September 14, 2005

Mr. George A. Williams
Site Vice President
Grand Gulf Nuclear Station
Entergy Operations, Inc.
P. O. Box 756
Port Gibson, MS 39150

SUBJECT: AUDIT REPORT FOR GRAND GULF NUCLEAR STATION, UNIT 1 IMPLEMENTATION OF STABILITY LONG TERM SOLUTION E1-A (TAC NO. MC7449)

Dear Mr. Williams:

The Nuclear Regulatory Commission (NRC) staff performed an on-site review of the implementation of the Boiling Water Reactors Owners Group (BWROG) Long-Term Stability Solution Option E1-A at Grand Gulf Nuclear Station, Unit 1 (GGNS) on July 20, 2005.

Overall, the NRC staff found the GGNS's Long-Term Stability Solution Option E1-A implementation to be complete and adequate to satisfy the requirements of a long term stability solution. In addition, the NRC staff found that the testing program of E1-A implementation was comprehensive and successful.

The NRC staff's audit report is enclosed.

Sincerely,

/RA/

Bhalchandra Vaidya, Project Manager, Section 1
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-416

Enclosure: Audit Report

cc w/encl: See next page

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Grand Gulf Nuclear Station

cc:

Executive Vice President
& Chief Operating Officer
Entergy Operations, Inc.
P. O. Box 31995
Jackson, MS 39286-1995

Wise, Carter, Child & Caraway
P. O. Box 651
Jackson, MS 39205

Winston & Strawn
1700 K Street, N.W.
Washington, DC 20006-3817

Chief
Energy and Transportation Branch
Environmental Compliance and
Enforcement Division
Mississippi Department of Environmental
Quality
P. O. Box 10385
Jackson, MS 39289-0385

President
Claiborne County
Board of Supervisors
P. O. Box 339
Port Gibson, MS 39150

Regional Administrator, Region IV
U.S. Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011-8064

Senior Resident Inspector
U. S. Nuclear Regulatory Commission
P. O. Box 399
Port Gibson, MS 39150

General Manager, GGNS
Entergy Operations, Inc.
P. O. Box 756
Port Gibson, MS 39150

Attorney General
Department of Justice
State of Louisiana
P. O. Box 94005
Baton Rouge, LA 70804-9005

State Health Officer
State Board of Health
P. O. Box 1700
Jackson, MS 39205

Office of the Governor
State of Mississippi
Jackson, MS 39201

Attorney General
Asst. Attorney General
State of Mississippi
P. O. Box 22947
Jackson, MS 39225-2947

Vice President, Operations Support
Entergy Operations, Inc.
P.O. Box 31995
Jackson, MS 39286-1995

Director
Nuclear Safety Assurance
Entergy Operations, Inc.
P. O. Box 756
Port Gibson, MS 39150

Director
Nuclear Safety & Licensing
Entergy Operations, Inc.
1340 Echelon Parkway
Jackson, MS 39213-8298

AUDIT REPORT BY THE OFFICE OF NUCLEAR REACTOR REGULATION

LICENSE NO. NPF-29

ENTERGY OPERATIONS, INC.

GRAND GULF NUCLEAR STATION, UNIT 1

DOCKET NO. 50-416

1.0 INTRODUCTION

The Nuclear Regulatory Commission (NRC) staff performed an on-site review of the implementation of the Boiling Water Reactors Owners Group (BWROG) Long-Term Stability Solution Option E1-A (Solution E1-A) at Grand Gulf Nuclear Station, Unit 1 (GGNS) on July 20, 2005. The review was conducted at the GGNS site by Dr. Tai L. Huang of the Reactor Systems Branch, Office of Nuclear Reactor Regulation and Dr. Jose March-Leuba of Oak Ridge National Laboratory, an NRC consultant.

Present at the review were Entergy Operations, Inc. (Entergy) employees Robert Thomson, Jim Head, Mike Larson, and David Grillis. A conference call was held with a representative of the River Bend Nuclear Station (River Bend) to review River Bend's experience with Solution E1-A implementation. The River Bend representative for this call was John Vukovics.

