November 29, 1983

Docket No.50-255

MEMORANDUM FOR: Dennis M. Crutchfield, Chief
Operating Reactors Branch #5
Division of Licensing

FROM: Thomas V. Wambach, Project Manager
Operating Reactors Branch #5
Division of Licensing

SUBJECT: FORTHCOMING MEETING WITH CONSUMERS POWER COMPANY

Time & Date: Wednesday
December 7, 1983
10:00 a.m.

Location: Rm 220
Landow Building
Bethesda, Maryland

Purpose: To report results of Steam Generator Inspection at Palisades including depth determination of IGA and proposed plugging criteria.

Participants: Consumers Power Company
D. VandeWalle et. al.

NRC

| | |
|---|---|
| B.D. Liaw | C. McCracken |
| C.E. Cheng | E. Murphy |
| L. Frank | D. Crutchfield |
| H. Conrad | T. Wambach |

Original signed by

Thomas V. Wambach, Project Manager
Operating Reactors Branch #5
Division of Licensing

cc: See next page



SEQ1
DSU use code 1/0

| OFFICE | DL:ORB #5 | | 04 | | | | |
|---|---|---|---|---|---|---|---|
| SURNAME | TWambach:jc | | | | | | |
| DATE | 11/29/83 | | | | | | |

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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Thomas V. Wambach

Thomas V. Wambach, Project Manager
Operating Reactors Branch #5
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Room 1 - Capitol Building
Lansing, Michigan 48913

Palisades Plant
ATTN: Mr. Robert Montross
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U. S. Environmental Protection Agency
Federal Activities Branch
Region V Office
ATTN: Regional Radiation Representative
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Resident Inspector
c/o U. S. NRC
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Central File

NOV 8 1983

MEMORANDUM FOR: Richard H. Vollmer, Director
Division of Engineering

THRU: William V. Johnston, Assistant Director
Materials, Chemical & Environmental Technology

FROM: B. D. Liaw, Chief
Materials Engineering Branch

SUBJECT: MEETING WITH CONSUMERS POWER COMPANY ON OCTOBER 25, 1983 TO DISCUSS INSPECTION OF PALISADES STEAM GENERATORS (VIEWGRAPHS ATTACHED)

The agenda covered the results of ongoing steam generator tube inspections, plans to complete 100% inspection of the tubes, proposed tube pulling and laboratory investigatory actions.

In 1982, circumferential cracks were found in two leaking tubes when 4 x 4 differentially linked surface riding pancake coil eddy-current probes were used.

In the present ongoing inspections, of which ~ 10% of the inspection data has been analyzed, approximately 26 tubes with similar circumferential cracks have been found. Two other types of flaws of unquantifiable depth have also been found throughout the steam generators. Tube inspections have been expanded to include 100% of the steam generator tubes using the 4 x 4 technique supplemented as needed by multifrequency and rotating pancake coils to quantify flaw depth.

Circumferential cracks identified by the 4 x 4 probe, irrespective of depth, will be plugged. Disposition of the remaining tubes with other type flaws will await the laboratory examination results of pulled tubes which will undergo ECT correlations with destructive metallurgical examinations. Chemical analyses will also be conducted to determine causative species responsible for the observed degradation.

Corrective actions will be based on the results of the above investigations and others, such as in-situ strength testing of tubes as a backup to ECT depth determinations.

50-255

Tube pulling will commence before the eddy current testing is complete with laboratory results expected sometime in January 1984.

