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ACCESSION NBR:8510160021 DOC.DATE: 85/10/10 NOTARIZED: NO DOCKET #
FACIL:50-316 Donald C. Cook Nuclear Power Plant, Unit 2, Indiana & 05000316
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ALEXICH,M.P. Indiana & Michigan Electric Co.
RECIP.NAME RECIPIENT AFFILIATION
DENTON,H.R. Office of Nuclear Reactor Regulation, Director

SUBJECT: Informs of program & course of action taken re steam generator sork during recent forced outages, Final rept being prepared to detail tube indication data, tubesheet indication mapping & comparison of data from previous insp.

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INDIANA & MICHIGAN ELECTRIC COMPANY

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October 10, 1985
AEP:NRC:0936A

Donald C. Cook Nuclear Plant Unit No. 2
Docket No. 50-316
License No. DPR-74
STEAM GENERATOR TUBE PLUGGING
INTERIM STATUS REPORT

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Denton:

Pursuant to the request of your staff, this letter is to inform you of the program and the course of action taken by Indiana & Michigan Electric Company (IMECo) in regard to the Donald C. Cook Plant Unit 2 steam generator (SG) work conducted during recent forced outages.

Unit 2 was removed from service on July 15, 1985 with a primary-to-secondary leak of 0.22 gpm. Visual inspection under a static head showed one leaking tube (R16-C56) in SG 23. Helium leak detection revealed no other leakage. Westinghouse Electric Corporation was brought in to perform eddy current (EC) testing of the leaking tube. Their tests revealed a defect about 1 inch below the top of the tubesheet. Additional EC testing of a block of 24 tubes around R16-C56 revealed tube R15-C55 to have a pluggable indication. Reanalysis of the 1984 data for R16-C56 confirmed that no reportable indications were present in 1984, but R15-C55 had an indication of 20% that was not identified. In view of the fact that previous inspections had not disclosed widespread tube degradation problems in the tubesheet region, and with only 90 days of fuel left in Cycle 5, a decision was made to plug the two tubes and return to service.

The unit was restarted on August 2. During the start-up, increases in activity at radiation monitors on air ejectors and blowdown samples indicated slight additional leakage in SG 23. The unit was again removed from service. Visual inspection under a static head revealed 2 leaking tubes (R7-C28 and R14-C70). Since we believed that the cause of the problem was associated with crevice leakage, helium testing was not performed. EC testing was begun on an initial

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sample of about 460 tubes and subsequently expanded to approximately 1500 tubes in the sludge pile region of the tubesheet, which is an area where industry experience and our own previous examinations had indicated potential problems. Attachment 1 provides a summary of the inspection results for SG 23 for this period.

During this inspection a primary and secondary EC data review was conducted to ensure accuracy. Westinghouse conducted the primary data review and Conam Inspection, an independent contractor, conducted the secondary review. As a result of that review, 35 tubes were plugged--20 due to defects as defined by the Technical Specifications, and 15 due to our administrative plugging criteria. Many of the tubes plugged had no previous indication of degradation. This gave us a concern, because our previous history of monitoring SGs--which included pulling tubes for examination--and industry experience with similar problems indicated that this type of degradation may have been caused by intragranular attack (IGA). Westinghouse, our NSSS supplier and consultant, recommended that we perform a boric acid soak to provide a 45-55 ppm boron concentration at 30 percent power followed by on-line boric acid addition to provide a 5-10 ppm boron concentration. Addition of boric acid was intended to neutralize the alkaline environment responsible for the IGA and thus possibly slow down or stop the IGA.

The unit was restarted, but on August 23, during the hold at 30 percent power for the boric acid soak, steam generator leakage was observed. The unit was removed from service when the leak rate reached 0.20 gpm. All four SGs were opened and visually inspected under a static head. Two leaking tubes were identified, one each in SG 22 and SG 24. Since it was judged that we could not operate the unit with continual SG leakage problems, a decision was made to perform an extensive EC inspection of SG tubes. This was later expanded to include 100% of the tubes in SGs 21, 22, and 24, and to inspect the balance of the tubes in SG 23. Attachment 2 provides a summary of the inspection results.

