a McDermott company

JHT/89-182 September 6, 1989

3315 Old Forest Road P.O. Box 10935 Lynchburg, VA 24506-0935 (804) 385-2000



Mr. Darl Hood U. S. Nuclear Regulatory Commission Washington, D.C. 20555

Subject: McGuire Nuclear Station, Unit 2

Evaluation of B&W Alloy 600 Plugs Justification for Return to Power

Dear Mr. Hood:

The NRC will be receiving under separate cover from Duke Power Company copies of the subject report. B&W considers this report to be proprietary and a supporting affidavit is attached. Please handle distribution within the NRC accordingly.

1 Haylor

J. H. TayYor, Manager Licensing Services

JHT/bcc

Attachments

cc: H. F. Conrad/NRC

K. R. Wichman/NRC

E. L. Murphy/NRC

L. B. Engle/NRC

C. F. Robinson/DPC

J. S. Warren/DPC

S. P. Hellman/B&W

R. B. Borsum/B&W

AFFIDAVIT OF JAMES H. TAYLOR

- A. My name is James H. Taylor. I am Manager of Licensing Services in the Nuclear Power Division of the Babcock & Wilcox Company. The 3&W Fuel Company is administratively responsible to the Babcock and Wilcox Nuclear Power Division (NPD) and utilities the NPD Licensing Services. Therefore I am authorized to execute this Affidavit.
- B. I am familiar with the criteria applied by Babcock & Wilcox to determine whether certain information of Babcock & Wilcox is proprietary and I am familiar with the procedures established within Babcock & Wilcox, particularly the Nuclear Power Division, to ensure the proper application of these criteria.
- C. In determining whether a Babcock & Wilcox document is to be classified as proprietary information, an initial determination is made by the Unit Manager, who is responsible for originating the document, as to whether it falls within the criteria set forth in Paragraph D hereof. If the information falls within any one of these criteria, it is classified as proprietary by the originating Unit Manager. This initial determination is reviewed by the cognizant Section Manager. If the document is designated as proprietary, it is reviewed again by Licensing personnel and other management within the Nuclear Power Division as designated by the Manager of Licensing Services to assure that the regulatory requirements of 10 CFR Section 2.790 are met.
- D. The following information is provided to demonstrate that the provisions of 10 CFR Section 2.790 of the Commission's regulations have been considered:
 - (i) The information has been held in confidence by the Babcock & Wilcox Company. Copies of the document are clearly identified as proprietary. In addition, whenever

AFFIDAVIT OF JAMES H. TAYLOR (Cont'd.)

Babcock & Wilcox transmits the information to a customer, customer's agent, potential customer or regulatory agency, the transmittal requests the recipient to hold the information as proprietary. Also, in order to strictly limit any potential or actual customer's use of proprietary information, the following provision is included in all proposals submitted by Babcock & Wilcox, and an applicable version of the proprietary provision is included in all of Babcock and Wilcox's contracts:

"Purchaser may retain Company's proposal for use in connection with any contract resulting therefrom, and, for that purpose, make such copies thereof as may be necessary. Any proprietary information concerning Company's or its Supplier's products or manufacturing processes which is so designated by Company or its Suppliers and disclosed to Purchaser incident to the performance of such contract shall remain the property of Company or its Suppliers and is disclosed in confidence, and Purchaser shall not publish or otherwise disclose it to others without the written approval of Company, and no rights, implied or otherwise, are granted to produce or have produced any products or to practice or cause to be practiced any manufacturing processes covered thereby.

Notwithstanding the above, Purchaser may provide the NRC or any other regulatory agency with any such proprietary information as the NRC or such other agency may require; provided, however, that

AFFIDAVIT OF JAMES H. TAYLOR (Cont'd.)

Purchaser shall first give Company written notice of such proposed disclosure and Company shall have the right to amend such proprietary information so as to make it non-proprietary. In the event that Company cannot amend such proprietary information, Purchaser shall, prior to disclosing such information, use its best efforts to obtain a commitment from NRC or such other agency to have such information withheld from public inspection.

