



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
REGION II  
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ATLANTA, GEORGIA 30303-8931**

August 17, 2000

Southern Nuclear Operating Company, Inc.  
ATTN.: Mr. D. N. Morey  
Vice President  
P. O. Box 1295  
Birmingham, AL 35201-1295

**SUBJECT: JOSEPH M. FARLEY NUCLEAR PLANT - NRC SUPPLEMENTAL INSPECTION  
REPORT NOs. 50-348/00-08 AND 50-364/00-08**

Dear Mr. Morey:

By letter dated June 26, 2000, you were informed that the NRC would conduct a supplemental inspection at your Farley Nuclear Plant for a degraded Mitigating Systems Cornerstone due to two White performance indicators (PIs). The enclosed inspection report presents the results of that supplemental inspection. The results of this inspection were discussed on July 10, 2000, with Mr. M. Stinson and other members of your staff. We also held a public meeting with you and your staff on July 11, 2000, at the Farley Nuclear Plant site to discuss your corrective actions associated with the causes of the White PIs.

This supplemental inspection was an examination of activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. Within these areas, the inspection consisted of a selected examination of procedures and representative records, observations of activities, and interviews with personnel. Specifically, the inspectors reviewed the issues, the circumstances, and the resulting root cause evaluations associated with White PIs for the unavailability of the Unit Two Heat Removal System (auxiliary feedwater) and of the Unit Two Emergency Alternating Current (AC) Power System. The resultant degraded Mitigating Systems Cornerstone for Unit Two was reviewed in detail per NRC Inspection Procedure (IP) 95002. A previous supplemental inspection was conducted per IP 95001 for the White Emergency AC Power System PI which was applicable to both Units 1 and 2. That supplemental inspection was documented in NRC Inspection Report 50-348/00-07 and 50-364/00-07. As described in the enclosed inspection report, this supplemental inspection focused on the auxiliary feedwater system issues and any common performance problems. Also, as described in the enclosed inspection report, to complete the effort needed by IP 95002, the NRC intends to perform additional supplemental inspection in the areas of breaker maintenance, maintenance program implementation, and Maintenance Rule. Although the NRC inspection of your response on this issue is not yet complete, our review thus far determined that your root cause evaluation was thorough. Your evaluation revealed that previous opportunities to address problems with preventive maintenance, system engineer involvement, and systems in the enhanced monitoring classification a(1) of the Maintenance Rule were not fully effective at precluding the latest unavailability problems.

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Sincerely,

/RA/

Loren R. Plisco, Director,  
Division of Reactor Projects

Docket Nos. 50-348 and 50-364  
License Nos. NPF-2 and NPF-8

Enclosure: NRC Inspection Report Nos. 50-348/00-08  
and 50-364/00-08

cc w/encl: (See page 3)

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cc w/encl:

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U. S. NUCLEAR REGULATORY COMMISSION

REGION II

Docket Nos.: 50-348 and 50-364

License Nos.: NPF-2 and NPF-8

Report Nos.: 50-348/00-08 and 50-364/00-08

Licensee: Southern Nuclear Operating Company, Inc.

Facility: Farley Nuclear Plant, Units 1 and 2

Location: 7388 N. State Highway 95  
Columbia, AL 36319

Dates: June 30 to July 21, 2000

Inspectors: T. P. Johnson, Senior Resident Inspector  
R. K. Caldwell, Resident Inspector

Approved by: Stephen J. Cahill, Chief  
Reactor Projects, Branch 2  
Division of Reactor Projects

Enclosure

## SUMMARY OF FINDINGS

IR 05000348-00-08, IR 05000364-00-08, on 06/30-07/21/2000; Southern Nuclear Operating Company Joseph M. Farley Nuclear Plant, Units 1 & 2. Supplemental Inspection - Degraded Cornerstone.

### **Cornerstone: Mitigating Systems**

This supplemental inspection was performed to assess the licensee's evaluation and corrective actions associated with a Unit 2 degraded Mitigating Systems Cornerstone due to two White performance indicators (PIs) for Heat Removal System (auxiliary feedwater [AFW]) and Emergency Alternating Current (AC) Power System unavailability. This supplemental inspection, performed in accordance with Inspection Procedure (IP) 95002, is the initial phase of the NRC follow up since an additional focused inspection will be done to assess extent of condition and programmatic implications of the licensee evaluation findings. This inspection also focused on the AFW issues because a previous supplemental inspection was conducted for the Emergency AC Power System PI.

