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Attachment 5 contains PROPRIETARY information

GNRO-2009-00054

November 3, 2009

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

SUBJECT: License Amendment Request
Power Range Neutron Monitoring System Upgrade

Grand Gulf Nuclear Station, Unit 1
Docket No. 50-416
License No. NPF-29

Dear Sir or Madam:

Pursuant to 10 CFR 50.90, Entergy Operations, Inc. (Entergy) proposes to revise the Grand Gulf Nuclear Station (GGNS) Technical Specifications (TS) to reflect the installation of the digital General Electric - Hitachi (GEH) Nuclear Measurement Analysis and Control (NUMAC) Power Range Neutron Monitoring (PRNM) System. The following TS (and associated TS Bases, if applicable) and Operating License (OL) sections are affected by this change:

- OL Section 2.C(2), *Technical Specifications*
- TS 1.1, *Definitions*
- TS 3.2.4, *Fraction of Core Boiling Boundary (FCBB)*
- TS 3.3.1.1, *Reactor Protection System (RPS) Instrumentation*
- TS 3.3.1.3, *Period Based Detection System (PBDS)*
- TS 3.10.8, *Shutdown Margin (SDM) Test - Refueling*
- TS 5.6.5, *Core Operating Limits Report (COLR)*

Entergy plans to replace the existing analog Average Power Range Monitor (APRM) subsystem of the existing Neutron Monitoring System with the more reliable, digital NUMAC PRNM System during the spring 2012 refueling outage. This modification will simplify management and maintenance of the system.

The PRNM System design retrofit also includes an Oscillation Power Range Monitor (OPRM) capability, which implements a GEH version of the Boiling Water Reactor Owners' Group (BWROG) Option III detect-and-suppress long-term reactor core stability solution methodology. The OPRM provides automatic detection and suppression of reactor thermal-hydraulic instabilities through monitoring neutron flux changes. This license amendment request (LAR) adds an OPRM Upscale function to the Reactor Protection System (RPS) Instrumentation TS, thereby implementing the Option III reactor stability solution. With installation of the NUMAC PRNM System, the GGNS stability licensing basis will transition from Enhanced Option I-A to Option III.

Following installation of the NUMAC PRNM System, GGNS will operate with the new OPRM Upscale function (TS Table 3.3.1.1-1 Function 2.f) in an "indicate only" mode for an initial monitoring period for a minimum of 90 days not to exceed one fuel cycle, as discussed in the LAR. GGNS will implement Backup Stability Protection (BSP) measures specified in BWROG document OG-02-0119-260, *GE to BWROG Detect and Suppress II Committee, "Backup Stability Protection (BSP) for Inoperable Option III Solution,"* as an alternate method for detecting and suppressing instabilities until the OPRM Monitoring Period has been successfully completed. The NRC approved the use of the BSP measures for the alternate method for Monticello as documented in its Safety Evaluation.

Reactor stability compliance using this method relies upon operator action to:

- Avoid regions where instability may occur,
- Exit such regions when necessary, and
- Detect an actual instability and take mitigating action by manual means.

Following review and evaluation of operating data from the monitoring period, Entergy will enable the OPRM Upscale function. Details of the monitoring period are provided in the LAR.

Attachment 1 provides the LAR, which contains a description of the proposed changes, the technical evaluation, and associated no significant hazards determination and environmental evaluation. Attachment 2 provides a copy of GEH Nuclear Energy Report GE-NE-0000-0102-0888, *Grand Gulf Nuclear Station - Plant-Specific Responses Required by NUMAC PRNM Retrofit Plus Option III Stability Trip Function Topical Report (NEDC-32410P-A)*, for NRC review in conjunction with the proposed LAR. Attachment 3 provides marked-up Operating License and TS pages indicating the proposed changes. Attachment 4 provides the associated draft marked-up TS Bases pages for information only.

Attachment 5 provides a proprietary version of GEH Nuclear Energy Report 0000-0107-7607-P, *Grand Gulf Nuclear Station – Grand Gulf PRNM Upgrade Project Option III Stability Deviations*, which provides the technical basis for several deviations from the traditional Option III stability solution design established by the BWR Owners' Group. Pursuant to 10 CFR 2.390, GEH has requested this report be withheld from public disclosure; the associated affidavit is provided following the report. Attachment 6 provides a non-proprietary version of the report.

Entergy has evaluated the proposed LAR in accordance with 10 CFR 50.91(a)(1) using criteria in 10 CFR 50.92(c). We have determined that this change involves no significant hazards consideration. The bases for this determination are included in Attachment 1.

This letter contains commitments as identified in Attachment 7.

Entergy plans to submit an LAR to support an extended power uprate (EPU) at GGNS in accordance with GEH Licensing Topical Report (LTR) NEDC-33004P-A, *Constant Pressure Power Uprate*. The NRC's Safety Evaluation Report approving NEDC-33004P-A contains a restriction that prohibits a licensee from submitting certain types of LARs in parallel with the EPU LAR. This PRNM System LAR falls within that restriction; therefore, Entergy is submitting this LAR prior to the EPU LAR.

Entergy requests NRC approval of the PRNMS LAR prior to submitting the EPU LAR, which is currently scheduled for July, 2010. Entergy will implement the approved PRNMS LAR prior to startup from the 2012 refueling outage.

If you have any questions or require additional information, please contact Mr. Guy Davant at (601) 368-5756.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on November 3, 2009.

Sincerely,

M. A Krupa

MAK/ghd

Attachments:

1. License Amendment Request – Power Range Neutron Monitoring System Upgrade
2. GE Hitachi Nuclear Energy Report GE-NE-0000-0102-0888, *Grand Gulf Nuclear Station - Plant-Specific Responses Required by NUMAC PRNM Retrofit Plus Option III Stability Trip Function Topical Report (NEDC-32410P-A)*
3. Marked-Up Operating License and Technical Specification Pages
4. Draft Marked-Up Technical Specification Bases Pages (For Information Only)
5. ~~GE Hitachi Nuclear Energy Report 0000-0107-7607-P-R0, *Grand Gulf Nuclear Station – Grand Gulf PRNM Upgrade Project Option III Stability Deviations* (Proprietary Version) with Affidavit Supporting Request to Withhold from Public Disclosure~~

REMOVED

6. GE Hitachi Nuclear Energy Report 0000-0107-7607-NP-R1, *Grand Gulf Nuclear Station – Grand Gulf PRNM Upgrade Project Option III Stability Deviations* (Non-Proprietary Version)
7. Licensee-Identified Commitments

cc:

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ATTACHMENT 1

GNRO-2009-00054

LICENSE AMENDMENT REQUEST

POWER RANGE NEUTRON MONITORING SYSTEM UPGRADE

TABLE OF CONTENTS

LICENSE AMENDMENT REQUEST

POWER RANGE NEUTRON MONITORING SYSTEM UPGRADE

1.0 DESCRIPTION

Pursuant to 10 CFR 50.90, Entergy Operations, Inc. (Entergy) proposes to revise the Grand Gulf Nuclear Station (GGNS) Operating License (OL) and Technical Specifications (TS) to reflect the installation of the digital General Electric - Hitachi (GEH) Nuclear Measurement Analysis and Control (NUMAC) Power Range Neutron Monitoring (PRNM) System. The proposed changes (described in Section 4.0, below) are consistent with the NRC-approved GEH Licensing Topical Report (LTR) NEDC-32410P-A, *Nuclear Measurement Analysis and Control Power Range Neutron Monitor (NUMAC PRNM) Retrofit Plus Option III Stability Trip Function,* Volumes 1 and 2, including Supplement 1 (References 1 and 2), referred to here-in collectively as the NUMAC PRNM LTR. The NUMAC PRNM LTR provides the primary technical basis for the proposed changes. The NRC approved the design and application of the NUMAC PRNM LTR via References 3 and 4.

Entergy and GEH evaluated the proposed GGNS-specific PRNM System installation against the requirements of the NUMAC PRNM LTR and associated NRC Safety Evaluations. GEH developed a plant-specific comparison report GE-NE-0000-0102-0888, *Grand Gulf Nuclear Station - Plant-Specific Responses Required by NUMAC PRNM Retrofit Plus Option III Stability Trip Function Topical Report (NEDC-32410P-A)*, (Reference 5), which is provided in Attachment 2. The deviations from the NUMAC PRNM LTR are identified in Section 5.1.3, below.

Entergy plans to replace the analog Average Power Range Monitor (APRM) subsystem of the existing Neutron Monitoring System at GGNS with the more reliable digital NUMAC PRNM System during the spring 2012 refueling outage.

The NUMAC PRNM System design includes an Oscillation Power Range Monitor (OPRM) capability, which implements a GEH version of the Boiling Water Reactor Owners' Group (BWROG) Option III detect-and-suppress long-term reactor core stability solution methodology. With installation of the OPRM and approval of this License Amendment Request (LAR), GGNS will transition from currently implemented Enhanced Option I-A stability solution to Option III.

2.0 PROPOSED CHANGES

The following OL and TS sections, and associated TS Bases sections are affected by this change:

- OL Section 2.C(2), *Technical Specifications*
- TS 1.1, *Definitions*
- TS 3.2.4, *Fraction of Core Boiling Boundary (FCBB)*
- TS 3.3.1.1, *Reactor Protection System (RPS) Instrumentation*

- TS 3.3.1.3, *Period Based Detection System (PBDS)*
- TS 3.10.8, *Shutdown Margin (SDM) Test -- Refueling*
- TS 5.6.5, *Core Operating Limits Report (COLR)*

The proposed changes support GGNS' replacement of the existing analog APRM subsystem, excluding the associated Local Power Range Monitor (LPRM) detectors and cables, with the NUMAC microprocessor-based PRNM System. This digital upgrade includes an OPRM Upscale function, which detects and suppresses reactor power instabilities through LPRM flux monitoring.

The planned modification involves replacing the existing eight APRM instrument channel modules of power range monitor electronics with four channels of NUMAC PRNM System hardware. The existing equipment is located in multi-bay panels in the main control room and the upper cable spreading room in the GGNS Control Building. The modification removes and replaces the existing power range monitor equipment within the panels but, with minor exceptions, leaves the plant cabling and interfaces undisturbed.

The modification provides redundancy to the LPRM detector power supply hardware and also upgrades the recirculation flow signal processing electronics. Unlike the current analog instrumentation, the new digital instrumentation is not vulnerable to instrument setpoint drift.

This LAR addresses changes to the OL, TS Limiting Conditions of Operation (LCOs), Surveillance Requirements (SRs), and RPS APRM functions as justified in the NUMAC PRNM LTR. These changes are identified and discussed in Section 4.0, below.

Attachment 3 provides marked-up OL and TS pages indicating the proposed changes. Attachment 4 provides the associated draft TS Bases pages for information only.

3.0 BACKGROUND

3.1 Current GGNS Neutron Monitoring System Description

The current Neutron Monitoring System at GGNS consists of five subsystems:

1. Source Range Monitors (SRM)
2. Intermediate Range Monitors (IRM)
3. Local Power Range Monitors (LPRM)
4. Average Power Range Monitors (APRM)
5. Traversing In-Core Probe (TIP)

Of the above subsystems, only the APRM subsystem is affected by this proposed change.

The APRM subsystem has eight APRM channels; each channel receiving input signals from a number of LPRM channels. Four APRM channels are associated with each trip system of the Reactor Protection System (RPS).

Each APRM channel uses:

(1) Electronic equipment that averages the output signals from a selected set of LPRMs;

(2) Trip units that actuate automatic devices; and

(3) Signal readout equipment.

The APRM channels supply signals to the RPS, the Rod Control and Information System (RC&IS), and the core monitoring computer. The RPS and RC&IS process the APRM inputs to initiate reactor scrams and manage control rod manipulations (e.g., control rod blocks), respectively. The core monitoring computer uses LPRM flux values for its calculations.

Each APRM channel receives two flow signals representative of reactor recirculation drive flow. The flow signals are sensed from two pairs of elbow taps, one in each recirculation loop.

One APRM channel in each RPS division contains a Period-Based Detection System (PBDS) card that takes input from A-, B-, and C-level LPRMs in the associated APRM. The PBDS is a defense-in-depth feature of the Option E-I-A core stability solution. (See Section 3.3, below, for more information pertaining to Option E-I-A.) The PBDS analyzes the incoming LPRM signals individually to detect power oscillations consistent with neutronic/thermal-hydraulic instability. Upon detecting power oscillations, control room annunciators alarm to indicate the need for operator action, as required.

Also in support of the Option E-I-A stability solution, the APRMs are used to determine the Fraction of Core Boiling Boundary (FCBB). FCBB is the ratio of power generated in the lower four feet of the reactor core to the power required to produce saturated boiling of the coolant entering the fuel channels. FCBB is established to ensure the core remains stable during normal reactor operations when operating in certain regions of the power/flow map. FCBB is controlled in accordance with TS 3.2.4, *Fraction of Core Boiling Boundary (FCBB)*.

Each APRM contains a digital Flow Control Trip Reference card (FCTR) that generates the flow-referenced scram and rod-block trip setpoints as a function of aligned reactor recirculation drive flow. The digital FCTR card provides a drive flow alignment feature to convert and compensate for changes in the reactor total core flow-to-recirculation drive flow relationship. The FCTR also performs real-time reactor recirculation drive flow signal validation. The purpose of the validation process is to provide adequate assurance that credible failures in the drive flow are detected and result in a conservative response from the FCTR. The drive flow signal is tested for upscale and downscale failures. Any detected failure of the drive flow signal causes the FCTR to generate a failsafe output. This output causes a reactor scram signal to be generated by the corresponding Neutron Monitoring System channel.

The APRM subsystem utilizes four safety-related functions, which provide input into the RPS. These functions are identified in TS Table 3.3.1.1-1, *Reactor Protection System Instrumentation*, and listed in the table below.

TS APRM Function Name	TS APRM Function Designation
Neutron Flux – High, Setdown	2.a
Fixed Neutron Flux – High	2.b
Inop	2.c
Flow Biased Simulated Thermal Power – High	2.d

3.2 NUMAC PRNM System Hardware Description

The proposed NUMAC PRNM System consists of four APRM/OPRM channels, each performing APRM and OPRM functions, and four 2-Out-Of-4 Voter channels. The modification removes and replaces the existing power range monitor equipment located in multi-bay panels in the main control room and the upper cable spreading room in the GGNS Control Building. With minor exceptions, the modification leaves the plant cabling and interfaces undisturbed. One APRM/OPRM channel chassis contains both APRM and OPRM channel circuitry.

As with the current system, the general APRM function averages LPRM information and, using a combination of predefined criteria and criteria based on inputs from the recirculation drive flow functions, compares average neutron flux and Simulated Thermal Power to specified limits.

The recirculation drive flow signal processing, which was previously accomplished using the FCTR within the APRM control panels, is now integrated into the APRM circuitry in the new NUMAC PRNM System design. The proposed modification utilizes the current recirculation drive flow channel configuration. See Section 3.1, above, for a description of the recirculation drive flow channel.

The OPRM is a microprocessor-based monitoring and protection system that:

(1) Detects a thermal-hydraulic instability in the reactor core;

(2) Alarms on small power oscillation magnitudes; and

(3) Initiates action to suppress an oscillation prior to exceeding safety limits.

The OPRM monitors the outputs from selected LPRMs and provides inputs to the RPS to initiate suppression actions.

Each 2-Out-Of-4 Voter channel (A1, A2, B1, and B2) receives input from the four APRM/OPRM channels. Voter Channels A1 and A2 input to RPS Trip System A, while B1 and B2 input to RPS Trip System B. A reactor trip occurs when at least two 2-Out-Of-4 Voter channels (one in each RPS trip system) confirms a trip condition is being sensed by two or more APRM/OPRM channels. For example, if any two of the four APRM/OPRM channels sense an APRM or OPRM trip condition, each sends a corresponding signal to the 2-Out-Of-4 Voters. Each Voter processes the signal, determines at least two APRM/OPRM channels sense a trip condition, and then sends a trip signal to its corresponding RPS trip system, resulting in a plant scram.

When one APRM/OPRM channel is bypassed, the voting trip logic becomes 2-out-of-3. The Voter channels cannot be bypassed.

GEH has modified the NUMAC PRNM System design from that described in the NUMAC PRNM LTR to have the APRM/OPRM channel send an OPRM Upscale trip and an APRM Inop trip to all four 2-Out-Of-4 Voters when the associated channel key switch is placed in the "INOP" position. As a result, an OPRM Upscale trip in one channel and an APRM Inop trip in another channel results in RPS trip outputs from all four 2-Out-Of-4 Voter channels. This deviation from the previously-approved NUMAC PRNM System design and licensing basis is identified in Section 5.1.3, below, and discussed within Appendix A of Attachment 2 (Reference 5).

The NUMAC PRNM System utilizes the four safety-related APRM functions of the existing GGNS power range monitoring system logic (identified in Section 3.1, above), as well as the existing LPRM detector signal processing, LPRM averaging, and APRM reactor trips, and adds two new functions that support the Option III stability solution; these are: (1) a 2-Out-Of-4 Voter function (new APRM Function 2.e); and (2) an OPRM Upscale function (new APRM Function 2.f).

As discussed in the NUMAC PRNM LTR (References 1 and 2) and recognized by the NRC in its Safety Evaluations approving the LTR (References 3 and 4), this modification has no impact on the control rod block instrumentation governed by TS 3.3.2.1, *Control Rod Block Instrumentation*, for a BWR/6 plant that has implemented Improved Technical Specifications (ITS). GGNS is such a plant; therefore, TS 3.3.2.1 is not affected.

In addition as noted in Section 2.3.3.5 of the NUMAC PRNM LTR, the Average Power Range Monitor, Rod Block Monitor, and Technical Specifications Improvement Program (ARTS) is not applicable to the BWR/6 design and, therefore, not applicable to GGNS.

3.3 <u>Changes to the Reactor Stability Solution Licensing Basis</u>

Under certain conditions, BWRs are susceptible to coupled neutronic/ thermal-hydraulic instabilities. These instabilities are characterized by periodic power/flow oscillations. Compliance with the stability licensing criteria of 10 CFR 50 Appendix A, General Design Criterion (GDC) 10, *Reactor Design*, and GDC 12, *Suppression of Reactor Power Oscillations*, can be achieved either by preventing or by detecting and suppressing stability-related reactor power oscillations prior to exceeding fuel design limits. If these power/flow oscillations become large enough, the fuel cladding integrity Minimum Critical Power Ratio (MCPR) Safety Limit could be challenged.

The BWROG developed several long-term stability solution options for detecting and suppressing core instability events, which are documented in NEDO-31960-A, *BWR Owners' Group Long-Term Stability Solutions Licensing Methodology*, and associated Supplement 1 (Reference 6). The option currently implemented at GGNS is referred to as Enhanced Option I-A (E-I-A) and was approved by the NRC in GGNS TS Amendment 141 (Reference 7). For this option, the existing APRM Flow Biased Simulated Thermal Power – High function (TS Table 3.3.1.1-1 Function 2.d) provides a preemptive reactor scram to prevent power/flow oscillations that could lead to grossly violating the operating domain.

The NUMAC PRNM System design uses a different, more general stability control approach and includes an OPRM Upscale function, referred to as Option III in the BWROG long-term stability solution methodology (Reference 6). The NUMAC PRNM LTR discusses implementing the OPRM functions within the PRNM equipment.

Option E-I-A is not currently licensed for use with the NUMAC PRNM System.

The traditional Option III solution employs three different software algorithms running on the NUMAC PRNM microprocessor computer platform to automatically detect and suppress reactor thermal-hydraulic instabilities: (1) an Amplitude-Based algorithm; (2) a Growth-Rate algorithm; and (3) a Period-Based Detection algorithm[1].

The Amplitude-Based algorithm discriminates between true stability-related neutron flux oscillations and other flux variations that may be expected during plant operation. The primary objectives of this algorithm are to:

(1) Provide a sufficiently low amplitude trip setpoint such that margin to the MCPR Safety Limit is maintained; and

(2) Identify stability-related neutron flux oscillations and discriminate against "false" signals from other expected plant evolutions.

The Growth-Rate algorithm follows the same logic as the Amplitude-Based algorithm, except that a trip is initiated if the relative signal value exceeds a specified growth-rate setpoint.

The Period-Based Detection algorithm is based on the observation that the neutron flux of an unstable core oscillates with a well-defined period and that the neutron flux of a stable core is characterized by random noise. Detecting the inception of thermal-hydraulic instability is confirmed by several consecutive, equal periods which results in an alarm signal. The oscillation amplitude is then compared against a trip setpoint. Meeting both conditions (both a sustained period and increasing signal amplitude) results in a channel trip signal.

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1 A similar Period-Based Detection algorithm is currently utilized by Option E-I-A, as discussed in Section 3.1.

Of the three algorithms, only the Period-Based Detection algorithm is credited to protect the MCPR Safety Limit against anticipated thermal-hydraulic instabilities. The Amplitude-Based and Growth-Rate algorithms are provided for defense-in-depth.

The Option III configuration replaces GGNS' Option E-I-A as the long-term stability solution required by NRC Generic Letter 94-02, *Long-Term Solutions and Upgrade of Interim Operating Recommendations for Thermal Hydraulic Instabilities in Boiling Water Reactors* (Reference 8).

Unlike Option E-I-A, Option III does not employ FCBB to detect and suppress potential reactor core instabilities. FCBB is discussed in Section 3.1, above.

The OPRM Upscale function (new APRM Function 2.f) is added to TS 3.3.1.1, *Reactor Protection System (RPS) Instrumentation*, to implement Option III (see Section 4.4.3.7, below).

Following NUMAC PRNM System installation and startup from the 2012 refueling outage, the OPRM will operate in an "indicate only" mode for an initial monitoring period. The purpose of the monitoring period is to ensure the OPRM algorithms perform according to design specifications. The OPRM Monitoring Period is discussed below.

<u>OPRM Monitoring Period</u>

Section 8.4 of the NUMAC PRNM LTR discusses an OPRM Monitoring Period during which time the OPRM Upscale trip function is not connected to RPS. The LTR designates the duration of this monitoring period to be one operating cycle after which the function will be connected to RPS.

Both the NRC staff and the industry recognized that a possibility of problems with the OPRM algorithms, system performance in an actual plant environment, hardware problems, etc., existed. Considering stability events are infrequent occurrences, the NRC Safety Evaluation for the NUMAC PRNM LTR contains the following provision:

> "The OPRM function will be monitored during the first full fuel cycle to ensure the OPRM algorithms perform according to the design specifications. During this monitoring period, the OPRM trip capabilities will be deactivated, but the OPRM alarms and indications will be provided to the operators. Upon completion of this initial surveillance phase, the OPRM trip functions will be enabled, and the licensee will submit to the NRC technical specification changes that address the OPRM functions."

Entergy recognizes the potential for identifying an intractable problem during the OPRM Monitoring Period, but based upon current industry / GEH experience with the NUMAC PRNM System, considers such a problem unlikely.

Although the NUMAC PRNM System with the OPRM Upscale trip function has now been operating at several plants for several years without any indication of an OPRM design problem, Entergy believes it remains prudent to assume that a design problem may still exist in the OPRM Upscale function. Therefore, to minimize operational risk and potentially avoid an otherwise unnecessary plant shutdown, Entergy will conduct a monitoring period of the OPRM for a minimum of 90 days not to exceed one fuel cycle after plant startup following the 2012 refueling outage.

The PRNM System configuration during the monitoring period and the monitoring period duration are discussed below.

a. PRNM System Configuration

During the OPRM Monitoring Period, the outputs from the OPRM Upscale function will not be connected to the RPS trip output relays while the OPRM alarms and indications will be provided to the operators. The OPRM portion of the PRNM System will operate in an "indicate only" mode and will be considered "functional" based upon successfully performing those surveillances that can be performed, or partially performed, prior to startup or on-line as part of post-modification testing, industry experience, and factory acceptance testing of the NUMAC PRNM System. System tuning may be performed as necessary during the OPRM Monitoring Period.

The OPRM Upscale function will not be relied upon to mitigate a stability event during this initial OPRM Monitoring Period; rather GGNS will implement Backup Stability Protection (BSP) measures specified in BWROG document OG-02-0119-260, *GE to BWROG Detect and Suppress II Committee, "Backup Stability Protection (BSP) for Inoperable Option III Solution,"* (Reference 9) as an alternate method for detecting and suppressing instabilities until the OPRM Monitoring Period has been successfully completed. The NRC approved the use of the BSP measures for the alternate method for Monticello as documented in its Safety Evaluation (Reference 10).

Reactor stability compliance using this method relies upon operator action to:

- Avoid regions where instability may occur,
- Exit such regions when necessary, and
- Detect an actual instability and take mitigating action by manual means.

The BSP measures will be implemented via plant procedures, consistent with other OPRM license amendments approved by the NRC.

At the end of the OPRM Monitoring Period, Entergy will review the operating data, setpoints, and margins. Once the results are determined to be acceptable, Entergy will enable the OPRM (with applicable SRs met) by connecting it to the RPS trip relays, completing implementation of the hardware changes for this amendment.

b. Monitoring Period Duration

The one-cycle monitoring period in the NUMAC PRNM LTR for the OPRM Upscale function was specified because, at that time, it was a new feature of the RPS. As such, further testing, monitoring, and evaluating the normal modes of operation was considered prudent to ensure this function performed as designed and did not create any unintended consequences. Since originally introduced, GEH NUMAC PRNM systems utilizing Option III with the OPRM Upscale function have been installed in many plants within the U.S. and overseas, accumulating more than 90 reactor years of fully-armed operation.

Based on this operational experience, Entergy believes that having the flexibility to complete the monitoring period after a minimum of 90 days or to continue it up to the end of the fuel cycle is appropriate. Although a slightly different approach, the NRC approved a fixed, 90-day monitoring period for Monticello (Reference 10).

Entergy will notify the NRC when the monitoring period has been successfully completed.

4.0 TECHNICAL ANALYSES

GGNS is a GE BWR/6 large core plant. The proposed OL and TS changes and associated draft TS Bases changes have been developed in accordance with the NUMAC PRNM LTR (except as specified within this LAR). Attachments 3 and 4 provide marked-up pages of the proposed OL and TS changes and corresponding TS Bases changes associated with installing the NUMAC PRNM System, respectively. The draft TS Bases mark-ups, provided for information only, will be issued in accordance with TS 5.5.11, *Technical Specification (TS) Bases Control Program*.

As discussed in Section 3.2, above, the NUMAC PRNM System utilizes the four functions of the existing GGNS APRM system logic, including LPRM detector signal processing, LPRM averaging, and APRM reactor trips, and adds two new functions. The new and existing functions are identified in the table below:

TS Function Name	TS Function Designation
Neutron Flux – High, Setdown (existing)	2.a
Fixed Neutron Flux – High (existing)	2.b
Inop (existing)	2.c
Flow Biased Simulated Thermal Power – High (existing)	2.d
2-Out-Of-4 Voter (new)	2.e
OPRM Upscale (new)	2.f

The proposed OL and TS changes pertaining to the NUMAC PRNM System and these functions are identified and described below.

4.1 <u>OL Section 2.C(2), *Technical Specifications*</u>

Section 3.3, above, discusses the OPRM Monitoring Period. Entergy proposes to conduct the OPRM Monitoring Period as directed by the NUMAC PRNM LTR and the NRC beginning at startup from the 2012 refueling outage into Cycle 19 with the following clarifications and modifications:

(1) During the monitoring period, the TS requirements will not apply to the OPRM Upscale function, thereby eliminating the requirement to reduce power to < 24% RTP after 120 days, as would be required by new Required Action K.1 (see Section 4.4.1.3, below). Also, BSP measures specified in BWROG document OG-02-0119-260 (Reference 9) will be implemented via GGNS procedures to provide an alternate method for detecting and suppressing reactor core thermal hydraulic instability oscillations during the monitoring period. The NRC approved the use of the Backup Stability Protection measures as an acceptable alternate method for Monticello (Reference 10).

(2) The monitoring period will last for a minimum of 90 days and may be completed prior to completing the fuel cycle if analysis of the collected data indicates the OPRM is functioning properly. Upon completing the monitoring period, the OPRM Upscale function will be enabled and subject to all applicable Technical Specification requirements. The NRC approved a 90-day monitoring period for Monticello (Reference 10).

In order to reflect this approach, Entergy proposes to modify OL Section 2.C(2). Section 2.C(2) currently states in part:

> "Entergy Operations, Inc. shall operate the facility in accordance with the Technical Specifications and the Environmental Plan."

Specifically, Entergy proposes to add a paragraph to Section 2.C(2) that states:

> "During Cycle 19, GGNS may conduct monitoring of the Oscillation Power Range Monitor (OPRM). During this time, the OPRM Upscale function (Function 2.f of Technical Specification Table 3.3.1.1-1) may be disabled and operated in an 'indicate only' mode at which time technical specification requirements would not apply. During such time, Backup Stability Protection measures will be implemented via GGNS procedures to provide an alternate method to detect and suppress reactor core thermal hydraulic instability oscillations."

Entergy has used this approach in the past to identify situations in which certain TS requirements would not apply to specific structures, systems, or components for a limited period of time.

Separate from the above proposal, Section 2.C(2) currently contains a paragraph pertaining to performing SRs related to previous TS Amendment 169. Since the current amendment to the GGNS TS is Amendment 182, this paragraph is no longer applicable. Therefore, Entergy proposes to delete it.

4.2 TS 1.1, *Definitions*

TS 1.1 defines the Fractions of Core Boiling Boundary (FCBB). As discussed in Section 4.3, below, this term and its associated TS is being deleted; therefore, Entergy proposes to delete this definition from TS 1.1.

4.3 TS 3.2.4, *Fraction of Core Boiling Boundary (FCBB)*

As discussed in Sections 3.1 and 3.3, above, FCBB is a component of the Option E-I-A stability solution that ensures the reactor core remains stable when operating in certain regions of the power/flow map. The new Option III stability solution does not use FCBB as a component to detect and suppress potential core instabilities; therefore, Entergy proposes to delete TS 3.2.4 in its entirety.

4.4 TS 3.3.1.1, *Reactor Protection System (RPS) Instrumentation*

4.4.1 Changes to Limiting Conditions for Operation (LCO) 3.3.1.1 Actions

4.4.1.1 New Notes Clarifying Required Action A.2 and Condition B

In the Actions for TS 3.3.1.1, Entergy proposes to add a new note to Required Action A.2 and also to Condition B. These notes indicate that neither Required Action A.2 nor Condition B apply to new and existing APRM Functions 2.a, 2.b, 2.c, 2.d, or 2.f when placing an associated channel in the tripped condition; rather, it applies to APRM Function 2.e, only.

Required Action A.2 is not applicable to the identified APRM functions because, with the new configuration following NUMAC PRNM System installation, inoperability of one APRM/OPRM channel affects both RPS trip systems. As discussed in Section 3.2, above, each APRM/OPRM channel inputs into the 2-Out-Of-4 Voters for both RPS trip systems. Thus, for an inoperable APRM/OPRM channel, Required Action A.1 must be satisfied and is the only action (other than restoring operability) that will restore the capability to accommodate a single failure. Also, Condition B is not applicable because the inoperability of more than one required APRM/OPRM channel results in the loss of trip capability; thus, in this circumstance, entry is required into Condition C, as well as into Condition A for each channel.

See Section 3.2, above, for a detailed description of the NUMAC PRNM system trip logic.

4.4.1.2 New Condition J and Associated Required Actions J.1 and J.2

In accordance with Section 8.4.2 of the NUMAC PRNM LTR, Entergy proposes to add new Action Statement Condition J for new OPRM Upscale Function 2.f. Condition J addresses a loss of trip capability in both RPS trip systems.

Condition J applies to Function 2.f when, for an OPRM Upscale channel, the Required Actions for Condition A, B, or C are not met within the specified Completion Time. Associated Required Actions are implemented to address Condition J. Specifically, Required Action J.1 is added to initiate an alternate method of detecting and suppressing thermal hydraulic instability conditions within 12 hours. This alternate method involves temporarily establishing Backup Stability Protection (BSP) measures specified in BWROG document OG-02-0119-260 (Reference 9)[2], and will be controlled by plant procedures. In addition, new Required Action J.2 requires restoring OPRM Upscale trip capability within 120 days. The use of the BSP measures as an alternate method was approved for Monticello by the NRC (Reference 10).

Condition J addresses situations where OPRM Upscale trip capability is not maintained. The most likely reason for such a condition would be a common-mode software error, which would affect the four channels of the OPRM. The NRC staff acknowledged in the Safety Evaluation of the NUMAC PRNM LTR (References 3 and 4) that a significant period of time would be needed to arrange a contract with the OPRM software developer, determine the cause of the error, repair the defect, test the software modification, and implement the software upgrade in the plant. Pursuant to Condition J, while the OPRM software is being upgraded, the plant would be required by Required Action J.1 to operate under the BSP measures , for up to 120 days. During this time period, GGNS management attention would be focused on restoring OPRM operability because the plant would be operating in a Required Action that would lead to a mandatory power reduction to less than 24% reactor thermal power (RTP) via new Condition K (see Section 4.4.1.3, below) if OPRM operability is not restored within 120 days.

