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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 28, 2012

Vice President, Operations
Entergy Operations, Inc.
Grand Gulf Nuclear Station
P.O. Box 756
Port Gibson, MS 39150

SUBJECT: GRAND GULF NUCLEAR STATION, UNIT 1 - ISSUANCE OF AMENDMENT RE: POWER RANGE NEUTRON MONITORING SYSTEM REPLACEMENT (TAC NO. ME2531)

Dear Sir or Madam:

The U.S. Nuclear Regulatory Commission (NRC) has issued the enclosed Amendment No. 188 to Facility Operating License No. NPF-29 for the Grand Gulf Nuclear Station, Unit 1 (GGNS). This amendment consists of changes to the Technical Specifications (TSs) in response to your application dated November 3, 2009, as supplemented by letters dated February 8, 2010, May 18, 2010, June 3, 2010, June 18, 2010, July 29, 2010, September 29, 2010, December 13, 2010, December 14, 2010, May 3, 2011, May 16, 2011, May 26, 2011, May 31, 2011, June 13, 2011, June 28, 2011, July 22, 2011, September 28, 2011, October 18, 2011, October 26, 2011, November 8, 2011, and December 1, 2011.

The amendment revises the TSs to reflect replacement of the existing Average Power Range Monitor (APRM) subsystem of the Neutron Monitoring System with a digital General Electric - Hitachi Nuclear Measurement Analysis and Control (NUMAC) Power Range Neutron Monitoring System (PRNMS). The replacement system will also change GGNS's reactor stability solution from an Enhanced Option 1-A solution to Option III, which provides an automatic instability detect-and-suppress long-term reactor core stability solution. These changes are based on prior NRC approvals of licensing topical reports for NUMAC-based PRNMS equipment and other power plant experiences when performing similar changes. In addition, the amendment adds a provision to the facility operating license that allows a monitoring period for the APRM scram Function 2.f, "OPRM [Oscillating Power Range Monitor] Upscale," before this function's trip output to the reactor protection system trip system would be enabled. This license provision allows the limiting conditions for operation (LCOs) that would otherwise be associated with the "OPRM Upscale" Function 2.f to be deferred until the monitoring period is complete and the OPRM trip output is permanently enabled. The amendment also revises the TSs in accordance with Technical Specification Task Force Traveler (TSTF) TSTF-493, Revision 4, "Clarify Application of Setpoint Methodology for LSSS [limiting safety system settings] Functions," to add surveillance footnotes in accordance with Option A of TSTF-493, Revision 4, to address instrumentation LCO issues that could occur during periodic testing and calibration of instrumentation.

NOTICE: Enclosure 3 to this letter contains Proprietary Information. Upon separation from the Enclosure 3, this letter is DECONTROLLED.

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The NRC has determined that the related safety evaluation (SE) contains proprietary information pursuant to Title 10 of the *Code of Federal Regulations*, Section 2.390, "Public Inspections, Exemptions, Requests for Withholding." Accordingly, the NRC staff has also prepared a non-proprietary version of the SE, which is provided in Enclosure 2; the proprietary version of the SE is provided in Enclosure 3. The Notice of Issuance will be included in the Commission's next biweekly Federal Register notice.

Sincerely,

Alan Wang

Alan Wang, Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-416

Enclosures:
1. Amendment No. 188 to NPF-29
2. Safety Evaluation (non-proprietary)
3. Safety Evaluation (proprietary)

cc w/encls 1 and 2: Distribution via Listserv

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

ENTERGY OPERATIONS, INC.

SYSTEM ENERGY RESOURCES, INC.

SOUTH MISSISSIPPI ELECTRIC POWER ASSOCIATION

ENTERGY MISSISSIPPI, INC.

DOCKET NO. 50-416

GRAND GULF NUCLEAR STATION, UNIT 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 188
License No. NPF-29

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Entergy Operations, Inc. (the licensee), dated November 3, 2009, as supplemented by letters dated February 8, 2010, May 18, 2010, June 3, 2010, June 18, 2010, July 29, 2010, September 29, 2010, December 13, 2010, December 14, 2010, May 3, 2011, May 16, 2011, May 26, 2011, May 31, 2011, June 13, 2011, June 28, 2011, July 22, 2011, September 28, 2011, October 18, 2011, October 26, 2011, November 8, 2011, and December 1, 2011, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

Enclosure 1

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and Paragraph 2.C.(2) of Facility Operating License No. NPF-29 is hereby amended to read as follows:

   (2) <u>Technical Specifications</u>

   The Technical Specifications contained in Appendix A and the Environmental Protection Plan contained in Appendix B, as revised through Amendment No. 188 are hereby incorporated in the license. Entergy Operations, Inc., shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

   During Cycle 19, GGNS will 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) will be disabled and operated in an "indicate only" mode and technical specification requirements will not apply to this function. 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. Once monitoring has been successfully completed, the OPRM Upscale function will be enabled and technical specification requirements will be applied to the function; no further operating with this function in an "indicate only" mode will be conducted.

3. This license amendment is effective as of its date of issuance and shall be implemented prior to startup from refueling outage number 18.

FOR THE NUCLEAR REGULATORY COMMISSION

Michael T. Markley

Michael T. Markley, Chief
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Facility Operating License No. NPF-29 and the Technical Specifications

Date of Issuance: March 28, 2012

ATTACHMENT TO LICENSE AMENDMENT NO. 188

FACILITY OPERATING LICENSE NO. NPF-29

DOCKET NO. 50-416

Replace the following pages of the Facility Operating License No. NPF-29 and the Appendix A, Technical Specifications with the attached revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

Facility Operating License

Remove	Insert
-4-	-4-

Technical Specifications

Remove	Insert
1.0-3	1.0-3
3.2-4	3.2-4
3.2-5	3.2-5
3.2-6	3.2-6
3.3-1	3.3-1
3.3-2	3.3-2
3.3-2a	3.3-2a
3.3-4a	3.3-4a
3.3-5a	3.3-5a
3.3-5b	3.3-5b
3.3-6	3.3-6
3.3-6a	3.3-6a
3.3-13a	3.3-13a
3.3-13b	3.3-13b
3.10-19	3.10-19
3.10-20	3.10-20
5.0-18	5.0-18
5.0-21	5.0-21

(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. 188 are hereby incorporated into this license. Entergy Operations, Inc. shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

During Cycle 19, GGNS will 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) will be disabled and operated in an "indicate only" mode and technical specification requirements will not apply to this function. 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. Once monitoring has been successfully completed, the OPRM Upscale function will be enabled and technical specification requirements will be applied to the function; no further operating with this function in an "indicate only" mode will be conducted.

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.
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)

3.2 POWER DISTRIBUTION LIMITS

3.2.4 Deleted

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

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

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.

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.	12 hours
	OR		
		---------Note-------- Not applicable for Functions 2.a, 2.b, 2.c, 2.d, or 2.f. ---------------------	
	A.2	Place associated trip system in trip.	12 hours
---------NOTE--------- Not applicable for Functions 2.a, 2.b, 2.c, 2.d, or 2.f. ---------------------- 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.	6 hours
	OR		
	B.2	Place one trip system in trip.	6 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
C. One or more Functions with RPS trip capability not maintained.	C.1	Restore RPS trip capability.	1 hour
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

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
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
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.	12 hours
	AND		
	J.2	------- NOTE -------- LCO 3.0.4 is not applicable. --------------------- Restore required channels to OPERABLE.	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. --- Perform CHANNEL CALIBRATION.	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	Deleted	
SR 3.3.1.1.17	Perform APRM recirculation flow transmitter calibration.	18 months
SR 3.3.1.1.18	Deleted	
SR 3.3.1.1.19	Perform CHANNEL CHECK.	24 hours

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
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 3.3.1.1.7 SR 3.3.1.1.10(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 3.3.1.1.2 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	≤ 119.3% RTP
c. Inop	1,2	3(c)	H	SR 3.3.1.1.20	NA
d. Flow Biased Simulated Thermal Power - High	1	3(c)	G	SR 3.3.1.1.2 SR 3.3.1.1.7 SR 3.3.1.1.10(d)(e) SR 3.3.1.1.17 SR 3.3.1.1.19 SR 3.3.1.1.20	(b)
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	≥ 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)

(continued)

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

(b) Two-Loop Operation 0.65W + 62.9% RTP and ≤ 113% RTP
Single-Loop Operation 0.65W + 42.3% RTP

(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 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.

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

3.3 INSTRUMENTATION

3.3.1.3 Deleted

Pages 3.3-13a and 3.3.13b have been deleted

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, 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.	3 hours
	AND	
	A.2 Disarm the associated CRD.	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, 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),

4) Deleted

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

6) Deleted

(continued)

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.

ENCLOSURE 2

(NON-PROPRIETARY)

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 188 TO FACILITY OPERATING LICENSE NO. NPF-29

POWER RANGE NEUTRON MONITORING SYSTEM

ENTERGY OPERATIONS, INC.

GRAND GULF NUCLEAR STATION, UNIT 1

DOCKET NO. 50-416

Proprietary information pursuant to Section 2.390 of Title 10 of the *Code of Federal Regulations* has been redacted from this document.

Redacted information is identified by blank space enclosed within double brackets.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

POWER RANGE NEUTRON MONITORING SYSTEM

ENTERGY OPERATIONS, INC.

GRAND GULF NUCLEAR STATION, UNIT 1

DOCKET NO. 50-416

1.0 INTRODUCTION

By letter dated November 3, 2009 (Reference 1), as supplemented by letters dated February 8, 2010 (Reference 2), May 18, 2010 (Reference 3), June 3, 2010 (Reference 4), June 18, 2010 (Reference 5), July 29, 2010 (Reference 6) September 29, 2010 (Reference 7), December 13, 2010 (Reference 8), December 14, 2010 (Reference 9), May 3, 2011 (Reference 10), May 16, 2011 (Reference 11), May 26, 2011 (Reference 12), May 31, 2011 (Reference 13), June 13, 2011 (Reference 14), June 28, 2011 (Reference 15), July 22, 2011 (Reference 16), September 28, 2011 (Reference 17), October 18, 2011 (Reference 18), October 26, 2011 (Reference 19), November 8, 2011 (Reference 20), and December 1, 2011 (Reference 21), Entergy Operations, Inc. (Entergy, the licensee), submitted a license amendment request (LAR), "Power Range Neutron Monitoring System Upgrade," to support the installation of a digital General Electric - Hitachi (GEH) Nuclear Measurement Analysis and Control (NUMAC) Power Range Neutron Monitoring System (PRNMS) for Grand Gulf Nuclear Station, Unit 1 (GGNS). Portions of the letters dated November 3, 2009, June 3, 2010, July 29, 2010, September 29, 2010, May 3, 2011, May 16, 2011, May 26, 2011, May 31, 2011, June 28, 2011, July 22, 2011, September 28, 2011, October 26, 2011, November 8, 2011, and December 1, 2011, contain sensitive unclassified non-safeguards information (proprietary) and those portions have been withheld from public disclosure.

The supplemental letters dated February 8, 2010, May 18, 2010, June 3, 2010, June 18, 2010, July 29, 2010, September 29, 2010, December 13, 2010, December 14, 2010, May 3, 2011, May 16, 2011, May 26, 2011, May 31, 2011, June 13, 2011, June 28, 2011, July 22, 2011, September 28, 2011, October 18, 2011, October 26, 2011, November 8, 2011, and December 1, 2011, provided additional information that clarified the application, did not expand the scope of the application as originally noticed, and did not change the U.S. Nuclear Regulatory Commission (NRC) staff's original proposed no significant hazards consideration determination as published in the *Federal Register* on January 5, 2010 (75 FR 462).

The licensee proposed changes to the Technical Specifications (TSs) for the GGNS Reactor Protection System (RPS) Instrumentation to reflect replacement of the existing Average Power Range Monitor (APRM) subsystem of the Neutron Monitoring System (NMS) with a digital GEH NUMAC PRNMS. The replacement system will also change GGNS's reactor stability solution from an Enhanced Option 1-A (Option E-1-A) solution to Option III, which provides an automatic instability detect-and-suppress long-term reactor core stability solution. Option III includes three

Oscillating Power Range Monitor (OPRM) algorithms; however, two algorithms, the amplitude-based and growth-rate, are provided as algorithmically diverse backups to the period-based algorithm. Only the period-based algorithm is credited in the safety analysis. In addition, the GGNS PRNMS change includes a fourth OPRM algorithm, confirmation density (DSS-CD), which is beyond Option III. The DSS-CD OPRM trip output is disabled in the GGNS PRNMS configuration, and within this LAR, the licensee has not proposed to enable it. Because this licensing action does not enable the DSS-CD OPRM trip output, the NRC staff limited its review of the DSS-CD OPRM trip to 1) confirm that the licensee will use its local indications to obtain operating experience, and 2) evaluate and confirm that the presence of the confirmation density algorithm would not adversely affect the performance of the required safety functions.

The change is based on the GE Nuclear Energy licensing topical reports 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" (LTRs), that were reviewed and approved by the NRC staff in October 1995 and November 1997, respectively (see References 22 and 23, respectively). The overall change is further supported by prior operating experience that has been gained from changes to install similar GEH NUMAC-based equipment in U.S. nuclear power plants. The LTRs and their corresponding safety evaluations (SEs) (both contained in References 22 and 23) establish utility-specific licensee actions that each referencing LAR must perform, as applicable. The LTRs provide a series of block diagrams to show a variety of GEH NUMAC PRNMS equipment configurations that could be applied to different General Electric (GE) Boiling Water Reactor (BWR) designs using GEH NUMAC hardware and software; however, the GGNS change is the first application of a GEH NUMAC PRNMS configuration to provide replacement instrumentation for a GE BWR/6 large core plant in the United States. In part, the LTR Supplement 1 (Reference 23) provided details beyond the base LTR (Reference 22) to govern a GEH NUMAC PRNMS configuration for a GE BWR/6 large core plant; nevertheless, the GGNS GEH NUMAC PRNMS proposes plant-specific software that reflects a subsystem configuration with interchannel communications that had not been evaluated in the base LTR and its LTR Supplement 1 (References 22 and 23).

The GEH NUMAC PRNMS development approach includes reliance upon pre-developed hardware and software components. A high-level description of these pre-developed components is contained in the LTRs (References 22 and 23). The set of pre-developed software supports interfaces with NUMAC boards and instrument-specific application functions, which are configured to construct plant-specific instrumentation such as the GGNS PRNMS. Most of this pre-developed software was produced to satisfy the applicable regulatory evaluation criteria that the NRC staff used to evaluate the base LTR in 1995; however, the current and applicable regulatory evaluation criteria that are used by the NRC staff to evaluate software that implements safety functions in digital safety-related equipment have since changed.

This review evaluates proposed TS changes, the plant-specific configuration of the GGNS PRNMS, and the safety functions that it performs against current and applicable regulatory criteria. Included in this review is an evaluation of the GGNS PRNMS against the plant-specific action items defined in the LTRs and their SEs (see References 22 and 23). This review evaluates the GGNS PRNMS development including its software which is, in part, justified by applicable operational experience. The software review is limited to changes that have occurred to the pre-developed safety software since the LTR approvals. Otherwise, this review does not re-evaluate earlier NRC staff conclusions that are documented in the SEs for the approved LTRs.

In addition, the LAR requests TS changes in accordance with Technical Specification Task Force Traveler (TSTF) TSTF-493, Revision 4, "Clarify Application of Setpoint Methodology for LSSS [limiting safety system settings] Functions." This SE addresses the proposed addition of surveillance footnotes in accordance with Option A of TSTF-493, Revision 4, to address instrumentation limiting condition for operation issues that could occur during periodic testing and calibration of instrumentation.

The applicable regulatory bases and corresponding guidance and regulatory acceptance criteria that were used to evaluate the proposed change are identified in Section 2.0 of this SE. The technical evaluation of the proposed changes is documented in Section 3.0 of this SE. Section 4.0 of this SE provides the NRC's staff conclusion and the Attachment to this SE provides a list of references.

2.0 REGULATORY EVALUATION

Plant protective systems are designed to initiate reactor trips (scrams) or other protective actions before selected unit parameters exceed analytical limits assumed in the safety analysis in order to prevent violation of the reactor core safety limits and reactor coolant system pressure safety limit from postulated anticipated operational occurrences and to assist the engineered safety features (ESF) systems in mitigating accidents. The reactor core safety limits and reactor coolant system pressure safety limit ensure that the integrity of the reactor core and reactor coolant system is maintained. The following regulations are applicable to the licensee's proposed change to install the GEH NUMAC PRNMS equipment at GGNS.

The Commission's regulatory requirements related to the content of TSs are contained in Section 50.36, "Technical specifications," of Title 10 of the *Code of Federal Regulations* (10 CFR). The regulations in 10 CFR 50.36 require applicants for nuclear power plant operating licenses to include TSs as part of the license. The regulation requires, in part, that the TSs include items in the following categories: (1) safety limits, limiting safety systems settings (LSSSs), and limiting control settings; (2) limiting conditions for operation (LCOs); (3) surveillance requirements (SRs); (4) design features; and (5) administrative controls. However, the regulation does not specify the particular requirements to be included in TSs.

Instrumentation required by the TSs has been designed to assure that the applicable safety analysis limits will not be exceeded during accidents and anticipated operational occurrences. This is achieved by specifying nominal trip setpoints (NTSPs), including testing requirements to assure the necessary quality of systems, in terms of parameters directly monitored by the applicable instrumentation systems for LSSSs, as well as specifying LCOs on other plant parameters and equipment in accordance with 10 CFR 50.36(c)(2).

The regulations in 10 CFR 50.36(c)(1)(i)(A) state, in part, that

> Safety limits for nuclear reactors are limits upon important process variables that are found to be necessary to reasonably protect the integrity of certain of the physical barriers that guard against the uncontrolled release of radioactivity.

The regulations in 10 CFR 50.36(c)(1)(ii)(A) state, in part, that

> Limiting safety system settings for nuclear reactors are settings for automatic protective devices related to those variables having significant safety functions. Where a limiting safety system setting is specified for a variable on which a safety limit has been placed, the setting must be so chosen that automatic protective action will correct the abnormal situation before a safety limit is exceeded. If, during operation, it is determined that the automatic safety system does not function as required, the licensee shall take appropriate action, which may include shutting down the reactor.

The regulations in 10 CFR 50.36(c)(2)(i) require that the TSs include LCOs for equipment required to ensure safe operation of the facility and state, in part, that

> When a limiting condition for operation of a nuclear reactor is not met, the licensee shall shut down the reactor or follow any remedial action permitted by the technical specifications until the condition can be met.

The regulations in 10 CFR 50.36(c)(3), "Surveillance requirements," state that

> Surveillance requirements are requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions for operation will be met.

The regulations in 10 CFR 50.36(c)(5), "Administrative controls," state, in part, that

> Administrative controls are the provisions relating to organization and management, procedures, recordkeeping, review and audit, and reporting necessary to assure the operation of the facility in a safe manner.

The regulations in 10 CFR 50.55a(a)(1), state that

> Structures, systems, and components must be designed, fabricated, erected, constructed, tested, and inspected to quality standards commensurate with the importance of the safety function to be performed.

The regulations in 10 CFR 50.55a(h), "Protection and safety systems," approve the 1991 version of Institute of Electrical and Electronics Engineers (IEEE) Standard 603, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations," for incorporation by reference, including the correction sheet dated January 30, 1995.

In performing its SE for the LAR, the NRC staff considered 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants" (GDCs); specifically:

- GDC 1, "Quality standards and records";

- GDC 2, "Design basis for protection against natural phenomena";
- GDC 4, "Environmental and dynamic effects basis";
- GDC 10, "Reactor design";
- GDC 12, "Suppression of reactor power oscillations";
- GDC 13, "Instrumentation and control";
- GDC 15, "Reactor coolant system design";
- GDC 19, "Control room";
- GDC 20, "Protection systems functions";
- GDC 21, "Protection system reliability and testability";
- GDC 22, "Protective system independence";
- GDC 23, "Protection system failure modes";
- GDC 24, "Separation of protection and control systems";
- GDC 25, "Protection system requirements for reactivity control malfunctions"; and
- GDC 29, "Protection against anticipated operational occurrences."

The human factors review in Section 3.12 of this SE included requirements from 10 CFR 50.120, "Training and qualification of nuclear power plant personnel."

The NRC staff evaluated the LAR using the applicable portions of the following guidance, which is one acceptable way of meeting regulatory requirements:

- Regulatory Guide (RG) 1.75, Revision 3, "Criteria for Independence of Electrical Safety Systems," February 2005 (Reference 24), describes a method acceptable to the NRC staff for satisfying physical independence of the circuits and electrical equipment that comprise or are associated with safety systems.
- Regulatory Guide 1.100, Revision 3, "Seismic Qualification of Electrical and Active Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants," September 2009 (Reference 25), describes a method acceptable to the NRC staff for satisfying the seismic qualification.
- Regulatory Guide 1.105, Revision 3, "Setpoints for Safety-Related Instrumentations," December 1999 (Reference 26), describes a method acceptable to the NRC staff for complying with the NRC's regulations for ensuring that instrumentation setpoints are initially within and remain within the TS limits. The RG endorses Part I of ISA-S67.04-1994, "Setpoints for Nuclear

Safety Instrumentation," subject to the NRC staff clarifications. The ISA standard provides a basis for establishing setpoints for nuclear instrumentation for safety systems and addresses known contributing errors in the channel. Part 1 establishes a framework for ensuring that setpoints for nuclear safety-related instrumentation are established and maintained within specified limits.

- Regulatory Guide 1.152, Revision 2, "Criteria for Use of Computers in Safety Systems of Nuclear Power Plants," January 2006 (Reference 27), describes a method acceptable to the NRC staff for complying with the NRC's regulations as they apply to high functional reliability and design requirements for computers used in safety systems of nuclear power plants.

- Regulatory Guide 1.168, Revision 1, "Verification, Validation, Reviews, and Audits for Digital Computer Software Used in Safety Systems of Nuclear Power Plants," February 2004 (Reference 28), describes a method acceptable to the NRC staff for complying with the NRC's regulations as they apply to the verification and validation of safety system software.

- Regulatory Guide 1.169, "Configuration Management Plans for Digital Computer Software Used in Safety Systems of Nuclear Power Plants," September 1997 (Reference 29), describes a method acceptable to the NRC staff for complying with the NRC's regulations as they apply to the configuration management of safety system software.

- Regulatory Guide 1.170, "Software Test Documentation for Digital Computer Software Used in Safety Systems of Nuclear Power Plants," September 1997 (Reference 30), describes a method acceptable to the NRC staff for complying with the NRC's regulations as they apply to test documentation of safety system software.

- Regulatory Guide 1.171, "Software Unit Testing for Digital Computer Software Used in Safety Systems of Nuclear Power Plants," September 1997 (Reference 31), describes a method acceptable to the NRC staff for complying with the NRC's regulations as they apply to the unit testing of safety system software.

- Regulatory Guide 1.172, "Software Requirements Specifications for Digital Computer Software Used in Safety Systems of Nuclear Power Plants," September 1997 (Reference 32), describes a method acceptable to the NRC staff for complying with the NRC's regulations as they apply to preparation of software requirement specifications for safety system software.

- Regulatory Guide 1.173, "Developing Software Life Cycle Processes for Digital Computer Software Used in Safety Systems of Nuclear Power Plants," September 1997 (Reference 33), describes a method acceptable to the NRC staff for complying with the NRC's regulations as they apply to the development processes for safety system software.

- Regulatory Guide 1.180, Revision 1, "Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems," October 2003 (Reference 34), describes a method acceptable to the NRC staff for the design, installation, and testing practices to address the effects of electromagnetic and radio-frequency interference (EMI/RFI) and power surges on safety-related instrumentation and control (I&C) systems.

- Regulatory Guide 1.209, "Guidelines for Environmental Qualification of Safety-Related Computer-Based Instrumentation and Control Systems in Nuclear Power Plants," March 2007 (Reference 35), describes a method acceptable to the NRC staff for satisfying the environmental qualification of safety-related computer-based I&C systems for service in mild environments at nuclear power plants.

- DI&C-ISG-02, Revision 2, "Task Working Group #2: Diversity and Defense-in-Depth Issues, Interim Staff Guidance," dated June 5, 2009 (Reference 36), describes methods acceptable to the NRC staff for implementing diversity and defense-in-depth (D3) in digital I&C system designs.

- DI&C-ISG-04, Revision 1, "Task Working Group #4: Highly-Integrated Control Rooms—Communications Issues (HICRc)," dated September 28, 2007 (Reference 37), describes methods acceptable to the NRC staff to prevent adverse interactions among safety divisions and between safety-related equipment and equipment that is not safety-related.

The NRC staff also considered applicable portions of the Branch Technical Positions (BTPs) in accordance with the review guidance established within NUREG-0800, Revision 3, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition" (SRP) (Reference 38), Chapter 7, "Instrumentation and Controls," as follows:

- BTP 7-11, "Guidance on Application and Qualification of Isolation Devices"

- BTP 7-12, "Guidance on Establishing and Maintaining Instrument Setpoints"

- BTP 7-14, "Guidance on Software Reviews for Digital Computer-Based Instrumentation and Control Systems"

- BTP 7-19, "Guidance for Evaluation of Diversity and Defense-In-Depth in Digital Computer-Based Instrumentation and Control Systems"

- BTP 7-21, "Guidance on Digital Computer Real-Time Performance"

In addition to the regulatory requirements and guidance stated above, the NRC staff also considered the previously approved guidance in NUREG-1434, Revision 3, "Standard Technical Specifications, General Electric Plants, BWR/6," June 2004 (Reference 39), NUREG-1764, "Guidance for the Review of Changes to Human Actions," February 2004 (Reference 40), NUREG-0711, Revision 2, "Human Factors Engineering Program Review Model," February 2004 (Reference 41), and NUREG-0800, specifically, review criteria contained in SRP Sections 13.2.1, Revision 3, "Reactor Operator Requalification Program; Reactor Operator

Training," 13.2.2, Revision 3, "Non-Licensed Plant Staff Training," 13.5.2.1, Revision 2, "Operating and Emergency Operating Procedures," and 18.0, Revision 2, "Human Factors Engineering."

3.0 TECHNICAL EVALUATION

The following subsections identify and describe the safety-related GGNS PRNMS I&C components of the proposed change and evaluate these components against the current and applicable regulatory evaluation criteria that are identified in Section 2.0 of this SE. Section 3.1 below provides a summary of the proposed change and the remaining subsections address specific technical evaluation areas that apply to the proposed instrumentation. Section 3.2 identifies and evaluates the proposed TS changes.

This evaluation includes consideration of earlier NRC staff conclusions that are documented in the SEs for the approved LTRs (see References 22 and 23) for which the NRC staff has determined that newer, current, and applicable regulatory evaluation criteria has no clear nexus with the proposed change. However, Sections 3.3 through 3.8 provide evaluations to address areas where newer and current regulatory evaluation criteria exist and apply to the change. Section 3.9 addresses the deviations from the prior approved LTRs. Section 3.10 addresses the confirmation that the plant-specific actions identified in the original LTR (Reference 22) have been satisfied.

3.1 System Description and Configuration

The licensee proposed the GGNS PRNMS change as a collection of Class 1E components that provides four channels of power range safety-related trip outputs via relay contacts (A1/A2 and B1/B2) to two divisions (A and B) of the RPS Trip System for GGNS's GE BWR/6 large core plant (see Reference 1). For the GGNS PRNMS change, each PRNMS channel has an identical configuration, and the channels are designated 1, 2, 3, or 4. The Division 1 (or A) 125 Volt direct current (VDC) bus provides power for PRNMS Channels 1 and 3 through inverters. Likewise, the Division 2 (or B) 125 VDC bus provides power for PRNMS Channels 2 and 4 through inverters. PRNMS Channels 1 and 3 provide redundant trip relay outputs to RPS Trip System A1 and A2, respectively. Similarly, PRNMS Channels 2 and 4 provide redundant trip relay outputs to RPS Trip System B1 and B2, respectively (see Reference 12, "NUMAC Power Range Neutron Monitoring (PRNM) Requirement Specification," 24A5221WA, Appendix C, Figure C-2, and Reference 4, Figure E.5.6).

As proposed, the GGNS PRNMS change replaces the APRM subsystem of the NMS without modifying GGNS's existing power distribution scheme or the RPS Trip System. The RPS Trip System will continue to implement one-out-of-two taken twice logic on the set of trip outputs from the GGNS PRNMS, as is the case for the existing APRM subsystem that will be replaced. The licensee provided a figure that is GGNS-specific to show the overall channel and division interface arrangement (see Reference 4, Figure E.2.2). The licensee also provided a GGNS-specific figure to show the overall power distribution scheme (see Reference 4, Figure E.5.6).