Original signed by
B. D. Liaw
B. D. Liaw, Chief
Materials Engineering Branch

Enclosure:
Vugraphs

cc: W. Johnston
B. D. Liaw
C. Cheng
L. Frank
H. Conrad
V. Benaroya

DISTRIBUTION:
Central File
MTEB Reading File
Palisades File

| DE:MTEB | DE:MTEB | DE:MTEB | DE:AD:MCET |
|---|---|---|---|
| LFrank:aj | CCheng | BDLiaw | WJohnston |
| 10/27/83 | 10/28/83 | 10/1 /83 | 10/ 4/83 |

# AGENDA

## CONSUMERS POWER COMPANY MEETING WITH NRC

## PALISADES PLANT

## STEAM GENERATOR PERFORMANCE

## OCTOBER 25, 1983

| | |
|---|---|
| INTRODUCTION AND OVERVIEW | WJBECKIUS |
| INSPECTION RESULTS AND PLANS | JSJANDOVITZ |
| TUBE PULLING AND ANALYSIS | JRSCHEPERS |
| LICENSING ACTIONS | DJVANDEWALLE |

# OVERVIEW

1. IN 1982 CPCO MADE A COMMITMENT TO DEVELOP AN EDDY CURRENT PROBE THAT COULD SEE CRACKING IN THE U-BEND REGION

2. WE USED THE COIL WE DEVELOPED TO DO THE 1983 INSPECTION AND HAVE SEEN MANY INDICATONS IN THE PALISADES STEAM

3. WE HAVE FORMED A TASK FORCE TO INVESTIGATE AND MAKE RECOMMENDATIONS TO CPCO MANAGEMENT

## PURPOSE OF THIS MEETING

1. TO TELL NRC WHAT WE HAVE FOUND SO FAR

2. TO TELL NRC WHAT WE ARE DOING ABOUT IT

3. TO OBTAIN AN UNDERSTANDING OF NRC CONCERNS AND TO UTILIZE ANY EXPERTISE NRC MAY HAVE DEVELOPED

4. TO OUTLINE WHAT NRC REVIEWS WE ARE LIKELY TO NEED TO RETURN TO POWER AND BEGIN PLANNING THEN

## ACTIONS TAKEN BY CPCO

1. PROCEEDING WITH 100% EDDY CURRENT TEST OF BOTH STEAM GENERATORS USING 4C4 PROBE

2. PROCEED TO PULL SAMPLES OF TUBING FROM THE STEAM GENERATORS

3. PROCEED WITH PLANT SAFETY ANALYSIS CALCULATIONS WHICH ARE PARAMETRIC IN THE NUMBER OF STEAM GENERATOR TUBES PLUGGED

4. DEVELOP THE ECT TECHNOLOGY TO RELIABLY DETERMINE DEPTH OF THE ATTACK

5. INVESTIGATING IN-PLACE STRENGTH TESTING AS A BACK UP TO ECT DEPTH DETERMINATION TECHNOLOGY

## 1982 SUMMARY

* LEAKAGE OBSERVED IN A STEAM GENERATOR IN 1ST QUARTER OF 1982

* TWO LEAKING TUBES NOTED; FOUND BY SECONDARY SIDE PRESSURIZATION

* TUBES WERE INSPECTED WITH VARIOUS EDDY CURRENT TECHNIQUES. FLAWS CHARACTERIZED AS VERY TIGHT CIRCUMFERENTIAL CRACKS.