Company shall be given the right to participate in pursuit of such confidential treatment."

- (ii) The following criteria are customarily applied by
 Babcock & Wilcox in a rational decision process to
 determine whether the information should be classified as
 proprietary. Information may be classified as
 proprietary if one or more of the following criteria are
 met:
 - a. Information reveals cost or price information, commercial strategies, production capabilities, or budget levels of Babcock & Wilcox, its customers or suppliers.
 - b. The information reveals data or material concerning Babcock & Wilcox research or development plans or programs of present or potential competitive advantage to Babcock & Wilcox.
 - c. The use of the information by a competitor would decrease his expenditures, in time or resources, in designing, producing or marketing a similar product.

AFFIDAVIT OF JAMES H. TAYLOR (Cont'd.)

- d. The information consists of test data or other similar data concerning a process, method or component, the application of which results in a competitive advantage to Babcock & Wilcox.
- e. The information reveals special aspects of a process, method, component or the like, the exclusive use of which results in a competitive advantage to Babcock & Wilcox.
- f. The information contains ideas for which patent protection may be sought.

The document(s) listed on Exhibit "A", which is a tached hareto and made a part hereof, has been evaluated in accordance with normal Babcock & Wilcox procedures with respect to classification and has been found to contain information which falls within one or more of the criteria enumerated above. Exhibit "B", which is attached hereto and made a part hereof, specifically identifies the criteria applicable to the document(s) listed in Exhibit "A".

- (iii) The document(s) listed in Exhibit "A", which has been made available to the United States Nuclear Regulatory Commission was made available in confidence with a request that the document(s) and the information contained therein be withheld from public disclosure.
- (iv) The information is not available in the open literature and to the best of our knowledge is not known by Combustion Engineering, EXXON, General Electric,

AFFIDAVIT OF JAMES H. TAYLOR (Cont'd.)

Westinghouse or other current or potential domestic or foreign competitors of Babcock & Wilcox.

- (v) Specific information with regard to whether public disclosure of the information is likely to cause harm to the competitive position of Babcock & Wilcox, taking into account the value of the information to Babcock & Wilcox; the amount of effort or money expended by Babcock & Wilcox developing the information; and the ease or difficulty with which the information could be properly duplicated by others is given in Exhibit "B".
- E. I have personally reviewed the document(s) listed on Exhibit "A" and have found that it is considered proprietary by Babcock & Wilcox because it contains information which falls within one or more of the criteria enumerated in Paragraph D, and it is information which is customarily held in confidence and protected as proprietary information by Babcock & Wilcox. This report comprises information utilized by Babcock & Wilcox in its business which afford Babcock & Wilcox an opportunity to obtain a competitive advantage over those who may wish to know or use the information contained in the document(s).

AFFIDAVIT OF JAMES H. TAYLOR (Cont'd.)

JAMES H. TAYLOR

State of Virginia)

SS. Lynchburg

City of Lynchburg)

James H. Taylor, being duly sworn, on his oath deposes and says that he is the person who subscribed his name to the foregoing statement, and that the matters and facts set forth in the statement are true.

JAMES H. TAYLOR

Subscribed and sworn before me this jeth day of September 1989.

Notary Public in and for the City of Lynchburg, State of Virginia

My Commission Expires april 5, 1992

Exhibit A

McGuire Nuclear Station, Unit 2

Evaluation of B&W Alloy 600 Plugs

Justification for Return to Power

B&W Document No. 51-1175791-00

Exhibit B

Description of Material

McGuire Nuclear Station, Unit 2 Evaluation of B&W Alloy 600 Plugs Justification for Return to Power B&W Doc. No. 51-1175791-00

Applicable Criteria

b, c, d, e

McGUIRE UNIT 2 TUBE INTEGRITY VERIFICATION PRESENTATION

DISCUSSION TOPICS

- O TUBE INTEGRITY VERIFICATION SUMMARY
- O McGUIRE UNIT 2 PLANT OPERATING HISTORY
- O DISCUSSION OF FIELD RELATED ACTIONS TO VERIFY TUBE BUNDLE INTEGRITY
- O STEAM GENERATOR TUBE INTEGRITY CONSIDERATIONS