Each GGNS PRNMS channel independently acquires Local Power Range Monitor (LPRM) detector and Loop Flow transmitter inputs, which are only assigned to that channel. A PRNMS channel consists of four functional processing blocks, as follows: 1) LPRM, 2) APRM, 3)

2-out-of-4 voter, and 4) a PRNMS Communication Interface (PCI); however, only the LPRM, APRM, and 2-out-of-4 voter processing blocks are relied upon to perform safety functions. The safety functions performed by each PRNMS channel involve the processing of sensor inputs to produce a set of trip votes that must then satisfy two-out-of-four coincidence voting logic to cause the PRNMS relay outputs to the RPS Trip System to change state.

The licensee identified all "Equipment Required for PRNM Critical System Functions" for the GGNS PRNMS in a proprietary response (see Reference 12, response to NRC's request for additional information (RAI) 28 including the functional block diagram, Figure 28-1). This information identifies components and signal paths that are associated with the equipment's safety functions to demonstrate the overall reliability of the safety functions for the proposed architecture.

The following summarizes each of the four functional processing blocks that are contained within a GGNS PRNMS channel. Each of these functional process blocks are mounted within their own instrument chassis of a channel-specific PRNMS panel (see Reference 13, "NUMAC Power Range Neutron Monitoring (PRNM) Requirement Specification," 24A5221WA, Appendix C, Figure C-1).

- Each LPRM (1 through 4) provides interfaces to a set of LPRM detectors, embeds vendor-developed software to process LPRM detector signals and exchanges data with its channel's APRM and the PCI of the other channel within its division (see Reference 4, Figure E.1.7).

- Each APRM (1 through 4) provides interfaces to a set of LPRM detectors, provides interfaces to each recirculation loop (Loops A and B) Flow Transmitters (transmitter channels A through D, respectively) (see Reference 4, Figure E.3.6), embeds vendor-developed software to process detector signals, performs algorithms to produce a set of trip votes, interfaces with all four 2-out-of-4 voters to provide its trip votes, receives bypass and self-test status information from its channel's 2-out-of-4 voter, exchanges data with its channel's LPRM and PCI, and provides analog outputs to the operator's bench board meters and recorders (see Reference 4, Figure E.2.1).

- The 2-out-of-4 voters associated with APRM channels 1, 3, 2, and 4 are typically referred to as A1, A2, B1, and B2, respectively (see Reference 4, Figure E.2.2); however, the licensee's documentation alternatively refers to the voter channels as 1, 3, 2, and 4, respectively (see Reference 4, Figure E.2.1 and Reference 12, Figure 14-1). Each 2-out-of-4 voter receives the operating panel bypass switch status and forwards this status to the three other 2-out-of-4 voters, receives the bypass status from the other three 2-out-of-4 voters, provides bypass and operational status to its channel's APRM, receives trip votes from all four channels of APRM, embeds vendor-developed programmable logic to implement a voting scheme where only one channel may be in bypass, and controls the state of redundant relay outputs to its corresponding subdivision of the RPS Trip System based on the voter logic. The corresponding subdivisions of the RPS Trip System are typically referred to as A1, A2, B1, or B2, respectively (see Reference 4, Figure E.2.2); however, the licensee's documentation alternatively refers to the RPS Trip System channels as A, B, C, and D, respectively (see Reference 4, Figure E.2.1). Each 2-out-of-4 voter also provides an APRM rod block signal (APRM Control Rod Withdrawal Block) as a relay output to the Rod Action Control System (RACS) portion of Rod Control and Information System (RC&IS) to support non-safety functions that are performed by the RACS (see Reference 10, Figure 13-1, and Reference 11, Figure 5-1).

- Each PCI embeds vendor-developed software to provide non-safety interfaces to other equipment, such as data exchange over a network to support periodic gain adjustments to account for changes in detector sensitivity and the performance of plant calorimetric calibrations. Each PCI also exchanges data with its channel's APRM, receives data from the LPRM of the other channel within its division, and exchanges data with the two PCIs outside of its division (see Reference 4, Figures E.1.7 and E.2.1). Each PCI uses loop flow data originating from all channels to perform a recirculation flow channel check to determine whether a flow mismatch condition exists. The PCI then provides the resulting status to its APRM, so that the APRM can generate the corresponding alarm output. Each PCI also provides LPRM flux values with upscale/downscale/bypass status to the RC&IS to support its operator display, which is not safety-related (see Reference 4, Figure E.2.1) and provides analog outputs to the non-safety operator bench board meters and recorders (see Reference 11, Figure 5-1).

The licensee provided a set of figures to show the PRNMS interfaces and signal/data flow within a PRNMS channel, between PRNMS channels, and with external equipment (see Reference 4, Figures E.1.7, E.2.1, E.2.2, and E.3.6). The licensee also provided a set of figures to categorize these interfaces in terms of data communications using one of following three types: 1) between safety and safety, 2) between safety and non-safety, or 3) between non-safety and non-safety (see Reference 4, Figures 4-1, 4-2, and 4-3).

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]] Section 3.3 of this SE contains the technical evaluation of each GGNS PRNMS interface.

The licensee described its PRNMS configuration and mapped equipment components to the descriptions and sections covered by the prior LTRs (see Reference 11, response to RAI 5). This description provides an explicit configuration for PRNMS channel components and their revisions; however, this configuration does not include a revision for either the APRM software (identified as 148C6122G036) or the PCI software (identified as 147C4698G002), because the final revision of each was to be determined upon completion of the verification and validation (V&V) testing (see Reference 11, Table 5-1). After PRNMS V&V testing was completed, the version of each PRNMS software item, including those associated with the APRM and PCI, were identified (see Reference 21, Section 2.1). For completeness, Table 5-1 also includes configurations for the NUMAC Interface Computer (NIC) (identified as 147C3736WAG001) and the Fiber-optic Bypass switch assembly (identified as 148C6420G001). These assemblies are part of the proposed change; however, they are neither assigned to a specific PRNMS channel nor are they relied upon to perform the safety function.

Two channels of NIC provide communication connectivity from each PRNMS channel's PCI to the Plant Process Computer and from the 3D Monicore to provide calculated APRM gain factors to each PRNMS channel's PCI (see Reference 4, Figures 4-2 and 4-3). These communications are identified as non-safety-to-non-safety, because the communications are not relied upon to perform the safety functions and the interface between the PCI and the APRM contain safety-related components that are designed to preclude the network data exchanges from adversely affecting the PRNMS channel's safety functions.

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]] This approach is consistent with the proposed TS operability requirements for three out of four APRM channels and all four 2-out-of-4 voter channels; thereby ensuring that no single failure will preclude a scram on a valid signal.

The GGNS PRNMS provides APRM scram functions for the following: 1) Neutron Flux – High, Setdown (existing), 2) Fixed Neutron Flux – High (existing), Inop (existing), 3) Flow Biased Simulated Thermal Power – High (existing), 4) 2-Out-of-4 Voter (new), and 5) OPRM Upscale (new). The licensee proposed changes to the TSs to address the operability and availability of these safety functions based on the proposed PRNMS configuration. The licensee proposes TS changes that are consistent with the previously approved LTRs including the example mark-ups of the TS that are contained each LTR (see References 22 and 23, including their Appendices H). Section 3.2 of this SE identifies the licensee's proposed TS changes and provides the NRC staff's evaluation for the GGNS PRNMS change using the previously approved LTRs, and their example TS mark-ups, as applicable to a GE BWR/6 large core plant.

3.2 Proposed TS Changes

Consistent with the previously approved LTRs, and as applicable to a GE BWR/6 large core plant, the licensee proposed TS changes for APRM scram functions. The NRC staff reviewed and evaluated the proposed changes to modify LCOs and SRs for existing PRNMS functions and to add LCOs and SRs for new PRNMS functions based on the proposed PRNMS configuration. Most of the changes would reduce existing surveillance frequencies in accordance with previous justifications and consistent with prior NRC staff approvals (see References 22 and 23).

The affected specifications and associated bases within the TSs are given as follows: (1) Facility Operating License No. NPF-29, Paragraph 2.C.(2); (2) TS 1.1, "Definitions"; (3) TS 3.2.4, "Fraction of Core Boiling Boundary (FCBB)"; (4) TS 3.3.1.1, "Reactor Protection System (RPS) Instrumentation"; (5) TS 3.3.1.3, "Period Based Detection System (PBDS)"; (6) TS 3.10.8, "Shutdown Margin (SDM) Test – Refueling"; and (7) TS 5.6.5, "Core Operating Limits Report (COLR)." Beyond the LCOs and SRs for APRM scram functions governed by the TSs, changes would also:

- Delete definitions and content for the "Fraction of Core Boiling Boundary (FCBB)" (TS 3.2.4) and the "Period Based Detection System (PBDS)" (TS 3.3.1.3), because each would no longer be required following the GGNS PRNMS change;

- Add MODE 2 operability for APRM scram Function 2.e, "2-Out-of-4 Voter," to the Special Operations for Shutdown Margin (SDM) Test-Refueling to enable the APRM scram functions "Neutron Flux – High, Setdown" and "Inop" to produce a trip signal to the RPS Trip System; and,

- Add an operating license condition to Paragraph 2.C.(2) of Facility Operating License No. NPF-29, which would state,

> During Cycle 19, GGNS will 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) will be disabled and operated in an "indicate only" mode and technical specification requirements will not apply to this function. 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. Once monitoring has been successfully completed, the OPRM Upscale function will be enabled and technical specification requirements will be applied to the function; no further operating with this function in an "indicate only" mode will be conducted.

3.2.1 RPS Instrumentation Functions Performed by the PRNMS

The following six numbered items within this section identify the details of the proposed TS changes for each RPS instrumentation APRM scram function that would be performed by the PRNMS as reflected TS 3.3.1.1-1, "Reactor Protection System Instrumentation."

1) The licensee summarized the proposed changes to the existing APRM scram Function 2.a, "Neutron Flux – High, Setdown" (see Reference 1, Section 4.4.3.2). This function would be changed as follows:

   a. The REQUIRED CHANNELS PER TRIP SYSTEM would add Note (c), which clarifies that, "Each trip channel provides inputs to both trip systems." In other words, each trip channel is provided to all 2-out-of-4 voters, so that it can affect both RPS Divisions, A and B.

   b. The SRs would: 1) replace SR 3.3.1.1.1 with SR 3.3.1.1.19, 2) replace SR 3.3.1.1.3 with SR 3.3.1.1.20, 3) remove SR 3.3.1.1.13, and 4) modify SR 3.3.1.1.10.

      i. The replacement of SR 3.3.1.1.1 with SR 3.3.1.1.19 would change the surveillance frequency for the CHANNEL CHECK from once every 12 hours to once every 24 hours without affecting any other function that relies upon SR 3.3.1.1.1.

      ii. The replacement of SR 3.3.1.1.3 with SR 3.3.1.1.20 would change the surveillance frequency for the CHANNEL FUNCTIONAL TEST from once every 7 days to once every 184 days and modify notes to indicate the channels and functions that will be included in the CHANNEL FUNCTIONAL TEST without affecting any other function that relies on SR 3.3.1.1.3.

      iii. The removal of SR 3.3.1.1.13 would eliminate applicability of the LOGIC SYSTEM FUNCTIONAL TEST without affecting any other function that relies upon SR 3.3.1.1.13, and an equivalent surveillance would be accomplished by the new SR 3.3.1.1.21 that applies to APRM Function 2.e.

      iv. The change to SR 3.3.1.1.10 would modify the surveillance frequency for the CHANNEL CALIBRATION from once every 184 days to once every 24 months and add Notes (d) and (e) to address instrument operability determinations. Note (d) would require channel operability to be evaluated if the as-found channel setpoint is outside its predefined as-found tolerance to verify the channel is operable before returning it to service. Note (e) would require the instrument channel setpoint to be reset to a value within the as-left tolerance around the Nominal Trip Setpoint (NTSP) at the completion of the surveillance; otherwise, the channel shall be declared inoperable. Note (e) would allow setpoints that are more conservative than the NTSP, as long as the as-found and as-left tolerances are applied to the more conservative value to confirm channel performance. Note (e) also identifies that the NTSP and the methodologies to determine the as-found and as-left tolerances would be specified in the Technical Requirements Manual.

2) The licensee summarized the proposed changes to the existing APRM scram Function 2.b, "Fixed Neutron Flux – High" (see Reference 1, Section 4.4.3.3). This function would be changed as follows:

a. The REQUIRED CHANNELS PER TRIP SYSTEM would add Note (c), which clarifies that each channel provides inputs to both trip systems. In other words, each trip channel is provided to all 2-out-of-4 voters, so that it can affect both RPS Divisions, A and B.

b. The SRs would: 1) replace SR 3.3.1.1.1 with SR 3.3.1.1.19, 2) replace SR 3.3.1.1.8 with SR 3.3.1.1.20, 3) remove SR 3.3.1.1.13 and SR 3.3.1.1.17, and 4) modify SR 3.3.1.1.10.

i. The replacement of SR 3.3.1.1.1 with SR 3.3.1.1.19 would change the surveillance frequency for the CHANNEL CHECK from once every 12 hours to once every 24 hours without affecting any other function that relies upon SR 3.3.1.1.1.

ii. The replacement of SR 3.3.1.1.8 with SR 3.3.1.1.20 would change the surveillance frequency for the CHANNEL FUNCTIONAL TEST from once every 92 days to once every 184 days and modify notes to indicate the channels and functions that will be included in the CHANNEL FUNCTIONAL TEST without affecting any other function that relies upon SR 3.3.1.1.8.

iii. The removal of SR 3.3.1.1.13 would eliminate applicability of the LOGIC SYSTEM FUNCTIONAL TEST without affecting any other function that relies upon SR 3.3.1.1.13, and an equivalent surveillance would be accomplished by the new SR 3.3.1.1.21 that applies to APRM Function 2.e.

iv. The removal of SR 3.3.1.1.15 would eliminate applicability of the surveillance requirement to verify the RPS RESPONSE TIME is within limits every 18 months on a staggered test basis from the "Fixed Neutron Flux – High" function without affecting any other function that relies upon SR 3.3.1.1.15, and an equivalent surveillance would be addressed by the new SR 3.3.1.1.22 that applies to APRM Function 2.e.

v. The change to SR 3.3.1.1.10 would modify the surveillance frequency for the CHANNEL CALIBRATION from once every

184 days to once every 24 months and add Notes (d) and (e) to address instrument operability determinations. Note (d) would require channel operability to be evaluated if the as-found channel setpoint is outside its predefined as-found tolerance to verify the channel is operable before returning it to service. Note (e) would require the instrument channel setpoint to be reset to a value within the as-left tolerance around the Nominal Trip Setpoint (NTSP) at the completion of the surveillance; otherwise, the channel shall be declared inoperable. Note (e) would allow setpoints that are more conservative than the NTSP, as long as the as-found and as-left tolerances are applied to the more conservative value to confirm channel performance. Note (e) also identifies that the NTSP and the methodologies to determine the as-found and as-left tolerances would be specified in the Technical Requirements Manual.

3) The licensee summarized the proposed changes to the existing APRM scram Function 2.c, "Inop" (see Reference 1, Section 4.4.3.4). This function would be changed as follows:

a. The REQUIRED CHANNELS PER TRIP SYSTEM would add Note (c), which clarifies that each channel provides inputs to both trip systems. In other words, each trip channel is provided to all 2-out-of-4 voters, so that it can affect both RPS Divisions, A and B.

b. The SRs would: 1) replace SR 3.3.1.1.8 with SR 3.3.1.1.20, and 2) remove SR 3.3.1.1.7 and SR 3.3.1.1.13.

i. The replacement of SR 3.3.1.1.8 with SR 3.3.1.1.20 would change the surveillance frequency for the CHANNEL FUNCTIONAL TEST from once every 92 days to once every 184 days and modify notes to indicate the channels and functions that will be included in the CHANNEL FUNCTIONAL TEST without affecting any other function that relies on SR 3.3.1.1.8.

ii. The removal of SR 3.3.1.1.7 would eliminate applicability of the surveillance requirement to calibrate of the local power range monitors from the "Inop" trip function, because the LPRM detector count would be removed from the "Inop" trip while remaining in the "Inop" alarm. SR 3.3.1.1.7 remains applicable to APRM functions 2.b and 2.d when in MODE 1 and APRM Function 2.a when in MODE 2.

iii. The removal of SR 3.3.1.1.13 would eliminate applicability of the LOGIC SYSTEM FUNCTIONAL TEST without affecting any other function that relies upon SR 3.3.1.1.13, and an equivalent surveillance would be addressed by the new SR 3.3.1.1.21 that applies to APRM Function 2.e.

4) The licensee summarized the proposed changes to the existing APRM scram Function 2.d, "Flow Biased Simulated Thermal Power – High" (see Reference 1, Section 4.4.3.5). This function would be changed as follows:

a. The Allowable Value would reference Note (b), which identifies it with two equations. The Allowable Value would become "0.65W + 62.9% Rated Thermal Power (RTP) AND <= 113% RTP" for two-loop operation and would become "0.65W + 42.3% RTP" for single-loop operation, where "W" represents the percent of rated recirculation drive flow. This information would be moved from the GGNS COLR into the TS, because these values would no longer be cycle-specific after the change from an Option E-1-A to an Option III OPRM core stability solution.

b. The REQUIRED CHANNELS PER TRIP SYSTEM would add Note (c), which clarifies that each channel provides inputs to both trip systems. In other words, each trip channel is provided to all 2-out-of-4 voters, so that it can affect both RPS Divisions, A and B.

c. The SRs for Function 2.d would: 1) replace SR 3.3.1.1.1 with SR 3.3.1.1.19, 2) replace SR 3.3.1.1.8 with SR 3.3.1.1.20, 3) remove SR 3.3.1.1.13, SR 3.3.1.1.15, SR 3.3.1.1.16, and SR 3.3.1.1.18, and 4) modify SR 3.3.1.1.10.

   i. The replacement of SR 3.3.1.1.1 with SR 3.3.1.1.19 would change the surveillance frequency for the CHANNEL CHECK from once every 12 hours to once every 24 hours without affecting any other function that relies upon SR 3.3.1.1.1.

   ii. The replacement of SR 3.3.1.1.8 with SR 3.3.1.1.20 would change the surveillance frequency for the CHANNEL FUNCTIONAL TEST from once every 92 days to once every 184 days and modify notes to indicate the channels and functions that will be included in the CHANNEL FUNCTIONAL TEST without affecting any other function that relies upon SR 3.3.1.1.8.

   iii. The removal of SR 3.3.1.1.13 would eliminate applicability of the LOGIC SYSTEM FUNCTIONAL TEST without affecting any other function that relies upon SR 3.3.1.1.13, and an equivalent surveillance would be accomplished by the new SR 3.3.1.1.21 that applies to APRM Function 2.e.

   iv. The removal of SR 3.3.1.1.15 would eliminate applicability of the surveillance requirement to verify the RPS RESPONSE TIME is within limits every 18 months on a staggered test basis without affecting any other function that relies upon SR 3.3.1.1.15, and an equivalent surveillance would be accomplished by the new SR 3.3.1.1.22 that applies to APRM Function 2.e.

v. The deletion of SR 3.3.1.1.16 would remove the verification of the simulated thermal power time constant based on prior justification which was previously approved (see Reference 22, SE, Section 4.1, page 32). This justification is based on verification of the setpoint being included within the CHANNEL CALIBRATION surveillance requirement, SR 3.3.1.1.10.

vi. The deletion of SR 3.3.1.1.18 would remove the verification of the flow control trip references that are associated with hardware that supports the Option E-1-A OPRM stability solution, because the proposed change eliminates the equipment associated with this surveillance.

vii. The change to SR 3.3.1.1.10 would modify the surveillance frequency for the CHANNEL CALIBRATION from once every 184 days to once every 24 months and would also change the verification of the simulated thermal power time constant from once every 18 months to once every 24 months. The change adds Notes (d) and (e) to address instrument operability determinations. Note (d) would require channel operability to be evaluated if the as-found channel setpoint is outside its predefined as-found tolerance to verify the channel is operable before returning it to service. Note (e) would require the instrument channel setpoint to be reset to a value within the as-left tolerance around the Nominal Trip Setpoint (NTSP) at the completion of the surveillance; otherwise, the channel shall be declared inoperable. Note (e) would allow setpoints that are more conservative than the NTSP, as long as the as-found and as-left tolerances are applied to the more conservative value to confirm channel performance. Note (e) also identifies that the NTSP and the methodologies to determine the as-found and as-left tolerances would be specified in the Technical Requirements Manual.

5) The licensee summarized the proposed changes to the add APRM scram Function 2.e, "2-Out-Of-4 Voter" (see Reference 1, Section 4.4.3.6). This function would be added to TS Table 3.3.1.1-1 as follows:

a. "2-Out-Of-4 Voter" would be added to the Function column as 2.e.

b. The APPLICABLE MODES would be MODES 1 and 2.

c. The REQUIRED CHANNELS PER TRIP SYSTEM would be two. This would require all four 2-out-of-4 Voter functions to be operable, because there are two 2-out-of-4 Voter functions per trip system.

d. The CONDITION REFERENCED FROM THE REQUIRED ACTION D.1 would be H, which is the action to be in MODE 3 with a completion time of

12 hours; thereby entering a mode wherein the function is no longer required.

e. The SRs would be SR 3.3.1.1.19, SR 3.3.1.1.20, SR 3.3.1.1.21, and SR 3.3.1.1.22.

   i. SR 3.3.1.1.19 would establish the CHANNEL CHECK at a surveillance frequency of once every 24 hours.

   ii. SR 3.3.1.1.20 would establish the CHANNEL FUNCTIONAL TEST at a surveillance frequency for of once every 184 days.

   iii. SR 3.3.1.1.21 would establish the LOGIC SYSTEM FUNCTIONAL TEST at a surveillance frequency of once every 24 months.

   iv. SR 3.3.1.1.22 would establish the RPS RESPONSE TIME verification at a surveillance frequency of once every 24 months on a staggered test basis for eight channels. The eight channels are based on two trip inputs to the RPS from four independent PRNMS channels. This would repeat RPS RESPONSE TIME verification on a specific channel once every 16 years.

f. The Allowable Value would be N/A, because a numeric setpoint is not applicable to the 2-out-of-4 voter, which responds to digital inputs that represent one of two states.

6) The licensee summarized the proposed changes to the add APRM scram Function 2.f, "OPRM Upscale" (see Reference 1, Section 4.4.3.7). This function would be added to TS Table 3.3.1.1-1 as follows:

   a. "OPRM Upscale" would be added to the Function column as 2.f.

   b. The APPLICABLE SPECIFIED CONDITION would be for operations at power greater than or equal to 24% RTP.

   c. The REQUIRED CHANNELS PER TRIP SYSTEM would be three with Note (c) applied. Note (c) clarifies that each channel provides inputs to both trip systems. In other words, each trip channel is provided to all 2-out-of-4 voters, so that it can affect both RPS Divisions, A and B.

   d. The Condition Referenced from the Required Action D.1 would be J, which is the action to initiate an alternate method to detect and suppress thermal hydraulic instability operations with a completion time of 12 hours, and to restore required channels to OPERABLE within 120 days. This alternate method is not one of the diverse backup algorithms already embedded in the PRNMS equipment. The change would also add Condition K, which applies whenever Condition J is not met within its required completion time. Condition K requires a reduction in THERMAL

POWER to less than 24% RTP within 4 hours; thereby entering a condition wherein the function is no longer required.

e. The SRs would be SR 3.3.1.1.7, SR 3.3.1.1.10, SR 3.3.1.1.19, SR 3.3.1.1.20, and SR 3.3.1.1.23.

   i. SR 3.3.1.1.7 would apply the existing surveillance and frequency to calibrate the local power range monitors.

   ii. SR 3.3.1.1.10 would establish the CHANNEL CALIBRATION at a surveillance frequency of once every 24 months.

   iii. SR 3.3.1.1.19 would establish the CHANNEL CHECK at a surveillance frequency of once every 24 hours.

   iv. SR 3.3.1.1.20 would establish the CHANNEL FUNCTIONAL TEST at a surveillance frequency of once every 184 days.

   v. SR 3.3.1.1.23 would establish a verification that the OPRM is not bypassed when the APRM Simulated Thermal Power is greater than or equal to 29% RTP and the recirculation drive flow is less than 60% of rated recirculation drive flow at a surveillance frequency of once every 24 months.

f. The Allowable Value would be provided by Note (f). Note (f) would state that the setpoint for the OPRM Upscale Period-Based Detection algorithm is specified in the CORE OPERATING LIMITS REPORT (COLR). The OPRM setpoints are established as nominal values based on cycle specific reload stability analysis.

3.2.2 Evaluation of TS Changes to PRNMS Functions

The NRC staff performed a limited evaluation of the I&C aspects of the proposed TS changes against the requirements of 10 CFR 50.36(c)(2)(i) and 10 CFR 50.36(c)(3), because of the continued applicability of staff conclusions documented in prior SEs (see References 22 and 23). This limited evaluation included an assessment of proposed GGNS PRNMS instrument configuration that: 1) implements four redundant but identical channels, 2) performs the identified APRM and OPRM functions, 3) performs 2-out-of-4 voting logic on the APRM and OPRM functions, and 4) produces RPS trip signal outputs that feed the RPS trip system's one-out-of-two taken twice logic. This evaluation included a review of the licensee's technical analysis (see Reference 1, Section 4.0) and the proposed mark-ups to the affected TS pages.

The NRC staff evaluated the proposed GGNS PRNMS instrument configuration to determine which prior SEs and conclusions related to TS changes remain applicable. The prior staff evaluations and conclusions are based on RPS instrumentation safety functions being performed by a sufficient number of redundant and independent PRNMS channels as assigned to redundant and independent electrical divisions (see References 22 and 23, Section 8.0, "Impact on Technical Specifications"). The NRC staff evaluated the GGNS PRNMS safety functions, which are performed by four redundant and independent channels with two channels assigned to each of two redundant and independent electrical safety divisions, against the previously documented and evaluated safety functions and configuration for a GE BWR/6 large core plant (see Reference 22, Figures E.2.1 and E.2.2, and Reference 23, Figures E.1.7, E.3.6, and E.5.6). The licensee clarified the proposed GGNS PRNMS configuration to support this evaluation (see Reference 4, Figures E.1.7, E.2.1, E.2.2, E.3.6, and E.5.6). Although some differences between the prior LTR configuration and the GGNS PRNMS exist (e.g., additional PCI data communications and interconnections, etc.), the NRC staff nevertheless determined that the prior evaluation of TS content for safety functions remains applicable to the proposed GGNS PRNMS instrumentation. Therefore, the prior NRC staff evaluations and the associated justifications remain valid for GGNS's proposed TS changes. Based on this conclusion, the NRC staff evaluated the details of each proposed TS change in consideration of the corresponding content, justifications, and evaluation as discussed in each prior LTR (References 22 and 23).

Example TS mark-ups are provided in each LTR (References 22 and 23, Appendices H), and the prior LTRs require plant-specific revised TSs that are consistent with these example mark-ups (see Reference 22, SE Section 5.0, "Plant-Specific Actions," paragraph 3). Therefore, the NRC staff evaluated each proposed change to existing APRM scram functions and each new APRM scram function against the TS changes that were identified and evaluated in the prior LTR SEs.

The following six numbered items within this section provide the NRC staff's evaluation of the proposed TS changes to the RPS instrumentation functions that would be performed by the PRNMS, which are identified in this SE in Sections 3.2.1, items 1 through 6.

1) Existing APRM scram Function 2.a, "Neutron Flux – High, Setdown" (see Section 3.2.1, item 1):

   While the previously reviewed TS mark-ups propose to modify the number of required channels per trip system to "3," the GGNS change does not require this as TS change, because the current GGNS NMS BWR/6 large core configuration has eight APRM channels with four channels per trip system and the previously reviewed mark-ups are for a BWR/4. The proposed equipment would provide all four channels to each 2-Out-Of-4 Voter. As is currently the case for GGNS, the required channels per trip system will remain at "3." Nevertheless, the proposed addition of Note (c) to the REQUIRED CHANNELS PER TRIP SYSTEM is provided for consistency with the example TS mark-ups (see References 22 and 23, Appendices H, page H-9). Three channels were previously approved as the number of required channels per trip system with Note (c) (see Reference 22, NEDC-32410P-A, Section 8.3.2.4).

