes, due to AVB Wear		Yes	
12	87	47	8C	9	Yes, due to AVB Wear		Yes	16
12	87	47	8C	6	Yes, due to AVB Wear		Yes	
12	87	47	8C	4	Yes, due to AVB Wear		Yes	
12	88	38	5H	7				17
12	92	44	5H	8				18
12	92	62	5C	3				19
12	92	72	8C	4	Yes, due to AVB Wear			20
12	96	66	8C	3	Yes, due to AVB Wear			21
13	3	3	7C	7				22
13	8	118	5C	9				23
13	8	118	6C	6			Yes	
13	8	118	6C	7			Yes	
13	38	12	6H	7				24
13	49	23	6H	5				25
13	52	12	6H	4				26
13	55	15	6C	5				27
13	56	16	6C	3				28
13	56	100	6H	4				29
13	56	104	6H	8				30

SG	ROW	COL	TSP	%TW +Point	Plugged and Stabilized?	Not detected by Bobbin?	Wear at multiple TSP Lands?	Tube Count
13	57	107	6C	7				31
13	58	22	6C	5				32
13	60	26	6H	6				33
13	63	23	6C	6				34
13	63	29	7C	6				35
13	66	20	6C	5				36
13	66	64	7C	6				37
13	69	19	6H	5				38
13	71	27	6H	9				39
13	74	38	8C	4			Yes	40
13	74	38	8C	4			Yes	
13	76	96	8H	10				41
13	79	93	6C	5				42
13	86	34	3H	5				43
13	86	34	6H	11				
13	87	39	6C	5				44
13	87	55	6H	4				45
13	87	67	6C	5				46
13	88	38	6C	5				47
13	89	51	6C	4			Yes	48
13	89	51	6C	4			Yes	
13	89	53	6C	6				49
13	89	67	6C	7				50
13	93	67	7H	7	Yes, due to AVB Wear			51
13	95	67	6C	8			Yes	52
13	95	67	6C	6			Yes	
13	95	67	7C	6				
13	96	52	6C	5			Yes	53
13	96	52	6C	5			Yes	
13	96	56	7H	5				54
13	96	56	6C	5			Yes	
13	96	56	6C	4			Yes	
14	4	14	6H	5				55
14	5	1	6H	6				56
14	12	8	4H	5				57
14	25	11	5C	6				58
14	28	102	5C	5				59
14	32	22	5C	5				60
14	52	12	5C	6				61
14	67	99	5C	4				62

SG	ROW	COL	TSP	%TW +Point	Plugged and Stabilized?	Not detected by Bobbin?	Wear at multiple TSP Lands?	Tube Count
14	68	20	7C	6				63
14	72	58	6H	5				64
14	73	25	5H	4				65
14	74	24	5C	4				66
14	77	25	5H	6				67
14	81	29	4H	6				68
14	81	29	6H	7				
14	95	67	5H	6				69
14	95	67	6H	6				

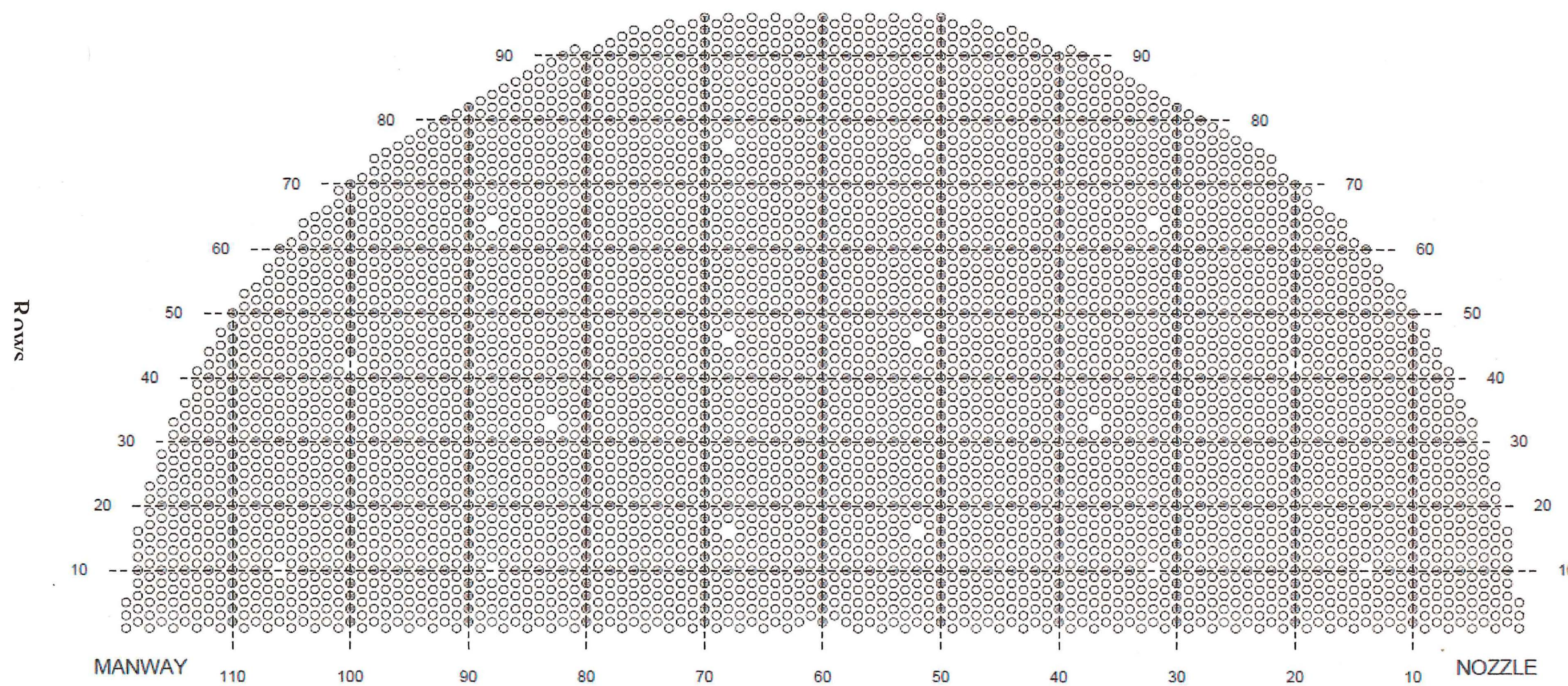
Table 6
CM Limits for DCPP Unit 1 SGs
Axially Oriented Thinning with Limited Circumferential Extent

