Entergy

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Attachment 1 contains PROPRIETARY information.
Withhold per 10 CFR 2.390.

GNRO-2013/00100

December 30, 2013

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

SUBJECT: Maximum Extended Load Line Limit Analysis Plus (MELLLA+) License Amendment Request – Responses to Requests for Supplemental Information

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

REFERENCES:
1. Entergy Operations, Inc. letter to the NRC, *Maximum Extended Load Line Limit Analysis Plus (MELLLA+) License Amendment Request*, dated September 25, 2013 (ML13269A140)
2. NRC letter to Entergy Operations, Inc., *Grand Gulf Nuclear Station, Unit 1 - Supplemental Information Needed for Acceptance of Licensing Action, Request to Allow Operation in Expanded Maximum Extended Load Line Limit Analysis Plus Domain*, dated December 19, 2013 (ML13345A182)

Dear Sir or Madam:

In Reference 1, Entergy Operations, Inc. (Entergy) submitted to the U.S. Nuclear Regulatory Commission (NRC) a license amendment request (LAR) that would allow Grand Gulf Nuclear Station, Unit 1 (GGNS) to operate in the expanded Maximum Extended Load Line Limit Analysis Plus (MELLLA+) domain. In Reference 2, the NRC requested supplemental information to support their acceptance review of the MELLLA+ LAR. Attachment 1 provides responses to these requests for supplemental information (RSIs).

General Electric – Hitachi (GEH) considers certain information contained in Attachment 1 to be proprietary and, therefore, exempt from public disclosure pursuant to Title 10 *Code of Federal Regulations* (10 CFR) 2.390. The associated affidavit for withholding information, executed by GEH, is provided in Attachment 2. The responses to the RSIs were provided by GEH to Entergy in a transmittal letter that is referenced in the affidavit. Therefore, on behalf of GEH, Entergy requests Attachment 1 be withheld from public disclosure in accordance with 10 CFR 2.390(b)(1). A non-proprietary version of Attachment 1 is provided in Attachment 3

When Attachment 1 is removed from this letter, the entire document is NON-PROPRIETARY

Attachment 1 contains PROPRIETARY information.
Withhold per 10 CFR 2.390.

This letter contains no new commitments.

If you have any questions or require additional information, please contact Mr. Jeff Seiter at (601) 437-2344.

I declare under penalty of perjury that the foregoing is true and correct; executed on December 30, 2013.

Sincerely,

Thomas Coutu for K. J. Mulligan

KJM/slw

Attachments:
1. Responses to NRC Requests for Supplemental Information (Proprietary Version)
2. General Electric – Hitachi Affidavit Supporting Request to Withhold Information from Public Disclosure
3. Responses to NRC Requests for Supplemental Information (Non-Proprietary Version)

cc: U.S. Nuclear Regulatory Commission
ATTN: Mr. Mark Dapas, (w/2)
Regional Administrator, Region IV
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U. S. Nuclear Regulatory Commission
ATTN: Mr. Alan Wang, NRR/DORL (w/2)
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NRC Senior Resident Inspector
Grand Gulf Nuclear Station
Port Gibson, MS 39150

When Attachment 1 is removed from this letter, the entire document is NON-PROPRIETARY.

Attachment 2 to GNRO-2013/00100

General Electric – Hitachi Affidavit Supporting Request to Withhold Information from Public Disclosure

GE-Hitachi Nuclear Energy Americas LLC

AFFIDAVIT

I, Linda C. Dolan, state as follows:

(1) I am the Manager of Regulatory Compliance, of GE-Hitachi Nuclear Energy Americas LLC ("GEH"), and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.

(2) The information sought to be withheld is contained in Enclosure 1 of GEH letter, GEH-GGNS-AEP-634, "GEH Responses to MELLLA Plus EICB Requests for Supplemental Information," dated December 19, 2013. The GEH proprietary information in Enclosure 1, which is entitled "Responses to EICB Requests for Supplemental Information in Support of GGNS MELLLA+ LAR," is identified by a dotted underline inside double square brackets. [[This sentence is an example.{3}]] In each case, the superscript notation {3} refers to Paragraph (3) of this affidavit, which provides the basis for the proprietary determination.

(3) In making this application for withholding of proprietary information of which it is the owner or licensee, GEH relies upon the exemption from disclosure set forth in the *Freedom of Information Act* ("FOIA"), 5 U.S.C. Sec. 552(b)(4), and the *Trade Secrets Act*, 18 U.S.C. Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4), and 2.390(a)(4) for trade secrets (Exemption 4). The material for which exemption from disclosure is here sought also qualifies under the narrower definition of trade secret, within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975 F.2d 871 (D.C. Cir. 1992), and Public Citizen Health Research Group v. FDA, 704 F.2d 1280 (D.C. Cir. 1983).

(4) The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs (4)a. and (4)b. Some examples of categories of information that fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by GEH's competitors without license from GEH constitutes a competitive economic advantage over other companies;

b. Information that, if used by a competitor, would reduce their expenditure of resources or improve their competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product;

c. Information that reveals aspects of past, present, or future GEH customer-funded development plans and programs, resulting in potential products to GEH;

d. Information that discloses trade secret or potentially patentable subject matter for which it may be desirable to obtain patent protection.

