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**Fred Dacimo**
Site Vice President
Administration

June 14, 2006

Re: Indian Point Unit No. 2
Docket No. 50-247
NL-06-067

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Stop O-P1-17
Washington, DC 20555-0001

**Subject:** **Steam Generator Examination Program Results**
**2006 Refueling Outage (2R17)**

Reference: Entergy letter NL-06-008 to NRC, "Proposed Steam Generator Examination Program – 2006 Refueling Outage (2R17)," dated February 13, 2006

Dear Sir or Madam:

Enclosed as Attachment 1 is a report of the results of the Indian Point Unit 2 Steam Generator Examination Program conducted during the 2006 refueling outage (designated as 2R17), submitted pursuant to Technical Specification 5.5.7.f.2. Attachment 2 provides Steam Generator Design Information.

No new regulatory commitments are being made by Entergy in this correspondence.

Should you or your staff have any questions regarding this matter, please contact Mr. Patric W. Conroy, Manager, Licensing at (914) 734-6668.

Sincerely,

Fred Dacimo
Site Vice President
Indian Point Energy Center

cc: Next page

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Attachment 1: Steam Generator Examination Program Results, 2006 Refueling Outage (2R17)

Attachment 2: Steam Generator Design Information

cc: Mr. Samuel J. Collins, Regional Administrator, NRC Region I
Mr. John P. Boska, Senior Project Manager, NRC NRR DORL
NRC Resident Inspectors Office, Indian Point Energy Center
Mr. Paul Eddy, New York State Department of Public Service
Mr. Peter R. Smith, NYSERDA

ATTACHMENT 1 TO NL-06-067

Steam Generator Examination Program Results
2006 Refueling Outage (2R17)

Entergy Nuclear Operations, Inc.
Indian Point Unit No. 2
Docket No. 50-247

# Steam Generator Examination Program Results
# 2006 Refueling Outage (2R17)

## 1.0 Examination Program Description

Details of the Indian Point Unit 2 steam generator examination program to be conducted during the 2R17 refueling outage were submitted to the NRC via Entergy letter NL-06-008 dated February 13, 2006. The examination scope is described in Section 2 below. The results and conclusions of the full examination scope are provided in Sections 3 and 4 respectively.

## 2.0 Examination Scope

### a. Steam Generator Tube Primary Side Eddy Current Examination

The Indian Point Unit 2 2R17 steam generator eddy current inspection was the second inservice inspection for the replacement steam generators, which were installed in December of 2000. See Table 5 for eddy current data acronyms.

The inspection program consisted of the following:

1) 50% Bobbin all four SGs full length except rows 1 & 2
2) 50% Bobbin all four SGs straight lengths hot and cold legs rows 1 & 2
3) 50% Rotating Pancake Coil (RPC) of U-Bend all four SGs Rows 1 & 2
4) RPC of tubes at top of tubesheet (TTS) $\pm$3" in all four SGs:
   - 20% patterned sample of hot leg TTS ( $\pm$3") in all four SGs
   - Three tubes in from the annulus on the hot leg not covered in the 20% sample above. Purpose was for possible loose part (PLP) identification and loose part wear
   - All row 1 & 2 tubes on the hot leg not covered in criteria 2 & 3 above. Purpose was for PLP identification and loose part wear
   - Three tubes in from the annulus on the cold leg. Purpose was for PLP identification and loose part wear
   - All row 1 & 2 tubes on the cold leg not covered in the criteria above: Purpose was for PLP identification and loose part wear
5) RPC of selected dents/dings in the hot leg straight sections
   - 100% of dents/dings $\geq$5 volts identified in 2R15
   - 20% sample of dents/dings $\geq$2 volts and <5 volts identified in 2R15
   - Any new dents/dings $\geq$2 volts identified in 2R17
6) RPC of selected indications in hot leg tubesheet:
   - 20% sample of OXP, BLG and DNT indications
7) Special Interest Examinations:
   - Special interest exams of abnormal indications

b. Secondary Side Examination

The secondary side inspection program consisted of the following:

1) Sludge lanced the top of the tubesheet in all four SGs and the flow distribution baffle in 23 & 24 steam generators.
2) Performed foreign object search and retrieval (FOSAR) in all four SGs (annulus and tube bundle) post sludge lancing
3) Performed TTS in-bundle visual inspection of approximately every 5$^{th}$ column of both hot and cold legs in all four SGs post sludge lancing
4) Visually inspected the Top Support Plate ("G" plate) in 23 & 24 SGs including:
   - The underside of the tube U-bends
   - The top of the plate the full length of the tube lane
   - The length of 11 columns on both hot and cold legs from the tube lane to the wrapper

3.0 2006 Examination Results

a. Steam Generator Tube Primary Side Eddy Current Examination

Inspection Results - Overall Summary

The only degradation detected during 2R17 was Anti-Vibration Bar (AVB) wear. There were 55 AVB wear indications in 23 tubes. All of the indications were new. Entergy administratively plugged all 7 tubes found with AVB wear indications $\geq$ 20% TW (through wall). The deepest indication was 28% TW. No crack-like indications were found in 2R17.