FREE SPAN OD INITIATED SCC

- DESTRUCTIVE EXAMINATION RESULTS
- EDDY CURRENT TEST RESULTS
- CHEMISTRY EXPERIENCE
- FUTURE ACTIVITIES

U-BEND RESTRICTIONS

SECONDARY SIDE LOOSE OBJECTS

o CONCLUSIONS

McGUIRE UNIT 2 TUBE INTEGRITY VERIFICATION SUMMARY

- O CRACK INITIATION ON TUBE R18C25 OF SG B McGUIRE
 UNIT 1 RESULTED FROM THE PRESENCE OF GROOVE PLUS
 LOCAL METALLURGICAL CONTAMINATION ON THE TUBE
 SURFACE
- O ANALYSIS OF EXTENSIVE INSPECTION AND TUBE EXAMINATION RESULTS ESTABLISHED THAT THE R18C25 RUPTURE WAS A UNIQUE EVENT
 - CRACKING HAS NOT BEEN EXPERIENCED IN OTHER TUBES
 - TWO PHASE MATERIAL DEPOSITED ON THE SURFACE
 CANNOT BE CORRELATED TO THE TOOL MATERIALS
 USED DURING THE MANUFACTURING PROCESS
 (ALTHOUGH GROOVE OCCURRED DURING THE TUBE
 MANUFACTURING PROCESS)
- O CONSERVATIVE ACTIONS HAVE BEEN TAKEN TO ASSURE THAT McGUIRE UNIT 2 CAN SAFELY RETURN TO POWER
 - EXTENSIVE EDDY CURRENT INSPECTION
 - CONSERVATIVE TUBE PLUGGING
 - SECONDARY SIDE VISUAL INSPECTION

MCGUIRE UNIT 2 PLANT OPERATING HISTORY

- O McGUIRE UNIT 2 IS A 4 LOOP WESTINGHOUSE PWR, RATED AT 3411 MWT, EQUIPPED WITH MODEL D3 PREHEAT STEAM GENERATORS
- O INITIAL CRITICALITY WAS REACHED IN MAY 1983; COMMERCIAL OPERATION IN MARCH 1984
- O PRIOR TO 1989, 743 TUBES WERE PLUGGED MOSTLY DUE TO PWSCC IN THE ROW 1 U-BENDS (PREVENTIVE) AND IN THE ROLL EXPANSION ZONES OF THE HOT LEG TUBESHEET
- O THERE IS NO EVIDENCE OF SYSTEMATIC SECONDARY SIDE TUBE CORROSION TO DATE
- O A FEW TUBES HAVE BEEN PLUGGED DUE TO WEAR
- O SINCE INITIAL STARTUP, THE SECONDARY WATER
 CHEMISTRY HAS BEEN ALL VOLATILE TREATMENT (AVT)

McGUIRE UNIT 2

FIELD RELATED ACTIONS TO VERIFY TUBE BUNDLE INTEGRITY

- O EDDY CURRENT TESTING INCLUDING SPECIAL RPC TESTING
- O REVIEW OF CHEMISTRY EXPERIENCE
- O TUBE PLUGGING
- o FOREIGN OBJECT SEARCH AND RETRIEVAL (FOSAR)
- O SECONDARY SIDE VISUAL INSPECTION

SCOPE OF EDDY CURRENT TESTING

- O BOBBIN COIL- 100 % FULL LENGTH- ALL STEAM GENERATORS
- O ROTATING PANCAKE COIL
 - CHARACTERIZATION OF ALL CLASSES OF BOBBIN SIGNALS

MANUFACTURING/INSTALLATION ARTIFACTS:

BUFF MARKS
PERMEABILITY VARIATIONS
INSTALLATION MARKS

ROLL EXPANSION PWSCC TUBE WEAR; PREHEATER, AVB, FOREIGN OBJECTS

McGUIRE UNIT 2 STEAM GENERATOR TUBE INTEGRITY CONSIDERATIONS

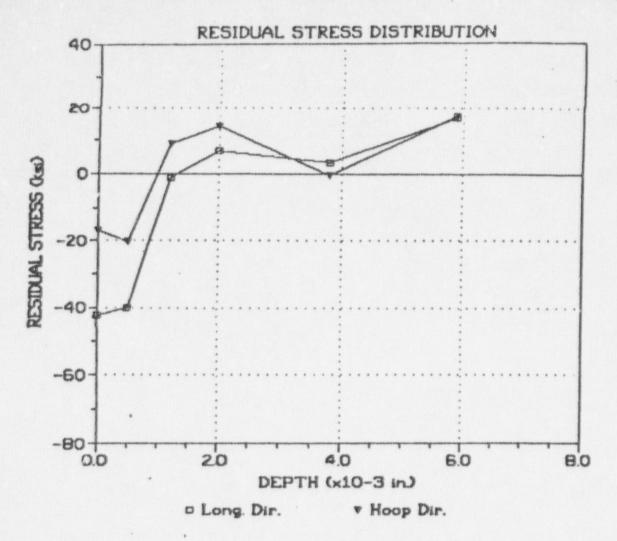
- O FREE SPAN OUTER DIAMETER INITIATED STRESS CORROSION CRACKING
- O U-BEND RESTRICTIONS
- O SECONDARY SIDE LOOSE OBJECTS

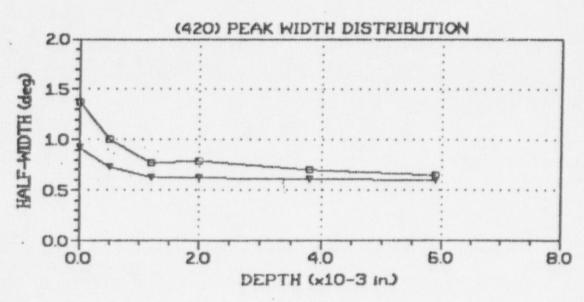
FREE SPAN OUTER DIAMETER INITIATED STRESS CORROSION CRACKING

THE RUPTURED TUBE FROM McGUIRE UNIT 1 WAS PULLED AND METALLURGICALLY EXAMINED TO PERMIT A CONCLUSIVE DETERMINATION OF THE DEGRADATION MECHANISM

INITIAL EXAMINATION

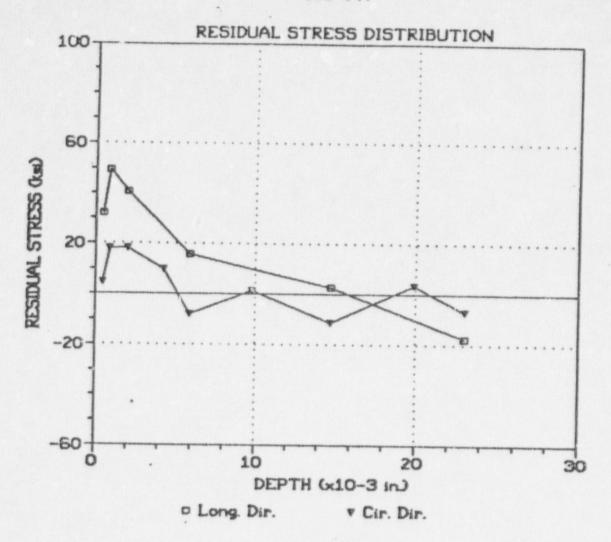
- O DEGRADATION WAS OD INITIATED SCC
- O DEGRADATION WAS CONFINED TO A SHALLOW, NARROW, AXIAL GROOVE
- O HIGH RESIDUAL STRESSES WERE PRESENT IN THE GROOVE
- O PRESENCE OF CONTAMINANT WAS POSTULATED TO BE REQUIRED FOR CRACK INITIATION