   The proposed changes or equivalent changes to the following surveillances were previously reviewed and approved:

   - Changing the CHANNEL CHECK surveillance frequency to once every 24 hours (see Reference 22, NEDC-32410P-A, Section 8.3.4.1);

- Changing the CHANNEL FUNCTIONAL TEST surveillance frequency to once every 184 days and modifying the Notes to indicate the channels and functions that will be included in the CHANNEL FUNCTIONAL TEST (see Reference 22, NEDC-32410P-A, Section 8.3.4.2);

- Deleting the LOGIC SYSTEM FUNCTIONAL TEST (see Reference 22, NEDC-32410P-A, Section 8.3.5); and

- Changing the CHANNEL CALIBRATION to once every 24 months (see Reference 22, NEDC-32410P-A, Section 8.3.4.3).

After reviewing these proposed changes to APRM scram Function 2.a, "Neutron Flux – High, Setdown," the NRC staff determined that the changes adequately document safety function operability. Furthermore, these proposed changes satisfy the NRC staff's prior evaluation (see Reference 22, NEDC-32410P-A, Section 4.1) and the previously reviewed example TS change pages (see (References 22 and 23, Appendices H), which the NRC staff has determined continue to be applicable.

The NRC staff applied BTP 7-12, "Guidance on Establishing and Maintaining Instrument Setpoints," and Regulatory Guide 1.105, "Setpoints for Safety-Related Instrumentations," in its evaluation of the proposed Notes (d) and (e), which apply to the CHANNEL CALIBRATION surveillance. The NRC staff determined that the proposed Notes (d) and (e) provide reasonable assurance that equipment inoperability is not masked by the tolerances applied during surveillance and calibration activities.

Based on this evaluation, the NRC staff concludes that the proposed TS changes to Section 3.3.1.1 APRM scram Function 2.a meet the criteria of 10 CFR 50.36(c)(2)(i) and are acceptable.

2) The existing APRM scram Function 2.b, "Fixed Neutron Flux – High" (see Section 3.2.1, item 2):

The proposed addition of Note (c) to the REQUIRED CHANNELS PER TRIP SYSTEM of three was previously approved (see Reference 22, NEDC-32410P-A, Section 8.3.2.4). The NRC staff's evaluation and acceptance of proposed Note (c) is provided in Section 3.2.2, item 1.

Similar to the evaluation in Section 3.2.2, item 1, the proposed changes or equivalent changes to the following surveillances were previously reviewed and approved:

- Changing the CHANNEL CHECK surveillance frequency to once every 24 hours (see Reference 22, NEDC-32410P-A, Section 8.3.4.1);

- Changing the CHANNEL FUNCTIONAL TEST surveillance frequency to once every 184 days and modifying the Notes to indicate the channels and functions that will be included in the CHANNEL FUNCTIONAL TEST (see Reference 22, NEDC-32410P-A, Section 8.3.4.2);

- Deleting the LOGIC SYSTEM FUNCTIONAL TEST (see Reference 22, NEDC-32410P-A, Section 8.3.5);
- Deleting the RPS RESPONSE TIME verification (see Reference 22, NEDC-32410P-A, Section 8.3.4.4); and
- Changing the CHANNEL CALIBRATION from to once every 24 months (see Reference 22, NEDC-32410P-A, Section 8.3.4.3).

After reviewing these proposed changes to APRM scram Function 2.b, "Fixed Neutron Flux – High," the NRC staff determined that the changes adequately document safety function operability. Furthermore, these proposed changes satisfy the NRC staff's prior evaluation (see Reference 2, NEDC-32410P-A, Section 4.1) and the previously reviewed example TS change pages (see (References 22 and 23, Appendices H), which the NRC staff has determined continue to be applicable.

The NRC staff's evaluation and acceptance of proposed Notes (d) and (e) is provided in Section 3.2.2, item 1.

Based on this evaluation, the NRC staff concludes that the proposed TS changes to Section 3.3.1.1 APRM scram Function 2.b meet the criteria of 10 CFR 50.36(c)(2)(i) and are acceptable.

3) The existing APRM scram Function 2.c, "Inop" (see Section 3.2.1, item 3):

The proposed addition of Note (c) to the REQUIRED CHANNELS PER TRIP SYSTEM of three was previously reviewed and approved (see Reference 22, NEDC-32410P-A, Section 8.3.2.4). The NRC staff's evaluation and acceptance of proposed Note (c) is provided in Section 3.2.2, item 1.

Similar to the evaluation in Section 3.2.2, item 1, the proposed changes or equivalent changes to the following surveillances were previously reviewed and approved:

- Changing the CHANNEL FUNCTIONAL TEST surveillance frequency to once every 184 days and the modifying Notes to indicate the channels and functions that will be included in the CHANNEL FUNCTIONAL TEST (see Reference 22, NEDC-32410P-A, Section 8.3.4.2);
- Deleting the surveillance to calibrate of the local power range monitors (see Reference 22, NEDC-32410P-A, Sections 8.3.1 and 8.3.4.3); and
- Deleting the LOGIC SYSTEM FUNCTIONAL TEST (see Reference 22, NEDC-32410P-A, Section 8.3.5).

After reviewing these proposed changes to APRM scram Function 2.c, "Inop," the NRC staff determined that the changes adequately document safety function operability. Furthermore, these proposed changes satisfy the NRC staff's prior evaluation (see Reference 22, NEDC-32410P-A, Section 4.1) and the previously reviewed example TS change pages (see References 22 and 23, Appendices H), which the NRC staff has determined continue to be applicable.

Based on this evaluation, the NRC staff concludes that the proposed changes to Section 3.3.1.1 APRM scram Function 2.c meet the criteria of 10 CFR 50.36(c)(2)(i) and are acceptable.

4) The existing APRM scram Function 2.d, "Flow Biased Simulated Thermal Power – High" (see Section 3.2.1, item 4):

The proposed addition of Note (c) to the REQUIRED CHANNELS PER TRIP SYSTEM of three was previously reviewed and approved (see Reference 22, NEDC-32410P-A, Section 8.3.2.4). The NRC staff's evaluation and acceptance of proposed Note (c) is provided in Section 3.2.2, item 1.

The current GGNS TS identifies the Allowable Value as being in the COLR due to reductions in feedwater temperature that may be delayed for up to 12 hours, and the proposed change would replace the Allowable Value with a Note (b). A similar but not identical set of equations with a Note (b) was previously reviewed and approved (see References 22 and 23, Appendix H, page H-9); however, the proposed Note (b) had not been previously evaluated in the form proposed. The licensee stated that equations to define the Allowable Values for two-loop and single-loop operations have been confirmed in GEH Report 0000-0102-8815 (see Reference 13, Enclosure 1). GEH Report 0000-0102-8815 was supplied to support the NRC staff's evaluation of setpoint calculations, and a summary of this evaluation is contained in Section 3.5, "Setpoint Methodology and Calculations." To address the proposed TS change, the NRC staff compared the equations provided by the proposed Note (b) against the equations documented and analyzed in GEH Report 0000-0102-8815. This staff review confirmed the equations that are proposed for the TS Note (b) match those contained in GEH Report 0000-0102-8815. Section 5.6.5, "Core Operating Limits Report (COLR)," of the TS would also be changed to delete its reference to APRM Function 2.d as required by the addition of Note (b). Therefore, the NRC staff determined the proposed change to include Note (b) is acceptable based on the acceptability of the setpoint methodology and calculations (see Section 3.5).

Similar to the evaluation in Section 3.2.2, item 1, the proposed changes or equivalent changes to the following surveillances were previously reviewed and approved:

- Changing the CHANNEL CHECK surveillance frequency to once every 24 hours (see Reference 22, NEDC-32410P-A, Section 8.3.4.1);

- Changing the CHANNEL FUNCTIONAL TEST surveillance frequency to once every 184 days and modifying the Notes to indicate the channels and functions that will be included in the CHANNEL FUNCTIONAL TEST (see Reference 22, NEDC-32410P-A, Section 8.3.4.2);

- Deleting the LOGIC SYSTEM FUNCTIONAL TEST (see Reference 22, NEDC-32410P-A, Section 8.3.5);

- Deleting the RPS RESPONSE TIME verification (see Reference 22, NEDC-32410P-A, Section 8.3.4.4);

- Deleting the verification of the simulated thermal power time constant (see Reference 22, NEDC-32410P-A, Section 8.3.4.3);

- Deleting the separate adjustment and verification of the flow control trip references (see Reference 22, NEDC-32410P-A, Section 8.3.4.3.2 2); and

- Changing the CHANNEL CALIBRATION from to once every 24 months (see Reference 22, NEDC-32410P-A, Section 8.3.4.3).

The NRC staff agrees that the elimination of the equipment associated with SR 3.3.1.1.18, as described by the licensee (see Reference 1, Section 4.4.2.3) justifies deletion of this surveillance requirement.

After reviewing these proposed changes to APRM scram Function 2.d, "Flow Biased Simulated Thermal Power – High," the NRC staff determined that the changes adequately document safety function operability. Furthermore, these proposed changes satisfy the NRC staff's prior evaluation (see Reference 22, NEDC-32410P-A, Section 4.1) and the previously reviewed example TS change pages (see References 22 and 23, Appendices H), which the NRC staff has determined continue to be applicable.

The NRC staff's evaluation and acceptance of proposed Notes (d) and (e) is provided in Section 3.2.2, item 1.

Based on this evaluation, the NRC staff concludes that the proposed changes to Section 3.3.1.1 function APRM scram 2.d meet the criteria of 10 CFR 50.36(c)(2)(i) and are acceptable.

5) The new APRM scram Function 2.e, "2-Out-Of-4 Voter" (see Section 3.2.1, item 5):

The proposed additions or equivalent additions were previously reviewed and approved:

- Adding the 2-Out-Of-4 Voter function under RPS instrumentation 3.3.1.1 (see Reference 22, NEDC-32410P-A, Section 8.3.2.4 as supplemented by Appendix H);
- Defining the APPLICABLE MODES as 1 and 2 (see Reference 22, NEDC-32410P-A, Section 8.3.3.4);
- Defining the REQUIRED CHANNELS PER TRIP SYSTEM as two (see Reference 22, NEDC-32410P-A, Section 8.3.2 and Reference 23, Section 8.4.2.2, as supplemented by each Appendix H);
- Defining the CONDITION REFERENCED FROM THE REQUIRED ACTION D.1 to require being in MODE 3 with a completion time of 12 hours (see Reference 22, NEDC-32410P-A, Appendix H);
- Defining the CHANNEL CHECK surveillance frequency to be once every 24 hours (see Reference 22, NEDC-32410P-A, Section 8.3.4.1);
- Defining the CHANNEL FUNCTIONAL TEST surveillance frequency to be once every 184 days and the Notes that indicate the channels and functions that will be included in the CHANNEL FUNCTIONAL TEST (see Reference 22, NEDC-32410P-A, Section 8.3.4.2 and Reference 3, Section 8.4.4.2);
- Defining the LOGIC SYSTEM FUNCTIONAL TEST surveillance frequency to be once every 24 months (see Reference 22, NEDC-32410P-A, Sections 8.3.5.2 and 8.4.5.2);
- Defining the RPS RESPONSE TIME verification surveillance frequency to be once every 24 months on a staggered test basis for eight channels (see Reference 22, NEDC-32410P-A, Section 8.3.4.4 and Reference 23, Section 8.4.4.4); and
- Defining the Allowable Value as N/A (see Reference 22, NEDC-32410P-A, Appendix H).

After reviewing the proposed APRM scram Function 2.e, "2-Out-Of-4 Voter," the NRC staff determined that the changes adequately document safety function operability. Furthermore, these proposed changes satisfy the NRC staff's prior evaluation (see Reference 22, NEDC-32410P-A, Section 4.1) and the previously reviewed example TS change pages (see References 22 and 23, Appendices H), which the NRC staff has determined continue to be applicable.

Based on this evaluation, the NRC staff concludes that the proposed TS addition of Section 3.3.1.1 APRM scram Function 2.e meet the criteria of 10 CFR 50.36(c)(2)(i) and are acceptable.

6) The new APRM scram Function 2.f, "OPRM Upscale" (see Section 3.2.1, item 6):

The proposed additions or equivalent additions were previously reviewed and approved:

- Adding the OPRM Upscale function under RPS instrumentation 3.3.1.1 (see Reference 23, NEDC-32410P-A, Section 8.4.1 as supplemented by Appendix H);

- Defining the APPLICABLE SPECIFIED CONDITION as greater than or equal to 24% RTP. This represents a GGNS specific value that is 1% RTP less than the LTR value of ≥25% RTP, because the GGNS specific nominal value for the APRM scram Function 2.d, "Flow Biased Simulated Thermal Power – High" is 29% RTP, which is 1 % RTP less than the LTR value of 30% RTP (see Reference 23, NEDC-32410P-A, Section 8.4.3);

- Defining the REQUIRED CHANNELS PER TRIP SYSTEM as three with Note (c) (Reference 23, NEDC-32410P-A, Section 8.4.2 as supplemented by Appendix H);

- Defining the CONDITION REFERENCED FROM THE REQUIRED ACTION D.1 to initiate an alternate method to detect and suppress thermal hydraulic instability operations with a completion time of 12 hours, and to restore required channels to OPERABLE within 120 days, and further requiring a failure to complete this action within its completion time to require a reduction in THERMAL POWER to less than 24% RTP within 4 hours. (see Reference 23, NEDC-32410P-A, Section 8.4.2.2 as supplemented by Appendix H);

- Defining the CHANNEL CHECK surveillance frequency to be once every 24 hours (see References 22 and 23, NEDC-32410P-A, Sections 8.4.4.1);

- Defining the CHANNEL FUNCTIONAL TEST surveillance frequency to be once every 184 days and the Notes that indicate the channels and functions that will be included in the CHANNEL FUNCTIONAL TEST (see References 22 and 23, NEDC-32410P-A, Sections 8.4.4.2);

- Defining a verification that the OPRM is not bypassed when the APRM Simulated Thermal Power is greater than or equal to 29% RTP and the recirculation drive flow is less than 60% of rated recirculation drive flow at a surveillance frequency of once every 24 months (see Reference 23, NEDC-32410P-A, Sections 8.4.4.2); and

- Defining the Allowable Value to be a setpoint that is specified in the COLR via Note (f), in contrast to N/A (see Reference 23, NEDC-32410P-A, Appendix H).

The licensee proposed to add new Function 2.f to TS Table 3.3.1.1-1. The OPRM Upscale function provides the capability to detect and suppress reactor thermal-hydraulic instabilities. This new safety-related function will be required to be operable only when reactor power is greater than or equal to 24% RTP. The required minimum number of operable OPRM channels will be three channels per trip system. Each OPRM channel provides inputs to both trip systems.

The minimum operable OPRM cells setpoint (30) is defined by GEH analyses based on the selection of the OPRM cell assignments and a requirement for a minimum of two LPRMs per cell. The OPRM Period-Based Detection Algorithm Upscale setpoint is determined using the Option III reload licensing methodology (Reference 50) with the exception that a plant/cycle-specific Delta CPR [critical power ratio] over Initial MCPR [minimum critical power ratio] MCPR versus the Oscillation Magnitude (DIVOM) curve slope is applied in place of the generic DIVOM curve slope. 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 proposed TS Bases markup). The amplitude based and growth rate algorithms are not credited in the safety analysis, and their settings are documented only in the GGNS procedures. The licensee proposed that the Period-Based Detection Algorithm setpoint for the OPRM Upscale function is as specified in COLR in the Allowable Value column of TS Table 3.3.1.1-1.

In addition, the licensee proposed to add new Action Statement Condition J for new OPRM Upscale Function 2.f and Condition K. Condition J addresses a loss of trip capability in both RPS trip systems. Condition K requires reducing power to < 24% RTP within 4 hours in accordance with Required Action K.1 if Condition J cannot be met.

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 procedures. New Required Action J.2 requires restoring OPRM Upscale trip capability within 120 days.

The NRC staff reviewed the proposed addition of Conditions J and K and concludes they are acceptable because the proposed addition of Conditions J and K provide conservative default conditions when the low-tier conditions associated with combinations of OPRM channel/function/RPS trip capability cannot be met. The licensee will implement BSP (Reference 3) as an alternate method for detection and suppression of instabilities during the initial monitoring period when PRNMS is operable but the OPRM trip is not enabled.

Prior NRC staff approvals of the "OPRM Upscale" function did not require an Allowable Value for the "OPRM Upscale" function, because it represents a nominal setpoint value that is not derived through calculations from either an analytical limit or safety limit. Furthermore, the setpoint value has no drift terms associated with it upon which to derive an Allowable Value. Regardless, the licensee proposed and discussed including this setpoint value in the COLR (see Reference 13, response to RAI 24). GGNS TS 5.6.5 will be changed to add a reference to APRM Function 2.f, because the "OPRM Upscale" setpoint is cycle-specific. The proposed addition of Note (f) is necessary when making the proposed COLR change. Furthermore, prior staff approvals, which the NRC staff has determined continue to be applicable, place the "OPRM Upscale" setpoint in the COLR (see Reference 42). Therefore, the NRC staff determined the proposed changes to include Note (f), and reference Function 2.f from within the TS 5.6.5 are acceptable.

After evaluating the proposed APRM scram Function 2.f, "OPRM Upscale," the NRC staff determined that the changes adequately document OPRM function operability. Furthermore, these proposed changes satisfy the NRC staff's prior evaluation (see Reference 22, NEDC-32410P-A, Section 4.1) and the previously reviewed example TS change pages (see References 22 and 23, Appendices H), which the NRC staff has determined continue to be applicable.

Based on this evaluation, the NRC staff concludes that the licensee's proposal for the bases of generating the OPRM setpoint and for documenting the Period-Based Detection Algorithm setpoint for the OPRM Upscale function in the COLR are acceptable because the Period-Based Detection Algorithm setpoint for the OPRM Upscale function is a plant and cycle-specific parameter, and calculated based on approved methodologies. Based on the above, the NRC staff reviewed the proposed addition of Function 2.f to TS Table 3.3.1.1-1 and found it acceptable because the OPRM Upscale Function 2.f provides the capability to detect and suppress reactor thermal-hydraulic instabilities and is consistent with the NUMAC PRNM LTR requirements.

3.2.3 <u>Evaluation of the Balance of Supporting TS Changes</u>

The following four numbered items within this section provide the NRC staff's evaluation of the proposed balance of TS changes.

1) Deletion of Fraction of Core Boiling Boundary (FCBB):

The FCBB will no longer be required following implementation of the GGNS PRNMS and the licensee proposed changes to the following TS sections:

- Section 1.1 - to delete the FCBB definition (see Reference 1, Section 4.2); The NRC staff reviewed the proposal and found it acceptable because FCBB is a component of the Option E-1-A stability solution and is no longer in use for the proposed Option III stability solution.

- Section 3.2.4 - to delete the section in its entirety, because its scope is the FCBB (see Reference 1, Section 4.3). The licensee proposed to delete TS 3.2.4 in its entirety. The proposed change is acceptable because FCBB is no longer in use for the proposed Option III stability solution.

- Section 5.6.5 - to delete references to Section 3.2.4 (see Reference 1, Section 4.7). The licensee proposed (1) to delete APRM Function 2.d, which is no longer included in the COLR, and to add APRM Function 2.f to TS 5.6.5.a.5 as "LCO 3.3.1.1, RPS Instrumentation, Table 3.3.1.1-1 APRM Function 2.f"; (2) to delete LCO 3.2.4 from TS 5.6.5.a.4; (3) to delete LCO 3.3.1.3 from TS 5.6.5.a.6; and to add NEDO-31960-A, "BWR Owners' Group Long-Term Stability Solutions Licensing Methodology," and NEDO-32465-A, "Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology and Reload Applications," to TS 5.6.5.b.

The NRC staff reviewed the licensee's proposed revision and found them acceptable because: (1) APRM Function 2.d, TS 5.6.5.a.4, and TS 5.6.5.a.6 are no longer in use for Option III stability solution; and (2) both NEDO-31960-A and NEDO-32465-A are NRC approved methodologies to support Option III stability solution. However, the approved methodologies should be specified with their version and date of approval in accordance with the COLR guidance specified in Generic Letter No. 88-16.

The NRC staff agrees that the proposed changes to the TS are necessary when changing GGNS's method to detect and suppress reactor core thermal power instability oscillations from Option E-1-A to Option III, which would no longer require the FCBB function. Based on the above, the NRC staff concludes that the proposed changes to delete FCBB content are acceptable.

2) Deletion of Period Based Detection System (PBDS):

The PBDS would no longer be required following implementation of the GGNS PRNMS, and the licensee proposed changes to the following TS sections:

- Section 3.3.1.3 - to delete the section in its entirety, because its scope is the PBDS (see Reference 1, Section 4.5); and

- Section 5.6.5 - to delete references to Section 3.3.1.3 (see Reference 1, Section 4.7).

The NRC staff agrees that the proposed changes to the TS are necessary when replacing the PBDS with the proposed PRNMS. The proposed PRNMS embeds a period-based algorithm within the APRM scram function, 2.f, "OPRM Upscale." Therefore, the addition of OPRM Upscale TSs replaces the PBDS TSs. These TSs are identified in Section 3.2.1, item 6 and evaluated in Section 3.2.2, item 6. Based on this evaluation, the NRC staff concludes the proposed changes to delete PBDS content are acceptable.

3) Addition of MODE 2 operability for APRM scram Function 2.e, "2-Out-Of-4 Voter," to SDM Test-Refueling:

The licensee proposed a change to the following TS section:

- Section 3.10.8 to add MODE 2 operability for APRM scram Function 2.e (see Reference 1, Section 4.6).

SDM Test-Refueling currently requires operability of APRM scram functions 2.a and 2.c. Following the proposed change to implement the PRNMS, operability of Function 2.e would also be required to produce RPS Trip System inputs based on either APRM scram Function 2.a or 2.c. The NRC staff agrees this change is necessary to adequately document safety function operability for SDM Test Refueling. Furthermore, this proposed change satisfies the NRC staff's prior evaluation (see Reference 23, NEDC-32410P-A, Section 8.6). Based on this evaluation, the NRC staff concludes the proposed change to add MODE 2 operability for APRM scram Function 2.e during SDM Test-Refueling meets the criteria of 10 CFR 50.36(c)(2)(i) and is acceptable.

4) Addition of Operating License Provision to Conduct Monitoring of the OPRM during Cycle 19 with the OPRM Upscale Function 2.f, Trip Output Disabled:

The licensee proposed that a provision be added to paragraph 2.C.(2) of Facility Operating License No. NPF-29 that would allow a monitoring period for the APRM scram Function 2.f, "OPRM Upscale," before this function's trip output to the RPS Trip System would be enabled (see Reference 1, Sections 3.3 and 4.1 and Reference 3, response to RAI 1, item (4)). During a monitoring period of 90 days beginning from startup into Cycle 19, the "OPRM Upscale" function would provide indications only without associated trips to the RPS, and GGNS would monitor the OPRM's performance using the available indications. For the monitoring period with the OPRM trip output disabled, GGNS would provide BSP measures as an alternate method to detect and suppress reactor core thermal power instability oscillations. Plant operation during this monitoring period will rely on operator action to avoid regions where instability may occur, to exit such regions when necessary, and to detect an actual instability and take mitigating action by the BSP as described in BWROG document OG-02-0119-260 (Reference 50). This license provision allows the LCOs that would otherwise be associated with the "OPRM Upscale" Function 2.f to be deferred until the monitoring period is complete and the OPRM trip output is permanently enabled.

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. Also, BSP measures specified in BWROG document OG-02-0119-260 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.

(2) The monitoring period will last for 90 days. Upon completing the monitoring period, the OPRM Upscale function will be enabled and subject to all applicable TS requirements.

In order to reflect this approach, Entergy proposes to modify Facility Operating License NPF-29 Paragraph 2.C.(2): (1) to delete a paragraph pertaining to performing SRs related to previous TS Amendment 169, which is no longer applicable; and (2) to add an applicable paragraph to Section 2.C.(2) that states:

> During Cycle 19, GGNS will 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) will be disabled and operated in an "indicate only" mode and technical specification requirements will not apply to this function. 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. Once monitoring has been successfully completed, the OPRM Upscale function will be enabled and technical specification requirements will be applied to the function; no further operating with this function in an "indicate only" mode will be conducted.

The NRC staff determined that this operating license condition is necessary for the proposed PRNMS to ensure correct operation of the OPRM function prior to relying upon its operability. Furthermore, this proposed change satisfies the NRC staff's prior evaluation (see Reference 22, SE Section 4.2 and NEDC-32410P-A, Section 8.4), because it specifies a suitable monitoring period up to one fuel cycle prior to enabling the "OPRM Upscale" function. The NRC staff determined that the proposed license condition provides equivalent assurance to the most recent staff approval to implement a PRNMS with OPRM Option III (see Reference 42). This most recent approval for the Monticello Nuclear Generating Plant established and justified a minimum 90-day monitoring period (shorter than one fuel cycle) based on other nuclear power plant operating experiences with GEH NUMAC PRNMS systems that have fully-enabled OPRM III functions. Based on this evaluation, the NRC staff concludes that the proposed operating license condition for Cycle 19 is acceptable. This operating license condition allows a monitoring period for the APRM scram Function 2.f of 90 days into Cycle 19.

3.3 PRNMS Interfaces Including Digital Instrumentation Communications

The regulations in 10 CFR 50.55a(h), "Protection and safety systems," approve the 1991 version of IEEE Standard 603, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations," for incorporation by reference including the correction sheet dated January 30, 1995. IEEE 603-1991 Clause 5.6, "Independence," requires independence between (1) redundant portions of a safety system, (2) safety systems and the effects of design basis events, and (3) safety systems and other systems. SRP Chapter 7, Appendix 7.1-C, Section 5.6, "Independence," provides acceptance criteria for this requirement, and among other guidance, provides additional acceptance criteria for communications independence. Section 5.6 states that where data communication exists between different portions of a safety system, the analysis should confirm that a logical or software malfunction in one portion cannot affect the safety functions of the redundant portions, and that if a digital computer system used in a safety system is connected to a digital computer system used in a non-safety system, a logical or software malfunction of the non-safety system must not be able to affect the functions of the safety system.

IEEE 7-4.3.2-2003, endorsed by Regulatory Guide 1.152, "Criteria for Use of Computers in Safety Systems of Nuclear Power Plants," Clause 5.6, "Independence," provided guidance on how IEEE 603 requirements can be met by digital systems. This clause of IEEE 7-4.3.2 states that, in addition to the requirements of IEEE Standard 603-1991, data communication between safety channels or between safety and non-safety systems shall not inhibit the performance of the safety function. SRP Chapter 7, Appendix 7.1-D, Section 5.6, "Independence" provides acceptance criteria for independence. This section includes a restatement from 10 CFR 50, Appendix A, GDC 24, "Separation of protection and control systems," that the protection system be separated from control systems to the extent that failure of any single control system component or channel, or failure or removal from service of any single protection system component or channel that is common to the control and protection systems leaves intact a system satisfying all reliability, redundancy, and independence requirements of the protection system, and that interconnection of the protection and control systems shall be limited so as to assure that safety is not significantly impaired. Additional guidance on interdivisional communications is contained in "Interim Staff Guidance, Digital Instrumentation and Controls, DI&C-ISG-04, Task Working Group #4, Highly-Integrated Control Rooms Communications Issues (HICRc)," Revision 1, dated March 6, 2009 (Reference 43).

The transmittal letters approving the LTR in 1995 (see Reference 22) and its supplement in 1997 (see Reference 23) state, in part, that

> Should NRC criteria or regulations change so as to invalidate the conclusions concerning the acceptability of the report, GE or the applicants referencing the topical report will be expected to revise or resubmit their respective documentation, or submit justification for the continued effective applicability of the topical report without revision of their respective documentation.

Since these prior reviews and approvals, further NRC staff guidance has been made available that provides evaluation criteria applicable to safety-to-non-safety interfaces of digital I&Cs to include interchannel communication. Guidance applicable to safety-to-non-safety interfaces is provided 1) Regulatory Guide 1.75, "Criteria for Independence of Electrical Safety Systems," 2) SRP Branch Technical Position (BTP) 7-11, "Guidance on Application and Qualification of Isolation Devices," and 3) DI&C-ISG-04, "Task Working Group #4: Highly-Integrated Control Rooms—Communications Issues (HICRc)." This set of guidance applies to the proposed change, because the GGNS PRNMS is digital instrumentation that performs safety functions and includes safety-to-non-safety interfaces and interchannel communications. While physical and electrical independence via separation and isolation devices were previously evaluated (see Reference 22, Sections 3.5 and 3.6) and remain valid, the PRNMS interfaces were not previously evaluated against the data independence criteria for interchannel communications in DI&C-ISG-04.

