Entergy Operations, Arkansas Nuclear One Unit One

LT - Apparent Cause Evaluation Report

ANO1 Steam Generator (E-24 A&B) Tube to Tube Wear

CR-ANO-1-2011-2609; Event Date: 11-07-2011

REPORT DATE: 12-01-2011, Rev 0

Position	Name	Date
Evaluator	Dan Meatheany	12/01/2011
Responsible Manager	Bill Greeson	12/01/2011
CARB Chairperson (if applicable)	N/A	

PROBLEM STATEMENT:

During the 1R23 refueling outage, operating experience from Three Mile Island (TMI) indicated a potential new damage mechanism for the once through steam generators. (tube to tube wear). This was not identified as degradation during the current inspection. The indications were evaluated and it was determined that ANO has indications similar to TMI.

Does this ACE report require an Equipment Failure Evaluation (EFE)? (See procedure steps 5.3 [3] (c) and 5.4) ☐ Yes ☒ No

IF Yes, THEN complete EN-LI-119-01 Equipment Failure Evaluation **AND** attach in PCRS

IF No, THEN an EFE analysis is not required.

Was an HPER performed for this CR?

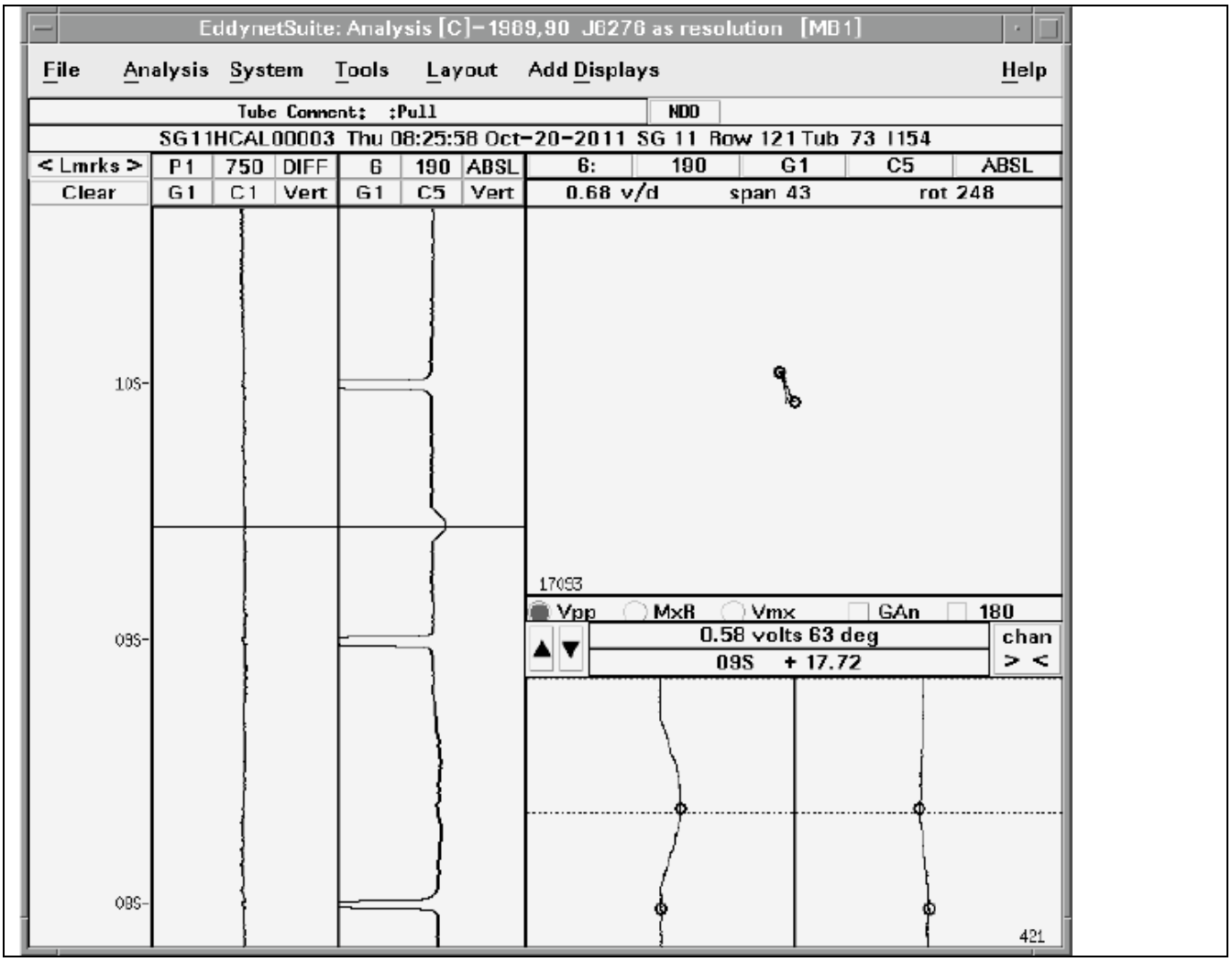
(See procedure step 5.3 [3] (c)) ☒ Yes ☐ No

IF Yes, THEN ensure results of the EN-HU-103 HPER are discussed in the Event Description section. Also attached to the end of the document and the CR action.