There were thirteen tubes identified with permeability variations (PVN). These tubes remain in service since no evidence of degradation has been identified in the area of interest in other tubes. Therefore, it is believed the PVN indications are not masking degradation.

The steam generator inspections were performed in accordance with Revision 6 of the EPRI PWR Steam Generator Examination Guidelines and the Indian Point 2 Steam Generator Program.

Table 1 summarizes the overall inspection results.

Inspection Results - Possible Loose Part Indications

No wear was found in any tubes with Possible Loose Part (PLP) indications. All PLP calls reported during the 2R17 inspections were detected by the Plus Point Rotating Pancake Coil (+PT RPC) and all were reported at or near the top of the tube sheet. All tubes adjacent to PLP calls were tested with +PT RPC to bound all PLP indications.

All PLP calls reported from eddy current were visually checked on the secondary side. Attempts were made to retrieve potential loose parts from locations identified with eddy current data. In many cases retrieval was successful; however, in other cases the part broke into pieces or was not found at the designated location. Any part found but not retrieved or that was unable to be retrieved was bounded by prior analysis based on mass, size and location. None of the PLP locations showed any sign of tube wear from +PT RPC testing.

Table 2 summarizes all PLP calls in the database.

Inspection Results - Tubes Plugged

A total of 7 tubes were administratively plugged during the 2R17 inspection with Westinghouse (W) mechanical plugs fabricated from Alloy 690. All 7 tubes were plugged due to AVB wear. None of the tubes plugged met EPRI Revision 6 criteria for requiring repair. No crack-like indications were reported.

The qualified bobbin sizing standard contains only single sided wear. The largest bobbin indication at an AVB location was 28% which was tested with +PT RPC and confirmed as single sided wear. Therefore, the qualified bobbin sizing technique that was used estimated the 28% call properly.

Based on engineering evaluation, it was determined that tube stabilization was not required for the 7 tubes plugged in 2R17 for AVB wear. The engineering evaluation also determined that the 13 tubes previously plugged for AVB wear in 2R15 do not require tube stabilization.

Table 3 summarizes the AVB wear and tubes plugged in RF17.

b. Secondary Side Examination Results

Visual inspections and Foreign Object Search and Retrieval (FOSAR) procedures were conducted in all four SGs around the annulus and within the tube bundle during 2R17. Additionally, approximately every fifth column was inspected for cleanliness in all four SGs following sludge lancing. The presence of any foreign objects seen during the in-bundle inspections was documented as well. There was no evidence of tube wear attributable to foreign objects. Any part found but not retrieved or that was unable to be retrieved was bounded by prior analysis based on mass, size and location.

## 4.0 Conclusions

This report provides a summary of the Indian Point Unit 2 steam generator tube integrity condition as determined during the 2R17 refueling outage by NDE inspection and a projection by analysis of the tube integrity until the next planned steam generator inspection. The next inspection is planned for 2R19, which is following the completion of two fuel cycles. All of the activities reported herein have been conducted in accordance with NEI 97-06 Revision 2 and associated guidelines.

The 2R17 refueling outage represents the end of the third fuel cycle after steam generator replacement, consequently, all four steam generators were inspected. A Condition Monitoring assessment was performed, on a defect-specific basis, to demonstrate compliance with integrity criteria by the comparison of 2R17 NDE measurements with calculated burst and leakage integrity limits. Calculated integrity limits, including consideration for appropriate uncertainties, burst and leak analytical correlations, material properties, NDE technique, and analyst uncertainties were provided in the degradation assessment report. All indications in this inspection were below the calculated integrity limits and, therefore, met integrity requirements without further testing. Based upon the inspection results, all four steam generators were found to be in compliance with Condition Monitoring requirements.

The 2R17 steam generator tube inservice examination demonstrates that the Indian Point Unit 2 steam generators are acceptable for continued service at full power. A Condition Monitoring Assessment performed for Indian Point Unit 2 has established that the end of cycle structural and leakage integrity of the steam generator tubing has been met.