The base LTR and its supplement contain limited details of the interfaces associated with a GE BWR/6 large core plant, and the GGNS change is the first GEH NUMAC PRNMS configuration to be reviewed by the NRC staff for a GE BWR/6 large core plant. When performing the SE, the NRC staff identified that the prior SE includes the statement that the "PCIs do not transmit information from the plant computer to the safety system" (see Reference 23, SE, page 2).
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]] Therefore, the NRC staff determined that the prior SEs had not addressed equivalent criteria to that in DI&C-ISG-04 and that data independence criteria required an evaluation to determine whether the operability of otherwise independent safety channels would be adversely affected by interchannel digital communications.

To address the interface criteria including data independence, by letter dated May 4, 2010, the NRC staff provided a request for additional information (RAI) for the licensee to demonstrate adherence to each point in DI&C-ISG-04 (see Reference 44, RAI 4), and the licensee provided a response (see Reference 4, Attachment 3). Based on the NRC staff's review of this response, by electronic mail dated April 27, 2011, the NRC staff requested additional information from the licensee to evaluate whether reasonable assurance exists that the communication interfaces would not adversely affect the PRNMS safety functions (see Reference 45, RAIs 12 through 19).

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]] In this way, the processing of data communications does not affect the timing or complicate the performance of the safety functions (see DI&C-ISG-04, "Interdivisional Communications," Staff Position 1.2).

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The PRNMS communication protocols and methods have not changed since the NRC staff's original review and approval of the LTRs, and the LTR includes watchdog timer features that ensure that a failure of the system to meet any of its cycle time performance requirements will be detected and alarmed (see DI&C-ISG-04, "Interdivisional Communications," Staff Position 1.5). As part of this review, the NRC staff confirmed that the GGNS PRNMS requirements include a watchdog timer features that will detect when software is not executing at the expected interval including the communication tasks. The following set of requirement documents trace the applicable watchdog timer requirements for the GGNS PRNMS (see Reference 12):

- 23A5082AA, "NUMAC REQUIREMENTS SPECIFICATION," Rev. 1, Sections 4.6.2.1, c. and 4.6.2.2 b. and c.(1);

- 26A8153, "NUMAC APRM WITH DSS-CD," Rev. 2, Sections 4.1.1, 4.3.4.10.1, and 4.3.6.2; and

- 26A7523, "APRM Functional Software Design Specification," Rev. 0, Sections 4.2.1, 4.3.10, 5.2.1, and 5.3.8.

The NRC staff also evaluated the potential effect of serial communication errors on the specified response time performance requirements (see Section 3.6 of this SE).

The licensee showed the PRNMS interfaces and signal/data flow within a PRNMS channel, between PRNMS channels, and external to the PRNMS equipment through a combination of block diagrams (see Reference 4, Figures E.1.7, E.2.1, E.2.2, and E.3.6). Additional figures provide further details and categorized and the data communications as one of three types: 1) between safety and safety, 2) between safety and non-safety, or 3) between non-safety and non-safety (see Reference 4, Figures 4-1, 4-2, and 4-3). And one additional functional block diagram identifies interfaces and signals required to remain operable for the PRNMS to successfully perform its safety functions (see Reference 12, Figure 28-1, signals shown as red lines). The NRC staff used these figures to identify each unique GGNS PRNMS interface, and the following sections summarize the evaluation of these interfaces against applicable acceptance criteria.

3.3.1 Intrachannel Communications Between PRNMS Safety Components

DI&C-ISG-04 does not directly address interfaces between safety-related components within a channel; nevertheless, the following two numbered items provide the NRC staff's evaluation of two PRNMS interfaces within a PRNMS channel 1) 2-out-of-4 Voter to APRM and 2) interfaces to support maintenance and monitoring, to determine whether the intrachannel communications depends upon data external to the channel in such a way that could adversely affect reliable performance of the safety functions within the otherwise independent PRNMS channels.

1) 2-out-of-4 Voter to APRM

DI&C-ISG-04, "Interdivisional Communications," Staff Position 1.8 states that "Data exchanged between redundant safety divisions should be processed in a manner that does not adversely affect the safety function of the sending divisions, the receiving divisions, or any other independent divisions." DI&C-ISG-04, "Interdivisional Communications," Staff Position 1.11 states, in part, that "The progress of a safety function processor through its instruction sequence should not be affected by a message from outside its division." The "NUMAC PRNM Requirement Specification" identifies both the 2-out-of-4 Voter and APRM as safety-related (see Reference 12), and each contains safety function processing.

The NRC staff evaluated the 2-out-of-4 Voter to APRM safety-to-safety interface to determine whether the data associated with interchannel communications between 2-out-of-4 Voters could be propagated to each APRM channel by the 2-out-of-4 Voter to APRM communications in a way that could reasonably have an adverse effect on the APRM safety functions. Both the 2-out-of-4 Voter and APRM have been qualified as safety-related Class 1E equipment. [[

]] In this way, the processing of data communications does not affect the timing or complicate performance of the safety functions.

In accordance with the LTR, this interface provides information about the 2-out-of-4 Voter's self test status and channel bypass state to the APRM (see Reference 22, Figure E.2.1), and this interface has been confirmed to exist even though it was not explicitly identified in the GGNS-specific replacement figure (see Reference 4, Figure E.2.1). The data provided by this communication path is not used by the APRM safety functions, and the licensee described compliance to DI&C-ISG-04 for this interface (see Reference 4, Attachment 3, page 3, item 20). In its response to DI&C-ISG-04, "Interdivisional Communications," Staff Position 1.2, the licensee stated that the APRM does not receive data from any other safety channel. Therefore, the communications from the 2-out-of-4 Voter to APRM does not include data from another safety channel that could influence the APRM safety functions.

In its response to DI&C-ISG-04, "Interdivisional Communications," Staff Position 1.8, the licensee stated that communications between safety divisions is validated by the receiving destination. As such, the NRC staff determined that the receiving interface of each safety-related Class 1E 2-out-of-4 Voter and that shares its channel with the APRM is responsible to ensure interchannel communications between 2-out-of-4 Voters cannot propagate errors to the APRM channel. The communications between 2-out-of-4 Voters is evaluated in Section 3.3.2, item 1.

Based on the determination that the 2-out-of-4 Voter to APRM communications utilizes the methods previously reviewed and approved for the LTR (Reference 22), does not include data from another safety division, and contains data that cannot adversely affect the safety function as further supported by the evaluation in Section 3.3.2, item 1, the NRC staff determined that the 2-out-of-4 Voter to APRM interface does not compromise the independence between safety channels such that operability of interconnected channels would be adversely affected.

2) Interfaces to Support Maintenance and Monitoring

As referenced by DI&C-ISG-04, "Multidivisional Control and Display Stations," Staff Position 3.1, DI&C-ISG-04, "Interdivisional Communications," also governs communications between a safety division and shared maintenance and monitoring equipment to ensure that performance of maintenance and monitoring does not present the potential to simultaneously adversely affect the safety functions in more than one redundant and independent channel.

The licensee confirmed that the PRNMS does not have a common operator workstation to control or monitor multiple PRNMS channels (see Reference 4, Attachment 3, and Reference 10, response to RAI 16). Rather, each PRNMS channel has built-in local front panels to perform maintenance and monitoring activities. These built-in maintenance and monitoring features are included within the APRM and LPRM and have been developed and qualified as safety-related Class 1E equipment in accordance with the "NUMAC PRNM Requirement Specification" (see Reference 12). These maintenance and monitoring features include local front panels, switches, and software maintenance modes. The licensee also confirmed that the PRNMS safety functions cannot be modified in the field using maintenance equipment; instead, all programmable devices are controlled as hardware configuration items by the original equipment manufacturer.

In addition to the built-in PRNMS local maintenance panels, the licensee's approach to detector gain and calorimetric adjustments includes functionality that is supported by the PCI. The PCI supports this functionality via the non-safety interface between the PCIs and the NICs (evaluated in Section 3.3.5, item 2), and the non-safety PCI interface to its channel's safety-related APRM (evaluated in Section 3.3.4, item 2). These interfaces remain active and there is no hardware interlock that requires a PRNMS channel to be placed into bypass in order for the pending gain adjustments to be made available within a PRNMS channel for local review and confirmation using the PRNMS's built-in maintenance and monitoring features.

The NRC staff requested clarification of the administrative controls that would be in place to bypass a PRNMS channel (see Reference 44, RAI 9). The staff reviewed the licensee's responses that clarified the administrative controls, the use of the local front panels, modes and switches (see Reference 4, response to RAI 9, and Reference 10, responses to RAIs 16 and 17). From this review, the NRC staff determined that the licensee's approach satisfies the basis that was previously reviewed and approved in the LTR (Reference 22). These licensee responses clarified that all maintenance activities will be performed in accordance with administrative controls that include a password and keylock. [[

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The number of APRM channels that can be simultaneously bypassed is restricted to one channel by the TS and the PRNMS 2-out-of-4 Voter logic design. By specification and design, the PRNMS requires maintenance activities to first place the instrument into bypass, use of the keylock switch and password (both administratively controlled), and additional operator confirmatory actions via the local front panel display and keypad input with the sole exception being the APRM calorimetric gain adjustments. [[

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Based on the NRC staff's review of the licensee's approach that does not include any common operator workstation to control or monitor multiple PRNMS channels and only includes hardwired control and indicating devices in the operator bench board, the NRC staff determined that Section 3 within DI&C-ISG-04 does not apply to the PRNMS. Based on the NRC staff's review of the design features of the proprietary protocol that ensure the active communications associated with non-safety equipment external to the PRNMS do not impact the APRM's ability to perform its safety functions, the NRC staff determined that these communications do not compromise the independence of the safety channels or adversely affect the operability of the safety functions.

3.3.2 Interchannel Communications Between PRNMS Safety Components

DI&C-ISG-04 states that digital instrumentation communication interfaces between independent safety channels should meet the same criteria as established for communication interfaces between non-safety and safety equipment. The following two numbered items provide the NRC staff's evaluation of two PRNMS interfaces within a PRNMS channel, 1) 2-out-of-4 Voter to 2-out-of-4 Voters and 2) APRM to 2-out-of-4 Voters, against the DI&C-ISG-04, Staff Position 1, "Interdivisional Communications."

1) 2-out-of-4 Voter to 2-out-of-4 Voters

DI&C-ISG-04 acknowledges the need to share trip signals from otherwise independent channels to perform a voting function; however, this does not directly address the licensee's approach to share bypass switch status information among voter channels. The proposed approach shares bypass signals between voters to allow the programmed voter logic to determine whether multiple channels are in bypass, and if so to take conservative actions. These actions include alarm annunciation and removal of all channels from bypass, as performed within each 2-out-of-4 voter's programmable logic. The voter logic will change from 2-out-of-4 to 2-out-of-3 by eliminating the bypassed channel from the voting when one-and-only-one channel is bypassed. The "NUMAC PRNM Requirement Specification" identifies the 2-out-of-4 Voter as safety-related (see Reference 12).

A block diagram identifies the interface from each 2-out-of-4 Voter to all other 2-out-of-4 Voters (see Reference 12, Figure 14-1). [[

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The NRC staff reviewed the licensee's responses that pertain to this interface to ensure that this interchannel communications satisfies the criterion established under DI&C-ISG-04, Staff Position 1, "Interdivisional Communications" (see Reference 10, response to RAI 13; Reference 12, response to RAI 14; Reference 11, response to RAI 15; and Reference 15, supplemental response to RAI 13, item 4). This review confirmed that this signal is not the type of digital data communications that DI&C-ISG-04, Staff Position 1, "Interdivisional Communications," was created to specifically consider; therefore, this review confirmed that the licensee's approach satisfies the applicable criterion of DI&C-ISG-04 for signal isolation and independence. The approach, as described, satisfies the basis that was previously reviewed and approved in the LTR (Reference 22), and its functionality is tested during formal PRNMS V&V activities. [[

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Based on the NRC staff's review of the 2-out-of-4 Voter to 2-out-of-4 Voter communications, the NRC staff determined that these interdivisional communications do not compromise the independence of the safety channels or adversely affect the operability of the safety functions.

2) APRM to 2-out-of-4 Voters

DI&C-ISG-04 acknowledges the need to share trip signals from otherwise independent channels to perform a voting function; nevertheless, the design of these interdivisional communications should not compromise the independence of the safety channels or adversely affect the operability of the safety functions. The "NUMAC PRNM Requirement Specification" identifies both the APRM and 2-out-of-4 Voter as safety-related (see Reference 12), and each contains a safety function processing.

Block diagrams identify the interface from each APRM to all 2-out-of-4 Voters (see Reference 4, Figures E.1.7 and E.2.2, and Reference 12, Figure 14-1). [[

]] In this way, the processing of data communications does not affect the timing or performance of the safety functions.

The NRC staff reviewed the licensee's responses that pertain to this interface (see Reference 4, Attachment 3, response to RAI 4) to ensure that this interchannel communications satisfies the criterion established under DI&C-ISG-04, Staff Position 1, "Interdivisional Communications." This review confirmed that the licensee's approach satisfies the applicable criterion of DI&C-ISG-04. The approach, as described, satisfies the basis that was previously reviewed and approved in the LTR (see Reference 22), and its functionality is tested during formal PRNMS V&V activities. [[

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Based on the NRC staff's review of the APRM to 2-out-of-4 Voter communications, the NRC staff determined that these interdivisional communications do not compromise the independence of the safety channels or adversely affect the operability of the safety functions.

3.3.3 Interfaces with the Operator Bench Board

Other than isolation requirements, DI&C-ISG-04 does not directly address interfaces between safety-related components within a channel and discrete switches or analog indications that may be shared among channels; nevertheless, in the following three numbered items, the NRC staff evaluated the this type of interface to confirm that components shared among PRNMS channels do not adversely affect reliable performance of the safety functions within independent PRNMS channels.

1) Operator Bench Board Bypass Switch to each 2-out-of-4 Voter

A single operator bench board bypass switch provides an intermediary signal path to allow each PRNMS channel to independently determine its bypass status. The single bypass switch is designed to return one and only one of the signals provided by the 2-out-of-4 voters to the originating channel when that channel is selected for bypass. The signal that is returned to each 2-out-of-4 Voter allows each 2-out-of-4 Voter to share its bypass signals with other channels (see discussion in Section 3.3.2, item 1). The "NUMAC PRNM Requirement Specification" identifies both the multi-channel Bypass Switch and the 2-out-of-4 Voter as safety-related (see Reference 12).

Block diagrams identify this interface between the bypass switch and each 2-out-of-4 voters (see Reference 4, Figure E.2.2 and Reference 12 and Figure 14-1). [[

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Based on the determination that the bypass switch to 2-out-of-4 Voter communication satisfies the basis that was previously reviewed and approved in the LTR (see Reference 22) and does not include data from another safety division, the NRC staff determined that the bypass switch to 2-out-of-4 Voter interface does not compromise the independence or isolation between safety channels such that operability of safety functions within multiple channels would be adversely affected.

2) PRNMS to Operator Bench Recorders and Meters

A single operator bench board provides recorders and meters for indication of parameters based on signals provided by each PRNMS channel. The reviewed and approved LTR identified the interface between the PRNMS and the plant operator's panel as a safety-to-non-safety analog interface that applies the required isolation (see Reference 22, Section 5.3.5.5 and Figure E.6.2). Whether the APRM or PCI provides the interface is identified in the "NUMAC PRNM Requirement Specification" (see Reference 12, "NUMAC PRNM Requirement Specification," Appendix B – External Interface Requirements).

The licensee provided a block diagram for the system that shows the LPRM & APRM portion of the PRNMS providing the copper-wire output signals to the "Analog Recorders & Meters" (see Reference 4, Figure E.2.1). This figure is consistent with the PRNMS configuration described in the LTR section that identifies PRNMS analog output signals (see Reference 22, Section 5.3.17.2.2). In the GGNS configuration, the analog input/output (I/O) module and broadcaster modules of the LPRM & APRM portion of the PRNMS provide some analog output signals to the plant operator's panel recorders and transient test monitoring equipment (see Reference 12, "NUMAC PRNM Requirement Specification," Sections 4.2.2.6.2, 4.2.2.6.3, and 4.2.3.5.1). These interfaces are safety-to-non-safety analog interfaces. The balance of analog signals is provided by the PCI (see Reference 12, "NUMAC PRNM Requirement Specification," Sections 4.1.8.2).

The licensee provided plant-specific changes to the base LTR that state the PCI will provide analog outputs (see Reference 4, modification to Section 5.3.3.7 of Reference 22). Consistent with these plant-specific changes, the licensee provided a system block diagram that shows the non-safety PCI provides analog signals via copper-wire to "Analog/Digital Recorders & Meters" in the operator bench board (see Reference 11, Figure 5-1). In the GGNS configuration the analog output module of PCI portion of the PRNMS provides these interfaces (see Reference 11, Table 5-1, and Reference 12, "NUMAC PRNM Requirement Specification," Sections 4.1.8.2 and 4.2.5.6.1). These interfaces are non-safety-to-non-safety analog interfaces.

Based on the NRC staff's review of the PRNMS configuration, the NRC staff determined that the provisions of DI&C-ISG-04 for independence and isolation of multidivisional control and display stations do not apply to the operator bench recorders and meters, because the PRNMS provides output only signals to conventional hardwired indications using an analog interface. Therefore, the NRC staff review was limited to confirming electrical separation and isolation between safety and non-safety equipment. The NRC staff confirmed that the GGNS PRNMS applies analog interface hardware to satisfy the basis that was previously reviewed and approved by LTR (Reference 22). These analog interfaces include safety-related devices that were also previously reviewed and approved as providing sufficient electrical separation and isolation. For these analog interfaces to external equipment,the GGNS PRNMS provides isolators (see Reference 22, Section 5.3.5.5 and Figure E.6.2, and Reference 12, Attachment 1, page 136). These isolators are powered by safety-related supplies that do not support or provide any PRNMS critical system function (see Reference 12, Attachment 1, page 135).

Based on the NRC staff's review of the PRNMS interface with the operator bench recorders and meters, the NRC staff determined that these PRNMS non-safety interfaces do not compromise the independence of the safety channels or adversely affect the operability of the safety functions.

3) 2-out-of-4 Voter to RPS Trip System

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The NRC staff reviewed the licensee proposal for the 2-out-of-4 Voter to RPS Trip System interface and confirmed that the approach satisfies the basis that was previously reviewed and approved in the LTR (Reference 22). Furthermore, the NRC staff confirmed that the provisions of DI&C-ISG-04 do not apply.

Based on the determination that the 2-out-of-4 Voter to RPS Trip System interface continues to satisfy the basis that was previously reviewed and approved, the NRC staff determined that this interface does not compromise the independence of the safety channels or adversely affect the operability of the safety functions.

3.3.4 Intrachannel or Intradivisional Communications Between PRNMS Safety Components and PRNMS Nonsafety Components

DI&C-ISG-04 establishes criteria for bidirectional communication interfaces between a safety division and non-safety equipment to ensure that these communications do not adversely affect the operability of the safety functions. The following two numbered items provide the NRC staff's evaluation of two types of PRNMS interfaces within a PRNMS channel, 1) APRM to PCI and LPRM to PCI and 2) PCI to APRM, against the DI&C-ISG-04, Staff Position 1, "Interdivisional Communications."

1) APRM to PCI and LPRM to PCI

The communication from the APRM to PCI and the LPRM to PCI are safety-to-non-safety digital communication interfaces. The "NUMAC PRNM Requirement Specification" identifies the PCI as non-safety (see Reference 12). The PCI is classified as non-safety, because it does not perform safety functions and its software was not subjected to an evaluation against safety-related development standards; nevertheless, the non-safety PCI resides within the PRNMS cabinet and uses hardware that has been qualified to safety-related levels. The APRM to PCI communication remains within a single PRNMS channel. The LPRM to PCI interface communicates from one PRNMS channel to the other PRNMS channel that shares the same RPS electrical safety division. [[

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The licensee provided a block diagram that identifies these interfaces (see Reference 4, Figure E.1.7) and addressed conformance with DI&C-ISG-04, Staff Position 1, "Interdivisional Communications" (see Reference 4, Attachment 3). These interfaces are not associated with the safety function signal path (see Reference 12, Figure 28-1, green dashed lines). [[

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The NRC staff reviewed the licensee's response that described conformance of APRM to PCI and LPRM to PCI safety-to-non-safety interfaces against the applicable evaluation criteria of DI&C-ISG-04, Staff Position 1, "Interdivisional Communications" (see Reference 4, Attachment 3). [[

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Based on conformance with DI&C-ISG-04, Staff Position 1, "Interdivisional Communications," and continuing to satisfy the basis that was previously reviewed and approved, the NRC staff determined that the APRM to PCI and LPRM to PCI safety-to-non-safety interfaces do not compromise the independence of the safety channels or adversely affect the operability of the safety functions. Operational history for other PRNMS systems provides additional assurance, because the operating history demonstrates continued operability of similar safety functions in instrumentation that use the same data communication architecture that was reviewed and approved in 1995.

2) PCI to APRM

The communication interface from the PCI to APRM is a non-safety-to-safety digital communication interface. The "NUMAC PRNM Requirement Specification" identifies the PCI as non-safety (see Reference 12). The PCI is classified as non-safety, because it does not perform safety functions and its software was not subjected to an evaluation against safety-related development standards; nevertheless, the non-safety PCI resides within the PRNMS cabinet and uses hardware that has been qualified to safety-related levels.

The licensee provided a block diagram that identifies these interfaces (see Reference 4, Figure E.1.7) and addressed conformance with DI&C-ISG-04, Staff Position 1, "Interdivisional Communications" (see Reference 4, Attachment 3). These interfaces are not associated with the safety function signal path (see Reference 12, Figure 28-1, green dashed lines). [[

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DI&C-ISG-04, "Interdivisional Communications," Staff Position 1.2 states that the safety function of each safety channel should be protected from adverse influence from outside the division of which that channel is a member. DI&C-ISG-04, "Interdivisional Communications," Staff Position 1.3 states that a safety channel should not receive any communication from outside its own safety division unless that communication supports or enhances the performance of the safety function. However, the licensee identified non-safety messages to the APRM that originate from outside its safety division when addressing PRNMS conformance with the NRC staff positions (see Reference 4, Attachment 3, pages 3 through 5, and Reference 11, response to RAI 12). The licensee identified three messages in addition to the APRM gain factors, which are discussed in

Section 3.3.1.2). Proprietary licensee responses addressed each of these messages to justify their presence as necessary to the overall simplicity of the PRNMS design and to ensure that the presence of these messages does not adversely affect performance of safety functions. One of these messages was identified as the Recirculation Flow channel check alarm status.

In its LAR (Reference 1), the license identified the interchannel communications to support the recirculation flow processing within each PCI as a deviation from the previously reviewed and approved LTRs (References 22 and 23), but did not explicitly identify the communication of the resultant status to the APRM. The licensee's deviation description states that incorporating this logic has no affect on any safety functions. To clarify the licensee's approach, the NRC staff requested additional information to determine how each PRNMS channel's behavior would be affected by the flow data originating from within the other channels (see Reference 45, RAI 26). The licensee responded with a description of the expected PRNMS channel behavior, as affected by data from the other PRNMS channels, but did not justify the inclusion of this function as enhancing APRM safety functions (see Reference 10, response to RAI 26). The licensee then supplemented its response to further describe the Recirculation Flow channel check alarm status processing and justify its presence within the APRM as enhancing the flow-biased APRM safety function without adversely affecting performance of safety functions (see Reference 15, supplemental response to RAI 26). The licensee described the enhancement provided by Recirculation Flow channel check alarm as an alert to the operator of a problem that could potentially have an adverse effect on the ability to correctly perform the flow-biased safety function.

The licensee's approach performs the Recirculation Flow channel check alarm determination in the PCI, which has been designated as non-safety equipment, and uses available APRM hardware to generate the alarm output in order to eliminate an additional board that would otherwise be required within the PCI. The NRC staff reviewed the proprietary description of the Recirculation Flow channel check alarm's data format and related serial message processing that was provided by the licensee (see Reference 15, response to RAI 26). The licensee's response explained that the required software operations within the APRM that are associated with the Recirculation Flow channel check alarm processing do not materially increase the complexity of the software tasks beyond that which is already performed within the APRM. Based on the NRC staff's review of the data format and processing, the NRC staff determined that the processing of the Recirculation Flow channel check alarm status cannot result in unacceptable influence of one channel over another by adversely affecting the channel's safety functions and that inclusion of the Recirculation Flow channel check alarm's data as an input from the PCI to the APRM minimizes overall PRNMS channel complexity. The PRNMS safety functions do not utilize the alarm status data.

The NRC staff reviewed the licensee's responses that described conformance of PCI to APRM non-safety-to-safety interface against the applicable evaluation criteria under DI&C-ISG-04, Staff Position 1, "Interdivisional Communications" (see Reference 4, Attachment 3, and Reference 11, responses to RAIs 12 and 15). **[[**

.]] Based on conformance with DI&C-ISG-04, Staff Position 1, "Interdivisional Communications," and continuing to satisfy the basis that was previously reviewed and approved in the LTRs (References 22 and 23), the NRC staff determined that the PCI to APRM non-safety-to-safety interface does not compromise the independence of the safety channels or adversely affect the operability of the safety functions. Operational history for other PRNMS systems provides additional assurance, because the operating history demonstrates continued operability of similar safety functions in instrumentation that use the same data communication architecture that was reviewed and approved in 1995.

3.3.5 Interfaces Between PRNMS Channels and Other Systems or Equipment

DI&C-ISG-04 establishes criteria for communication interfaces between safety and non-safety equipment to ensure that these communications do not adversely affect the operability of the safety functions; however, its criteria only applies to bidirectional communications. DI&C-ISG-04 does not establish criteria for communication interfaces between non-safety and non-safety equipment even when it is bidirectional. Therefore, the following subsections provide the NRC staff's evaluation of three PRNMS interfaces with the PRNMS channel, 1) 2-out-of-4 Voter to RC&IS, 2) PCI to RC&IS, and 3) PCI and NIC, to ensure appropriate isolation requirements have been met and that the safety functions are not dependent on conditions of or information from connected equipment.

1) 2-out-of-4 Voter to RC&IS

The licensee provided block diagrams that identify these interfaces (see Reference 4, Figure E.2.1, and Reference 11, Figure 5-1). Each 2-out-of-4 Voter provides an output via copper wiring to the RC&IS. The "NUMAC PRNM Requirement Specification" identifies the 2-out-of-4 Voter as safety-related (see Reference 12), and the licensee stated that the RACS portion of the RC&IS is classified as non-safety (see Reference 10, response to RAI 13). Therefore, the NRC staff evaluated this as a safety-to-non-safety interface.

Two pairs of APRM Rod Withdrawal Block signals, each from two 2-out-of-4 voters that are associated different electrical safety divisions, are connected in series to provide a rod block input to one of two RC&IS divisions. These signals are based on the power level being below the APRM upscale trip-point and are not involved in the determination of the rod insert permissive. The licensee stated that the signal provided by each 2-out-of-4 voter is an APRM Rod Withdrawal Block that is not credited by any safety analysis and that is provided as a one-way interface with adequate isolation (see Reference 10, response to RAI 13).

The licensee's original response to RAI 13 identified isolators within in the RACS were used to establish the safety grade isolation boundary for the PRNMS; however, the licensee later supplemented its response (see Reference 15, supplemental response to RAI 13, item 2) to adequately address the requirement of IEEE Standard 603-1998 Clause 5.6.3.1, Interconnected equipment, that states in part that isolation devices used to create a safety system boundary shall be classified as part of the safety system and that IEEE Standard 384-1992 provides detailed criteria for the independence of Class 1E equipment and circuits. [[

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The NRC staff reviewed the licensee's approach to determine applicability of DI&C-ISG-04, ensure electrical independence among PRNMS channels was maintained, and ensure that appropriate safety-related isolation was provided between the PRNMS and the non-safety RACS.

DI&C-ISG-04 does not apply to this interface, because these communications are point-to-out relay outputs, and only two states can be represented by the continuously available analog signals. [[

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Based on the NRC staff's review of the 2-out-of-4 Voter to RC&IS interface and confirmation that the approach continues to satisfy with the isolation provisions of the previously reviewed and approved LTR (Reference 22), the NRC staff determined that this interface does not compromise the independence of the safety channels or adversely affect the operability of the safety functions.