EVENT DESCRIPTION: (*The **HOW**) (see Procedure step 5.3[3](d))*

During the ANO1 1R23 refueling outage, the steam generators were inspected 100% full length with bobbin. During that inspection **absolute drift indications** (ADI) were called in the middle of the generator (typically 08S + 17”). The ADI calls were tested with the X-probe for disposition or if previously called by history review were analytically evaluated. These were called no detectable flaw (NDF) for those tested with the x-probe. The following is a summary of the post inspection testing that was performed by AREVA based on finding this issue at Three Mile Island (TMI). Hind sight review would indicate that the same damage mechanism could be found at ANO1.

At approximately the mid-point of the tubing, ADI calls were made utilizing the bobbin coil. These indications tend to be in pairs or triplets and are associated with tubes being in compression while at power. This results in the tubes making contact with neighboring tubes. Due to the local velocities, fretting of the tubing material has resulted in a long tapered wear scar. The following is a representative example of the bobbin indication followed by an example of the X-probe data: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File
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Clear
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750
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C1
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190
ABSL
G1
C5
Vert
6:
190
G1
C5
ABSL
0.68 v/d
span 43
rot 248
10S-
09S-
08S-
17093
Vpp
MxR
Vmx
GAn
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0.58 volts 63 deg
09S + 17.72
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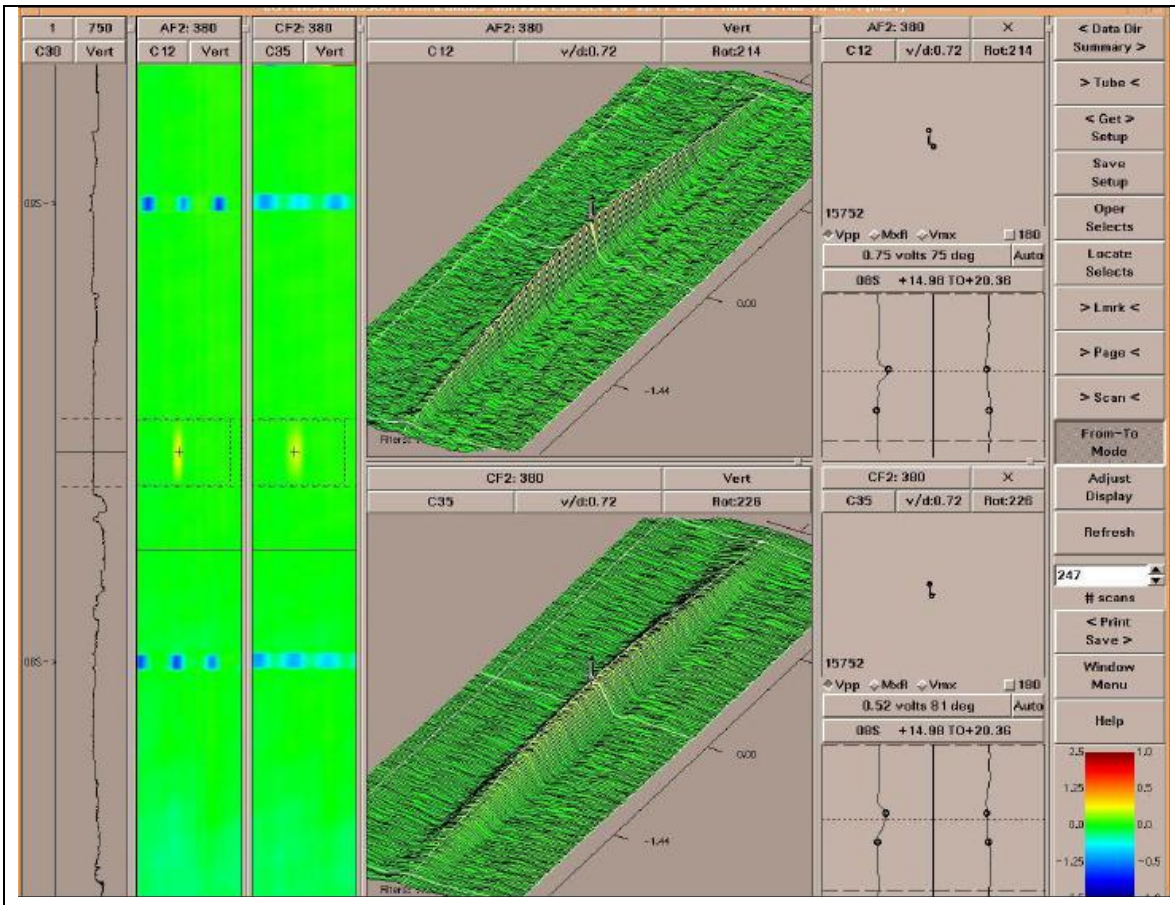
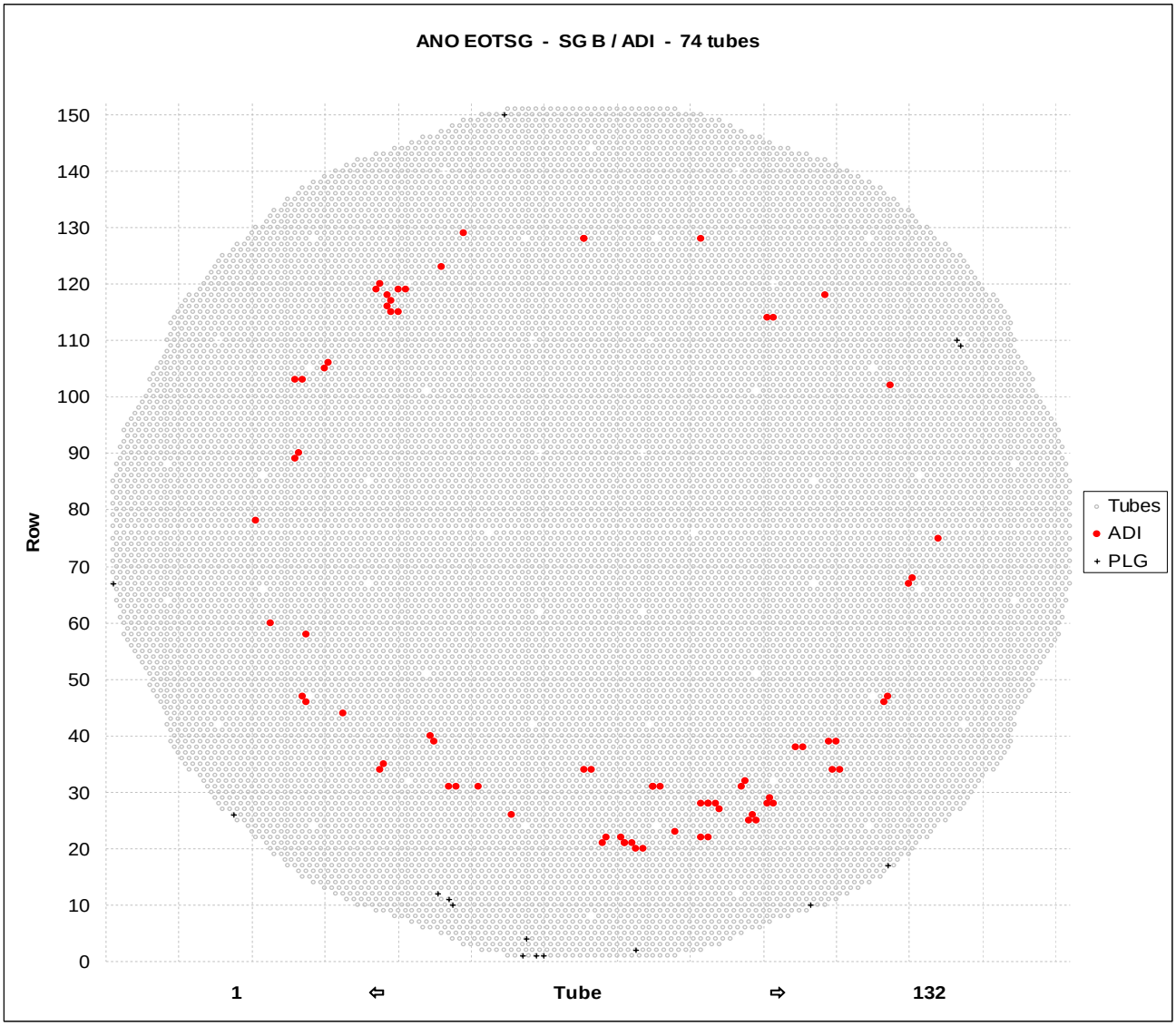