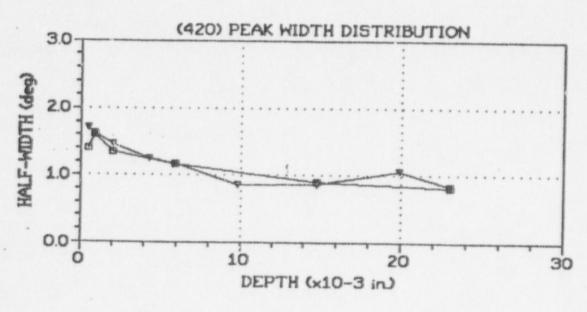




INCONEL 600 MCGUIRE-1 STEAM GENERATOR TUBES Specimen 13/34-2-3C.1 110 Deg. Location

Figure 4





IN 600 TUBING SAMPLE Specimen 18/25-2-11 Groove Location

FURTHER EXAMINATION

TUBE R18C25

- O PRESENCE OF A FOREIGN MATERIAL IN THE GROOVE HAS BEEN CONFIRMED
- O COMPOSITION OF THE FOREIGN MATERIAL WAS NICKEL-FREE, IRON CHROMIUM (12% CR)
- O THE GROOVE OCCURRED DURING THE TUBE MANUFACTURING PROCESS
- O THE METALLURGICAL ANOMALY APPEARS TO BE A UNIQUE EVENT LIMITED TO THE TUBE WHICH RUPTURED

TUBE R13C34

- O NO SCC WAS IDENTIFIED BY BURST TEST FOR THIS TUBE
 OF THE SAME HEAT AS R18C25 AND WITH A LINEAR AXIAL
 INDICATION FROM EC INSPECTION
- O X-RAY RESIDUAL STRESS ANALYSIS OF PULLED TUBE
 R13C34 SHOWS THE RESIDUAL STRESSES AT THE GROOVE
 TO BE COMPRESSIVE

OF THE CRACKING MECHANISM

CONSISTENT WITH:

- O PULLED TUBE EVIDENCE
- O PLANT OPERATING HISTORY
- O NDE INSPECTION RESULTS
- O GENERAL FIELD AND LABORATORY EXPERIENCE WITH SCC BEHAVIOR OF ALLOY 600

CRACK INITIATION- COMBINED ACTION OF THE PRESENCE OF A GROOVE WITH HIGH RESIDUAL TENSILE STRESSES AND A LOCAL, METALLURGICAL CONTAMINANT ON THE TUBE SURFACE AT THE START OF SERVICE

CRACK GROWTH- DUE TO APPLIED STRESSES AND THE ACTION OF THE BULK SECONDARY SIDE WATER ENVIRONMENT

RESULTS OF EDDY CURRENT TESTING

- O BOBBIN COIL INDICATIONS WERE IN EXPECTED CATEGORIES AND LOCATIONS
- O RPC CHARACTERIZATION CONFIRMED ABSENCE OF CRACK-LIKE INDICATIONS FOR VARIOUS CLASSES OF BOBBIN COIL SIGNALS
- O NO INDICATIONS OF ODSCC WERE DISCOVERED IN EITHER
 THE #1 AND #2, #21 AND 22 BAFFLE PLATE SAMPLES OR
 IN THE SUPPLEMENTAL PROGRAM

McGUIRE UNIT 2 PLUGGED TUBE SUMMARY

	SG A	SG B	SG C	SG D
PREVIOUSLY PLUGGED TUBES (TOTAL)1	191	191	198	163
TUBES PLUGGED DURING JULY 1989 OUTAGE				
o PWSCC WITHIN F* REGION	49	24	29	29
O WEAR (PREHEATER)	0	2	0	0
o MANUFACTURING ARTIFACTS (FREE SPAN IND)2	7	1	3	18
o OTHER REASONS	2	6	1	2
TOTAL TUBES	249	224	231	212

¹ INCLUDES 144 ROW 1 TUBES PREVENTIVELY FLUGGED IN EACH STEAM GENERATOR EXCEPT FOR SG D WHICH HAD 12 ROW 1 TUBES RETURNED TO SERVICE