2) PCI to RC&IS

The licensee provided block diagrams that identify these interfaces (see Reference 4, Figure E.2.1, and Reference 11, Figure 5-1). [[

]] The "NUMAC PRNM Requirement Specification" identifies the PCI as non-safety (see Reference 12). The PCI is classified as non-safety, because it does not perform safety functions and its software was not subjected to an evaluation against safety-related development standards; nevertheless, the non-safety PCI resides within the PRNMS cabinet and uses hardware that has been qualified to safety-related levels. The licensee stated that the display portion of the RC&IS is classified as a non-safety (see Reference 10, response to RAI 13). Therefore, the NRC staff evaluated this as a non-safety-to-non-safety interface.

DI&C-ISG-04 does not apply, because this interface is non-safety-to-non-safety. The licensee identified the communication module that provides this interface and a description of this interface under the plant-specific modifications to Sections 5.3.3.10 and 5.3.17.3.4 of the LTR (see Reference 4, Attachment 6, pages 7 and 14, and Reference 11, response to RAI 15). The licensee clarified that this interface includes isolators that satisfy the basis of the original LTR to ensure that a fault on external to the PRNMS will not propagate past the isolators (see Reference 4, Attachment 6, page 7 and Reference 22, Section 5.3.5.5). The NRC staff reviewed the change descriptions and determined that they satisfy the basis of the previously reviewed and approved LTR. Furthermore, the evaluation for the PCI to APRM interface in Section 3.3.4, item 2 provides assurance that the PCI to RC&IS interface cannot adversely affect the operability of the safety functions.

Based on the NRC staff's review of the PCI to RC&IS interface and confirmation that the approach satisfies the basis of the previously reviewed and approved LTR, the NRC staff determined that this interface does not adversely affect the operability of the safety functions.

3) PCI and NIC

The licensee provided block diagrams that identify these interfaces (see Reference 4, Figures E.2.1 and 4-2, and Reference 11, Figure 5-1). Each PCI exchanges information with plant computers on an external network over fiber-optic communication links through a pair of NICs. The fiber-optic interface provides electrical separation. The "NUMAC PRNM Requirement Specification" identifies the NIC and PCI as non-safety (see Reference 12). Regardless that the PCI resides within the PRNMS cabinet and its hardware is qualified to safety-related levels, the PCI is classified as non-safety, because it does not perform safety functions and its software was not developed to meet safety-related standards. Therefore, the NRC staff evaluated this as non-safety-to-non-safety interface.

DI&C-ISG-04 does not apply, because this interface is non-safety-to-non-safety. The licensee described this interface under the plant-specific modifications to Section 5.3.3.12 of the LTR (see Reference 4, Attachment 6, page 7). The NRC staff reviewed the change description and determined that it continues to satisfy the basis of the previously reviewed and approved LTR. Furthermore, the evaluation in Section 3.3.4, item 2 provides assurance that the PCI to NIC interface cannot adversely affect the operability of the safety functions.

Based on the NRC staff's review of the PCI to NIC interface and confirmation that the approach satisfies the basis of the previously reviewed and approved LTR, the NRC staff determined that this interface does not adversely affect the operability of the safety functions.

3.3.6 Nonsafety Interfaces Between PRNMS Channels

DI&C-ISG-04 establishes criteria for interdivisional communications to ensure that these communications do not adversely affect the operability of the safety functions; however beyond isolation requirements, DI&C-ISG-04 does not establish criteria for bidirectional communications between non-safety and non-safety equipment even when it exists in different divisions. Therefore, the following subsection provides the NRC staff's evaluation of one bidirectional interface between PRNMS channels, 1) PCI to PCI, to ensure appropriate isolation requirements have been met and that the safety functions are not dependent on conditions of or information from connected equipment.

1) PCI to PCI

The licensee provided block diagrams that identify these interfaces (see Reference 4, Figures E.2.1 and 4-1). Each of the four PCIs exchanges information with two other PCIs that are outside of its RPS Trip System division over point-to-point fiber-optic communication links that provide two-way communication between PCIs. The fiber-optic communication provides electrical isolation between channels. The "NUMAC PRNM Requirement Specification" identifies the PCI as non-safety (see Reference 13). Regardless that the PCI resides within the PRNMS cabinet and its hardware is qualified to safety-related levels, the PCI is classified as non-safety, because it does not perform safety functions and its software was not developed to meet safety-related standards. Therefore, the NRC staff evaluated this as a non-safety-to-non-safety interface.

DI&C-ISG-04 does not directly apply, because this interface is non-safety-to-non-safety; however, the NRC staff notes that the licensee's plant-specific approach adds interfaces that span electrical divisions when compared to the previously reviewed and approved LTR (see Reference 4, Figures E.1.7 in comparison to Reference 3, Figure E.1.7).
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]] The evaluation of the PCI to APRM interface in Section 3.3.4, item 2 provides reasonable assurance that the PCI-to-PCI interfaces do not adversely affect the operability of the safety functions.

Based on the NRC staff's review of the PCI to PCI interface, the NRC staff determined that this interface does not adversely affect the operability of the safety functions.

3.4 Diversity and Defense-in-Depth

Branch Technical Position (BTP) 7-19 and DI&C-ISG-02 provide guidance to address diversity and defense-in-depth. BTP 7-19 provides guidance to evaluate an applicant/licensee's defense-in-depth assessment and the design of manual controls and displays to ensure conformance with the NRC positions on defense-in-depth. These positions apply to I&C systems that incorporate digital computer-based reactor trip systems. The evaluation must confirm that vulnerabilities to common-cause failures have been adequately addressed. DI&C-ISG-02 provides acceptable methods for implementing diversity and defense-in-depth in digital I&C system designs and clarifies the criteria the NRC staff would use to evaluate whether a digital system design satisfies the defense-in-depth guidelines. Taken together, the guidance in BTP 7-19 and DI&C-ISG-02 establishes evaluation criteria to provide reasonable assurance that common-cause failures do not defeat either the protection provided by alternative means (i.e., an independent and diverse safety function) or an echelon of defense that provides defense-in-depth.

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The NRC staff reviewed the PRNMS using the guidance provided in BTP 7-19 and DI&C-ISG-02 to establish whether vulnerabilities to common-cause failures had been adequately addressed by the licensee. BTP 7-19 establishes that the licensee should analyze each postulated common-cause failure coincident with each anticipated operational occurrence and postulated accident within the design basis using a best-estimate (i.e., realistic assumptions). The licensee's analysis should demonstrate adequate diversity for each of these events. The NRC staff issued a series of RAIs to support this evaluation after reviewing the LAR (Reference 1) and the event design basis established by the LTR (Reference 22) against the accident analysis section of the licensee's Updated Final Safety Analysis Report (UFSAR) for each event that involves a PRNMS safety function.

The licensee provided a response that reiterated the approach established by LTR and the confirmation statement that previously provided the LAR without supporting analysis (see Reference 6, response to RAI 3). This response highlights and documents non-APRM parameters that are processed by equipment other than the PRNMS to provide a diverse means of detecting an event and initiating a scram. The response also includes a mapping of the LTR event bases to corresponding sections of the licensee's UFSAR Chapter 15.

The NRC staff provided additional RAIs after reviewing the licensee's response, because the response did not directly address each event evaluated in Chapter 15 of the licensee's UFSAR or the potential of the PRNMS to adversely affect other echelons of defense (e.g., the control echelon). The NRC staff provided RAIs requesting that the licensee address each event in Chapter 15 of its UFSAR where an APRM-based scram trip is credited in the analysis. These RAIs asked the licensee to confirm that no echelon other than the APRM-based scram portion of the protection system used programming common to that implemented in the PRNMS and to demonstrate that other echelons of defense could not be adversely influenced by interfaces with the PRNMS. In part, these RAIs sought to confirm that the alternative trip parameter signal path remained diverse and did not provide signals to a voter of a common logic design to one in the PRNMS (see Reference 45, RAIs 8 through 11, 19, and 29).

The licensee provided responses to these RAIs, and through this set of responses, the licensee provided information to demonstrate that the plant has the ability to cope with any potential common-cause failure in the programmable entities within the PRNMS (see Reference 12, responses to RAIs 8, 9, 10, 19, and 29). The licensee defined the worst-case common-cause failure to be one that completely impairs all functionality of the PRNMS, wherein the failure provided no advanced notice of trouble, failed to provide the correct instrument responses from all four channels instrumentation and provided potentially misleading information.

The licensee's response addressed the acceptance criteria defined within BTP 7-19 (see Reference 12, responses to RAIs 8 and 9). The response evaluated BTP 7-19 acceptance criteria 1 and 2, which establishes an evaluation of each anticipated operational occurrence and design basis accident with the underlying assumption that a single common-cause failure exists in the digital I&C system. The response provides a table of event and accident references to the licensee's UFSAR Chapter 15 to evaluate each in terms of the credited trip signals and any PRNMS function that may be credited. For most events identified, no PRNMS function is credited; however, where a PRNMS function is credited the table identifies an alternate trip signal that is diverse from the PRNMS and not potentially affected by a PRNMS common-cause failure. From this analysis, the licensee determined that there are no events that lead to any threat to specified safety limits should the event or accident occur coincident with a PRNMS common-cause failure. The licensee's conclusion is based on the presence of other diverse trip signals or other bounding analysis.

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The licensee addressed BTP 7-19 acceptance criteria 3 through 5 (see Reference 12, response to RAI 9). Acceptance criteria 3 and 4 relate to element or signal sources that are potentially shared by the control system and either the reactor trip system or engineered safety features actuation system (ESFAS). Criterion 5 addresses potential influence of monitoring or display systems on either the reactor trip system or ESFAS. [[

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Based on the NRC staff's review of the licensee's responses to address the protection system interface to the control system and that describe the diversity between the PRNMS and the RC&IS (see References 10 and 12), the NRC staff determined that a common-cause programming failure of the PRNMS cannot be associated with a similar common-cause failure within RC&IS nor can a common-cause programming failure of the PRNMS adversely affect the RC&IS safety-functions.

The licensee addresses BTP 7-19 acceptance criteria 6 through the confirmation that the safety-related means to initiate manual actuation of the reactor trip system and ESFAS functions is unaffected by the PRNMS upgrade (see Reference 12, response to RAI 8). [[

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To address BTP 7-19 acceptance criteria 7, 8, and 9, the licensee's response is based on its diversity and defense-in-depth assessment (see see Reference 12, response to RAI 8). [[

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The NRC staff notes that the licensee's response does not include an equivalent of a BTP 7-19 analysis to demonstrate adequate diversity for vulnerabilities to common-cause failures to the OPRM DSS-CD trip function. However, the licensee stated that the DSS-CD trip function will remain disabled, and that an evaluation of the DSS-CD trip function is not part of this licensing action (see References 10 and 12). Therefore, the NRC staff did not evaluate the adequacy of the diversity of DSS-CD trip function in consideration of potential common-cause failures within the PRNMS.

Based on the NRC staff evaluation in this section, the NRC staff determined that the proposed change provides sufficient diversity and defense-in-depth to satisfy with the acceptance criteria in BTP 7-19 and the guidance provided in DI&C-ISG-02.

3.5 Setpoint Methodology and Calculations

The regulations in 10 CFR 50.36(c)(1)(ii)(A) state that,

> Limiting safety system settings for nuclear reactors are settings for automatic protective devices related to those variables having significant safety functions. Where a limiting safety system setting is specified for a variable on which a safety limit has been placed, the setting must be so chosen that automatic protective action will correct the abnormal situation before a safety limit is exceeded. If, during operation, it is determined that the automatic safety function does not function as required, the licensee shall take appropriate action, which may include shutting down the reactor.

Regulatory Guide (RG) 1.105, Revision 3, "Setpoints for Safety-Related Instrumentation," December 1999 (Reference 26), describes a method acceptable to the NRC staff for complying with the NRC's regulations to ensure that setpoints for safety-related instrumentation are initially within and remain within the TS limits. The RG endorses Part I of Instrument Society of

America (ISA)-S67.04-1994, "Setpoints for Nuclear Safety-Related Instrumentation," subject to NRC staff clarifications. Part I defines a framework for ensuring that setpoints for nuclear safety-related instrumentation are established and maintained within specified limits. The RG does not address or endorse Part II of ISA-S67.04-1994, "Methodologies for the Determination of Setpoints for the Nuclear Safety-Related Instrumentation." Part II provides recommended practices and guidance for implementing Part I.

RG 1.105 establishes acceptance criterion that there is a 95 percent probability that the constructed limits contain 95 percent of the population of interest for the surveillance interval selected. Branch Technical Position (BTP) 7-12 provides guidance for NRC staff reviewers for evaluating the process an applicant/licensee follows to establish and maintain instrument setpoints.

To support an evaluation of digital instrumentation, licensees identify digital elements (hardware and software) where error could be introduced into the measurement. These elements are related to the overall instrument channel accuracy and typically defined in accordance with ISA-S67.04-1994, Part I. The NRC staff's setpoint review is performed in consideration of 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," dated August 24, 2006 (Reference 47). In part, RIS 2006-17 highlights the importance of assuring setpoints and their tolerances do not mask equipment inoperability.

The LAR included a summary description of the setpoint methodology, but did not include the setpoint methodology itself or related calculations (see Reference 1, Section 5.1.5), so the NRC staff requested documentation of the setpoint methodology including representative calculations used to establish the limiting setpoint (i.e., the NTSP) and the limiting acceptable As-Found and As-Left values for the PRNMS setpoints (see Reference 44, RAI 10, and Reference 45, RAIs 24 and 25). The licensee provided responses to describe the applied setpoint methodology with summaries of the calculations (see Reference 4, response to RAI 10, Reference 13, response to RAI 24, and Reference 10, response to RAI 25). As applicable to PRNMS setpoints, the NRC staff reviewed the licensee's explanation of the applied setpoint methodology and performed an audit of the licensee's detailed calculations to determine acceptability of the proposed setpoints and surveillance intervals. The licensee's response and audit provided information that documented the bases and the calculations of measurement uncertainties along with the methods by which the setpoints are calculated.

The licensee's responses address OPRM setpoints differently from the other PRNMS setpoints for APRM functions. For the APRM setpoints the licensee stated that its method is based on (i.e., but not identical to) ISA Method 2 of ISA Recommended Practice RP67.04.02-2000, "Methodologies for the Determination of Setpoints for Nuclear Safety Related Instrumentation," in a way that leads to more conservative setpoints. NEDC-31336P-A, "General Electric Setpoint Methodology," September 1996 (Reference 48), documents this methodology along with the NRC staff's SE. In contrast, for the OPRM setpoints, the licensee stated that the setpoints are considered as nominal values without regard to measurement accuracy in relation to a defined analytical limit. The "OPRM Upscale" setpoint is based on a cycle-specific reload stability analysis and will be included in the Core Operating Limits Report (COLR). The documented approach for the "OPRM Upscale" setpoint is consistent with the TSs identified in Section 3.2.1, item 6 and evaluated in Section 3.2.2, item 6.

For the APRM setpoints, the licensee stated that the setpoint method uses single-sided distributions in the development of setpoint allowable values and NTSPs, because each of these PRNMS trips are generated by a setpoint that is approached from only one direction. The licensee stated that the setpoint methodology applies vendor instrument error specifications conservatively to provide setpoints that meet margin requirements to a high degree of confidence. The licensee stated that achieving a high degree of confidence in the setpoint can be demonstrated by data analysis that ensures that the 95 percent confidence level is bounded by the design allowances that have been established within the applied setpoint methodology. The licensee stated that the calculation methodology provides sufficient margin between the analytical limit and the allowable value to assure [[

]] The licensee confirmed that all setpoints are reset to the NTSP within the As-Left Tolerance (ALT) after calibration (see Reference 4, response to RAI 10, and Reference 13, response to RAI 24). The licensee provided further clarification to ensure that the as-found instrument setting value is within the As-Found Tolerance (AFT) prior to performing any calibration activity. In this clarification, the licensee also identified the method by which the as-left instrument setting value is set within the ALT following calibration (see Reference 17, revised response to RAI 24).

The licensee's responses commit to setting the AFT equal to the square root of the sum of the squares (SRSS) combination of ALT and the projected drift over the calibration interval and to reflect the ALTs and AFTs in the associated surveillance test procedures. This commitment was reaffirmed and will be completed prior to startup from the 2012 refueling outage (see Reference 10, response to RAI 25).

The prior SEs and LTRs (References 22 and 23) identify the TS setpoints necessary to comply with 10 CFR 50.36(c)(1)(ii)(A) when implementing a PRNMS with OPRM Option III. For this licensing action, the licensee did not request a change to establish different allowable values for the Neutron Flux–High, Setdown and Fixed Neutron Flux–High, and defined the allowable value for the Flow Biased Simulated Power–High consistent with the previously reviewed and approved LTRs. Therefore, the bases for the Neutron Flux–High, Setdown and Fixed Neutron Flux–High setpoints has not changed, and the LTRs provide the basis for the Flow Biased Simulated Power–High setpoint. Based on the continued applicability of the prior SEs for GGNS' existing design basis, the NRC staff limited the GGNS evaluation to a review of the setpoint methodology and calculations, because the PRNMS change represents different instrumentation wherein different errors and magnitudes affect the measurements associated with the trip functions.

The NRC staff performed an audit of the related setpoint calculations on May 24, 2011 (see Reference 49). This audit reviewed calculations and values used to derive the Fixed Neutron Flux–High and Flow Biased Simulated Power–High setpoints and tolerances. This audit occurred prior to the receipt of the licensee's response to RAI 24 (see Reference 13), which identified individual error terms for PRNMS components. This licensee response reiterates and clarifies portions of an earlier response (see Reference 4, response to RAI 10). The licensee later provided clarifying corrections to this description (see References 17 and 18, revised responses to RAI 24).

During the NRC staff audit of the setpoint methodology and calculations, the NRC staff confirmed that the random errors and biased terms were identified and that random terms are combined using the SRSS method while non-conservative bias errors are algebraically summed. The NRC staff's audit also confirmed that the surveillance intervals are identified and form the basis for the drift errors that are applied in the calculations. The calculations were observed to incorporate impacts to signal uncertainty due to environmental conditions. The application of numerical rounding in the determination of the NTSP was performed in the direction away from the analytical limit to ensure a conservative result. No issues or open items resulted from the NRC staff's audit of the calculations related to the Fixed Neutron Flux–High and Flow Biased Simulated Power–High setpoints.

The licensee described how its setpoint methodology and calculations ensure that the difference between the analytical limit and NTSP meets or exceeds the 95 percent probability/95 percent confidence criterion within RG 1.105 (see Reference 13, response to RAI 24). In this response, the licensee provided and described a figure showing the relationship between a safety limit, the analytical limit, the allowable value, and the final NTSP with its associated AFTs and ALTs (see Reference 13, Figure 24-1). This figure summarizes the error contributions that are involved in the derivation and control of the NTSP and its tolerances. The response identifies and describes the PRNMS error terms that are included in the associated setpoint calculations. The licensee stated that conservative values are used for each error component to produce an NTSP that provides 95 percent probability of not exceeding the analytical limit with at least 95 percent confidence, and that additional margin is included, which causes PRNMS setpoints to conservatively exceed the 95 percent probability requirement. The methodology statistically combines random error terms that have a high confidence to produce a channel error that has a 95 percent confidence. When calculating setpoints approached from one direction, a factor of 1.645 is applied to the channel before adding the non-conservative bias errors. The licensee's approach is based on field data that demonstrated that calculations by this methodology bound 95 percent of the data within 95 percent confidence limits.

The licensee also described how its setpoint methodology and calculations ensure that excessive margin is not included between allowable value and the NTSP, which could mask equipment inoperability. The methodology requires that the NTSP be close enough to the conservative side of allowable value so that the difference is equal to or less than the TSTF-493 performance allowance margin, which is based on all errors during calibration conditions. The licensee stated that its methodology leads to tighter control of instrument performance during surveillance tests when compared to the margin required by TSTF-493, because the methodology produces a smaller margin than allowed by TSTF-493. As such, the licensee determined that its approach is more conservative with respect to TSTF-493 performance monitoring.

For the OPRM setpoints, the licensee stated there is no analytical limit or allowable value with defined instrument error margins to the NTSP. The OPRM setpoints associated with the OPRM Upscale trip are established as nominal values based on cycle-specific reload stability analysis that is performed in accordance with the previously reviewed and approved a BWR Owners' Group (BWROG) methodology. For OPRM Option III, NEDO-32465-A, "BWR Owners' Group

Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications," dated August 1996 (Reference 50), establishes the methodology by which plants demonstrate safety limit protection based on a generic Delta CPR [critical power ratio] over Initial MCPR [minimum critical power ratio] MCPR versus the Oscillation Magnitude (DIVOM) curve. For GGNS, a plant/cycle-specific DIVOM curve is applied, as required to resolve a 10 CFR Part 21 report, and the use of a plant/cycle-specific DIVOM curve satisfies the basis of subsequent SE conclusions. The licensee stated that the setpoints to enable the OPRM Upscale function are also considered as nominal values without regard to measurement accuracy, because they represent only one of multiple conservative starting assumptions for an accident analysis.

The licensee stated that the OPRM setpoints are based on operating experience and engineering judgment and that RG 1.105 does not apply to these setpoints, because there is no analytical limit established based on formal accident analyses for these settings (see Reference 13, response to RAI 24). Nevertheless, Entergy will apply the performance monitoring requirements of TSTF-493 to these setpoints.

The NRC staff compared the confirmations reached during its audit of PRNMS setpoint calculations against the docketed licensee responses and determined both responses to be consistent with one another. The NRC staff reviewed the licensee's responses against the RG 1.105 acceptance criterion for a 95 percent probability that the constructed limits contain 95 percent of the population of interest for the surveillance interval. The NRC staff reviewed the licensee's responses to assure that the setpoint AFTs and allowable values do not mask equipment inoperability.

Based on the NRC staff's review of the methodology and calculations to determine the allowable value, NTSP, AFT, and ALT for each PRNMS setpoint, as documented in the licensee's submittals and responses to the NRC staff's requests for additional information, the NRC staff determined that the proposed setpoint methodology provides an acceptable method for the GGNS PRNMS setpoints, and that the application of the methodology to the PRNMS setpoints satisfies the system design basis in accordance with the safety analysis, TSs, and expected maintenance practices. As such, the NRC staff determined that the methodology and calculations for the PRNMS setpoints address the requirements of the regulations identified within 10 CFR 50.36(c)(1)(ii)(A) and are acceptable.

3.6 Response Time Performance

The accident analysis of design basis events at nuclear power plants includes a determination of how soon the protective actions are needed to mitigate those design basis events. The basis for this determination is contained in 10 CFR 50.55a, "Codes and standards." This states that "protective systems must meet the requirements set forth in editions or revisions of the Institute of Electrical and Electronics Engineering Standard: 'Criteria for Protective Systems for Nuclear Power Generating Stations,' (IEEE-279)..." which remains applicable with respect to response time performance, because GGNS' design basis for safety related equipment is IEEE Standard 279-1971. Also, 10 CFR 50.36(c)(1)(ii)(A) requires inclusion in the TSs the limiting safety systems settings for nuclear reactors, those settings "so chosen that automatic protective action will correct the abnormal situation before a safety limit is exceeded." Once the total time required for a protective action has been determined, licensees allocate portions of that time to portions of the protective system (i.e., the time required for the sensors response to changes in plant conditions, time required for the actuation logic, and the time required for a valve to close or rods to insert).

Branch Technical Position (BTP) 7-21 provides "Guidance on Digital Computer Real-Time Performance," and identifies acceptance criteria to reach an NRC staff conclusion that a completed system will meet timing requirements. BTP 7-21 criteria establishes that an applicant should demonstrate that limiting response times are sufficient to satisfy applicable safety requirements and that digital computer timing is sufficient to satisfy the limiting response times for the systems implementation including hardware, software, and data communication architecture and associated performance characteristics. The link between the setpoint analyses and limiting response times should be demonstrated.

As described in Section 3.5, the safety bases for the NTSPs, allowable values, ALTs, and AFTs of APRM setpoints is not being changed and the safety bases for OPRM setpoints continues to satisfy the basis that was previously reviewed and approved in the LTRs (References 22 and 23), which rely upon a BWROG methodology for stability analysis that was previously reviewed and approved by the NRC (Reference 50).

The LTRs established digital response time specifications for each PRNMS trip function (see References 2 and 3, Section 3.3.2). For APRM Neutron Flux–High, Setdown and APRM Fixed Neutron Flux–High trips, the PRNMS relay output must transition to the tripped state within a specified time of the average flux level reaching the respective trip setpoint. For the APRM Flow Biased Simulated Thermal Power–High, the PRNMS relay output must transition to the tripped state within a specified time of the plant parameters reaching the trip's setpoint (while excluding the time constant of the Simulated Thermal Power algorithm from the measurement). For the OPRM Upscale trip, the PRNMS relay output must transition to the tripped state within specified time of the plant parameters reaching a setpoint determined by any of the instability detect-and-suppress algorithms. For trip setpoints that are calculated based on recirculation flow, the time from a change in the process flow value until this value is reflected in the trip setpoint shall not exceed a specified time. These limiting response times for the PRNMS have not changed since they were established and previously reviewed and approved.

Because the safety bases for the PRNMS setpoints has not changed and the limiting APRM and OPRM response times associated with these setpoints have not been proposed to change, the safety bases values and digital response times have not been reanalyzed as part of this SE. Rather this SE limits its review to an assessment of the GGNS PRNMS performance given its equipment configuration in order to provide reasonable assurance that the applicable safety requirements to suppress power oscillations and prevent fuel design limits from being exceeded will be maintained. The NRC staff documented its determination that the prior staff evaluations in LTRs remain applicable, because the NRC staff review of the GGNS PRNMS equipment configuration determined that the proposed GGNS PRNMS instrument configuration and its descriptions continue to satisfy the basis that was previously evaluated (see Section 3.2.2).

The NRC staff's review of response time performance included an evaluation of the PRNMS hardware, software, and data communication architecture for the safety signal path to which the limiting response times apply. To facilitate this review, the NRC staff provided a series of RAIs to establish and clarify the response time requirements and performance applicable to the

GGNS PRNMS (see Reference 44, RAI 2, and Reference 45, RAIs 18 and 20). The licensee responded to demonstrate that the plant-specific system response time requirements applicable to the RPS with the current APRM continue to apply to the response time performance established for PRNMS modification (see Reference 6, response to RAI 2, Table 2-2). The licensee clarified this response to state that only 40 milliseconds of the total 90 milliseconds of response time are available for the PRNMS APRM scram functions. Per the existing GGNS UFSAR, the design basis for the RPS response time from the opening of a trip sensor contact up to and including opening of the trip actuator contacts is less than 50 milliseconds, which leaves 40 milliseconds for the PRNMS APRM functions (see Reference 12, response to RAI 20). The NRC staff evaluated the licensee's responses and determined that response time performance requirements that are established in the LTRs have been maintained. The NRC staff also determined that the specified response time performance requirement for PRNMS was established by the design basis of the current APRM and has not been changed. The NRC staff compared these two response time performance requirements and determined them to be consistent with one another. Therefore, the NRC staff determined that the prior LTR response time performance requirement remains bounding, applicable to the PRNMS modification, and consistent with the plant's safety requirements.

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The licensee identified the response time requirements for safety functions identified in the LTRs and compared the response time requirements to the calculated response times both with and without the maximum delay associated with data error rates (see Reference 12, Table 18-1 in comparison to References 22 and 23, Sections 3.3.2). This analysis demonstrates that the response time requirements will continue to be met in the presence of the established data error rates with margin.

The licensee further addressed conformance to BTP 7-21 by describing the processing delays that contribute to the overall PRNMS response. The licensee identified the magnitude of response time delays for each individual processing activity and summarized the total delay in comparison to the individual response time requirements. The sum of the individual delays satisfies the overall PRNMS response time requirements. The licensee also stated that tests during system validation and factory acceptance on the final equipment configuration are used to confirm that the PRNMS responds as expected and that each safety function response time requirement has been satisfied and will continue to be met within the full range of the qualified equipment envelope (see Reference 12, response to RAI 20, Tables 20-1 and 20-2). The licensee summarized the successful completion of its system validation efforts in its V&V Test Summary Report (see Reference 21).

Based on the specification, analysis, testing, and successful test results for PRNMS response time performance, the NRC staff has determined that the PRNMS meets the GGNS response time requirements and that these response time requirements satisfy the GGNS PRNMS safety bases.