Flaw Length	Applicability	ETSS 96004.1 (Bobbin)	ETSS 96910.1 (+Point)	ETSS 10908.4 (+Point)
0.8"	AVB Rows 39 Thru 96	53.5%TW	N/A	52.4%TW
1.125"	Tube Support Plates	51.9%TW	44.9%TW	N/A
1.5"	AVB Rows 8 Thru 38	50.9%TW	N/A	50.1%TW

Notes:

- The AVB contact length varies with the tube row based on the geometry of the AVB/tube. The contact length decreases as the tube row increases. The bounding contact length for rows 8 through 38 is 1.5 inches, and the bounding contact length for rows 39 through 96 is 0.8 inches.
- The bounding TSP contact length of 1.125 inch (width of the TSP) is the same for every tube row.
- For 1R19 depth sizing of TSP wear, +Point (96910.1) was applied for CM. Bobbin (96004.1) was not applied.
- For 1R19 depth sizing of single sided and double sided AVB wear, bobbin (96004.1) was applied for CM. For 1R19 depth sizing of AVB wear not detected by bobbin, +Point (10908.4) was applied for CM.
- CM Limit reflects material strength, burst relation, and NDE sizing uncertainties.

Figure 1
DCPP Unit 1 and 2 Westinghouse Delta 54 Steam Generator Tubesheet Map



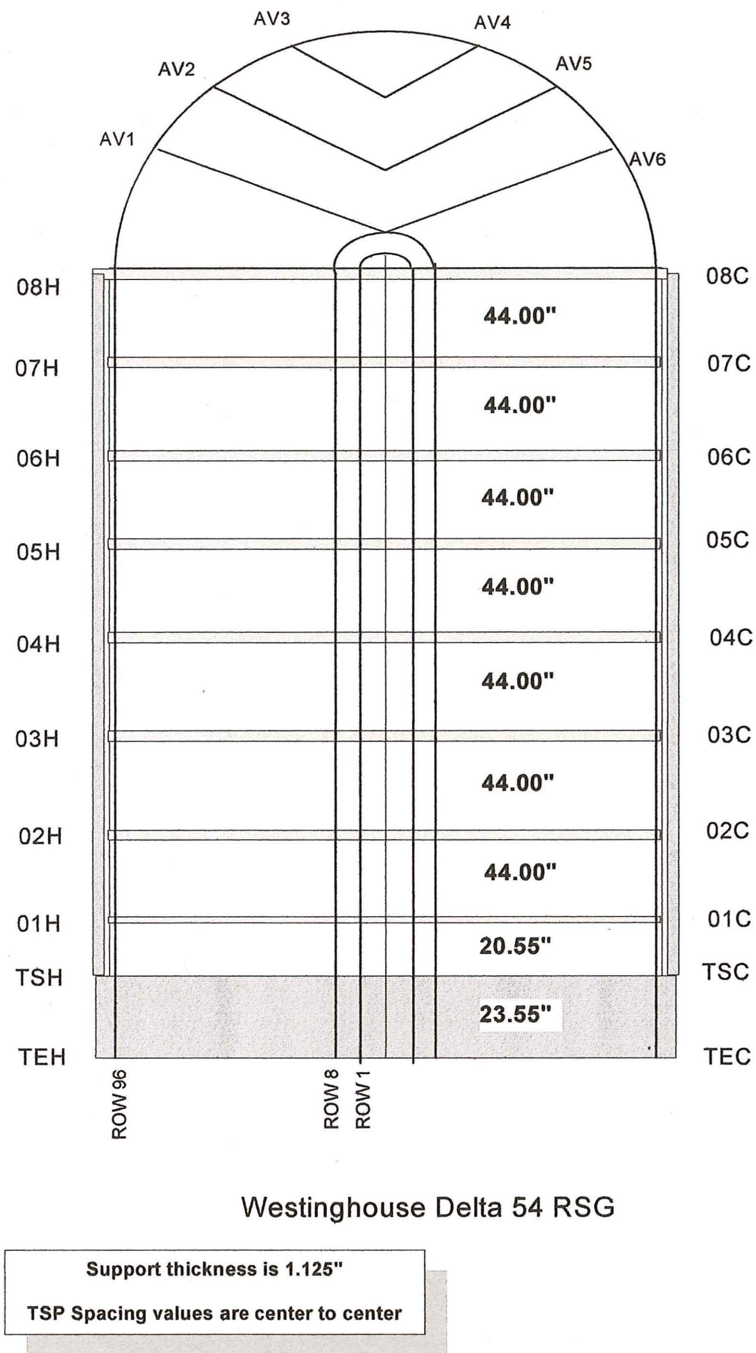


Figure 2
Sketch of DCPP Unit 1 and 2 Westinghouse Delta 54 Steam Generator