The ANO1 data was re-analyzed using the AIDA automatic computer analysis. The screening threshold was reduced from the original screening voltage **of 0.5 v to 0.35 v**. Based on this re-analysis there were 48 tubes in SGA and 74 in SGB that exhibit this type of degradation. The deepest indications are in SGB with the largest being 26% through wall. These indications are in the same circular pattern that has been seen on the 8th tube support plate.



The new data was evaluated for end of cycle conditions based on the growth rate. After performing a historic review of the data, the majority of the indications in SGB would be traced back to the first in-service inspection (ISI) (1R20). The estimated growth rate was ~ 4 % through wall (TW) per effective full power year (EFPY).

The maximum return to service NDE depth of 26% in EOTSG B must be corrected for NDE uncertainty per ETSS 27905.3 Rev. 0 and then adjusted for growth to obtain the EOC real depth.

RD = 1.09 * %TW -1.44 +1.12 * 2.14 *1.645 + Growth * EFPY

RD = 1.09 * 26 -1.44 + 1.12 * 2.14 *1.645+ 4.07 * 4.13 = 47.7 % < 58.3% (limit)

The predicted real depth is less than the structural limit of 58.3 %TW; therefore, the tube-to-tube wear flaws returned to service are acceptable for 4.13 EFPY through EOC 26. There is considerable conservatism in the calculation, which used a conservative flaw length rather

than adjusting to the structural length and used the Maximum Growth Rate for both repeat and new indications. Since wear indications will leak and break at essentially the same pressure, leakage integrity at a much lower faulted pressure differential of approximately 2575 psi is also demonstrated. **Therefore there are no structural issues associated with this mechanism.**

It should be noted that contributing to this was the fact that new tie rod bowing was identified in SGB which was the first time this was found (reference CR-ANO-1-2011-1925). Also a change in the bowing in the upper spans was identified. This was a distraction to the Resolution and Lead analysts. (contributing cause) The failure occurred at the resolution level when they incorrectly dispositioned and mischaracterized the signals. The Lead analysts failed because they did not recognize the incorrect disposition and mischaracterization of signals.

A review was performed to evaluate why these indications were not called wear on the original analysis.