The NRC staff was positively impressed by the depth of knowledge and cooperation of all the GGNS personnel involved in this review.

2.0 METHODOLOGY SUMMARY

GGNS has chosen to implement Solution E1-A, which is a "preventive" option. Solution E1-A is a modification to the reactor protection system, which automatically shuts down a reactor if it enters an exclusion region, before the instabilities develop. This solution was reviewed and approved by the NRC staff.

Solution E1-A is a well-thought out solution, and it has a number of defense-in-depth features, including a Restricted Region, a Monitored Region, and a Period Based Detection System (PBDS), which may detect incipient oscillations. Immediate operator actions are required inside the Monitored and Restricted Regions if the PBDS detects incipient oscillations. Figure 1, below, shows the GGNS E1-A Regions.

Other features of Solution E1-A include stability control methods for entry into the Restricted Region. For example during startup operations, GGNS requires an effective Boiling Boundary greater than 4 feet to intentionally enter the Restricted Region. This Boiling Boundary restriction guarantees that heavily bottom peaked power distributions will not be allowed for startup, which improves significantly the stability margin during these operations.

The implementation of Solution E1-A involves the replacement of the old analog flow-biased scram cards with new Flow Control Reference Cards (FCTR). One FCTR is placed in each

Average Power Range Monitor (APRM) channel to define the exclusion region. If the exclusion region is entered, the FCTR generates a flow-biased scram signal. As with all Boiling Water Reactor (BWR) protection system signals, two FCTRs must generate a scram signal for the scram to take place.

Eight FCTRs have been installed in the GGNS, one for each of the APRM channels (A through H).

The primary defense-in-depth feature involved the PBDS. Each PBDS card monitors every Low Power Range Monitor (LPRM) signal in its APRM cabinet individually and provides an alarm if it detects incipient oscillations. In principle, the PBDS algorithm should detect oscillations while they are very small, or even before they occur, when the decay ratio is close to but less than 1.0. The primary issue with PBDS is the possibility of false alarms. Other plants (including Solution III, which uses a similar algorithm called PBDA) have had similar false alarm problems.

The only manufacturer of the FCTR and PBDS cards is General Electric (GE), but the GGNS has an adequate supply. In addition, other plants that originally implemented Solution E1-A have now moved to Solution III, so additional cards are available if necessary.

The GGNS loaded GE fuel from 1993 through 2000, but the last three fuel reloads were made entirely of Framatome fuel. The very last GE-11 fuel bundles in the periphery were replaced by even-older Siemens' 9x9 bundles from the spent fuel pool to resolve some leakage issues. Framatome performs all stability-related calculations for the GGNS.

The Solution E1-A hardware installation was initiated in 1993 with some testing of the E1-A feature. However, the installation with the final hardware was initiated in 1998 and completed in 2000. In 1998, the GGNS installed only one FCTR and two PDBS cards and collected experience and data for a full cycle. In 2000, the final installation and arming was complete. The GGNS has been collecting operational data since.

The Solution E1-A regions are defined in the Core Operating Limits Report and are displayed prominently in the control room and simulator. The NRC staff interviewed reactor operators and simulator instructors and found that the GGNS personnel had a good working knowledge of the manual and automatic features of the EI-A implementation.

The E1-A regions are confirmed on a cycle-specific basis for each reload. However, the regions have not changed size since the initial implementation in 1993.

The GGNS Technical Specifications (TSs) do not include any reference to the old BWROG Interim Corrective Actions (ICAs). If the E1-A hardware were declared inoperative for any reason, the GGNS would be required to shut down. The GGNS treats the FCTR and PBDS cards as any other protection system cards; if all of them are unavailable, then there is no protection and the reactor cannot operate. The GGNS personnel indicated that should a methodology issue be raised that invalidates the FCTR setpoint, this would result in declaring all the protection channels inoperable. In that unlikely case, even though the GGNS is required to shut down by the TSs, the licensee would immediately contact the NRC staff and bring the protection hardware back in operation while the methodology issue gets resolved. Thus, the licensee does not see a need for generic ICAs or backup solutions, and it would rather solve this unlikely event on a case-specific basis.