Entergy also proposes a note that states LCO 3.0.4.b is not applicable to new Required Action J.2. This note allows unit restart in the event of a shutdown during the 120-day completion time. This approach is consistent with the original intent of NUMAC PRNM LTR, which is to allow normal plant operations to continue

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[2] The BSP is an update to the Interim Corrective Actions specified in NRC Bulletin 88-07, Supplement 1, *Power Oscillations in Boiling Water Reactors (BWRs)*.

during the recovery time from a hypothesized design problem with the Option III algorithms.

Adding this note avoids processing exigent TS changes to allow plant startup if a problem arises with the Option III algorithms during the 120-day completion time of Required Action J.2, while still maintaining plant safety.

An exception to LCO 3.0.4 was not included within the NUMAC PRNM LTR, but has been approved in recent NRC Safety Evaluations for activating the OPRM Upscale function at Monticello (Reference 10) and Peach Bottom Units 2 and 3 (Reference 11) via a note that reads, "LCO 3.0.4 is not applicable."

The NRC stated in the Peach Bottom Safety Evaluation that, while not included in the scope of the NUMAC PRNM LTR, the exception to LCO 3.0.4 would allow the plant to restart in the event of a shutdown during the 120-day completion time of the Required Action. The NRC recognized that the original intent "was to allow normal plant operations to continue during the recovery time from a hypothesized design problem with the Option III algorithms."

Entergy revised LCO 3.0.4 in GGNS TS Amendment 175 to reflect NRC-approved changes regarding mode change limitations via BWROG TSTF-359, "Increased Flexibility in Mode Restraints." Entergy has modified the wording of the approved note to state, "LCO 3.0.4.b is not applicable." The note is applied to Required Action J.2 and reflects standard wording currently reflected in the GGNS TS. Although worded differently from the NRC-approved notes, the intent of the proposed note remains the same.

4.4.1.3 <u>New Condition K and Associated Required Action K.1</u>

In accordance with Section 8.4.3 of the NUMAC PRNM LTR, Entergy proposes to add new Condition K. Condition K requires reducing power to < 24% RTP within 4 hours in accordance with Required Action K.1 if Condition J cannot be met (i.e., required number of OPRM channels restored). By requiring this action, the plant would be placed in a condition in which the OPRM Upscale function is not required to be operable (see Section 4.4.3.7.b, below).

4.4.2 <u>Changes to Surveillance Requirements (SRs)</u>

4.4.2.1 <u>SR 3.3.1.1.10 - Channel Calibration</u>

Currently, SR 3.3.1.1.10 requires channel calibrations to be performed once every 184 days. This SR applies to APRM Functions 2.a, 2.b, and 2.d, only; it does not apply to any other RPS instrumentation functions identified in TS Table 3.3.1.1-1. The SR also has four notes clarifying application of the SR to APRM Functions 2.a and 2.d.

Sections 8.3.4 and 8.4.4.3 of the NUMAC PRNM LTR provide justification for performing channel calibrations on new and existing APRM Functions 2.a, 2.b, 2.d, and 2.f once every 24 months. Based on this justification and because SR 3.3.1.1.10 only applies to APRM Functions 2.a, 2.b, 2.d, and 2.f, Entergy proposes to change the frequency of SR 3.3.1.1.10 from "once every 184 days" to "once every 24 months."

In addition to the change in frequency, Note 4 is deleted. Note 4 currently states, "For Function 2.d, the digital components of the flow control trip reference cards are excluded." As discussed in Section 3.2, above, the function performed by the FCTRs have been integrated into the APRM circuitry. With this change, the FCTRs are removed; therefore, Note 4 is no longer applicable and is deleted.

4.4.2.2 <u>SR 3.3.1.1.16 – Simulated Thermal Power Time Constant</u>

To support the current Option E-I-A stability solution at GGNS, APRM Function 2.d uses a simulated thermal power time constant. SR 3.3.1.1.16 requires the simulated thermal power time constant to be calibrated once every 18 months. This SR applies to APRM Function 2.d, only; it does not apply to any other RPS instrumentation functions identified in TS Table 3.3.1.1-1.

Section 8.3.4.3 of the NUMAC PRNM LTR provides justification for deleting the requirement to check the simulated thermal power time constant. Based on this justification, Entergy proposes to delete SR 3.3.1.1.16 in its entirety.

4.4.2.3 <u>SR 3.3.1.1.18 – Recirculation Flow Control Trip Reference</u>

To support the current Option E-I-A stability solution utilized at GGNS, APRM Function 2.d uses a trip level generated by the FCTRs based on recirculation loop drive flow. (The FCTRs are discussed in Sections 3.1 and 3.2, above.) SR 3.3.1.1.18 requires adjusting the FCTRs. This SR applies to APRM Function 2.d, only; it does not apply to any other RPS instrumentation functions identified in TS Table 3.3.1.1-1.

As discussed in Sections 3.2 and 4.4.2.1, above, the NUMAC PRNM System with Option III removes this equipment. Therefore, Entergy proposes to delete SR 3.3.1.1.18 in its entirety.

4.4.2.4 New SR 3.3.1.1.19 - Channel Check

Currently, SR 3.3.1.1.1 requires channel checks to be performed once every 12 hours for those functions identified in TS Table 3.3.1.1-1. Included in these functions are existing APRM Functions 2.a, 2.b, and 2.d.

Sections 8.3.4.1 and 8.4.4.1 of the NUMAC PRNM LTR provide justification for performing channel checks on new and existing APRM Functions 2.a, 2.b, 2.d, 2.e, and 2.f on a frequency of once every 24 hours. Because other RPS instrumentation functions identified in TS Table 3.3.1.1-1 require a channel check once every 12 hours per SR 3.3.1.1.1, the frequency of this SR cannot be changed.

To implement this change, Entergy proposes to add new SR 3.3.1.1.19, which requires a channel check once every 24 hours, and to apply it to new and existing APRM Functions 2.a, 2.b, 2.d, 2.e, and 2.f, only. With this change, current SR 3.3.1.1.1 no longer applies to the existing APRM Functions 2.a, 2.b, and 2.d, but remains applicable to the other identified functions.

4.4.2.5 New SR 3.3.1.1.20 - Channel Functional Test

Currently, SRs 3.3.1.1.3 and 3.3.1.1.8 require channel functional tests to be performed once every 7 days and 92 days, respectively, for those functions identified in TS Table 3.3.1.1-1. Included in these functions are existing APRM Functions 2.a, 2.b, 2.c, and 2.d. SR 3.3.1.1.3, which applies to APRM Function 2.a, contains a note that allows the channel functional test to be postponed for up to 12 hours when entering Mode 2 from Mode 1.

Sections 8.3.4.2 and 8.4.4.2 of the NUMAC PRNM LTR provide justification for performing channel functional tests on new and existing APRM Functions 2.a, 2.b, 2.c, 2.d, 2.e, and 2.f on a frequency of once every 184 days. Because SRs 3.3.1.1.3 and 3.3.1.1.8 apply to other RPS instrumentation functions identified in TS Table 3.3.1.1-1, the frequencies of these SRs cannot be changed.

To implement this change, Entergy proposes to add new SR 3.3.1.1.20, which requires a channel functional test once every 184 days, and to apply it to new and existing APRM Functions 2.a, 2.b, 2.c, 2.d, 2.e, and 2.f, only. With this change, current SRs 3.3.1.1.3 and 3.3.1.1.8 no longer apply to the existing APRM Functions 2.a, 2.b, 2.c, and 2.d but remain applicable to the other identified functions.

Also in accordance with Section 8.3.4.2 of the NUMAC PRNM LTR, SR 3.3.1.1.20 includes the following notes:

1. For Function 2.a, not required to be performed when entering Mode 2 from Mode 1 until 12 hours after entering Mode 2.

2. For Functions 2.a, 2.b, and 2.c, the APRM/OPRM channels and the 2-Out-Of-4 Voter channels are included in the channel functional test.

3. For Functions 2.d and 2.f, the APRM/OPRM channels and the 2-Out-Of-4 Voter channels plus the flow input function, excluding the flow transmitters, are included in the channel functional test.

Because the 2-Out-Of-4 Voter is included in the channel functional test for the other APRM functions, Function 2.e does not require a separate channel functional test.

4.4.2.6 <u>New SR 3.3.1.1.21 – Logic System Functional Test</u>

Currently, SR 3.3.1.1.13 requires a logic system functional test (LSFT) to be performed once every 18 months for those functions identified in TS Table 3.3.1.1-1. Included in these functions are existing APRM Functions 2.a, 2.b, 2.c, and 2.d.

Sections 8.3.5 and 8.4.5 of the NUMAC PRNM LTR provide justification to:

- Delete the LSFT requirement from existing APRM Functions 2.a, 2.b, 2.c, and 2.d; and

- Apply an LSFT requirement to new APRM Function 2.e, requiring performance once every 24 months.

Because other RPS instrumentation functions identified in TS Table 3.3.1.1-1 require an LSFT once every 18 months per SR 3.3.1.1.13, the frequency of this SR cannot be changed. Therefore, to implement this change, Entergy proposes to:

a. Delete SR 3.3.1.1.13 from Table 3.3.1.1-1 for existing APRM Functions 2.a, 2.b, 2.c, and 2.d; and

b. Add new SR 3.3.1.1.21, which requires performing an LSFT once every 24 months, and apply it to APRM Function 2.e.

With these changes, current SR 3.3.1.1.13 no longer applies to existing APRM Functions 2.a, 2.b, 2.c, and 2.d, but remains applicable to the other identified functions.

4.4.2.7 <u>New SR 3.3.1.1.22 – Response Time Testing</u>

Currently, SR 3.3.1.1.15 requires response time testing to be performed once every 18 months on a staggered basis for those functions identified in TS Table 3.3.1.1-1. Included in these functions are existing APRM Functions 2.b and 2.d.

Section 8.3.4.4 of the NUMAC PRNM LTR provides justification to:

- Delete the response time testing requirement from existing APRM Functions 2.b and 2.d; and

- Apply a response time testing requirement to new APRM Function 2.e, requiring performance once every 24 months on a staggered basis. (Although the NUMAC PRNM LTR discusses applying staggered testing to the 2-Out-Of-4 Voter function, it provides no specific changes to the SRs or Bases to define the testing requirements.)

Because other RPS instrumentation functions identified in TS Table 3.3.1.1-1 require a response time test once every 18 months per SR 3.3.1.1.15, the frequency of this SR cannot be changed.

Therefore, to implement these changes, Entergy proposes to:

a. Delete SR 3.3.1.1.15 from Table 3.3.1.1-1 for existing APRM Functions 2.b and 2.d.

b. Add new SR 3.3.1.1.22, which requires performing response time testing once every 24 months on a staggered basis, and apply it to APRM Function 2.e.

c. Add a note to SR 3.3.1.1.22 that defines the testing requirements by stating:

   > "For Function 2.e, 'n' equals 8 channels for the purpose of determining the STAGGERED TEST BASIS Frequency. Testing APRM and OPRM outputs shall alternate."

   Adding this note was approved by the NRC in the Safety Evaluation for Monticello (Reference 10) and Brunswick Units 1 and 2 (Reference 12).

With these changes, SR 3.3.1.1.15 no longer applies to existing APRM Functions 2.b and 2.d, but remains applicable to the other identified functions.

4.4.2.8 <u>New SR 3.3.1.1.23 - Verify OPRM not Bypassed</u>

In accordance with Section 8.4.4.2 in Supplement 1 of the NUMAC PRNM LTR, Entergy proposes new SR 3.3.1.1.23 to verify that the OPRM auto-enable setpoints are correctly set. SR 3.3.1.1.23 applies to new APRM Function 2.f (see Section 4.4.3.7, below). This verification is to be performed once every 24 months.

New SR 3.3.1.1.23 verifies APRM Function 2.f is not bypassed when the APRM Simulated Thermal Power is ≥ 29% RTP and the recirculation drive flow is < 60% of rated recirculation drive flow. The settings for this auto-enable (not-bypassed) region have been determined for GGNS and are established as nominal setpoints only, as described in the proposed TS Bases markup and designated in SR 3.3.1.1.23.

4.4.3 <u>Changes to TS Table 3.3.1.1-1, *Reactor Protection System Instrumentation*</u>

Four functions are currently included under the APRM heading (Function 2) in TS Table 3.3.1.1-1:

- Neutron Flux – High, Setdown (Function 2.a)
- Fixed Neutron Flux – High (Function 2.b)
- Inop (Function 2.c)
- Flow Biased Simulated Thermal Power - High (Function 2.d).

Installing the NUMAC PRNM System requires modifying the TS table by adding two new APRM functions:

- 2-Out-Of-4 Voter (new Function 2.e) and
- OPRM Upscale (new Function 2.f)

These were previously discussed in Section 3.2, above.

For each of the new and existing APRM functions, corresponding changes are required to TS Table 3.3.1.1-1 to reflect the following criteria, as applicable:

- Applicable Modes or Other Specified Conditions
- Required Channels per Trip System
- Conditions Referenced from Required Action D.1
- Surveillance Requirements
- Allowable Values

Entergy proposes the following changes and additions to TS Table 3.3.1.1-1:

4.4.3.1 Addition of New Notes to Clarify Requirements for APRM Functions

a. In accordance with Section 8.3.2.4 of the NUMAC PRNM LTR, reflect the new NUMAC PRNM System configuration (i.e., the identified APRM/OPRM channel provides inputs to both RPS trip systems) by adding new Note (c). Note (c) states:

   "Each channel provides inputs to both trip systems."

   Apply this note to APRM Functions 2.a, 2.b, 2.c, 2.d, and 2.f, as identified in the individual sections, below.

b. Reflect application of actions to address the industry setpoint methodology issue as documented in TSTF-493, *Clarify Application of Setpoint Methodology for LSSS Functions*, (Reference 13) by adding new Notes (d) and (e), as follows:

   i) Note (d) states:

      "If the as-found channel setpoint is outside its predefined as-found tolerance, then the channel shall be evaluated to verify that it is functioning as required before returning the channel to service."

   ii) Note (e) states:

      "The instrument channel setpoint shall be reset to a value that is within the as-left tolerance around the Nominal Trip Setpoint (NTSP) at the completion of the surveillance; otherwise, the channel shall be declared inoperable. Setpoints more conservative than the NTSP are acceptable provided the as-found and as-left tolerances apply to the actual setpoint implemented in the Surveillance procedures to confirm channel performance. The NTSP and the methodologies used to determine the as-found and as-left tolerances are specified in the Technical Requirements Manual."

   Apply these notes to the channel calibration SR 3.3.1.1.10 listings for APRM Functions 2.a, 2.b, 2.d, and 2.f, as identified in the individual sections, below.

   Refer to Section 5.1.5, below, for additional discussion of the setpoint methodology issue.

c. In accordance with Section 8.4.6.1 of the NUMAC PRNM LTR, add new Note (f) to denote that the Allowable Value is contained in the Core Operating Limits Report (COLR). Note (f) states:

> "The Allowable Value for the OPRM Upscale Period-Based Detection algorithm is specified in the COLR."

This note is applied to new APRM Function 2.f, as discussed in Section 4.4.3.7, below. Placing the OPRM Upscale Allowable Value in the COLR was approved by the NRC for Monticello (Reference 10).

4.4.3.2 <u>Neutron Flux – High, Setdown (existing Function 2.a)</u>

This existing function compares APRM flux to an adjustable trip with an Allowable Value set at ≤ 20% RTP and activated in Mode 2 (bypassed in the other Modes). Three channels are required for operability. No change in the Allowable Value is required.

APRM Function 2.a has been retained but modified in TS Table 3.3.1.1-1 as follows:

a. Apply new Note (c) to the "Required Channels per Trip System" value, as discussed in Section 4.4.3.1.a, above.

b. Reflect the following changes to the list of applicable SRs:

   i) Delete SR 3.3.1.1.1 and add new SR 3.3.1.1.19 as discussed in Section 4.4.2.4, above.

   ii) Delete SR 3.3.1.1.3 and add new SR 3.3.1.1.20 as discussed in Section 4.4.2.5, above.

   iii) Delete the requirement to perform LSFTs by deleting SR 3.3.1.1.13, as discussed in Section 4.4.2.6, above.

c. Apply new Notes (d) and (e) to the channel calibration SR 3.3.1.1.10 listing, as discussed in Section 4.4.3.1.b, above.

4.4.3.3 <u>Fixed Neutron Flux – High, (existing Function 2.b)</u>

This existing function compares APRM neutron flux to a fixed trip setpoint with an Allowable Value of ≤ 120% RTP. Function 2.b is required to be operable in Mode 1 with three channels required per trip system. No change to the Allowable Value is required. This function is standard for the BWR/6 design.

APRM Function 2.b has been retained but modified in TS Table 3.3.1.1-1 as follows:

a. Apply new Note (c) to the "Required Channels per Trip System" value, as discussed in Section 4.4.3.1.a, above.

b. Reflect the following changes to the list of applicable SRs:

   i) Delete SR 3.3.1.1.1 and add new SR 3.3.1.1.19 as discussed in Section 4.4.2.4, above.

   ii) Delete SR 3.3.1.1.8 and add new SR 3.3.1.1.20 as discussed in Section 4.4.2.5, above.

   iii) Delete the requirement to perform LSFTs by deleting SR 3.3.1.1.13, as discussed in Section 4.4.2.6, above.

   iv) Delete the requirement to perform response time testing by deleting SR 3.3.1.1.15, as discussed in Section 4.4.2.7, above.

c. Apply new Notes (d) and (e) to the channel calibration SR 3.3.1.1.10 listing, as discussed in Section 4.4.3.1.b, above.

4.4.3.4 Inop (existing Function 2.c)

This existing function ensures that a minimum number of APRMs are operable. Anytime an APRM mode switch is moved to any position other than "Operate," an APRM module is unplugged, the electronic operating voltage is low, or the APRM has too few LPRM inputs, an inoperative trip signal is sent to the RPS. Function 2.c is required to be operable in Modes 1 and 2 with three channels required per trip system. No Allowable Value is applicable to Function 2.c.

As discussed in Section 8.3.1 of the NUMAC PRNM LTR, the NUMAC PRNM System design has removed the LPRM detector count from the automatic Inop trip; however, it is retained in the Inop alarm. SR 3.3.1.1.7, which requires calibrating the LPRM detectors, was used to ensure the minimum LPRM detector count was satisfied. With the removal of this parameter from Function 2.c, this SR is no longer required. This change is consistent with the TS marked-up pages contained in NUMAC PRNM LTR, Vol. 2 and Supplement 1.

APRM Function 2.c has been retained but modified in TS Table 3.3.1.1-1 as follows:

a. Apply new Note (c) to the "Required Channels per Trip System" value, as discussed in Section 4.4.3.1.a, above.

b. Reflect the following changes to the list of applicable SRs:

i) Delete SR 3.3.1.1.7, as discussed above.

ii) Delete SR 3.3.1.1.8 and add new SR 3.3.1.1.20 as discussed in Section 4.4.2.5, above.

iii) Delete the requirement to perform LSFTs by deleting SR 3.3.1.1.13, as discussed in Section 4.4.2.6, above.

4.4.3.5 <u>Flow Biased Simulated Thermal Power – High (existing Function 2.d)</u>

This existing function compares filtered flux (simulated thermal power) to a variable flow-biased trip point and also includes a clamp to assure that the variable trip does not exceed an Allowable Value, which is currently depicted in the GGNS COLR. Function 2.d is required to be operable in Mode 1 with three channels required per trip system. This function is standard for the BWR/6 design.

APRM Function 2.d has been retained but modified in TS Table 3.3.1.1-1 as follows:

a. Currently, the Allowable Values for APRM Function 2.d are depicted in the GGNS COLR. With the change in core stability solution from Option E-I-A to Option III (see Section 3.3, above), these values will no longer be cycle-specific; therefore, they are being identified in TS Table 3.3.1.1-1. This is accomplished by revising existing Note (b) to state:

   "Two-Loop Operation: 0.65W + 62.9% RTP and clamped at 113% RTP

   "Single-Loop Operation: 0.65W + 42.3% RTP"

   (W is total recirculation drive flow in percent of rated flow.)

   The Allowable Values have been confirmed in GEH Report 0000-0102-8815, *Instrument Limits Calculation - Average Power Range Monitor – Power Range Neutron Monitoring System (NUMAC) – CLTP Operation* (Reference 14).

   In addition, Entergy proposes an editorial change to reposition the reference for Note (b) located the "ALLOWABLE VALUES" column of TS Table 3.3.1.1-1 to align with the first row of APRM Function 2.d information in the table.

b. Apply new Note (c) to the "Required Channels per Trip System" value, as discussed in Section 4.4.3.1.a, above.

c. Reflect the following changes to the list of applicable SRs:

i) Delete SR 3.3.1.1.1 and add new SR 3.3.1.1.19 as discussed in Section 4.4.2.4, above.

ii) Delete SR 3.3.1.1.8 and add new SR 3.3.1.1.20 as discussed in Section 4.4.2.5, above.

iii) Delete the requirement to perform LSFTs by deleting SR 3.3.1.1.13, as discussed in Section 4.4.2.6, above.

iv) Delete the requirement to perform response time testing by deleting SR 3.3.1.1.15, as discussed in Section 4.4.2.7, above.

v) Delete the requirement to verify the simulated thermal power constant by deleting SR 3.3.1.1.16, as discussed in Section 4.4.2.2, above.

vi) Delete the requirement to adjust the FCTR by deleting SR 3.3.1.1.18, as discussed in Section 4.4.2.3, above.

d. Apply new Notes (d) and (e) to the channel calibration SR 3.3.1.1.10 listing, as discussed in Section 4.4.3.1.b, above.

4.4.3.6 2-Out-Of-4 Voter (new Function 2.e)

In accordance with Section 8.3.1.2 of the NUMAC PRNM LTR, this new function facilitates minimum operable channel definition and associated actions. Unlike the other APRM functions, each 2-Out-Of-4 Voter does not provide inputs to both RPS trip systems. See Section 3.2, above, for additional information pertaining to the 2-Out-Of-4 Voter channel and its configuration.

APRM Function 2.e is added to TS Table 3.3.1.1-1 with the following denotations, which are consistent with the NUMAC PRNM LTR requirements:

a. Add Function 2.e, “2-Out-Of-4 Voter,” to the “Function” column.

b. Specify the “Applicable MODES or Other Specified Conditions” to be “1, 2” to reflect the associated Modes specified for the APRM functions, which input into this function.

c. Specify the “Required Channels per Trip System” to be “2” in accordance with Section 8.3.2 of the NUMAC PRNM LTR.

d. Specify the “Conditions Referenced from Required Action D.1” to be “H.” Current TS Condition H provides a conservative default condition when the lower tier conditions associated with combinations of channel / function / RPS trip capability cannot be met. That is, it requires the plant to be placed in a mode in which the function is not required.

e. Apply the following SRs in accordance with the noted sections of the NUMAC PRNM LTR:

   i) SR 3.3.1.1.19 – Channel Check (8.3.4.1)

   ii) SR 3.3.1.1.20 – Channel Functional Test (8.3.4.2, 8.4.4.2)

   iii) SR 3.3.1.1.21 – LSFT (8.3.5.2, 8.4.5.2)

   iv) SR 3.3.1.1.22 – Response Time Testing (8.3.4.4)

f. Specify the "Allowable Value" to be "NA"; no allowable value is applicable to the 2-Out-Of-4 Voter function.

4.4.3.7 OPRM Upscale (new Function 2.f)

As discussed in Sections 3.3.2 and 8.4 of the NUMAC PRNM LTR, this new function provides the capability to detect and suppress reactor thermal-hydraulic instabilities. This instability trip function is defined by the BWROG as Option III in NEDO-31960-A and Supplement 1 (Reference 6). NEDO-32465-A, *BWR Owners' Group Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications*, (Reference 15) defines the Option III implementation requirements for basic logic and algorithms, provides the licensing basis for specific requirements, and defines the process by which plants demonstrate safety limit protection.

The minimum number of OPRM cells required for OPRM Upscale operability (30) is defined by GEH analyses performed in accordance with GEH LTR NEDO-32465-A based on selecting the OPRM cell assignments and a requirement for a minimum of two LPRMs per cell. The setpoint is established to conform to the licensing bases defined in NEDO-31960-A and NEDO-32465-A consistent with the guidance provided in the NUMAC PRNM LTR.

The OPRM Period-Based Detection algorithm Upscale trip setpoint is determined using the Option III reload licensing methodology described in NEDO-32465-A (Reference 15) with the exception that a plant/cycle-specific DIVOM[3] curve slope is applied in place of the generic DIVOM curve slope. As described in the NRC staff Safety Evaluation for activating the OPRM trip for Peach Bottom (Reference 11), this change from the original LTR licensing basis was necessitated by the BWROG resolution of a 10 CFR Part 21 report filed by GEH (then General Electric).

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[3] DIVOM – Delta CPR over Initial MCPR versus the Oscillation Magnitude

The Period-Based Detection algorithm includes several "tuning" parameters. These parameters, as has been the case for other licensees, will be established in accordance with GGNS procedures as part of the system setup and calibration, and will be defined in plant procedures.

The Period-Based Detection algorithm trip setpoint, which can change with each new fuel cycle, will be documented in the COLR. Since the OPRM Upscale function trip setpoint is cycle-specific, it meets the requirements for inclusion in the COLR. Also, this approach provides the same information as previously approved for other licensees and is consistent with the ITS format for references to parameters provided in the COLR and with the NUMAC PRNM LTR requirements. The NRC approved placing the OPRM Upscale trip setpoint in the COLR for Monticello (Reference 10).

There are also setpoints for the defense-in-depth algorithms, i.e., the Amplitude-Based algorithm and the Growth-Rate algorithm, which are discussed in the OPRM Upscale function description within the draft TS Bases markup. These algorithms, together with the Period-Based Detection algorithm, are treated as nominal setpoints based on qualitative studies documented in Appendix A of NEDO-32465-A (Reference 15). Use of Appendix A of NEDO-32465-A as a basis for establishing these defense-in-depth settings is consistent with the approach used by other licensees (and approved by the NRC) for activating the OPRM Upscale function. The Amplitude-Based and Growth-Rate algorithms are not credited in the safety analysis, and their settings are documented only in GGNS procedures.

The TS-related setpoints for the auto-enable (not-bypassed) region are established as nominal setpoints only, as described in the draft TS Bases markup and designated in new SR 3.3.1.1.23 (see Section 4.4.2.8, above).

APRM Function 2.f is added to TS Table 3.3.1.1-1 with the following denotations, which are consistent with the NUMAC PRNM LTR requirements:

a. Add Function 2.f, "OPRM Upscale," to the "Function" column in accordance with Section 8.4.1 of the NUMAC PRNM LTR.

b. Specify the "Applicable Modes or Other Specified Conditions" to be "$\geq$ 24% RTP" in accordance with Section 8.4.3 of the NUMAC PRNM LTR and reflecting the GGNS-specific value.

c. Specify the "Required Channels per Trip System" to be "3" in accordance with Section 8.4.2 of the NUMAC PRNM LTR and apply new Note (c) to the value, as discussed in Section 4.4.3.1.a, above.

d. Specify the "Condition Referenced from Required Action D.1" to be "J". New TS Condition J provides a conservative default condition when the lower tier conditions associated with combinations of OPRM channel/function/RPS trip capability cannot be met. This is discussed in more detail in Section 4.4.1.2, above.

e. Apply the following SRs in accordance with the noted sections of the NUMAC PRNM LTR:

   i) SR 3.3.1.1.7 – LPRM Calibration (8.3.5 and 8.4.5)

   ii) SR 3.3.1.1.10 – Channel Calibration (8.4.4.3)

   iii) SR 3.3.1.1.19 – Channel Check (8.4.4.1)

   iv) SR 3.3.1.1.20 – Channel Functional Test (8.4.4.2)

   v) SR 3.3.1.1.23 – OPRM not Bypassed (8.4.4.2)

f. Apply new Notes (d) and (e) to the Channel Calibration SR 3.3.1.1.10 listing, as discussed in Section 4.4.3.1.b, above.

g. Apply new Note (f) to the Allowable Value reflecting that it is contained in the COLR, as discussed in Section 4.4.3.1.c, above.

4.5 TS 3.3.1.3, *Period Based Detection System (PBDS)*

The current Option E-I-A stability solution methodology (discussed in Sections 3.1 and 3.3, above) utilizes the Period-Based Detection algorithm to detect when conditions consistent with a significant degradation in the stability performance of the reactor core have occurred and the potential for imminent onset of neutronic/thermal-hydraulic instability may exist. The PRNM System upgrade encompasses this algorithm within new OPRM Upscale Function 2.f, as described in Sections 3.3 and 4.4.3.7, above. As such, TS 3.3.1.3 is duplicative to the proposed TS changes and is no longer needed; therefore, Entergy proposes to delete TS 3.3.1.3 in its entirety.

4.6 TS 3.10.8, *Shutdown Margin (SDM) Test – Refueling*

TS 3.10.8 permits SDM testing to be performed in Mode 5; i.e., the reactor pressure vessel head is either not in place or the head bolts are not fully tensioned. LCO 3.10.8 specifies conditions that must be met in order to perform SDM tests, one of these being the Mode 2 requirements for APRM Functions 2.a and 2.c. In addition, SR 3.10.8.1 requires Mode 2-applicable SRs for these functions be performed.

As discussed in Section 4.4.3.6, above, the NUMAC PRNM System adds APRM Function 2.e, which is also required to be operable in Mode 2. Therefore, Entergy proposes to add Function 2.e to LCO 3.10.8.a and SR 3.10.8.1 as follows (change noted in ***bold, italicized*** text):

a. LCO 3.10.8.a is changed to read:

   "LCO 3.3.1.1, 'Reactor Protection System (RPS) Instrumentation,' MODE 2 requirements for Function 2.a, 2.c***, and 2.e*** of Table 3.3.1.1-1;"

b. SR 3.10.8.1 is changed to read:

   "Perform the MODE 2 applicable SRs for LCO 3.3.1.1, Functions 2.a, 2.c***, and 2.e*** of Table 3.3.1.1-1."

4.7 <u>TS 5.6.5, *Core Operating Limits Report (COLR)*</u>

TS 5.6.5 identifies the TS sections for which core operating limits are established and the analytical methods used to determine these limits. To implement the NUMAC PRNM System with Option III, Entergy proposes the following changes to TS 5.6.5:

a. Delete APRM Function 2.d, which is no longer included in the COLR (see Section 4.4.3.5, above), and add APRM Function 2.f to TS 5.6.5.a.5 as follows (changes noted in ***bold, italicized*** text):

   "5) LCO 3.3.1.1, RPS Instrumentation, Table 3.3.1.1-1 APRM Function ***2.f***"

b. Delete LCO 3.2.4 from TS 5.6.5.a.4; TS 3.2.4 is being deleted as discussed in Section 4.3, above.

c. Delete LCO 3.3.1.3 from TS 5.6.5.a.6; TS 3.3.1.3 is being deleted as discussed in Section 4.5, above.

d. Add the following references to TS 5.6.5:

   i) NEDO-31960-A, *BWR Owners' Group Long-Term Stability Solutions Licensing Methodology*

   ii) NEDO-32465-A, *Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology and Reload Applications*

4.8 <u>Conclusion</u>

With the above changes, the GGNS OL and TS appropriately reflect the NUMAC PRNM LTR, as approved by the NRC, insuring design requirements and acceptance criteria are met.

5.0 REGULATORY ANALYSIS

5.1 Applicable Regulatory Requirements and Guidance

5.1.1 10 CFR Part 50

10 CFR 50.36, *Technical Specifications*, provides the regulatory requirements for the content required in the Technical Specifications (TS). As stated in 10 CFR 50.36, TS include Surveillance Requirements (SRs) to assure that the Limiting Conditions for Operation (LCO) are met. The proposed TS changes would revise SRs and the LCO actions and completion times, as applicable, for each change in APRM functions and related LCOs.

The GGNS Neutron Monitoring System was designed and licensed to the GDCs specified in 10 CFR 50 Appendix A. The applicable GDCs are discussed below.

Criterion 13 -- Instrumentation and control. Instrumentation shall be provided to monitor variables and systems over their anticipated ranges for normal operation, for anticipated operational occurrences, and for accident conditions as appropriate to assure adequate safety, including those variables and systems that can affect the fission process, the integrity of the reactor core, the reactor coolant pressure boundary, and the containment and its associated systems. Appropriate controls shall be provided to maintain these variables and systems within prescribed operating ranges.