An Operational Assessment for an assumed inspection interval of 3.7 EFPY covering Cycles 18 and 19 concluded that the steam generator tube structural and leakage integrity will be maintained until the next planned steam generator inspection in 2R19.

**Table 1**
**Inspection Results - Overall Summary**

| Identification Code | SG21 | SG22 | SG23 | SG24 |
|---|---|---|---|---|
| Final "I" Codes | 0 | 0 | 0 | 0 |
| >=20% | 2 | 2 | 0 | 3 |
| PCT | 9 | 13 | 14 | 19 |
| PVN | 5 | 2 | 5 | 4 |
| DNT | 58 | 7 | 39 | 11 |
| DNG | 70 | 47 | 32 | 30 |
| DNR | 26 | 5 | 23 | 1 |
| BLG | 265 | 1 | 130 | 369 |
| FSD | 221 | 248 | 155 | 131 |
| FSA | 55 | 72 | 33 | 72 |
| PLP | 13 | 4 | 0 | 7 |
| INR | 114 | 54 | 73 | 139 |
| Bobbin "S" Codes | 1 | 0 | 0 | 2 |
| NDD | 3273 | 3520 | 3382 | 3247 |
| **Bobbin Coil Results** | | | | |
| Tubes with Indications <20% | 4 | 5 | 6 | 8 |
| Tubes with Indications 20-39% | 2 | 2 | 0 | 3 |
| Tubes with Indications ≥40% | 0 | 0 | 0 | 0 |
| Tubes with Bobbin "I" Codes | 0 | 0 | 0 | 0 |
| Tubes with 3-Letter Codes | 463 | 267 | 336 | 457 |
| **+Point Inspection Results** | | | | |
| Number of Flaws | 0 | 0 | 0 | 0 |
| Number of Tubes with Flaws | 0 | 0 | 0 | 0 |
| **Tube Repair and Engineering Evaluation** | | | | |
| Tubes Requiring Condition Monitoring Review | 0 | 0 | 0 | 0 |
| Tubes Requiring In-Situ Testing | 0 | 0 | 0 | 0 |
| Tubes Plugged | 2 | 2 | 0 | 3 |

**Table 2**
**Summary of Possible Loose Part (PLP)**

| | SG21 | SG22 | SG23 | SG24 |
|---|---|---|---|---|
| PLP Indications | 13 | 4 | 0 | 7 |

**Table 3**
**AVB Wear Identified in 2R17**

| SG | Tube Row | Tube Column | AV1 %TW | AV2 %TW | AV3 %TW | AV4 %TW | Tube Status |
|---|---|---|---|---|---|---|---|
| 21 | 39 | 35 | NR | 21 | NR | 17 | Plugged |
| | 33 | 46 | 15 | NR | NR | NR | In-Service |
| | 34 | 60 | 13 | 13 | NR | 16 | In-Service |
| | 37 | 60 | 16 | 20 | 16 | NR | Plugged |
| 22 | 34 | 43 | NR | 20 | 15 | NR | Plugged |
| | 36 | 44 | 14 | 15, 16* | NR | NR | In-Service |
| | 23 | 54 | 13 | 11 | 13 | 18 | In-Service |
| | 40 | 59 | 13 | 15 | 25 | NR | Plugged |
| | 30 | 67 | NR | 11 | NR | NR | In-Service |
| 23 | 37 | 39 | 13 | 16 | 19 | NR | In-Service |
| | 41 | 40 | NR | 18 | 14 | 15 | In-Service |
| | 39 | 56 | 15 | NR | 16 | NR | In-Service |
| | 40 | 58 | NR | 16 | 15 | NR | In-Service |
| | 34 | 64 | 14 | NR | 16 | 13 | In-Service |
| | 41 | 64 | NR | 13 | NR | NR | In-Service |
| 24 | 38 | 57 | 22 | 25 | 28 | 16 | Plugged |
| | 33 | 63 | NR | 15 | 11 | NR | In-Service |
| | 33 | 64 | NR | NR | 15 | 14 | In-Service |
| | 38 | 64 | NR | 25 | 16 | NR | Plugged |
| | 33 | 71 | 12 | 15 | 14 | NR | In-Service |
| | 35 | 71 | NR | 16 | 23 | NR | Plugged |
| | 36 | 71 | 14 | 15 | 11 | NR | In-Service |
| | 35 | 73 | NR | NR | 12 | NR | In-Service |

NOTES: all wear identified in 2R17 is new wear; all wear identified during the previous inspection was plugged; NR represents no recorded wear; * represents two separate indications

