



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
REGION II  
101 MARIETTA ST., N.W.  
ATLANTA, GEORGIA 30323

Report Nos.: 50-369/89-08 and 50-370/89-08

Licensee: Duke Power Company  
422 South Church Street  
Charlotte, NC 28242

Docket Nos.: 50-369 and 50-370

License Nos.: NPF-9 and NPF-17

Facility Name: McGuire 1 and 2

Inspection Conducted: March 27 - March 31, 1989

Inspector: R. W. Newsome 4/5/89  
R. W. Newsome Date Signed

Approved by: J. J. Blake 4/6/89  
J. J. Blake, Chief Date Signed  
Materials and Processes Section  
Engineering Branch  
Division of Reactor Safety

#### SUMMARY

#### Scope

This special, announced inspection was conducted in the areas of Steam Generator (SG) tubing Eddy Current examination and activities associated with the Unit 1 Steam Generator B ruptured tube.

#### Results

In the areas inspected, violations or deviations were not identified.

All areas inspected indicated adequate control of activities associated with SG Eddy Current activities and SG tube rupture activities.

8904270353 890406  
PDR ADDCK 05000369  
Q PNU

## REPORT DETAILS

### 1. Persons Contacted

#### Licensee Employees

C. Cheezem, Inservice Inspection Engineer, Quality Assurance Department  
\*J. Day, Compliance, Associate Engineer  
T. Hilderbrand, Supervisor, Eddy Current Examination  
\*D. Mays, Mechanical Maintenance, Nuclear Maintenance  
\*C. Robinson, Mechanical Maintenance, Maintenance Engineer

Other licensee employees contacted during this inspection included craftsmen, engineers, technicians, and administrative personnel.

#### NRC Resident Inspectors

\*K. Van Doorn, Senior Resident Inspector  
R. Croteau, Resident Inspector

\*Attended exit interview

Acronyms and initialisms used throughout this report are listed in the last paragraph.

### 2. Steam Generator Tubing Eddy Current Examination

The inspector reviewed documents and records and observed activities, as indicated below, to determine whether Eddy Current (EC) was being conducted in accordance with applicable procedures, regulatory requirements, and licensee commitments. The applicable code is the American Society of Mechanical Engineers Boiler and Pressure Vessel (ASME B&PV) Code, Section XI, 1980 edition with addenda through Winter 1980. Steam generator tubing eddy current examination data collection was being accomplished by Duke Power personnel with Babcock and Wilcox (B&W) personnel performing the primary data analysis and Zetec personnel performing a secondary data evaluation for Duke Power.

#### a. Eddy Current Inspection Plan Review, Unit 1 (73051)

The inspector reviewed the Eddy Current Inspection Plan for this unscheduled outage. The plan was written in conformance with the licensee's Technical Specification 3/4.4.5 Steam Generators. The plan requires 100 percent of each of the four steam generators tubing to be examined using the bobbin coil technique and also required that a select number of tubes in each of the four steam generators be examined by the "Rotating Pancake Coil" method. The plan was reviewed to determine whether it had been approved by the licensee and to assure that the plan established control of applicable activities.

b. Review of Eddy Current Procedures, Units 1 and 2 (73052)

- (1) The inspector reviewed the procedures listed below to determine whether the procedures were consistent with regulatory requirements and licensee commitments. The procedures were also reviewed in the areas of procedure approval, requirements for qualification of Nondestructive Examination (NDE) personnel, and compilation of required records; and, if applicable, division of responsibility between the licensee and contractor personnel if contractor personnel are involved in the examination effort.

- ISI-510 (R6)                    Eddy-360/RDAU System Operating  
With CA-DPC-88-005                Procedure
- ISI-424 (R14)                    Multifrequency Eddy Current  
Examination Of .750" OD x .044" Wall  
RSG Tubing for ASME Exam And Tube  
Wear At Support Plates
- Eddy Current Analysis Guidelines For McGuire Nuclear  
Station Unit 1, Unscheduled Outage 3/89

All procedures listed above have been reviewed during previous NRC inspections. Only current revisions were reviewed during this inspection.

- (2) The inspector reviewed the Eddy Current procedures for technical content relative to: multichannel examination unit, multichannel examination indication equipment is specified, examination sensitivity, material permeability, method of examination, method of calibration and calibration sequence, and acceptance criteria.

c. Observation of Eddy Current Work Activities, Unit 1 (73753)

The inspector observed the EC activities indicated below. The observations were compared with the applicable procedures and the Code in the following areas: method for maximum sensitive is applied; method of examination has been recorded; examination equipment has been calibrated in accordance with the applicable performance reference; amplitude and phase angle have been calibrated with the proper calibration reference and is recalibrated at predetermined frequency; required coverage of steam generator tubes occurs during the examination; acceptance criteria is specified or referenced and is consistent with the procedure or the ASME Code; and, results are consistent with the acceptance criteria.