3.7 System and Software Development for the GGNS PRNMS

This section evaluates the GGNS PRNM system and software development lifecycle to include consideration of component reuse. The GGNS PRNMS development emphasized and systematically applied components with applicable operating experience that are based on previously approved LTRs and prior similar PRNMS applications. This evaluation based upon BTP 7-14 applies staff technical judgment in the determination of whether the development processes applied to the GGNS PRNMS, along with compensatory measures that were also identified and performed, are considered equivalent methods to those methods currently endorsed in regulatory guidance for system and software development.

The initial NUMAC PRNMS development was completed in the early to mid-1990s, and the acceptability of both the system level approach, functionality to be provided, and software development processes, including V&V, was determined using the applicable regulatory evaluation criteria of that time. The earlier NRC staff reviews and approvals of the LTRs were performed to enable improvements in regulatory efficiency without adversely affecting regulatory effectiveness (see References 22 and 23). However, the applicable regulatory evaluation criteria have changed since these earlier reviews and approvals, and these changes include criteria against which the PRNMS development processes had not been previously evaluated. As applicable to software-based digital safety systems, a series of regulatory guides did not yet exist in 1995, and these include:

- Regulatory Guide 1.168 (Reference 28), which addresses with software-based system development and independent V&V throughout the development lifecycle;
- Regulatory Guide 1.169 (Reference 29), which addresses software configuration control;
- Regulatory Guide 1.170 (Reference 30), which addresses software test documentation;
- Regulatory Guide 1.171 (Reference 31), which addresses software unit testing;
- Regulatory Guide 1.172 (Reference 32), which addresses software requirements specifications; and
- Regulatory Guide 1.173 (Reference 33), which addresses lifecycle process development.

Each of the preceding regulatory guides was originally released in 1997 and only Regulatory Guide 1.168 was subsequently revised in 2004. Also, Regulatory Guide 1.152, which addresses high functional reliability and design requirements for computers used in safety systems of nuclear power plants, has been revised since the earlier reviews and approvals. SRP Chapter 7, "Instrumentation and Controls," BTP 7-14, which provides guidance to the NRC staff when performing software reviews for digital computer-based I&C systems that perform safety system functions, directly references each of these regulatory guides. However, BTP 7-14 did not exist before the revision to the SRP in 1997 and was unavailable for consideration during the prior LTR reviews.

The following subsections address the software lifecycle and development process aspects of Regulatory Guides 1.152, 1.168, 1.169, 1.170, 1.171, 1.172, and 1.173, as applied within this GGNS PRNMS SE.

3.7.1 Applicability of Current Regulatory Evaluation Criteria to Changes

The NRC staff identified gaps between current and applicable regulatory evaluation criteria and the regulatory guides that are documented in the PRNMS LTRs and the GGNS UFSAR. The NRC staff asked the licensee to provide information that would allow the NRC staff to determine whether the processes applied in the GGNS PRNMS development satisfy the current and applicable regulatory evaluation criteria associated with the digital computer-based I&C systems that perform safety system functions wherever changes had occurred since the LTR review and approval (see Reference 44, RAI 1). The licensee's response provided summaries of changes that had occurred; however in all cases the response did not demonstrate that the processes applied to the GGNS PRNMS were equivalent to the methods currently endorsed in the regulatory guidance. The licensee's response provided an overall summary of the development processes and a table to correlate regulatory guidance cited in NUREG-0800, Standard Review Plan, with the guidance listed in the original LTR. The licensee's correlation for Regulatory Guides 1.168 through 1.173 (see Reference 6, Attachment 2, response to RAI 1, Table 1-9) acknowledges that the guidance and reference standards were not specifically incorporated into the PRNMS development processes, provides a correlation of the design processes of BTP 7-14 to the processes that were applied to the PRNMS development, and offers that extensive field experience of equipment developed using the existing processes—which had been reviewed and approved by the prior LTRs—provides reasonable assurance that the development processes will produce a PRNMS that reliably performs the safety functions for which it was designed and tested. The licensee also provided a separate and more detailed evaluation for Regulatory Guide 1.152 (see Reference 6, Attachment 2, response to RAI 1, Table 1-10).

After reviewing the licensee's initial response including the correlation to PRNMS development processes, the NRC staff requested more detailed descriptions of the development processes, procedures, products, and organizational independence as applied to the development of software and programmable logic devices within the GGNS PRNMS (see Reference 45, RAIs 1 through 4). The licensee provided a further narrative and mapping of licensee processes to procedures, docketed the major software plans and GGNS specifications, highlighted the degree that organizational independence was applied during the development, described the software tool qualification approach, and justified inclusion of the DSS-CD software (see

Reference 10, response to RAI 4 and Reference 11, responses to RAI 5 and RAI 6). The NRC staff reviewed these responses and based on its evaluation of the software development documentation, the staff identified that the module (i.e., unit) testing as defined by the processes allowed for unstructured testing to be performed by the designer and did not require formal structured testing by an independent organization. The NRC staff reviewed the balance of V&V testing efforts and confirmed that adequate independence was provided for integration testing, system testing, and factory acceptance testing. The NRC staff also determined that the licensee's historical approach to unit testing is consistent with Software Integrity Level (SIL) 3 unit testing; however, the current revision of Regulatory Guide 1.168 requires that all V&V tasks, including the unit testing task, to be performed by an independent V&V organization in accordance with SIL 4 for safety system software.

Consistent with the purpose of improved regulatory efficiency without adverse effect on regulatory effectiveness, the PRNMS development processes leverage the prior LTRs by emphasizing a systematic evaluation of the GGNS-specific system requirements to produce a replacement PRNMS modification that applies components that had been qualified through earlier developments that were previously reviewed and approved by the NRC staff. This approach maximizes reuse of the previously reviewed PRNMS architecture and components (hardware and software) that are used in other nuclear power plant systems. The components used in digital safety systems are not expected to remain static during the maintenance phase of a product's lifecycle, and the processes used to develop them may also be changed to affect improvements. In accordance with Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50, both change types must be controlled through an overall quality assurance program for which the licensee remains responsible. The licensee provided a detailed list of changes to hardware and software to demonstrate sufficient design control measures are in place (see Reference 6, Attachment 2, response to RAI 1, Parts 1 and 2).

In addition to the implementation of corrective actions, each subsequent version of PRNMS and the revisions to its components include engineering change actions for both product maintenance and to implement improvements gained from operating experience. The PRNMS components are not commercial items, and the current regulatory acceptance criteria defined to evaluate a digital I&C modification does not directly address the use of operating experience for nuclear power plant specific developmental items when assessing the reliability and quality of safety system software-based instrumentation. Nevertheless, this NRC staff evaluation has taken into consideration the method and degree of reuse applied in the GGNS PRNMS development, which has produced documented and applicable operating experience. The NRC staff evaluation of operating experience for reusable components considers the amount and applicability of operating experience. In the case of the GGNS PRNMS, all of its operating experience is directly applicable for unmodified components. To address differences between the current regulatory evaluation criteria and the processes used to develop the GGNS PRNMS, the licensee performed a compensatory measure that formally documents the operating experience applicability of the GGNS PRNMS and its safety-related software and identifies all modified programming (see Reference 19).

The licensee documented the history of GGNS PRNMS application and reuse from prior APRM systems that were based on the prior LTRs (References 2 and 3). These APRM system were or are deployed in other nuclear power plants in the United States, the first being Edwin I. Hatch

Nuclear Plant (Hatch), Unit 2 in April 1997. Within this documentation, the licensee stated that since the Peach Bottom Atomic Power Station (PBAPS) application variant, which was first carried forward into Limerick Generating Station, Unit 1 in April 2000, there have been no known unresolved anomalies, problem reports, or non-conformances that could carry forward to adversely affect the safety functions of the GGNS PRNMS application. The licensee also stated that any future anomaly, which may be identified in another power plant's APRM application that is based on PBAPS application variant, will be evaluated for correction and inclusion into the GGNS PRNMS. This includes the Brunswick Steam Electric Plant application, which was the first to implement the DSS-CD algorithm in December 2003. The operating experience for APRM channels that implement DSS-CD (consistent with the GGNS PRNMS) represents approximately 2,768 operating months (over 230 operating years) or 17,636 operating months (over 1,469 operating years) for all APRM applications that were based on the LTRs (see Reference 19, Section 3.0 Operating Experience).

The NRC staff determined that the level of operating experiences that was described and demonstrated by the licensee exceeds that proposed for COTS products in NUREG/CR-6421, "A Proposed Acceptance Process for Commercial Off-the-Shelf (COTS) Software in Reactor Applications," March 1996 (Reference 51). While not an endorsed method to meet the regulations, this document proposed the criteria that the product have a significant (greater than 1 year) operating time, with severe-error-free operating experience, where at least two independent operating locations used a product of identical version, release, and operating platform encompassing the same or nearly the same usage as the proposed usage. The criteria also proposed to establish that any adverse reports, regardless of operating location, be considered.

The licensee documented its evaluation of the previously developed software starting from Hatch, Revision 4, which represents the first licensed application of the LTR (Reference 22) in the United States. This evaluation was performed on each APRM software package (i.e., source code or supporting files) (see Reference 19, Section 4.0 Analysis). Source code changes that affected actual software execution were subjected to reviews and formal independent unit, integration, and system validation regression test activities. All source code changes between Hatch, Revision 4, and the GGNS PRNMS were identified and analyzed. First, file versions containing differences were identified, and then where any change was detected, the details of the change were identified and reviewed. The review process determined whether the change affected path execution, mathematic operations, or algorithmic logic. These types of changes were subjected to specific regression testing, wherever either the change was not already adequately tested by formal unit or integration testing that had already been performed and the GGNS-specific system validation testing was determined to be insufficient to adequately test the change. For the changes identified as requiring regression testing, the complexity of the change is established via a metric, the number of modified source code lines, and this metric was used to assess the depth of regression testing to be performed.

The APRM contains four sets of safety-related microprocessor software: 1) APRM Functional Controller, 2) APRM Display Controller, 3) Scanning Automatic Signal Processor, and 4) Stability Automatic Signal Processor. For each set of safety-related microprocessor software, the licensee performed a software change identification and impact analysis. The changes to software packages were summarized in tabular form (see Reference 19, Tables 3, 5, and 7). These tables highlight in yellow the changes that required further regression test analysis. Only the Scanning Automatic Signal Processor software set for the GGNS PRNMS is identical to Hatch, Revision 4, and required no further analysis.

The licensee identified software unit test criteria under the module test definition within the software management plan (see Reference 12, NUMAC Software Management Plan, 23A5162, Section 2.6.3), and the details of the software changes to each software component file and function were evaluated to assess the potential impact of the change against the previously defined unit test criteria (see Reference 19, Tables 4, 6, and 8). Based on the results of this analysis, the licensee proposed supplemental testing with test cases that are to be developed by an independent team for the modified software sets: 1) APRM Functional Controller, 2) APRM Display Controller, and 2) Stability Automatic Signal Processor (see Reference 19, Section 5.1).

In part, the compensatory measure assessed the degree that the overall software V&V process satisfies the acceptance criteria that is established by Regulatory Guide 1.168. The licensee determined that it would perform regression testing as compensatory measure for the identified software logic changes since Hatch, Revision 4. The documentation of this regression testing is to include tests (e.g., module or unit, integration, etc.) that are written to the design requirements and that apply formal test procedures and/or test cases that have been developed by personnel who are independent from the design organization. The test procedures are proposed to have traceability to the Software Evaluation Report (Reference 19) in addition to the applicable Software Design Specification.

The licensee performed a separate evaluation for the 2-out-of-4 voter programmable logic devices similar to the evaluation performed for microprocessor-based software changes. The licensee documented the history of the programmable logic devices within the 2-out-of-4 voter (see Reference 19, Appendix A). The licensee had previously stated that the voting logic has not changed since the initial U.S. application at Hatch in 1997; however, for the BWR/6 platform, a change would be required (see Reference 6, Attachment 2, response to RAI 1, Part 4). Later the licensee rescinded this earlier intent, provided justification that this BWR/6 platform change would not be required, and provided GGNS-specific LTR change pages to reflect this revised approach (see Reference 12, Attachment 1, response to RAI 27). Nevertheless, the licensee described the vendor's standard NUMAC software development process to be applied to future programmable logic devices development efforts to adequately address any future corrective actions that necessitate changes to the programmable logic devices. This description acknowledges the current regulatory approach treatment of programmable logic devices for safety systems as software and will similarly apply to future regression testing of the programmable logic device modifications.

The NRC staff agreed to compensatory measures to address the lack of module (i.e., unit) test with formal structured test procedures and/or test cases that are developed by personnel that are independent from the design organization. The NRC staff agreed with the compensatory measure to perform V&V tasks, including regression testing, for safety system software or programmable devices by independent personnel in accordance with SIL 4 as established by Regulatory Guide 1.168 for modified software and programmable devices for which an applicable successful operating history could not be demonstrated. To support this limited applicability of independent V&V tasks, the compensatory measures included identification of applicable operating history for safety system software or programmable devices and identification of modifications since the original licensing topical report. As such, the NRC staff concluded that the compensatory measures to provide a report to demonstrate an applicable successful operating history for unmodified software and to perform formal independent V&V tasks, including regression testing, on modified safety system software or safety system software without an applicable successful operating history is acceptable.

3.7.2 System and Software Requirements Development Approach

Regulatory Guide 1.172, "Software Requirements Specifications for Digital Computer Software Used in Safety Systems of Nuclear Power Plants," September 1997, describes a method acceptable to the NRC staff for complying with the NRC's regulations as they apply to preparation of software requirement specifications for safety system software through its endorsement of IEEE Standard 830-1993, and BTP 7-14 provides guidance to the NRC staff when performing software reviews for digital computer-based I&C systems. However, the GGNS PRNMS development does not represent the original generation of the safety-related software or system components.

The licensee's approach to the GGNS PRNMS development has characteristics that differ from typical system and software developments for new safety systems, because the GGNS PRNMS development is based on a previously reviewed and approved LTR. This licensee approach reuses the architecture, functionality, hardware, and software that are defined within the LTRs that had been previously reviewed and approved by the NRC staff. Furthermore, the GGNS PRNMS firmware is not loaded into a fielded system, but rather is configured and embedded as part of the hardware configuration. The NRC staff identified and reviewed these characteristics in further consideration that regulatory guidance may be written to address a new system's development and contains considerations applicable to the use of general purpose computer hardware that requires software to be loaded into the system when installed in the plant. The licensee provided a high level mapping and descriptions of the development processes that were applied to the GGNS PRNMS development (see Reference 6, Attachment 2, response to RAI 1, Part 3 and Table 1-7). The licensee later provided more detailed descriptions of the development process to include the software development plans and specifications that were applied to the GGNS PRNMS (see Reference 12, Responses to RAIs 1 and 2).

The GGNS PRNMS life cycle did not include typical concept development, because the previously reviewed and approved LTR defines an overall system concept, functionality, and architecture to allocate functions to hardware and software components. Conformance to the previously reviewed and approved LTR acts to fulfill the need for a typical concept development and includes identification of deviations from the LTR along with the plant-specific actions required to apply the LTR (see Sections 3.9 and 3.10). To develop the GGNS PRNMS, the licensee's plant-specific system requirements have been mapped to the architecture and components identified in the LTR. The licensee provided the generic "NUMAC Requirements Specification," 23A5082AA, and the GGNS-specific "NUMAC PRNM System Requirements Specification," 24A5221WA (see Reference 12, Attachment 1, Enclosure 1), to demonstrate that the LTR concepts have been translated into specific system requirements during the Definition and Planning Phase.

In lieu of performing a confirmatory audit, the NRC staff reviewed requirement traceability through a sample set of the system requirements to software specifications within docketed information, assessed the applicable operational experience for prior NUMAC products that were developed in accordance with documented NUMAC processes (see References 19), assessed the final GGNS NUMAC V&V Report 's documentation of anomalies and corrective actions (see Reference 21), and assessed the traceability provided (see Reference 21, Sections 4.2 and 4.3). Based upon these reviews and assessments, the NRC staff concluded that the system and software requirement development approach is acceptable and continues to satisfy the intent of the LTRs, because conformance to the previously reviewed and approved LTRs has been established and the licensee has provided documentation that demonstrates the LTR concepts have been translated into specific system requirements and V&V activities with formally documented traceability.

3.7.3 Software Configuration Control

Regulatory Guide 1.169, "Configuration Management Plans for Digital Computer Software Used in Safety Systems of Nuclear Power Plants," describes a method acceptable to the NRC staff for complying with the NRC's regulations as they apply to the configuration management of safety system software.

The licensee described its configuration control processes and tools, which limit access and changes to formal baselines of the software. The controlled products and baselines are established in accordance with the "NUMAC Software Management Plan," 23A5162, and performed in accordance with the "NUMAC Software Configuration Management Plan," 23A5161 (see Reference 12 Attachment 1, Enclosure 1). The NRC staff review confirmed that a software baseline is established at defined points in the software lifecycle process and that independent reviews are performed at these points to assess the adequacy of the software products and documentation throughout the development. The licensee treats the final software end-product the same as hardware from a configuration control standpoint. A unique hardware configuration item that includes a unique hardware drawing and revision is created for each programmed device (programmable read-only memory or programmable logic devices). The PRNMS does not include provisions that require post delivery configuration of its operational software.

While BTP 7-14 contains guidance that software versions should be readable by maintenance tools, the PRNMS does not include features to retrieve version information from the installed programmable read-only memory or programmable logic devices. Rather the programmed devices are provided with unique part number and revision labels (see Reference 10, response to RAI 7). The NRC staff concluded that this approach is acceptable, because the device programming process verifies the correct version at the time the device is programmed and labeled, and this further allows for confirmation that the software is the correct version upon receipt inspection at the plant. Assurance that the received version is not subsequently modified is provided, because the PRNMS does not include provisions for plant personnel to subsequently change the configuration of the installed operational safety software.

The licensee provided detailed configuration and change information that demonstrates appropriate configuration control processes are in place (see Reference 6, Attachment 2, response to RAI 1 and Reference 19). Additionally, operational history provided by the licensee for each variant of its PRNMS system and its reused software components further demonstrates the adequacy of its configuration control processes (see Reference 19).

Based on the NRC staff's review and evaluation the licensee's configuration control processes, applicable operational history of products based on these configuration control processes, and in further consideration of its approach to treat programmed devices as hardware configuration items, the NRC staff concluded that the software development includes adequate reviews and configuration control to satisfy the acceptance criteria of Regulatory Guide 1.169.

3.7.4 Software Safety

The GGNS PRNMS development process did not produce a separate Software Safety Plan or analysis, or utilize a separate software safety organization as provided for within BTP 7-14. Rather, the LTR established the safety-significant aspects of the PRNMS system, and these safety attributes are directly included in the software requirement specifications and confirmed during the overall design and V&V process (see Reference 6, Attachment 2, page 34). Additionally, the diversity and defense-in-depth analysis that was performed is consistent with the plant's overall safety analysis (see Section 3.4).

The NRC staff concluded that this approach is acceptable, because conformance to the previously reviewed and approved LTRs has been established and the licensee has provided a diversity and defense-in-depth analysis that addresses software failures.

3.7.5 Hazard Analysis

Similar to the approach to a Software Safety Plan, no separate Hazards Analysis is performed as part of the system V&V tasks during each software lifecycle stage to determine the safety integrity level required for individual software components during the development, as is provided for by Regulatory Guide 1.168. Rather, the licensee discussed the vendor's software verification and validation process which specifies a software integrity level for each set of processing software that is contained within individual PRNMS components. The overall software integrity level is based on the safety-significant aspects of the PRNMS system and whether any portion of a set of processing software is required to perform a safety function. This safety basis is defined by the previously reviewed and approved LTRs, and each software unit within an individual PRNMS component must be developed to the highest safety integrity level for any software within that component.

The NRC staff concluded that this approach is acceptable, because conformance to the previously reviewed and approved LTRs has been established, the highest safety integrity level within an individual PRNMS component is applied to all software within that component, and the licensee has provided a diversity and defense-in-depth analysis that addresses software performance (including failures) that may contribute to hazards.

3.7.6 Verification and Validation (V&V) Testing

The licensee performed unit test, integration test, system test, and factory acceptance testing in accordance with the "NUMAC Software Verification and Validation Plan," 23A5163 (see Reference 12, Attachment 1, Enclosure 1). The NRC staff reviewed the plan and assessed the activities that were performed in accordance with this plan. This evaluation identified satisfactory compliance with Regulatory Guide 1.168 except for independently developed unit structured and documented testing of safety software (see discussion in Section 3.7.1). The licensee provided V&V summary reports to document the software V&V activities, including the compensatory measures previously identified (see References 20 and 21). The NRC staff reviewed these reports and evaluated the test activity summary and the independence applied when performing the compensatory measures against the acceptance criteria established in Regulatory Guide 1.168.

The NRC staff concluded that the acceptance criteria established in Regulatory Guide 1.168 have been satisfied for the GGNS PRNMS based on performance of the compensatory measures in addition to the V&V activities as originally planned, organized, and performed.

3.7.7 Evaluation of DSS-CD as Potentially Unused Code

The PRNMS includes the DSS-CD algorithm; however, its trip outputs are disabled in hardware. Therefore, the DSS-CD function was not evaluated as part of this license amendment except to ensure that its presence is not adverse to reliable performance of PRNMS safety functions. The DSS-CD output will not be enabled until a later license amendment is requested. In the meantime, following installation of the PRNMS, the licensee has committed to use the algorithm results to establish plant-specific operating history in preparation for the subsequent license amendment (see Reference 10, response to RAI 4, and Reference 15, supplemental response to RAI 4). The operating experience evaluated in the previous section includes the presence of the DSS-CD algorithm. The inclusion of the DSS-CD algorithm was specified in the requirements and will be used by the licensee to collect data and monitor DSS-CD performance although the DSS-CD function remains disabled. Furthermore, prior NRC staff precedent allowed inclusion of the disabled DSS-CD algorithm (see see Reference 42, Section 3.8.1.3, 1st and 2nd paragraphs).

Based on this evaluation, the NRC staff concluded that the inclusion of the disabled DSS-CD algorithm is acceptable and does not consider it adverse unused software per the BTP 7-14 guidance that unused functions and code should not be present in the safety-related system software.

3.7.8 Secure Software Development and Operations

The licensee addresses secure software development and operations throughout the product development to ensure the system is reliable (see Reference 6, Attachment 2 Table 1-10). The administrative controls established in the original LTR (see Reference 22, Section 5.3.13) have been confirmed for the GGNS PRNMS (see Section 3.10, item 5) and these requirements are included in the "NUMAC PRNM System Requirements Specification," 24A5221WA (see Reference 12, Attachment 1, Enclosure 1). Also, the development process includes specific code and design reviews between defined lifecycle phases, which in part act to verify that undocumented or unwanted code is not included in the delivered product. The specified features are confirmed as part of the product's V&V. Once fielded, the safety-related software is contained in programmed devices which becomes part of the documented system configuration and cannot be subsequently modified by the licensee. The correct software configuration is determined prior to delivery of the PRNMS equipment.

The configuration and control processes and tools limit access and changes to formal baselines of the software, which are established in accordance with the "NUMAC Software Management Plan," 23A5162, and performed in accordance with the "NUMAC Software Configuration Management Plan," 23A5161 (see Reference 12, Attachment 1, Enclosure 1). These formal configuration control processes limit personnel access to the software at the correct version.

NRC staff review of equipment security features is limited to ensuring that their inclusion is not adverse to the reliability of equipment safety functions. The licensee identified the use of a protocol that utilizes encryption techniques. The NRC staff confirmed that this protocol is not included within the safety processors of the PRNMS; therefore, the inclusion of this feature cannot have an adverse effect on reliable performance of the PRNMS safety functions. The security protocol is implemented between the non-safety NIC and its connection to the non-safety portion of the PRNMS, which is the PCI (see Reference 12, NUMAC PRNM System Requirements Specification," 24A5221WA, Sections 4.10.4.7); therefore, the performance of the encryption/decryption algorithms does not complicate or otherwise adversely affect the safety functions.

The NRC staff concluded that these approaches provide an acceptable method to meet the evaluation criteria established in Regulatory Guide 1.152, Staff Positions 2.1 through 2.5 for the previously approved software and for all software changes since the approved LTRs, because the approaches provide reasonable assurance that undocumented, malicious or unwanted code is not included in the delivered product through the use of a secure development and operational environment, configuration control procedures, design review procedures, and the implementation of security features that do not adversely affect the safety functions.

3.8 Equipment Qualification

Two objectives of the PRNMS system environmental testing are 1) to demonstrate that the system will not experience failures due to abnormal service conditions of temperature, humidity, power source, radiation, or seismic, and 2) to verify those tests meet the GGNS requirements.

Criteria for environmental qualifications of safety-related equipment are provided in 10 CFR Part 50, Appendix A, "General Design Criterion (GDC) 2, "Design Bases for Protection Against Natural Phenomena," and GDC 4, "Environmental and Dynamic Effects Design Bases."

The equipment will be installed in the GGNS control room, which is a mild environment. The licensee performed equipment qualification on the PRNMS equipment and the non-safety NUMAC Interface Computer (NIC) to establish operating envelopes applicable to the GGNS installation. Qualifications that were performed include environmental, seismic, and electromagnetic compatibility. Some of the testing defines an operating envelope for the NIC that is different than that of PRNMS; regardless, this section primarily addresses the PRNMS equipment, because only non-safety-related functions are associated with the NIC.

Documentation of equipment qualification that confirms the equipment qualification envelopes plant-specific requirements is required in the plant-specific license amendment when referencing the previously approved LTRs (References 22 and 23). However, the LAR (Reference 1) did not identify an overall GGNS operating envelope for all environmental conditions (i.e., only identified a nominal value in some cases), so the NRC staff requested this information along with documentation of the qualification efforts (see Reference 44, RAI 5, and Reference 45, RAIs 21 through 23). The licensee provided responses that revised the temperature, humidity, and radiation levels from those originally identified within the LAR, which defined the required plant-specific environmental operating conditions (see Reference 4 and Reference 9, responses to RAI 5 in comparison to Reference 1, Attachment 1, page 3). Nevertheless, these responses did not include documentation of the qualification activities including a plant unique qualification summary, because these activities had not yet been performed to completion. The licensee later provided documentation of the qualification activities and a qualification summary (see Reference 13, responses to RAIs 21 through 23).

The licensee performed equipment qualification activities on the PRNMS to comply with IEEE Standard 603 Clause 5.4, and described the approach to equipment qualification by the combination of type test, previous operating experience, and analysis (see Reference 13). The approach qualifies equipment on an instrument chassis basis and then extends this qualification to the bounding panel installation. The approach includes analysis of prior qualifications based on design similarities and differences of each instrumentation chassis to justify extending the applicability of prior tests through similarity. The approach analyzes the panels to establish bounding specifications for temperature rise, seismic spectrum, and electromagnetic compatibility for the installed instrumentation. The licensee provided a detailed description of the environmental qualification (see Reference 13, responses to RAIs 21 and 22), the seismic qualification (see Reference 13, response to RAI 22), and electromagnetic compatibility qualification (see Reference 13, responses to RAIs 22 and 23). In these responses, the licensee describes the testing performed to include the unique test setup(s) and units under test. Qualification by type testing included measurements of critical parameters and operability of the PRNMS safety functions to ensure that the unit under test continued to perform for the required operational environment. All testing was performed in accordance with independently verified test procedures and all test results were analyzed and independently verified in a test report. The NRC staff's evaluation of each equipment qualification test is discussed in the following subsections.

3.8.1 Environmental Qualification

Regulatory Guide 1.209, "Guidelines for Environmental Qualification of Safety-Related Computer-Based Instrumentation and Control Systems in Nuclear Power Plants," March 2007 (Reference 35), endorses and provides guidance for compliance with IEEE Standard 323-2003 to describe a method acceptable to the NRC staff for satisfying the environmental qualification of safety-related computer-based I&C systems for service in mild environments.

The licensee identified the environmental qualification levels for the PRNMS equipment (see Reference 9, Table 1-1); however, the licensee did not provide environmental qualification information for the NIC, because it does not perform a safety function. The table identifies minimum, nominal and maximum values, as applicable, for each of the following environmental characteristics: 1) Operating Temperature, 2) Operating Humidity, 3) Pressure, 4) Radiation, Gamma Rate, and 5) Radiation Gamma Total Integrated Dose. The licensee identified the GGNS Control Room's mild environmental operating conditions in the same format (see Reference 9, Table 2-2).