**Table 4**
**Summary of Tubes Plugged**

| Year | Outage | SG21 | SG22 | SG23 | SG24 | Total |
|---|---|---|---|---|---|---|
| 1988 | Fabrication | 0 | 0 | 0 | 2 | 2 |
| 2000 | Pre-service | 0 | 0 | 0 | 0 | 0 |
| 2002 | 2R15 | 8 | 1 | 3 | 4 | 16 |
| 2004 | 2R16 | 0 | 0 | 0 | 0 | 0 |
| 2006 | 2R17 | 2 | 2 | 0 | 3 | 7 |
| **Total Plugged** | | 10 | 3 | 3 | 9 | 25 |
| **Percent Plugged** | | 0.31% | 0.09% | 0.09% | 0.28% | 0.19% |

Notes:
All tubes were plugged on both the hot and cold legs.
All tubes plugged in 2002 and 2006 used Westinghouse (W) mechanical plug fabricated from thermally treated Alloy 690.
All tubes plugged during fabrication used (W) welded plug fabricated from thermally treated Alloy 690.
There were no steam generator inspections in 2004 during 2R16.

**Table 5**
**Eddy Current Data Acronyms**

| 3-Letter Code | Description |
|---|---|
| **BLG** | Bulge |
| **DNG** | Ding |
| **DNR** | Ding With Rotation |
| **DNT** | Dent |
| **FSA** | Freespan Absolute Signal |
| **FSD** | Freespan Differential Signal |
| **INR** | Indication Not Reportable |
| **NDD** | No Detectable Degradation |
| **OXP** | Overexpansion |
| **PCT** | AVB wear detected by bobbin |
| **PLP** | Possible Loose Part |
| **PVN** | Permeability Variation |

**TABLE 5 NOTE**: Ding with Rotation (DNR) is a reporting code used by resolution analysts only to describe a signal which reads 1% or greater on the 200 and 100 kHz differential bobbin channels and is less than 3.0 volts. These signals are originally reported as FSD (Freespan Differential) or FSA (Freespan absolute) signal. The resolution analyst performs a history review of the signal in the baseline data to determine if there is a change of 10 degrees or 0.5 volts. If there is, but the signal in baseline was a ding signal, the resolution analyst will report as DNR.

