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ATTN: Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT:
Beaver Valley Power Station, Unit No. 2
Docket No. 50-412, License No. NPF-73
Steam Generator Tube Inspection Report – Technical Specification 5.6.6.2.4

In accordance with Technical Specification 5.6.6.2.4, FirstEnergy Nuclear Operating Company hereby submits a report containing tube inspection results for Beaver Valley Power Station, Unit No. 2, steam generators. The enclosed report provides information required by the technical specification that was obtained during inspections conducted during the spring 2011 refueling outage.

There are no regulatory commitments contained in this letter. If there are any questions or if additional information is required, please contact Mr. Thomas A. Lentz, Manager – Fleet Licensing, at (330) 761-6071.

Sincerely,

Paul A. Harden

Enclosure:
Unit #2 – 2R15 Steam Generator F* (F Star) Report

cc: NRC Region I Administrator
NRC Resident Inspector
NRC Project Manager
Director BRP/DEP
Site BRP/DEP Representative

# FIRST ENERGY NUCLEAR OPERATING COMPANY

Technical Services Engineering Department
Nuclear Engineering Programs Section

**Issue Date:** May 13, 2011

**Subject:** Unit #2 - 2R15 Steam Generator F* (F Star) Report

Prepared by: Gary Alberti Date: 05/13/11
SG Program Owner

Reviewed by: Jeff Severyn Date: 05/13/11
Supervisor, Nuclear Programs

Approved by: Doug Reeves Date: 5/13/11
Manager, Technical Services

# UNIT #2 - 2R15 STEAM GENERATOR F* (F STAR) REPORT

Pursuant to Specification 5.6.6.2.4 of the Technical Specifications, the following information is to be transmitted to the NRC within 90 days after entering MODE 4 following an outage in which the F* (F Star) methodology was implemented. For 2R15, MODE 4 occurred on April 7th, 2011. Therefore, this information must be submitted to the NRC on or before July 6, 2011.

Per Specification 5.6.6.2.4, the following information is to be submitted and is discussed within this document:

(a) The total number of indications, the location of each indication, the orientation of each indication, the severity of each indication and whether the indications initiated from the inside or outside surface,

(b) The cumulative number of indications detected in the tubesheet region as a function of elevation within the tubesheet,

(c) The projected end-of-cycle accident induced leakage from tubesheet indications.

During the 2R15 outage, the Plus Point probe was utilized to inspect the top of tubesheet region. The 2R15 inspection scope was 100% of the inservice hot leg tubes in all three steam generators (SG's) plus a 20% random sample of the inservice cold leg tubes in SG "A". The inspection distance in either leg was from 6.0 inches above the top of tubesheet to 3.0 inches below the top of tubesheet and bounds the required F* examination distance (i.e. the expanded portion of the tube below the bottom of roll expansion transition) of 2.22 inches below the bottom of the expansion transition. A small number of tubes (10 total in the hot leg of all 3 SG's and 4 in SG "A" cold leg) have roll expansion transitions at lower than nominal elevations. These particular tubes were inspected to a depth of 5.0 inches below the top of tubesheet to ensure that the F* distance was adequately examined.

As seen from the information contained within, the morphology for the vast majority of the indications reported from the hot leg tubesheet region is believed to be attributed to circumferentially oriented outside diameter stress corrosion cracking (ODSCC). This is based on signal recognition and location of the reported indications. All ODSCC indications observed were plugged upon detection. All top of tubesheet circumferential indications were stabilized prior to installing the hot leg plug. None of the indications that were removed from service during 2R15 represented a (Cycle 15) leakage potential at postulated main steam line break (MSLB) conditions.

The information provided on the following pages summarizes the degradation observed during the 2R15 tubesheet region examinations.

The data has been analyzed utilizing the 300 kHz channel from the Plus Point probe. This provides the most accurate sizing technique and is used for assessing the severity of the indications.

SG "A" Hot Leg Tubesheet:

Twenty tubes were plugged for indications reported during the hot leg tubesheet region examination. Of these tubes; nineteen tubes were reported with either single or multiple circumferential ODSCC indications located at or slightly below the top of tubesheet and one tube was reported with single axial ODSCC indication located above the top of tubesheet.

SG "A" Cold Leg Tubesheet:

No indications were reported during the 20% random sample inspection of the cold leg tubesheet region.