One possibility stated by the GGNS staff in case of a future methodology problem with E1-A setpoints would be to use the FCTR Alternative Trip Settings. These settings are not plant-specific in the GGNS, and they use the Maximal Regions defined in the E1-A LTR. These regions were defined in a conservative manner to address most situations.

The NRC staff finds that the implementation of Solution E1-A at the GGNS appears to be complete and adequate to satisfy the requirements of a long term solution.

3.0 TESTING AND IMPLEMENTATION

The FCTR and PBDS cards were installed and tested according to plant procedures, and the safety features of the system are tested periodically.

Following installation, the E1-A setpoints were verified. Proper connection to plant data was verified by tracing the cables in the back of the APRM cabinet. This is possible because each PBDS and FCTR use only APRM and LPRM signals from the same cabinet (of the order of 25 LPRM) and the cable continuity can be confirmed visually.

The FCTR and PBDS cards have periodic surveillance requirements similar to other reactor protection system (RPS) components.

The GGNS uses relative sensitive settings for the PBDS algorithm, which are allowed under the topical report. This results in a relatively large number of PBDS confirmation counts, even at full power conditions. During our visit to the control room, PBDS was regularly reporting 5 confirmation counts, even though the plant was operating at full power close to the EOC. Operators informed us that cases with 8 consecutive confirmations were not unusual. The number of confirmation counts in the GGNS is not necessarily an indication of a high degree of instability in this plant.

The PBDS function provides two alarms settings. A High alarm is produced when 8 consecutive confirmation counts are reached in a single LPRM. A High-High alarm is produced when 11 consecutive confirmation counts occur in at least two LPRM channels simultaneously. Operator actions (e.g. scram) are required following a High-High alarm.

River Bend had a recent event, when a High alarm occurred at relatively low flow inside the monitored region. River Bend does not experience such alarms routinely, so the licensee took action to tighten the alarm criteria. Since that event, the High alarm at River Bend requires 8 consecutive confirmation counts in two LPRM channels. This will maintain consistency with its operating philosophy of a black alarm panel – i.e., minimize false alarms. The High-High alarms (which requires TS operator actions) remained unchanged.

The GGNS and River Bend TSs disable all manual trip function outside the monitored region. Therefore, PBDS alarms will only be of relevance during low-flow maneuvers at high power, and the number of false positives is expected to be small. The licensee for the GGNS has several years worth of data and is confident with its settings. The NRC staff was shown the implementation of the E1-A system in the GGNS control room, cabinet rooms, and the GGNS simulator. A demonstration of the control and operator actions of the E1-A system was provided in the simulator.

The GGNS personnel stated that they may also switch to Solution III if and when they upgrade their protection system to a digital platform. No decision has been made, and none is expected in the near future.

Overall, the NRC staff finds the testing program of the E1-A implementation in the GGNS to be comprehensive and successful.

4.0 RESPONSE TO THE "PART 21 DIVOM" ISSUE

The Part 21 DIVOM issue has been the main cause of the implementation delay in Solution III plants. The GGNS and River Bend have implemented Solution E1-A and the Part 21 DIVOM issue has not affected them at all. No action is required from either the GGNS or River Bend.

5.0 SUMMARY AND CONCLUSIONS

Overall, the NRC staff finds the GGNS E1-A implementation to be complete and adequate to satisfy the requirements of a long term stability solution. In addition, the NRC staff also finds the testing program of E1-A implementation is be comprehensive and successful.

6.0 REPORTS REVIEWED

1. The GGNS, TS 3.3.1.3, Period Based Detection System (PBDS) in Amendment No. 141.

2. Licensing Document Change No. 98-037 E1-A.

3. River Bend Condition Report CR-RBS-2004-00990.

4. Plant Operations Manual 17-S-02-40, 05-1-02-III-3, 02-S-01-27, 06-IC-1C51-0-0004, 06-IC-1C51-0-0003, and 06-IC-1C51-0-0002.