Criterion 20 -- Protection system functions. The protection system shall be designed (1) to initiate automatically the operation of appropriate systems including the reactivity control systems, to assure that specified acceptable fuel design limits are not exceeded as a result of anticipated operational occurrences and (2) to sense accident conditions and to initiate the operation of systems and components important to safety.

Criterion 21 -- Protection system reliability and testability. The protection system shall be designed for high functional reliability and in-service testability commensurate with the safety functions to be performed. Redundancy and independence designed into the protection system shall be sufficient to assure that (1) no single failure results in loss of the protection function and (2) removal from service of any component or channel does not result in loss of the required minimum redundancy unless the acceptable reliability of operation of the protection system can be otherwise demonstrated. The protection system shall be designed to permit periodic testing of its functioning when the reactor is in operation, including a capability to test channels independently to determine failures and losses of redundancy that may have occurred.

Criterion 22 -- Protection system independence. The protection system shall be designed to assure that the effects of natural phenomena, and of normal operating, maintenance, testing, and postulated accident conditions on redundant channels do not result in loss of the protection function, or shall be demonstrated to be acceptable on some other defined basis. Design techniques, such as functional diversity or diversity in component design and principles of operation, shall be used to the extent practical to prevent loss of the protection function.

Criterion 29 -- Protection against anticipated operational occurrences. The protection and reactivity control systems shall be designed to assure an extremely high probability of accomplishing their safety functions in the event of anticipated operational occurrences.

The BWROG long-term stability solution Option III approach consists of detecting and suppressing stability-related power oscillations by automatically inserting control rods (scramming) to terminate power oscillations, thereby complying with the requirements of GDCs 10 and 12 discussed below.

Criterion 10 -- Reactor design. The reactor core and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences.

Criterion 12 -- Suppression of reactor power oscillations. The reactor core and associated coolant, control, and protection systems shall be designed to assure that power oscillations which can result in conditions exceeding specified acceptable fuel design limits are not possible or can be reliably and readily detected and suppressed.

Entergy has evaluated the proposed changes against the applicable regulatory requirements and acceptance criteria and finds the design of the NUMAC PRNM System consistent with the applicable regulatory criteria described above. The technical analysis in Section 4.0, above, concludes that the proposed changes to install and implement the NUMAC PRNM System continue to assure that the design requirements and acceptance criteria of the RPS are met. Based on this, there is reasonable assurance the health and safety of the public, following approval of this change, remain unaffected.

5.1.2 <u>NRC Safety Evaluation and NUMAC PRNM LTR Requirements</u>

To receive NRC approval of an NUMAC PRNM System retrofit installation (including the Option III OPRM Upscale function), a licensee must indicate how the requirements of the NUMAC PRNM LTR and the conditions of the NRC Safety Evaluations for the system are met, or provide an acceptable alternative (deviation) for NRC staff evaluation. The Safety Evaluations for the NUMAC PRNM System specify conditions to be demonstrated by each licensee applying to install the NUMAC PRNM System.

To demonstrate conformance, Entergy has evaluated the GGNS-specific PRNM System installation against the requirements of the NUMAC PRNM LTR and associated NRC Safety Evaluations. Attachment 2 provides a plant-specific comparison matrix entitled, *Grand Gulf Nuclear Station Plant-Specific Responses Required by NUMAC PRNM Retrofit Plus Option III Stability Trip Function Topical Report (NEDC-32410P-A)*. A response to each NRC staff requirement is provided below:

1. Confirm the applicability of the NUMAC PRNM LTR (NEDC-32410P-A and its supplement), including clarifications and reconciled differences between the specific plant design and the topical report design descriptions.

   RESPONSE

   Entergy performed an evaluation of the proposed GGNS-specific PRNM System installation against the requirements of the NUMAC PRNM LTR and associated NRC Safety Evaluations; the resulting document is provided in Attachment 2. Clarifications and reconciled differences between the plant-specific design and the NUMAC PRNM LTR design descriptions are identified in Section 5.1.3, below.

2. Confirm the applicability of the BWROG topical reports that address PRNMS and associated instability functions, setpoints, and margins.

   RESPONSE

   The applicability of the various BWROG LTRs that address the NUMAC PRNM System, the Option III stability solution, the reload-related aspects, and the development of setpoints is discussed herein or through reference to the various reports.

3. Provide plant-specific revised TS for the NUMAC PRNMS functions consistent with NEDC-32410P-A, Appendix H, and Supplement 1.

   RESPONSE

   Entergy confirms the plant-specific TS changes to implement the NUMAC PRNM System (including the OPRM Option III stability solution), which are provided in Attachment 3, are consistent with the requirements of the NUMAC PRNM LTR.

4. Confirm the plant-specific environmental conditions are enveloped by the NUMAC PRNM System equipment environmental qualification values.

   RESPONSE

   The analysis of the plant-specific environmental conditions to the NUMAC PRNM System equipment qualification (EQ) values is discussed in GEH Report GE-NE-0000-0102-0888 (Reference 5), which is provided in Attachment 2. The results of this analysis confirm the plant-specific environmental conditions are enveloped by the NUMAC PRNM System EQ values.

5. Confirm that administrative controls are provided for manually bypassing APRM / OPRM channels or protective functions, and for controlling access to the APRM / OPRM panel and channel bypass switch.

   <u>RESPONSE</u>

   In the NRC Safety Evaluation for the NUMAC PRNM LTR, the NRC staff found the NUMAC PRNM System design features that control access to setpoint adjustments, calibrations, and test points acceptable. Entergy is not proposing any changes to those features. In accordance with the requirements of the NUMAC PRNM LTR, administrative controls will be provided for manually bypassing the APRM / OPRM channels or protective functions, and for controlling access to the APRM / OPRM panel and channel bypass switch.

6. Confirm that any changes to the plant operator's panel have received human factors reviews per plant-specific procedures.

   <u>RESPONSE</u>

   The site design change process requires performing a Human Factors Engineering (HFE) review of changes to the Control Room Operator's panels. Documenting the HFE review will be included in the final design package(s) for the PRNM System and available on-site for NRC inspection.

Based upon the above discussions, Entergy believes the requirements raised within the NRC staff Safety Evaluations have been adequately addressed.

5.1.3 <u>GGNS PRNM System Deviations from the NUMAC PRNM LTR</u>

The NUMAC PRNM System in development for GGNS by GEH reflects three deviations from the NUMAC PRNM LTR. They are:

1. APRM Upscale / OPRM Upscale / APRM Inop Function Logic
2. OPRM Pre-Trip Alarms
3. Recirculation Flow Processing

Each deviation is discussed and justified in Appendix A of GEH Report 0000-0102-0888 (Reference 5), which is provided in Attachment 2.

5.1.4 <u>GGNS Option III Stability Solution Deviations from the BWROG Stability LTR</u>

The Option III stability solution developed for GGNS by GEH reflects two deviations from the BWROG Option III methodology (References 6 and 15). They are:

1. Base Period Definition for Period-Based Detection Algorithm (PBDA)

2. Period Tolerance Offset

Each deviation is discussed and justified in GEH Report 0000-0107-7607-P, *Grand Gulf Nuclear Station – Grand Gulf PRNM Upgrade Project Option III Stability Deviations* (Reference 16), which is provided in Attachments 5 and 6 (proprietary and non-proprietary versions, respectively).

5.1.5 Setpoint Methodology

Description

The instrument setpoint methodology currently implemented at GGNS is based on Instrument Society of America (ISA) Standard 67.04 Part II, 1994, *Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation* (Reference 17), and the GEH Instrument Setpoint Methodology (ISM) specified in NEDC-31336P-A, *General Electric Instrument Setpoint Methodology* (Reference 18).

Setpoint calculations provide a conservative analysis of setpoints, taking into account the applicable instrument measurement errors.

The Nominal Trip Setpoint (NTSP) is more conservative than the Allowable Value (AV). Because it is impossible to set an instrument channel to an exact value, a calibration tolerance is established around the NTSP. The NTSP is, therefore, considered a nominal value and the instrument adjustment is considered successful if the "as-left" instrument setting is within the calibration tolerance established around the NTSP.

Entergy calculates the setpoints from the Analytical Limit (AL), establishing margins between the AL, the AV, and the NTSP based on calculated instrument errors. Random errors are combined using the square-root-of-the-sum-of-the-squares method, and non-conservative bias errors are added algebraically. This approach provides sufficient margin between the AL and AV to ensure at least 95% probability that the AL is not exceeded if the setpoint drifts toward the AV.

Entergy's Typical Calibration Process

At the start of each calibration, the instrument is declared inoperable (in the case of TS-controlled instruments) and removed from service. The Operations Shift Supervisor or Manager reviews the results of the surveillance and determines whether the results are acceptable based on TS operability requirements prior to returning the instrument to service.

If the as-found setpoint value exceeds its designated tolerance, the condition is documented for trending purposes and appropriate corrective actions are taken before the instrument is returned to service. Once actions have been taken to correct the condition, the instrument setpoint is reset to as close to the NTSP value as practicable and the instrument is returned to service.

For cases in which the as-found setpoint value is within its designated tolerance, it is common practice to reset the setpoint value to as close to the NTSP value as practicable.

This process is applied to both safety-related and non-safety-related setpoints.

NRC and Industry Guidance and Application

Over the past several years, the NRC and the nuclear industry have participated in various forums to address the setpoint methodology issue. On September 7, 2005, the NRC transmitted a letter to the NEI Setpoint Methods Task Force (Reference 19) that described setpoint-related TS that are acceptable for instrument settings associated with Safety Limit-related setpoints. On August 24, 2006, the NRC issued Regulatory Issue Summary (RIS) 2006-17 (Reference 20) to provide guidance and information pertaining to the requirements of 10 CFR 50.36 with respect to limiting safety system settings (LSSSs) assessed during periodic instrument testing and calibration.

The NRC and industry have been working together on a Technical Specifications Task Force (TSTF) proposal, TSTF-493, *Clarify Application of Setpoint Methodology for LSSS Functions*, to address the setpoint methodology issue. In a letter to the NRC dated February 23, 2009 (Reference 21), the TSTF documented a proposed course of action to be taken by the industry to address the NRC's questions and concerns with TSTF-493. The NRC responded in a letter dated March 9, 2009 (Reference 22) stating the TSTF letter "meets the agreed course of action ... for resolving the TSTF-493 setpoint issue". The NRC's comments have been incorporated into TSTF-493, Rev. 4, which was submitted to the staff on July 31, 2009 (Reference 13).

In order to address the setpoint methodology issue, Entergy has applied the actions identified in TSTF-493 (Reference 13) to this LAR; the results being that the two notes specified in the TSTF are applied to channel calibration SR 3.3.1.1.10 for the following APRM functions listed in TS Table 3.3.1.1-1:

TS APRM Function Name	**TS APRM Function Designation**
Neutron Flux – High, Setdown	2.a
Fixed Neutron Flux – High	2.b
Flow Biased Simulated Thermal Power – High	2.d
OPRM Upscale	2.f

The new notes, Notes (d) and (e) of TS Table 3.3.1.1-1, are specified in Section 4.4.3.1.b, above.

The TRM will be revised to reflect the NTSP and methodologies used to determine the as-found and as-left tolerances prior to startup from the 2012 refueling outage.

New Notes (d) and (e) are not applicable to Inop Function 2.c and 2-Out-Of-4 Voter Function 2.e since they meet the third criterion for exemption provided in the TSTF letter, as follows:

> "3. Instrument functions that derive input from contacts which have no associated sensor or adjustable device, e.g., limit switches, breaker position switches, etc. Many permissives or interlocks are excluded under this criterion. Other permissives and interlocks rely on the input from a sensor or adjustable device (e.g., a pressure transmitter). ***If the permissive or interlock derives input from a sensor or adjustable device that is tested as part of another TS function, then the permissive or interlock is excluded from the footnotes*** (emphasis added). Otherwise, the footnotes are added to the permissive or interlock to ensure that it is functioning as expected."

The Bases for TS 3.3.1.1 describe the application of the notes to SR 3.3.1.1.10 as applied to APRM Functions 2.a, 2.b, 2.d, and 2.f. Draft marked-up pages of the affected TS Bases are provided in Attachment 4, for information only. In addition, GGNS calibration procedures for these APRM functions will be revised to reflect the instructions given in the above notes.

5.2 No Significant Hazards Determination

In accordance with the requirements of 10 CFR 50.90, Entergy Operations, Inc. (Entergy) requests an amendment to facility Operating License NPF-29, for the Grand Gulf Nuclear Station (GGNS). This license amendment request proposes to revise the GGNS Technical Specifications (TS) to reflect installation of the Nuclear Measurement Analysis and Control (NUMAC) Power Range Neutron Monitoring (PRNM) System.

Entergy has evaluated the proposed license amendment request in accordance with 10 CFR 50.91 against the standards in 10 CFR 50.92 and has determined that the operation of GGNS in accordance with the proposed amendment presents no significant hazards. Entergy's evaluation against each of the criteria in 10 CFR 50.92 follows.

1. Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

RESPONSE: No.

The probability (frequency of occurrence) of design basis accidents (DBAs) occurring is not affected by the NUMAC PRNM System, since the system does not interact with equipment whose failure could cause an accident. Compliance with the regulatory criteria established for plant equipment are maintained with the installation of the upgraded NUMAC PRNM System. Scram setpoints in the NUMAC PRNM System are established such that the analytical limits are met.

The unavailability of the new NUMAC PRNM System is equal to or less than the existing system and, as a result, the scram reliability is equal to or better than the existing analog power range monitoring system. No new challenges to safety-related equipment result from the NUMAC PRNM System modification. Therefore, the proposed change does not involve a significant increase in the probability of an accident previously evaluated.

The proposed change replaces the current Option E-I-A stability solution with an NRC-approved Option III long-term stability solution. The NUMAC PRNM hardware incorporates the Oscillation Power Range Monitor (OPRM) Option III detect-and-suppress solution, which has been previously reviewed and approved by the NRC. The OPRM meets General Design Criterion (GDC) 10, *Reactor Design*, and GDC 12, *Suppression of Reactor Power Oscillations*, requirements by automatically detecting and suppressing design basis thermal-hydraulic oscillations prior to exceeding the fuel Minimum Critical Power Ratio (MCPR) Safety Limit.

Based on the above, installation of the new NUMAC PRNM System with the OPRM Option III stability solution integrated into the NUMAC PRNM equipment does not increase the probability or consequences of an accident previously evaluated.

2. **Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?**

<u>*RESPONSE*</u>: No.

The components of the NUMAC PRNM System are equivalent or of better design and qualification criteria than those currently installed and utilized in the plant. No new operating mode, safety-related equipment lineup, accident scenario, or system interaction mode not reviewed and approved as part of the design and licensing of the NUMAC PRNM System has been identified. Therefore, the NUMAC PRNM System retrofit does not adversely affect plant equipment.

The new NUMAC PRNM System uses digital equipment that has software-controlled digital processing compared to the existing power range system that uses mostly analog and discrete component processing. Specific failures of hardware and potential software common-cause failures are different from the existing system. The effects of potential software common-cause failure are mitigated by specific hardware design and system architecture as discussed in Section 6.0 of NEDC-32410P-A. Failure(s) of the system have the same overall effect as the present design. No new or different kinds of accidents are introduced. Therefore, the NUMAC PRNM System does not adversely effect plant equipment.

The currently installed Average Power Range Monitoring (APRM) system is replaced with a NUMAC PRNM System that performs the existing power range monitoring functions and adds an OPRM to react automatically to potential reactor thermal-hydraulic instabilities. Based on the above, the proposed change does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. Does the proposed amendment involve a significant reduction in a margin of safety?

RESPONSE: No.

The proposed TS changes associated with the NUMAC PRNM System retrofit implement the constraints of the NUMAC PRNM System design and related stability analyses. The NUMAC PRNM System change does not impact reactor operating parameters or the functional requirements of the APRM system. The replacement equipment continues to provide information, enforce control rod blocks, and initiate reactor scrams under appropriate specified conditions. The proposed change does not reduce safety margins. The replacement APRM equipment has improved channel trip accuracy compared to the current analog system, and meets or exceeds system requirements previously assumed in setpoint analysis. Thus, the ability of the new equipment to enforce compliance with margins of safety equals or exceeds the ability of the equipment which it replaces.

Therefore, the proposed changes do not involve a reduction in a margin of safety.

Based on the above, Entergy has determined that operation of the facility in accordance with the proposed change does not involve a significant hazards consideration as defined in 10 CFR 50.92(c), in that it:

(1) Does not involve a significant increase in the probability or consequences of an accident previously evaluated; or

(2) Does not create the possibility of a new or different kind of accident from any accident previously evaluated; or

(3) Does not involve a significant reduction in a margin of safety.

5.3 Environmental Consideration

Entergy has determined that the proposed amendment would not change a requirement with respect to installation or use of a facility or component located within the restricted area, as defined in 10 CFR 20, nor would it change an inspection or surveillance requirement. The proposed amendment:

(i) Does not involve a significant hazards consideration; or

(ii) Does not authorize a significant change in the types or a significant increase in the amounts of any effluent that may be released offsite; or

(iii) Does not result in a significant increase in individual or cumulative occupational radiation exposure.

Accordingly, the proposed amendment meets the eligibility criterion for a categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), Entergy concludes no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

6.0 PRECEDENCE

License amendments for installing the NUMAC PRNM System with Option III have been approved for many plants, among them: Susquehanna Units 1 and 2; Nine Mile Point Unit 2; Browns Ferry Units 1, 2, and 3; Hatch Units 1 and 2; Fermi Unit 2; Limerick Units 1 and 2; Peach Bottom Units 2 and 3; Brunswick Units 1 and 2; and Monticello.

7.0 REFERENCES

1. GE Nuclear Energy Licensing Topical Report (LTR) NEDC-32410P-A Volume 1 and NEDC-32410P-A Volume 2 -- Appendices, *Nuclear Measurement Analysis and Control Power Range Neutron Monitor (NUMAC PRNM) Retrofit Plus Option III Stability Trip Function*, dated October 1995 (ADAMS Ascension No. ML9605290009 includes NRC SE)

2. GE Nuclear Energy LTR NEDC-32410P-A Supplement 1, *Nuclear Measurement Analysis and Control Power Range Neutron Monitor (NUMAC PRNM) Retrofit Plus Option III Stability Trip Function*, dated November 1997 (ADAMS Ascension No. ML9806120242 includes NRC SE)

3. NRC letter to GE Nuclear Energy, *Acceptance of Licensing Topical Report NEDC-32410P, Nuclear Measurement Analysis and Control Power Range Neutron Monitor (NUMAC-PRNM) Retrofit Plus Option III Stability Trip Function*, (TAC No. M90616) dated September 5, 1995

4. NRC letter to GE Nuclear Energy, *Acceptance of Licensing Topical Report NEDC-32410P, Supplement 1, Nuclear Measurement Analysis and Control Power Range Neutron Monitor (NUMAC-PRNM) Retrofit Plus Option III Stability Trip Function*, dated August 15, 1997

5. GE Hitachi Nuclear Energy Report 0000-0102-0888, *Grand Gulf Nuclear Station - Plant-Specific Responses Required by NUMAC PRNM Retrofit Plus Option III Stability Trip Function Topical Report (NEDC-32410P-A)*

6. GE Hitachi Nuclear Energy LTR NEDO-31960-A, *BWR Owners' Group Long-Term Stability Solutions Licensing Methodology*, and associated Supplement 1

7. NRC letter to Entergy Operations, Inc., *Grand Gulf Nuclear Station, Unit 1 – Issuance of Amendment Re: Reactor Core Stability Enhanced Option I-A (TAC NO. MA3406)*, January 19, 2000

8. NRC Generic Letter 94-02, *Long-Term Solutions and Upgrade of Interim Operating Recommendations for Thermal Hydraulic Instabilities in Boiling Water Reactors*

9. BWR Owners' Group Document OG-02-0119-260, *GE to BWROG Detect and Suppress II Committee, "Backup Stability Protection (BSP) for Inoperable Option III Solution"*

10. NRC letter to Northern States Power Company, *Monticello Nuclear Generating Plant (MNGP) – Issuance of Amendment Regarding the Power Range Neutron Monitoring System (TAC No. MD8064)*, dated January 30, 2009 (ADAMS Ascension No. ML083440681)

11. NRC letter to Exelon Nuclear, *Peach Bottom Atomic Power Station, Units 2 and 3 – Issuance of Amendment Re: Activation of Oscillation Power Range Monitor Trip (TAC Nos. MC2219 and MC2220)*, dated March 21, 2005 (page 4 of SE) (ADAMS Accession No. ML05270020)

12. NRC letter to the Carolina Power and Light Company, *Brunswick Steam Electric Plant, Units 1 and 2 – Issuance of Amendment to Incorporate the General Electric Digital Power Range Neutron Monitoring System (TAC Nos. MB2321 and MB2322)*, dated March 8, 2002

13. Technical Specifications Task Force letter to the NRC, *Transmittal of TSTF-493, Rev. 4, "Clarify Application of Setpoint Methodology for LSSS Functions,"* dated July 31, 2009 (ADAMS Accession Number ML092150990)

14. GE Hitachi Nuclear Energy Report 0000-0102-8815, *Instrument Limits Calculation – Average Power Range Neutron Monitor – Power Range Neutron Monitoring System (NUMAC) - CLTP Operation*

15. GE Nuclear Energy LTR NEDO-32465-A, *BWR Owners' Group Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications*

16. GE Hitachi Nuclear Energy Report 0000-0107-7607-P, *Grand Gulf Nuclear Station – Grand Gulf PRNM Upgrade Project Option III Stability Deviations*

17. Instrument Society of America standard 67.04, Part II, 1994, *Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation*

18. GE Nuclear Energy LTR NEDC-31336P-A, *General Electric Instrument Setpoint Methodology*

19. NRC letter to the NEI Setpoints Methods Task Force, *Technical Specification for Addressing Issues Related to Setpoint Allowable Values*, dated September 7, 2005 (ADAMS Accession Number ML052500004)

20. NRC Regulatory Issue Summary (RIS) 2006-17, *NRC Staff Position on the Requirements of 10 CFR 50.36, "Technical Specifications," Regarding Limiting Safety System Settings During Periodic Testing and Calibration of Instrument Channels*

21. Technical Specifications Task Force letter to the NRC, *Industry Plan to Resolve TSTF-493, "Clarify Application of Setpoint Methodology for LSSS Functions,"* dated February 23, 2009 (ADAMS Accession Number ML090540849)

22. NRC letter to the Technical Specifications Task Force, *Reply to Industry Plan to Resolve TSTF-493, "Clarify Application of Setpoint Methodology for LSSS Functions,"* dated March 9, 2009 (ADAMS Accession Number ML0905460592)

ATTACHMENT 2

GNRO-2009-00054

GE HITACHI NUCLEAR ENERGY REPORT 0000-0102-0888-R0

GRAND GULF NUCLEAR STATION - PLANT-SPECIFIC RESPONSES REQUIRED BY NUMAC PRNM RETROFIT PLUS OPTION III STABILITY TRIP FUNCTION TOPICAL REPORT (NEDC-32410P-A)

GE Hitachi Nuclear Energy

0000-0102-0888-R0
GEH DRF 0000-0098-4327
Class III
October 2009

Grand Gulf Nuclear Station

Plant-Specific Responses Required By NUMAC PRNM Retrofit Plus Option III Stability Trip Function Topical Report (NEDC-32410P-A)

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Approved by: E. Schrull

Table of Contents

Grand Gulf Specific Responses Required by NUMAC PRNM Retrofit Topical Report

The section numbers and Utility Actions Required listed below are from the NUMAC PRNM Retrofit Plus Option III Stability Trip Function Topical Report NEDC-32410P-A including Supplement 1.

Section No.	Utility Action Required	Response
2.3.2	Option III Stability Implementation Not a required specific LTR response Confirm that the actual plant Option III configuration is included in the variations covered in the Power Range Neutron Monitor (PRNM) Licensing Topical Report (LTR) [NEDC-32410P-A, Volumes 1 & 2 and Supplement 1].	The GGNS Option III implementation is in accordance with the LTR Requirements of section 2.3.2 with the exception of 2 deviations from the BWROG Option III Topical Report. Justification for these deviations is provided separately (GEH document 0000-0107-7607-P-R0, September 2009).
2.3.4	Plant Unique or Plant-Specific Aspects Confirm that the actual plant configuration is included in the variations covered in the Power Range Neutron Monitor (PRNM) Licensing Topical Report (LTR) [NEDC-32410P-A, Volumes 1 & 2 and Supplement 1], and the configuration alternative(s) being applied for the replacement PRNM are covered by the PRNM LTR. Document in the *plant-specific licensing submittal* for the PRNM project the actual, current plant configuration of the replacement PRNM, and document confirmation that those are covered by the PRNM LTR. For any changes to the plant operator's panel, document in the submittal the human factors review actions that were taken to confirm compatibility with existing plant commitments and procedures.	The actual, current plant configuration and the proposed replacement PRNM are included in the PRNM LTR as follows: (Applicable LTR sections are listed.) Current / Proposed APRM 2.3.3.1.1.3 / 2.3.3.1.2.2 RBM 2.3.3.2.1.2 / 2.3.3.2.2.2 Flow Unit 2.3.3.3.1.3 / 2.3.3.3.2.2 Rod Control 2.3.3.4.1.3 / 2.3.3.4.2.3 ARTS 2.3.3.5.1.5 / 2.3.3.5.2.3 Panel Interface 2.3.3.6.1.2 / 2.3.3.6.2.1 Human Factors Engineering review will be performed as part of the normal design process. The actual PRNMS System to be installed at GGNS contains 3 deviations from the system design as described in the LTR. Justification for these deviations is provided as Appendix A.
3.4	System Functions As part of the *plant-specific licensing submittal*, the utility should document the following: 1) The pre-modification flow channel configuration, and any changes planned (normally changes will be either adding two channels to reach four or no change planned) NOTE: If transmitters are added, the requirements on the added transmitters should be: • Non-safety related, but qualified	1) The current flow channel configuration consists of four flow channels, eight transmitters. Thus, the current configuration meets the requirements described in LTR Section 3.2.3.2.2, therefore no changes will be made.

Section No.	Utility Action Required	Response
	environmentally and seismically to operate in the application environment. • Mounted with structures equivalent or better than those for the currently installed channels. • Cabling routed to achieve separation to the extent feasible using existing cableways and routes.	
	2) Document the APRM trips currently applied at the plant. If different from those documented in the PRNM LTR, document plans to change to those in the LTR.	2) The new and existing APRM trip functions are listed below. The "post-modification" trips will be the same as those identified in the LTR. • The Neutron Flux – High, Setdown function (APRM Function 2.a) has been retained as described in LTR paragraphs 3.2.4 and 8.3.1.4. • The Fixed Neutron Flux-High function (APRM Function 2.b) has been retained as described in LTR paragraph 3.2.5). • The Inop function (APRM Function 2.c) has been retained as described in LTR paragraph 3.2.10. • The Flow Biased Simulated Thermal Power – High function (APRM Function 2.d) has been retained as described in LTR paragraph 3.2.5. • The 2-Out-of-4 Voter function (APRM Function 2.e) has been added as described in as described in LTR paragraphs 3.2.2 and 8.3.2.4. • The OPRM Upscale function (APRM Function 2.f) has been added as described in LTR paragraph 8.4.1.2.
	3) Document the current status related to ARTS and the planned post modification status as: • ARTS currently implemented, and retained in the PRNM • ARTS will be implemented concurrently with the PRNM (reference ARTS submittal) • ARTS not implemented and will not be implemented with the PRNM • ARTS not applicable	3) ARTS is not applicable to GGNS because Grand Gulf is a BWR6.
4.4.1.11	<u>Regulatory Requirements of the Replacement System – System Design</u>	A review of the GGNS requirements confirms that the regulatory requirements addressed in the LTR encompass the related GGNS

Section No.	Utility Action Required	Response
	This section identifies requirements that are expected to encompass most specific plant commitments relative to the PRNM replacement project, but may not be complete and some may not apply to all plants. Therefore, the utility must confirm that the requirements identified here address all of those identified in the plant commitments. The plant-specific licensing submittal should identify the specific requirements applicable for the plant, confirm that any clarifications included here apply to the plant, and document the specific requirements that the replacement PRNM is intended to meet for the plant.	requirements. Part of the normal design process confirms that the detailed PRNM design meets the applicable detailed GGNS technical and licensing requirements.
4.4.2.2.1.4	Regulatory Requirements for the Replacement System -Equipment Qualification - Temperature and Humidity Plant-specific action will confirm that the maximum control room temperatures plus mounting panel temperature rise, allowing for heat load of the PRNM equipment, does not exceed the temperatures presented in the PRNM LTR, and that control room humidity is maintained within the limits stated in the PRNM LTR. This evaluation will normally be accomplished by determining the operating temperature of the current equipment which will be used as a bounding value because the heat load of the replacement system is less than the current system while the panel structure, and thus cooling, remains essentially the same. Documentation of the above action, including the specific method used for the required confirmation should be included in *plant-specific licensing submittals.*	The PRNM control room electronics are qualified for continuous operation under the following temperature conditions: 5 to 50 $^{\circ}$C [41 to 122 $^{\circ}$F]. The GGNS normal control room temperature is: 72°F. The design process includes actions to confirm that the PRNM equipment, as installed in the plant, is qualified for the environmental limits, including temperature rise measurements. The PRNM control room electronics are qualified for continuous operation under the following relative humidity conditions: 10 to 90% (non-condensing). The GGNS relative humidity requirement for control room equipment is 20-50%, which is within the range for which the PRNM equipment is qualified. The qualification results will be documented in a plant unique "Qualification Summary".
4.4.2.2.2.4	Regulatory Requirements for the Replacement System -Equipment Qualification - Pressure Plant-specific action will confirm that the maximum control room pressure does not exceed the limits presented in the PRNM LTR. Any pressure differential from inside to outside the mounting panel assumed to be negligible since the panels are not sealed and there is no forced cooling or ventilation. Documentation of this action and the required confirmation should be included in *plant-specific licensing submittals.*	The PRNM control room electronics are qualified for continuous operation under the following pressure conditions: 13 - 16 psia. The GGNS normal control room pressure is ambient atmospheric pressure +1/4 in. – 0 in w.g. This range is within these limits. The qualification results will be documented in a plant unique "Qualification Summary.
4.4.2.2.3.4	Regulatory Requirements for the Replacement System -Equipment Qualification -Radiation	The PRNM control room electronics are qualified for continuous operation under the

Section No.	Utility Action Required	Response
	Plant-specific action will confirm that the maximum control room radiation levels do not exceed the limits presented in the PRNM LTR. Documentation of this action and the required confirmation should be included in *plant-specific licensing submittals.*	following conditions: Dose Rate ≤ 0.001 Rads (carbon)/hr and Total Integrated Dose (TID) ≤ 1000 Rads (carbon). The GGNS control room (Zone A) dose rates are 0.2 and 0.5 mrem/hr and TID are within the qualified limits. The qualification results will be documented in a plant unique "Qualification Summary.
4.4.2.3.4	<u>Regulatory Requirements for the Replacement System -Seismic Qualification</u> Plant-specific action or analysis will confirm that the maximum seismic accelerations at the mounting locations of the equipment (control room floor acceleration plus panel amplification) for both OBE and SSE spectrums do not exceed the limits stated in the PRNM LTR. Documentation of this action and the required confirmation should be included in *plant-specific licensing submittals.*	Evaluations to confirm that the maximum seismic accelerations at the mounting locations of the equipment do not exceed qualification limits of the equipment is completed as part of the normal design change process. The seismic qualification results will be documented in "Qualification Summary".
4.4.2.4.4	<u>Regulatory Requirements for the Replacement System -EMI Qualification</u> The utility should establish or document practices to control emission sources, maintain good grounding practices and maintain equipment and cable separation.	
	<u>1) Controlling Emissions</u> a) <u>Portable Transceivers (walkie-talkies):</u> Establish practices to prevent operation of portable transceivers in close proximity of equipment sensitive to such emissions. (NOTE: The qualification levels used for the NUMAC PRNM exceed those expected to result from portable transceivers, even if such transceivers are operated immediately adjacent to the NUMAC equipment.) b) <u>ARC Welding:</u> Establish practices to assure that ARC welding activities do not occur in the vicinity of equipment sensitive to such emissions, particularly during times when the potentially sensitive equipment is required to be operational for plant safety. (NOTE: The qualification levels used for NUMAC PRNM minimize the likelihood of detrimental effects due to ARC welding as long as reasonable ARC welding control and shielding practices are used.)	1) <u>Controlling Emissions</u> a) The qualification levels used for the NUMAC PRNM system exceed those expected to result from portable transceivers, even if such transceivers are operated immediately adjacent to NUMAC equipment. GGNS generally prohibits operation of portable transceivers near sensitive equipment, and if warranted, requires positioning of warning signs at critical locations throughout the plant. Placement of warning signs is evaluated as part of the modification process. b) The qualification levels used for the NUMAC PRNM system minimize the likelihood of detrimental effects due to ARC welding as long as reasonable ARC welding control and shielding practices are used. ARC welding is only performed at GGNS with specific work orders and directions, and is known to have the potential to affect operation of I&C equipment at a number of locations in the plant. Therefore, ARC welding activity is only performed when any potential effect on I&C equipment is tolerable relative to plant operation.