**2RCS-SG21A**
2R15 Tubesheet Indications

| Indication Location | | | | Orientation** | Severity*** | | | Initiation Surface/ Degradation | Projected Leakage |
|---|---|---|---|---|---|---|---|---|---|
| SG | Row | Column | Elevation* | | Volts | Axial Length | Arc Length | | |
| A | 6 | 50 | TSH -0.12" | SCI | 0.12 | | 65° | ODSCC | 0 |
| A | 8 | 38 | TSH -0.03" | SCI | 0.18 | | 110° | ODSCC | 0 |
| A | 8 | 57 | TSH -0.09" | SCI | 0.16 | | 123° | ODSCC | 0 |
| A | 9 | 23 | TSH -0.08" | SCI | 0.21 | | 132° | ODSCC | 0 |
| A | 11 | 38 | TSH -0.14" | SCI | 0.13 | | 33° | ODSCC | 0 |
| A | 12 | 37 | TSH -0.15" | SCI | 0.20 | | 59° | ODSCC | 0 |
| A | 12 | 41 | TSH -0.09" | SCI | 0.13 | | 82° | ODSCC | 0 |
| A | 12 | 42 | TSH +0.00" | SCI | 0.17 | | 69° | ODSCC | 0 |
| A | 13 | 44 | TSH -0.07" | SCI | 0.19 | | 69° | ODSCC | 0 |
| A | 19 | 55 | TSH -0.20" | MCI | 0.13 | | 190° | ODSCC | 0 |
| A | 20 | 21 | TSH -0.13" | SCI | 0.14 | | 98° | ODSCC | 0 |
| A | 25 | 33 | TSH -0.08" | SCI | 0.24 | | 91° | ODSCC | 0 |
| A | 27 | 72 | TSH -0.05" | SCI | 0.20 | | 155° | ODSCC | 0 |
| A | 33 | 33 | TSH -0.06" | MCI | 0.17 | | 130° | ODSCC | 0 |
| A | 38 | 49 | TSH +0.49" | SAI | 0.12 | 0.17" | | ODSCC | 0 |
| A | 40 | 43 | TSH -0.05" | MCI | 0.27 | | 229° | ODSCC | 0 |
| A | 41 | 49 | TSH -0.10" | SCI | 0.16 | | 50° | ODSCC | 0 |
| A | 42 | 42 | TSH -0.07" | SCI | 0.17 | | 106° | ODSCC | 0 |
| A | 42 | 45 | TSH -0.01" | SCI | 0.07 | | 107° | ODSCC | 0 |
| A | 43 | 47 | TSH -0.01" | SCI | 0.08 | | 34° | ODSCC | 0 |

* TSH - Top of Tubesheet (Hot Leg)

** MCI - Multiple Circumferential Indications
SAI - Single Axial Indication
SCI - Single Circumferential Indication

*** Reported Using the 300 kHz Plus Point Coil

SG "B" Hot Leg Tubesheet:

Twenty four tubes were plugged for indications reported during the hot leg tubesheet region examination. Of these tubes; twenty one tubes were reported with either single or multiple circumferential ODSCC indications located at or slightly below the top of tubesheet and three tubes were reported with single axial ODSCC indications located above the top of tubesheet.

**2RCS-SG21B**
2R15 Tubesheet Indications

| Indication Location | | | | Orientation** | Severity*** | | | Initiation Surface/ Degradation | Projected Leakage |
|---|---|---|---|---|---|---|---|---|---|
| SG | Row | Column | Elevation* | | Volts | Axial Length | Arc Length | | |
| B | 7 | 41 | TSH +0.00" | SCI | 0.19 | | 87° | ODSCC | 0 |
| B | 8 | 32 | TSH -0.01" | SCI | 0.10 | | 47° | ODSCC | 0 |
| B | 8 | 54 | TSH -0.04" | MCI | 0.29 | | 219° | ODSCC | 0 |
| B | 9 | 54 | TSH -0.12" | SCI | 0.18 | | 75° | ODSCC | 0 |
| B | 11 | 19 | TSH +0.00" | SCI | 0.12 | | 27° | ODSCC | 0 |
| B | 11 | 46 | TSH -0.08" | SCI | 0.19 | | 61° | ODSCC | 0 |
| B | 11 | 47 | TSH +0.00" | MCI | 0.21 | | 161° | ODSCC | 0 |
| B | 12 | 57 | TSH -0.12" | SCI | 0.20 | | 68° | ODSCC | 0 |
| B | 15 | 53 | TSH -0.06" | SCI | 0.19 | | 44° | ODSCC | 0 |
| B | 16 | 32 | TSH -0.12" | SCI | 0.14 | | 124° | ODSCC | 0 |
| B | 17 | 9 | TSH -0.08" | SCI | 0.16 | | 80° | ODSCC | 0 |
| B | 17 | 24 | TSH -0.08" | SCI | 0.11 | | 34° | ODSCC | 0 |
| B | 17 | 38 | TSH -0.10" | SCI | 0.24 | | 75° | ODSCC | 0 |
| B | 18 | 49 | TSH -0.10" | SCI | 0.28 | | 134° | ODSCC | 0 |
| B | 20 | 33 | TSH -0.09" | SCI | 0.15 | | 27° | ODSCC | 0 |
| B | 21 | 24 | TSH +0.04" | SAI | 0.31 | 0.28" | | ODSCC | 0 |
| B | 21 | 25 | TSH +0.01" | SAI | 0.15 | 0.16" | | ODSCC | 0 |
| B | 21 | 44 | TSH -0.11" | SCI | 0.13 | | 41° | ODSCC | 0 |
| B | 22 | 14 | TSH -0.09" | SCI | 0.10 | | 59° | ODSCC | 0 |
| B | 25 | 26 | TSH +0.14" | SAI | 0.10 | 0.23" | | ODSCC | 0 |
| B | 32 | 51 | TSH -0.09" | MCI | 0.10 | | 267° | ODSCC | 0 |
| B | 32 | 56 | TSH +0.00" | SCI | 0.12 | | 58° | ODSCC | 0 |
| B | 37 | 51 | TSH -0.11" | SCI | 0.08 | | 27° | ODSCC | 0 |
| B | 38 | 56 | TSH -0.09" | SCI | 0.13 | | 70° | ODSCC | 0 |