The following characteristics led to the determination of tube-to-tube wear at TMI:

- The eddy current signals are distinctive and, upon close review, can be differentiated from Manufacturing Buff Marks, material property changes, lack of deposit, etc.
- The bobbin, array, +Point and pancake coil techniques confirm a condition of shallow OD tube wall loss.
- The array and +Point techniques show long axial, circumferentially narrow, indications that taper perfectly on each end, which meets reasonable expectations for tube-to-tube wear.
- All three techniques provide depth estimates which correlate well.
- The indications are all in the middle of either the 8^{th} or 9^{th} freespan region (07S-08S or 08S-09S). The 9^{th} freespan is also the middle of the tube's overall length.
- The indications most often occur in pairs where tubes are next to one another.
- The paired tubes, as viewed on a tubesheet map, are most often oriented in the same direction rather than being randomly oriented.
- For paired tubes, the indications are always aligned with one another; at the same elevation as well as circumferential positions which face one another.
- Some indications occur in a triangular three tube pattern with indications which are aligned axially and circumferentially and show two indications approximately 60 degrees apart on the tube which is facing two tubes and one indication in each of the other two tubes.
- Indications in paired tubes have similar depths (i.e., a 7% with a 8%; a 12% with a 13%; a 16% with a 18%; a 26% with a 26%) and there are no instances of uneven wear among tubes with indications which are aligned with indications in neighboring

tubes; showing expected even wear between tubes.

- Indications in paired tubes have very similar lengths.
- Tubes which are alone, and not paired, have very shallow depth estimates, less than 8% TW, and in no instances are there any deeper indications in tubes which are not paired; showing wear is still probable and the neighboring tube is below the detection threshold.
- All indications are absent in the Pre-Service Inspection (PSI) data.

The ANO indications meet the above characteristics and offer some additional confirmation:

- Two neighboring tubes at ANO each have indications in two spans, rather than one, and they are both above the depth threshold where you would expect to see the indications in both tubes, and you do.
- Some ANO indications show an increase in signal voltage over a few cycles and that change is essentially the same for neighboring tubes.
- The ANO indications which have the same characteristics as the TMI indications confirm in the array data, where array data is available, and none of those having different characteristics confirm in the array data.

Analysts involved with the TMI inspection remembered similar indications in the ANO1 data, warranting further assessment of the condition in these EOTSGs. A reanalysis of the ANO1 bobbin probe data from the 1R23 inspection was conducted to identify potential indications. This reanalysis included 100% of the in-service tubes in both steam generators and was performed with AREVA's automated analysis system, AIDA. The reanalysis focused solely on absolute (ADI) indications ≥ 0.35 Vpp (volts peak to peak). Previously it was screened at 0.50 volts.

The identified ADI indications were further analyzed to determine which were indicative of the indications diagnosed as tube-to-tube wear at TMI. A process was setup to first determine if an ADI signal in one tube had an adjacent tube with an ADI signal at the same location and faced each other. This was one of the factors at TMI which caused a more thorough look at these indications. A look back of previous outage bobbin data was also performed on the tubes to determine when the signal first occurred and no indications indicative of tube-to-tube wear were present in the PSI data. Any array data that may have been acquired during previous inspections was also evaluated to help determine if the ADI signals were actually tube-to-tube wear and all that were indicative of tube-to-tube wear with bobbin confirmed as such with the available array data. The results of the reanalysis concluded that ANO1 has tube-to-tube wear dating back to the first ISI (1R20).

Outage Bobbin Analysis Process (not the reanalysis)

The bobbin analysis process for reporting absolute indications is defined in the bobbin Examination Technique Specification Sheet (ETSS #1).

The production analysis instruction is to scroll the bobbin data on the prime differential channel and to monitor the strip chart of channel 6 (which is an absolute channel) for indications of degradation. The flow chart direction for these types of indications is to report

absolute signals in the flaw plane that are ≥ 0.50 volts and >0.50" in length on channel 6 as ADI. The ETSS also requires the production analyst to address all previous history calls which including ADI, manufacturing burnish marks (MBM) and non quantifiable signal (NQS).

The resolution team evaluates all ADI or NQI signals reported by the production analyst. The resolution analyst is to determine if these signals were present in history and if so, have they changed, using the following criteria:

- ***The previous inspection data to be used to evaluate a signal for change is the 2007 data, 1R20. Change is defined as a signal that has changed by more than 10 degrees and/or increased in voltage by 0.50 volts or more.***

- This voltage increase or phase shift should not be the only factor a resolution analyst should consider for change. If the resolution analyst believes the signal has changed from 1R20, no matter what the voltage or phase angle, it should be reported with the appropriate code.

- The resolution analyst may characterize a bobbin probe indication as an MBM provided the indication was characterized as an MBM in historical data from a bobbin probe, rotating probe or array probe examination. A new MBM may be reported provided it is present in the PSI data and shows no change. Evaluate all ADI indications for possible characterization as an MBM.

A review of past inspection results shows that the bobbin analysis process was performed in accordance with the applicable ETSS. The majority of the ADI signals reported by the production analyst were kept by the resolution team as an ADI, MBM or NQS. A review of the reanalysis results shows more than a third of the new ADI signals were not reported during the outage because they were below the reporting threshold for voltage.

							VOLTS			%TW		
SG	Row	Tube	Degrees	Indication	Location	Inch	1R20	1R21	1R23	1R20	1R21	1R23
B	116	29	87	ADI	7	20.62	0.60	2.35	2.30	9	27	**26**
B	117	29	78	ADI	7	20.80	0.62	2.45	2.21	10	27	**26**

From 1R21 to 1R23 the change in voltage is < 0.5 volts which meets the requirement. However the change from the baseline is > 0.5 volts. This did not meet the procedure requirement and was mischaracterized by the analyst. The HPER was evaluated using EN-HU-103. The results were overconfidence and distractions by the analyst. The resolution analysts using prior knowledge and experience with similar absolute drift indications lead to the incorrect disposition of the signals

There are instances where the analysts (production, resolution, Independent Qualified Data Analyst (IQDA)) did not report an absolute indication and there are several reasons why this occurs:

- The analyst determines that the signal is not indicative of tube wall degradation, but instead a more common source of absolute signals with the general characteristics of a long length and absence of differential channel response like material property changes, manufacturing burnish marks, etc.