The Unit 2 AFW unavailability resulted from 4160 volt supply breaker failures and turbine driven AFW (TDAFW) pump control system failures. The licensee determined that the root causes of these failures were ineffective preventive maintenance and corrective actions for previous problems. Causal factors included a lack of vendor guidance resulting in a lack of preventive maintenance, weak control of troubleshooting activities and post maintenance testing, poor system specialist/engineer involvement, and a lack of timely resolution for those components and systems in the enhanced monitoring classification a(1) of the Maintenance Rule. As corrective actions, the licensee implemented additional monitoring and work controls for the AFW system by system engineering, operations, and maintenance. Planned outages for testing or maintenance will receive additional oversight. Changes to preventive maintenance, calibration, testing, and related procedures have been completed. The licensee also performed an independent assessment and scheduled a Safety Audit and Engineering Review effectiveness evaluation to assess the adequacy of the root cause and corrective actions.

The licensee's root cause investigation was considered thorough and the proposed corrective actions were considered acceptable. However, the NRC intends to perform additional supplemental inspection in the areas of breaker maintenance, maintenance program implementation, and Maintenance Rule.

## Report Details

### 01 Inspection Scope

This supplemental inspection was performed in accordance with Inspection Procedure (IP) 95002 to assess the licensee's evaluation and corrective actions associated with a degraded Mitigating Systems Cornerstone. Inspectors reviewed the licensee effort which was done under several Condition Reports (CRs) enumerated in subsequent sections of this report. The licensee also initiated CR 2-2000-5079 after the investigation to integrate the earlier CRs. The Unit 2 cornerstone is considered degraded due to White performance indicators (PIs) for both auxiliary feedwater system (AFW) and emergency alternating current (AC) power system unavailability. White PIs for Emergency AC Power System unavailability on both Units 1 and 2 were previously inspected using Inspection Procedure 95001 and documented in Inspection Report 50-348,364/00-07. That report determined that the licensee performed a comprehensive investigation and evaluation of the Emergency AC Power System White PI, therefore this supplemental inspection focused on the specific conditions and corrective actions for the White AFW PI as well as any common performance problems. This supplemental inspection is also only the initial phase of the NRC follow up. An additional focused supplemental inspection will be done per IP 95002 to assess extent of condition and programmatic implications of the licensee evaluation findings. Since this supplemental inspection was conducted using the requirements of IP 95002, the following report details are organized by the specific inspection requirements of IP 95002 which are noted in italics in the following sections.

### 02 Evaluation of Inspection Requirements

#### 02.01 Problem Identification

- a. *Determine that the evaluation identifies who (i.e. licensee, self revealing, or NRC), and under what conditions the issue was identified.*

The White PI for AFW resulted primarily from fault exposure hours due to failures of the 2A motor-driven AFW (MDAFW) pump and the turbine-driven AFW (TDAFW) pump during routine surveillances. Inoperability of the 2A MDAFW pump was identified by the licensee during routine surveillance testing on February 9 and March 15, 2000. The associated room cooler fan, which is necessary attendant equipment, failed to start due to dirty contacts on the manually operated contactor (MOC) switch. Inoperability of the TDAFW pump was identified during testing on February 10, April 6, May 4, and May 11, 2000. The pump either failed to reach rated speed or tripped on overspeed. A failed ramp generator signal converter (RGSC) module was the initial cause. Subsequent causes included a failed speed switch potentiometer and a failed or drifting electronic governor module (EGM).

The licensee documented these AFW failures in CRs 2-2000-079, 083, 230, 339, 477 and 513. These failures were also previously inspected as part of resident inspector baseline inspection activities and documented in Inspection Report 50-348,364/00-03.

- b. *Determine that the evaluation documents how long the issue existed and prior opportunities for identification.*

The licensee determined that the 2A MDAFW pump had 683.5 fault exposure unavailability hours during the period January to March 2000. The TDAFW pump had 846.1 fault exposure unavailability hours during the period March to May 2000. The licensee determined the MOC switch has had previous instances of failures. The TDAFW controls acted in an erratic manner for several months. The inspectors confirmed that the licensee's evaluation appropriately considered these and other prior opportunities for identification.