Discussions were held to determine a course of action in case the rate of SG tube degradation should increase and involve either derating the unit or continually shutting down because of SG leakage problems. Several solutions, including sleeving the tubes in areas of serious degradation, were considered. It was noted that during the course of this complete EC inspection, defects and distorted indications at hot leg support plate intersections were found. Since the condition of the tubes at support plate intersections could impact any future decision to sleeve the tubesheet region, we elected to remove tube samples to assess the condition of the tubes at the support plates. Five tubes were removed--three including the first-to-third support plate intersections and two including the first-to-fifth support plate intersections. In-situ sludge samples

and crevice scrapings were also collected at the location of the removed tubes, and fiberoptic examination of the crevice and top of tubesheet was performed. Preliminary results of sample analyses and metallographic examinations are expected in four to six weeks from Westinghouse.

Final results of hot leg EC indications found during the three forced outages are given in Attachment 3. A total of 147 tubes were plugged. The plugging criteria implemented for this EC inspection included not only the ≥40% through-wall Technical Specification plugging limit for defective tubes but additional conservatism of an administrative plugging limit for tubes with indications at the top of the tubesheet and in the crevice region.

Of the total examined, 93 tubes were plugged to comply with Technical Specification requirements. The others were plugged for conservatism to prevent further deterioration of tubes at the top of the tubesheet and in the crevice region, since these could impact future decisions regarding remedial actions of the type discussed above.

During the upcoming Unit 2 start-up, boric acid (1000-2000 ppm boron) crevice flushing will be conducted in each steam generator. This will be followed by boric acid soaks and continued on-line boric acid addition during power operation.

A final report is in preparation which will detail individual EC tube indication data, tubesheet indication mapping, and comparison of data from the previous inspection. This report will provide the basis for our discussion with your staff at the meeting which has been requested for mid or late November. At that meeting we will be prepared to discuss our investigations, findings, and proposed actions as well as to address any of your concerns.

This document has been prepared following Corporate procedures which incorporate a reasonable set of controls to insure its accuracy and completeness prior to signature by the undersigned.

Very truly yours,

M. P. Alexich
Vice President

10/10/85

MPA/ad

cc: John E. Dolan
W. G. Smith, Jr. - Bridgman
R. C. Callen
G. Bruchmann
G. Charnoff
NRC Resident Inspector - Bridgman

ATTACHMENT 1 TO AEP:NRC:0936A

SUMMARY OF INSPECTION

OF TUBES IN STEAM GENERATOR NO. 23

DURING OUTAGE BEGINNING AUGUST 2, 1985

DONALD C. COOK NUCLEAR PLANT UNIT NO. 2

SUMMARY OF INDICATIONS - Steam Generator No. 23 (Hot Leg)
(August 2-23, 1985)

Tubes to test: 1468 full length; 37 part length, U-bend
Punched: 1505
Analyzed: 1505

	<20	20-29	30-39	≥40	SQR	DI	TOTAL
SUPPORT PLATES	--	--	--	--	--	--	--
CREVICE REGION	--	1	1	18	10	3	33
TUBESHEET +*	1	--	--	2	--	--	3
MISCELLANEOUS	--	5	--	--	--	--	5
TOTAL	1	6	1	20	10	3	41

* covers an area from the top of the tubesheet to not more than 6 inches above the top of the tubesheet.

ATTACHMENT 2 TO AEP:NRC:0936A

SUMMARY OF INSPECTION OF TUBES IN ALL STEAM GENERATORS

DURING OUTAGE BEGINNING AUGUST 24, 1985

DONALD C. COOK NUCLEAR PLANT UNIT NO. 2

SUMMARY OF INDICATIONS - Steam Generator No. 21 - Hot Leg

Tubes to Test: 3282 full length
Punched: 3282
Analyzed: 3282

	<20	20-29	30-39	≥40	SQR	DI	TOTAL
SUPPORT PLATES	7	9	9	6	--	66	97
CREVICE REGION	--	--	--	3	--	--	3
TUBESHEET +*	2	1	--	2	--	3	8
MISCELLANEOUS	10	2	2	--	--	--	14
TOTAL	19	12	11	11	--	69	122

* covers an area from the top of the tubesheet to not more than 6 inches above the top of the tubesheet.