* FLAWS NOT DETECTED WITH BOBBIN STYLE PROBE

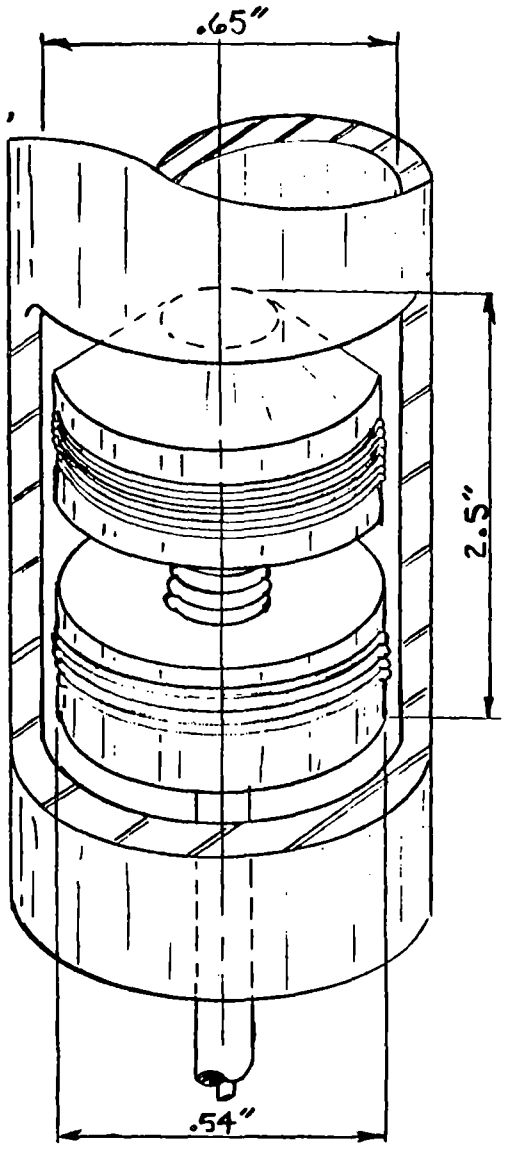
* ADDITIONAL 9% OF TUBES INSPECTED WITH 4x4 PROBE - STRAIGHT SECTIONS ONLY

* NO FURTHER INDICATIONS NOTED

* PLANT WAS RETURNED TO SERVICE

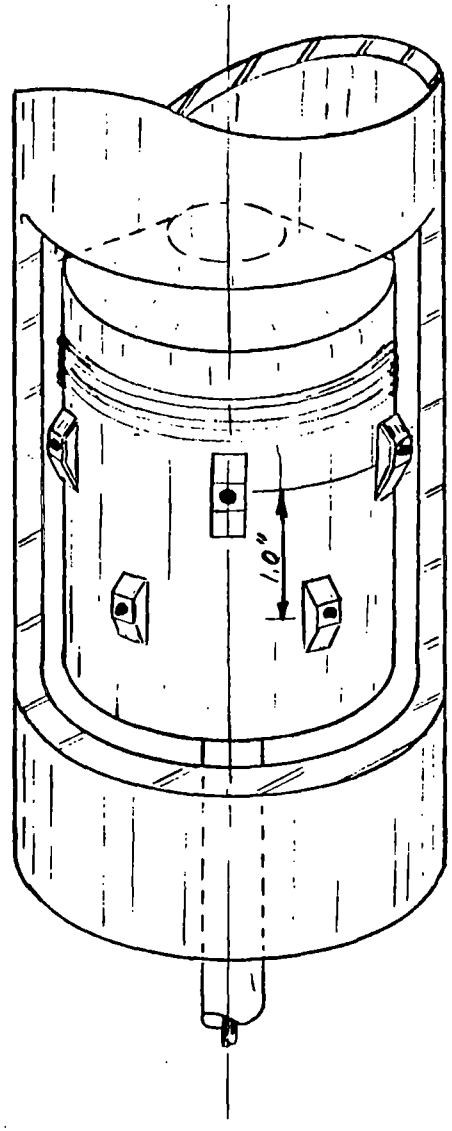
# EDDY CURRENT PROBES

BOBBIN,
SFW



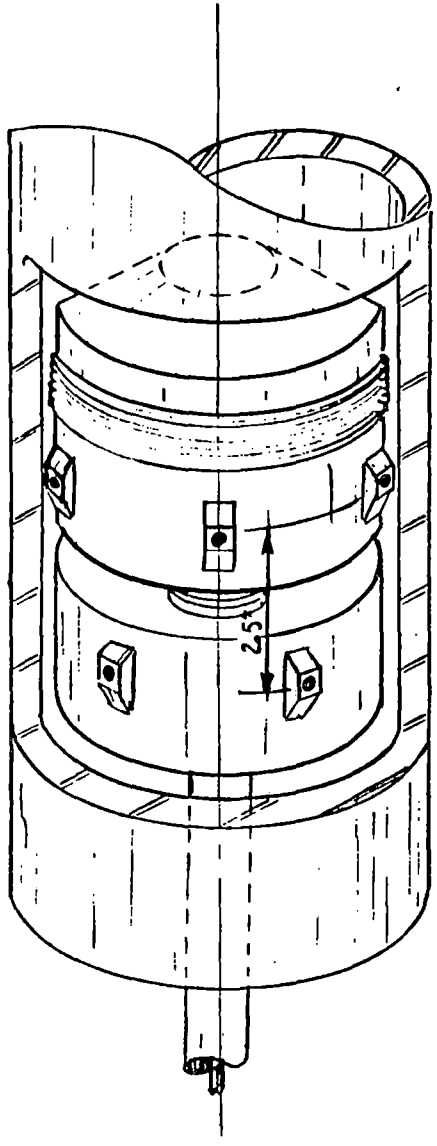

- SFW PROBE
- DIFFERENTIAL MULTIFREQUENCY
- CIRCUMFERENTIAL WINDING

4X4




- DIFFERENTIALLY LINKED
- SURFACE RIDING COILS
- PANCAKE COILS .187"DIAMETER

4C4




- DIFFERENTIALLY LINKED
- SURFACE RIDING COILS
- PANCAKE COILS .187" DIAMETER

# 1983 INSPECTION

## WASTAGE

(No increase wastage)

MULTIFREQUENCY BOBBIN PROBE all > 30%

35 - 40% OF THE HL TUBES INSPECTED

RESULTS INDICATE ESSENTIALLY ZERO WASTAGE GROWTH

## DENTING

4 BLOCKED TUBES FOUND - 3 IN B/HL AND 1 IN A/HL

not pass .540 probe

PROFILOMETRY PLANNED BUT NOT COMPLETED YET

LESS BLOCKED TUBES IN 1983 THAN IN 1979 AND 1981

## SLEEVES

INSPECTED WITH SLOW PULL BOBBIN PROBE AND ROTATING PANCAKE COIL PROBE

SLEEVES FOUND OK

## LOOSE PARTS

PERIPHERY TUBES INSPECTED FROM TOP OF TUBESHEET TO FIRST SUPPORT

INSPECTED WITH 100 Kz ABSOLUTE MODE BOBBIN TECHNIQUE

NO INDICATIONS OF WEAR NOTED

## CIRCUMFERENTIAL CRACKS

3% SAMPLE IN A AND B HOT LEG (INCLUDING U-BENDS)