Attachment: GGNS E1-A Regions

Principal Contributor: Tai L. Huang

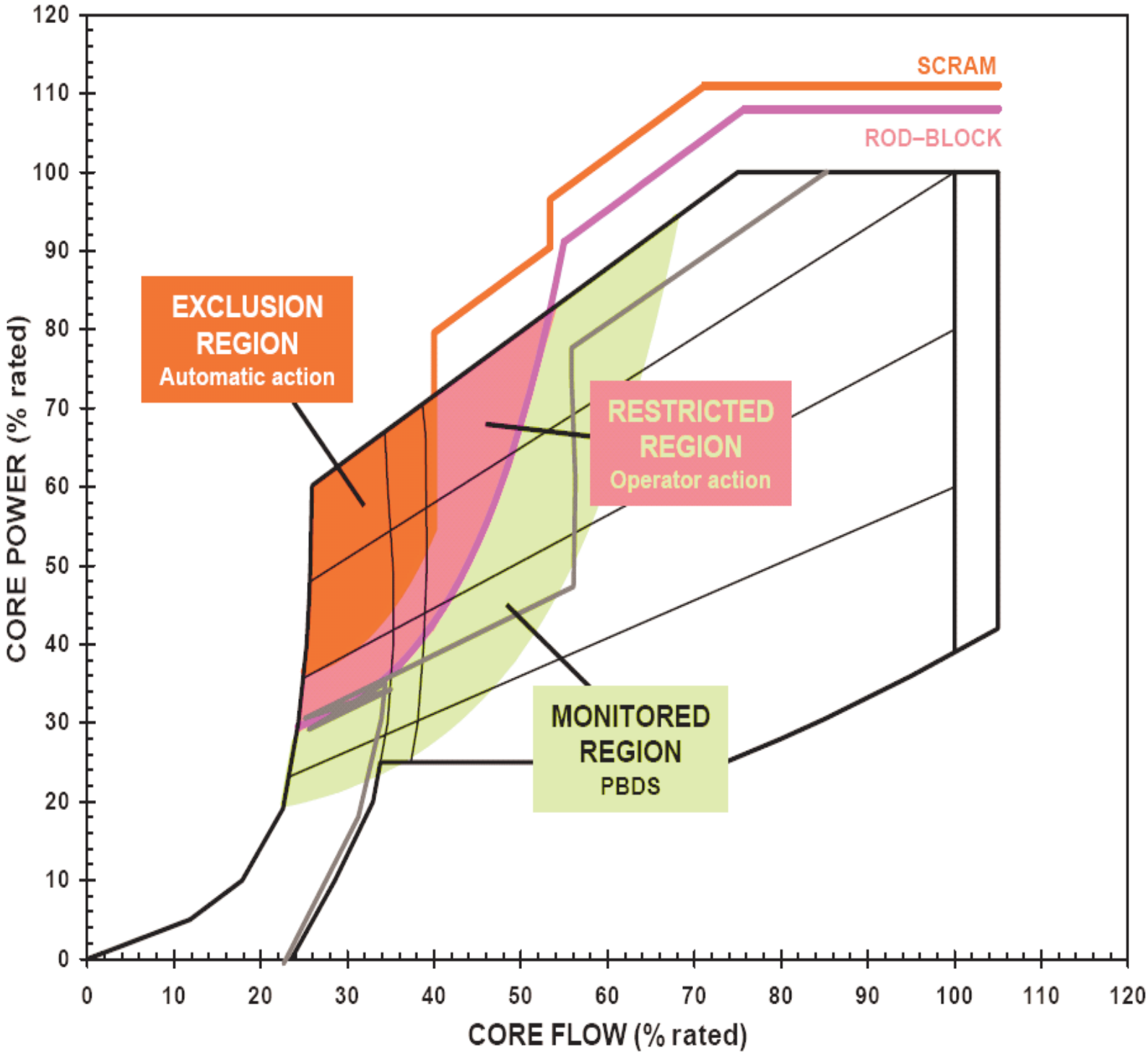

Figure 1 Grand Gulf E-IA Regions

Attachment