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The licensee identified the locations of the records that document the PRNMS qualification details and provided additional documentation of margin between the environmental requirements for the GGNS control room and the environmental qualification levels (see Reference 13, response to RAI 21). In this response, the licensee provided additional tables to document the GGNS control room environmental requirements (see Reference 13, Table 21-1) and to document of the PRNMS equipment environmental qualification levels (see Reference 13, Tables 21-2 and 21-3). The licensee also provided justification for radiation qualification based on prior testing, similarity analysis, and operating experience data as applicable to the GGNS PRNMS equipment operating environment and its dose rate.

The licensee described details of the environmental qualification (see Reference 13, response to RAI 22). To demonstrate qualification of the installed equipment for temperature, the temperature rise in the mounting cabinet was determined. In determining the maximum cabinet temperature rise, the licensee evaluated prior temperature rise test experiences with adjustments to address the GGNS PRNMS panel configuration. The qualification summary demonstrates that the qualified instrument temperature is greater than the maximum ambient room temperature plus the maximum cabinet temperature rise. The temperature qualification provides margin between the maximum temperature to which PRNMS components have been qualified and the estimated maximum installed operating temperature. Similarly, margin is provided between the minimum temperature to which PRNMS components have been tested and the estimated minimum installed operating temperature, which is conservatively assumed to be the GGNS control room ambient without consideration of internal cabinet temperature rise.

The licensee summarized its comparison of the qualification levels against the GGNS control room requirements for temperature, and this comparison demonstrates the degree of margin provided between the temperature test conditions and the GGNS control room temperature requirements (see Reference 13, response to RAI 22, Temperature, pages 20 and 21). Likewise, the licensee summarized its comparison of the qualification levels against the GGNS control room requirements for humidity (see Reference 13, response to RAI 22, Humidity, page 21).

GGNS-specific type testing was performed where the GGNS installation-specific environmental requirements were not bounded by prior equipment qualification and similarity analysis. The licensee described this environmental type testing, which was conducted on the APRM and PCI instruments on August 19 and September 29, 2010, and on 2-Out-Of-4 Logic Module and Quad Low Voltage Power Supply from April 30 through May 2, 2011. During the environmental type testing, the acceptance criteria required all instrument inputs and outputs to continue to operate as specified, and the instrument under test to continue to operate as specified without any self-test failure or failure of any component required to perform a safety function. Other PRNMS components were qualified by analysis and similarity in part because they had been analyzed to ensure that they contain no components that are sensitive to either temperature or humidity.

The NRC staff compared the GGNS control room environmental requirements against the qualification levels provided and confirmed that the PRNMS equipment environmental qualification levels envelope the environmental requirements identified for the GGNS control room.

Based on the specification for a mild environment, analysis, testing, and availability of test results for PRNMS environmental performance, the NRC staff has concluded that the PRNMS satisfies the GGNS environmental requirements consistent with the GGNS safety bases.

3.8.2 Seismic Qualification

Regulatory Guide 1.100, Revision 3, "Seismic Qualification of Electrical and Active Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants," September 2009, endorses and provides guidance for IEEE Standard 344-2004, "Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generation Stations," to identify a method acceptable to the NRC staff for satisfying the seismic qualification.

The licensee identified the seismic qualification envelope and described the details of the seismic qualification envelope in terms of Required Response Spectra per IEEE Standard 344-1987 for prior NUMAC component qualifications (see Reference 9). This description also includes the details of the seismic qualification envelope in terms of Required Response Spectra per IEEE Standard 344-2004 for the APRM and PCI, which were subjected to GGNS-specific seismic qualification testing. The response documents GGNS seismic floor input spectra for the operating basis earthquake and the safe shutdown earthquake. The licensee performed analysis to determine that the test input motion Required Response Spectra envelopes the installed equipment response spectra throughout the frequency range of interest for the PRNMS panels.

The licensee provided details of the seismic qualification test setup and test specimens for the APRM instrument chassis and PCI instrument chassis, because all other components were previously qualified and subject to analysis to extend prior qualification as bounding for the GGNS installation (see Reference 13). The APRM and OPRM were tested and qualified to the seismic criteria identified in IEEE 323-2003, "Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations," and IEEE 344-2004. The testing confirmed that the APRM and PCI instruments continued to perform as expected including operability of the safety functions for five operating basis earthquakes and one safe shutdown earthquake without either structural or equipment failure. The seismic qualification for GGNS PRNM components other than APRM and PCI was performed by analysis and comparison against previously qualification levels for the NUMAC hardware (see Reference 13, Table 22-4).

The licensee did not provide seismic qualification information for the NIC, because it does not perform a safety function; however, the licensee performed a seismic evaluation to confirm that installation of the NIC would not adversely affect safety-related panels within its proximity. The seismic qualification analyzed all safety-related panels to confirm that stresses in the modified panels are within acceptable limits for the safe shutdown earthquake. This analysis was performed in addition to the analysis that established the bounding specifications for the seismic spectrum that may be experienced by the installed instrumentation within a panel.

GGNS-specific type testing was performed where the GGNS installation-specific seismic requirement was not bounded by prior equipment qualification and similarity analysis. This seismic type testing was conducted on the APRM and PCI instruments on July 19 and 20, 2010. During the seismic type testing, the acceptance criteria required all instrument inputs and outputs to continue to operate as specified, and the instrument under test to continue to operate as specified without any self-test failure or failure of any component required to perform a safety function. Other PRNMS components were qualified by analysis and similarity to equipment qualifications that were completed in May 1996.

Based on the analysis, testing, and availability of test results for GGNS PRNMS seismic performance, the NRC staff has concluded that the PRNMS satisfies the GGNS seismic requirements consistent with GGNS safety bases.

3.8.3 Electromagnetic Compatibility Qualification

Regulatory Guide 1.180, Revision 1, "Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems," October 2003, describes a method acceptable to the NRC staff for the design, installation, and testing practices to address the effects of electromagnetic and radio-frequency interference (EMI/RFI) and power surges on safety-related I&C systems.

The licensee identified the location where the equipment is to be installed as an administratively controlled radio exclusion zone in accordance with a GGNS procedure that requires new equipment be evaluated to determine susceptibility to EMI/RFI and the new equipment's potential to affect nearby equipment through electromagnetic and radio frequency emissions (see References 9 and 13).

The licensee provided a summary of the electromagnetic compatibility (EMC) qualification of the PRNMS (see Reference 9, Table 3-3 for susceptibility and Table 3-4 for emissions). This summary was provided to demonstrate that GGNS PRNMS components were qualified by type testing or analysis to demonstrate that the PRNMS will perform all specified functions when operated with the specified EMC limits and when mounted in accordance with the specified methods. The licensee performed EMC testing to demonstrate GGNS PRNMS components satisfy the guidance provided within Regulatory Guide 1.180, Revision 1.

The licensee provided a separate summary of the EMC qualification of the NIC (see Reference 9, Table 3-4 for susceptibility and Table 3-5 for emissions). The licensee performed EMC testing to demonstrate GGNS NIC components satisfy the guidance provided within EPRI TR-102323, Revision 3, "Guidelines for Electromagnetic Interference Testing in Power Plants," 2004 (Reference 52). The licensee clarified that the electromagnetic and radio frequency susceptibility information for the NIC was not required, because the NIC does not perform a safety function; however, the licensee performed electromagnetic and radio frequency emissions testing on the NIC to confirm its installation would not adversely affect safety-related equipment within its proximity (see Reference 13).

The licensee provided details of the EMC qualification test setup and test specimens that are specific to the GGNS PRNMS, and also discussed prior EMC type testing that has been performed (see Reference 13, Table 23-1). In addition to GGNS PRNMS-specific testing, prior testing had been performed on equipment considered sufficiently similar to that used in the GGNS PRNMS and this prior testing includes the original NUMAC component qualification effort. The details provided include identification of the equipment and quantities that were subjected to EMC testing and the applicable EMC tests that were performed on individual components. The licensee provided a series of tables to describe the specific EMC testing performed, and these tables compare the actual test method and levels applied to individual components against the EMC test methods and levels identified in Regulatory Guide 1.180 (see Reference 13, Tables 23-2 through 23-7).

As indicated by the EMC test result, EMC emissions are satisfactory when the measured levels are less than or equal to the limits specified in Regulatory Guide 1.180. Similarly, the EMC susceptibilities are satisfactory when the applied test levels are greater than or equal to the limits specified in Regulatory Guide 1.180. The test result tables provide a remark for the each test to clarify the basis for concluding that the equipment performance is acceptable (i.e., the test passed). For all tests, the clarifying remark indicates one of the following: 1) the test level envelopes those identified in RG 1.180, 2) the test level equals those identified in RG 1.180, or 3) the test result meets the RG 1.180 criteria. When the RG 1.180 emission test criteria was not applied during the test, the licensee provided a graph to demonstrate the test results nevertheless met the levels identified in RG 1.180. Where RG 1.180 guidance was not strictly followed, the table provides clarifying information as notes to provide technical justification for the alternative approach. In some cases, the licensee referenced EPRI TR-102323, Revision 3, as providing the supporting basis for these alternatives.

The NRC staff reviewed the summary of EMC tests to confirm the test result conclusions and technical justifications for alternate approaches. The NRC staff's review was limited to the components used in the GGNS PRNMS and NIC, did not include other generic NUMAC components, and did not include a review of the entirety of EPRI TR-102323, Revision 3. The tests that were reviewed document the equipment qualification levels for EMC. These tests results provide sufficient information for the licensee to determine the equipment's suitability for use in the GGNS control room environment with respect to electromagnetic and radio frequency compatibility in accordance with its plant procedures, which may be verified during installation testing.

Based on the analysis, testing, and availability of test results for PRNMS EMC, the NRC staff has concluded that the PRNMS satisfies the EMC guidance provided by RG 1.180 to support installation within the GGNS control room.

3.9 Deviations from the Prior LTRs

The licensee's LAR identified and provided technical basis justifying three deviations from the NUMAC PRNM LTR (see Reference 1, Sections 5.1.3, and Reference 4, Attachment 5, Appendix A) and two deviations from the BWROG Option III methodology (see Reference 1, Section 5.1.4 and Attachment 5). This section identifies and addresses the acceptability of each of these five deviations.

1) APRM Upscale / OPRM Upscale, APRM Inop Function Logic (see Reference 1, Section 5.1.3, item 1)

The licensee provided the technical basis for this deviation in GEH Report 0000-0103-7166-R0, "Grand Gulf Nuclear Station NUMAC PRNM LTR Deviations "(see Reference 1, Attachment 5, pages A-2 through A-5). The justification for this deviation is that it improves operating flexibility.

The deviation changes the OPRM trip function that is voted upon within the 2-out-of-4 voter logic to be the combination of either an APRM Inop trip or the OPRM Upscale trip, such that the occurrence of either will be applied as an OPRM trip within the voter logic. This logical combination is justified by the PRNMS design, which implements the OPRM trip function in the same equipment as the APRM trip function; therefore, conditions that could disable the APRM trip function would likely disable the OPRM trip function as well.

The NRC staff reviewed the justification and determined that the proposed change is conservative relative to the current LTR approach. Furthermore, the NRC staff confirmed that the deviation request satisfies the basis of previously approved precedent (see Reference 42, Section 3.8.1.1). Therefore, the NRC staff concluded that this plant-specific deviation is acceptable.

2) OPRM Pre-Trip Alarms (see Reference 1, Section 5.1.3, item 2)

The licensee provided the technical basis for this deviation in GEH Report 0000-0103-7166-R0, "Grand Gulf Nuclear Station NUMAC PRNM LTR Deviations" (see Reference 1, Attachment 5, pages A-2 and A-5). The justification for this deviation is that portions of the existing pre-trip alarm functionality are ineffective, because their contributions to the alarm function do not occur in a sufficiently timely fashion to allow for effective operator action.

The deviation retains the OPRM pre-trip alarm, but modifies it so that the alarm is only derived from the period-based detection algorithm and excludes the amplitude-based and growth-rate algorithms.

The NRC staff confirmed that the deviation request does not adversely impact safety functions and satisfies the basis of previously approved precedent (see Reference 42, Section 3.8.1.2); therefore, the NRC staff concluded that this plant-specific deviation is acceptable.

3) Recirculation Flow Processing (see Reference 1, Section 5.1.3, item 3)

The licensee provided the technical basis for this deviation in GEH Report 0000-0103-7166-R0, "Grand Gulf Nuclear Station NUMAC PRNM LTR Deviations" (see Reference 1, Attachment 5, pages A-2 and A-5). The justification for this deviation is that it does not affect any safety functions while providing improved detection of total flow mismatches.

The deviation adds interdivisional communications (between divisions A and B) and additional interchannel communications (from LPRMs in one channel to a PCI in another channel), which have been designed to impact only non-safety functionality without adversely affecting safety functions. The deviation permits non-safety processing to produce a recirculation flow alarm that is based on four total flow signals (from all four channels) in lieu of two total flow signals (only from the two channels within the same division).

The NRC staff evaluated the impact of this deviation in Section 3.3.4, items 1 and 2 and Section 3.3.6, item 1. These evaluations determined that the impact of the proposed change does not adversely affect the safety functions; therefore, the NRC staff concluded that this plant-specific deviation is acceptable.

4) Base Period Definition for Period-Based Detection Algorithm (see Reference 1, Section 5.1.4, item 1)

The licensee provided the technical basis for this deviation in GEH Report 0000-0107-7607-P, "Grand Gulf Nuclear Station - Grand Gulf PRNM Upgrade Project Option Stability Deviations" (see Reference 1, Attachment 5, pages 1 and 2). The justification for this deviation is that it does not adversely impact the plant ability to provide Safety Limit Minimum Critical Power Ratio (SLMCPR) protection and is conservative relative to the Option III licensing basis.

The deviation modifies the period-based detection algorithm from using an average of all successively confirmed periods to using only the previous successively confirmed period.

The NRC staff confirmed that the deviation request does not adversely affect safety functions and satisfies the basis of previously approved precedent (see Reference 42, Section 3.8.1.3, third paragraph); therefore, the NRC staff concluded that this plant-specific deviation is acceptable.

5) Period Tolerance Offset (see Reference 1, Section 5.1.4, item 2)

The licensee provided the technical basis for this deviation in GEH Report 0000-0107-7607-P, "Grand Gulf Nuclear Station - Grand Gulf PRNM Upgrade Project Option Stability Deviations" (see Reference 1, Attachment 5, page 2). The justification for this deviation is that it does it does not adversely impact the plant ability to provide SLMCPR protection, and that the change is conservative relative to the Option III licensing basis.

The deviation modifies the use of the period offset tolerance within period-based detection algorithm to improve the ability of the algorithm to recognize the initiation of oscillations following a fast flow runback.

The justification includes results of a simulated instability event that compares the algorithm's performance, both with and without the addition of the period tolerance offset. The simulation results show that the successive confirmation counts associated with the period-based detection algorithm will be confirmed sooner so that the trip will occur earlier when the algorithm includes the period offset tolerance.

The NRC staff confirmed that algorithm's performance is conservative relative to the Option III licensing basis, and that the deviation satisfies the basis of previously approved precedent (see Reference 42, Section 3.8.1.3, fourth paragraph); therefore, the NRC staff concluded that this plant-specific deviation is acceptable.

3.10 Confirmation of Plant-Specific Actions

The SE for the LTR identifies six plant-specific actions that are required when a licensee references the LTR as part of a license amendment submittal (see Reference 22, SE Section 5.0). This section identifies each of these actions and summarizes the actions taken by the licensee to fulfill each action to address each required confirmation.

1) Confirm applicability of NEDC-32410 and reconcile any differences between the specific plant design and the topical report description.

The LAR identified the specific GGNS PRNMS configuration option from those available in NEDC-32410 to demonstrate general applicability (see Reference 1, Section 5.1.2, item 1, and Attachment 2). Subsequently, the licensee provided a revision to Attachment 2 (see Reference 4, Attachment 5). To further reconcile differences between the plant-specific design and the topical report description, the licensee provided plant-specific changes to sections and figures of NEDC-32410 (see Reference 4, Attachments 2 and 6).

This I&C evaluation reviewed the confirmation of applicability and the reconciliation of differences between the plant-specific design and the topical report description for the GGNS PRNMS, as provided by the licensee. Based on the above, the NRC staff concluded that this plant-specific action has been fulfilled.

2) Confirm the applicability of the BWROG topical reports that address the PRNMS and its associated instability functions, set points and margins.

The LAR provided this confirmation through its direct reference to the BWROG topical reports and their uses when developing the PRNMS setpoints to include the reload-related aspects (see Reference 1, Section 5.1.2, item 2). Subsequently, the licensee provided additional supporting information related to 1) the bounding LTR assumptions for diversity and defense-in-depth for PRNMS-related safety requirements, 2) the setpoint calculations, 3) the bounding LTR assumptions for equipment safety function response times, and 4) continued applicability of the LTR's reliability conclusion in consideration of the plant-specific hardware configuration (see Reference 7, Attachment 1, response to RAI 8, and Reference 12, Attachment 1, responses to RAIs 28 and 29).

This I&C evaluation reviewed the confirmation of applicability of the BWROG topical reports to the PRNMS and its associated instability functions, set points and margins, as provided by the licensee. Based on the above, the NRC staff concluded that this plant-specific action has been fulfilled.

3) Provide plant-specific revised Technical Specification pages for the PRNMS functions consistent with NEDC-32410, Appendix H.

The LAR provided an initial set of plant-specific revised TS pages (see Reference 1, Section 5.1.2, item 3, and Attachments 3 and 4). Subsequently, the licensee provided additional revisions to the TS pages in response to NRC staff requests for additional information.

This I&C evaluation identifies the proposed Technical Specification changes (see Section 3.2 of this SE) and evaluates each proposed change (see Section 3.2.2 of this SE). Based on the above, the NRC staff concluded that this plant-specific action has been fulfilled.

4) Confirm the plant-specific environmental conditions are enveloped by the PRNMS equipment qualifications values.

The LAR discussed analysis to support this confirmation (see Reference 1, Section 5.1.2, item 4); however, the environmental qualification for the plant-specific PRNMS configuration had not yet been performed. Subsequently, the licensee provided additional supporting information for GGNS-specific type testing where the GGNS installation-specific environmental requirements were not bounded by prior equipment qualification and similarity analysis.

This I&C evaluation reviewed the equipment qualification to determine that GGNS installation-specific environmental requirements have been suitably enveloped (see Section 3.8). Based on the above, the NRC staff concluded that this plant-specific action has been fulfilled.

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

The LAR stated that the design features that control access to the PRNMS for setpoint adjustments, calibrations and test points are not proposed to change from the approach previously reviewed and approved. The LAR also confirmed that administrative controls will be provided for manually bypassing APRM/OPRM channels or protective functions, and for controlling access to the panel and the APRM/OPRM channel bypass switch (see Reference 1, Section 5.1.2, item 5). Subsequently, the licensee provided additional information and committed to placing an APRM/OPRM channel into bypass prior to any setpoint adjustment or calibrations, even though the PRNMS design features do not require this as an interlock for all maintenance activities (see Section 3.3.1, item 2).

This I&C evaluation reviewed the specifications for and commitment to administrative controls, as provided by the licensee. Based on the above, the NRC staff concluded that this plant-specific action has been fulfilled.

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

The LAR acknowledged that the change process requires a human factors evaluation review of the changes to the Control Room Operator's panel, and while this evaluation was not yet complete, documentation of the human factors evaluation review would be included in the final design package and available on-site for NRC inspection (see Reference 1, Section 5.1.2, item 6). Subsequently, the licensee provided additional information to document the human factors evaluation review scope and the effort that had been performed to review the safety-related panels (see Reference 8, response to RAI 7). The licensee's human factors evaluation concludes that the human-machine interfaces are essentially equivalent although some aspects (e.g., the bypass switch) have been modified by this licensing action.

The safety determination associated with the adequacy of the human factors evaluation review is provided in Section 3.12.1, "Operator Actions," of this safety evaluation. Based on the above, the NRC staff concludes this is acceptable.

3.11 Technical Specification Task Force Traveler TSTF-493, Revision 4, "Clarify Application of Setpoint Methodology for LSSS Functions"

As part of the analog APRM subsystem replacement by the NUMAC PRNM system, which includes an OPRM capability, the licensee has proposed TS changes in accordance with TSTF-493, Revision 4, "Clarify Application of Setpoint Methodology for LSSS Functions". This section of the SE addresses the proposed addition of surveillance footnotes in accordance with Option A of TSTF-493, Revision 4, to address instrumentation limiting condition for operation (LCO) issues that could occur during periodic testing and calibration of instrumentation. Attachment A to the TSTF contains functions related to those variables that have a significant safety function as defined in 10 CFR 50.36(c)(1)(ii)(A).

The proposed change revises the GGNS TSs to be consistent with the NRC-approved TSTF-493, Revision 4, Option A. Under Option A, two surveillance footnotes would be added to SRs in the Surveillance Requirements column of TS Table 3.3.1.1-1, Reactor Protection System Instrumentation." Specifically, surveillance footnotes would be added to SRs that require verifying trip setpoint setting values (i.e., Channel Calibration). The list of affected instrument functions as identified in the TSTF are in Attachment 1 of Reference 1. This list includes instrument functions in the LCOs for the Reactor Protection System Instrumentation, TS 3.3.1.1.

The proposed change will resolve operability determination issues associated with potentially non-conservative TSs allowable values[1] calculated using some methods in the industry standard ISA-S67.04-1994 Part 2, "Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation." The concern is that when these values are used to assess instrument channel performance during testing, non-conservative decisions about the equipment operability may result. In addition, the proposed change will resolve operability determination issues related to relying on allowable values associated with TS LSSSs[2] to ensure that TSs requirements, not plant procedures, will be used for assessing instrument channel operability.

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[1] The instrument setting "Allowable Value" is a limiting value of an instrument's as-found trip setting used during surveillances. The allowable value is more conservative than the analytical limit) to account for applicable instrument measurement errors consistent with the plant-specific setpoint methodology. If during testing, the actual instrumentation setting is less conservative than the allowable value, the channel is declared inoperable and actions must be taken consistent with the TS requirements.

[2] The regulations in 10 CFR 50.36(c)(1)(ii)(A) state that, "Limiting safety system settings for nuclear reactors are settings for automatic protective devices related to those variables having significant safety functions."

Entergy also added a new note to TS 3.3.1 Required Action J.2, which would state, "LCO 3.0.4.b is not applicable." In its LAR, the licensee stated that the proposed new note would allow unit restart in the event of a shutdown during the 120-day completion time.

3.11.1 Background

3.11.1.1 Nominal Trip Setpoints

The licensee added the term "Nominal Trip Setpoint" as terminology for the setpoint value calculated by means of the plant-specific setpoint methodology documented in the Technical Requirements Manual (TRM).

The licensee stated that the NTSP is more conservative than the allowable value and is the least conservative value to which the instrument channel is adjusted following surveillance testing. The NTSP is the limiting setting for the channel trip setpoint considering all credible instrument errors associated with the instrument channel. The NTSP is the least conservative value (with an ALT) to which the channel must be reset at the conclusion of periodic testing to ensure that the analytical limit will not be exceeded during an anticipated operational occurrence or accident before the next periodic surveillance or calibration. It is impossible to set a physical instrument channel to an exact value, so a calibration tolerance is established around the NTSP. Therefore, the NTSP adjustment is considered successful if the as-left instrument setting is within the setting tolerance (i.e., a range of values around the NTSP). The field setting is within the ALT (i.e., a range of values around the NTSP). The trip setpoint is the NTSP with margin added. The trip setpoint is equal to or more conservative than the NTSP.

The allowable value may still be the only value included in the TSs to indicate the least conservative value that the as-found trip point may have during testing for the channel to be operable. In this case, the NTSP values in the TRM, and the title of this document are identified in surveillance footnote (e) in TS Table 3.3.1.1-1 in order to satisfy the 10 CFR 50.36 requirements that the LSSS be in the TSs. Additionally, to ensure proper use of the allowable value, trip setpoint, and NTSP, the methodology for calculating the ALT and AFT must also be included in a document incorporated by reference in the UFSAR and listed in surveillance footnote (e) as discussed in Section 3.11.1.2, below.

3.11.1.2 Addition of Surveillance Footnotes to TS Functions

Setpoint calculations calculate a NTSP based on the analytical limit of the safety analysis to ensure that trips or protective actions will occur prior to exceeding the process parameter value assumed by the safety analysis calculations. These setpoint calculations may also calculate an allowable limit of change to be expected (i.e., the AFT) between performance of the surveillance tests for assessing the value of the setpoint setting. The least conservative as-found instrument setting value that a channel can have during calibration without requiring performance of a TS remedial action is the setpoint allowable value. Discovering an instrument setting to be less conservative than the setting allowable value indicates that there may not be sufficient margin between the NTSP setting and the analytical limit. TSs channel calibrations are performed to verify channels are operating within the assumptions of the setpoint methodology used to calculate the NTSP and that channel settings have not exceeded the TS allowable values.

When the measured as-found setpoint is non-conservative with respect to the allowable value, the channel is inoperable and the actions identified in the TSs must be taken.

TS Table 3.3.1.1-1 – New Surveillance Footnote (d)

New surveillance footnote (d) would state:

> 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.

Surveillance footnote (d) requires evaluation of channel performance for the condition where the as-found setting for the channel setpoint is outside its AFT but conservative with respect to the allowable value. Evaluation of channel performance will verify that the channel will continue to function in accordance with safety analysis assumptions and the channel performance assumptions in the GGNS setpoint methodology and establishes a high confidence of acceptable channel performance in the future. Because the AFT allows for both conservative and non-conservative deviation from the NTSP, changes in channel performance that are conservative with respect to the NTSP will also be detected and evaluated for possible effects on expected performance. The purpose of the assessment is to ensure confidence in the channel performance prior to returning the channel to service. For channels determined to be OPERABLE but degraded after returning the channel to service, the channels will be evaluated under the GGNS Corrective Action Program (CAP). Entry into the CAP will ensure required review and documentation of the condition to establish a reasonable expectation for continued operability.

Verifying that a trip setting is conservative with respect to the allowable value when a surveillance is performed does not by itself verify the instrument channel will operate properly in the future because setpoint drift is a concern. Although the channel was operable during the previous surveillance interval, if it is discovered that channel performance is outside the performance predicted by the plant setpoint calculations for the test interval, then the design basis for the channel may not be met, and proper operation of the channel for a future demand cannot be assured. Surveillance footnote (d) formalizes the establishment of the appropriate AFT for each channel. This AFT is applied about the NTSP or about any other more conservative trip setpoint. The as-found setting tolerance ensures that channel operation is consistent with the assumptions or design inputs used in the setpoint calculations and establishes a high confidence of acceptable channel performance in the future. Because the setting tolerance allows for both conservative and non-conservative deviation from the NTSP, changes in channel performance that are conservative with respect to the NTSP will also be detected and evaluated for possible effects on expected performance.

Implementation of surveillance footnote (d) requires the licensee to calculate an AFT. The licensee calculated the AFT using the SRSS method, and non-conservative bias errors are added algebraically.

The licensee has added footnote (d) to the Surveillance column of TS Table 3.3.1.1-1 as required for the adoption of TSTF-493, Revision 4, Option A. The bases for the addition of footnote (d) is discussed above. The NRC staff has reviewed footnote (d) and it is verbatim to the proposed new footnote in TSTF-493, Revision 4, Option A, and is, therefore, acceptable.

TS Table 3.3.1.1.-1 – New Surveillance Footnote (e)

New surveillance footnote (e) would state:

> 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 that the as-found and as-left tolerances apply to the actual setpoint implemented in the Surveillance procedures (Nominal Trip Setpoint) to confirm channel performance. The Nominal Trip Setpoint and the methodologies used to determine the as-found and the as-left tolerances are specified in the Technical Requirements Manual.

Surveillance footnote (e) requires that the as-left setting for the channel be returned to within the ALT of the NTSP. Where a setpoint more conservative than the NTSP is used in the plant surveillance procedures, the ALT and AFT, as applicable, will be applied to the surveillance procedure setpoint. This will ensure that sufficient margin to the safety limit and analytical limit is maintained. If the as-left channel setting cannot be returned to a setting within the ALT of the NTSP, then the channel would be declared inoperable. Surveillance footnote (e) also requires that the NTSP and the methodologies for calculating the ALT and the AFT be included in the TRM.