Section No.	Utility Action Required	Response
	c) Limit Emissions from New Equipment: Establish practices for new equipment and plant modifications to assure that they either do not produce unacceptable levels of emissions, or installation shielding, filters, grounding or other methods prevent such emissions from reaching other potentially sensitive equipment. These practices should address both radiated emissions and conducted emissions, particularly conducted emissions on power lines and power distribution systems. Related to power distribution, both the effects of new equipment injecting noise on the power system and the power system conducting noise to the connected equipment should be addressed. (NOTE: For the qualification of the PRNM equipment includes emissions testing.) 2) Grounding Practices Existing Grounding System: The specific details and effectiveness of the original grounding system in BWRs varied significantly. As part of the modification process, identify any known or likely problem areas based on previous experience and include in the modification program either an evaluation step to determine if problems actually exist, or include corrective action as part of the modification. (NOTE: The PRNM equipment is being installed in place of existing PRM electronics which is generally more sensitive to EMI than the NUMAC equipment. As long as the plant has experienced no significant problems with the PRM, no problems are anticipated with the PRNM provided grounding is done in a comparable manner.) Grounding Practices for New Modifications: New plant modifications process should include a specific evaluation of grounding methods to be used to assure both that the new equipment is installed in a way equivalent to the conditions used in the qualification. (NOTE: NUMAC PRNM equipment qualification is performed in a panel assembly comparable to that used in the plant.)	c) EMI emissions from new equipment installed at GGNS are evaluated as part of the normal design modification process described in GGNS procedures. 2) Grounding Practices The PRNM system equipment is being installed in place of existing Power Range Monitor (PRM) system electronics. The replacement system interfaces with the same cables and wiring at the panel interfaces as the current system, including ground bus connections. No problems have been identified with the current PRM system related to grounding or grounding practices. The original installation included specific grounding practices designed to minimize performance problems. The replacement PRNM system is less sensitive to grounding issues than is the current system and includes specific actions in the wiring inside the panel to maximize shielding and grounding effectiveness.

Section No.	Utility Action Required	Response
	3) <u>Equipment and Cable Separation</u> • <u>Cabling</u>: Establish cabling practices to assure that signal cables with the potential to be "receivers" are kept separate from cables that are sources of noise. (NOTE: The original PRM cable installation requirements met this objective. The replacement PRNM uses the same cable routes and paths, so unless some specific problem has been identified in the current system, no special action should be necessary for the PRNM modification.) • <u>Equipment</u>: Establish equipment separation and shielding practices for the installation of new equipment to simulate that equipment's qualification condition, both relative to susceptibility and emissions. (NOTE: The original PRM cabinet design met this objective. The replacement PRNM uses the same mounting cabinet, and used an equivalent mounting assembly for qualification. No special action should be necessary for the PRNM modification.) The *plant-specific licensing submittals* should identify the practices that are in place or will be applied for the PRNM modification to address each of the above items.	3) <u>Equipment and Cable Separation</u> The original PRM system cable installation requirements met this objective. The replacement PRNM system uses the same cable routes and paths at comparable energy levels where feasible. Because no specific problem has been identified in the current system, no special action is necessary for the PRNM modification. The existing system cabling complies with applicable GGNS cable routing and separation requirements. Additionally, the modification process is performed in accordance with the existing separation criteria.
6.6	<u>System Failure Analysis</u> The utility must confirm applicability of the failure analysis conclusions contained in the PRNM LTR by the following actions: 1. Confirm that the events defined in EPRI Report No. NP-2230 or in Appendices F and G of Reference 11 of the PRNM LTR, encompass the events that are analyzed for the plant;	 1. The GGNS Technical Specification Surveillance Requirements for the Reactor Protection System (RPS) are based on Reference 11 of the PRNM LTR as discussed in the GGNS Technical Specification Bases (Section 3.3.1.1, Reactor Protection System Instrumentation, Reference 9 in GGNS TS Bases). Therefore, the Reference 11 failure analysis is applicable to GGNS. The overall redundancy and diversity of sensors available to provide trip signals in the RPS meets NRC-approved licensing basis requirements.

Section No.	Utility Action Required	Response
	2. Confirm that the configuration implemented by the plant is within the limits described in the LTR; and 3. Prepare a plant-specific 10CFR50.59 evaluation of the modification per the applicable plant procedures. These confirmations and conclusions should be documented in the *plant-specific licensing submittals* for the PRNM modification. [Reference 11 of the LTR is NEDC-30851P-A, "Technical Specification Improvement Analysis for BWR Reactor Protection System", Licensing Topical Report, GE Nuclear Energy, Class III (proprietary), dated March 1988.	2. The proposed PRNM configuration is included among the configurations described in the PRNM LTR, as itemized under Section 2.3.4 above. The proposed configuration is being designed by GEH and is within the limits described in the LTR. 3. The requirements of 10CFR50.59 applies to the PRNMS modification in accordance with applicable plant procedures.
7.6	Impact on UFSAR The plant-specific action required for FSAR updates will vary between plants. In all cases, however, existing FSAR documents should be reviewed to identify areas that have descriptions specific to the current PRNM using the general guidance of Sections 7.2 through 7.5 of the PRNM LTR to identify potential areas impacted. The utility should include in the *plant-specific licensing submittal* a statement of the plans for updating the plant FSAR for the PRNM project.	Applicable sections of the FSAR are reviewed and appropriate revisions of those sections are prepared and approved as part of the normal design process. Following implementation of the design modification, and closure of the design package, the FSAR revisions are included in the updated FSAR as part of the periodic 10 CFR 50.71(e) FSAR update submittal.
8.3.1.4	APRM-Related RPS Trip Functions - Functions Covered by Tech Specs 1. Delete the APRM Downscale function, if currently used, from the RPS Instrumentation "function" table, the related surveillance requirements, and, if applicable, the related setpoint, and related descriptions in the bases sections. 2. Delete the APRM Flow-biased Neutron Flux Upscale function, if currently used, from the RPS Instrumentation "function" table, the related surveillance requirements, and, if applicable, the related setpoint, and related descriptions in the bases sections. Replace these with the corresponding entries for the APRM Simulated Thermal Power - High and the APRM Neutron Flux - High functions. Perform analysis necessary to establish setpoints for	1. GGNS does not have an "APRM Downscale" RPS Trip Function Tech Spec. 2. APRM Flow Biased Simulated Thermal Power - High and the APRM Fixed Neutron Flux - High functions have been retained.

Section No.	Utility Action Required	Response
	added trips. 3. Add the APRM Neutron Flux - High (Setdown) function, if not currently used, to the RPS Instrumentation "function" table, add the related surveillance requirements, and, if applicable, the related setpoints, and related descriptions in the bases sections. Perform analysis necessary to establish setpoints for added trips.	 3. The current APRM Neutron Flux – High, Setdown function has been retained.
8.3.2.4	<u>APRM-Related RPS Trip Functions - Minimum Number of Operable APRM Channels</u> 1. For the 4-APRM channel replacement configuration, revise the RPS Instrumentation "function" table to show 3 APRM channels, shared by both trip systems for each APRM function shown (after any additions or deletions per PRNM LTR Paragraph 8.3.1.4). Add a "2-out-of-4 Voter" function with two channels under the "minimum operable channels". For plants with Tech Specs that include a footnote calling for removing shorting links, remove the references to the footnote related to APRM (retain references for SRM and IRM) and delete any references to APRM channels in the footnote. For smaller core plants, delete the notes for and references to special conditions related to loss of all LPRMs from the "other" APRM. 2. Review action statements to see if changes are required. If the improvements documented in Reference 11 have not been implemented, then changes will likely be required to implement the 12-hour and 6-hour operation times discussed above for fewer than the minimum required channels. If Improved Tech Specs are applied to the plant, action statements remain unchanged. 3. Revise the Bases section as needed to replace the descriptions of the current 6- or 8-APRM channel systems and bypass capability with a corresponding description of the 4-APRM system, 2-out-of-4 Voter channels (2 per RPS system), and allowed one APRM bypass total.	 1. The PRNM modification and the proposed Tech Spec and Bases change implement the changes as described in the PRNM LTR for a BWR6 plant. GGNS Tech Specs do not include notes related to APRMs that call for removal of shorting links or references to special conditions related to loss of all LPRMs from the "other" APRM. Therefore, no related note changes are required. A "2-out-of-4 Voter" function with two channels under the "minimum operable channels" have been added as Function 2.e. 2. Action statement changes in the proposed Tech Spec change are consistent with the PRNM LTR described changes for plants with Improved Tech Specs. GGNS has previously switched to the ISTS format. 3. The proposed Tech Spec Bases changes include revisions to the descriptions of the architecture, consistent with the PRNM LTR.
8.3.3.4	<u>APRM-Related RPS Trip Functions - Applicable Modes of Operation</u>	

Section No.	Utility Action Required	Response
	1) APRM Neutron Flux - High (Setdown) Change Tech Spec "applicable modes" entry, if required, to be Mode 2 (startup). Delete references to actions and surveillance requirements associated with other modes. Delete any references to notes associated with "non-coincidence" mode and correct notes as required. Revise Bases descriptions as required.	1) Tech Spec and Bases changes are consistent with the PRNM LTR.
	2) APRM Simulated Thermal Power - High Retain as is unless this function is being added to replace the APRM Flow-biased Neutron Flux Trip. In that case, add requirement for operation in Mode 1 (RUN) and add or modify Bases descriptions as required. 3) APRM Neutron Flux - High Retain as is unless this function is being added to replace the APRM Flow-biased Neutron Flux Trip. In that case, add requirement for operation in Mode 1 (RUN) and add or modify Bases descriptions as required. 4) APRM Inop Trip Delete any requirements for operation in modes other than Mode 1 and Mode 2 (RUN and STARTUP). Revise the Bases descriptions as needed.	2) The APRM Flow Biased Simulated Thermal Power - High function has been retained and is consistent with the PRNM LTR. 3) The APRM Fixed Neutron Flux - High function has been retained and is consistent with the PRNM LTR. 4) The current GGNS TS require this function only in Modes 1 and 2.
8.3.4.1.4	APRM-Related RPS Trip Functions - Channel Checks/ Instrument Checks a) For plants without Channel Check requirements, add once per 12 hour or once per day Channel Check or Instrument Check requirement for the three APRM flux based functions. No Channel Check requirements are added for APRM Inop function. Plants with once per 12 hour or once per shift requirements may change them to once per day.	a) The GGNS Technical Specifications currently include a once-per-shift Channel Check requirement for the APRM Functions (except for Inop). The APRM Function Channel Check requirement has been changed from once per 12 hours to once per day (24 hours). The new Channel Check SR 3.3.1.1.19 with a frequency of 24 hours has been added to TS 3.3.1.1 and applies to Functions 2.a, 2.b, 2.d, 2.e, and 2.f.

Section No.	Utility Action Required	Response
	b) For plants with 4 full recirculation flow channels and with Tech Specs that call for daily or other channel check requirements for flow comparisons under APRM Flow Biased Simulated Thermal Power Trip, delete those requirements. Move any note reference related to verification of flow signals to Channel Functional Test entry.	b) GGNS currently uses 8 recirculation flow transmitters. Associated surveillances have been included in those for the APRM Flow Biased Simulated Thermal Power – High and the OPRM Upscale functions (the latter because of the OPRM trip enable function). The proposed Technical Specification and Bases changes for the recirculation flow related SRs are consistent with the PRNM LTR but with some expansion to clarify that the recirculation flow functions also support the OPRM Upscale function trip enable.
8.3.4.2.4	<u>APRM-Related RPS Trip Functions - Channel Functional Tests</u> a) Delete existing channel functional test requirements and replace with a requirement for a Channel Functional Test frequency of each 184 days (6 months) [delete any specific requirement related to startup or shutdown except for the APRM Neutron Flux - High (Setdown) function as noted in Paragraph 8.3.4.2.2(1) of the PRNM LTR. Add a notation that both the APRM channels and the 2-out-of-4 Voter channels are to be included in the Channel Functional Test. b) Add a notation for the APRM Simulated Thermal Power - High function that the test shall include the recirculation flow input processing, excluding the flow transmitters. <u>CAUTION: Plants that have not implemented the APRM surveillance improvements of Reference 11 of the PRNM LTR, or those that have continued to use a weekly surveillance of scram contactors, may need to implement or modify surveillance actions to continue to provide a once per week functional test of scram contactors. (Prior to changes defined in Reference 11, the weekly APRM functional test also provides a weekly test of all automatic scram contactors.)</u>	 a) The proposed Technical Specification and Bases changes related to Channel Functional Tests are consistent with the PRNM LTR. b) The proposed Technical Specification and Bases changes to Channel Functional Test for the APRM functions include a notation, applicable to the Flow Biased Simulated Thermal Power – High (Function 2.d) and the OPRM Upscale (Function 2.f), consistent with the PRNM LTR requirements, that the SR includes the recirculation flow input processing, excluding the flow transmitters. However, the PRNM LTR includes this notation only in the Bases. For the GGNS Technical Specification, the Channel Functional Test has been added as SR 3.3.1.1.20, and has been expanded to also apply to the OPRM Upscale function (to cover OPRM Upscale trip enable). The functional test procedure will be established to test all of the hardware required to produce the trip functions, but not to directly re-test software-only (firmware-only) logic. The APRM automatic self-test function monitors the integrity of the EPROMs storing all of the firmware so that if a hardware fault results in a "change" to the firmware (software), that fault will be detected by the self-test logic. The continued operation of the self-test procedures is

Section No.	Utility Action Required	Response
		monitored by the built-in "watch-dog timer" function, so if for some unforeseen reason the self-test function (lowest priority in the instrument logic) stops running, that failure also will be detected automatically. To provide further assurance that the self-test function continues to operate, a step will be included in the APRM Channel Check surveillance to confirm that self-test is still running.
8.3.4.3.4	<u>APRM-Related RPS Trip Functions - Channel Calibrations</u> a) Replace current calibration interval with either 18 or 24 months except for APRM Inop. Retain Inop requirement as is (i.e., no requirement for calibration). b) Delete any requirements for flow calibration and calibration of the 6 second time constant separate from overall calibration of the APRM Simulated Thermal Power – High function. c) Replace every 3 day frequency for calibration of APRM power against thermal power with a 7 day frequency if applicable. d) Revise Bases text as required.	a) The proposed Technical Specification and Bases changes related to Channel Calibration has been changed to 24-month interval, with no calibration required for the Inop Function, consistent with the PRNM LTR. b) Consistent with the PRNM LTR requirements, the proposed Technical Specification and Bases changes add a notation applicable to the Channel Calibration for the APRM Flow Biased Simulated Thermal Power – High function to exclude requirements to calibrate the recirculation flow transmitters. However, the PRNM LTR includes this notation only in the Bases. For the GGNS Technical Specification, the notation has been included in Channel Calibration SR 3.3.1.1.10. In addition, current SRs 3.3.1.1.16, which verifies the simulated thermal power time constant, and 3.3.1.1.18, which adjusts the flow control reference card, have been deleted. c) The current GGNS Technical Specifications include a "weekly" frequency for the verification of APRM power versus calculated plant thermal power so no change in that frequency is required to be consistent with the PRNM LTR. d) The proposed Technical Specification Bases changes related to Channel Calibrations are consistent with the PRNM LTR.
8.3.4.4.4	<u>APRM-Related RPS Trip Functions - Response Time Testing</u> Delete response time testing requirement from Tech Specs or plant procedures, as applicable,	The proposed Technical Specification and Bases changes related to Response Time Testing (new SR 3.3.1.1.22 and Table 3.3.1.1-1) are consistent with the justification in the PRNM LTR Supplement 1.

Section No.	Utility Action Required	Response
	for the APRM functions. Replace it with a response time testing requirement for the 2-out-of-4 Voter "pseudo" function, to include the output solid-state relays of the voter channel through the final RPS trip channel contactors. Frequency of response time testing shall be determined using four 2-out-of-4 Voter channels, but tests may alternate use of 2-out-of-4 Voter outputs provided each APRM/RPS interfacing relay is tested at least once per eight refueling cycles (based on a maximum 24 month cycle), and each RPS scram contactor is tested at least once per four refueling cycles. Each 2-out-of-4 Voter output shall be tested at no less than half the frequency of the tests of the APRM/RPS interface relays. Tests shall alternate such that one logic train for each RPS trip system is tested every two cycles.	Consistent with the PRNM LTRs, the only APRM Function to which the SR applies is Function 2.e (voter). However, while the PRNM LTRs justified reduced response time testing frequency for Function 2.e, no TS markups were included to implement an "n" greater than 4 (the total number of voter channels). Therefore, a note has been added to the GGNS SR Table 3.3.1.1-1 to define that "n=8" for Function 2.e. The PRNM LTR Supplement 1 justified response time testing at a rate that tested one RPS Interface relay every plant operating cycle, with tests using the APRM output for one cycle and the OPRM output for the next cycle. This yields a testing rate once per 8 operating cycles for each RPS interface relay and once per every 16 operating cycles for the APRM or OPRM output. The PRNM modification includes redundant APRM trip and redundant OPRM trip outputs from each 2-Out-Of-4 Voter channel. One of the OPRM outputs and one of the APRM outputs are connected in series to the coil of one RPS interface relay. The second OPRM output and the second APRM output from the 2-Out-Of-4 Voter channel are connected in series with the coil to a second RPS interface relay. There are 8 total RPS interface relays.
8.3.5.4	<u>APRM-Related RPS Trip Functions - Logic System Functional Testing (LSFT)</u> Revise Tech Specs to change the interval for LSFT from 18 months to 24 months unless the utility elects to retain the 18-month interval for plant scheduling purposes. Delete any LSFT requirements associated with the APRM channels and move it to the 2-out-of-4 Voter channel. Include testing of the 2-out-of-4 voting logic and any existing LSFTs covering RPS relays.	The GGNS Technical Specifications have been changed to delete the LSFT requirement from the existing APRM Functions 2.a, 2.b, 2.c, and 2.d. New SR 3.3.1.1.21 with a 24-month interval, has been added to TS 3.3.1.1 and applied to the new 2-Out-of-4 Voter function, APRM Function 2.e. .
8.3.6.1	<u>APRM-Related RPS Trip Functions - Setpoints</u> Add to or delete from the appropriate document any changed RPS setpoint information. If ARTS is being implemented concurrently with the PRNM modification, either include the related Tech Spec submittal information with the PRNM information in the plant-specific submittal, or reference the ARTS submittal in the PRNM submittal. In the *plant-specific licensing submittal,* identify what changes, if	ARTS is not applicable at GGNS. PRNM setpoints and Allowable Values are re-calculated or confirmed using approved setpoint methodology. The Allowable Values for the APRM RPS Functions are included in the Technical Specifications or the COLR, comparable to what is currently in the GGNS Technical Specifications and consistent with the PRNM LTR.

Section No.	Utility Action Required	Response
	any, are being implemented and identify the basis or method used for the calculation of setpoints and where the setpoint information or changes will be recorded.	
8.4.1.4	OPRM-Related RPS Trip Functions - Functions Covered by Tech Specs Add the OPRM Upscale function as an "APRM function" in the RPS Instrumentation "function" table. Also add the related surveillance requirements and, if applicable, the related setpoint, and the related descriptions in the bases sections. Perform analysis necessary to establish setpoints for the OPRM Upscale trip. Add discussions related to the OPRM function in the Bases for the APRM Inop and 2-out-of-4 Voter functions. NOTE: The markups in Appendix H of Supplement 1 to the PRNM LTR show the OPRM Upscale as an APRM sub-function. However, individual plants may determine that for their particular situation, addition of the OPRM to the RPS Instrumentation table separate from the APRM, or as a separate Tech Spec, better meets their needs. In those cases, the basis elements of the Tech Spec as shown in this Supplement would remain, but the specific implementation would be different.	An OPRM Upscale Function has been added to the GGNS Technical Specification as an "APRM Function" (Function 2.f) consistent with PRNM LTR Supplement 1, Appendix H. Additions to the Technical Specification Bases for Function 2.f have also been incorporated consistent with the PRNM LTR. The PRNM LTR Supplement 1 included some additional wording for Function 2.e (voter) to address independent voting of the OPRM and APRM signals.
8.4.2.4	OPRM-Related RPS Trip Functions - Minimum Number of Operable OPRM Channels For the OPRM functions added (Section 8.4.1), include in the OPRM Tech Spec a "minimum operable channels" requirement for three OPRM channels, shared by both trip systems. Add the same action statements as for the APRM Neutron Flux - High function for OPRM Upscale function. In addition, add a new action statement for OPRM Upscale function unavailable per Paragraph 8.4.2.2 of the PRNM LTR. Revise the Bases section as needed to add descriptions of the 4-OPRM system with 2-out-of-4 output Voter channels (2 per RPS Trip System), and allowed one OPRM bypass total.	A minimum operable channels requirement of three, shared by both trip systems has been included in the Technical Specification for the OPRM Upscale Function (Function 2.f). This addition, as well as addition of Required Action statements and Bases descriptions, is consistent with the PRNM LTR and LTR Supplement 1. However, to make the Required Action statements more consistent with the intent of the LTR, a note has been added to Required Action J.2 stating that LCO 3.0.4(c) is applicable. LCO 3.0.4 was revised in GGNS Technical Specifications Amendment 175 to reflect NRC-approved changes regarding Mode change limitations via BWROG TSTF-359, "Increased Flexibility in Mode Restraints." Although applying LCO 3.0.4(c) is not included in the NUMAC PRNM LTR Supplement 1, it is consistent with the intent of Required Action J.2. Inclusion of Action J.2 is intended to allow

Section No.	Utility Action Required	Response
		orderly identification and Implementation of a resolution plan for an unanticipated design problem with the OPRM system without undue impact on normal plant operation. The LCO 3.0.4(c) application does not eliminate the requirement to restore the OPRM Upscale function to OPERABLE status within a 120—day period. Applying LCO 3.0.4(c) does, however, allow the plant to start up with the alternate detect and suppress provision of Action J.2 in effect during the 120-day period.
8.4.3.4	OPRM-Related RPS Trip Functions - Applicable Modes of Operation Add the requirement for operation of the OPRM Upscale function in Mode 1 (RUN) when Thermal Power is $\geq$ 25% RTP, and add Bases descriptions as required.	A GGNS-specific Modes of Operation requirement of $\geq$ 24% RTP, consistent with the PRNM LTR Supplement 1 has been included in the Technical Specification along with associated Bases descriptions.
8.4.4.1.4	OPRM-Related RPS Trip Functions - Channel Check Add once per 12 hour or once per day Channel Check or Instrument Check requirements for the OPRM Upscale function.	A new Channel Check requirement of once per day (24 hours), SR 3.3.1.1.19, has been added. It is applied to the OPRM Upscale function, consistent with the PRNM LTR.
8.4.4.2.4	OPRM-Related RPS Trip Functions - Channel Functional Test Add Channel Functional Test requirements with a requirement for a test frequency of every 184 days (6 months), including the 2-out-of-4 Voter function. Add a "confirm auto-enable region" surveillance on a once per outage basis up to 24 month intervals.	A new Channel Functional Test requirement with a test frequency of every 184 days (Table 3.3.1.1-1) has been added to TS 3.3.1.1 as SR 3.3.1.1.20 for the OPRM Upscale and 2-Out-Of 4 Voter Functions consistent with the PRNM LTR, Supplement 1. The third note to SR 3.3.1.1.20 (not included in the PRNM LTR) clarifies that the SR also applies to the flow input function, except the flow transmitters. New "confirm auto-enable region" surveillance requirement, SR 3.3.1.1.23, has been added to TS 3.3.1.1 to require confirmation that the OPRM Upscale trip output auto-enable (not bypassed) setpoints remain correct. The SR Bases wording is consistent with the LTR.

Section No.	Utility Action Required	Response
8.4.4.3.4	OPRM-Related RPS Trip Functions - Channel Calibration Add calibration interval requirement of every 24 months for the OPRM Upscale function. Revise Bases text as required.	Channel Calibration SR 3.3.1.1.10 has been applied to the OPRM Upscale function to be consistent with the PRNM LTR Supplement 1. The frequency of SR 3.3.1.1.10 has been changed from 184 days to 24 months, consistent with the LTR.
8.4.4.4.4	OPRM-Related RPS Trip Functions - Response Time Testing Modify as necessary the response time testing procedure for the 2-out-of-4 Voter function to include the Voter OPRM output solid-state relays as part of the response time tests, alternating testing of the Voter OPRM output with the Voter APRM output.	See response to 8.3.4.4.4. That response also addresses OPRM.
8.4.5.4	OPRM-Related RPS Trip Functions - Logic System Functional Testing (LSFT) Add requirement for LSFT every refueling cycle, 18 or 24 months at the utility's option based on which best fits plant scheduling.	The LSFT surveillance (new SR 3.3.1.1.21) for the OPRM Upscale Function is a test of the 2-Out-Of-4 Voter only, consistent with the PRNM LTR. Consistent with the PRNM LTR Supplement 1, revision of the related plant procedures to include testing of the OPRM Upscale trip outputs from the 2-Out-Of-4 Voter is required. The procedure changes are made as part of the normal modification process.
8.4.6.1	OPRM-Related RPS Trip Functions - Setpoints Add setpoint information to the appropriate document and identify in the plant-specific submittal the basis or method used for the calculation and where the setpoint information will be recorded.	There are four "sets" of OPRM related setpoints and adjustable parameters: a) OPRM trip auto-enable (not bypassed) setpoints for STP and drive flow; b) period based detection algorithm (PBDA) confirmation count and amplitude setpoints; c) PBDA tuning parameters; and d) growth rate algorithm (GRA) and amplitude based algorithm (ABA) setpoints. The first set, the setpoints for the "auto-enable" region for OPRM, as discussed in the Bases for Function 2.f, will be treated as nominal setpoints with no additional margins added. The deadband for these setpoints is established so that it increases the enabled region once the enabled region is entered. The settings are defined plant procedures. The second set, the PBDA trip setpoints, will be established in accordance with the BWROG LTR 32465-A methodology, previously reviewed and approved by the NRC, and will be documented in the COLR. The third set, the PBDA "tuning" parameter

Section No.	Utility Action Required	Response
		values, will be established in accordance with and controlled by GGNS procedures, within the limits established in the BWROG LTRs, or as documented in this submittal, and documented in the GGNS Core Operating Limits Report. The fourth set, the GRA and ABA setpoints, consistent with the BWROG submittals, will be established as nominal values only, and controlled by GGNS procedures.
8.5.1.4	APRM-Related Control Rod Block Functions - Functions Covered by Tech Specs If ARTS will be implemented concurrently with the PRNM modification, include or reference those changes in the *plant-specific PRNM submittal.* Implement the applicable portion of the above described changes via modifications to the Tech Specs and related procedures and documents. In the *plant-specific submittal,* identify functions currently in the plant Tech Specs and which, if any, changes are being implemented. For any functions deleted from Tech Specs, identify where setpoint and surveillance requirements will be documented. NOTE: A utility may choose not to delete some or all of the items identified in the PRNM LTR from the plant Tech Specs.	ARTS is not applicable at GGNS. GGNS Technical Specifications currently do not contain any APRM rod block functions.
8.5.2.4	APRM-Related Control Rod Block Functions - Minimum Number of Operable Control Rod Block Channels Change the minimum number of APRM channels to three, if APRM functions are retained in Tech Specs. No additional action is required relative to minimum operable channels beyond that required by Paragraph 8.5.1.4 of the PRNM LTR.	See 8.5.1.4 above. No additional confirmation of action required relative to minimum operable channels as shown in the Technical Specifications beyond that required by 8.5.1.4 above.
8.5.3.4	APRM-Related Control Rod Block Functions - Applicable Modes of Operation No action required relative to modes during which the function must be available beyond that required by Paragraph 8.5.1.4 of the PRNM LTR unless APRM functions are retained in Tech Specs and include operability requirements for Mode 5. In that case, delete such requirements.	See 8.5.1.4 above. No additional confirmation of action required relative to applicable modes of operation as shown in the Technical Specifications beyond that required by 8.5.1.4 above.
8.5.4.1.4	APRM-Related Control Rod Block Functions - Required Surveillances and Calibration - Channel Check	GGNS Technical Specifications currently do not contain any APRM rod block functions, or any Channel Check requirements for the RBM rod

Section No.	Utility Action Required	Response
	Delete any requirements for instrument or channel checks related to RBM and, where applicable, recirculation flow rod block functions (non-ARTS plants), and APRM functions. Identify in the plant-specific PRNM submittals if any checks are currently included in Tech Specs, and confirm that they are being deleted.	block functions. Therefore, no change to GGNS Technical Specifications is required to implement the PRNM LTR requirements. The RBM is not applicable to GGNS.
8.5.4.2.4	<u>APRM-Related Control Rod Block Functions - Required Surveillances and Calibration - Channel Functional Test</u> Change Channel Functional Test requirements to identify a frequency of every 184-days (6 months). In the *plant-specific licensing submittal,* identify current Tech Spec test frequencies that will be changed to 184 days (6 months).	GGNS Technical Specifications currently do not contain any APRM rod block functions.
8.5.4.3.4	<u>APRM-Related Control Rod Block Functions - Required Surveillances and Calibration - Channel Calibrations</u> Change channel calibration requirements to identify a frequency of every 24 months. In the *plant-specific licensing submittal,* identify current Tech Spec test frequencies that will be changed to 24 months.	GGNS Technical Specifications currently do not contain any APRM rod block functions
8.5.4.4.4	<u>APRM-Related Control Rod Block Functions - Required Surveillances and Calibration - Response Time Testing</u> None.	GGNS Technical Specifications currently do not contain any APRM rod block functions.
8.5.5.4	<u>APRM-Related Control Rod Block Functions - Required Surveillances and Calibration - Logic System Functional Testing (LSFT)</u> None.	GGNS Technical Specifications currently do not contain any APRM rod block functions.
8.5.6.1	<u>APRM-Related Control Rod Block Functions - Required Surveillances and Calibration - Setpoints</u> Add to or delete from the appropriate document any changed control rod block setpoint information. If ARTS is being implemented concurrently with the PRNM modification, either include the related Tech Spec submittal information with the PRNM information in the *plant-specific submittal,* or reference the ARTS submittal in the PRNM submittal. In the *plant-specific submittal,* identify what changes, if any, are being implemented and identify the basis or	ARTS is not applicable to GGNS.

Section No.	Utility Action Required	Response
	method used for calculation of setpoints and where the setpoint information or changes will be recorded.	
8.6.2	Shutdown Margin Testing - Refueling As applicable, revise the Shutdown Margin Testing - Refueling (or equivalent Tech Spec) LCO(s), action statements, surveillance requirements and Bases as required to be consistent with the APRM Tech Spec changes implemented for PRNM.	Technical Specification and Technical Specification Bases changes to Specification 3.10.8, Shutdown Margin (SDM) Test – Refueling have been made by adding APRM Function 2.e to LCO 3.10.8 and SR 3.10.8.1. .
None	Specification 3.4.1, Recirculation Loops Operating No action identified in the PRNM LTR.	Changes are included in the proposed Tech Spec Bases for LCO 3.4.1. Deleted statements related to Fraction of Core Boiling Boundary and PBDS and Reference 4 (NEDO 32339-A). These changes, although not directly addressed in the PRNM LTR, are consistent with the remainder of the PRNM modification and implementation of the Option III Stability Solution.
None	Core Operating Limits Report Reporting requirements Section 5.6.5 does not currently address the OPRM.	Specification 5.6.5 has been modified to require the setpoints for APRM Function 2.f (OPRM Upscale) to be included in the COLR.
9.1.3	Utility Quality Assurance Program As part of the *plant-specific licensing submittal*, the utility should document the established program that is applicable to the project modification. The submittal should also document for the project what scope is being performed by the utility and what scope is being supplied by others. For scope supplied by others, document the utility actions taken or planned to define or establish requirements for the project, to assure those requirements are compatible with the plant-specific configuration. Actions taken or planned by the utility to assure compatibility of the GEH quality program with the utility program should also be documented. Utility planned level of participation in the overall V&V process for the project should be documented, along with utility plans for software configuration management and provision to support any required changes after delivery should be documented.	Quality assurance requirements for work performed at GGNS are defined and described in GGNS Quality Assurance Program Manual. For the PRNM modification, GGNS has contracted with GEH to include the following PRNM scope: 1) design, 2) hardware/ software, 3) licensing support, 4) training, 5) O&M manuals and design documentation, 6) EMI/RFI qualification of equipment, and 7) PRNMS setpoint calculations. On-site engineering work to incorporate the GEH provided design information into an Engineering Change (EC) or to provide any supporting, interface design changes will be performed per requirements of applicable GGNS procedures. Modification work to implement the design change will be performed per GGNS procedures or GGNS-approved contractor procedures. GGNS participates in appropriate reviews of GEH's design and V&V program for the PRNM modification.