- The analyst measures only a portion of the absolute signal, due to its extreme

length, and the voltage reading is below the reporting threshold.

- The analyst monitors historical results and notes that the indication has historically been reported as No Degradation Found (NDF) from the array inspection and assumes that analysis was evaluated correctly and that the bobbin voltage has not changed significantly.

- The resolution analyst incorrectly assesses the change in a signal and changes the ADI to NQS.

Outage Array Analysis Process

The array (x-probe) analysis process for special interest locations is defined in the array ETSS #2.

The production analyst is instructed to review all Special Interest (SI) locations (ADI, NQI, etc.) and report any degradation with a characterization code. If the degradation is characterized as volumetric in the tube's freespan it is to be reported as a Single Volumetric Indication (SVI). If there is no confirmation of degradation, the SI location is to be reported as NDF.

The resolution analyst is to review all calls (WAR, SVI, NDF, etc.) made by the production analyst. For volumetric indications the criteria is:

- WAR calls from production; verify the indication is present and properly characterized.

- SVI calls from production; determine if the signal is characteristic of an MBM, present in the PSI data and not changed, then change the call to MBM. If it has changed or not present in PSI, then leave the call as an SVI.

- NDF calls, review for degradation and confirm correct reporting.

A review of the 1R23 results revealed that the bobbin ADI indications indicative of tube-to-tube wear were mischaracterized by the analysts during the SI analysis in several ways.

- ***The production analyst reported the indications as NDF.***
- ***The production analyst reported the indications as SVI and the resolution analyst changed the call to NDF.***

Assessment of Tubes 116-29 and 117-29 in SGB (largest depths)

A curve was constructed to measure the depth of the tube-to-tube wear signals. It was derived from EPRI Appendix H +Point probe qualification 27905.3 and correlated to both TMI and ANO1 bobbin voltages. This curve was used to estimate the depths of all ANO1 tube-to-tube wear indications. The largest depths were in tubes B-R116-T29 and B-R117-T28 and both measured 26% TW. An in-depth review of these tubes was performed to understand how they had been mischaracterized.

Tube 116-29:

- 1R20 reported as an NQI with bobbin and a VOL with the array.
- 1R21 reported as ADI by the production analyst. One production analyst reported an MBM and one production analyst reported an SVI in the array exam. The resolution analyst inserted a comment stating the signal was a tube anomaly or geometry and changed the call to NDF. Because the array call was NDF, the corresponding bobbin call was changed to a Non Quantifiable Signal (NQS). The IQDA agreed with the NDF call.
- 1R23 reported as ADI by the production analyst. The call was changed to NQS to be monitored again next outage. There was no special interest performed because NQS calls do not require SI.

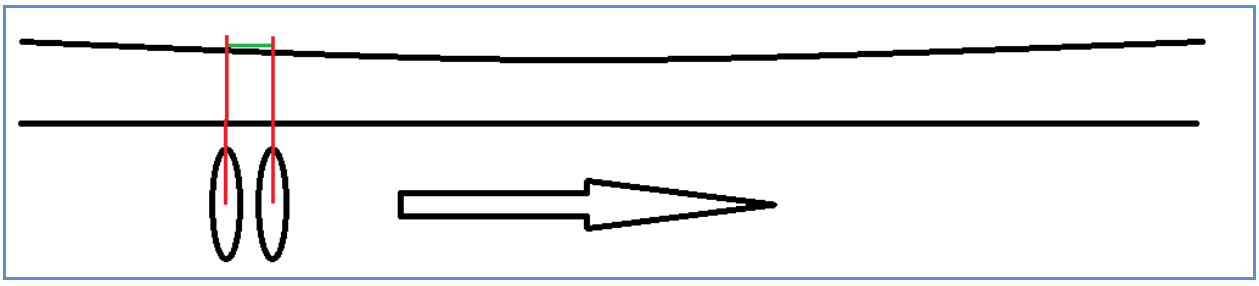
Tube 117-29:

- 1R20 not reported but a reportable signal was present.
- 1R21 reported as ADI by the production analyst. One production analyst reported an MBM and one production analyst reported an SVI in the array exam. The resolution analyst inserted a comment stating the signal was a tube anomaly or geometry and changed the call to NDF. Because the array call was NDF, the corresponding bobbin call was changed to a Non Quantifiable Signal (NQS). The IQDA agreed with the NDF call.
- 1R23 reported as ADI by the production analyst. The call was changed to NQS to be monitored again next outage. There was no special interest performed because NQS calls do not require SI.