- c. *Determine that the evaluation documents the plant specific risk consequences (as applicable) and compliance concerns associated with the issue.*

Because this condition only affected PIs, the licensee did not evaluate and assign a specific core damage frequency. Although the fault exposure unavailability hours for the emergency AC power and AFW components did overlap, other aspects mitigate the risk significance. Manual operator action from the control room or locally to start the AFW room cooler fan could have successfully mitigated the MOC switch problem. Further, the Unit 2 TDAFW pump did not fail surveillance tests every time. The condition that caused the failures was intermittent during the fault exposure period. The licensee declared the affected AFW pump inoperable when warranted and complied with the Technical Specification allowed outage time. Inspection Report 50-348,364/00-03 previously evaluated compliance concerns for these issues. No further concerns were identified in the licensee evaluation.

## 02.02 Root Cause and Extent of Condition Evaluation

- a. *Determine that the problem was evaluated using a systematic method to identify root causes and contributing causes.*

The inspectors verified that the licensee evaluated these issues with the systematic method in procedures FNP-0-ACP-9.0, Root Cause Program, and FNP-0-ACP-9.1, Root Cause Investigation, to evaluate this issue. This included barrier, change, and event and causal factor analysis. The procedures required conducting interviews with key personnel, data collection, document review, and the preservation of physical evidence associated with the issue. In addition, the system engineers/specialists reviewed the failures and corrective actions.

- b. *Determine that the root cause evaluation was conducted to a level of detail commensurate with the significance of the problem.*

The licensee's root cause evaluations were thorough. The primary root causes for the MOC switch failure were oxidation on the contacts primarily due to aging, some misalignment, and poor spring tension. Causal factors included a lack of vendor guidance resulting in a lack of preventive maintenance, poor system specialist/engineer involvement, and lack of corrective actions for breaker problems relative to the Maintenance Rule enhanced monitoring classification.

The primary root cause for the pump TDAFW failures was an oxidation buildup on electronic components. Causal factors included weak control of troubleshooting and post maintenance testing, weak system specialist/engineer involvement, inadequate communication, and an inadequate calibration procedure.

- c. *Determine that the root cause evaluation included a consideration of prior occurrences of the problem and knowledge of prior operating experience.*

The licensee reviewed NRC Information Notices and industry operating experience to see if similar problems had previously been reported with the MOC switches and the TDAFW issues. In addition, previous Farley operating experience was evaluated. Previous MOC switch failures and TDAFW control problems have existed and were relevant to the current problems. The prior occurrences were appropriately considered by the licensee in their evaluation.

- d. *Determine that the root cause evaluation included consideration of potential common cause and extent of condition of the problem.*

The licensee considered the potential for common cause and conducted a broadness (extent of condition) review associated with the MOC switch failures and the TDAFW speed control issues. The licensee determined that the causes of the above issues could affect other safety-related equipment. The licensee did not find any additional problems and long-term corrective actions addressing the causes were included in the Condition Reports.

#### 02.03 Corrective Actions

- a. *Determine that appropriate corrective actions are specified for each root/contributing cause or that there is an evaluation that no actions are necessary.*

The missed prior opportunities, system specialist/engineering oversight, operations and maintenance communications, PM programs and procedures, and control of trouble shooting and testing, were all addressed. However, not all corrective actions were explicitly linked to an associated root cause in the licensee's evaluation. Increased management sensitivity and attention for planned out of service time and for root cause effectiveness were addressed. Maintenance Rule program corrective actions are also planned.

- b. *Determine that the corrective actions have been prioritized with consideration of the risk significance and regulatory compliance.*

The licensee restored the AFW pumps to an operable status within the Technical Specification allowed outage time. The other breakers' MOC switches were inspected and replaced. The other unit's TDAFW pump was also assessed for similar issues. The inspectors reviewed the licensee's actions and concluded that the AFW pumps were operable. The inspectors determined that the licensee had appropriately prioritized short term corrective actions to restore operability and longer term corrective actions to evaluate and to consider options are planned. However, the corrective action options are dependent upon completion of the planned evaluations and therefore are not fully prioritized yet.

- c. *Determine that a schedule has been established for implementing and completing the corrective actions.*

The licensee's plans for the evaluating the breaker PM program and procedures, root cause effectiveness, communications issues, and system engineering issues were consistent with risk significance of the equipment. The licensee will consider and prioritize options when the evaluations are complete. A schedule was developed for the evaluations.