Section No.	Utility Action Required	Response
		For software delivered in the form of hardware (EPROMs), GGNS intends to have GEH maintain post delivery configuration control of the actual source code and handle any changes. GGNS handles any changes in the EPROMs as hardware changes under its applicable hardware modification procedures.

Appendix A

Grand Gulf Nuclear Station NUMAC PRNM LTR Deviations

Grand Gulf Nuclear Station NUMAC PRNM LTR Deviations

Grand Gulf Nuclear Station (GGNS) will be submitting a license application for the implementation of Power Range Neutron Monitor (PRNM). The bases for the license application are the referenced documents in the relevant licensing topical reports (Reference 1-3).

The PRNM developed for GGNS has three deviations from the referenced documents. These are summarized in Table 1 and discussed in detail below. The licensing topical reports explicitly allow for plant-to-plant variation of some features. These are not addressed herein.

Table 1. GGNS NUMAC PRNM LTR Deviations

	Function/ Equipment	PRNM Licensing Basis	GGNS Design	Justification
a.	APRM Upscale / OPRM Upscale / APRM Inop Function Logic	OPRM Upscale function voted separately from the APRM Inop function	OPRM Upscale function voted with the APRM Inop function	Improved operating flexibility
b.	OPRM Pre-Trip Alarm	Alarm if any instability algorithm exceeds defined alarm setpoints.	Alarm if the period based algorithm exceeds defined alarm setpoints.	Delete function that does not afford timely operator action.
c.	Recirculation Flow Processing	The PCI uses 2 Total Flow signals for the Flow Comparison.	The PCI uses 4 Total Flow signals for the Flow Comparison.	Safety functions are not affected; design was reviewed and approved for all plants in original report.

Technical Justifications

a. APRM Upscale / OPRM Upscale / APRM Inop Function Logic

Licensing Topical Report NEDC-32410P-A Supplement 1 (Reference 3) Section 8.4.1.3 describes the logic wherein the OPRM Upscale function is voted separately from the APRM Inop function. That is, an APRM Inop in one APRM channel and an OPRM Upscale in another will result in two half-trips in each of the 2-out-of-4 voter channels, but no RPS trips.

Designed this way, when an APRM chassis keylock switch is placed in the "INOP" position, the APRM upscale trip signal sent to the 2-out-of-4 voter channels is set to trip. However, the OPRM trip output from that chassis continues to be processed normally. Typically this logic is of no consequence because if an APRM chassis (affecting both the APRM and OPRM channels) is declared inoperable, the APRM bypass can be used to bypass both the APRM and OPRM trips from that channel, which in turn modifies the logic in the 2-out-of-4 voter to be a 2-out-of-3 vote of both the APRM and OPRM trips from the remaining 3 channels. However, if the need to declare a second APRM/OPRM channel inoperable arises when another APRM/OPRM channel is already bypassed (and cannot be returned to service within the allowed out of service time), it is necessary to place the APRM and OPRM outputs from the second channel in the tripped condition to satisfy Technical Specification requirements. If the APRM channel is still sufficiently functional to process trip outputs, placing the keylock switch in the INOP position will force a trip for the APRM channel, but not for the OPRM channel. Other action, such as disconnecting a fiber-optic cable to the 2-out-of-4 voters or removing power from the APRM chassis, is necessary to satisfy the requirement to place the OPRM channel in the tripped condition.

The automatic APRM Inop trip is intended to provide a trip when the APRM channel is known to be incapable of providing a trip based on normal functions. This trip occurs immediately even though the Technical Specification requirements allow a period of time for action. The automatic trip is provided to assure that conditions that may disable the APRM trip function do not go undetected. Since the OPRM trip function is implemented in the same equipment as the APRM trip function, conditions that could disable the APRM trip function would likely disable the OPRM trip function as well.

For the Grand Gulf PRNM, the OPRM Upscale function is combined with the APRM Inop function as the OPRM channel input to be voted. That is, an APRM Inop in one APRM channel and an OPRM Upscale in another will result in RPS trip outputs from all four 2-out-of-4 voter channels. Again this logic is typically of no consequence because if an APRM chassis (affecting both the APRM and OPRM channels) is declared inoperable, the APRM bypass can be used to bypass both the APRM and OPRM trips from that channel, which in turn modifies the logic in the 2-out-of-4 voter to be a 2-out-of-3 vote of both the APRM and OPRM trips from the remaining 3 channels. This design allows using the APRM chassis keylock switch to place APRM and OPRM outputs from a second channel in the tripped condition when another APRM/OPRM channel is already bypassed (and cannot be returned to service within the allowed out of service time) without having to resort to other actions such as disconnecting a fiber-optic cable to the 2-out-of-4 voters or removing power from the APRM chassis.

For the GGNS PRNM, the Supplement 1 (Reference 3) Bases are changed as follows.

1. Page H-12: change the second paragraph as shown below.

The APRM System is divided into four APRM channels and four 2-out-of-4 voter channels. Each APRM channel provides inputs to each of the four voter channels. The four voter channels are divided into two groups of two each, with each group of two providing inputs to one RPS trip system. The system is designed to allow one APRM channel, but no voter channels, to be bypassed. A trip from any one unbypassed APRM will result in a "half-trip" in all four of the voter channels, but no trip inputs to either RPS trip system. ~~APRM trip Functions 2.a, 2.b, 2.c, and 2.d are voted independently from OPRM Upscale Function 2.f. Therefore, any Function 2.a, 2.b, 2.c, or 2.d trip from any two unbypassed APRM channels will result in a full trip in each of the four voter channels, which in turn results in two trip inputs into each RPS trip system logic channel (A1, A2, B1, and B2). Similarly, a Function 2.f trip from any two unbypassed APRM channels will result in a full trip from each of the four voter channels.~~ Three of the four APRM channels and all four of the voter channels are required to be OPERABLE to ensure that no single failure will preclude a scram on a valid signal. In addition, to provide adequate coverage of the entire core, consistent with the design bases for the APRM Functions 2.a, 2.b, and 2.d, at least [20] LPRM inputs, with at least [three] LPRM inputs from each of the four axial levels at which the LPRMs are located, must be operable for each APRM channel. For the OPRM Upscale, Function 2.f, LPRMs are assigned to "cells" of [4] detectors. A minimum of [later] cells, each with a minimum of [2] LPRMs, must be OPERABLE for the OPRM Upscale Function 2.f to be OPERABLE.

Replaced deleted text with the following:

Since APRM trip Functions 2.a, 2.b, 2.d and 2.f are implemented in the same hardware, these trip Functions are combined with APRM Inop trip Function 2.c. Any Function 2.a, 2.b, 2.c or 2.d trip from any two unbypassed APRM channels will result in a full trip in each of the four voter channels, which in turn results in two trip inputs into each RPS trip system logic channel (A1, A2, B1, and B2). Similarly, any Function 2.c or 2.f trip from any two unbypassed APRM channels will result in a full trip from each of the four voter channels.

2. Page H-13: For Function 2.e, change the 1st sentence of the 3rd paragraph to the following. "The 2-Out-Of-4 Voter Function votes APRM Functions 2.a, 2.b, and 2.d independently of Function 2.f."

b. OPRM Pre-Trip Alarms

Licensing Topical Report NEDC-32410P-A (Reference 1) paragraph 3.3.3.1.2 states that the OPRM provides an oscillation pre-trip alarm when one of the instability algorithms (period based, amplitude based, or growth based) for an operable OPRM cell has exceeded user defined setpoints. The GGNS PRNM design will provide the OPRM pre-trip alarm when the Period Based Algorithm for an operable OPRM cell has exceeded user defined setpoints.

The pre-trip Alarms are intended to alert the operator of a developing instability event so that manual actions to avoid a reactor scram can be attempted. The OPRM Licensing Topical Reports (References 4-6) do not require pre-trip alarms.

For Option III, the OPRM cell signals are analyzed by the Period Based Algorithm (PBA), the Amplitude Based Algorithm (ABA), and the Growth Rate Algorithm (GRA). Automatic protection is actuated if any one of the three algorithms meets its trip conditions. However, only the PBA is required to provide protection of the Safety Limit Minimum Critical Power Ratio (SLMCPR) for anticipated reactor instabilities. The other two algorithms (ABA and GRA) are included as defense-in-depth.

The PBA amplitude trip setpoint is the relative power level, or peak over average (P/A), at which the OPRM cell generates a trip signal, provided the required number of Successive Confirmation Counts (SCCs) has been reached. The following two conditions must both be met for at least one cell in an OPRM channel to result in a PBA-based channel trip.

1. The Successive Confirmation Count (SCC) reaches or exceeds the SCC trip setpoint.

2. The cell relative power level, or peak over average (P/A), signal reaches or exceeds the amplitude trip setpoint.

The GRA and ABA are designed to detect large, fast growing oscillations. Unlike the PBA, the ABA and GRA trips do not require a minimum number of SCCs to generate a trip signal. During fast growing oscillation events, the trips will occur very early in the event with little time for effective operator action. Consequently, GRA and ABA pre-trip alarms are not provided in the GGNS PRNM design.

c. Recirculation Flow Processing

Licensing Topical Report NEDC-32410P-A Volume 1 (Reference 1) and Supplement 1 (Reference 3) Section 3.2.3.2.2 provide a Description of (flow processing) Logic in the PRNM System for plants with 4 Flow Channels and 8 Transmitters. Statement (c) explains that each APRM sends its total flow signal to two PRNM Communication Interface (PCI) chassis for the BWR6. Statement (d) explains that the PCI chassis compares two total flows, one from each of two APRMs, and that alarms are issued if the flow differs by more than a user-entered value.

In the replacement system at GGNS, each PCI will compare all four total flows. One total flow signal is from the APRM chassis in the same channel and one is from the LPRM in the other channel belonging to the same RPS trip system. The other two flow signals are provided by the other PCI chassis When the PCI determines that the flow differs by more than the user-entered value, it will transmit this status to its associated APRM, which will issue the alarm as described.

In order to make all four total flow signals available at each PCI chassis, fiber optic communication between all four PCI chassis will be established. Licensing Topical Report NEDC-32410P-A Supplement 1 (Reference 3) Figure E.1.7 (BWR 6, Larger Core), which illustrates the APRM/PCI configuration block diagram, is amended to include a dotted line (fiber-optic) network between the PCI chassis. Additionally, Figure E.1.7 is also amended to show that each APRM chassis communicates with the PCI in the same channel, and each LPRM chassis communicates with the PCI belonging to the other channel in the same RPS trip system. There is no effect on any APRM hardware.

By using all four total flow signals, the logic is the same as that described in Reference 1 for all plants with a similar configuration (4 Flow Channels and 8 Transmitters), and in Reference 3 for non-BWR6 plants with a similar configuration. The communication network between the PCI chassis agrees conceptually with Figure E.3.6 of Reference 3. Additionally, by providing all four flow signals for comparison, the logic satisfies what is discussed in Licensing Topical Report NEDC-32410P-A (Reference 1) Section 8.3.4.1.2, where it is explained that any requirement for a daily flow comparison check is deleted from surveillances and replaced by the automatic comparison of all four total recirculation flow values. It is noted that the justification (Section 8.3.4.1.3) explicitly calls out comparison logic that includes all four channels.

Incorporating this logic has no affect on any safety functions.

References

1. NEDC-32410P-A Volume 1, "Nuclear Measurement Analysis and Control Power Range Neutron Monitor (NUMAC PRNM) Retrofit Plus Option III Stability Trip Function," October, 1995.

2. NEDC-32410P-A Volume 2 -- Appendices, "Nuclear Measurement Analysis and Control Power Range Neutron Monitor (NUMAC PRNM) Retrofit Plus Option III Stability Trip Function," October, 1995.

3. NEDC-32410P-A Supplement 1, "Nuclear Measurement Analysis and Control Power Range Neutron Monitor (NUMAC PRNM) Retrofit Plus Option III Stability Trip Function," November, 1997.

ATTACHMENT 3

GNRO-2009-00054

MARKED-UP OPERATING LICENSE AND
TECHNICAL SPECIFICATION PAGES

GGNS OPERATING LICENSE

(b) SERI is required to notify the NRC in writing prior to any change in (i) the terms or conditions of any new or existing sale or lease agreements executed as part of the above authorized financial transactions, (ii) the GGNS Unit 1 operating agreement, (iii) the existing property insurance coverage for GGNS Unit 1 that would materially alter the representations and conditions set forth in the Staff's Safety Evaluation Report dated December 19, 1988 attached to Amendment No. 54. In addition, SERI is required to notify the NRC of any action by a lessor or other successor in interest to SERI that may have an effect on the operation of the facility.

C. The license shall be deemed to contain and is subject to the conditions specified in the Commission's regulations set forth in 10CFR Chapter I and is subject to all applicable provisions of the Act and to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) Maximum Power Level

Entergy Operations, Inc. is authorized to operate the facility at reactor core power levels not in excess of 3898 megawatts thermal (100 percent power) in accordance with the conditions specified herein.

(2) Technical Specifications

The Technical Specifications contained in Appendix A and the Environmental Protection Plan contained in Appendix B, as revised through Amendment No. 182 are hereby incorporated into this license. Entergy Operations, Inc. shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

~~The Surveillance Requirements (SRs) for Diesel Generator 12 contained in the Technical Specifications and listed below, are not required to be performed immediately upon implementation of Amendment No. 169. The SRs listed below shall be successfully demonstrated at the next regularly scheduled performance.~~

~~SR 3.8.1.9,~~
~~SR 3.8.1.10, and~~
~~SR 3.8.1.14~~

INSERT A - Exception

INSERT A – Exception

During Cycle 19, GGNS may conduct monitoring of the Oscillation Power Range Monitor (OPRM). During this time, the OPRM Upscale function (Function 2.f of Technical Specification Table 3.3.1.1-1) may be disabled and operated in an "indicate only" mode at which time technical specification requirements would not apply. During such time, Backup Stability Protection measures will be implemented via GGNS procedures to provide an alternate method to detect and suppress reactor core thermal hydraulic instability oscillations.

1.1 Definitions

DOSE EQUIVALENT I-131 (continued)	be those listed in Federal Guidance Report (FGR) 11, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion," 1989.
EMERGENCY CORE COOLING SYSTEM (ECCS) RESPONSE TIME	The ECCS RESPONSE TIME shall be that time interval from when the monitored parameter exceeds its ECCS initiation setpoint at the channel sensor until the ECCS equipment is capable of performing its safety function (i.e., the valves travel to their required positions, pump discharge pressures reach their required values, etc.). Times shall include diesel generator starting and sequence loading delays, where applicable. The response time may be measured by means of any series of sequential, overlapping, or total steps so that the entire response time is measured.
END OF CYCLE RECIRCULATION PUMP TRIP (EOC-RPT) SYSTEM RESPONSE TIME	The EOC-RPT SYSTEM RESPONSE TIME shall be that time interval from initial movement of the associated turbine stop valve or the turbine control valve to complete suppression of the electric arc between the fully open contacts of the recirculation pump circuit breaker. The response time may be measured by means of any series of sequential, overlapping, or total steps so that the entire response time is measured, except for the breaker arc suppression time, which is not measured but is validated to conform to the manufacturer's design value.
~~FRACTION OF CORE BOILING BOUNDARY (FCBB)~~	~~The FCBB shall be the ratio of the power generated in the lower 4 feet of the active reactor core to the power required to produce bulk saturated boiling of the coolant entering the fuel channels. The core boiling boundary is the axial elevation of core average bulk saturation above the bottom of the active reactor core.~~
ISOLATION SYSTEM RESPONSE TIME	The ISOLATION SYSTEM RESPONSE TIME shall be that time interval from when the monitored parameter exceeds its isolation initiation setpoint at the channel sensor until the isolation valves travel to their required positions. The response time

(continued)

Deleted

3.2 POWER DISTRIBUTION LIMITS

3.2.4 ~~Fraction of Core Boiling Boundary (FCBB)~~

Deleted

~~LCO 3.2.4~~ ~~The FCBB shall be ≤ 1.0.~~

~~APPLICABILITY:~~ ~~THERMAL POWER and core flow in the Restricted Region as Specified in the COLR,~~
~~MODE 1 when RPS Function 2.d, APRM Flow Biased Simulated Thermal Power – High, Allowable Value is "Setup" as specified in the COLR.~~

ACTIONS

~~CONDITION~~	~~REQUIRED ACTION~~	~~COMPLETION TIME~~
~~A. FCBB not within limit for reasons other than an unexpected loss of feedwater heating or unexpected reduction in core flow.~~	~~A.1 Restore FCBB to within limit.~~	~~2 hours~~
~~B. Required Action and associated Completion Time of Condition A not met.~~ ~~OR~~	~~B.1 Initiate action to exit the Restricted Region.~~ ~~AND~~ ~~B.2 Initiate action to return APRM Flow Biased Simulated Thermal Power – High Allowable Value to "non-Setup" value.~~	~~Immediately~~ ~~Immediately following exit of Restricted Region~~

~~(continued)~~

Pages 3.2-4, 3.2-5, and 3.2-6 have been deleted.

~~ACTIONS~~

~~CONDITION~~	~~REQUIRED ACTION~~	~~COMPLETION TIME~~
~~B. (continued)~~ ~~------NOTE------~~ ~~Required Action B.1 and Required Action B.2 shall be completed if this Condition is entered due to an unexpected loss of feedwater heating or unexpected reduction in core flow.~~ ~~------------------~~ ~~FCBB not within limit due to an unexpected loss of feedwater heating or unexpected reduction in core flow.~~		

Pages 3.2-4, 3.2-5, and 3.2-6 have been deleted.

~~SURVEILLANCE REQUIREMENTS~~

~~SURVEILLANCE~~		~~FREQUENCY~~
~~SR 3.2.4.1~~	~~NOTE~~ ~~Not required to be performed until 15 minutes after entry into the Restricted Region if entry was the result of an unexpected transient.~~ ~~Verify FCBB ≤ 1.0.~~	~~24 hours~~ ~~AND~~ ~~Once within 15 minutes following unexpected transient~~

Pages 3.2-4, 3.2-5, and 3.2-6 have been deleted.

3.3 INSTRUMENTATION

3.3.1.1 Reactor Protection System (RPS) Instrumentation

LCO 3.3.1.1 The RPS instrumentation for each Function in Table 3.3.1.1-1 shall be OPERABLE.

--------------------NOTE--------------------
Not applicable for Functions 2.a, 2.b, 2.c, 2.d, or 2.f.

APPLICABILITY: According to Table 3.3.1.1-1.

ACTIONS

------------------------------------NOTE------------------------------------
Separate Condition entry is allowed for each channel.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more required channels inoperable.	A.1 Place channel in trip. __OR__ A.2 Place associated trip system in trip.	12 hours 12 hours
B. One or more Functions with one or more required channels inoperable in both trip systems.	B.1 Place channel in one trip system in trip. __OR__ B.2 Place one trip system in trip.	6 hours 6 hours
C. One or more Functions with RPS trip capability not maintained.	C.1 Restore RPS trip capability.	1 hour

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
D. Required Action and associated Completion Time of Condition A, B, or C not met.	D.1	Enter the Condition referenced in Table 3.3.1.1-1 for the channel.	Immediately
E. As required by Required Action D.1 and referenced in Table 3.3.1.1-1.	E.1	Reduce THERMAL POWER to < 40% RTP.	4 hours
F. As required by Required Action D.1 and referenced in Table 3.3.1.1-1.	F.1	Reduce THERMAL POWER to < 25% RTP.	4 hours
G. As required by Required Action D.1 and referenced in Table 3.3.1.1-1.	G.1	Be in MODE 2.	6 hours
H. As required by Required Action D.1 and referenced in Table 3.3.1.1-1.	H.1	Be in MODE 3.	12 hours
I. As required by Required Action D.1 and referenced in Table 3.3.1.1-1.	I.1	Initiate action to fully insert all insertable control rods in core cells containing one or more fuel assemblies.	Immediately

INSERT B - New Conditions J and K with Required Actions

INSERT B – New Conditions J and K with Required Actions

J. As required by Required Action D.1 and referenced in Table 3.3.1.1-1.	J.1 Initiate alternate method to detect and suppress thermal hydraulic instability oscillations. AND J.2 --------- NOTE -------- LCO 3.0.4.b is not applicable. ---------------------- Restore required channels to OPERABLE.	12 hours 120 days
K. Required Action and associated Completion Time of Condition J not met.	K.1 Reduce THERMAL POWER to < 24% RTP.	4 hours

SURVEILLANCE REQUIREMENTS (continued)

	SURVEILLANCE	FREQUENCY
SR 3.3.1.1.10	-------------------NOTES------------------ 1. Neutron detectors are excluded. 2. For Function 2.a, not required to be performed when entering MODE 2 from MODE 1 until 12 hours after entering MODE 2. 3. For Function 2.d, APRM recirculation flow transmitters are excluded. ~~4. For Function 2.d, the digital components of the flow control trip reference cards are excluded.~~ -- Perform CHANNEL CALIBRATION.	~~184 days~~ 24 months

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.3.1.1.15	------------------NOTES------------------ 1. Neutron detectors are excluded. 2. For Functions 3, 4, and 5 in Table 3.3.1.1-1, the channel sensors may be excluded. 3. For Function 6, "n" equals 4 channels for the purpose of determining the STAGGERED TEST BASIS Frequency. --- Verify the RPS RESPONSE TIME is within limits.	18 months on a STAGGERED TEST BASIS
SR 3.3.1.1.16	~~Verify the simulated thermal power time constant~~. Deleted	~~18 months~~
SR 3.3.1.1.17	Perform APRM recirculation flow transmitter calibration.	18 months
SR 3.3.1.1.18	~~Adjust the flow control trip reference card to conform to reactor flow~~. Deleted	~~Once within 7 days after reaching equilibrium conditions following refueling outage~~

INSERT C - New SRs 3.3.1.1.19, 3.3.1.1.20, 3.3.1.1.21, 3.3.1.1.22, and 3.3.1.1.23

INSERT C – New SRs 3.3.1.1.19, 3.33.1.1.20, 3.3.1.1.21, 3.3.1.1.22, and 3.3.1.1.23

SR 3.3.1.1.19	Perform CHANNEL CHECK.	24 hours
SR 3.3.1.1.20	---------------------- NOTE ---------------------- 1. For Function 2.a, not required to be performed when entering MODE 2 from MODE 1 until 12 hours after entering MODE 2. 2. For Functions 2.a, 2.b, and 2.c, the APRM/OPRM channels and the 2-Out-Of-4 Voter channels are included in the CHANNEL FUNCTIONAL TEST. 3. For Functions 2.d and 2.f, the APRM/OPRM channels and the 2-Out-Of-4 Voter channels plus the flow input function, excluding the flow transmitters, are included in the CHANNEL FUNCTIONAL TEST. -- Perform CHANNEL FUNCTIONAL TEST.	184 days
SR 3.3.1.1.21	Perform LOGIC SYSTEM FUNCTIONAL TEST.	24 months
SR 3.3.1.1.22	---------------------- NOTE ---------------------- For Function 2.e, "n" equals 8 channels for the purpose of determining the STAGGERED TEST BASIS Frequency. Testing APRM and OPRM outputs shall alternate. -- Verify the RPS RESPONSE TIME is within limits.	24 months on a STAGGERED TEST BASIS
SR 3.3.1.1.23	Verify OPRM is not bypassed when APRM Simulated Thermal Power is greater than or equal to 29% RTP and recirculation drive flow is less than 60% of rated recirculation drive flow.	24 months

Table 3.3.1.1-1 (page 1 of 3)
Reactor Protection System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS PER TRIP SYSTEM	CONDITIONS REFERENCED FROM REQUIRED ACTION D.1	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
1. Intermediate Range Monitors					
a. Neutron Flux—High	2	3	H	SR 3.3.1.1.1 SR 3.3.1.1.3 SR 3.3.1.1.12 SR 3.3.1.1.13	≤ 122/125 divisions of full scale
	5(a)	3	I	SR 3.3.1.1.1 SR 3.3.1.1.4 SR 3.3.1.1.12 SR 3.3.1.1.13	≤ 122/125 divisions of full scale
b. Inop	2	3	H	SR 3.3.1.1.3 SR 3.3.1.1.13	NA
	5(a)	3	I	SR 3.3.1.1.4 SR 3.3.1.1.13	NA
2. Average Power Range Monitors					
a. Neutron Flux—High, Setdown	2	3 (c)	H	~~SR 3.3.1.1.1~~ ~~SR 3.3.1.1.3~~ SR 3.3.1.1.7 SR 3.3.1.1.10 ~~SR 3.3.1.1.13~~ (d), (e) SR 3.3.1.1.19 SR 3.3.1.1.20	≤ 20% RTP
b. Fixed Neutron Flux—High	1	3 (c)	G	~~SR 3.3.1.1.1~~ SR 3.3.1.1.2 SR 3.3.1.1.7 ~~SR 3.3.1.1.8~~ SR 3.3.1.1.10 ~~SR 3.3.1.1.13~~ ~~SR 3.3.1.1.15~~ (d), (e) SR 3.3.1.1.19 SR 3.3.1.1.20	≤ 120% RTP
c. Inop	1,2	3 (c)	H	~~SR 3.3.1.1.7~~ ~~SR 3.3.1.1.8~~ ~~SR 3.3.1.1.13~~ SR 3.3.1.1.20	NA
d. Flow Biased Simulated Thermal Power - High	1	3 (c)	G	~~SR 3.3.1.1.1~~ SR 3.3.1.1.2 SR 3.3.1.1.7 ~~SR 3.3.1.1.8~~ SR 3.3.1.1.10 ~~SR 3.3.1.1.13~~ ~~SR 3.3.1.1.15~~ ~~SR 3.3.1.1.16~~ SR 3.3.1.1.17 ~~SR 3.3.1.1.18~~ (d), (e) SR 3.3.1.1.19 SR 3.3.1.1.20	~~(b)~~
INSERT D - New APRM Functions 2.e and 2.f					

(continued)

(a) With any control rod withdrawn from a core cell containing one or more fuel assemblies.

(b) ~~Allowable Values specified in the COLR. Allowable Value modification required by the COLR due to reductions in feedwater temperature may be delayed for up to 12 hours.~~

Two-Loop Operation: 0.65W + 62.9% RTP and ≤ 113% RTP
Single-Loop Operation: 0.65W + 42.3% RTP

INSERT E - New Table Notes (c), (d), (e), and (f)

INSERT D – New APRM Functions 2.e and 2.f

e.	2-Out-Of-4 Voter	1, 2	2	H	SR 3.3.1.1.19 SR 3.3.1.1.20 SR 3.3.1.1.21 SR 3.3.1.1.22	NA
f.	OPRM Upscale	$\geq$ 24% RTP	3[c]	J	SR 3.3.1.1.7 SR 3.3.1.1.10 [d], [e] SR 3.3.1.1.19 SR 3.3.1.1.20 SR 3.3.1.1.23	(f)

INSERT E – New Table Notes (c), (d), (e), and (f)

(c) Each channel provides inputs to both trip systems.

(d) If the as-found channel setpoint is outside its predefined as-found tolerance, then the channel shall be evaluated to verify that it is functioning as required before returning the channel to service.

(e) The instrument channel setpoint shall be reset to a value that is within the as-left tolerance around the Nominal Trip Setpoint (NTSP) at the completion of the surveillance; otherwise, the channel shall be declared inoperable. Setpoints more conservative that the NTSP are acceptable provided that the as-found and as-left tolerances apply to the actual setpoint implemented in the Surveillance procedures to confirm channel performance. The NTSP and the methodologies used to determine the as-found and as-left tolerances are specified in the Technical Requirements Manual.

(f) The Allowable Value for the OPRM Upscale Period-Based Detection algorithm is specified in the COLR.

Deleted

Deleted

3.3 INSTRUMENTATION

3.3.1.3 ~~Period Based Detection System (PBDS)~~

~~LCO 3.3.1.3~~ ~~One channel of PBDS instrumentation shall be OPERABLE~~.

AND

~~Each OPERABLE channel of PBDS instrumentation shall not indicate Hi-Hi DR alarm~~.

~~APPLICABILITY~~: ~~THERMAL POWER and core flow in the Restricted Region specified in the COLR,~~
~~THERMAL POWER and core flow in the Monitored Region specified in the COLR~~.

~~ACTIONS~~

~~CONDITION~~	~~REQUIRED ACTION~~		~~COMPLETION TIME~~
~~A. Any OPERABLE PBDS channel indicating Hi-Hi DR Alarm~~	~~A.1~~	~~Place the reactor mode switch in the shutdown position~~.	~~Immediately~~
~~B. Required PBDS channel inoperable while in the Restricted Region~~.	~~B.1~~	~~--------NOTE--------~~ ~~Only applicable if RPS Function 2.d, APRM Flow Biased Simulated Thermal Power - High, Allowable Value is "Setup"~~. --------------------- ~~Initiate action to exit the Restricted Region~~.	~~Immediately~~
	~~OR~~		

~~(continued)~~

Pages 3.3-13a and 3.3-13b have been deleted.

~~ACTIONS~~

~~CONDITION~~	~~REQUIRED ACTION~~	~~COMPLETION TIME~~
~~B. (continued)~~	~~B.2 Place the reactor mode switch in the shutdown position.~~	~~Immediately~~
~~C. Required PBDS channel inoperable while in the Monitored Region.~~	~~C.1 Initiate action to exit the Monitored Region.~~	~~15 minutes~~

~~SURVEILLANCE REQUIREMENTS~~

~~SURVEILLANCE~~		~~FREQUENCY~~
~~SR 3.3.1.3.1~~	~~Verify each OPERABLE channel of PBDS instrumentation not in Hi-Hi DR Alarm.~~	~~12 hours~~
~~SR 3.3.1.3.2~~	~~Perform CHANNEL CHECK.~~	~~12 hours~~
~~SR 3.3.1.3.3~~	~~Perform CHANNEL FUNCTIONAL TEST.~~	~~24 months~~

Pages 3.3-13a and 3.3-13b have been deleted.

3.10 SPECIAL OPERATIONS

3.10.8 Shutdown Margin (SDM) Test—Refueling

LCO 3.10.8 The reactor mode switch position specified in Table 1.1-1 for MODE 5 may be changed to include the startup/hot standby position, and operation considered not to be in MODE 2, to allow SDM testing, provided the following requirements are met:

a. LCO 3.3.1.1, "Reactor Protection System (RPS) Instrumentation," MODE 2 requirements for Function 2.a, ~~and~~ 2.c, and 2.e of Table 3.3.1.1-1;

b. 1. LCO 3.3.2.1, "Control Rod Block Instrumentation," MODE 2 requirements for Function 1.b of Table 3.3.2.1-1,

<u>OR</u>

2. Conformance to the approved control rod sequence for the SDM test is verified by a second licensed operator or other qualified member of the technical staff;

c. Each withdrawn control rod shall be coupled to the associated CRD;

d. All control rod withdrawals during out of sequence control rod moves shall be made in single notch withdrawal mode;

e. No other CORE ALTERATIONS are in progress; and

f. CRD charging water header $\geq$ 1520 psig.

APPLICABILITY: MODE 5 with the reactor mode switch in startup/hot standby position.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
-----------NOTE---------- Separate Condition entry is allowed for each control rod. ------------------------- A. One control rod not coupled to its associated CRD.	-------------NOTE------------ Inoperable control rods may be bypassed in RACS in accordance with SR 3.3.2.1.9, if required, to allow insertion of inoperable control rod and continued operation. ----------------------------- A.1 Fully insert inoperable control rod. **AND** A.2 Disarm the associated CRD.	 3 hours 4 hours
B. One or more of the above requirements not met for reasons other than Condition A.	B.1 Place the reactor mode switch in the shutdown or refuel position.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.10.8.1	Perform the MODE 2 applicable SRs for LCO 3.3.1.1, Functions 2.a, ~~and~~ 2.c, and 2.e of Table 3.3.1.1-1.	According to the applicable SRs

(continued)

5.6 Reporting Requirements

5.6.2 Annual Radiological Environmental Operating Report (continued)

results are not available for inclusion with the report, the report shall be submitted noting and explaining the reasons for the missing results. The missing data shall be submitted in a supplementary report as soon as possible.

5.6.3 Radioactive Effluent Release Report

The Radioactive Effluent Release Report covering the operation of the unit during the previous calendar year shall be submitted by May 1 of each year. The report shall include a summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the unit. The material provided shall be consistent with the objectives outlined in the ODCM and process control program and in conformance with 10 CFR 50.36a and 10 CFR 50, Appendix I, Section IV.B.1.