In hindsight these two tubes should have been investigated further. They are side by side and the indications are at the same axial location. The bobbin voltage was greater than 2 volts and the array exam had a volumetric response. **In the 1R23 outage the calls were mischaracterized as NQS because the voltage had changed by more than 0.50 volts from the 1R20 outage.**

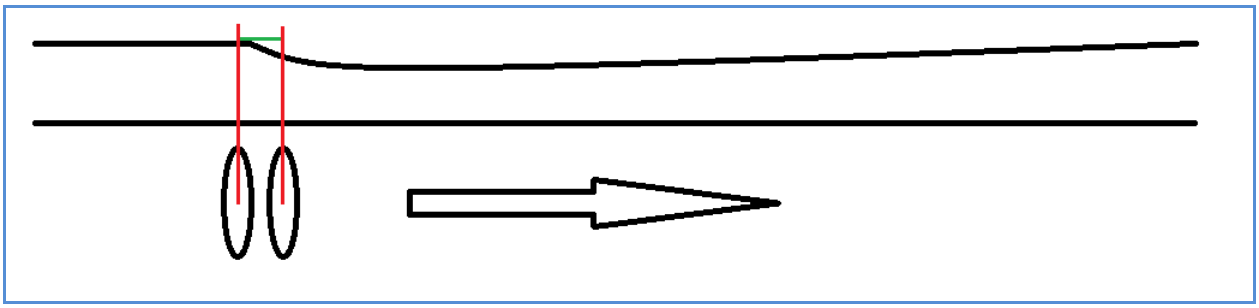
Using the 0.50 volt threshold, there were 5 paired tube locations in SGB.

The following graphics display presents a reasonable example of why the indications were mischaracterized:



The above figure depicts why the differential bobbin coils do not respond to the OD wall loss. The tube wall is represented by the two parallel lines; the differential eddy current bobbin coils by the two ellipses; and the direction of the eddy current probe scan by the arrow. The top line represents tube's OD surface and the symmetric tapered tube-to-wear

signal which occurs over several inches. The differential bobbin coil's response relies on a material property change to occur over a short enough distance (within the effective coverage of these two coils) to imbalance the bridge circuitry and produce a measurable impedance change. Wear morphology of this type, which is symmetrically tapered and changing in depth slowly over several inches does not impact the differential coil balance sufficiently to produce a signal. If you do look at the differential channel on a long strip chart you will observe one complete cycle of coil imbalance over the length of this degradation. The below signal depicts the required condition to produce a differential signal and is the typical morphology where at least one end of the wear quickly returns to nominal tube wall where the two wearing surfaces meet (i.e., the edge of structure or loose part).



ANALYSIS and APPARENT/CONTRIBUTING CAUSE(S): (*The **WHY**) (see Procedure step 5.3[3](e))*

The processes utilized include the why staircase and the event and causal charting and are attached to the back of this document. Also the HPER that was performed is attached to the back of the document.

It was determined that this was a human performance issue since the analyst did not call tubes 116-29 and 117-29 as an ADI for further testing. There is subjectivity that must be allowed based on the analyst knowledge and experience. Otherwise there would be literally thousands of indications such a sludge that would be called and require additional testing. Also the fact that this has not previously been reported (new damage mechanism) for the once through design. It therefore will be characterized as a human performance issue and processes changed to account for this new damage mechanism.

TMI recognized this because they had a large number of "new" paired indications during their first inspection and was not distracted with tie rod bowing.

AC_1: Analysis Process Did Not Address this New Mechanism Adequately

The apparent cause is that the analysis process (which includes the analysis guidelines OP-5120.524) was not followed correctly***. It should be noted that this does not guarantee that the new damage would have been identified since history supported the fact that this was not changing.*** The screening voltage was appropriate to call everything $\geq$ to a 0.50 volt change if the first ISI was used. If the largest indications would have been called

an ADI and X-probe tested, the connection to the paired tube may have been identified similar to what TMI did. **(WP4B - Documents not followed correctly)**

CC_1: Emergent Issues (Tie Rod Bowing in SGB and Upper Span Bowing) distracted the analysis team

During the course of the inspection which spanned over 4 days, approximately 32,000 inspections were performed and analyzed. Coming out of the analysis were new issues that the analyst had to address. This included first time bowing in SGB and changes in the upper span bowing in both steam generators. Specific attention was not given to the assessment of ADI calls due to special analysis associated with the tie rod bowing in both Steam Generators. At TMI, due to the large number of paired tube indications, this damage mechanism was investigated to a much more detailed level. (**OP2N - Job scoping didn't identify potential task interruptions/environmental stress)**

Process Improvement

The analysis process used during the ANO1 steam generator inspections correctly identified the bobbin ADI indications and achieved appropriate special interest array probe examinations, both of which provide important data to understand how this form of degradation develops over time. The process can be strengthened in the following areas:

- The ET signals from tube-to-tube wear are distinctive and, upon close review, can be differentiated from MBMs, material property changes, lack of deposit, etc. Training on this form of degradation should be administered to all analysts just prior to the next inspection including expectations for reporting these types of signals.
- Strengthen the reporting requirements for volumetric indications. Volumetric indications detected with the array probe need to be reported with a characterization code, rather than NDF, and further reviewed by the Lead Analyst.
- Instructions for evaluating “paired” indications should be provided as a screening tool (2 adjacent tubes with indications at the same level)
- Database checking should be implemented to validate accurate assessment of change (All indications that increase in voltage from 1R20 to present outage).

EXTENT OF CONDITION: *(see Procedure step 5.3[3](g))*

This condition is limited to the once through steam generator design. The tube to tube contact is a function of the preload that is placed on the tube with an upper and lower tubesheet configuration. Therefore, ANO1 is the only plant in the fleet that is affected. In the industry, the most obvious is TMI since it was fabricated and designed by the same vendor as ANO1. It has already identified the issue. The other OTSG plants may or may not be affected. An OE from both ANO1 and TMI will be issued to the industry.