² INCLUDES ALL AXIAL INDICATIONS

McGUIRE UNIT 2 CHEMISTRY EXPERIENCE

- O McGUIRE UNIT 2 CHEMISTRY DATA WAS EVALUATED SINCE INITIAL STARTUP
 - OPERATING CHEMISTRY DATA, CHEMISTRY EXCURSION
 DATA, AND WET LAYUP CHEMISTRY DATA HAVE SHOWN
 THAT SECONDARY SYSTEMS CHEMISTRY CONTROL HAS
 BEEN WELL WITHIN CHEMISTRY GUIDELINES
 - HIDEOUT RETURN DATA INDICATED THAT CREVICE CHEMISTRY WAS ALKALINE
- O THERE WERE NO SIGNIFICANT CONCERNS IDENTIFIED
 WHICH WOULD HAVE BEEN ATTRIBUTABLE TO A CORROSION
 CONDITION IN THE McGUIRE UNIT 2 STEAM GENERATORS

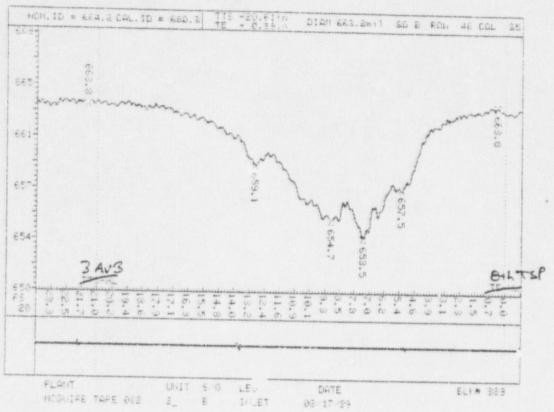
FUTURE ACTIVITIES

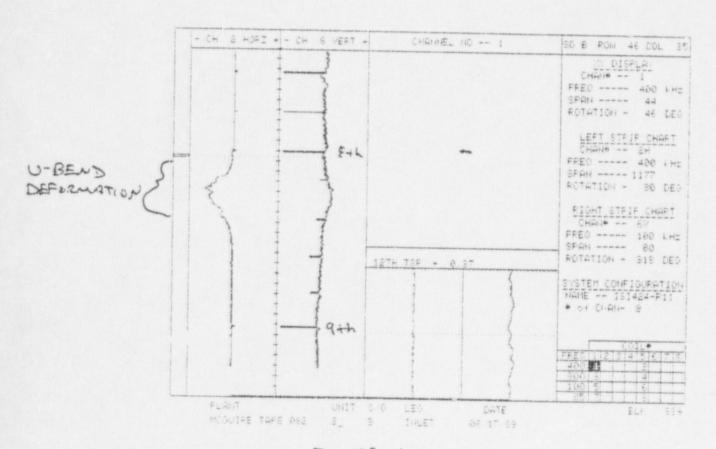
- O 100% BOBBIN COIL INSPECTION OF THE McGUIRE UNIT 1 STEAM GENERATORS IN 1990
- O IMPLEMENT EDDY CURRENT SAMPLE SIZE CONSISTENT WITH EPRI NDE GUIDELINES

STEAM GENERATOR U-BEND RESTRICTIONS

- O TUBES R46C35 AND R46C36 OF SG B RESTRICTED THE PASSAGE OF A 0.610" PROBE BETWEEN #1 AND #2 AVB'S
- O THE IDENTIFIED U-BEND RESTRICTIONS WERE DISCOVERED DURING PREVIOUS INSPECTIONS (1986, 1988) USING BOBBIN COIL PROFILOMETRY TECHNIQUES; EACH TUBE CONTINUES TO PASS A 0.590" PROBE
- O AUGUST 1989 DATA INDICATED THAT R46C37 EXHIBITED A SIMILAR TYPE PROFILE TRACE
- O EIGHTEEN (18) ADDITIONAL TUBES EXHIBIT VERY MINOR APPARENT REDUCTIONS AS COMPARED TO TUBES R46C35, 36, AND 37
- O NO CAUSATIVE REASON FOR TUBE DIAMETER REDUCTION HAS BEEN IDENTIFIED:
 - EDDY CURRENT INSPECTION DATA
 - SECONDARY SIDE VISUAL INSPECTIONS
- O NO CONTINUING SERVICE RELATED TUBE DEFORMATION OR RESTRICTION MECHANISM IS PRESENT IN THE McGUIRE UNIT 2 STEAM GENERATORS
- o TUBES R46C35, 36 AND 37 HAVE BEEN PLUGGED

