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U.S. Nuclear Regulatory Commission
Mail Station P1-137
Washington, D.C. 20555

Attention: Document Control Desk

Subject: Grand Gulf Nuclear Station
Unit 1
Docket No. 50-416
License No. NPF-29
Grand Gulf Nuclear Station (GGNS) Plant Specific Design
Evaluation for NEDO-31558

GNRO-93/00032

Gentlemen:

On April 1, 1988 the BWR Owners Group submitted the Licensing Topical Report; "Position on NRC Regulatory Guide 1.97, Revision 3 Requirements for Post-Accident Neutron Monitoring System (NEDO-31558)". This Topical Report provided an event analysis of the neutron monitoring system functions for post accident use. The results of this analysis provided alternate neutron monitoring functional design criteria to that of Regulatory Guide 1.97.

By letter to the BWR Owners Group dated January 13, 1993 the NRC found the alternate criteria of NEDO-31558 for neutron flux monitoring instrumentation acceptable in lieu of Regulatory Guide 1.97 criteria for currently licensed BWRs. The Safety Evaluation Report states, in part, that licensees should review their neutron flux monitoring instrumentation against the criteria of NEDO-31558 and confirm they meet these criteria. Any deviations to the criteria are to be explicitly stated, and a commitment made to meet the criteria or supporting justification provided for alternatives.

Grand Gulf is submitting the GGNS neutron monitoring system design evaluation as it relates to the Topical Report (Attachment 1). To facilitate NRC review, the section numbering in Attachment 1 corresponds to the design criteria sections of the Topical Report.

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The NRC's safety evaluation report for NEDO-31558 also recommended that each licensee perform a plant specific evaluation of the power distribution to the neutron flux monitoring instrumentation, including recorders. This review should verify that, in addition to the events identified in NEDO-31558, a single power supply failure would not cause the loss of redundant channels of neutron flux monitoring instrumentation. GGNS has reviewed the power distribution for neutron flux monitoring instrumentation and concludes that each division is powered from separate and reliable class 1E uninterruptible power supplies (UPS). Loss of a single UPS will not cause loss of redundant neutron flux monitoring instrumentation. However, review of the power for the neutron flux monitoring recorders has identified that these recorders are powered by the same non-class 1E UPS power supply. GGNS has scheduled to provide redundant non-class 1E UPS power for these recorders during the next refueling outage (RFO6). This will ensure that loss of a single UPS supply will not cause loss of redundant neutron flux monitoring recorders per the recommendations of the safety evaluation report.

This submittal fulfills the license condition as stated in Attachment I (c)(4) of the GGNS Operating License. Entergy Operations plans to submit a request for removal of this license condition, as provided for in the SER approving NEDO-31558, under separate cover.

Yours truly,

WTC

WTC/RLP/mtc

attachment: Topical Report

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GGNS Neutron Monitoring

Plant Specific Design Evaluation

(NEDO-31558)

Introduction

A preliminary evaluation was provided to the NRC by letter dated April 28, 1988. This submittal completely supercedes that evaluation, and provides more up to date information.

This attachment provides plant specific information relative to the capabilities of the existing Neutron Monitoring System (NMS) at Grand Gulf as it applies to the alternative design requirements stated in NEDO-31558 (Reference 1), "Position on NRC Regulatory Guide 1.97, Revision 3 Requirements for Post Accident Neutron Monitoring System".

The topics of discussion in the following sections of this attachment correspond to subsections 5.2.1 through 5.3 of NEDO-31558. To facilitate understanding of the information presented by this attachment, the individual NEDO-31558 subsection headings and requirements are restated followed by the existing capabilities of the GGNS NMS with respect to the alternate criteria. Where necessary, clarifying information is provided. The basis for the alternative requirements is not restated as this information is provided in NEDO-31558.

The information provided under each subsection primarily applies to the APRM subsystem. However, when appropriate, information is also being provided for the IRM subsystem to show its capability to provide a backup or confirmatory support function to the APRMs when at the lower end of their operating range (i.e., overlap region).

Since the position of NEDO-31558 is based on the operators' actions stated in the emergency operating procedures (utilization of the NMS for these actions) an initial discussion of the applicable GGNS Emergency Procedures (EPs) and their similarities/differences to the generic BWR Emergency Procedure Guidelines (EPGs) is as follows:

GGNS Emergency Procedure (EP) Overview

The GGNS EPs were developed directly from Revision 4 of the BWROG EPGs. Because core power (neutron flux) is the parameter of interest, discussion will be restricted to those EPs that are concerned with maintaining and controlling this parameter. At Grand Gulf the EPs related to core power are; EP-2, "RPV Control" and EP-2A, "RPV Control - ATWS".