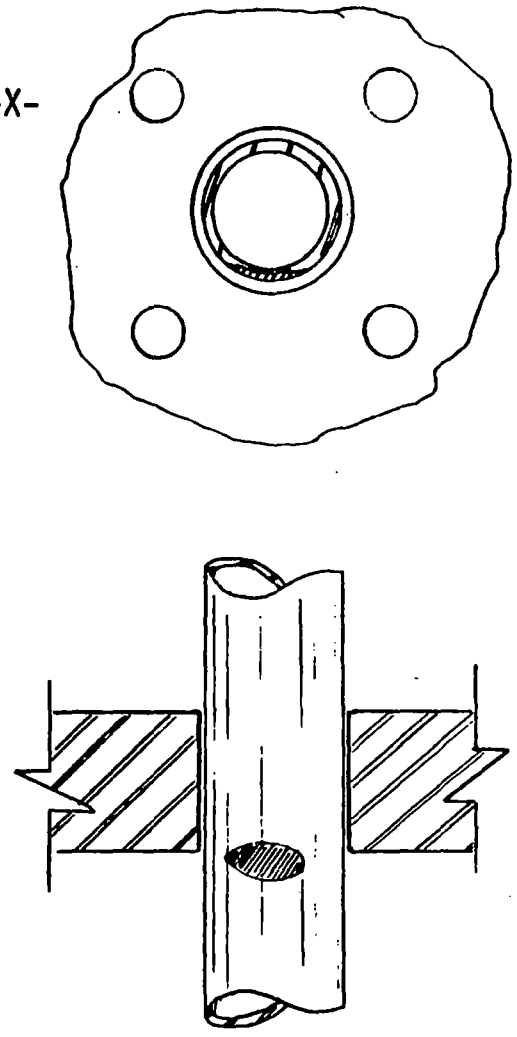
4c4 TECHNIQUE USED

SEVERAL INDICATIONS NOTED, EXPANDED TESTING INITIATED

support plate 9 / outside of annulus

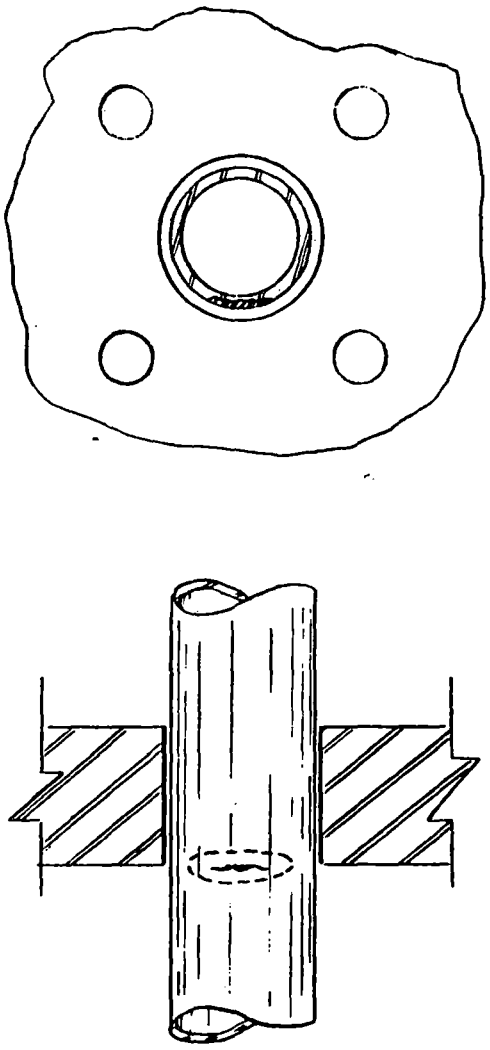
# POSTULATED INDICATION CHARACTERIZATION

## -X-



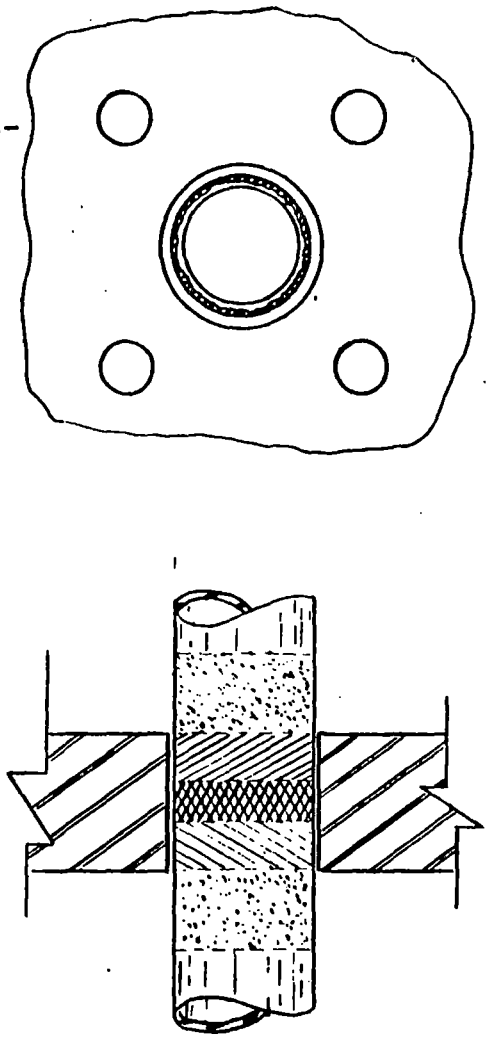
- ~90° CIRCUMFERENTIAL EXTENT
- .2" AXIAL EXTENT
- LOCATED AT UPPER OR LOWER EDGE OF SUPPORT