(5) To address 10 CFR 2.390(b)(4), the information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GEH,

and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by GEH, not been disclosed publicly, and not been made available in public sources. All disclosures to third parties, including any required transmittals to the NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary or confidentiality agreements that provide for maintaining the information in confidence. The initial designation of this information as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in the following paragraphs (6) and (7).

(6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, who is the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge, or who is the person most likely to be subject to the terms under which it was licensed to GEH. Access to such documents within GEH is limited to a "need to know" basis.

(7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist, or other equivalent authority for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside GEH are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary or confidentiality agreements.

(8) The information identified in paragraph (2), above, is classified as proprietary because it contains the detailed GEH methodology for stability analysis for the GEH Boiling Water Reactor (BWR). These methods, techniques, and data along with their application to the design, modification, and analyses associated with the DSS-CD were achieved at a significant cost to GEH.

The development of the evaluation processes along with the interpretation and application of the analytical results is derived from the extensive experience databases that constitute a major GEH asset.

(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GEH's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of GEH's comprehensive BWR safety and technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology and includes development of the expertise to determine and apply the appropriate evaluation process. In addition, the technology base includes the value derived from providing analyses done with NRC-approved methods.

The research, development, engineering, analytical and NRC review costs comprise a substantial investment of time and money by GEH. The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial. GEH's competitive advantage will be lost if its competitors are able to use the results of the GEH experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to GEH would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive GEH of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing and obtaining these very valuable analytical tools.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct to the best of my knowledge, information, and belief.

Executed on this 19th day of December 2013.

Linda C. Dolan

Linda C. Dolan
Manager, Regulatory Compliance
GE-Hitachi Nuclear Energy Americas LLC
3901 Castle Hayne Rd.
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Attachment 3 to GNRO-2013/00100

Responses to NRC Requests for Supplemental Information

(Non-Proprietary Version)

This is a non-proprietary version of Attachment 1 from which the proprietary information has been removed. The proprietary portions that have been removed are indicated by double square brackets as shown here: [[ ]]

Non-Proprietary Information – Class I (Public)

MELLLA+ LICENSE AMENDMENT REQUEST

RESPONSES TO NRC REQUESTS FOR SUPPLEMENTAL INFORMATION

In a letter to the U.S. Nuclear Regulatory Commission (NRC) dated September 25, 2013, Entergy Operations, Inc. (Entergy) submitted to the NRC a license amendment request (LAR) that would allow Grand Gulf Nuclear Station, Unit 1 (GGNS) to operate in the expanded Maximum Extended Load Line Limit Analysis Plus (MELLLA+) domain. In a letter to Entergy dated December 19, 2013, the NRC requested supplemental information to support their acceptance review of the MELLLA+ LAR. Responses to these requests for supplemental information (RSIs) are provided below.

RSI #1

Page xiii of the September 17, 2007, MELLLA+ topical report (TR) states: *"Therefore, the NRC staff concluded that manual backup stability protection is not appropriate and a NRC-approved automatic backup stability protection must be implemented for MELLLA+ operation."* Please provide the required supplemental information on the automatic backup stability protection.

Response

The NRC approved automatic backup stability protection is implemented for GGNS MELLLA+ Safety Analysis Report (SAR) application (Reference 1.1) as documented in Section 2.4.3 in Reference 1.1. The approval of this automatic backup stability protection is documented in the NRC Safety Evaluation (SE) included in Reference 1.2. All the information about this Automatic Backup Stability Protection (ABSP) is provided in Section 7 of Reference 1.2, which is the approved Detect and Suppress Solution – Confirmation Density (DSS-CD) licensing topical report (LTR) revision applicable to GGNS MELLLA+ SAR.

In the October 2008 MELLLA+ LTR NEDC-33006P-A, Revision 3 (page xiii), NRC stated: "*Therefore, the NRC staff concluded that manual backup stability protection is not appropriate and a NRC-approved automatic backup stability protection must be implemented for MELLLA+ operation.*" To meet this requirement, GEH has provided in the approved DSS-CD LTR (NEDC-33075P-A, Revision 6, Reference 1.3) a Backup Stability Protection (BSP) approach that includes an automatic function and that may be used when the Oscillation Power Range Monitor (OPRM) system is inoperable up to and including operation in the MELLLA+ domain. The BSP solution and the ABSP function are maintained and approved in the DSS-CD LTR NEDC-33075P-A, Revision 8, that is applied to the GGNS MELLLA+ SAR application (Reference 1.1).