Consistent with the intent of the EPGs, the RPV Control procedure provides the operator with direction to control reactor power under conditions where the reactor will remain shutdown under all conditions, while the RPV Control - ATWS procedure provides the necessary direction to control RPV parameters when it can not be determined that the reactor will remain shutdown under all conditions. The entry conditions for EP-2 provide plant specific values for RPV pressure, level, scram/power, and drywell pressure. The scram/power entry condition encompasses the condition where the operator may not be able to determine reactor power. The bases document for the EPGs discusses the fact that loss of electrical power to the APRMs does not, by itself, necessarily mean that reactor power cannot be determined. The ensuing discussion provided by the bases document further supports the variables/methods used to determine reactor power that were specified in NEDO-31558 Section 6.3. The general guidance provided by EP-2A regarding the control of reactor power is as follows:

- If all control rods are not inserted to or beyond position 02 (Maximum Subcritical Banked Withdrawal position), transfer recirc pumps to LFMG, initiate ARI/RPT, attempt to insert all control rods to or beyond position 02 using all possible methods and if required initiate boron injection using both SLC pumps prior to the suppression pool reaching 110°F (Boron Injection Initiation Temperature).
- If at any time during the performance of EP-2A, all control rods are inserted to or beyond position 02 then terminate boron injection, enter the scram Off Normal Event Procedure (ONEP), and exit the power control logic leg of EP-2A and re-enter EP-2.
- If while performing the above actions it is determined that the reactor will remain shutdown under all conditions without Boron, then terminate Boron injection, enter the scram ONEP, exit EP-2A and re-enter EP-2.

The injection of boron into the RPV for the above listed actions is initiated by a limiting suppression pool temperature of 110°F (Suppression Pool Temperature is a Category 1 variable as defined in RG 1.97). Action is conservatively taken before reaching this temperature to preclude the possibility of compromising the integrity of the containment from a forced emergency depressurization at high power levels. The actions required of the operator when performing EP-2A are those actions which will ensure that the hot shutdown boron weight is injected while minimizing the energy being discharged into the containment. In addition, EP-2A assures that adequate boron is injected into the vessel to achieve and maintain cold shutdown conditions.

5.2.1 Range

Alternate Requirement: 1 to 100% (GGNS downscale alarm is 4%)

RG 1.97 Requirement: $10^{-6}\%$ to 100%

The operating range associated with the APRM subsystem at GGNS is 1 to 100% core thermal power (approximately 2.8×10^{12} nv to 2.8×10^{14} nv). This range satisfies the alternate requirement stated above.

5.2.2 Accuracy

Alternate Requirement: $\pm 2\%$ of Rated Power

RG 1.97 Requirement: None stated

The instrument accuracy of the GGNS APRM subsystem is $\pm 2\%$ of rated power. The APRM subsystem meets the alternate requirements as stated in NEDO-31558.

5.2.3 Response Characteristic

Alternate Requirement: 5 Sec/10% Change

RG 1.97 Requirement: None Specified

The existing GGNS APRM subsystem exceeds the specified response characteristics, satisfying the alternate requirement.

5.2.4 Equipment Qualification

Alternate Requirement: Operate in ATWS Environment

RG 1.97 Requirement: RG 1.89 and 1.100

A plant specific evaluation was performed for GGNS to insure that the APRM subsystem was designed to function in the abnormal environments of ATWS events. Based on review of existing calculations, GGNS may exceed the typical design conditions delineated in Table 5-1 of NEDO-31558. Although GGNS may exceed the typical design conditions delineated in Table 5-1 of NEDO-31558, the APRM subsystem has been designed to function within the environmental parameters expected for GGNS during the required events.

5.2.5 Function Time

Alternate Requirement: 1 Hour

RG 1.97 Requirement: None Specified.

From the results of the ATWS event discussed in the previous section and presented in NEDO-24222, it is evident reactor power has been reduced to essentially 0% at approximately thirty minutes into the event. As stated in the previous section, the APRM subsystem is qualified for the environmental conditions of an ATWS, and would operate for greater than one hour. The NMS meets the alternate requirement specified above.

5.2.6 Seismic Qualification

Alternate Requirement: Seismic qualification not required

RG 1.97 Requirement: Seismically qualify Cat 1 equipment as important to safety per RG 1.100 and IEEE-344

Since the event which has been determined to set the design basis requirements for the NMS is an ATWS event, seismic requirements for the NMS should be consistent with the ATWS rule (10CFR50.62). This rule specifies ATWS environmental conditions which do not require seismic qualification.

5.2.7 Redundancy and Separation

Alternate Requirement: Redundancy to Assure Reliability

F.G 1.97 Requirement: Redundant in Division Meeting RG 1.75

The APRM subsystem consists of eight independent channels, each channel consisting of inputs from up to twenty-two LPRM detectors and the necessary signal conditioning equipment, to provide an output signal directly reflecting average power in the core. This output signal is then utilized to provide reactor trip signals, alarms, and indication. The eight channels are divided into four separate divisions with each division consisting of two APRM channels. Because of the redundancy in detector inputs (only 14 required for operability per GGNS Technical Specifications) per channel, the application of power and equipment separation, and the total number of channels, the APRM subsystem satisfies the alternate redundancy and separation criteria.

