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

Report No.: 50-416/92-04

Licensee: Entergy Operations, Inc.
Jackson, MS 39205

Docket No.: 50-416 License No.: NPF-29

Facility Name: Grand Gulf Nuclear Station

Inspection Conducted: January 14 - 16, 1992

Inspector: P. T. Burnett 2-10-92
Date Signed

Accompanying Personnel: B. L. Holbrook
J. L. Mathis

Approved by: R. V. Crlenjak, Chief 2/10/92
Date Signed
Operational Programs Section
Operations Branch
Division of Reactor Safety

SUMMARY

Scope:

This special, announced inspection addressed the return to criticality during the shutdown performed on December 29 - 30, 1992.

Results:

This shutdown followed one of the infinite number of reactivity-insertion and unit-cooldown paths that could be followed within the envelope of safe temperature and reactivity control. However, the path chosen was not an optimum, in that flux reduction was too rapid to permit performance of a required surveillance before dropping below range three on the intermediate range neutron monitors. The continuing cooldown of the reactor, without additional control rod insertion, led to a return to criticality. The operators anticipated the return to criticality, and monitored the rising flux, while continuing to upscale the intermediate range monitors, until the slow power increase was terminaced by increasing fuel temperature.

The operators then performed the required surveillance of the control rod withurawal block function of the source range instruments. The remainder of the shutdown was completed in the order required by the procedure in use.

One violation was identified: Failure to follow the procedure requirement to complete a required surveillance above the limiting power range (paragraph 2).

REPORT DETAILS

1. Persons Contacted

Licensee Employees

*W. T. Cottle, Vice President, Nuclear Operations
*L. F. Daughtery, Supervisor, Compliance
*M. I. Dorsett, Technical Specialist
*C. W. Ellsaesser, Superintendent, Operations
T. N. Errington, Reactor Engineering Supervisor
*J. M. Hendrie, Safety Review Committee
*C. R. Hutchinson, General Manager, GGNS
*R. O. Martin, Reactor Engineer
*M. J. Meisner, Director, Nuclear Licensing
*J. V. Parrish, Manager, Plant Operations
W. R. Patterson, Technical Assistant to the General Manager
*J. C. Roberts, Manager, Plant Maintenance
*R. I. Ruffin, Licensing Specialist
*C. L. Stafford, Operations Assistant
*M. J. Wright, Manager, Nuclear Training
*G. W. Zinke, Superintendent, Plant Licensing

Other licensee employees contacted included engineers, operators, security force members, and office personnel.

NRC Resident Inspectors

C. A. Hughey, Resident Inspector
*J. L. Mathis, Senior Resident Inspector

*Attended the exit interview on January 16, 1992.

Acronyms and initialisms used throughout this report are defined in the final paragraph.

2. Return to Criticality during Shutdown on December 30, 1992 (93702)

This summary of the event is based upon review of station records, procedures, and interviews with operators on the control console and managers in the control room at the time of the event on December 30, 1991.

The shutdown began on December 29, 1991, to initiate a maintenance outage to replace a recirculation pump shaft. From a nominal 12 percent RTP, the shutdown was controlled by Integrated Operating Instruction No. 03-1-01-3 (Revision 36), Plant Shutdown (IOI-3). Although the TS allow a cooldown rate as high as 100 Degrees F in one hour, the licensee administratively limits the rate to 80 Degrees F in one hour, in IOI-3.

In order to reduce radiation doses during the work, consistent with ALARA principles, management ordered a "soft shutdown" to minimize the release of plated-out, radioactive material from the fuel cladding and channels to the coolant system.

Soft shutdown methodology further limits the cooldown rate to 30-40 Degrees F/hr. Past experience at Grand Gulf and Clinton reactors supported the opinion that the concomitant pressure reduction in coolant system pressure is less likely to release plated-out material to the coolant system. Accordingly, the operators were instructed to perform a slow pressure reduction and cooldown at about 30 Degrees F/hr.