5.6.4 Deleted

5.6.5 Core Operating Limits Report (COLR)

a. Core operating limits shall be established prior to each reload cycle, or prior to any remaining portion of a reload cycle, and shall be documented in the COLR for the following:

1) LCO 3.2.1, Average Planar Linear Heat Generation Rate (APLHGR),

2) LCO 3.2.2, Minimum Critical Power Ratio (MCPR),

3) LCO 3.2.3, Linear Heat Generation Rate (LHGR),

Deleted

4) ~~LCO 3.2.4, Fraction of Core Boiling Boundary (FCBB)~~,

5) LCO 3.3.1.1, RPS Instrumentation, Table 3.3.1.1-1 ~~function 2.d, and~~

6) ~~LCO 3.3.1.3, Period Based Detection System (PBDS).~~ Deleted

(continued)

APRM Function 2.f

5.6 Reporting Requirements

5.6.5 Core Operating Limits Report (COLR) (continued)

21. NEDE-33383-P, "GEXL97 Correlation Applicable to ATRIUM-10 Fuel," Global Nuclear Fuel.

22. EMF-CC-074(P)(A), Volume 4, "BWR Stability Analysis Assessment of STAIF with Input from MICROBURN-B2", Siemens Power Corporation, Richland, WA.

23. EMF-2292(P)(A), "ATRIUM-10 Appendix K Spray Heat Transfer Coefficients", Siemens Power Corporation, Richland, WA.

24. NEDE-24011 -P-A, General Electric Standard Application for Reactor Fuel (GESTAR-II).

25. NEDO-31960-A, "BWR Owners' Group Long-Term Stability Solutions Licensing Methodology"

26. NEDO-32465-A, "Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology and Reload Applications"

c. The core operating limits shall be determined such that all applicable limits (e.g., fuel thermal mechanical limits, core thermal hydraulic limits, Emergency Core Cooling Systems (ECCS) limits, nuclear limits such as SDM, transient analysis limits, and accident analysis limits) of the safety analysis are met.

d. The COLR, including any midcycle revisions or supplements, shall be provided upon issuance for each reload cycle to the NRC.

ATTACHMENT 4

GNRO-2009-00054

DRAFT MARKED-UP TECHNICAL SPECIFICATION BASES PAGES (FOR INFORMATION ONLY)

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B 3.2 POWER DISTRIBUTION LIMITS

B 3.2.4 ~~Fraction of Core Boiling Boundar~~y ~~(FCBB)~~

~~BASES~~

~~BACKGROUN~~D

~~General Design Criterio~~n ~~12 requires protectio~~n ~~of fuel thermal safety limits from condition~~s ~~caused by neutronic/thermal-hydrau~~lic ~~instability~~. ~~Neutronic/thermal~~-~~hydrauli~~c ~~instabilitie~~s ~~result in power oscillation~~s ~~which could result in exceedin~~g ~~the MCPR Safety Limit (SL).~~ ~~The MCPR SL ensures that at least 99.9% of the fuel rods avoid boiling transitio~~n ~~during normal operatio~~n ~~and during an anticipate~~d ~~operationa~~l ~~occurrenc~~e ~~(AOO) (refer to the Bases for SL 2.1.1.2)~~.

~~The FCBB is the ratio of the power generate~~d ~~in the lower 4 feet of the active reactor core to the power required to produce bulk saturate~~d ~~boiling of the coolant entering the fuel channels~~. ~~The value of 4 feet above the bottom of the active fuel is set as the boiling boundar~~y ~~limit based on analysis describe~~d ~~in Section 9 of Referenc~~e ~~1.~~ ~~The boiling boundary limit is establishe~~d ~~to ensure that the core will remain stable during normal reactor operation~~s ~~in the Restricte~~d ~~Region of the power and flow map defined in the COLR which may otherwis~~e ~~be susceptibl~~e ~~to neutronic/thermal-hydrau~~lic ~~instabilitie~~s ~~and therefor~~e ~~the MCPR SL remains protecte~~d.

~~Planned operatio~~n ~~in the Restricte~~d ~~Region is accommodate~~d ~~by manuall~~y ~~establishin~~g ~~the "Setup" values for the APRM Flow-Biase~~d ~~Simulated Thermal Power - High Scram and APRM Flow-Biase~~d ~~Neutron Flux~~ - ~~Upscale Control Rod Block functions~~. ~~The "Setup" Allowabl~~e ~~Values of the APRM Flow~~ - ~~Biased Thermal Power~~ - ~~High Function (refer to LCO 3.3.1.1~~, ~~Table 3.3.1.1-1~~, ~~Function 2.d) are consisten~~t ~~with assumed operatio~~n ~~in the Restricte~~d ~~Region with FCBB ≤ 1.0.~~ ~~Operation with the "Setup" values enables entry into the Restricte~~d ~~Region without a control rod block that would otherwis~~e ~~occur~~. ~~Plant operation with the "Setup" values is limited as much as practica~~l ~~due to the effects on plant operatio~~n ~~required to meet the FCBB limit~~.

Pages B 3.2-12 through B 3.2-18 have been deleted.

~~(continue~~d)

~~BASES (continued)~~

~~APPLICABLE SAFETY ANALYSES~~

~~The analytical methods and assumptions used in establishing the boiling boundary limit are presented in Section 9 of Reference 1. Operation with the FCBB ≤ 1.0 (i.e., a bulk saturated boiling boundary ≥ 4 feet) is expected to ensure that operation within the Restricted Region will not result in neutronic/thermal-hydraulic instability due to either steady-state operation or as the result of an AOO which initiates and terminates entirely within the Restricted Region. Analysis also confirms that AOOs initiated from outside the Restricted Region (i.e., without an initial restriction on FCBB) which terminate in the Restricted Region are not expected to result in instability. The types of transients specifically evaluated are loss of flow and coolant temperature decrease which are limiting for the onset of instability (Ref. 1).~~

~~Although the onset of instability does not necessarily occur if the FCBB is greater than 1.0 in the Restricted Region, bulk saturated boiling at the 4 foot boiling boundary limit has been adopted to preclude neutronic/thermal-hydraulic instability during operation in the Restricted Region. The effectiveness of this limit is based on the demonstration (Ref. 1) that with the limit met large margin to the onset of neutronic/thermal-hydraulic instability exists and all major state parameters that affect stability have relatively small impacts on stability performance.~~

~~The FCBB satisfies Criterion 2 of the NRC Policy Statement.~~

~~LCO~~

~~Requiring FCBB ≤ 1.0 ensures the bulk coolant boiling boundary is ≥ 4 feet from the bottom of the active core. Analysis (Ref. 1) has shown that for anticipated operating conditions of core power, core flow, axial and radial power shapes, and inlet enthalpy, a boiling boundary of 4 feet ensures variations in these key parameters do not have a significant impact on stability performance.~~

~~Neutronic/thermal-hydraulic instabilities result in power oscillations which could result in exceeding the MCPR Safety Limit (SL). The MCPR SL ensures that at least 99.9% of the fuel rods avoid boiling transition during normal operation and during an AOO (refer to the Bases for SL 2.1.1.2).~~

~~(continued)~~

Pages B 3.2-12 through B 3.2-18 have been deleted.

~~BASES (continued)~~

~~APPLICABILITY~~

~~The FCBB limit is used to prevent core conditions necessary for the onset of instability and thereby preclude neutronic/thermal-hydraulic instability while operating in the Restricted Region defined in the COLR.~~

~~The boundary of the Restricted Region in the Applicability of this LCO is analytically established in terms of thermal power and core flow. The Restricted Region is defined by the APRM Flow Biased Neutron Flux - Upscale Control Rod Block setpoints, which are a function of reactor recirculation drive flow. The Restricted Region Entry Alarm (RREA) signal is generated by the Flow Control Trip Reference (FCTR) card using the APRM Flow Biased Neutron Flux - Upscale Control Rod Block setpoints. As a result, the RREA is coincident with the Restricted Region Boundary when the setpoints are not "Setup," and provides indication of entry into the Restricted Region. However, APRM Flow Biased Neutron Flux - Upscale Control Rod Block signals provided by the FCTR card, that are not coincident with the Restricted Region boundary, do not generate a valid RREA. The Restricted Region boundary for this LCO applicability is specified in the COLR.~~

~~The FCBB limit is also used to ensure that core conditions, while operating with "Setup" values, remain consistent with analyzed transients initiated from inside and outside the Restricted Region.~~

~~When the APRM Flow Biased Neutron Flux - Upscale Control Rod Block setpoints are "Setup" the applicable setpoints used to generate the RREA are moved to the interior boundary of the Restricted Region to allow controlled operation within the Restricted Region. While the setpoints are "Setup" the Restricted Region boundary remains defined by the normal ("non-Setup") APRM Flow Biased Neutron Flux - Upscale Control Rod Block setpoints.~~

~~Parameters such as reactor power and core flow available at the reactor controls may be used to provide immediate confirmation that entry into the Restricted Region could reasonably have occurred.~~

~~(continued)~~

Pages B 3.2-12 through B 3.2-18 have been deleted.

~~BASES~~

~~APPLICABILIT~~Y ~~(continued~~)

~~Operation outside the Restricte~~d ~~Region is not susceptibl~~e ~~to neutronic/thermal-hydrau~~lic ~~instabilit~~y ~~when applicabl~~e ~~thermal power distributio~~n ~~limits such as MCPR are met.~~

~~ACTIONS~~

~~A.1~~

~~If FCBB is not within the required limit, core condition~~s ~~necessary for the onset of neutronic/thermal-hydrau~~lic ~~instabilit~~y ~~may result~~. ~~Therefore~~, ~~prompt action should be taken to restore the FCBB to within the limit such that the stability of the core can be assured~~. ~~Following uncontrolle~~d ~~entry into the Restricte~~d ~~Region (i.e., operatio~~n ~~in the restricte~~d ~~region without the APRM Flow Biased Simulated Thermal Power~~ - ~~High Function "Setup")~~, ~~prompt restoratio~~n ~~of FCBB within limit can be expected if FCBB is known to not significantl~~y ~~exceed the limit~~. ~~Therefore~~, ~~efforts to restore FCBB within limit followin~~g ~~an uncontrolle~~d ~~entry into the Restricte~~d ~~Region are appropriat~~e ~~if operation prior to entry was consisten~~t ~~with planned entry or the potentia~~l ~~for entry was recognize~~d ~~as demonstrate~~d ~~by FCBB being monitore~~d ~~and known to not significantl~~y ~~exceed the limit~~. ~~Actions to exit the Restricte~~d ~~Region are appropriat~~e ~~when FCBB can not be expected to be restored in a prompt manner~~.

~~Actions to restart an idle recirculatio~~n ~~loop, withdraw control rods or reduce recirculatio~~n ~~flow may result in approachin~~g ~~unstable reactor condition~~s ~~and are not allowe~~d ~~to be used to comply with this Required Action~~. ~~The 2 hour Completio~~n ~~Time is based on engineerin~~g ~~judgment as to a reasonabl~~e ~~time to restore the FCBB to within limit~~. ~~The 2 hour Completio~~n ~~Time is acceptabl~~e ~~based on the availabilit~~y ~~of the PBDS per Specificatio~~n ~~3.3.1.3~~, ~~"Period Based Detectio~~n ~~System" and the low probabilit~~y ~~of a neutronic/thermal-hydrau~~lic ~~instabilit~~y ~~event~~.

Pages B 3.2-12 through B 3.2-18 have been deleted.

~~(continued)~~

~~BASES~~

~~ACTIONS (continued)~~

~~B.1 and B.2~~

~~Changes in reactor core state conditions resulting from an unexpected loss of feedwater heating or reduction in core flow - any unexpected reduction in feedwater temperature, recirculation pump trip, recirculation pump down shift to slow speed, or significant flow control valve closure (small changes in flow control valve position are not considered significant) - require immediate initiation of action to exit the Restricted Region and return the APRM Flow Biased Simulated Thermal Power - High Function (refer to LCO 3.3.1.1, Table 3.3.1.1-1, Function 2.d) to the "non-Setup" value. Condition B is modified by a Note that specifies that Required Actions B.1 and B.2 must be completed if this Condition is entered due to an unexpected loss of feedwater heating or reduction in core flow. The completion of Required Actions B.1 and B.2 is required even though FCBB may be calculated and determined to be within limit. Core conditions continue to change after an unexpected loss of feedwater heating or reduction in core flow due to transient induced changes with the potential that the FCBB may change and the limit not be met. The potential for changing core conditions, with FCBB not met, is not consistent with operation in the Restricted Region or with the APRM Flow Biased Simulated Thermal Power - High Function "Setup". Therefore, actions to exit the Restricted Region and return the APRM Flow Biased Simulated Thermal Power - High Function to the "non-Setup" value are required to be completed in the event Condition B is entered due to an unexpected loss of feedwater heating or an unexpected reduction in core flow.~~

~~If operator actions to restore the FCBB to within limit are not successful within the specified Completion Time of Condition A, reactor operating conditions may be changing and may continue to change such that core conditions necessary for the onset of neutronic/thermal-hydraulic instability may be met. Therefore, in the event the Required Action and associated Completion Time of Condition A is not met, immediate action to exit the Restricted Region and return the APRM Flow Biased Simulated Thermal Power - High Function to the "non-Setup" value is required.~~

Pages B 3.2-12 through B 3.2-18 have been deleted.

~~(continued)~~

~~BASES~~

~~ACTIONS~~

~~B.1 and B.2 (continued)~~

~~Exit of the Restricted Region can be accomplished by control rod insertion and/or recirculation flow increases. Actions to restart an idle recirculation loop, withdraw control rods or reduce recirculation flow may result in approaching unstable reactor conditions and are not allowed to be used to comply with this Required Action. The time required to exit the Restricted Region will depend on existing plant conditions. Provided efforts are begun without delay and continued until the Restricted Region is exited, operation is acceptable.~~

~~SURVEILLANCE REQUIREMENTS~~

~~SR 3.2.4.1~~

~~Verifying FCBB ≤ 1.0 is required to ensure the reactor is operating within the assumptions of the safety analysis. The boiling boundary limit is established to ensure that the core will remain stable during normal reactor operations in the Restricted Region of the power and flow map defined in the COLR which may otherwise be susceptible to neuronic/thermal-hydraulic instabilities.~~

~~FCBB is required to be verified every 24 hours while operating in the Restricted Region defined in the COLR. The 24 hour Frequency is based on both engineering judgment and recognition of the slow rate of change in power distribution during normal operation.~~

~~The Second Frequency requires FCBB to be within the limit within 15 minutes following an unexpected transient. The verification of the FCBB is required as a result of the possibility that the unexpected transient results in the limit not being met. The 15 minute Frequency is based on both engineering judgment and the availability of the PBDS to provide the operator with information regarding the potential imminent onset of neutronic/thermal-hydraulic instability. The 15 minute Frequency for this SR is not to be used to delay entry into Condition B following an unexpected reduction in feedwater heating, recirculation~~

Pages B 3.2-12 through B 3.2-18 have been deleted.

~~(continued)~~

~~BASES~~

~~SURVEILLANCE REQUIREMENTS~~

~~SR 3.2.4.1 (continued)~~

~~pump trip, recirculation pump down shift to slow speed, or significant flow control valve closure (small changes in flow control valve position are not considered significant).~~

~~This Surveillance is modified by a Note which allows 15 minutes to verify FCBB following entry into the Restricted Region if the entry was the result of an unexpected transient (i.e., an unintentional or unplanned change in core thermal power or core flow). The 15 minute allowance is based on both engineering judgment and the availability of the PBDS to provide the operator with information regarding the potential imminent onset of neutronic/thermal-hydraulic instability. The 15 minute allowance of the Note is not to be used to delay entry into Condition B if the entry into the Restricted Region was the result of an unexpected reduction in feedwater heating, recirculation pump trip, recirculation pump down shift to slow speed, or significant flow control valve closure (small changes in flow control valve position are not considered significant).~~

~~REFERENCES~~

~~1. NEDO-32339-A, "Reactor Stability Long Term Solution: Enhanced Option I-A".~~

Pages B 3.2-12 through B 3.2-18 have been deleted.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY

1.a. Intermediate Range Monitor (IRM) Neutron Flux—High (continued)

unexpected reactivity excursions. In MODE 1, the APRM System, the rod withdrawal limiter (RWL), and the RPC provide protection against control rod withdrawal error events and the IRMs are not required.

1.b. Intermediate Range Monitor—Inop

This trip signal provides assurance that a minimum number of IRMs are OPERABLE. Anytime an IRM mode switch is moved to any position other than "Operate," the detector voltage drops below a preset level, or a module is not plugged in, an inoperative trip signal will be received by the RPS unless the IRM is bypassed. Since only one IRM in each trip system may be bypassed, only one IRM in each RPS trip system may be inoperable without resulting in an RPS trip signal.

This Function was not specifically credited in the accident analysis, but it is retained for the RPS as required by the NRC approved licensing basis.

Six channels of Intermediate Range Monitor—Inop with three channels in each trip system are required to be OPERABLE to ensure that no single instrument failure will preclude a scram from this Function on a valid signal.

Since this Function is not assumed in the safety analysis, there is no Allowable Value for this Function.

This Function is required to be OPERABLE when the Intermediate Range Monitor Neutron Flux—High Function is required.

2.a. Average Power Range Monitor Neutron Flux—High, Setdown

~~The APRM channels receive input signals from the local power range monitors (LPRMs) within the reactor core to provide an indication of the power distribution and local power changes. The APRM channels average these LPRM signals to provide a continuous indication of average reactor power~~

INSERT A - APRM Subsystem Description

(continued)

INSERT A – APRM Subsystem Description

Average Power Range Monitor (APRM)

The APRM subsystem provides the primary indication of neutron flux within the core and responds almost instantaneously to neutron flux increases. The APRMs receive input signals from the local power range monitors (LPRMs) within the reactor core to provide an indication of the power distribution and local power changes. The channels average these LPRM signals to provide a continuous indication of average reactor power from a few percent to greater than RTP. Each APRM also includes an Oscillation Power Range Monitor (OPRM) Upscale Function which monitors small groups of LPRM signals to detect thermal-hydraulic instabilities.

The APRM subsystem is divided into four APRM/OPRM channels and four 2-Out-Of-4 Voter channels. Each APRM/OPRM channel provides inputs to each of the four voter channels. The four voter channels are divided into two groups of two each, with each group of two providing inputs to one RPS trip system. The system is designed to allow one APRM/OPRM channel, but no voter channels, to be bypassed. A trip from any one un-bypassed APRM/OPRM channel will result in a "half-trip" in all four of the voter channels, but no trip inputs to either RPS trip system. Since APRM Functions 2.a, 2.b, 2.d, and 2.f are implemented in the same hardware, these functions are combined with APRM Inop Function 2.c. Any Function 2.a, 2.b, 2.c, or 2.d trip from any two unbypassed APRM/OPRM channels will result in a full trip in each of the four 2-Out-Of-4 Voter channels, which in turn results in two trip inputs to each RPS trip system logic channel (A1, A2, B1, and B2). Similarly, any Function 2.d or 2.f trip from any two unbypassed APRM/OPRM channels will result in a full trip from each Voter channel. Three of the four APRM/OPRM channels and all four of the voter channels are required to be OPERABLE to ensure that no single failure will preclude a scram on a valid signal. In addition, to provide adequate coverage of the entire core, consistent with the design bases for APRM Functions 2.a, 2.b, and 2.d, at least 20 LPRM inputs, with at least three LPRM inputs from each of the four axial levels at which the LPRMs are located, must be operable for each APRM/OPRM channel. For the OPRM Upscale, Function 2.f, LPRMs are assigned to "cells" of four detectors. A minimum of 30 cells, each with a minimum of two LPRMs, must be OPERABLE for the OPRM Upscale Function 2.f to be OPERABLE.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY

2.a. Average Power Range Monitor Neutron Flux—High, Setdown (continued)

~~from a few percent to greater than RTP.~~ For operation at low power (i.e., MODE 2), the Average Power Range Monitor Neutron Flux—High, Setdown Function is capable of generating a trip signal that prevents fuel damage resulting from abnormal operating transients in this power range. For most operation at low power levels, the Average Power Range Monitor Neutron Flux—High, Setdown Function will provide a secondary scram to the Intermediate Range Monitor Neutron Flux—High Function because of the relative setpoints.

With the IRMs at Range 9 or 10, it is possible that the Average Power Range Monitor Neutron Flux—High, Setdown Function will provide the primary trip signal for a corewide increase in power.

No specific safety analyses take direct credit for the Average Power Range Monitor Neutron Flux—High, Setdown Function. However, this Function indirectly ensures that, before the reactor mode switch is placed in the run position, reactor power does not exceed 25% RTP (SL 2.1.1.1) when operating at low reactor pressure and low core flow. Therefore, it indirectly prevents fuel damage during significant reactivity increases with THERMAL POWER < 25% RTP.

~~The APRM System is divided into two groups of channels with four APRM channel inputs to each trip system. The system is designed to allow one channel in each trip system to be bypassed. Any one APRM channel in a trip system can cause the associated trip system to trip. Six channels of Average Power Range Monitor Neutron Flux—High, Setdown, with three channels in each trip system are required to be OPERABLE to ensure that no single failure will preclude a scram from this Function on a valid signal. In addition, to provide adequate coverage of the entire core, at least 14 LPRM inputs are required for each APRM channel, with at least two LPRM inputs from each of the four axial levels at which the LPRMs are located.~~

The Allowable Value is based on preventing significant increases in power when THERMAL POWER is < 25% RTP.

(continued)

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY

2.a. Average Power Range Monitor Neutron Flux—High, Setdown (continued)

The Average Power Range Monitor Neutron Flux—High, Setdown Function must be OPERABLE during MODE 2 when control rods may be withdrawn since the potential for criticality exits. In MODE 1, the Average Power Range Monitor Neutron Flux—High Function provides protection against reactivity transients and the RWL and RPC protect against control rod withdrawal error events.

2.b. Average Power Range Monitor Fixed Neutron Flux—High

~~The APRM channels provide the primary indication of neutron flux within the core and respond almost instantaneously to neutron flux increases.~~ The Average Power Range Monitor Fixed Neutron Flux—High Function is capable of generating a trip signal to prevent fuel damage or excessive RCS pressure. For the overpressurization protection analysis of Reference 2, the Average Power Range Monitor Fixed Neutron Flux—High Function is assumed to terminate the main steam isolation valve (MSIV) closure event and, along with the safety/relief valves (S/RVs), limits the peak reactor pressure vessel (RPV) pressure to less than the ASME Code limits. The control rod drop accident (CRDA) analysis (Ref. 7) takes credit for the Average Power Range Monitor Fixed Neutron Flux—High Function to terminate the CRDA.

~~The APRM System is divided into two groups of channels with four APRM channels inputting to each trip system. The system is designed to allow one channel in each trip system to be bypassed. Any one APRM channel in a trip system can cause the associated trip system to trip. Six channels of Average Power Range Monitor Fixed Neutron Flux—High with three channels in each trip system arranged in a one-out-of-three logic are required to be OPERABLE to ensure that no single instrument failure will preclude a scram from this Function on a valid signal. In addition, to provide adequate coverage of the entire core, at least 14 LPRM inputs are required for each APRM channel, with at least two LPRM inputs from each of the four axial levels at which the LPRMs are located.~~

The Allowable Value is based on the Analytical Limit assumed in the CRDA analyses.

(continued)

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY

2.b. Average Power Range Monitor Fixed Neutron Flux—High (continued)

The Average Power Range Monitor Fixed Neutron Flux—High Function is required to be OPERABLE in MODE 1 where the potential consequences of the analyzed transients could result in the SLs (e.g., MCPR and RCS pressure) being exceeded. Although the Average Power Range Monitor Fixed Neutron Flux—High Function is assumed in the CRDA analysis that is applicable in MODE 2, the Average Power Range Monitor Neutron Flux—High, Setdown Function conservatively bounds the assumed trip and, together with the assumed IRM trips, provides adequate protection. Therefore, the Average Power Monitor Fixed Neutron Flux—High Function is not required in MODE 2.

INSERT B

2.c. Average Power Range Monitor—Inop

~~This signal provides assurance that a minimum number of APRMs are OPERABLE. Anytime an APRM mode switch is moved to any position other than Operate, an APRM module is unplugged, the electronic operating voltage is low, or the APRM has too few LPRM inputs (< 14), an inoperative trip signal will be received by the RPS, unless the APRM is bypassed. Since only one APRM in each trip system may be bypassed, only one APRM in each trip system may be inoperable without resulting in an RPS trip signal.~~ This Function was not specifically credited in the accident analysis, but it is retained for the RPS as required by the NRC approved licensing basis.

~~Six channels of Average Power Range Monitor—Inop with three channels in each trip system are required to be OPERABLE to ensure that no single failure will preclude a scram from this Function on a valid signal.~~

There is no Allowable Value for this Function.

This Function is required to be OPERABLE in the MODES where the APRM Functions are required.

(continued)

INSERT B

Three of the four APRM/OPRM channels are required to be OPERABLE for each of the APRM Functions. This Function (Inop) provides assurance that the minimum number of channels is OPERABLE.

For any APRM/OPRM channel, any time its mode switch is in any position other than "Operate," a module is unplugged, or the automatic self-test system detects a critical fault with the APRM/OPRM channel, an Inop trip is sent to all four voter channels. Inop trips from two or more unbypassed APRM/OPRM channels result in a trip output from all four voter channels to their associated trip system.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

2.d. Average Power Range Monitor Flow Biased Simulated Thermal Power - High

INSERT C

The Average Power Range Monitor Flow Biased Simulated Thermal Power - High Function monitors neutron flux to approximate the THERMAL POWER being transferred to the reactor coolant. The APRM neutron flux is electronically filtered with a time constant representative of the fuel heat transfer dynamics to generate a signal proportional to the THERMAL POWER in the reactor. The trip level is varied as a function of recirculation drive flow ~~and~~ is clamped at an upper limit that is always lower than the Average Power Range Monitor Fixed Neutron Flux - High Function Allowable Value. ~~The Average Power Range Monitor Flow Biased Simulated Thermal Power - High Function provides a general definition of the licensed core power/core flow operating domain.~~

INSERT D

~~The Average Power Range Monitor Flow Biased Simulated Thermal Power - High Function is not associated with a limiting safety system setting. Operating limits established for the licensed operating domain are used to develop the Average Power Range Monitor Flow Biased Simulated Thermal Power - High Function Allowable Values to provide preemptive reactor scram and prevent gross violation of the licensed operating domain. Operation outside the license operating domain may result in anticipated operational occurrences and postulated accidents being initiated from conditions beyond those assumed in the safety analysis. Operation within the licensed operating domain also ensures compliance with General Design Criterion 12.~~

~~General Design Criterion 12 requires protection of fuel thermal safety limits from conditions caused by neutronic/thermal-hydraulic instability. Neutronic/thermal-hydraulic instabilities result in power oscillations which could result in exceeding the MCPR SL.~~

~~The area of the core power and flow operating domain susceptible to neutronic/thermal-hydraulic instability can be affected by reactor parameters such as reactor inlet feedwater temperature (Ref. 12). Two complete and~~

(continued)

INSERT C

(i.e., at lower core flows, the setpoint is reduced proportional to the reduction in power experienced as core flow is reduced with a fixed control rod pattern) but

INSERT D

The APRM Flow Biased Simulated Thermal Power – High function provides protection against transients where THERMAL POWER increases slowly (such as the loss of feedwater heating event) and protects the fuel cladding integrity by ensuring that the MCPR SL is not exceeded. During these events, the THERMAL POWER increase does not significantly lag the neutron flux response and, because of a lower trip setpoint, will initiate a scram before the high neutron flux scram. For rapid neutron flux increase events, the THERMAL POWER lags the neutron flux and the APRM Neutron Flux - High function will provide a scram signal before the APRM Flow Biased Simulated Thermal Power - High function setpoint is exceeded.

BASES

~~APPLICABL~~E
~~SAFETY ANALYSES~~,
~~LCO, and~~
~~APPLICABILIT~~Y

~~2.d. Average Power Range Monitor Flow Biased Simulate~~d
~~Thermal Power - High~~ ~~(continued~~)

~~independen~~t ~~sets of Average Power Range Monito~~r ~~Flow-Biase~~d ~~Simulate~~d ~~Thermal Power - High Function Allowabl~~e ~~Values may be specifie~~d ~~in the COLR.~~ ~~Set 1 (Normal Trip Reference Set) provides protectio~~n ~~against neutronic/thermal-hydrau~~lic ~~instabilit~~y ~~during expected reactor operatin~~g ~~conditions~~. ~~Set 2 (Alternate Trip Referenc~~e ~~Set) provide~~s ~~protectio~~n ~~against neutronic/thermal-hydrau~~lic ~~instabilit~~y ~~during reactor operatin~~g ~~condition~~s ~~requirin~~g ~~added stabilit~~y ~~protectio~~n ~~and is conservativ~~e ~~with respect to Set 1.~~ ~~Feedwater temperatur~~e ~~values requirin~~g ~~transitio~~n ~~betwee~~n ~~flow control trip reference card sets are specifie~~d ~~in the COLR, when necessary~~. ~~In the event of a feedwate~~r ~~temperatur~~e ~~reduction~~, ~~Allowabl~~e ~~Value modificatio~~n ~~(from the Normal Trip Reference Set to the Alternat~~e ~~Trip Reference~~ ~~Set) as specifie~~d ~~in the COLR is required to preserve the margin associate~~d ~~with the potentia~~l ~~for the onset of neutronic/thermal-hydrau~~lic ~~instabilit~~y ~~which existed prior to the feedwate~~r ~~temperatur~~e ~~reduction~~. ~~The Allowabl~~e ~~Value modificatio~~n ~~required by the COLR may be delayed up to 12 hours to allow time to adjust and check the adjustmen~~t ~~of each flow control trip referenc~~e ~~card~~. ~~At the end of the 12 hour period, the Allowabl~~e ~~Value modificatio~~ns ~~must be complete for all of the required channel~~s ~~or the applicabl~~e ~~Condition(s~~) ~~must be entered and the Required Actions taken~~. ~~The 12 hour time period is acceptabl~~e ~~based on the low probabilit~~y ~~of a neutronic/thermal-hydrau~~lic ~~instabilit~~y ~~event and the continue~~d ~~protectio~~n ~~provided by the flow control trip reference card~~. ~~In addition, when the feedwate~~r ~~temperatur~~e ~~reductio~~n ~~results in operatio~~n ~~in either the Restricte~~d ~~Region or the Monitore~~d ~~Region, the requirement~~s ~~for the Period Based Detectio~~n ~~System (LCO 3.3.1.3~~, ~~Period Based Detectio~~n ~~System (PBDS)) provide added protectio~~n ~~against neutronic/thermal-hydrau~~lic ~~instabilit~~y ~~during the 12 hour time period~~.

~~The area of the core power and flow operatin~~g ~~domai~~n ~~susceptibl~~e ~~to neutronic/thermal-hydrau~~lic ~~instabilit~~y ~~is affected by the value of Fraction of Core Boiling Boundar~~y ~~(LCO 3.2.4, FCBB) (Ref. 12).~~ ~~"Setup" and normal ("non-Setup") Average Power Range Monitor Flow Biased Simulate~~d ~~Thermal Power~~ - ~~High Function Allowabl~~e ~~Values are specifie~~d ~~in the COLR~~.

(continued)

~~APPLICABLE SAFETY ANALYSES~~, ~~LCO, and APPLICABILITY~~

~~2.d. Average Power Range Monitor Flow Biased Simulated Thermal Power - High~~ ~~(continued~~)

~~The normal ("non-Setup"~~) ~~value provides protection against neutronic/thermal-hydraulic instability by preventing operation in the susceptible area of the operating domain when operating outside the Restricted Region specified in the COLR with the FCBB limit not required to be met.~~ ~~When the "Setup" value is selected, meeting the FCBB limit provides protection against instability~~.

~~"Setup" and "non-Setup" values are selected by operator manipulation of a Setup button on each flow control trip reference card.~~ ~~Selection of the "Setup" value is intended only for planned operation in the Restricted Region as specified in the COLR~~. ~~Operation in the Restricted Region with the Average Power Range Monitor Flow Biased Simulated Thermal Power - High Function "Setup" requires the FCBB limit to be met and is not generally consistent with normal power operation~~.

~~The Average Power Range Monitor Flow Biased Simulated Thermal Power - High Function uses a trip level generated by the flow control trip reference card based on recirculation loop drive flow.~~ ~~Proper trip level generation as a function of drive flow requires drive flow alignment~~. ~~This is accomplished by selection of appropriate dip switch positions on the flow control trip reference cards (Refer to SR 3.3.1.1.18)~~. ~~Changes in the core flow to drive flow functional relationship may vary over the core flow operating range.~~ ~~These changes can result from both gradual changes in recirculation system and core components over the reactor life time as well as specific maintenance performed on these components (e.g., jet pump cleaning)~~.