5.2.8 Power Sources

Alternate Requirements: Uninterruptable and Reliable Power Sources

RG 1.97 Requirement: Standby Power Source (RG 1.32)

The four divisions of the APRM subsystems are supplied UPS power from four separate inverters. The normal power supply is from the station batteries with backup power supplied from the associated Division 1 or 2 ESF bus. The recorders located on the operators control console are supplied power from a single non-class 1E UPS power supply. A design change is scheduled for RF06 to provide redundant non-class 1E UPS power for these recorders. This will insure that loss of a single UPS supply will not cause loss of redundant neutron flux monitoring recorders per the requirements of the safety evaluation report issued January 13, 1993 for the BWR Owner's Group Topical Report NEDO-31558.

5.2.9 Channel Availability

Alternate Requirement: Available Prior to Accident

RG 1.97 Requirement: Available Prior to Accident

As discussed in NEDO-31558, the power range instrumentation is available and in service while the plant is operating; therefore, the existing design satisfies this requirement.

5.2.10 Quality Assurance

Alternate Requirement: Limited QA Requirements Based on Generic Letter 85-06 (Reference 3)

RG 1.97 Requirement: Application of Specific Reg. Guides

The entire APRM subsystem is safety related with the exception of the APRM recorders located on the operators control console. The guidance provided under NRC Generic Letter 85-06 for non-safety related ATWS equipment has been fully satisfied by the procurement, design, installation, and ongoing operational quality assurance program, for the APRM subsystem. Based on the above, the APRM subsystem satisfies the alternate requirement as stated above.

5.2.11 Display and Recording

Alternate Requirement: Continuous Recording

RG 1.97 Requirement: Continuous Recording

Every APRM channel has continuous recording capability provided by strip chart recorders located on the operators control console. The requirement of NEDO-31558 is fully satisfied.

5.2.12 Equipment Identification

Alternate Requirement: Identify in Accordance with CRDR

RG 1.97 Requirement: Identify in Post-Accident Monitors

The NMS recorders are all clearly marked and labeled by division, and signal input. These recorders are located on the central portion of the operators control console along with the other plant parameters which are of primary significance to the operator. Located between the four APRM recorders are the APRM status indicators, clearly identifying alarm levels (upscale/downscale/inop, etc.). This instrumentation was reviewed from a Human Factors standpoint for both useability and identification during performance of the DCRDR effort. Based on the above, the identification of the equipment satisfies the requirement of NEDO-31558.

5.2.13 Interfaces

Alternate Requirement: No Interference with RPS Trip functions

RG 1.97 Requirement: Isolators to be used for Alternate Functions

At Grand Gulf the non IE portions of the APRM subsystem are isolated and separated as required from the IE portions of the system. The NMS, therefore, satisfies the alternate requirement as stated above.

5.2.14 Service, Test, and Calibration

Alternate Requirement: Establish In Plant Procedures

RG 1.97 Requirement: Establish In Plant Procedures

The APRM subsystem is tested and calibrated on the frequencies as specified in the GGNS Technical Specifications, which are implemented by plant procedures.

The frequency of performance of these procedures is performed in the same manner as all other Technical Specification surveillance procedures. Based on the above discussion, this requirement as specified in NEDO-31558 is satisfied.

5.2.15 Human Factors

Alternate Requirement: Incorporate HFE Principles

RG 1.97 Requirement: Incorporate HFE Principles

The DCRDR effort has been performed for the instrumentation and controls located on the operators control console. Human factors engineering principles were incorporated into this review process, therefore, the NMS satisfies this criteria.

5.2.16 Direct Measurement

Alternate Requirement: Direct Measurement of Neutron Flux

RG 1.97 Requirement: Direct Measurement of Neutron Flux

The APRM subsystem utilizes miniature fission detectors and as such directly monitors neutron flux in the core. This criteria is satisfied.

5.3 Conclusion

In all cases the APRM subsystem of the NMS meets or exceeds the alternate requirements established by NEDO-31558 and in many cases complies with the requirements of RG 1.97.

References:

1. NEDO-31558; Position on NRC Regulatory Guide 1.97, Revision 3 Requirements for Post Accident Neutron Monitoring System. March 14, 1988, General Electric Company.
2. NEDO-24222; Assessment of BWR Mitigation of ATWS, Volume 2 (NUREG 0460 Alternate No. 3), February 1981, General Electric Company.
3. Generic Letter 85-06; Quality Assurance Guidance for ATWS Equipment That Is Not Safety Related, April 16, 1985, Nuclear Regulatory Commission.
4. AECM-88/0083; GGNS Plant Specific Design Evaluation for NEDO-31558, dated April 28, 1988.
5. NRC Evaluation of BWR Owner's Group Topical Report NEDO-31558, "Position on NRC Regulatory Guide 1.97, Revision 3, Requirements for Post-Accident Neutron Flux Monitoring System" (TAC M77660), by letter to BWROG dated January 13, 1993.
6. GENE 637-006-0393, GE Nuclear Energy, "Qualification Assessment of Grand Gulf Neutron Monitoring System for Post-Accident Monitoring", dated March 12, 1993.