To implement surveillance footnote (e), the ALT for some instrumentation function channels is established to ensure that realistic values are used that do not mask instrument performance. The licensee stated that setpoint calculations assume that the instrument setpoint is left at the NTSP within a specific ALT (e.g., 25 pounds per square inch gauge (psig) + 2 psig). A tolerance is necessary because it is not possible to read and adjust a setting to an absolute value due to the readability and/or accuracy of the test instruments or the ability to adjust potentiometers. The licensee stated that the ALT is normally as small as possible considering the tools and the objective to meet an as low as reasonably achievable calibration setting of the instruments. The ALT is considered in the setpoint calculation. Failure to set the actual plant trip setpoint to the NTSP and within the ALT would invalidate the assumptions in the setpoint calculation because any subsequent instrument drift would not start from the expected as-left setpoint.

The licensee has added footnote (e) to the Surveillance column of TS Table 3.3.1.1-1 as required for the adoption of TSTF-493, Revision 4, Option A. The bases for the addition of footnote (e) is discussed above. The NRC staff has reviewed footnote (e) and it is verbatim to the proposed new footnote in TSTF-493, Revision 4, Option A, and is, therefore, acceptable.

3.11.1.3 Evaluation of Exclusion Criterion

Exclusion criteria that are used to determine which functions do not need to receive the additional surveillance test requirements. Instruments are excluded from the additional requirements when their functional purpose can be described as (1) a manual actuation circuit, (2) an automatic actuation logic circuit, or (3) an instrument function that derives input from contacts which have no associated sensor or adjustable device. Many permissives or interlocks are excluded if they derive input from a sensor or adjustable device that is tested as part of another TS function. The list of affected functions in Attachment 1 of the LAR was developed by the licensee on the principle that all the average power range monitor functions in TS 3.3.1.1 are included unless one or more of the exclusions that follow apply. In general, Entergy excluded the following functions from additional surveillance testing requirements applied as surveillance footnotes:

1. The two surveillance footnotes are not applied to functions which utilize manual actuation circuits, automatic actuation logic circuits, or to instrument functions that derive input from contacts which have no associated sensor or adjustable device (i.e., limit switches, breaker position switches, manual actuation switches, float switches, proximity detectors, etc.). In addition, the two surveillance Notes do not apply to those permissives and interlocks that derive input from a sensor or adjustable device that is tested as part of another TS function.

   The two surveillance footnotes are not applied to functions which utilize mechanical components to sense the trip setpoint, or to manual initiation circuits (the latter are not explicitly modeled in the accident analysis) because current functional SRs, which have no setpoint verifications, adequately demonstrate the operability of these functions. Surveillance footnote (d) requires a comparison of the periodic SR results to provide an indication of channel (or individual device) performance. This comparison is not valid for most mechanical components. While it is possible to verify that a limit switch perform its function at a point of travel, a change in the surveillance result is likely caused by the mechanical properties of the limit switch, for example, not that the input/output relationship has changed. Therefore, a comparison of SR results would not provide an indication of the channel or component performance.

2. The two surveillance footnotes are not applied to TSs associated with mechanically operated safety relief valves. The performance of these components is already controlled (i.e., trended with ALT and AFT) under the American Society of Mechanical Engineers (ASME) Code for Operation and Maintenance of Nuclear Power Plants testing program.

3. The two surveillance footnotes are not normally applied to functions and SRs, which test only digital components. Digital components, such as actuation logic circuits, relays, and input/output modules are not expected to exhibit drift characteristics; therefore, a change in result between surveillances or any test result other than the identified TS surveillance acceptance criteria would cause the digital component to be declared inoperable. However, where separate ALT

and AFT are established for digital component SRs, the footnote requirements would apply.

3.11.2 Technical Evaluation

3.11.2.1 Addition of Surveillance Footnotes to TS Functions

The licensee has added surveillance footnotes to TS 3.3.1.1, "Reactor Protection System Instrumentation." The licensee stated that the determination to include surveillance footnotes for specific functions in these TS tables is based on these functions being automatic protective devices related to variables having significant safety functions as delineated by 10 CFR 50.36(c)(1)(ii)(A). Furthermore, the licensee stated that if during calibration testing the setpoint is found to be conservative with respect to the allowable value but outside its predefined AFT band, then the channel shall be brought back to within its predefined calibration tolerance before returning the channel to service. The calibration tolerances are specified in the TRM. Changes to the values will be controlled by 10 CFR 50.59. The licensee has applied surveillance footnotes to the following functions in Table 3.3.1.1-1:

2. Average Power Range Monitors
    a. Neutron Flux – High, Setdown
    b. Fixed Neutron Flux – High
    d. Flow Biased Simulated Thermal Power – High
    f. OPRM (Oscillation Power Range Monitor) Upscale

The proposed surveillance footnotes will add the requirement to address operability of the subject functions in the TS as discussed in TSTF-493, Revision 4, Option A. The NRC staff reviewed the list of affected TS functions in the SE above. While reviewing the LAR for the GGNS, the NRC staff identified that the submitted LAR was not consistent with TSTF-493, Revision 4. To address the inconsistencies with TSTF-493, Revision 4 the NRC staff issued an RAI to the licensee dated January 15, 2010 (Reference 53). The following summarizes the NRC staff's questions and the licensee's responses:

RAI 1: Please provide revised proposed TS Bases changes that are consistent with Technical Specification Task Force (TSTF)-493, Revision 4, or justify deviations.

The applicability section in *Federal Register* (74 FR 58065; November 10, 2009), "Notice of Opportunity for Public Comment on the Proposed Model Safety Evaluation for Plant-Specific Adoption of Technical Specification Task Force Traveler-493, Revision 4, "Clarify Application of Setpoint Methodology for LSSS [Limited Safety System Settings] Functions" stated, "The licensee must add footnotes to all the functions identified in TSTF Traveler-493, Revision 4, Appendix A, and must incorporate the related TS Bases changes" for any licensee wishing to adopt TSTF-493, option A, without changes to setpoint values. The NRC staff considers the changes made by TSTF-493, Revision 4 to TS 3.3.1.1 Bases sections: (1) background; (2) applicable safety analyses, LCO, and applicability; (3) actions; and (4) surveillance requirements (SRs), to be related to GGNS proposed amendment.

RAI 2: Please state which SRs verify trip setpoint settings for functions 2.a, 2.b, 2.c, 2.d, 2.e, and 2.f in TS Table 3.3.1.1-1, and provide a revised TS Table 3.3.1.1-1 with the addition of notes (d) and (e) for these functions as needed.

The proposed change revises GGNS TSs to incorporate NRC-approved TSTF Traveler-493, Revision 4, to be consistent with Option A. Option A, without changes to setpoint values, adds two Notes to SRs in the Surveillance Requirement Column of TSs Instrumentation Function Tables. Specifically, Notes are added to TS 3.3.1.1 SRs that require verifying trip setpoint setting values, (i.e., Channel Calibration and Channel Functional Test SRs) for NUREG-1434.

The first Surveillance 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. This is proposed note (d) to TS Table 3.3.1.1-1. The second Surveillance Note requires that the As-Left setting for the channel be returned to within the As-Left Tolerance of the Nominal Trip Setpoint (NTSP)]. This is proposed note (e) to TS Table 3.3.1.1-1.

On February 8, 2010 (Reference 2), the licensee provided its responses to the NRC staff's RAI as follows:

Response to RAI 1: Entergy plans to revise the "BACKGROUND" and "APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY" sections of TS Bases 3.3.1.1 to reflect TSTF-493 Rev. 4 wording as applied to the APRM functions. Specifically, Entergy has added subsections entitled Application of TSTF-493, Rev. 4 (Ref. 17) to APRM Functions 2.a, 2.b, 2.d, and 2.f to TS Bases pages B 3.3-2 and B 3.3-4 as Inserts 1 and 2, respectively.

Response to RAI 2: At GGNS, trip setpoints are typically verified via channel calibration procedures, only. APRM Functions 2.a, 2.b, 2.d, and 2.f will follow this practice with their trip setpoints being verified via channel calibration SR 3.3.1.1.10, only. The proposed Notes (d) and (e) have been applied in TS Table 3.3.1.1 to SR 3.3.1.1.10 for these functions, as discussed in Section 4.4.3.1 of the LAR. Notes (d) and (e) are not applicable to APRM Functions 2.c and 2.e, as discussed in Section 5.1.5 of the LAR.

The NRC staff reviewed the licensee's response to the staff's RAI, and found them acceptable since they are consistent with TSTF-493 Revision 4. The NRC staff concludes the licensee's proposed changes are acceptable.

The RAI issued to the licensee in Reference 53, also addressed the new proposed note for TS 3.3.1 Required Action J.2. The following summarizes the NRC staff's question, and the licensee's response:

RAI 3: Please explain how a unit restart is allowed by adding the note, "LCO 3.0.4.b is not applicable" to new Required Action J.2.

Attachment 1, page 14 of the application letter states, "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." However, Limiting Condition for Operation (LCO) 3.0.4.a and LCO 3.0.4.c remain applicable. LCO 3.0.4.a allows entry into a MODE or other specified condition in the Applicability, when an LCO is not met, only when the associated ACTIONS to be entered permit continued operation in the MODE or other specified condition in the Applicability for an unlimited period of time. Condition J is referenced in Table 3.3.1.1-1 and entered as required by Required Action O.1. Condition J Required Action J.1 requires initiating an alternate method to detect and suppress thermal hydraulic instability oscillations within 12 hours and J.2 requires restoring the required channels to operable status within 120 days. Condition J does not permit continued operation for an unlimited period of time. LCO 3.0.4.c allows entry into a MODE or other specified condition in the Applicability, when an LCO is not met, only when an allowance is stated in the individual value, parameter, or other Specification. LCO 3.0.4.c is not allowed in any condition in GGNS TS 3.3.1.1.

On February 8, 2010 (Reference 2), the licensee provided its response to the NRC staff's RAI as follows:

Response to RAI 3: Entergy agrees with the NRC's comments and proposes to revise the wording of the proposed note applied to Required Action J.2 to read, "LCO 3.0.4 is not applicable." This revised wording addresses the NRC's comments and allows unit restart in the event of a shutdown during the 120-day completion time of Required Action J.2.

As discussed in Section 4.4.1.2 of the LAR, this note is consistent with the original intent of the Nuclear Measurement Analysis and Control (NUMAC) Power Range Neutron Monitoring (PRNM) Licensing Topical Report (LTR), which is to allow normal plant operations to continue during the recovery time from a hypothesized design problem with the Option III stability solution algorithms. This proposed note was approved by the NRC for Monticello Nuclear Generating Plant and Peach Bottom Atomic Power Station, Units 2 and 32 Entergy has revised TS Insert B and the discussion of Required Action J.2 in TS Bases Insert J (contained on page 9 of LAR Attachment 3 and page 27 of LAR Attachment 4, respectively) to reflect the wording change for the note, as specified above.

The NRC staff reviewed the licensee's response to the NRC staff's RAI, and found it acceptable, in part, since the revised note is consistent with NUREG-1434, "Standard Technical

Specifications General Electric Plants, BWR/6," Revision 3. The NRC staff concludes the licensee's proposed changes are acceptable.

3.12 Operator Performance

The NRC staff reviewed the LAR to confirm that changes made to implement the proposed upgrade to its PRNMS will not adversely affect operator performance. The area of human factors deals with programs, procedures, staffing, training, qualification, and plant design features related to operator performance during normal and accident conditions. The NRC staff reviewed the changes to operator actions, human/system interfaces, procedures, and training identified by the licensee as needed for the proposed upgrade.

3.12.1 Operator Actions

The licensee stated that there are no changes to existing operator actions and no new operator actions needed to support the operation of the upgraded PRNMS as proposed in this LAR. The PRNMS design includes an OPRM capability, which implements a GEH version of the BWROG Option III, detect-and-suppress, long-term reactor core stability solution. With installation of the PRNMS, the GGNS stability licensing basis will transition from Enhanced Option I-A to Option III. Following installation of the PRNMS, the upscale function will be initially operated in an "indicate-only" mode for 90 days. During that time, GGNS will implement Backup Stability Protection document OG-02-0119-260, "Backup Stability Protection (BSP) for Inoperable Option III Solution."

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 means.

Although the BSP actions (specified in ONEP 05-1-02-III-3) are not new actions, they represent a change in operating philosophy and will be included in the training program to support the proposed LAR, as noted in the licensee's clarifying electronic mail dated June 20, 2011 (Reference 54). Following review and evaluation of operating data from the monitoring period, Entergy will enable the OPRM Upscale function.

Based on the licensee's review of the of the UFSAR, TS, and TS Bases, the NRC staff concludes that there are no changes to existing operator actions and no new operator actions needed to support the operation of the upgraded PRNMS.

3.12.2. Changes in Emergency and Abnormal Operating Procedures

3.12.2.1 Analysis

The licensee has determined that the proposed LAR will not affect any emergency operating procedure (EOP) regarding abnormal operating procedure (AOP) or "Off-Normal Operating

Procedures" (ONEPs). The only ONEP affected by the PRNMS modification is ONEP 05-1-02-III-3, "Reduction in Recirculation System Flow Rate." ONEP 05-1-02-III-3 currently provides operators with instructions to follow if reactor recirculation flow is reduced to within certain power/flow regions defined in the Core Operating Limits Report (COLR). As discussed in 3.1 above, the operator actions specified in ONEP 05-1-02-III-3 are being retained as backup stability protection measures to be implemented for the initial "indication-only" monitoring period and, for the long term, in the event of a loss of the OPRM Upscale trip function. No changes are needed to use this procedure as a BSP solution. The NRC staff concludes that the licensee's position is acceptable since there no changes to EOPs or AOPs are necessary based on the licensee's review of the UFSAR, TSs, and TS Bases, and that ONEP 05-1-02-III-3 will be retained unchanged.

3.12.2.2 Staffing

Based on the similarity of the new equipment to the old, and the simplicity of operation, no changes to staffing or qualifications are required.

3.12.3 Human/System Interfaces

The licensee stated that the GGNS human factors engineering (HFE) review is performed as part of the engineering design and modification process in accordance with Entergy Nuclear Management Manual Procedure EN-DC-115, "Engineering Change Process." To accomplish the review, the Power Range Neutron Monitoring System (PRNMS) design will be analyzed in accordance with Grand Gulf Nuclear Station (GGNS) Engineering Standard No. 17, "Human Factors Design Criteria," which applies the guidance of NUREG-0700, "Human-System Interface Design Review Guidelines," to the GGNS control room design. The HFE review will be included in the final design package(s) for the PRNMS and available on-site for NRC inspection (Reference 1).

Based on the licensee's description of the control room changes required to support the PRNMS modification, the NRC staff finds the changes to be adequate in terms of the interface with operators. Primarily, the function of current instruments will not change, but the physical appearance will change slightly.

Additionally, the licensee's use of an established HFE program that includes guidance from NUREG-0700, provides reasonable assurance that the human/system interfaces of the new PRNMS and other supporting changes, such as the conversion of the APRM / IRM post-accident recorders on the 1H13-P680 panel from analog to digital, will be suitable to support timely and accurate execution of the existing operator tasks.

3.12.4 Training and Simulator Changes

Based on the licensee's use of controlled processes to identify training needs and simulator updates (Entergy procedure EN-TQ-201, "Systematic Approach to Training Process"), and its proposal to complete the training and testing of operators prior to operation with the upgraded PRNMS, the NRC staff concludes that the licensee's position on training and simulator updates is acceptable.

The NRC staff has reviewed the licensee's statements regarding changes to operator actions, human-system interfaces, procedures, and training required for the proposed PRNMS upgrade and concludes that the licensee has or will: (1) account(ed) for the effects of the proposed upgrade on operator actions and (2) take(n) appropriate actions to ensure that operator performance is not adversely affected by the proposed upgrade. The NRC staff further concludes that the licensee has acceptably responded to the NRC staff's questions in its RAI. Therefore, the NRC staff finds the licensee's proposed LAR acceptable regarding the human performance aspects of the identified system changes.

4.0 ACCEPTABILITY OF PRNMS

The NRC staff determined the proposed replacement of the GGNS Unit 1 Average Power Range Monitor (APRM), Local Power Range Monitor (LPRM), and Flow Unit subsystems of the Neutron Monitoring System (NMS) with a digital GEH NUMAC PRNMS satisfies the applicable 10 CFR 50, Appendix A, GDC 1, GDC 2, GDC 4, GDC 10, GDC 12, GDC 13, GDC 15, GDC 20, GDC 21, GDC 22, GDC 23, GDC 24, GDC 25, and GDC 29. As evaluated in Section 3.0 using the current and applicable regulatory evaluation criteria that is identified in Section 2.0, the NRC staff concludes that the proposed replacement meets 10 CFR 50.36(c)(2)(i) and (ii), 10 CFR 50.36(c)(3), 10 CFR 50.55a(a)(1), 10 CFR 50.55a(h), and thereby provides reasonable assurance of continued adequate protection of public health, safety and security. Based on the above, the NRC staff concludes that the proposed I&C changes are acceptable.

5.0 REGULATORY COMMITMENTS

In References 1, 3, 4, 5, 6, 15, 16, and 20, the licensee made the following regulatory commitments, with respect to its licensing amendment request:

GNRO-2009-00054 (Reference 1)
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.
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.
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.
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.
5. The BSP measures will be implemented via plant procedures.

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.
7. Entergy will notify the NRC when the OPRM Monitoring Period has been successfully completed.
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.
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.
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).
GNRO-2010-00035 (Reference 3)
1. Entergy will conduct the OPRM Monitoring Period for 90 days following startup from the 2012 refueling outage. This commitment replaces the one made in the PRNM System LAR that stated, "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."
2. The use of the DSS-CD algorithm trip is not within the scope of the PRNM System LAR; therefore, it will be jumpered out until GGNS implements MELLLA+.
GNRO-2010/00040 (Reference 4)
1. Entergy will provide a schedule to the NRC for responding to RAI Nos. 1, 2, and 3 by June 18, 2010.
2. Entergy will: (1) Confirm the worst-case environmental conditions in which the PRNM System equipment is required to remain operable for temperature, humidity, pressure, and radiation have been enveloped by equipment qualification or analysis. (2) Provide documentation to the NRC that confirms qualification actions for seismic conditions and EMI compatibility have taken place.
3. Entergy will provide the requested human factors evaluation information to the NRC on or before June 30, 2011.
4. Entergy will provide a table reflecting failure rate data for a BWR/6 PRNM System design to the NRC on or before September 30, 2010.
5. The key for the APRM OPERATE-INOP keylock switch will be controlled by Operations in accordance with plant procedures.
6. The password that is used to access the OPERATE-SET mode of the APRM channels for gain adjustments will be controlled by Operations in accordance with plant procedures.

7. Per the guidance provided in TSTF-493, Rev. 4, Entergy will set the as-found tolerance equal to the Square Root Sum of the Squares (SRSS) combination of as-left tolerance and the projected drift. The as-found and as-left tolerances will be reflected in the associated surveillance test procedures.
GNRO-2010/00045 (Reference 5)
Entergy will provide responses to NRC I&C Branch RAI Nos. 1, 2, and 3 on or before July 29, 2010.
GNRO-2010/00051 (Reference 6)
Entergy will provide the human factors information requested in RAI No. 7 on or before January 17, 2011.
GNRO-2011/00045 (Reference 15)
1. Regarding the presence of the Detect and Suppress-Confirmation Density (DSS-CD) stability solution software and its application to the Maximum Extended Load Line Limit Analysis – Plus (MELLLA+) operating domain, Entergy commits to: (1) Monitor DSS-CD and evaluate data on performance during startup testing and plant operation in preparation for a MELLLA+ LAR; (2) Submit a MELLLA+ LAR by December 31, 2012, which requires the use of the DSS-CD software; and (3) Remove the jumpers from the DSS-CD trip function outputs once the MELLLA+ LAR has been approved and implemented.
2. After Option III is placed into service, the outputs from the DSS-CD algorithm will continue to run with its indications available and monitored by operators, but with its trip outputs disabled until GGNS is licensed to operate in the MELLLA+ domain.
3. To ensure APRM gain adjustments are performed only on bypassed PRNMS instruments, Entergy commits to implement procedure controls that require the instrument to be placed into BYPASS when making these adjustments.
GNRO-2011/00057 (Reference 16)
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GNRO-2011/00091 (Reference 20)
The V&V summary test report for the Programmable Logic Device of the 2-Out-Of-4 Logic Module will be transmitted to the NRC by December 14, 2011.

The licensee stated that the following regulatory commitments have been implemented:

GNRO-2009-00054
14. 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.
GNRO-2010/00040
2. Entergy will provide a schedule to the NRC for responding to RAI Nos. 1, 2, and 3 by June 18, 2010.
2. Entergy will: (3) Confirm the worst-case environmental conditions in which the PRNM System equipment is required to remain operable for temperature, humidity, pressure, and radiation have been enveloped by equipment qualification or analysis. (4) Provide documentation to the NRC that confirms qualification actions for seismic conditions and EMI compatibility have taken place.
8. Entergy will provide the requested human factors evaluation information to the NRC on or before June 30, 2011.
9. Entergy will provide a table reflecting failure rate data for a BWR/6 PRNM System design to the NRC on or before September 30, 2010.
GNRO-2010/00045
Entergy will provide responses to NRC I&C Branch RAI Nos. 1, 2, and 3 on or before July 29, 2010.
GNRO-2010/00051
Entergy will provide the human factors information requested in RAI No. 7 on or before January 17, 2011.
GNRO-2011/00057
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The NRC staff has reviewed the above regulatory commitments and agree that they were implemented prior to the issuance of this LAR. These regulatory commitments are needed to support the NRC's SE and help form the basis for the NRC staff's acceptance of the LAR.

6.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Mississippi State official was notified of the proposed issuance of the amendment. The State official had no comments.

7.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, and there has been no public comment on such finding published in the *Federal Register* on January 5, 2010 (75 FR 462). Accordingly, the amendments meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

8.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

9.0 REFERENCES

References are provided in the Attachment to this SE.

Principal Contributors: B. Dittman
K. Bucholtz
G. Lapinsky
T. Huang
A. Wang

Date: March 28, 2012

Attachment:
References

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1. Krupa, M. A., Entergy Operations, Inc., GNRO-2009-00054, letter to U.S. Nuclear Regulatory Commission, "License Amendment Request, Power Range Neutron Monitoring System Upgrade," dated November 3, 2009 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML093140463).

2. Krupa, M. A., Entergy Operations, Inc., GNRO-2010/00010, letter to U.S. Nuclear Regulatory Commission, "Responses to NRC Requests for Additional Information Pertaining to License Amendment Request for Power Range Neutron Monitoring System (TAC No. ME2531)," dated February 8, 2010 (ADAMS Accession No. ML100430825).

3. Krupa, M. A., Entergy Operations, Inc., GNRO-2010-00035, letter to U.S. Nuclear Regulatory Commission, "Responses to NRC Requests for Additional Information Pertaining to License Amendment Request for Power Range Neutron Monitoring System (TAC No. ME2531)," dated May 18, 2010 (ADAMS Accession No. ML101410094).

4. Krupa, M. A., Entergy Operations, Inc., GNRO-2010/00040, letter to U.S. Nuclear Regulatory Commission, "Responses to NRC Requests for Additional Information Pertaining to License Amendment Request for Power Range Neutron Monitoring System (TAC No. ME2531)," dated June 3, 2010 (ADAMS Accession No. ML101790440).

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6. Krupa, M. A., Entergy Operations, Inc., GNRO-2010/00051, letter to U.S. Nuclear Regulatory Commission, "Responses to NRC Requests for Additional Information Pertaining to License Amendment Request for Power Range Neutron Monitoring System (TAC No. ME2531)," dated July 29, 2010 (ADAMS Accession No. ML102150029).

7. Krupa, M. A., Entergy Operations, Inc., GNRO-2010/00064, letter to U.S. Nuclear Regulatory Commission, "Response to NRC Requests for Additional Information Pertaining to License Amendment Request for Power Range Neutron Monitoring System (TAC No. ME2531)," dated September 29, 2010 (ADAMS Accession No. ML102810306).

8. Krupa, M. A., Entergy Operations, Inc., GNRO-2010/00075, letter to U.S. Nuclear Regulatory Commission, "Response to NRC Requests for Additional Information Pertaining to License Amendment Request for Power Range Neutron Monitoring System (TAC No. ME2531)," dated December 13, 2010 (ADAMS Accession No. ML103480114).

9. Krupa, M. A., Entergy Operations, Inc., GNRO-2010/00070, letter to U.S. Nuclear Regulatory Commission, "Response to NRC Requests for Additional Information Pertaining to License Amendment Request for Power Range Neutron Monitoring System (TAC No. ME2531)," dated December 14, 2010 (ADAMS Accession No. ML103490095).

Attachment

10. Krupa, M. A., Entergy Operations, Inc., GNRO-2011/00032, letter to U.S. Nuclear Regulatory Commission, "Responses to NRC Requests for Additional Information Pertaining to License Amendment Request for Power Range Neutron Monitoring System (TAC No. ME2531)," dated May 3, 2011 (ADAMS Accession No. ML111230756).

11. Krupa, M. A., Entergy Operations, Inc., GNRO-2011/00038, letter to U.S. Nuclear Regulatory Commission, "Responses to NRC Requests for Additional Information Pertaining to License Amendment Request for Power Range Neutron Monitoring System (TAC No. ME2531)," dated May 16, 2011 (ADAMS Accession No. ML111370259).

12. Krupa, M. A., Entergy Operations, Inc., GNRO-2011/00039, letter to U.S. Nuclear Regulatory Commission, "Responses to NRC Requests for Additional Information Pertaining to License Amendment Request for Power Range Neutron Monitoring System (TAC No. ME2531)," dated May 26, 2011 (ADAMS Accession No. ML111460590).

13. Krupa, M. A., Entergy Operations, Inc., GNRO-2011/00042, letter to U.S. Nuclear Regulatory Commission, "Responses to NRC Requests for Additional Information Pertaining to License Amendment Request for Power Range Neutron Monitoring System (TAC No. ME2531)," dated May 31, 2011 (ADAMS Accession No. ML111520123).

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15. Krupa, M. A., Entergy Operations, Inc., GNRO-2011/00045, letter to U.S. Nuclear Regulatory Commission, "Supplemental Information Pertaining to License Amendment Request for Power Range Neutron Monitoring System (TAC No. ME2531)," dated June 28, 2011 (ADAMS Accession No. ML111800505).

16. Krupa, M. A., Entergy Operations, Inc., GNRO-2011/00057 (CORRECTED COPY), letter to U.S. Nuclear Regulatory Commission, "Responses to NRC Requests for Additional Information Pertaining to License Amendment Request for Power Range Neutron Monitoring System (TAC No. ME2531)," dated July 22, 2011 (ADAMS Accession No. ML112061524).

17. Krupa, M. A., Entergy Operations, Inc., GNRO-2011/00066, letter to U.S. Nuclear Regulatory Commission, "Responses to NRC Requests for Additional Information Pertaining to License Amendment Request for Power Range Neutron Monitoring System (TAC No. ME2531)," dated September 28, 2011 (ADAMS Accession No. ML112720128).

18. Krupa, M. A., Entergy Operations, Inc., GNRO-2011/00089, letter to U.S. Nuclear Regulatory Commission, "Responses to NRC Requests for Additional Information Pertaining to License Amendment Request for Power Range Neutron Monitoring System (TAC No. ME2531)," dated October 18, 2011 (ADAMS Accession No. ML112911553).

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The NRC has determined that the related safety evaluation (SE) contains proprietary information pursuant to Title 10 of the *Code of Federal Regulations*, Section 2.390, "Public inspections, exemptions, requests for withholding." Accordingly, the NRC staff has also prepared a non-proprietary version of the SE, which is provided in Enclosure 2; the proprietary version of the SE is provided in Enclosure 3. The Notice of Issuance will be included in the Commission's next biweekly Federal Register notice.

Sincerely,

/RA/

Alan Wang, Project Manager
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-416

Enclosures:
1. Amendment No. 188 to NPF-29
2. Safety Evaluation (non-proprietary)
3. Safety Evaluation (proprietary)

cc w/Enclosures 1 and 2: Distribution via Listserv

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KBucholtz, NRR/DSS/STSB
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Amendment w/Encl 1 and 3 (Proprietary) ML120320352
Amendment w/Encl 1 and 2 (Non-Proprietary) ML120400319 *SE dated

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DATE	2/15/12	2/14/12	5/11/10	2/27/12	1/14/2012

OFFICE	NRR/DRA/AHPB/BC	OGC NLO	NRR/LPL4/BC	NRR/LPL4/PM
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