~~The APRM System is divided into two groups of channels with four APRM inputs to each trip system.~~ ~~The system is designed to allow one channel in each trip system to be bypassed~~. ~~Any one APRM channel in a trip system can cause the associated trip system to trip.~~ ~~Six channels of Average Power Range Monitor Flow Biased Simulated Thermal Power - High with three channels in each trip system arranged in a~~

(continued)

~~APPLICABLE SAFETY ANALYSES~~, ~~LCO~~, ~~and~~ ~~APPLICABILITY~~

~~2.d. Average Power Range Monitor Flow Biased Simulated Thermal Power - High~~ ~~(continued)~~

~~one out of three logic are required to be OPERABLE to ensure that no single instrument failure will preclude a scram from this Function on a valid signal~~. ~~In addition~~, ~~to provide adequate coverage of the entire core, at least 14 LPRM inputs are required for each APRM channel, with at least two LPRM inputs from each of the four axial levels at which the LPRMs are located~~. Each APRM channel ~~receives~~ uses one total drive flow signal representative of total core flow. INSERT E ~~The recirculation loop drive flow signals are generated by eight flow units~~. ~~One flow unit from each recirculation loop is provided to each APRM channel~~. ~~Total drive flow is determined by each APRM by summing up the flow signals provided to the APRM from the two recirculation loops~~.

INSERT F

The THERMAL POWER time constant of < 7 seconds is based on the fuel heat transfer dynamics and provides a signal proportional to the THERMAL POWER.

The Average Power Range Monitor Flow Biased Simulated Thermal Power - High Function is required to be OPERABLE in MODE 1 when there is the possibility of generating excessive THERMAL POWER and potentially exceeding ~~neutronic/thermal-hydraulic instability~~. ~~The potential to exceed~~ the SL applicable to high pressure and core flow conditions (MCPR SL)~~, which provides fuel cladding integrity protection, exists if neutronic/thermal-hydraulic instability can occur~~. During MODES 2 and 5, OTHER IRM and APRM Functions provide protection for fuel cladding integrity.

INSERT G - New APRM Functions 2.e and 2.f

(continued)

INSERT E

The total drive flow signal is generated by the flow processing logic, part of the APRM/OPRM channel, but summing up the flow calculated from two flow transmitter signal inputs, one from each of the two recirculation loop flows. The flow processing logic OPERABILITY is part of the APRM/OPRM channel OPERABILITY requirements for this Function.

INSERT F

The clamped Allowable Value is based on analyses that take credit for the Average Power Range Monitor Simulated Thermal Power-High Function for the mitigation of the loss of feedwater heating event.

INSERT G – New APRM Functions 2.e and 2.f

2.e 2-Out-Of-4 Voter

The 2-Out-Of-4 Voter Function provides the interface between the APRM Functions, including the OPRM Upscale Function, and the final RPS trip system logic. As such, it is required to be OPERABLE in the MODES where the APRM Functions are required and is necessary to support the safety analysis applicable to each of those Functions. Therefore, the 2-Out-Of-4 Voter Function must be OPERABLE in MODES 1 and 2.

All four voter channels are required to be OPERABLE. Each voter channel includes self-diagnostic functions. If any voter channel detects a critical fault in its own processing, a trip is issued from that voter channel to the associated trip system.

The 2-Out-Of-4 Voter Function votes APRM Functions 2.a, 2.b, and 2.d independently of Function 2.f. The voter also includes separate outputs to RPS for the two independently voted sets of functions, each of which is redundant (four total outputs). The voter Function 2.e must be declared inoperable if any of its functionality is inoperable. However, due to the independent voting of APRM trips, and the redundancy of outputs, there may be conditions where the voter Function 2.e is inoperable, but trip capability for one or more of the other APRM Functions through that voter is still maintained. This may be considered when determining the condition of other APRM Functions resulting from partial inoperability of the Voter Function 2.e redundant (four total outputs). The voter Function 2.e must be declared inoperable if any of its functionality is inoperable. However, due to the independent voting of APRM trips, and the redundancy of outputs, there may be conditions where the voter Function 2.e is inoperable, but trip capability for one or more of the other APRM Functions through that voter is still maintained. This may be considered when determining the condition of other APRM Functions resulting from partial inoperability of the Voter Function 2.e.

There is no Allowable Value for this Function.

2.f. Oscillation Power Range Monitor (OPRM) Upscale

The OPRM Upscale Function provides compliance with GDC 10 and GDC 12, thereby providing protection from exceeding the fuel MCPR safety limit (SL) due to anticipated thermal-hydraulic power oscillations.

References 13 and 14 describe three algorithms for detecting thermal-hydraulic instability related neutron flux oscillations: (1) the Period-Based Detection algorithm; (2) the Amplitude-Based algorithm; and (3) the Growth-Rate algorithm. All three are implemented in the OPRM Upscale Function, but the safety analysis takes credit only for the Period-Based Detection algorithm. The remaining algorithms provide defense-in-depth and additional protection against unanticipated oscillations. OPRM Upscale Function OPERABILITY for Technical Specification purposes is based only on the Period-Based Detection algorithm. The Allowable Value for the OPRM Upscale Period-Based Detection algorithm is specified in the COLR.

The OPRM Upscale Function receives input signals from the local power range monitors (LPRMs), which are combined into "cells" for evaluation by the OPRM algorithms.

The OPRM Upscale Function is required to be OPERABLE when the plant is at ≥ 24% RTP, the region of power-flow operation where anticipated events could lead to thermal-hydraulic instability and related neutron flux oscillations. Within this region, the automatic trip is enabled when THERMAL POWER, as indicated by the APRM Simulated Thermal Power, is ≥ 29% RTP and reactor core flow, as indicated by recirculation drive flow, is < 60% of rated flow, the operating region where actual thermal-hydraulic oscillations may occur. The lower bound, 24% RTP, is chosen to provide margin in the unlikely event of loss of feedwater heating while the plant is operating below the 29% automatic OPRM Upscale trip enable point. Loss of feedwater heating is the only identified event that could cause reactor power to increase into the region of concern without operator action.

An OPRM Upscale trip is issued from an APRM/OPRM channel when the Period-Based Detection algorithm in that channel detects oscillatory changes in the neutron flux, indicated by the combined signals of the LPRM detectors in a cell, with period confirmations and relative cell amplitude exceeding specified setpoints. One or more cells in a channel exceeding the trip conditions will result in a channel trip. An OPRM Upscale trip is also issued from the channel if either the Growth-Rate or Amplitude-Based algorithms detect growing oscillatory changes in the neutron flux for one or more cells in that channel.

Three of the four channels are required to be OPERABLE. Each channel is capable of detecting thermal-hydraulic instabilities, by detecting the related neutron flux oscillations, and issuing a trip signal before the MCPR SL is exceeded.

There is no Allowable Value for this function.

BASES

ACTIONS (continued)

Times, specifies that once a Condition has been entered, subsequent divisions, subsystems, components, or variables expressed in the Condition, discovered to be inoperable or not within limits, will not result in separate entry into the Condition. Section 1.3 also specifies that Required Actions of the Condition continue to apply for each additional failure, with Completion Times based on initial entry into the Condition. However, the Required Actions for inoperable RPS instrumentation channels provide appropriate compensatory measures for separate, inoperable channels. As such, a Note has been provided that allows separate Condition entry for each inoperable RPS instrumentation channel.

A.1 and A.2

and 15

Because of the diversity of sensors available to provide trip signals and the redundancy of the RPS design, an allowable out of service time of 12 hours has been shown to be acceptable (Ref. 9) to permit restoration of any inoperable channel to OPERABLE status. However, this out of service time is only acceptable provided the associated Function's inoperable channel is in one trip system and the Function still maintains RPS trip capability (refer to Required Actions B.1, B.2, and C.1 Bases.) If the inoperable channel cannot be restored to OPERABLE status within the allowable out of service time, the channel or the associated trip system must be placed in the tripped condition per Required Actions A.1 and A.2. Placing the inoperable channel in trip (or the associated trip system in trip) would conservatively compensate for the inoperability, restore capability to accommodate a single failure, and allow operation to continue. Alternately, if it is not desired to place the channel (or trip system) in trip (e.g., as in the case where placing the inoperable channel in trip would result in a full scram), Condition D must be entered and its Required Action taken.

INSERT H - Note Description

B.1 and B.2

Condition B exists when, for any one or more Functions, at least one required channel is inoperable in each trip system. In this condition, provided at least one channel

(continued)

INSERT H – Note Description

As noted, Action A.2 is not applicable to APRM Functions 2.a, 2.b, 2.c, 2.d, or 2.f. Inoperability of one required APRM/OPRM channel affects both trip systems. For that condition, Required Action A.1 must be satisfied, and is the only action (other than restoring OPERABILITY) that will restore capability to accommodate a single failure. Inoperability of more than one required APRM/OPRM channel of the same trip function results in loss of trip capability and entry into Condition C, as well as entry into Condition A for each channel.

BASES

ACTIONS

B.1 and B.2 (continued)

per trip system is OPERABLE, the RPS still maintains trip capability for that Function, but cannot accommodate a single failure in either trip system.

Required Actions B.1 and B.2 limit the time the RPS scram logic for any Function would not accommodate single failure in both trip systems (e.g., one-out-of-one and one-out-of-one arrangement for a typical four channel Function). The reduced reliability of this logic arrangement was not evaluated in Reference 9 or 15 for the 12 hour Completion Time. Within the 6 hour allowance, the associated Function will have all required channels either OPERABLE or in trip (or in any combination) in one trip system.

Completing one of these Required Actions restores RPS to an equivalent reliability level as that evaluated in Reference 9 or 15, which justified a 12 hour allowable out of service time as presented in Condition A. The trip system in the more degraded state should be placed in trip or, alternatively, all the inoperable channels in that trip system should be placed in trip (e.g., a trip system with two inoperable channels could be in a more degraded state than a trip system with four inoperable channels, if the two inoperable channels are in the same Function while the four inoperable channels are all in different Functions). The decision as to which trip system is in the more degraded state should be based on prudent judgment and current plant conditions (i.e., what MODE the plant is in). If this action would result in a scram or recirculation pump trip, it is permissible to place the other trip system or its inoperable channels in trip.

The 6 hour Completion Time is judged acceptable based on the remaining capability to trip, the diversity of the sensors available to provide the trip signals, the low probability of extensive numbers of inoperabilities affecting all diverse Functions, and the low probability of an event requiring the initiation of a scram.

Alternately, if it is not desired to place the inoperable channels (or one trip system) in trip (e.g., as in the case where placing the inoperable channel or associated trip

(continued)

ACTIONS

B.1 and B.2 (continued)

system in trip would result in a scram or RPT), Condition D must be entered and its Required Action taken.

INSERT I - Note Description

C.1

Required Action C.1 is intended to ensure that appropriate actions are taken if multiple, inoperable, untripped channels within the same trip system for the same Function result in the Function not maintaining RPS trip capability. A Function is considered to be maintaining RPS trip capability when sufficient channels are OPERABLE or in trip (or the associated trip system is in trip), such that both trip systems will generate a trip signal from the given Function on a valid signal. For the typical Function with one-out-of-two taken twice logic and the IRM and APRM Functions, this would require both trip systems to have one channel OPERABLE or in trip (or the associated trip system in trip). For Function 6 (Main Steam Isolation Valve—Closure), this would require both trip systems to have each channel associated with the MSIVs in three MSLs (not necessarily the same MSLs for both trip systems), OPERABLE or in trip (or the associated trip system in trip). For Function 9 (Turbine Stop Valve Closure, Trip Oil Pressure—Low), this would require both trip systems to have three channels, each OPERABLE or in trip (or the associated trip system in trip).

The Completion Time is intended to allow the operator time to evaluate and repair any discovered inoperabilities. The 1 hour Completion Time is acceptable because it minimizes risk while allowing time for restoration or tripping of channels.

D.1

Required Action D.1 directs entry into the appropriate Condition referenced in Table 3.3.1.1-1. The applicable Condition specified in the table is Function and MODE or other specified condition dependent and may change as the Required Action of a previous Condition is completed. Each time an inoperable channel has not met any Required Action

(continued)

INSERT I – Note Description

As noted, Condition B is not applicable to APRM Functions 2.a, 2.b, 2.c, 2.d, or 2.f. Inoperability of one required APRM/OPRM channel affects both trip systems and is not associated with a specific trip system, as are the APRM 2-Out-Of-4 Voter and other non-APRM/OPRM channels for which Condition B applies. For an inoperable APRM/OPRM channel, Required Action A.1 must be satisfied, and is the only action (other than restoring OPERABILITY) that will restore capability to accommodate a single failure. Inoperability of more than one required APRM/OPRM channel of the same trip function results in loss of trip capability and entry into Condition C, as well as entry into Condition A for each channel. Because Conditions A and C provide Required Actions that are appropriate for the inoperability of APRM Functions 2.a, 2.b, 2.c, 2.d, and 2.f, and these functions are not associated with specific trip systems as are the APRM 2-Out-Of-4 Voter and other non-APRM channels, Condition B does not apply.

BASES

ACTIONS

D.1 (continued)

of Condition A, B, or C, and the associated Completion Time has expired, Condition D will be entered for that channel and provides for transfer to the appropriate subsequent Condition.

E.1, F.1, G.1, ~~and~~ H.1 , and K.1

If the channel(s) is not restored to OPERABLE status or placed in trip (or the associated trip system placed in trip) within the allowed Completion Time, the plant must be placed in a MODE or other specified condition in which the LCO does not apply. The Completion Times are reasonable, based on operating experience, to reach the specified condition from full power conditions in an orderly manner and without challenging plant systems. In addition, the Completion ~~Time~~ Times of Required ~~Action~~ Actions E.1 ~~is~~ and K.1 are consistent with the Completion Time provided in LCO 3.2.2, "MINIMUM CRITICAL POWER RATIO (MCPR)."

I.1

If the channel(s) is not restored to OPERABLE status or placed in trip (or the associated trip system placed in trip) within the allowed Completion Time, the plant must be placed in a MODE or other specified condition in which the LCO does not apply. This is done by immediately initiating action to fully insert all insertable control rods in core cells containing one or more fuel assemblies. Control rods in core cells containing no fuel assemblies do not affect the reactivity of the core and are, therefore, not required to be inserted. Action must continue until all insertable control rods in core cells containing one or more fuel assemblies are fully inserted. Subsequently, if the manual scram channels are inoperable, the reactor mode switch is locked in the shutdown position to prevent inadvertent control rod withdrawals.

INSERT J - New Required Actions J.1 and J.2

SURVEILLANCE REQUIREMENTS

As noted at the beginning of the SRs, the SRs for each RPS instrumentation Function are located in the SRs column of Table 3.3.1.1-1.

(continued)

INSERT J – New Required Actions J.1 and J.2

J.1

If OPRM Upscale trip capability is not maintained, Condition J exists. Reference 15 justified use of alternate methods to detect and suppress oscillations for a limited period of time. The alternate methods are procedurally established consistent with the guidelines identified in Reference 16 requiring manual operator action to scram the plant if certain predefined events occur. The 12-hour allowed action time is based on engineering judgment to allow orderly transition to the alternate methods while limiting the period of time during which no automatic or alternate detect and suppress trip capability is formally in place. Based on the small probability of an instability event occurring at all, the 12 hours is judged to be reasonable.

J.2

The alternate method to detect and suppress oscillations implemented in accordance with J.1 was evaluated (Reference 15) based on use up to 120 days only. The evaluation, based on engineering judgment, concluded that the likelihood of an instability event that could not be adequately handled by the alternate methods during this 120-day period was negligibly small. The 120-day period is intended to be an outside limit to allow for the case where design changes or extensive analysis might be required to understand or correct some unanticipated characteristic of the instability detection algorithms or equipment. This action is not intended and was not evaluated as a routine alternative to returning failed or inoperable equipment to OPERABLE status. Correction of routine equipment failure or inoperability is expected to normally be accomplished within the completion times allowed for Actions for Conditions A and B.

LCO 3.0.4.b is not applicable to J.2 to allow unit restart in the event of a shutdown during the 120-day completion time.

SURVEILLANCE REQUIREMENTS (continued)

The Surveillances are modified by a Note to indicate that, when a channel is placed in an inoperable status solely for performance of required Surveillances, entry into associated Conditions and Required Actions may be delayed for up to 6 hours, provided the associated Function maintains trip capability. Upon completion of the Surveillance, or expiration of the 6 hour allowance, the channel must be returned to OPERABLE status or the applicable Condition entered and Required Actions taken. This Note is based on the RPS reliability analysis (Ref. 9) assumption of the average time required to perform channel surveillance. That analysis demonstrated that the 6 hour testing allowance does not significantly reduce the probability that the RPS will trip when necessary.

SR 3.3.1.1.1 and SR 3.3.1.1.19

Performance of the CHANNEL CHECK ~~once every 12 hours~~ ensures that a gross failure of instrumentation has not occurred. A CHANNEL CHECK is normally a comparison of the parameter indicated on one channel to a similar parameter on other channels. It is based on the assumption that instrument channels monitoring the same parameter should read approximately the same value. Significant deviations between the instrument channels could be an indication of excessive instrument drift on one of the channels or something even more serious. A CHANNEL CHECK will detect gross channel failure; thus, it is key to verifying the instrumentation continues to operate properly between each CHANNEL CALIBRATION.

Agreement criteria are determined by the plant staff based on a combination of the channel instrument uncertainties, including indication and readability. If a channel is outside the criteria, it may be an indication that the instrument has drifted outside its limit.

The agreement criteria include an expectation of overlap when transitioning between neutron flux instrumentation. The overlap between SRMs and IRMs must be demonstrated prior to withdrawing SRMs from the fully inserted position since indication is being transitioned from SRMs to the IRMs. This will ensure that reactor power will not be increased into a neutron flux region without adequate indication. The

(continued)

and SR 3.3.1.1.19

SURVEILLANCE REQUIREMENTS

SR 3.3.1.1.1 (continued)

overlap between IRMs and APRMs is of concern when reducing power into the IRM range. On power increases, the system design will prevent further increases (by initiating a rod block) if adequate overlap is not maintained.

Overlap between IRMs and APRMs exists when sufficient IRMs and APRMs concurrently have on-scale readings such that the transition between MODE 1 and MODE 2 can be made without either APRM downscale rod block, or IRM upscale rod block. Overlap between SRMs and IRMs similarly exists when, prior to withdrawing the SRMs from the fully inserted position, IRMs are above 2/40 on range 1 before SRMs have reached the upscale rod block.

If overlap for a group of channels is not demonstrated (e.g., IRM/APRM overlap), the reason for the failure of the Surveillance should be determined and the appropriate channel(s) that are required in the current MODE or condition should be declared inoperable.

of once every 12 hours for SR 3.3.1.1.1

The Frequency is based upon operating experience that demonstrates channel failure is rare. The CHANNEL CHECK supplements less formal, but more frequent, checks of channels during normal operational use of the displays associated with the channels required by the LCO.

The Frequency of once every 24 hours for SR 3.3.1.1.19 is based on the improved processing and reduced drift of the digital equipment in combination with four fully redundant flow transmitter channels and improved failure detection (Reference 15).

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.3.1.1.10, SR 3.3.1.1.12 and SR 3.3.1.1.17 (continued)

Note 3 to SR 3.3.1.1.10 states that the APRM recirculation flow transmitters are excluded from CHANNEL CALIBRATION of Function 2.d, Average Power Range Monitor Flow Biased Simulated Thermal Power - High. Calibration of the flow transmitters is performed on an 18-month frequency (SR 3.3.1.1.17). ~~Note 4 to SR 3.3.1.1.10 states that the digital components of the flow control trip reference card are excluded from CHANNEL CALIBRATION of Function 2.d, Average Power Range Monitor Flow Biased Simulated Thermal Power - High. The analog output potentiometers of the flow control trip reference card are not excluded. The flow control trip reference card has an automatic self-test feature which periodically tests the hardware which performs the digital algorithm. Exclusion of the digital components of the flow control trip reference card from CHANNEL CALIBRATION of Function 2.d is based on the conditions required to perform the test and the likelihood of a change in the status of these components not being detected.~~

INSERT K - Note Description for SR 3.3.1.1.10

The Frequency of ~~SR 3.3.1.1.10,~~ 18 months for SR 3.3.1.1.12 and SR 3.3.1.1.17 is based upon the assumption of the magnitude of equipment drift in the setpoint analysis.

INSERT L - Frequency of SR 3.3.1.1.10

(continued)

INSERT K – Note Description for SR 3.3.1.1.10

SR 3.3.1.1.10 for the designated function is modified by two Notes as identified in Table 3.3.1.1-1. The first Note requires evaluation of channel performance for the condition where the as-found setting for the channel setpoint is outside its as-found tolerance but conservative with respect to the Allowable Value. Evaluation of channel performance will verify that the channel will continue to behave in accordance with safety analysis assumptions and the channel performance assumptions in the setpoint methodology. The purpose of the assessment is to ensure confidence in the channel performance prior to returning the channel to service. The performance of these channels will be evaluated under the station's Corrective Action Program. Entry into the Corrective Action Program will ensure required review and documentation of the condition to establish a reasonable expectation for continued OPERABILITY.

The second Note requires that the as-left setting for the channel be within the as-left tolerance of the Nominal Trip Setpoint (NTSP). Where a setpoint more conservative than the NTSP is used in the plant surveillance procedures, the as-left and as-found tolerances, as applicable, will be applied to the surveillance procedure setpoint. This will ensure that sufficient margin to the Safety Limit and/or Analytical Limit is maintained. If the as-left channel setting cannot be returned to a setting within the as-left tolerance of the NTSP, then the channel shall be declared inoperable. The second Note also requires that NTSP and the methodologies for calculating the as-left and the as-found tolerances be in the Technical Requirements Manual.

INSERT L – Frequency of SR 3.3.1.1.10

The Frequency of 24 months for SR 3.3.1.1.10 is based upon the justification provided in Reference 15. The only analog components involved with main signal processing are input isolation amplifiers (one per LPRM and one per flow input), a sample-and-hold circuit, and an analog-to-digital (A/D) converter. These analog components are highly reliable and very stable with virtually no drift. In addition, the sample-and-hold circuit and A/D converters are tested as part of the automatic self-test.

The processing hardware for the APRM Functions is digital and has no drift. One of the most sensitive signals, the flow processing, is automatically compared between channels. Any digital failures will be identified by the automatic self-test, CHANNEL CHECK, or in very rare cases by the CHANNEL FUNCTIONAL TEST.

The automatic self-test includes steps that check the performance and accuracy of the sample and hold circuits and the A/D converters, and the related processing. Self-test logic also periodically tests the input amplifiers and processing for accuracy. In addition, CHANNEL FUNCTIONAL TESTS include an automated "cal check" which will check the performance of all of the analog amplifiers and the entire processing loop.

The combined improvement justifies the factor-of-four increase in calibration interval, particularly in that the calibration will actually be checked at the CHANNEL FUNCTIONAL TEST and self-test frequencies.

SURVEILLANCE REQUIREMENTS

SR 3.3.1.1.15 (continued)

RPS RESPONSE TIME tests are conducted on an 18 month STAGGERED TEST BASIS. Note 3 requires STAGGERED TEST BASIS Frequency to be determined based on 4 channels per trip system, in lieu of the 8 channels specified in Table 3.3.1.1-1 for the MSIV Closure Function. This Frequency is based on the logic interrelationships of the various channels required to produce an RPS scram signal.

Therefore, staggered testing results in response time verification of these devices every 18 months. This Frequency is consistent with the typical industry refueling cycle and is based upon plant operating experience, which shows that random failures of instrumentation components causing serious time degradation, but not channel failure, are infrequent.

Deleted

SR 3.3.1.1.16 and SR 3.3.1.1.18

~~The Average Power Range Monitor Flow Biased Simulated Thermal Power - High Function uses an electronic filter circuit to generate a signal proportional to the core THERMAL POWER from the APRM neutron flux signal. This filter circuit is representative of the fuel heat transfer dynamics that produce the relationship between the neutron flux and the core THERMAL POWER. The filter time constant must be verified to ensure that the channel is accurately reflecting the desired parameter.~~

~~The Frequency of 18 months is based on engineering judgment and reliability of the components.~~

~~SR 3.3.1.1.18~~

~~The Average Power Range Monitor Flow Biased Simulated Thermal Power - High Function uses a trip level generated by the flow control trip reference card based on the recirculation loop drive flow. The drive flow is adjusted by a digital algorithm according to selected drive flow alignment dip switch settings. This SR sets the flow~~

(continued)

SURVEILLANCE REQUIREMENTS

~~SR 3.3.1.1.18 (continued)~~

~~control trip reference card to ensure the drive flow alignment used results in the appropriate trip level being generated from the digital components of the card.~~

~~The Frequency of once following a refueling outage is based on the expectation that any change in the core flow to drive flow functional relationship during power operation would be gradual and that maintenance on recirculation system and core components which may impact the relationship is expected to be performed during refueling outages. The completion time of 7 days after reaching equilibrium conditions is based on plant conditions required to perform the test and engineering judgment of the time required to collect and analyze the necessary flow data and the time required to adjust and check the adjustment of each flow control trip reference card. The completion time of 7 days after reaching equilibrium conditions is acceptable based on the low probability of a neutronic/thermal-hydraulic instability event.~~

INSERT M - New SRs 3.3.1.1.20, 3.3.1.1.21, 3.3.1.1.22, and 3.3.1.1.23

REFERENCES

1. UFSAR, Fig

2. UFSAR, Sec

3. UFSAR, Section 6.3.3.

4. UFSAR, Chapter 15.

5. UFSAR, Section 15.4.1.

6. NEDO-23842, "Continuous Control Rod Withdrawal in the Startup Range," April 18, 1978.

7. UFSAR, Section 15.4.9.

(continued)

INSERT M – New SRs 3.3.1.1.20, 3.3.1.1.21, 3.3.1.1.22, and 3.3.1.1.23

SR 3.3.1.1.20

A CHANNEL FUNCTIONAL TEST is performed on each required channel to ensure that the entire channel will perform the intended function.

For the APRM Functions, this test supplements the automatic self-test functions that operate continuously in the APRM/OPRM and voter channels. The CHANNEL FUNCTIONAL TEST covers the APRM/OPRM channels (including recirculation flow processing -- applicable to Function 2.b only), the 2-Out-Of-4 Voter channels, and the interface connections into the RPS trip systems from the voter channels. Any setpoint adjustment shall be consistent with the assumptions of the current plant specific setpoint methodology.

The 184 day Frequency of SR 3.3.1.1.20 is on the reliability analysis of Reference 15. (NOTE: Actual voting logic of the 2-Out-Of-4 Voter Function is as part of SR 3.3.1.1.21.)

Note 1 is provided for APRM Function 2.a that requires this SR to be performed within 12 hours of entering MODE 2 from MODE 1. Testing of the MODE 2 APRM Function cannot be performed in MODE 1 without utilizing jumpers or lifted leads. This Note allows entry into MODE 2 from MODE 1 if the associated Frequency is not met per SR 3.0.2.

Note 2 is provided for APRM Functions 2.a, 2.b, and 2.c to clarify that the APRM/OPRM channels and 2-Out-Of-4 Voter channels are included in the CHANNEL FUNCTIONAL TEST.

Note 3 is provided for APRM Functions 2.d and 2.f to clarify that the APRM/OPRM channels and the 2-Out-Of-4 Voter channels plus the flow input function, excluding the flow transmitters, are included in the CHANNEL FUNCTIONAL TEST.

SR 3.3.1.1.21

The LOGIC SYSTEM FUNCTIONAL TEST for APRM Function 2.e simulates APRM and OPRM trip conditions at the 2-Out-Of-4 Voter channel inputs to check all combinations of two tripped inputs to the 2-out-of-4 logic in the voter channels and APRM-related redundant RPS relays. The test is only required to include the voting logic of the 2-Out-Of-4 Voter channels and RPS relays not tested as part of the CHANNEL FUNCTIONAL TEST.

The 24-month Frequency is based on the justification that virtually all of the equipment is tested by the CHANNEL FUNCTIONAL TESTS. The periodic LPRM calibrations (every 2000 full power hours) provide an indirect test of LPRM interfaces including detectors. The design of the equipment allows virtually all testing and routine adjustments to be performed with no changes to the configuration (e.g., no disconnecting wires), so the risk of problems caused by the normal operation of the system is greatly reduced.

SR 3.3.1.1.22

This SR ensures that the individual channel response times for Function 2.e are less than or equal to the maximum values assumed in the accident analysis. This test may be performed in one measurement or in overlapping segments, with verification that all associated components are tested. The RPS RESPONSE TIME acceptance criteria are included in the applicable plant procedures.

RPS RESPONSE TIME for the APRM 2-Out-Of-4 Voter Function 2.e includes the output relays of the voter and the associated RPS relays and contactors. (The digital portion of the APRM and 2-Out-Of-4 Voter channels are excluded from RPS RESPONSE TIME testing because self-testing and calibration checks the time base of the digital electronics. Confirmation of the time base is adequate to assure required response times are met. Neutron detectors are excluded from RPS RESPONSE TIME testing because the principles of detector operation virtually ensure an instantaneous response time.)

APRM and OPRM RESPONSE TIME tests are conducted on a 24 month STAGGERED TEST BASIS. The Note requires the STAGGERED TEST BASIS to be determined based on 4 channels of APRM outputs and 4 channels of OPRM outputs, (total "n" = 8) being tested on an alternating basis. This allows the STAGGERED TEST BASIS Frequency for Function 2.e to be determined based on 8 channels rather than the 4 actual 2-Out-Of-4 Voter channels.

The redundant outputs from the 2-Out-Of-4 Voter channel (2 for APRM trips and 2 for OPRM trips) are considered part of the same channel, but the OPRM and APRM outputs are considered to be separate channels for application of SR 3.3.1.1.22, so "n" = 8. The note further requires that testing of OPRM and APRM outputs from a 2-Out-Of-4 Voter be alternated. In addition to these commitments, Reference 15 require that the testing of inputs to each RPS Trip System alternate.

Combining these frequency requirements, an acceptable test sequence is one that:

a. Tests each RPS trip system interface every other cycle,

b. Alternates testing APRM and OPRM outputs from any specific 2-Out-Of-4 Voter channel, and

c. Alternates between divisions at least every other test cycle.

Each test of an APRM or OPRM output tests each of the redundant outputs from the 2-Out-Of-4 Voter channel for that Function and each of the corresponding relays in the RPS. Consequently, each of the RPS relays is tested every fourth cycle. The RPS relay testing frequency is twice the frequency justified by Reference 15.

SR 3.3.1.1.23

This SR ensures that scrams initiated from OPRM Upscale Function 2.f will not be inadvertently bypassed when THERMAL POWER, as indicated by the APRM Simulated Thermal Power is greater than or equal to 29% RTP and core flow as indicated by recirculation drive flow is less than 60% rated flow. This normally involves confirming the bypass setpoints. Adequate margins for the instrument setpoint methodologies are incorporated into the actual setpoint. The actual surveillance ensures that the OPRM Upscale Function is enabled (not bypassed) for the correct values of APRM Simulated Thermal Power and recirculation drive flow. Other surveillances ensure that the APRM Simulated Thermal Power and recirculation flow properly correlate with THERMAL POWER and core flow, respectively.

If any bypass setpoint is non-conservative (i.e., the OPRM Upscale function is bypassed when APRM Simulated Thermal Power is greater than or equal 29% RTP and recirculation drive flow is less than 60% of rated flow), then the affected channel is considered inoperable for the OPRM Upscale function. Alternatively, the bypass setpoint may be adjusted to place the channel in a conservative condition (non-bypassed). If placed in "non-bypassed," this SR is met and the channel is considered OPERABLE.

The Frequency of once every 24 months is based on engineering judgment recognizing that the actual values are stored digitally, so there is no drift, and that any hardware failures that affect these setpoints will most likely be detected by the automatic self-test function.

REFERENCES (continued)

8. Letter, P. Check (NRC) to G. Lainas (NRC), "BWR Scram Discharge System Safety Evaluation," December 1, 1980, as attached to NRC Generic Letter dated December 9, 1980.

