

## LICENSEE EVENT REPORT (LER)

FACILITY NAME (1) Joseph M. Farley - Unit 2										DOCKET NUMBER (2) 0 5 0 0 0 3 6 4				PAGE (3) 1 OF 0 8		
TITLE (4) Failed Containment Tendon Field Anchors																
EVENT DATE (5)			LER NUMBER (6)				REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)						
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES				DOCKET NUMBER(S)			
0 1	2 7	8 5	8 5	0 0 5	0 1	0 8	1 2	8 5					0 5 0 0 0			
OPERATING MODE (9)		THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §. (Check one or more of the following) (11)														
5		20.402(b)				20.406(c)				60.73(a)(2)(iv)				73.71(b)		
POWER LEVEL (10)		20.406(a)(1)(i)				60.38(c)(1)				60.73(a)(2)(v)				73.71(c)		
0 1 0 0		20.406(a)(1)(ii)				60.38(c)(2)				60.73(a)(2)(vii)				<input checked="" type="checkbox"/> OTHER (Specify in Abstract below and in Text, NRC Form 366A)		
		20.406(a)(1)(iii)				60.73(a)(2)(i)				60.73(a)(2)(viii)(A)				Voluntary Report		
		20.406(a)(1)(iv)				60.73(a)(2)(ii)				60.73(a)(2)(viii)(B)						
		20.406(a)(1)(v)				60.73(a)(2)(iii)				60.73(a)(2)(x)						
LICENSEE CONTACT FOR THIS LER (12)																
NAME J. D. Woodard										TELEPHONE NUMBER AREA CODE 2 0 5 8 9 9 - 5 1 5 6						
COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)																
CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRC		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRC						
B	NH	SIPIT	I 1 0 8 1 0	N												
SUPPLEMENTAL REPORT EXPECTED (14)												EXPECTED SUBMISSION DATE (15)		MONTH	DAY	YEAR
<input type="checkbox"/> YES (If yes, complete EXPECTED SUBMISSION DATE)												<input checked="" type="checkbox"/> NO				

ABSTRACT (Limit to 1400 spaces - i.e. approximately fifteen single space typewritten lines) (16)

During an inspection prior to the Integrated Leak Rate Testing (ILRT) of containment during the Unit 2 third refueling outage, it was discovered that the grease-cover for the shop end of containment vertical tendon V17 was deformed. The cover for the field end of tendon V17 was removed on 1-27-85 and it was determined that the field anchor had broken allowing the tendon to detension completely. A program was initiated to find anchor failures and to determine the cause of the failures. This inspection and repair program was completed for Unit 2 on 4-16-85 with the exception of final greasing which was completed on 6-15-85 and the replacement of vertical tendon V31 which was completed on 7-16-85. Two additional failures were discovered in Unit 2. Following the successful completion of the ILRT on 3-3-85, Unit 2 returned to power operation on 3-20-85. Meetings were held on 2-7-85 and 3-1-85 to brief the NRC on the tendon program status.

A tendon inspection and repair program for Unit 1 was initiated during the sixth refueling outage and was completed 6-19-85. No failures were found on Unit 1.

The tendon inspection and repair program results demonstrated that containment structural integrity has been maintained continuously for both units and that the health and safety of the public was not affected.

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## LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OMS NO 3150-0104

EXPIRES 8/31/85

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TEXT (if more space is required, use additional NRC Form 366A's) (17)

During an inspection prior to the Integrated Leak Rate Testing (ILRT) of containment during the Unit 2 third refueling outage, it was discovered that the cover for the shop end of containment vertical tendon V17 was deformed. The cover for the field end was removed on 1-27-85 and it was determined that the field anchor had broken allowing the tendon to detension completely. Programs to inspect and repair the tendons were initiated.

The tendon inspection program consisted of visual inspections for moisture on the field anchorage components and for evidence of failed field anchors. The repair program consisted of field anchor replacement, magnetic particle testing of removed anchors and greasing. This combined tendon inspection and repair program was applied to all Unit 1 and Unit 2 vertical and eight Unit 2 horizontal field anchors. Reports from Inland Steel Company and Battelle Laboratories, which provide details of the laboratory investigations conducted and which conclude that the most likely cause of failures is hydrogen stress cracking, were transmitted to the NRC by letter dated 7-10-85. Additional laboratory analyses of selected field anchors are in progress and the results will be provided to the NRC by letter at a later date.