ACTIONS COMPLETED

(See EN-LI-119 step 5.3[3](k))

APPARENT OR CONTRIBUTING CAUSE, OR EXTENT OF CONDITION ISSUE **(Add PCRS CA #, if applicable)**	**ACTION COMPLETED** [note any Work Orders/Requests, ER'S, other]	Date Completed
AC_1	Issued OE to the OE group	11/19/2011
AC_1	Re-analyzed 100% of the 1R23 Data	11/11/2011
AC_1	Determine condition monitoring and operational assessment relative to the new findings	11/12/2011

PROPOSED CORRECTIVE ACTIONS

(See EN-LI-119 step 5.3[3](k))

APPARENT OR CONTRIBUTING CAUSE, OR EXTENT OF CONDITION ISSUE **(Add PCRS CA #)**	**CORRECTIVE ACTION DESCRIPTION** [note any Work Orders/Requests, ER's, other]	**Assigned Department**	**Due Date**
AC_1 **CR-ANO-1-2011-2609-06**	Revise the training manual to reflect new findings prior to next inspection **LTCA**	EP&C	2/15/13
AC_1 **CR-ANO-1-2011-2609-07**	Revise the SSPD to include the new damage mechanism prior to next inspection **LTCA**	EP&C	2/15/13
AC_1 **CR-ANO-1-2011-2609-08**	Revise the analysis guidelines to include new damage mechanism prior to next inspection **LTCA**	EP&C	2/8/13
AC_1 **CR-ANO-1-2011-2609-09**	Evaluate if the vendor database can search for deltas in degrees and voltages in 1R20 and current outage prior to next inspection **LTCA**	EP&C	12/14/12
CC_1 **CR-ANO-1-2011-2609-10**	Determine if the number of lead analyst and independent QDA is adequate prior to the next inspection **LTCA**	EP&C	12/7/12

TREND DATA (coordinate entry in the PCRS Trend Table of this CR):

Cause Codes:

Human Performance Causal Factor(s) (List all): **WP4B**

O&P Causal Factor(s) (List all): **OP2N**

Equipment Causal Factors (List all): N/A

EFE Codes ((see Procedure step 5.4 [4]) :

INPO ER PO&C codes: N/A

Failure Mode Codes: N/A

Why Staircase

1. Why were the indications not called wear?

   They were dispositioned by the Resolution Analysts on History

2. Why were they dispositioned by history?

   The requirement to look at a change of 0.5 v was not followed for 1R20.

3. Why was the voltage change not followed?

   Resolution analysts using past experience decided it was a material property change or other geometric distortion and concluded the signal had not change from 1R21. This turned out to be a new damage mechanism that the analyst was unfamiliar with.

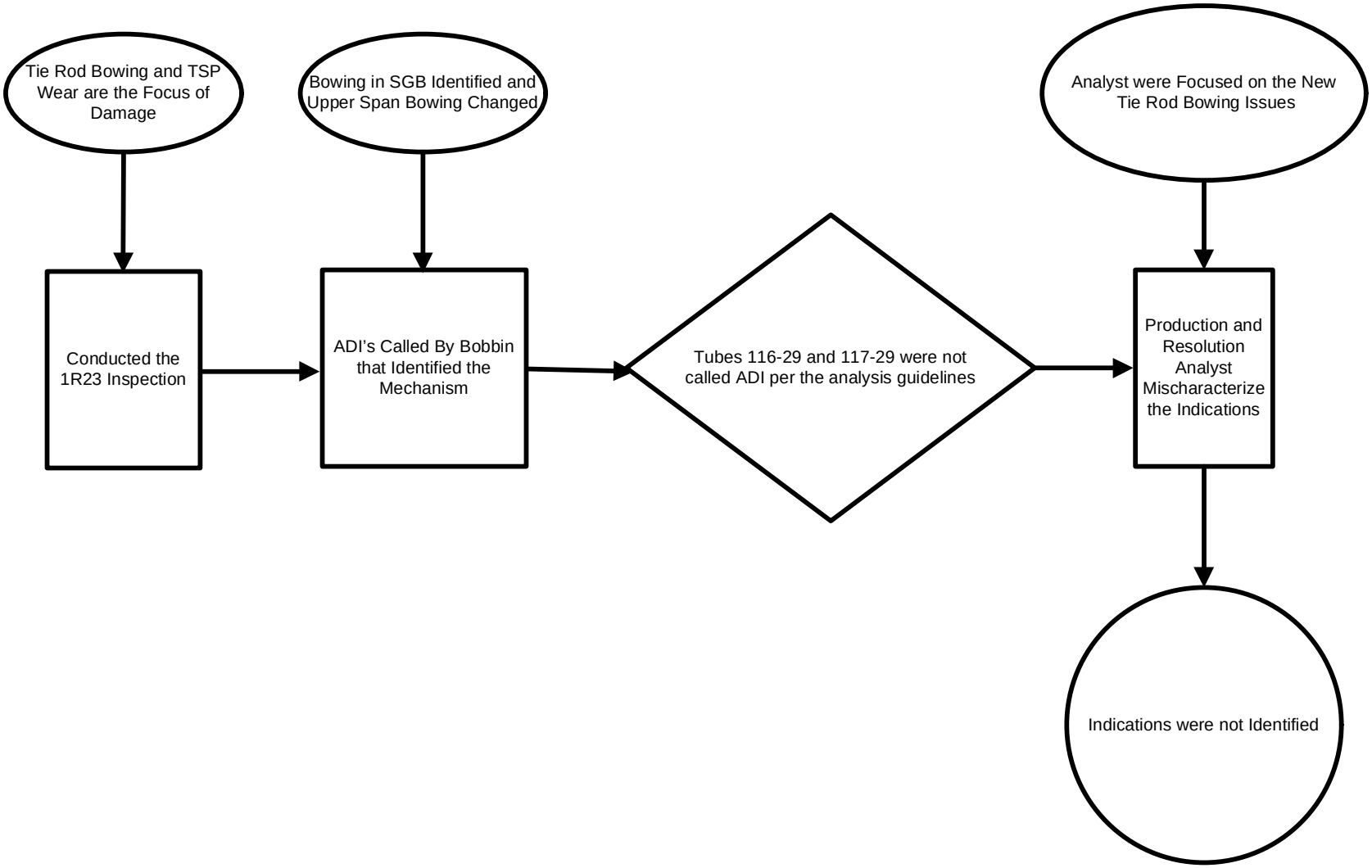
4. Why was history supportive that it was not wear?