* TSH - Top of Tubesheet (Hot Leg)

** MCI - Multiple Circumferential Indications
SAI - Single Axial Indication
SCI - Single Circumferential Indication

*** Reported Using the 300 kHz Plus Point Coil

SG "C" Hot Leg Tubesheet:

Seven tubes were plugged for indications reported during the hot leg tubesheet region examination. Of theses tubes; six tubes were reported with either single or multiple circumferential ODSCC indications located at or slightly below the top of tubesheet and one tube was reported with a single axial ODSCC indication located above the top of tubesheet.

**2RCS-SG21C**
2R15 Tubesheet Indications

| Indication Location | | | | Orientation** | Severity*** | | | Initiation Surface/ Degradation | Projected Leakage |
|---|---|---|---|---|---|---|---|---|---|
| SG | Row | Column | Elevation* | | Volts | Axial Length | Arc Length | | |
| C | 3 | 46 | TSH -0.17" | SCI | 0.09 | | 47° | ODSCC | 0 |
| C | 8 | 57 | TSH -0.06" | SCI | 0.20 | | 155° | ODSCC | 0 |
| C | 8 | 58 | TSH +0.12" | SAI | 0.20 | 0.16" | | ODSCC | 0 |
| C | 9 | 92 | TSH -0.16" | SCI | 0.08 | | 30° | ODSCC | 0 |
| C | 11 | 53 | TSH -0.03" | SCI | 0.18 | | 36° | ODSCC | 0 |
| C | 20 | 57 | TSH -0.07" | SCI | 0.06 | | 33° | ODSCC | 0 |
| C | 35 | 61 | TSH -0.09" | MCI | 0.19 | | 67° | ODSCC | 0 |

* TSH - Top of Tubesheet (Hot Leg)

** MCI - Multiple Circumferential Indications
SAI - Single Axial Indication
SCI - Single Circumferential Indication

*** Reported Using the 300 kHz Plus Point Coil

Non Tubesheet Region Degradation:

The following information lists the tubes that were removed from service for degradation in other areas of the steam generators. This information is being submitted for completeness of the tube plugging performed 2R15 and is not required to be reported by Technical Specification 5.6.6.2.4.

**2RCS-SG21A**

| Indication Location | | | | Orientation** | Severity *** | | | Initiation Surface/ Degradation | Projected Leakage |
|---|---|---|---|---|---|---|---|---|---|
| SG | Row | Column | Elevation* | | Volts | Axial Length | Arc Length | | |
| A | 7 | 37 | 4H -0.10" | SAI | 0.16 | 0.26" | | ODSCC | 0 |
| A | 8 | 25 | 2H -0.26" | SAI | 0.13 | 0.31" | | ODSCC | 0 |
| A | 16 | 8 | 3H -0.04" | SAI | 0.11 | 0.23" | | ODSCC | 0 |
| A | 16 | 9 | 2H +0.14" | SAI | 0.12 | 0.41" | | ODSCC | 0 |
| A | 16 | 24 | 6H -0.05" | SAI | 0.16 | 0.31" | | ODSCC | 0 |