The aforementioned tendon inspection and repair program was completed utilizing a detensioning and retensioning sequence designed to ensure continued integrity of the containment during operation by minimizing the stress variations within the structure while field anchor inspections and repairs proceeded. This report provides the corrective actions and final inspection results for each unit and a description of the planned additional tests and inspections which are consistent with Technical Specification requirements and previous commitments.

#### Unit 2 Corrective Actions and Final Inspection Results

All vertical tendon field anchors and eight horizontal tendon field anchors were removed, magnetic particle tested and replaced with new or acceptable used anchors. Field anchors for vertical tendons V17, V21 and V31 were found in the failed condition. When the field anchor on V31 failed, wires were damaged in the tendon itself; therefore, V31 was also replaced.

The eight horizontal field anchors consisted of seven field anchors with the same material heat code as two of the failed field anchors. The eighth was replaced when significant moisture was found in the grease cover. There was one other horizontal tendon (tendon 7FD) which exhibited evidence of significant moisture. This field anchor could not be removed without breaching Penetration Room integrity during plant operation. This field anchor will be removed and inspected during the next refueling outage. The fact that no horizontal anchors were found cracked or failed provides further assurance that the inability to replace this anchor at this time does not affect containment integrity.

All vertical field anchors were regreased using a new grease treatment procedure to ensure grease coating on the front and back surfaces of the anchor prior to retensioning. The existing greasing procedure was used for horizontal

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TEXT (If more space is required, use additional NRC Form 366A's) (17)

tendons since their orientation (horizontal) prevents use of the new procedure which involves dipping the anchor in hot grease after anchor installation, but prior to tensioning.

A visual inspection for moisture and failed anchors was performed on a random sample of dome and horizontal tendons sufficient to establish a 95% probability with a 95% confidence level that no other failed anchors exist. Since at one time it was thought that ground water may be the source of tendon moisture, all horizontal tendon field anchors below ground level were also inspected for moisture. No failed field anchors were found in these two groups.

In addition to the inspection of these field anchors for evidence of failure, the presence of moisture was evaluated and quantified where practical. For the purpose of determining the significance of the presence of moisture on the anchorage components, "significant moisture" was defined as 1/2 pint (8 ounces) or more of free water. Where droplets or traces of water existed in quantities less than 8 ounces, the presence was noted but not considered "significant." All moisture inspection results are estimates. During the earliest stages of the Unit 2 inspection program, the significance of moisture was not fully understood; therefore, the inspection and documentation of inspection results were not as rigorous as those performed during the later stages of the inspection program. Results of the inspection for moisture are as follows:

## UNIT 2

TENDON FIELD ANCHORS INSPECTED	TOTAL INSPECTED	NO. W/SIGNIFICANT MOISTURE	NO. W/TRACES OF MOISTURE	NO. W/O MOISTURE
Vertical	130	9	52	69
Horizontal	73	2	3	68
Dome	46	0	2	44
TOTAL	249	11	57	181

In evaluating these results and comparing the presence of moisture in the vertical tendons to their location within the containment structure, the architect/engineer found no correlation between location and the presence or absence of moisture except that vertical tendons located closer to the containment interior (i.e., smaller distance to vertical centerline of containment building) evidenced more moisture than those located closer to the outside surface. Due to this correlation, ground water intrusion may be an unlikely source of the moisture in the tendons. Rain water intrusion and condensation, particularly during construction, remain as the primary suspected sources of moisture. After the original installation, the tendon anchors were covered with plastic and tape until the tendons could be greased. In some cases this was as long as 130 days. This method of protection could have made the vertical tendons more susceptible to the collection of water on the field anchor.