SUMMARY OF INDICATIONS - Steam Generator No. 22 - Hot Leg

Tubes to Test: 3250 full length
Punched: 3250
Analyzed: 3250

	< 20	20-29	30-39	≥ 40	SQR	DI	TOTAL
SUPPORT PLATES	7	9	6	2	--	25	49
CREVICE REGION	--	--	--	10	2	2	14
TUBESHEET +*	4	1	2	8	--	--	15
MISCELLANEOUS	4	2	--	--	--	--	6
TOTAL	15	12	8	20	2	27	84

* covers an area from the top of the tubesheet to not more than 6 inches above the top of the tubesheet.

SUMMARY OF INDICATIONS - Steam Generator No. 23 - Hot Leg

Tubes to Test: 2012 full length
Punched: 2012
Analyzed: 2012

	<20	20-29	30-39	≥40	SQR	DI	TOTAL
SUPPORT PLATES	3	2	--	2	--	17	24
CREVICE REGION	--	--	1	2	--	4	7
TUBESHEET +*	1	1	2	1	--	--	5
MISCELLANEOUS	2	2	2	--	--	--	6
TOTAL	6	5	5	5	--	21	42

* covers an area from the top of the tubesheet to not more than 6 inches above the top of the tubesheet.

SUMMARY OF INDICATIONS - Steam Generator No. 24 - Hot Leg

Tubes to Test: 3265 full length
Punched: 3265
Analyzed: 3265

	< 20	20-29	30-39	≥40	SQR	DI	TOTAL
SUPPORT PLATES	9	12	5	6	--	34	66
CREVICE REGION	1	--	1	12	1	1	16
TUBESHEET +*	5	6	10	17	--	4	42
MISCELLANEOUS	10	10	1	--	--	--	21
TOTAL	25	28	17	35	1	39	145

* covers an area from the top of the tubesheet to not more than 6 inches above the top of the tubesheet.

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ATTACHMENT 3 TO AEP:NRC:0936A

FINAL RESULTS OF EDDY CURRENT TEST INDICATIONS

FOUND DURING THREE UNSCHEDULED OUTAGES

AND TOTAL TUBES PLUGGED TO DATE

DONALD C. COOK NUCLEAR PLANT UNIT NO. 2

	% Indication						
	<20	20-29	30-39	≥40	SQR	DI**	Total
Support Plates	26	32	20	16	N/A	142	236
Crevice Region	1	1	3	47	13	10	75
Tubesheet Surface	13	9	14	30	0*	7	73
Miscellaneous	26	21	5	0	N/A	-	52
Total	66	63	42	93	13	159	436

Note: Plugging criteria are defined by the boundary line above (142 tubes); in addition, 1 tube with a cold leg defect at a peripheral tube support plate and 4 non-defective tubes (removed for analysis) were plugged.

Plugging criteria are based on Technical Specification limits and plant administrative requirements. Administrative criteria for degraded tubes are as follows: Tube crevice region, any indication reported (included <20%, SQRs and DIs. Tubesheet Surface, 30-39%, all SQRs and DIs.

* SQR (Squirrel Indication) considered to be a special class of distorted indication confined to the tubesheet region. These indications have historically proven to compromise tube wall integrity and have thus been classified as defects and have normally been plugged even though the signal is unquantifiable.

** DI (Distorted Indication) is used in lieu of a percent (%) through-wall value on a signal that the analyst believes to be an indication but is too distorted to quantify. DIs at support plate intersections were not deemed pluggable because of a weak signal (low voltage) as compared to those previously found at the top of tubesheet and within the crevice. In addition, when reviewing the other frequencies, they did not provide the expected correlation to further define the DIs at the support plates to be as significant as those found in the tubesheet regions.

Total tubes plugged to date on Cook 2 are as follows:

40	- Row 1 fretting at Tube Lane Blocking Devices
16	- Row 1 ECT indications
320	- Row 1 preventative plugging
4	- Defects at anti-vibration bar intersections
94	- Defects at tubesheet surface, hot leg
21	- Indications at tubesheet surface, hot leg (administrative plugging)
3	- Defects at tubesheet surface, cold leg
39	- Defects in crevice region, hot leg
41	- Indications in crevice region, hot leg (administrative plugging)
4	- Defects at 1st support plate intersections, cold leg
16	- Defects at support plate intersections, hot leg
6	- Non-defective tubes removed for tube analysis
8	- Miscellaneous (Preservice, mistakes, etc.)
612	Total