[illegible] contains a caution that a scram from power would have an undesirable effect on the reactor system from thermal - hydraulic cycling. The mechanical shock and vibration effects of a scram would also release the plated-out material from the fuel assemblies and defeat the purpose of the slow cooldown. However, the operators were not further cautioned to avoid a scram, nor were they instructed in the soft shutdown concept. Hence, the operators at the control console were no more inhibited against initiating a manual scram than they would have been during a standard shutdown.

The slow power reduction led to xenon burnout during the power decrease. Thus there was little or no xenon peak produced after the unit was taken off line. The slow power reduction and an earlier outage also reduced the amount of decay heat available relative to other shutdowns. Trouble with the RCIS prevented rod insertion in gang. Once in operating condition two, these conditions combined to create a situation in which neutron flux was higher relative to system temperature than in the typical shutdown.

The operators continued to insert rods to reduce flux to the level (range three on the IRMs) at which the surveillance of SRM rod block function could be performed. During this flux deduction the rods entered a region of high worth where rod insertion caused a rapid decrease in flux to range 1 before the surveillance could be performed. Other procedure activities led to cooling the unit by increasing the steam load. The cooldown increased reactivity through moderator and fuel doppler coefficient feedback, and flux began to rise. Steam loads were then reduced to limit the temperature decrease. In response to the flux increase, the operator ranged up the IRMs to monitor the flux and to avoid a full scale scram from the IRMs. In response to questions from the

inspectors, the operator stated that he expected the temperature coefficients to level power once heating began in IRM range six or seven, which it did. Hence he did not choose to trip the unit; although he felt no inhibitions against taking a trip. Some of the IRMs were on range 8, when flux was stabilized.

The maximum reactor period has been estimated to be between 300 and 800 seconds. However, with the IRM ranges spanning only one-third of a decade on each of the eight channels, the operator's full attention had to be given to ranging IRMs to avoid a scram, rather than to inserting rods to terminate the otherwise benign period.

Once flux was leveled by the fuel temperature coefficient, and the cooldown rate decreased, rods were inserted to reduce the flux; the rod block surveillance was performed satisfactorily, and the remainder of the shutdown was completed successfully in accordance with IOI-3.

The inspectors concluded that the operators were aware of plant status and anticipated behavior at all times; that they were in command of the situation at all times, and acted appropriately. The operators were prepared for the return to criticality by specific training on a similar event on another BWR. In addition, the shift supervisor had alerted the operators to the possibility of a return to criticality as the cooldown continued.

Failure to complete the rod withdrawal block surveillance for the SRMs, before dropping below IRM range 3, as required by IOI-3, step 5.15.2, has been identified as a violation (50-416/92-04-01).

Attachment 1 is a figure showing the relationships of reactor temperature, reactor pressure, APRM power, and control rod density during the period from midnight to 4:00 am on December 30, 1991.

Other procedures reviewed for content during the course of this inspection included:

- SOI 04-1-01-C-2 (Revision 19), Rod Control and Information System.
- SP 06-OP-1C51-V-001 (Revision 29), SRM Channel Functional Test.

3. Exit Interview

The inspection scope and findings were summarized on January 16, 1992, with those persons indicated in paragraph 1

above. The inspector described the areas inspected and discussed in detail the inspection findings. The violation described below was discussed. No dissenting comments were received from the licensee. Proprietary material was reviewed in the course of the inspection, but is not included in this report.

Violation 50-416/92-04-01: Failure to complete the rod withdrawal block surveillance for the SRMs, before the flux dropped below IRM range 3, as required by procedure.

4. Acronyms and Initialisms Used in This Report

APRM	average power range monitor
IOI	integrated operating instruction
IRM	intermediate range monitor
RCIS	rod control and information system
RTP	rated thermal power
SOI	system operating instruction
SP	surveillance procedure
SRM	source range monitor
TS	Technical Specifications

Attachment 1: Plots of reactor temperature, pressure, APRM power and control rod density during the event.

ATTACHMENT 1

REACTOR SHUTDOWN

DEC 30, 1991