- (1) Steam generator tube eddy current data collection is being accomplished by Duke Power personnel. In-process tube data acquisition, including calibration confirmation and tube location verifications were observed for the steam generator tubes listed below:

<u>Steam Generator A</u>		<u>Steam Generator C</u>	
<u>Row</u>	<u>Col.</u>	<u>Row</u>	<u>Col.</u>
5	97	31	30
5	96	31	31
5	98	31	32
5	99	31	33
5	100	31	34

- (2) In-process Eddy Current data evaluation, including calibration confirmation, was observed for approximately 200 tubes. Primary data analysis was being accomplished by B&W and secondary data analysis was accomplished by Zetec for Duke Power. If differences are noted between the two evaluations, they are resolved by a designated lead analysts. The below listed tubes were jointly evaluated by the NRC inspector during the data evaluation observations conducted by the inspector. The inspector's evaluation indicated that the tubes appeared to be correctly evaluated by the analysts and that any noted indications were being reported as required.

#### Primary Analysis

<u>Steam Generator A</u>		<u>Steam Generator C</u>	
<u>Row</u>	<u>Column</u>	<u>Row</u>	<u>Column</u>
12	84	35	18
12	83	35	19
12	82	35	20
12	80	35	21
12	79	35	23
12	78	35	24
12	77	35	25
12	76	35	26
12	75	35	28
12	74	35	30
4	78		
4	77		
4	74		
4	76		

### Secondary Analysis

<u>Steam Generator A</u>		<u>Steam Generator C</u>	
<u>Row</u>	<u>Column</u>	<u>Row</u>	<u>Column</u>
16	108	46	47
16	107	46	44
16	106	49	57
16	105	48	57
16	102	46	57
16	101	45	57
16	100	99	57
14	59		
14	58		
13	58		
13	59		
13	60		
13	61		
13	62		
13	63		
13	64		
9	105		
9	106		
9	110		

- (3) Certification records for EC calibration standards 50-79 and 50286 were reviewed for material type, correct fabrication, and artificial flaw location/size.

d. Steam Generator Tubing EC Examination Data Review, Unit 1 (73755)

The inspector reviewed the data analysis results and a sample of associated completed records for approximately 100 SG-B and D tubes including those listed below. The reviews were compared with the applicable procedures and the ASME B&PV Code in the following areas: the multichannel eddy current examination equipment has been identified; material permeability has been recorded; method of examination has been recorded; and, results are consistent with acceptance criteria.

<u>SG-B</u>		<u>SG-D</u>	
<u>Row</u>	<u>Col.</u>	<u>Row</u>	<u>Col.</u>
3	95	2	61
7	29	3	39
15	93	8	76
20	11	9	83
22	93	13	65
23	23	16	17
34	13	22	38
41	90	29	67
43	22	33	43
45	66	38	53
49	52	41	53
49	57	49	79

The inspector compared randomly selected current examination results with historical examination results. No significant discrepancies were noted.

By the conclusion of the NRC inspection all EC examinations had not been completed. The final examination results will be reported to the NRC in accordance with plant Technical Specification requirements.

In this area of inspection, violations or deviations were not identified.

### 3. Steam Generator B Tube Rupture Activities, Unit 1 (73753) (73755)

**Background:** On March 7, 1989 a steam generator tube rupture occurred in Steam Generator B. The damaged tube was identified using water under pressure. The tube is located at row 18 column 25. The rupture is located on the cold leg (outlet) side of the steam generator. The rupture location was determined by using eddy current testing. The tube rupture is located near the 20th support plate and appears to be approximately 3-1/2 inches long extending axially starting at 2" below and running through the area of the 20th tube support plate (TSP) to approximately 1/2" above the TSP. The rupture appears to be 1/4" wide at its widest point, as determined visually by use of a fiberscope and camera. The 20th tube support plate is located at 28" above the top of the tube sheet at approximately 50" from the tube end at the bottom of the steam generator. For additional information see NRC Report No. 50-369,370/89-07.

- a. The ruptured tube was determined to be from Heat #3835. All four steam generators in both Unit 1 and Unit 2 contain tubes from this heat. The number of tubes from this heat in each SG is tabulated below.