## -XX-



- LESS THAN .1" AXIAL EXTENT
- ~60° CIRCUMFERENTIAL EXTENT
- LOCATED IN AN X OR XS CONDITION
- SIMILAR TO 1982 LEAK INDICATIONS

## -XS-



- LOCATED WITHIN TUBE SUPPORT PLATES

MINIMUM AREA 360°x.2"
NORMALLY ALSO EFFECTED
OCCASIONALLY EFFECTED

## NATURE OF INDICATIONS

THE INDICATIONS WERE EVALUATED AND DETERMINED NOT TO BE REPRESENTATIVE OF THESE FLAWS:

WASTAGE

PITTING

DENTING

PLATING

MECHANICAL WEAR

## DEPTH OF INDICATIONS

THE 4c4 PROBE IS NOT QUALIFIED FOR DETERMINATION OF CRACK DEPTH. IF INDICATIONS OF CRACKING WERE OBSERVED IT WAS TO BE CONSIDERED PLUGGABLE.

Absolute

CRACK DEPTH IS QUANTIFIABLE THROUGH THE ROTATING PANCAKE PROBE (RPC) TECHNIQUE. SEVERAL CRACKS DETECTED BY 4c4 WERE SIZED WITH RPC AND DETERMINED TO BE 80 - 90% THROUGH WALL.

DEPTH CORRELATION OF THE x AND xs CONDITIONS IS CURRENTLY UNDERWAY AND AS YET DEPTH CANNOT BE QUANTIFIED.

## HISTORY OF x, xs

SEVERAL TUBES EXHIBITING x AND xs INDICATION WERE SELECTED AND THEIR RESPECTIVE BOBBIN HISTORIES WERE REVIEWED. IN ALL CASES A SLIGHT (10%) INDICATION HAS BEEN PRESENT SINCE 1974 - 75 AND HAS NOT CHANGED THROUGH 1983.

ALSO, NINE (9) TUBES WERE SELECTED WITH 1982 4x4 RESULTS AND THE SIGNALS COMPARED. RESULTS OF THE COMPARISON SHOW EVIDENCE OF THE SAME TUBE CONDITION IN 1982.

# 1983 PALISADES STEAM GENERATOR EXPANDED INSPECTION

| S/G LEG | TUBES INSPECTED/ | % | INDICATIONS X | XX | XS | TUBES AFFECTED | % |
|---|---|---|---|---|---|---|---|
| A HL | 780 | 12% | 440 | 13 (10)* | 178 | 459 | 59% |
| A CL | 704 | 10% | 185 | 7 (6)* | 279 | 421 | 60% |
| B HL | 575 | 9% | 408 | 3 (3)* | 1175 | 544 | 94% |
| B CL | 682 | 10% | 175 | 3 (3)* | 820 | 591 | 87% |

* NO OF TUBES WITH INDICATIONS.

MI1083-TF08-NS02

## 100% INSPECTION

* STARTED ON OCTOBER 15.

* ALL FOUR LEGS IN PARALLEL.

* ALL TUBES TO BE INSPECTED WITH 4c4 TECHNIQUE SUPPLEMENTED AS NEEDED BY MULTIFREQUENCY AND ROTATING PANCAKE COIL.

* INSPECTION RATE OF ABOUT 200 TUBES/DAY/LEG, COMPLETION DATE SCHEDULE TO BE END OF NOVEMBER.

## STATUS

| S/G LEG | TUBES TO BE INSPECTED | AS OF 10/24 TUBES INSPECTED*/ | % |
|---|---|---|---|
| A HL | 5703 | 1845 | 32% |
| A CL | 5849 | 2583 | 44% |
| B HL | 6012 | 1694 | 28% |
| B CL | 6012 | 1365 | 22% |

* DOES NOT INCLUDE TUBES INSPECTED IN ORIGINAL SAMPLE.