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TEXT (If more space is required, use additional NRC Form 306A's) (17)

Results of the magnetic particle inspection, including moisture inspection results, are as follows:

## UNIT 2

TENDON FIELD ANCHORS REMOVED	TOTAL NO. MT INSPECTED	NO. W/CRACKED/ FAILED ANCHORS	NO. CRACKED/ FAILED ANCHORS W/SIGNIFICANT MOISTURE	NO. CRACKED/ FAILED ANCHORS W/TRACES	NO. CRACKED/ FAILED ANCHORS W/O MOISTURE
Vertical	127*	17/3	2/1	3/2	12/0
Horizontal	8	0	0	0	0
Dome	0	0	0	0	0
TOTALS	135	20	3	5	12

\*The remaining three field anchors (of the 130 vertical tendons) had failed.

A listing of the vertical tendon anchor material heat codes, including the number of cracked or failed field anchors, is summarized as follows:

## UNIT 2

HEAT CODE	TOTAL	NO. CRACKED	NO. FAILED
HP	73	6	1
HU	33	0	0
HV	24	11	2
TOTAL	130	17	3

A failed anchor is defined as one that appeared to be potentially incapable of maintaining 100 percent of tendon force. A cracked anchor is defined as one that had indications detected by magnetic particle inspection (not visible) but which appeared capable of carrying full load. Laboratory analyses confirmed that the presence of cracks did not necessarily prevent an anchor from meeting its design intent. Based on examinations and analyses conducted to date, cracks found in the vertical field anchors appear to have resulted from hydrogen stress cracking. Reports from Inland Steel Company and Battelle Laboratories, which provide details of the laboratory investigations conducted, were transmitted to the NRC by letter dated 7-10-85. Additional laboratory analysis of selected field anchors is in progress and the results will be provided to the NRC by letter at a future date.



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TEXT IF MORE SPACE IS REQUIRED, use additional NRC Form 266A's (17)

In addition to inspections for cracked anchorheads, lift off tests were conducted on five vertical tendons to ensure that relaxation was within design limits. The results were acceptable.

The tendon inspection and repair program implemented on Unit 2 was discussed in meetings held with the NRC on 2-7-85 and 3-1-85. This program was completed on 4-16-85 with the exception of final greasing which was completed on 6-15-85. Work on vertical tendon V31, which was removed, replaced, retensioned and greased, was completed on 7-16-85.

#### Unit 1 Corrective Actions and Final Inspection Results

As discussed in the original LER submittal, a tendon inspection and repair program was initiated on Unit 1. The results of these inspections are provided for information purposes.

All vertical tendon field anchors and a random sample of horizontal and dome tendon field anchors were visually inspected for evidence of failed anchors and moisture. The random sampling basis for the selection of the number of horizontal and dome tendon field anchors included in the inspection establishes a 95% probability with a 95% confidence level that no failed anchors exist in either group. No failed field anchors were found in any of the three groups.

In addition to the inspection of these field anchors for evidence of failure, the presence of moisture was evaluated and quantified where practical. The presence of significant moisture was evaluated based on the definition of "significant moisture" described above for Unit 2. All moisture inspection results are estimates. The results of the inspection for moisture are as follows:

#### UNIT 1

TENDON FIELD ANCHORS INSPECTED	TOTAL INSPECTED	NO. W/SIGNIFICANT MOISTURE	NO. W/TRACES OF MOISTURE	NO. W/O MOISTURE
Vertical	130	4	57	69
Horizontal	28	0	1	27
Dome	29	0	2	27
TOTAL	187	4	60	123

Based on the results of the visual inspection, all 61 vertical tendon field anchors which had observable moisture (those with significant moisture and traces of moisture) were removed. Following removal of each of these anchors, replacement with a new or an acceptable used anchor was made. Each anchor removed received a magnetic particle inspection. Of the 61 vertical

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TEXT (If more space is required, use additional NRC Form 365A's) (17)

tendon field anchors replaced due to observable moisture, three were found to contain cracks. Due to the cracks found, a decision was made to remove, replace and perform magnetic particle examination on all remaining 69 vertical tendon field anchors. Of these, three additional cracked anchors were found. During removal, no moisture was found on any of these 69 field anchors. Since no significant moisture was found in the horizontal and dome tendon field anchors inspected, none were removed, replaced or magnetic particle inspected. The results of the magnetic particle (MT) inspection, including correlation with the presence of moisture, are summarized as follows:

## UNIT 1

TENDON FIELD ANCHORS REMOVED	TOTAL NO. MT INSPECTED	NO. W/CRACKED ANCHORS	NO. CRACKED ANCHORS W/SIGNIFICANT MOISTURE	NO. CRACKED ANCHORS W/TRACES	NO. CRACKED w/O MOISTURE
Vertical	130	6	0	3	3
Horizontal	0	0	0	0	0
Dome	0	0	0	0	0
TOTALS	130	6	0	3	3

A listing of the vertical tendon anchor material heat codes, including the number of cracked or failed field anchors, is summarized as follows:

## UNIT 1

HEAT CODE	TOTAL	NO. CRACKED
FE	23	0
FK	42	1
FL	15	0
FM	26	1
FN	24	4
TOTAL	130	6

Planned Additional Tests and Inspections

In order to confirm the continued structural integrity of the containment tendon field anchors in both units, the following inspections and tests will be performed:

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TEXT (If more space is required, use additional NRC Form 386A's) (17)

1. Following one year of service after completion of the tendon inspection and repair program, samples of the contents of all vertical tendon field anchor grease covers will be collected and visually examined for water.
2. Following three years of service after completion of the tendon inspection and repair program, samples of the contents of all vertical tendon field anchor grease covers will be collected and visually examined for water. The vertical tendon field anchors, for the tendons whose samples were found with water at the one or three year inspection, will be visually examined (without detensioning) including inspection for evidence of moisture.
3. Following five years of service after completion of the tendon inspection and repair program, samples of the contents of all vertical tendon field anchor grease covers will be collected and visually examined for water. The vertical tendon field anchors, for the tendons whose samples were found with water at the one, three or five year inspection, will be visually examined (without detensioning) including inspection for evidence of moisture. Those found with moisture at this five year inspection will be detensioned and an inspection made to identify anchorheads with water in contact with the anchorhead surface. A random sample of anchorheads identified as having water in contact with the anchorhead surface will be removed, magnetic particle tested, inspected, and replaced. Further action will be based on results obtained.
4. Since confidence has been established in the integrity of horizontal and dome tendon field anchors, at three years a visual inspection for moisture and evidence of failures will be conducted on a random sample basis to again establish a 95% probability with a 95% confidence level that no failed field anchors exist in either group.
5. At the next Unit 2 refueling outage, horizontal tendon 7FD will have its field anchor removed, magnetic particle tested and replaced.

Significant results from these inspections, including descriptions of further inspections or repairs required as a result of these inspections, will be provided later. These non Technical Specification programs, and the tentative dates provided, are subject to change based on results of a long term evaluation program being developed, and may be modified based on results of future inspections and analyses.

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Joseph M. Farley - Unit 2

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\*AT (If more space is required, use additional NRC Form 266A's) (17)

In addition to the above, the tendon surveillance program required for each unit by the Technical Specifications will be completed. The Unit 2 Five Year Tendon Surveillance was completed concurrent with the repair program. A report detailing the results of the inspection will be submitted to the NRC, in accordance with routine practices, by 9-17-85. The Unit 1 Ten Year Tendon Surveillance is tentatively scheduled to begin in February 1987 with a report to be submitted to NRC by the end of July 1987. The next Unit 1 ILRT is tentatively planned for the 7th refueling outage which is currently scheduled to begin on 10-3-86.

Conclusion

The architect/engineer has evaluated the structural integrity of the Unit 1 and Unit 2 containments and has concluded that containment structural integrity has been maintained continuously for both units. The Unit 2 ILRT, which was successfully completed on 3-3-85, provided additional demonstration of the structural adequacy of the Unit 2 containment. The planned additional tests and inspections will provide assurance that the Unit 1 and Unit 2 containment structures will continue to meet all functional requirements.



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Alabama Power  
*the southern electric system*

August 12, 1985

Docket No. 50-364

Document Control Desk  
U. S. Nuclear Regulatory Commission  
Washington, D.C. 20555

Dear Sir:

Joseph M. Farley Nuclear Plant, Unit 2, Licensee Event Report  
No. LER 85-005-01 is being voluntarily submitted.

If you have any questions, please advise.

Yours very truly,

R. P. McDonald

RPM:sam

Enclosure

xc: IE, Region II

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