**2RCS-SG21B**

| Indication Location | | | | Orientation** | Severity *** | | | Initiation Surface/ Degradation | Projected Leakage |
|---|---|---|---|---|---|---|---|---|---|
| SG | Row | Column | Elevation* | | Volts | Axial Length | Arc Length | | |
| B | 1 | 33 | 3H +0.18" | SAI | 0.10 | 0.45" | | ODSCC | 0 |
| B | 6 | 31 | 3H +0.09" | SAI | 0.10 | 0.45" | | ODSCC | 0 |
| B | 6 | 35 | 3H -0.02" | SAI | 0.16 | 0.33" | | ODSCC | 0 |
| B | 6 | 42 | 2H +0.16" | MAI | 0.16 | 0.40" | | ODSCC | 0 |
| B | 8 | 35 | 6H +0.05" | SAI | 0.11 | 0.16" | | ODSCC | 0 |
| B | 10 | 32 | 3H +0.01" | SAI | 0.10 | 0.32" | | ODSCC | 0 |
| B | 11 | 55 | 2H +0.00" | SAI | 0.09 | 0.17" | | ODSCC | 0 |
| B | 11 | 59 | 2H +0.10" | SAI | 0.09 | 0.37" | | ODSCC | 0 |
| B | 11 | 60 | 3H +0.06" | SAI | 0.08 | 0.34" | | ODSCC | 0 |
| B | 13 | 72 | 3H +0.04" | SAI | 0.08 | 0.28" | | ODSCC | 0 |
| B | 14 | 55 | 2H +0.10" | SAI | 0.18 | 0.52" | | ODSCC | 0 |
| B | 15 | 66 | 3H -0.04" | SAI | 0.07 | 0.16" | | ODSCC | 0 |
| B | 16 | 12 | 4H +0.00" | SAI | 0.16 | 0.28" | | ODSCC | 0 |
| B | 16 | 14 | 3H +0.01" | SAI | 0.34 | 0.28" | | ODSCC | 0 |
| B | 17 | 34 | 6H +0.17" | SAI | 0.10 | 0.29" | | ODSCC | 0 |
| B | 18 | 31 | 2H +0.06" | SAI | 0.12 | 0.16" | | ODSCC | 0 |
| B | 18 | 67 | 3H +0.08" | SAI | 0.11 | 0.23" | | ODSCC | 0 |
| B | 20 | 34 | 2H -0.14" | SAI | 0.13 | 0.61" | | ODSCC | 0 |
| B | 29 | 57 | 2H +0.00" | SAI | 0.07 | 0.23" | | ODSCC | 0 |
| B | 31 | 17 | 2H -0.18" | SAI | 1.15 | 0.20" | | PWSCC | 0 |

## 2RCS-SG21C

| Indication Location | | | | Orientation** | Severity *** | | | Initiation Surface/ Degradation | Projected Leakage |
|---|---|---|---|---|---|---|---|---|---|
| SG | Row | Column | Elevation* | | Volts | Axial Length | Arc Length | | |
| C | 3 | 55 | 8C +0.04" | SAI | 0.21 | 0.21" | | ODSCC | 0 |
| C | 15 | 29 | 4H +0.00" | SAI | 0.31 | 0.21" | | ODSCC | 0 |
| C | 15 | 29 | 6H +0.00" | SAI | 0.13 | 0.26" | | ODSCC | 0 |
| C | 29 | 12 | VARIOUS | PVN | See Below | | | | 0 |
| C | 30 | 74 | 4H -0.03" | SAI | 0.17 | 0.42" | | ODSCC | 0 |
| C | 31 | 59 | 6H +41.53" | SCI | 0.37 | | 26° | ODSCC | 0 |
| C | 31 | 63 | 3H +0.12" | SAI | 0.11 | 0.17" | | ODSCC | 0 |
| C | 31 | 63 | 4H +0.07" | SAI | 0.07 | 0.16" | | ODSCC | 0 |

* 2H, 3H, 4H, 6H - 2nd, 3rd, 4th, 6th Hot Leg Tube Support Plate (Flow distribution baffle is referred to as 1H/1C)
8C - 8th Cold Leg Tube Support Plate

** MAI - Multiple Axial Indications
PVN - Permeability Variation
SAI - Single Axial Indication
SCI - Single Circumferential Indication

*** Reported Using the 300 kHz Plus Point Coil

R29 C12 - This tube exhibited permeability variations ranging from 0.16 volts to 11.58 volts between the 7th hot leg tube support plate and the 4th cold leg tube support plate. The bobbin probe (200 kHz) was used to verify that no axial ODSCC was present at the tube support plate intersections. The bobbin probe (100 kHz) was used to verify that no axial ODSCC was present in the free span regions. A magnetically biased Plus Point probe was used to verify that no circumferential ODSCC was present at free span dings which may have represented a structural or leakage potential. A full length in-situ pressure test was subsequently performed on the tube. No leakage or burst was observed at any of the test pressures. Post in-situ bobbin probe testing showed no detectable degradation at the tube support plate intersections or in the free span regions. The tube was stabilized on the hot leg side prior to removing it from service via plugging.