## INTENDED INVESTIGATORY ACTIONS

* ET INSPECTION OF TUBES PULLED IN 1974

* DEPLUG AND ET INSPECTION OF A SAMPLE OF TUBES PLUGGED IN 1974, 1975 AND 1976

* DATA COMPARISON OF BOBBIN DATA FROM 1974 THROUGH 1983, AND 4c4 DATA OF 1981, 1982 AND 1983

* INSPECTION OF IGA SAMPLES:

  EXISTING LABORATORY IGA SAMPLES

  REAL S/G IGA TUBES

  LABORATORY SAMPLES FABRICATED BY CPCO TO SIMULATE THE PALISADES INDICATIONS

* INDEPENDENT DEPTH QUANTIFICATION STUDY

TUBE PULLING

Objectives

1. Validate x and xs ECT indications are defects.

2. Attempt to corrolate ECT signals and defect depth.

3. Attempt to determine the cause of the defects.

Candidates

| | |
|---|---|
| - Secondary side | "A" Steam Generator<br>"Batwing" Area |
| - Primary Side | "B" Steam Generator<br>2nd TSP |

Schedule

| | |
|---|---|
| - Tube Pull Complete | Mid-December |
| - Analysis Complete | Mid-January |

LABORATORY ANALYSIS

- The analysis plan will be developed with assistance from EPRI SGOG.
- Candidate laboratories are the Vendor Labs and Battelle Columbus.
- Two laboratories will probably perform independent analysis.
- The analysis focus will be:
  a. Defect Morphology
  b. Extent of Defects (ECT Detectability)
  c. Metallurgical Microstructure of the Tubing
  d. Chemical Species Associated With the Defect

All Heat Treated ?

LABORATORY RESULTS EVALUATION

1. Eddy Current Testing

   - Compare post pull ECT with actual defect depth data.

   - Develop a signal to depth corrolation.

2. Defect Cause

   - Review the laboratory results for an assessment as to cause (and rate).

   - Review Palisades secondary cycle operation.

   - Perform stress analysis of selected steam generator locations.

   - Review past ECT results (rate).

   - Integrate and assign probable cause.

3. Corrective Action

   - Assess corrective actions based upon probable cause and rate of corrosion.

# LICENSING ACTIONS

- INSPECTION RESULTS
- ANALYSIS OF PULLED TUBES
- REPAIR CRITERIA
- REVISED OPERATING LIMITS AND SETPOINTS (IF REQUIRED)

# STEAM GENERATOR TUBE PLUGGING CRITERIA

| | CRITERIA | ALLOWABLE DEGRADATION (%)* | OPERATING LIMIT |
|---|---|---|---|
| 1. | TUBES MUST NOT BE STRESSED BEYOND YIELD STRENGTH DURING FULL RANGE OF NORMAL OPERATION | 64 | PRIMARY-TO-SECONDARY $\Delta P < 1380$ PSID** |
| 2. | THE FACTOR OF SAFETY AGAINST FAILURE BY BURSTING MUST BE NO LESS THAN 3 DURING NORMAL OPERATION | 64 | PRIMARY-TO-SECONDARY $\Delta P < 1380$ PSID** |
| 3. | STRESSES INDUCED BY THE COMBINATION OF LOADS DUE TO LOCA AND SSE SHALL NOT EXCEED LIMITS FOR FAULTED CONDITIONS (MEMBRANE + BENDING STRESS INTENSITY = 80.6 KSI) | 64 | PRIMARY PRESSURE < 2100 PSIA |
| 4. | STRESSES INDUCED BY LOADS DUE TO A POSTULATED MAIN STEAMLINE BREAK SHALL NOT EXCEED LIMITS FOR FAULTED CONDITIONS | 73 | PRIMARY PRESSURE < 2100 PSIA |

* ASSUMES UNIFORMLY THINNED TUBES

** 1530 PSID DURING ANTICIPATED OPERATIONAL TRANSIENTS

Plugging limit - 58% — 6% ECT error