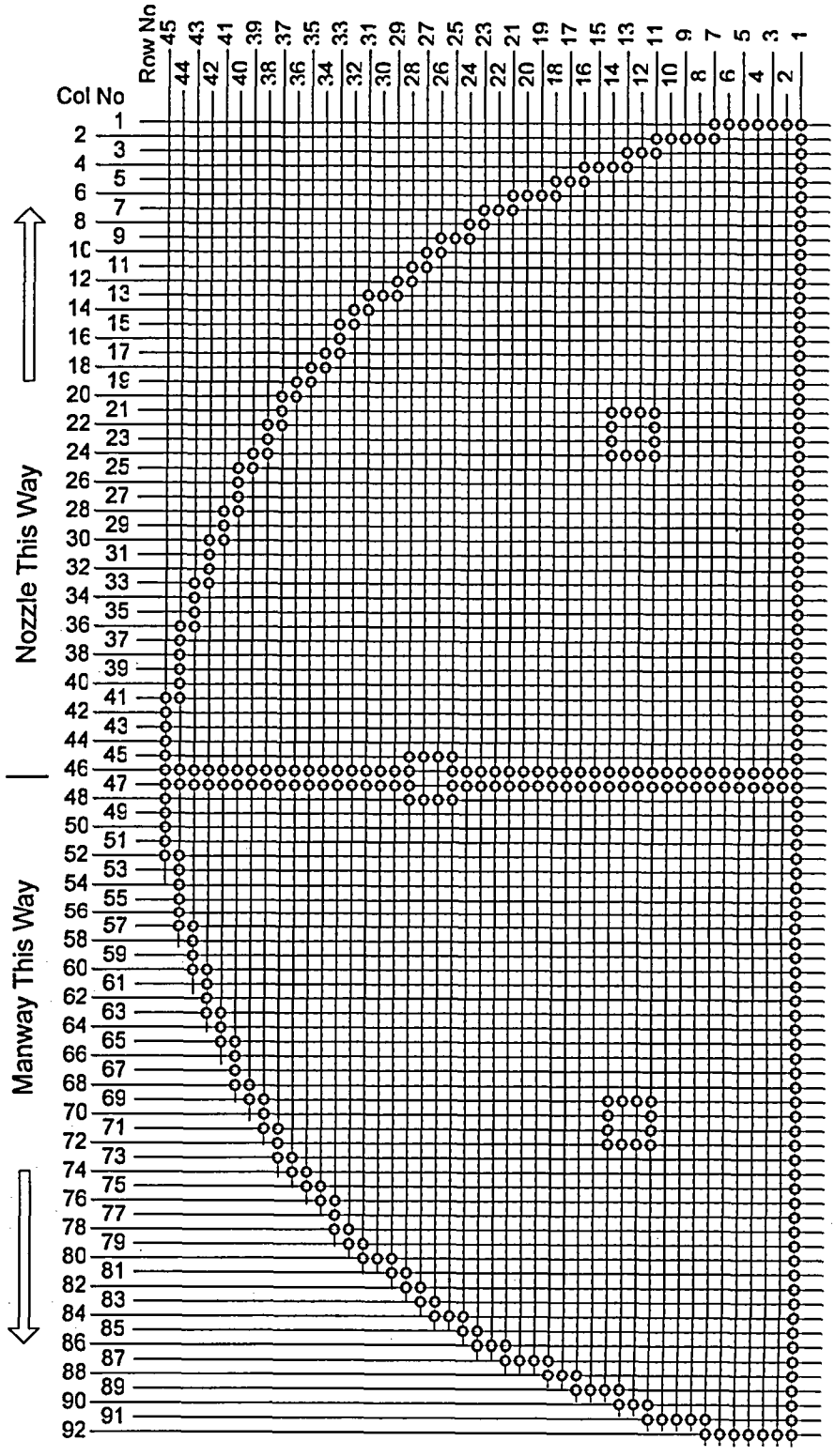
These signals which are associated with the tube loading process during manufacture are well documented to be a benign condition which occurs in plants with thermally treated Alloy 600 tubing. During the tube loading, the tube is wiggled from side to side. As the tube is wiggled, contact is made with the land corners of the quatrefoil support plate, causing small depressions or dings in the tube. Signals of this type can be observed at any point in the straight length of the tube up to and including the tangent point. These signals, normally close to the ding-like phase plane on channel 1 (160-185 degrees), are known to rotate more into the flaw plane after the plant begins operation, the fastest rotation usually occurring after the first inservice inspection.

ATTACHMENT 2 TO NL-06-067

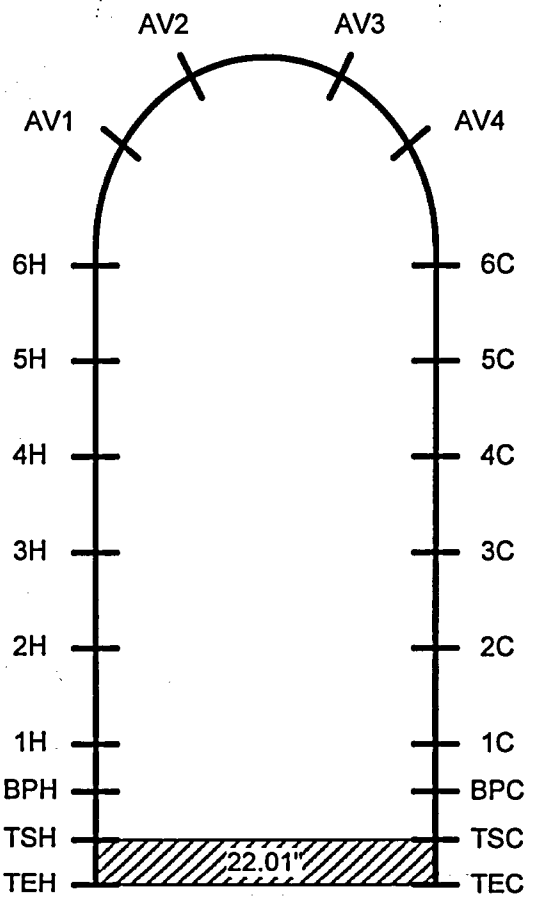
Steam Generator Design Information

Entergy Nuclear Operations, Inc.
Indian Point Unit No. 2
Docket No. 50-247

## Indian Point 2 Steam Generator Tubesheet Map



**Indian Point 2**
**Steam Generator Tube**
**Support Landmarks**




Westinghouse Model 44F
Steam Generator

**Legend**

AV = Anti-Vibration Bar (AVB)
C = cold leg
H = hot leg
# = support plate (TSP)
BP = baffle plate (FDB)
TS = tubesheet
TE = tube end