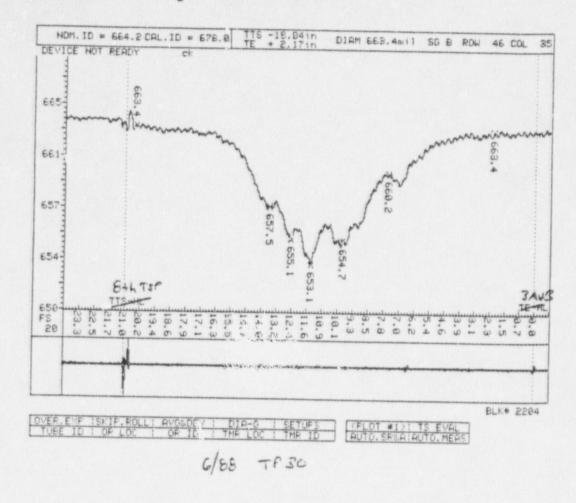
MIN DIA! .6535 MEDUCTION: .01 03





BOBBIN COIL PROFILE OF TUBE 46-35 U-BEND REGION, 8/89

NCM. DIA: . 6531 MIN. DIA: . 6531 REDUCTION: . 01 63



BOSSIN CCIL PROFILE OF TUSE 46-35 U-BEND REGION, G/BB

STEAM GENERATOR SECONDARY SIDE LOOSE OBJECTS

- o INVENTORY INCLUDES:
 - 2.5" X 1/16" DIAMETER WIRE FRAGMENT IN SG A
 - 3.5" X 1/16" DIAMETER WIRE FRAGMENT IN SG B
 - HEXAGONAL HEAD NUT- 0.375" ACROSS FLATS,
 0.433 INCH ACROSS CORNERS IN SG B
 - FLAT WASHER 0.5" OUTER DIAMETER BY 0.049"
 THICK IN SG B
- O ANALYSIS SHOWS PLANT OPERATION DURING CYCLE 6 IS ACCEPTABLE
- O SECONDARY SIDE FOREIGN OBJECT SEARCH AND RETRIEVAL WILL BE PERFORMED DURING THE NEXT OUTAGE
- O PERIPHERAL TUBES WILL BE EXAMINED BY EDDY
 CURRENT INSPECTION FOR TUBE WEAR INDICATIONS

McGUIRE UNIT 2 TUBE INTEGRITY VERIFICATION CONCLUSIONS

- O THE FOLLOWING ISSUES IN SUPPORT OF THE RETURN TO POWER OF McGUIRE UNIT 2 HAVE BEEN CONSIDERED:
 - McGUIRE UNIT 1 TUBE RUPTURE
 - McGUIRE UNIT 2 100% ECT INSPECTIONS
 - McGUIRE UNIT 2 U-BEND RESTRICTIONS
 - SECONDARY SIDE LOOSE OBJECT EVALUATION
- O BASED ON BOTH NDE AND METALLOGRAPHIC RESULTS, IT IS CONCLUDED THAT THE McGUIRE UNIT 1 TUBE RUPTURE WAS A UNIQUE EVENT
- O THE U-BEND RESTRICTIONS ENCOUNTERED IN STEAM
 GENERATOR B ARE NOT EXPECTED TO ADVERSELY IMPACT
 SG OPERABILITY OR STRUCTURAL INTEGRITY
- O PLANT OPERATION WITH THE IDENTIFIED SECONDARY SIDE LOOSE OBJECTS DURING CYCLE 6 HAS BEEN ANALYZED AND FOUND TO BE ACCEPTABLE