   Even though there was an absolute signal associated with the indication, there was very little differential. There was little change in voltage once the signal originated.

5. Why was there no differential indication?

   The tube to tube wear was very gradual and extended over a long area. Because of this the wall loss difference is insufficient to produce an imbalance between the differential coils.

Event and Causal Factor Chart



ATTACHMENT 9.9 **LEVEL 2 HPER REPORT**

Sheet 1 of 2

CR No:	Problem Statement:
ANO-1-2011-2609	During the 1R23 refueling outage, operating experience from TMI indicated a potential new damage mechanism for the once through steam generators. (tube to tube wear). This was not identified as degradation the current inspection. The indications were evaluated and it was determined that ANO has indications similar to TMI.

Description:

During the 1R23 steam generator inspection for ANO1, it was determined that tube to tube wear was not identified. Operating experience from Three Mile Island identified the new damage mechanism. Since some of the analysts at TMI were also at ANO1, they remembered similar indications. Upon re-review of the data, it was confirmed that ANO1 also had tube to tube wear.

Based on the review to support the ACE, it was determined that there was one instance where an analyst did not call an indication per the guidance. The procedure would require if a tube changes in voltage by greater than 0.5 volts that it will be further tested. The 2 largest wear marks have a voltage of ~ 2.0 volts. Two outages ago (1R23) they were consistent with the current voltage. However if the 1R20 results were reviewed, the voltage is ~ 0.6 volts.

This damage mechanism has never been called in this design of generator. There was history to support the fact that the signals were not changing and there was no differential channel to support the fact that it was wear. Additionally the wear scar was long and tapered making it hard to detect.

Explain why the barriers put in place failed:

Overconfidence of the analysts. We rely on the skill and knowledge of the analyst to make several subjective calls based on a number of inputs. Variables such as sludge, changes in the material properties in the tubing and buff marks from fabrication all contribute to a large number of indications. This degradation has never been called for this design and it lacked some of the key inputs that the analysts typically find to call wear. Based on history, the requirement to further test the flaw was not employed. With that said, there were a very limited number of tubes that met this scenario so the odds were not good for it to be identified.

Also there were lots of distractions with finding tie rod bowing in SGB – first time.

ATTACHMENT 9.9 **LEVEL 2 HPER REPORT**

Sheet 2 of 2

APPLICABLE HU TRAPS:

☐ Time Pressure	☒ Vague Guidance	☐ Physical Environment
☒ Distraction/Interruption	☐ First Shift/Late Shift	☐ Mental Stress
☐ Multiple Tasks	☐ Peer Pressure	
☒ Overconfidence	☐ Change/Off-Normal	

WORKER TOOLS: (Mark those which were not IAW standards AND directly contributed to the error)

☒ Procedure Use/Adherence	☒ Self-Checking	☐ Job Briefing
☐ Placekeeping	☐ Peer Checking	☐ Turnover
☐ Verbal Communication	☐ Knowledge/Training	☐ Coaching
☐ Written Communication	☐ Job Site Review	☒ Questioning Attitude
☐ Concurrent Verification	☐ Independent Verification	

SUPERVISOR TOOLS: (Mark those which were not IAW standards AND directly contributed to the error)

☐ Worker Properly Qualified	☐ Roles and Responsibilities	☐ Lead By Example
☐ Priority and Focus Established	☐ Contingencies Planned	☐ Coaching
☐ Error Traps Considered	☐ Accountability	
☐ Support Management Expectations	☐ Clear Performance Standards	

MANAGEMENT TOOLS: (Mark those which were not IAW standards AND directly contributed to the error)

☐ Well Communicated Plans	☐ Resource Allocation	☐ Coaching
☐ Clear Consistent Priorities	☐ Learning Environment	☐ Change Management
☐ Clear, Well Communicated Expectations	☐ Promoting a Self-Critical Culture	
☐ Sponsorship of Error Reduction & Risk Mgmt.	☐ Elimination of Non-Productive Barriers	

MANAGED DEFENSES: (Mark those which were not IAW standards AND directly contributed to the error)

☐ IPTE	☐ Flagging	☐ Engineered Controls
☐ Robust Barriers	☐ Post Job Review	☐ Oversight Controls
☐ Critical Step Identification	☐ Procedure Quality	☐ Risk Management
☐ Walk Downs	☐ Work Order Quality	☐ Abort Criteria Not Clear/Met

LATENT ORGANIZATIONAL WEAKNESSES: (Mark which LOWs contributed to the issue)

☐ Training/Qualification	☐ Values and Norms	☐ Change Management
☐ Maintenance/Testing	☐ Resources Management	☐ Human Factors
☐ Work Planning and Scheduling	☐ Displays and Labels	☐ Procedures and Documents
☐ Environmental Conditions		

PERFORMANCE MODE AT THE TIME OF ERROR

☒ Skill ☐ Rule ☐ Knowledge Prepared by : Dan Meatheany Date: 11/29/2011