- d. *Determine that quantitative or qualitative measures of success have been developed for determining the effectiveness of the corrective actions to prevent recurrence.*

Licensee management has reviewed and concurred with the root cause evaluations and proposed corrective actions. Enhanced monitoring and work control processing of the AFW pumps by system engineering, operations, and maintenance has been implemented. Planned outages for testing or maintenance will receive additional oversight including approvals. Changes to the PM program, testing, calibration, and related procedures have been completed. An independent assessment of the root causes, commonalities, and corrective actions was completed by a management oversight team. Further, the licensee has scheduled a Safety Audit and Engineering Review effectiveness evaluation to assess the adequacy of the root cause and corrective actions.

#### 02.04 Independent Assessment of Extent of Condition and Generic Implications

The inspectors independently assessed the validity of the licensee's conclusions regarding the extent of the issues that contributed to the equipment unavailability and resultant White PIs. The inspectors determined that the licensee had identified some broad areas that contributed to the problem and were preparing to address the associated programs. The inspectors also noted that the safety related breaker issues (on both the Emergency AC and AFW problems) involved Allis-Chalmers 4160 volt and Westinghouse 600 volt load center and motor control center breakers. Commonalities included ineffective corrective actions on long standing issues and an ineffective PM program for breakers. Breaker issues have been in the licensee's Maintenance Rule (a)(1) category for over five years. A number of issues have been identified in that process, but not all have been effectively addressed and resolved.

Speed control failures of the TDAFW pump have occurred on several occasions since 1994. The Unit 1 TDAFW pump has also been in Maintenance Rule (a)(1) status on two occasions (March 1995 - January 1997 and February 1998 - March 1999). The Unit 2 TDAFW pump also failed to reach rated speed on two occasions in 1996. However, the equipment was not classified as a Maintenance Rule (a)(1) system at that time. After the four failures in 2000, the Unit 2 TDAFW pump was classified as a Maintenance Rule (a)(1). All of these problems were attributed to the EGM and/or the RGSC electronic cards. Preventive maintenance, predictive maintenance, and component failure analyses established or performed after the initial failures did not prevent the failure's recurrence. A Green finding and non-cited violation was also identified in NRC Inspection Report 50-348, 364/00-03 for inadequate corrective actions associated with one of the TDAFW performance tests.

Consequently, the NRC will perform additional focused inspections using IP 95002 to assess broad common aspects that the licensee's root cause evaluation determined were root or contributing causes. These include Maintenance Rule implementation, Preventive Maintenance Program, and other related Maintenance activities.

## **MANAGEMENT MEETING**

### **Exit Meeting Summary**

The inspectors presented the inspection results to members of licensee management on July 10, 2000. The licensee acknowledged the findings presented. The inspectors asked the licensee whether any materials examined during the inspection should be considered proprietary. No proprietary information was identified.

### **Public Meeting Summary**

The NRC held a public meeting with the licensee on July 11, 2000, at the Training Center Complex auditorium. The NRC discussed the revised oversight program, the results of the NRC's inspections, and related concerns and issues. The licensee presented the sequence of events, root causes and causal factors, the organizational and hardware aspects of the failures and resultant White Pls, and the completed and proposed corrective actions. A copy of the slides used in the licensee presentation is attached to this report.

### **Partial List of Persons Contacted**

R. V. Badham, Safety Audit Engineering Review Supervisor  
T. Cherry, Root Cause Team  
C. D. Collins, Operations Manager  
M. Conner, System Specialist  
G. Dykes, Root Cause Team  
S. Fulmer, Plant Training and Emergency Preparedness Manager  
D. E. Grisette, Assistant General Manager - Operations  
D. Hartline, Root Cause Team  
J. R. Johnson, Maintenance Manager  
R. Lovvorn, System Specialist and Root Cause Team  
R. R. Martin, Engineering Support Manager  
R. Monk, Engineering Support Supervisor  
C. D. Nesbitt, Assistant General Manager - Plant Support  
J. Simmons, Maintenance Rule Coordinator  
E. Stephenson, Root Cause Team  
L. M. Stinson, Plant General Manager - FNP  
R. Yance, Independent Assessment Team Leader

Attachment - Licensee Presentation Slides from July 11, 2000, Public Meeting