Unit 1	Unit 2
SG-A 194	SG-A 35
SG-B 285	SG-B 88
SG-C 167	SG-C 9
SG-D 85	SG-D 6

The licensee has been informally trending the EC results for these tubes and there does not appear to be any correlation between this heat and specific tube indications. The licensee is continuing to trend these tubes as the EC examinations progress.

The NRC inspector reviewed the chemical and mechanical certifications for this tube heat and all the parameters appeared to be within specification requirements.

- b. The most recent eddy current data for the ruptured tube (row 18 column 25), using the most recent state of the art techniques, indicates there is an indication running from approximately 3-1/2" below TSP 20 to just above TSP 19. The 1978 preservice inspection (PSI) eddy current examination report for this tube did not reveal indications at this location, however, the PSI examination was accomplished with a single frequency 400KHz technique using the differential mode of examination and as such not very sensitive to shallow small volume defects. Also, this mode of inspection is not particularly responsive to indications that are tapered on the ends and the present eddy current examination data shows the indication in question to have tapered ends and except for the ruptured portion appears to be a small volume discontinuity.

The NRC inspector independently evaluated the 1978 PSI eddy current data for the five SG-B tubes listed below. The tubes were only reviewed in the area of the 20th support plate. These tubes include the ruptured tube and four tubes in close proximity to the ruptured tube.

#### 1978 Data

<u>Row</u>	<u>Column</u>
17	25
18	25
19	25
20	25
21	25

With respect to the above tube EC data, the NRC inspector noted the following:

- All data was noisy by todays standards
- The ruptured tube, row 18 column 25, had what could be a low voltage indication, on the order of .75 volts, located at approximately 4" below TSP 20. However, with the noise level of the data it is not possible to determine if this is a valid indication or what could be attributed to a normal noise signal unless a more sophisticated eddy current technique had been available and used at the time of the PSI examination. Unfortunately, eddy current technology of this kind was not available in 1978.
- The four remaining tubes did not appear to have indications in the suspect area.

c. Portions of the below listed tubes are to be removed from Steam Generator B and shipped to B&W for analysis. A preliminary analysis report on the tubes is expected within a few days after tube arrival at the B&W laboratory in Lynchburg, Virginia. The reasons for selecting these tubes are noted.

- Row 18 Column 25                          Ruptured tube. Analysis of the rupture mechanism and evaluation of the remaining EC indication extending through the 19th TSP. NOTE: In preparation for the tube pulling operation, this tube was erroneously expanded at the 19th TSP which may result in the loss of the EC indication at this location.
- Row 19 Column 25                          This tube is to be removed in order to visually examine the outside of tube 18-25 prior to it's removal. This is necessary in case the ruptured portion of tube 18-25 is damaged during the tube pulling operations. Also, this tube will be used for comparison purposes during the analysis at B&W.
- Row 13 Column 34                          This tube has EC indications at the 14th and 17th TSP's very similar to those noted in tube 18-25 which start at the tube rupture and extend through the 19th TSP. B&W will conduct an analysis of these indications.

- d. The NRC inspector reviewed the general B&W tube pulling procedure and found no significant problems with the procedure.
- e. At the conclusion of this NRC inspection, no tubes had been removed from SG-B due to a variety of unexpected delays. Visual examination of the outside of tube 18-25 had not yet been accomplished and all tube pulling operations were in a hold state with tube pulling operations expected to be started in the immediate future.

In this area of inspection, violations or deviations were not identified.

#### 4. Exit Interview

The inspection scope and results were summarized on March 31, 1989, with those persons indicated in paragraph 1. The inspector described the areas inspected and discussed in detail the inspection results. Although reviewed during this inspection, proprietary information is not contained in this report. Dissenting comments were not received from the licensee.

#### 5. Acronyms and Initialisms

ASME	- American Society of Mechanical Engineers
B&PV	- Boiler and Pressure Vessel
B&W	- Babcock and Wilcox
CA	- Change Authorization
Col	- Column
DPC	- Duke Power Company
EC	- Eddy Current
KH	- Kilahertz
ND <sup>E</sup>	- Nondestructive Examination
No.	- Number
NPF	- Nuclear Power Facility
NRC	- Nuclear Regulatory Commission
OD	- Outside Diameter
PSI	- Preservice Inspection
R	- Revision
RDAU	- Remote Digital Data Acquisition System
RSG	- Recirculating Steam Generator
SG	- Steam Generator
TSP	- Tube Support Plate