9. NEDO-30851-P-A, "Technical Specification Improvement Analyses for BWR Reactor Protection System," March 1988.

10. NEDO-32291-A, "System Analyses for Elimination of Selected Response Time Testing Requirements," October 1995.

11. GNRI-97/00181, Amendment 133 to the Operating License.

12. NEDO-32339-A, "Long Term Stability Solution: Enhanced Option I-A."

13. NEDO-31960-P-A, "BWR Owners' Group Long-Term Stability Solution Licensing Methodology," and Supplement 1.

14. NEDO-32465-P-A, "BWR Owners' Group Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications"

15. NEDC-32410-P-A, "Nuclear Measurement Analysis and Control - Power Range Neutron Monitor (NUMAC PRNM) Retrofit Plus Option III Stability Trip Function," Vols 1 and 2, and Supplement 1

16. BWR Owners' Group Letter, L. A. England to the NRC, M. J. Virgilio, "BWR Owners' Group Guidelines for Stability Interim Corrective Action," June 6, 1994

17. TSTF-493, "Clarify Application of Setpoint Methodology for LSSS Functions"

Deleted

Deleted

B 3.3 INSTRUMENTATION

B 3.3.1.3 ~~Period Based Detection System (PBDS)~~

~~BASES~~

~~BACKGROUND~~

~~General Design Criterion 12 requires protection of fuel thermal safety limits from conditions caused by neutronic/thermal-hydraulic instability. Neutronic/thermal-hydraulic instabilities can result in power oscillations which could result in exceeding the MCPR Safety Limit (SL). The MCPR SL ensures that at least 99.9% of the fuel rods avoid boiling transition during normal operation and during an anticipated operational occurrence (AOO) (refer to the Bases for SL 2.1.1.2).~~

~~The PBDS provides the operator with an indication that conditions consistent with a significant degradation in the stability performance of the reactor core have occurred and the potential for imminent onset of neutronic/thermal-hydraulic instability may exist. Indication of such degradation is cause for the operator to initiate an immediate reactor scram if the reactor is being operated in either the Restricted Region or Monitored Region. The Restricted Region and Monitored Region are defined in the COLR.~~

~~The PBDS instrumentation of the Neutron Monitoring System consists of two channels. Each of the PBDS channels includes input from local power range monitors (LPRMs) within the reactor core. These inputs are continually monitored by the PBDS for variations in the neutron flux consistent with the onset of neutronic/thermal-hydraulic instability. Each channel includes separate local indication and control room Hi-Hi DR Alarm. While this LCO specifies OPERABILITY requirements only for one monitoring and indication channel of the PBDS, if both are OPERABLE, a Hi-Hi DR Alarm from either channel results in the need for the operator to take actions.~~

~~The primary PBDS component is a card in the Neutron Monitoring System with analog inputs and digital processing. The PBDS card has an automatic self-test feature to periodically test the hardware circuit. The self-test~~

Pages B 3.3-39a through B 3.3-39i have been deleted.

~~(continued)~~

BASES

BACKGROUND ~~(continued)~~

~~function~~s ~~are executed~~ ~~during~~ ~~their~~ ~~allocate~~d ~~portion~~ ~~of the~~ ~~executive~~ ~~loop sequence~~. ~~Any self-test~~ ~~failure~~ ~~indicatin~~g ~~loss of critica~~l ~~functio~~n ~~results~~ ~~in a contro~~l ~~room alarm~~.

~~The inoperabl~~e ~~conditio~~n ~~is also displayed~~ ~~by an indicatin~~g ~~light on the card front~~ ~~panel~~. A ~~manuall~~y ~~initiate~~d ~~interna~~l ~~test sequence~~ ~~can be actuated~~ ~~via a recessed~~ ~~push~~ ~~button~~. ~~This~~ ~~interna~~l ~~test consist~~s ~~of simulatin~~g ~~alarm~~ ~~and~~ ~~inoperabl~~e ~~condition~~s ~~to verify~~ ~~card OPERABILITY~~. ~~Description~~s ~~of the PBDS are provided~~ ~~in Reference~~s ~~1 and 2.~~

~~Actuatio~~n ~~of the PBDS Hi-Hi~~ ~~DR Alarm~~ ~~is not postulate~~d ~~to~~ ~~occur~~ ~~due to neutronic/thermal-hydrau~~lic ~~instabilit~~y ~~outside~~ ~~the Restricte~~d ~~Region~~ ~~and the Monitore~~d ~~Region~~. ~~Periodic~~ ~~perturbation~~s ~~can be introduce~~d ~~into the thermal-hydrau~~lic ~~behavior~~ ~~of the reacto~~r ~~core from externa~~l ~~sources~~ ~~such as~~ ~~recirculatio~~n ~~system~~ ~~component~~s ~~and the pressure~~ ~~and~~ ~~feedwate~~r ~~control~~ ~~systems~~. ~~These~~ ~~perturbation~~s ~~can~~ ~~potentiall~~y ~~drive~~ ~~the neutron~~ ~~flux to oscillate~~ ~~within~~ ~~a~~ ~~frequenc~~y ~~range expecte~~d ~~for neutronic/thermal-hydrau~~lic ~~instabilit~~y. ~~The presence~~ ~~of such oscillation~~s ~~would~~ ~~be~~ ~~recognize~~d ~~by the perio~~d ~~based~~ ~~algorith~~m ~~of the PBDS and~~ ~~potentiall~~y ~~result~~ ~~in a Hi-Hi~~ ~~DR Alarm~~. ~~Actuatio~~n ~~of the~~ ~~PBDS Hi-Hi~~ ~~DR Alarm~~ ~~outside~~ ~~the Restricte~~d ~~Region~~ ~~and the~~ ~~Monitore~~d ~~Region would~~ ~~indicate~~ ~~the presence~~ ~~of a source~~ ~~externa~~l ~~to the reacto~~r ~~core and are not indication~~s ~~of~~ ~~neutronic/thermal-hydrau~~lic ~~instability~~.

APPLICABLE SAFETY ANALYSES

~~Analysis~~, ~~as described~~ ~~in Sectio~~n ~~4 of Reference~~ ~~1, confirms~~ ~~that AOOs~~ ~~initiated~~ ~~from outside~~ ~~the Restricte~~d ~~Region~~ ~~without~~ ~~stabilit~~y ~~control~~ ~~and from within~~ ~~the Restricte~~d ~~Region with~~ ~~stabilit~~y ~~control~~ ~~are not expected~~ ~~to result~~ ~~in~~ ~~neutronic/thermal-hydrau~~lic ~~instability~~. ~~The stabilit~~y ~~contro~~l ~~applied~~ ~~in the Restricte~~d ~~Region~~ ~~(refer~~ ~~to LCO~~ ~~3.2.4,~~ ~~"Fraction of Core~~ ~~Boiling~~ ~~Boundar~~y ~~(FCBB)"~~) ~~is~~ ~~establishe~~d ~~to prevent~~ ~~neutronic/thermal-hydrau~~lic ~~instabilit~~y ~~during~~ ~~operatio~~n ~~in the Restricte~~d ~~Region~~. ~~Operatio~~n ~~in the Monitore~~d ~~Region~~ ~~is only susceptibl~~e ~~to~~ ~~instabilit~~y ~~under~~ ~~hypothetica~~l ~~operatin~~g ~~condition~~s ~~beyond~~ ~~those~~ ~~analyzed~~ ~~in Reference~~ ~~1.~~ ~~The types~~ ~~of transient~~s ~~specificall~~y ~~evaluated~~ ~~are loss of flow and coolant~~ ~~temperatur~~e ~~decrease~~ ~~which~~ ~~are limiting~~ ~~for the onset~~ ~~of~~ ~~instabilit~~y.

~~(continued)~~

Pages B 3.3-39a through B 3.3-39i have been deleted.

~~BASES~~

~~APPLICABLE SAFETY ANALYSES~~ (~~continued~~)

~~The initial conditions assumed in the analysis are reasonably conservative and the immediate post-event reactor conditions are significantly stable. However, these assumed initial conditions do not bound each individual parameter which impacts stability performance (Ref. 1.). The PBDS instrumentation provides the operator with an indication that conditions consistent with a significant degradation in the stability performance of the reactor core has occurred and the potential for imminent onset of neutronic/thermal-hydraulic instability may exist. Such conditions are only postulated to result from events initiated from initial conditions beyond the conditions assumed in the safety analysis (refer to Section 4, Ref. 1). The PBDS Hi-Hi alarm setpoint of 2 monitored LPRMs with 11 or more successive confirmation counts is selected to provide adequate indication of degraded stability performance (refer to Section 5, Ref. 1).~~

~~The PBDS has no safety function and is not assumed to function during any FSAR design basis accident or transient analysis. However, the PBDS provides the only indication of the imminent onset of neutronic/thermal-hydraulic instability during operation in regions of the operating domain potentially susceptible to instability. Therefore, the PBDS is included in the Technical Specifications.~~

~~LCO~~

~~One PBDS channel is required to be OPERABLE to monitor reactor neutron flux for indications of imminent onset of neutronic/thermal-hydraulic instability. OPERABILITY requires the ability for the operator to be immediately alerted to a Hi-Hi DR Alarm. This is accomplished by the instrument channel control room alarm. OPERABILITY also requires the minimum number of valid LPRM inputs, 8 for RTP > 30% and 4 for RTP ≤ 30%, be satisfied. The LCO also requires reactor operation be such that the Hi-Hi DR Alarm is not actuated by an OPERABLE PBDS instrumentation channel.~~

~~APPLICABILITY~~

~~At least one of two PBDS instrumentation channels is required to be OPERABLE during operation in either the Restricted Region or the Monitored Region specified in the COLR. Similarly, operation with the PBDS Hi-Hi DR Alarm of any OPERABLE PBDS instrumentation channel is not allowed in~~

(~~continued~~)

Pages B 3.3-39a through B 3.3-39i have been deleted.

APPLICABILITY (continued)

the Restricted Region or the Monitored Region. Operation in these regions is susceptible to instability (refer to the Bases for LCO 3.2.4 and Section 4 of Ref. 1). OPERABILITY of at least one PBDS instrumentation channel and operation with no indication of a PBDS Hi-Hi DR Alarm from any OPERABLE PBDS instrumentation channel is therefore required during operation in these regions.

The boundary of the Restricted Region in the Applicability of this LCO is analytically established in terms of thermal power and core flow. The Restricted Region is defined by the APRM Flow Biased Neutron Flux - Upscale Control Rod Block setpoints, which are a function of reactor recirculation drive flow. The Restricted Region Entry Alarm (RREA) signal is generated by the Flow Control Trip Reference (FCTR) card using the APRM Flow Biased Neutron Flux - Upscale Control Rod Block setpoints. As a result, the RREA is coincident with the Restricted Region boundary when the setpoints are not “Setup”, and provides indication of entry into the Restricted Region. However, APRM Flow Biased Neutron Flux - Upscale Control Rod Block signals provided by the FCTR card, that are not coincident with the Restricted Region boundary, do not generate a valid RREA. The Restricted Region boundary for this LCO Applicability is specified in the COLR.

When the APRM Flow Biased Neutron Flux - Upscale Control Rod Block setpoints are “Setup” the applicable setpoints used to generate the RREA are moved to the interior boundary of the Restricted Region to allow controlled operation within the Restricted Region. While the setpoints are “Setup” the Restricted Region boundary remains defined by the normal APRM Flow Biased Neutron Flux - Upscale Control Rod Block setpoints.

Parameters such as reactor power and core flow available at the reactor controls, may be used to provide immediate confirmation that entry into the Restricted Region could reasonably have occurred.

The Monitored Region in the Applicability of this LCO is analytically established in terms of thermal power and core flow. However, unlike the Restricted Region boundary the Monitored Region boundary is not specifically monitored by plant instrumentation to provide automatic indication of

Pages B 3.3-39a through B 3.3-39i have been deleted.

(continued)

~~BASES~~

~~APPLICABILITY (continued)~~

~~region entry. Therefore, the Monitored Region boundary is defined in terms of thermal power and core flow. The Monitored Region boundary for this LCO Applicability is specified in the COLR.~~

~~Operation outside the Restricted Region and the Monitored Region is not susceptible to neutronic/thermal-hydraulic instability even under extreme postulated conditions.~~

~~ACTIONS~~

~~A.1~~

~~If at any time while in the Restricted Region or Monitored Region, an OPERABLE PBDS instrumentation channel indicates a valid Hi-Hi DR Alarm, the operator is required to initiate an immediate reactor scram. Verification that the Hi-Hi DR Alarm is valid may be performed without delay against another output from a PBDS card observable from the reactor controls in the control room prior to the manual reactor scram. This provides assurance that core conditions leading to neutronic/thermal-hydraulic instability will be mitigated. This required Action and associated Completion Time does not allow for evaluation of circumstances leading to the Hi-Hi DR Alarm prior to manual initiation of reactor scram.~~

~~B.1 and B.2~~

~~Operation with the APRM Flow Biased Simulated Thermal Power - High Function (refer to LCO 3.3.1.1, Table 3.3.1.1-1, Function 2.d) "Setup" requires the stability control applied in the Restricted Region (refer to LCO 3.2.4) to be met. Requirements for operation with the stability control met are established to prevent reactor thermal-hydraulic instability during operation in the Restricted Region. With the required PBDS channel inoperable, the ability to monitor conditions indicating the potential for imminent onset of neutronic/thermal-hydraulic instability as a result of unexpected transients is lost. Therefore, action must be immediately initiated to exit the Restricted Region. While the APRM Flow Biased Neutron Flux - Upscale Control Rod~~

Pages B 3.3-39a through B 3.3-39i have been deleted.

~~(continued)~~

~~BASES~~

~~ACTIONS~~

~~B.1 and B.2 (continued)~~

~~Block setpoints are "Setup," operation in the Restricted Region may be confirmed by use of plant parameters such as reactor power and core flow available at the reactor controls.~~

~~Exit of the Restricted Region can be accomplished by control rod insertion and/or recirculation flow increases. Actions to restart an idle recirculation loop, withdraw control rods or reduce recirculation flow may result in unstable reactor conditions and are not allowed to be used to comply with this Required Action.~~

~~The time required to exit the Restricted Region will depend on existing plant conditions. Provided efforts are begun without delay and continued until the Restricted Region is exited, operation is acceptable based on the low probability of a transient which degrades stability performance occurring simultaneously with the required PBDS channel inoperable.~~

~~Required Action B.1 is modified by a Note that specifies that initiation of action to exit the Restricted Region only applies if the APRM Flow Biased Simulated Thermal Power - High Function is "Setup". Operation in the Restricted Region without the APRM Flow Biased Simulated Thermal Power - High Function "Setup" indicates uncontrolled entry into the Restricted Region. Uncontrolled entry is consistent with the occurrence of unexpected transients, which, in combination with the absence of stability controls being met may result in significant degradation of stability performance.~~

~~When the APRM Flow Biased Neutron - Flux - Upscale Control Rod Block setpoints are not "Setup" uncontrolled entry into the Restricted Region is identified by receipt of a valid RREA. Immediate confirmation that RREA is valid and indicates an actual entry into the Restricted Region may be performed without delay. Immediate confirmation constitutes observation that plant parameters immediately available at the reactor controls (e.g., reactor power and core flow) are reasonably consistent with entry into the Restricted Region.~~

Pages B 3.3-39a through B 3.3-39i have been deleted.

~~(continued)~~

BASES

ACTIONS

B.1 and B.2 (continued)

This immediate confirmation may also constitute recognition that plant parameters are rapidly changing during a transient (e.g., a recirculation pump trip) which could reasonably result in entry into the Restricted Region.

For uncontrolled entry into the Restricted Region with the required PBDS instrumentation channel inoperable, the ability to monitor conditions indicating the potential for imminent onset of neutronic/thermal-hydraulic instability is lost and continued operation is not justified. Therefore, Required Action B.2 requires immediate reactor scram.

C.1

In the Monitored Region the PBDS Hi-Hi DR Alarm provides indication of degraded stability performance. Operation in the Monitored Region is susceptible to neutronic/thermal-hydraulic instability under postulated conditions exceeding those previously assumed in the safety analysis. With the required PBDS channel inoperable, the ability to monitor conditions indicating the potential for imminent onset of neutronic/thermal-hydraulic instability is lost. Therefore, action must be initiated to exit the Monitored Region.

Actions to restart an idle recirculation loop, withdraw control rods or reduce recirculation flow may result in approaching unstable reactor conditions and are not allowed to be used to comply with this Required Action. Exit of the Monitored Region is accomplished by control rod insertion and/or recirculation flow increases. However, actions which reduce recirculation flow are allowed provided the Fraction of Core Boiling Boundary (FCBB) is recently (within 15 minutes) verified to be ≤ 1.0. Recent verification of FCBB being met, provides assurance that with the PBDS inoperable, planned decreases in recirculation drive flow should not result in significant degradation of core stability performance.

Pages B 3.3-39a through B 3.3-39i have been deleted.

(continued)

~~ACTIONS~~

~~C.1 (continued)~~

~~The specified Completion Time of 15 minutes ensures timely operator action to exit the region consistent with the low probability that reactor conditions exceed the initial conditions assumed in the safety analysis. The time required to exit the Monitored Region will depend on existing plant conditions. Provided efforts are begun within 15 minutes and continued until the Monitored Region is exited, operation is acceptable based on the low probability of a transient which degrades stability performance occurring simultaneously with the required PBDS channel inoperable.~~

~~SURVEILLANCE REQUIREMENTS~~

~~SR 3.3.1.3.1~~

~~During operation in the Restricted Region or the Monitored Region the PBDS Hi-Hi DR Alarm is relied upon to indicate conditions consistent with the imminent onset of neutronic/thermal-hydraulic instability. Verification every 12 hours provides assurance of the proper indication of the alarm during operation in the Restricted Region or the Monitored Region. The 12 hour Frequency supplements less formal, but more frequent, checks of alarm status during operation.~~

~~SR 3.3.1.3.2~~

~~Performance of the CHANNEL CHECK every 12 hours ensures that a gross failure of instrumentation has not occurred. This CHANNEL CHECK is normally a comparison of the PBDS indication to the state of the annunciator, as well as comparison to the same parameter on the other channel if it is available. It is based on the assumption that the instrument channel indication agrees with the immediate indication available to the operator, and that instrument channels monitoring the same parameter should read similarly. Deviations between the instrument channels could be an indication of instrument component failure. A CHANNEL CHECK will detect gross channel failure; thus, it is key to~~

Pages B 3.3-39a through B 3.3-39i have been deleted.

~~(continued)~~

~~BASES~~

~~SURVEILLANCE REQUIREMENTS~~

~~SR 3.3.1.3.2 (continued)~~

~~verifying the instrumentation continues to operate properly between each CHANNEL FUNCTIONAL TEST. Agreement criteria are determined by the plant staff based on a combination of the channel instrument uncertainties, including indication and readability.~~

~~The 12 hour Frequency is based on operating experience that demonstrates channel failure is rare. The CHANNEL CHECK supplements less formal, but more frequent, checks of channels during normal operational use of the displays associated with the channels required by the LCO.~~

~~SR 3.3.1.3.3~~

~~A CHANNEL FUNCTIONAL TEST is performed for the PBDS to ensure that the entire system will perform the intended function. The CHANNEL FUNCTIONAL TEST for the PBDS includes manual initiation of an internal test sequence and verification of appropriate alarm and inop conditions being reported.~~

~~Performance of a CHANNEL FUNCTIONAL TEST at a Frequency of 24 months verifies the performance of the PBDS and associated circuitry. The Frequency considers the plant conditions required to perform the test, the ease of performing the test, and the likelihood of a change in the system or component status. The alarm circuit is designed to operate for over 24 months with sufficient accuracy on signal amplitude and signal timing considering environment, initial calibration and accuracy drift (Ref. 2).~~

~~REFERENCES~~

~~1. NEDO-32339-A, "Reactor Stability Long Term Solution: Enhanced Option I-A.~~

~~2. NEDC-32339P-A, Supplement 2, "Reactor Stability Long Term Solution: Enhanced Option I-A Solution Design."~~

Pages B 3.3-39a through B 3.3-39i have been deleted.

BASES

APPLICABLE SAFETY ANALYSES (continued)

margins during abnormal operational transients (Ref. 2), which are analyzed in Chapter 15 of the UFSAR.

A plant specific LOCA analysis has been performed assuming only one operating recirculation loop. This analysis has demonstrated that, in the event of a LOCA caused by a pipe break in the operating recirculation loop, the Emergency Core Cooling System response will provide adequate core cooling, provided the APLHGR requirements are modified accordingly (Ref. 3).

The transient analyses of Chapter 15 of the UFSAR have also been performed for single recirculation loop operation (Ref. 3) and demonstrate sufficient flow coastdown characteristics to maintain fuel thermal margins during the abnormal operational transients analyzed provided the MCPR requirements are modified. The APLHGR and MCPR limits for single loop operation are specified in the COLR.

Recirculation loops operating satisfies Criterion 2 of the NRC Policy Statement.

LCO

Two recirculation loops are normally required to be in operation with their flows matched within the limits specified in SR 3.4.1.1 to ensure that during a LOCA caused by a break of the piping of one recirculation loop the assumptions of the LOCA analysis are satisfied. Alternatively, with only one recirculation loop in operation, modifications to the required APLHGR limits (LCO 3.2.1, "AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR)"), MCPR limits (LCO 3.2.2, "MINIMUM CRITICAL POWER RATIO (MCPR)", and ~~APRM Flow Biased Simulated Thermal Power-High, ALLOWABL~~E ~~Value (LCO 3.2.4, "Fraction~~n ~~of Core Boiling Boundary~~" ~~(FCBB)~~, LCO 3.3.1.1, "RPS Instrumentation"~~, and LCO 3.3.1.3, "Period Based Detection System" (PBDS)~~) must be applied to allow continued operation consistent with the assumptions of Reference~~s~~ 3 ~~and 4~~.

The LCO is modified by a Note which allows up to 12 hours before having to put in effect the required modifications to required limits after a change in the reactor operating conditions from two recirculation loops operating to single recirculation loop operation. If the required limits are

(continued)

BASES (continued)

REFERENCES

1. UFSAR, Section 6.3.3.7.
2. UFSAR, Section 5.4.1.1.
3. UFSAR, Chapter 15, Appendix 15C.
4. ~~NEDO-32339-A~~, ~~“Reactor~~ ~~Stabilit~~y ~~Long Term~~ ~~Solution~~: ~~Enhance~~d ~~Option~~ ~~I-A.”~~ Deleted
5. Deleted

BASES

APPLICABLE SAFETY ANALYSES (continued)

CRDA analyses assume that the reactor operator follows prescribed withdrawal sequences. For SDM tests performed within these defined sequences, the analyses of References 1 and 2 are applicable. However, for some sequences developed for the SDM testing, the control rod patterns assumed in the safety analyses of References 1 and 2 may not be met. Therefore, special CRDA analyses, performed in accordance with an NRC approved methodology, are required to demonstrate that the SDM test sequence will not result in unacceptable consequences should a CRDA occur during the testing. For the purpose of this test, protection provided by the normally required MODE 5 applicable LCOs, in addition to the requirements of this LCO, will maintain normal test operations as well as postulated accidents within the bounds of the appropriate safety analyses (Refs. 1 and 2). In addition to the added requirements for the Rod Pattern Controller (RPC), APRM, and control rod coupling, the single notch withdrawal mode is specified for out of sequence withdrawals. Requiring the single notch withdrawal mode limits withdrawal steps to a single notch, which limits inserted reactivity, and allows adequate monitoring of changes in neutron flux, which may occur during the test.

As described in LCO 3.0.7, compliance with Special Operations LCOs is optional, and therefore, no criteria of the NRC Policy Statement apply. Special Operations LCOs provide flexibility to perform certain operations by appropriately modifying requirements of other LCOs. A discussion of the criteria satisfied for the other LCOs is provided in their respective Bases.

LCO

As described in LCO 3.0.7, compliance with this Special Operations LCO is optional. SDM tests may be performed while in MODE 2, in accordance with Table 1.1-1, without meeting this Special Operations LCO or its ACTIONS. For SDM tests performed while in MODE 5, additional requirements must be met to ensure that adequate protection against potential reactivity excursions is available. To provide additional scram protection, beyond the normally required IRMs, the APRMs are also required to be OPERABLE (LCO 3.3.1.1, Functions 2.a, ~~and~~ 2.c, and 2.e) as though the reactor were in MODE 2. Because multiple control rods will be withdrawn and the reactor will potentially become critical, the approved control rod withdrawal sequence must be enforced by the RPC (LCO 3.3.2.1, Function 1b, MODE 2), or

(continued)

ATTACHMENT 6

GNRO-2009-00054

GE HITACHI NUCLEAR ENERGY REPORT 0000-0107-7607-NP-R1

GRAND GULF NUCLEAR STATION – GRAND GULF PRNM UPGRADE PROJECT OPTION III STABILITY DEVIATIONS

(NON-PROPRIETARY VERSION)

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Grand Gulf Nuclear Station
Grand Gulf PRNM Upgrade Project
Option III Stability Deviations

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REVISION SUMMARY

Rev	Required Changes to Achieve Revision
1	Editorial change: the header was modified from “GEH Proprietary Information” to “GEH Non-Proprietary Information” since this is the Non-Proprietary version of the report.

INFORMATION NOTICE

This is a non-proprietary version of the document GE-NE-0000-0107-7607-NP-R0, which has the proprietary information removed. Portions of the document that have been removed are indicated by an open and closed bracket as shown here [[ ]].

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

PLEASE READ CAREFULLY

The information contained in this document is furnished for the purpose to support the NRC review of the Grand Gulf Nuclear Station license application for implementation of the power range neutron monitor. The only undertakings of GEH with respect to information in this document are contained in contracts between GEH and the parent company of Grand Gulf Nuclear Station, and nothing contained in this document shall be construed as changing those contracts. The use of this information by anyone other than those participating entities and for any purposes other than those for which it is intended is not authorized; and with respect to any unauthorized use, GEH makes no representation or warranty, and assumes no liability as to the completeness, accuracy, or usefulness of the information contained in this document.

Grand Gulf Option III Stability Deviations

Grand Gulf Nuclear Station (GGNS) will submit a license application for the implementation of Power Range Neutron Monitor (PRNM) using the Long Term Stability Solution Option III. The basis for the license application is contained in the relevant licensing topical reports (References 1 – 6) and Safety Communications (References 7 – 12).

The special Long Term Stability Solution Option III developed for GGNS has two deviations from the referenced documents. Each deviation is justified as being conservative relative to the relevant licensing documents as is summarized in Table 1. A more detailed discussion of the justification is presented below.

Technical Justifications:

The justifications for these two deviations in Table 1 are provided below.

a) Base Period Definition for PBDA

The Option III licensing basis defines the base period as the average of all successively confirmed periods (Reference 1). The GGNS Option III defines the successive base period as equal to the previous period that is within PBDA T_{min} and T_{max} limits. T_{max} is defined as the oscillation period upper time limit for the Period Based Detection Algorithm (PBDA) while T_{min} is defined as the oscillation period lower time limit for the PBDA. [[

]] Therefore, this change does not significantly increase the frequency of spurious scrams during normal operation, precluding any anomalous oscillatory behavior with a frequency range typical of thermal-hydraulic instability, or adversely impact the plant ability to provide SLMCPR protection.

This change is conservative relative to the Option III licensing basis.

b) Period Tolerance Offset

The period tolerance offset is a feature to maximize the ability of the PBDA to recognize the initiation of oscillations following a fast flow runback event. [[

]] The comparison is based on a simulated instability event and shows that the indicated signal will confirm successive confirmation counts much sooner with the period tolerance offset. [[

]] Therefore, this change does not significantly increase the likelihood of spurious scram or adversely impact the plant ability to provide SLMCPR protection.

This change is conservative relative to the Option III licensing basis.

References

1. NEDO-31960-A Supplement 1, "BWR Owners' Group Long-Term Stability Solutions Licensing Methodology," November 1995.
2. NEDO-31960-A, "BWR Owners' Group Long-Term Stability Solutions Licensing Methodology," November 1995.
3. NEDO-32465-A, "Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications," August 1996.
4. NEDC-32410P-A Volume 1, "Nuclear Measurement Analysis and Control Power Range Neutron Monitor (NUMAC PRNM) Retrofit Plus Option III Stability Trip Function," October 1995.
5. NEDC-32410P-A Volume 2 -- Appendices, "Nuclear Measurement Analysis and Control Power Range Neutron Monitor (NUMAC PRNM) Retrofit Plus Option III Stability Trip Function," October 1995.
6. NEDC-32410P-A, Supplement 1, "Nuclear Measurement Analysis and Control Power Range Neutron Monitor (NUMAC PRNM) Retrofit Plus Option III Stability Trip Function," November 1997.
7. Safety Communication 02-09, "Stability Option III Trip Adequacy for Instability During Fast Transients," July 26, 2002.
8. Safety Communication 02-21, "Stability Option III: OPRM Tmin Specification," November 22, 2002.
9. Safety Communication 03-20, "Stability Option III Period Based Detection Algorithm Allowable Settings," October 4, 2003.
10. Safety Communication 03-02, "Stability Option III OPRM Armed Region Boundary," February 17, 2003.
11. Safety Communication 07-18 Rev. 1,"OPRM Armed Region Boundary," October 19, 2007.
12. Safety Communication 07-19 Rev. 1,"OPRM Armed Region Boundary," October 19, 2007.
13. NEDC-33075P-A Revision 6, "General Electric Boiling Water Reactor Detect and Suppress Solution – Confirmation Density," January 2008.

Table 1. GGNS Option III Deviations

Item	Parameter	Option III Licensing Basis	GGNS Option III	Justification
a	Base Period definition for PBDA	Average of all successively confirmed periods (Reference 1)	The previous successively confirmed period (Reference 13)	Conservative
b	Period Tolerance Offset	Not a solution feature.	[[ ]] following a fast flow reduction event (Reference 13).	Conservative

Figure 1. Effect of Period Tolerance Offset on the Successive Confirmation Count Response*

[[

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* [[ ]]

ATTACHMENT 7

GNRO-2009-00054

LICENSEE-IDENTIFIED COMMITMENTS

LICENSEE-IDENTIFIED COMMITMENTS

The following table identifies those actions committed to by Entergy in this document. Any other statements in this submittal are provided for information purposes and are not considered to be regulatory commitments.

COMMITMENT	TYPE (Check one)		SCHEDULED COMPLETION DATE (If Required)
	ONE-TIME ACTION	CONTINUING COMPLIANCE	
1. Entergy will conduct a monitoring period of the OPRM for a minimum of 90 days not to exceed one fuel cycle after plant startup following the 2012 refueling outage to be successfully completed prior to enabling the OPRM.	√		Following completion of the OPRM Monitoring Period
2. During the OPRM Monitoring Period, the outputs from the OPRM Upscale function will not be connected to the RPS trip output relays while the OPRM alarms and indications will be provided to the operators.	√		During the OPRM Monitoring Period
3. Entergy will perform OPRM surveillances that can be performed, or partially performed, prior to startup from the 2012 refueling outage or on-line as part of post-modification testing, industry experience, and factory acceptance testing of the NUMAC PRNM System.	√		Prior to and during the OPRM Monitoring Period
4. During the OPRM Monitoring Period, the OPRM Upscale function will not be relied upon to mitigate a stability event; rather GGNS will implement Backup Stability Protection (BSP) specified in BWROG document OG 02-0119-260, *GE to BWROG Detect and Suppress II Committee, "Backup Stability Protection (BSP) for Inoperable Option III Solution,"* as an alternate method for detecting and suppressing instabilities until the OPRM Monitoring Period has been successfully completed.	√		During the OPRM Monitoring Period
5. The BSP measures will be implemented via plant procedures.		√	

COMMITMENT	TYPE (Check one)		SCHEDULED COMPLETION DATE (If Required)
	ONE-TIME ACTION	CONTINUING COMPLIANCE	
6. At the end of the OPRM Monitoring Period, Entergy will review the operating data, setpoints, and margins. Once the results are determined to be acceptable, Entergy will enable the OPRM (with applicable SRs met) by connecting it to the RPS trip relays.	√		Completion of the OPRM Monitoring Period
7. Entergy will notify the NRC when the OPRM Monitoring Period has been successfully completed.	√		Completion of the OPRM Monitoring Period
8. The Period-Based Detection algorithm "tuning" parameters will be established in accordance with GGNS procedures as part of the system setup and calibration, and will be defined in plant procedures.		√	
9. The Period-Based Detection algorithm trip setpoint will be documented in the COLR.		√	
10. Administrative controls will be provided for manually bypassing the APRM / OPRM channels or protective functions, and for controlling access to the APRM / OPRM panel and channel bypass switch.		√	
11. Documenting the HFE review will be included in the final design packages for the PRNM System and available on-site for NRC inspection.	√		Prior to startup from the 2012 refueling outage
12. The TRM will be revised to reflect the NTSP and methodologies used to determine the as-found and as-left tolerances prior to startup from the 2012 refueling outage.	√		Prior to startup from the 2012 refueling outage
13. GGNS calibration procedures for APRM Functions 2.a, 2.b, 2.d, and 2.f will be revised to reflect the instructions given in new Notes (d) and (e).	√		Prior to startup from the 2012 refueling outage