This comprehensive BSP approach provides an alternative means for stability protection by preventing the onset of growing power oscillations in the specific region of the power/flow map identified as likely to develop thermal-hydraulic instabilities. In the June 2011 DSS-CD LTR (NEDC-33075P-A, Revision 6 (page 5), Reference 1.3), the NRC stated that "*The BSP concept, documented in Section 7 of NEDC-33075P, Revision 5, is a technically acceptable solution to the backup issue.*"

This comprehensive BSP is described in Section 7 and implemented per the Technical Specification (TS) changes documented in Appendix A of the approved DSS-CD LTR (NEDC-33075P-A, Revision 6, Reference 1.3) and includes two BSP options that are based on selected elements from three distinct constituents. The three constituents are:

4. BSP Manual Regions that comprise plant-specific scram (Region I) and Controlled Entry (Region II) regions in the licensed power/flow operating domain and associated manual operator actions (Section 7.2 of Reference 1.3).
5. BSP Boundary that defines the operating domain portion where potential instability events can be effectively addressed by specific operator actions (Section 7.3 of Reference 1.3).
6. ABSP Scram Region, which comprises an automatic reactor scram region initiated by the Average Power Range Monitor (APRM) flow-biased scram setpoint (Section 7.4 of Reference 1.3).

The two BSP options are:

Option 1: Consists of the BSP Manual Regions, BSP Boundary and associated operator actions.

Option 2: Consists of the ABSP Scram Region, as implemented by the APRM flow-biased scram setpoint, Region II and associated operator actions.

The TS changes contained in Reference 1.3 and in the GGNS MELLLA+ LAR delineate specific implementation requirements for both BSP options in the unlikely event the OPRM system is declared inoperable. In such instance, the operators have 12 hours to manually implement the ASBP function. In the interim, instability protection is implemented via the Manual BSP regions, which are administratively implemented. With the ABSP (Option 2), a scram is automatically generated if the reactor enters a pre-determined scram region regardless of whether or not a thermal-hydraulic instability occurs.

In case the ABSP function cannot be implemented or is inoperable, the licensed stability solution becomes the Manual BSP region with the BSP Boundary, which is manually implemented through administrative actions. [[

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Therefore, NRC concluded in the DSS-CD LTR NEDC-33075P-A, Revision 6 (page 6), in Reference 1.3 *"that the proposed BSP methodology is an acceptable solution, because it provides sufficient protection against Safety Limit Minimum Critical Power Ratio (SLMCPR) violations commensurate with the probability of an instability event in the short period of time that they are active."*

All these elements and functions of the BSP solution, including the ABSP function, are maintained and approved in the DSS-CD LTR NEDC-33075P-A, Revision 8, and SE of

NEDC-33075P, Revision 7, (Reference 1.2) that is applied to the GGNS MELLLA+ SAR application (Reference 1.1).

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References:

1.1 GE Hitachi Nuclear Energy, "Safety Analysis Report for Grand Gulf Nuclear Station - Maximum Extended Load Line Limit Analysis Plus," NEDC-33612P, September 2013 (Attachment 4 to ML13269A140).

1.2 GE Hitachi Nuclear Energy, "GE Hitachi Boiling Water Reactor Detect and Suppression Solution – Confirmation Density," NEDC-33075P-A, Revision 8, November 2013 (ML111610593).

1.3 GE Hitachi Nuclear Energy, "General Electric Boiling Water Reactor Detect and Suppression Solution – Confirmation Density," NEDC-33075P-A, Revision 6, January 2008.

RSI #2

Please provide hardware/software technical information as emphasized in the reference document General Electric – Hitachi (GEH) NEDC-33075P, pages 1-2. This information should specifically document the hardware and software and/or firmware designs as per any variations from MELLLA to the MELLLA+ algorithm.

Response

As noted in page 1-1 of the approved licensing topic report (LTR) for Detect and Suppress Solution – Confirmation Density (DSS-CD), NEDC-33075P-A (Reference 2.1):

"The DSS-CD is based on the same hardware design as Option III, which is described in References 1 through 3."[4]

Also, in page 2-2:

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[4] The references 1 through 3 cited are from NEDC-33075P-A.

"The DSS-CD solution introduces a number of changes relative to the Option III solution. In addition, it introduces a number of modifications and restrictions to the successive confirmation period element of the Period Based Detection Algorithm (PBDA) to improve its ability for early recognition of reactor oscillations. These changes only affect the system software/firmware, and therefore, may be able to be implemented on-line."

The NRC staff previously reviewed and approved the implementation of DSS-CD using the approved GEH Option III hardware and software. The DSS-CD solution is not generically approved for use with non-GEH hardware. The hardware components required to implement DSS-CD are those currently used for the approved Option III. If the DSS-CD hardware implementation deviates from the approved Option III solution, a hardware review by the NRC staff will be required. Implementations on other Option III platforms will require plant-specific reviews. The DSS-CD stability solution (CDA, ABSP,[5] and Option III) for GGNS is implemented in the GGNS Power Range Neutron Monitor (PRNM) system.

Limitation and Condition 5.1 in the approved DSS-CD LTR NEDC-33075P-A (Reference 2.1) states that:

"The NRC staff previously reviewed and approved the implementation of DSS-CD using the approved GEH Option III hardware and software. The DSS-CD solution is not approved for use with non-GEH hardware. The hardware components required to implement DSS-CD are expected to be those currently used for the approved Option III. If the DSS-CD hardware implementation deviates from the approved Option III solution, a hardware review by the NRC staff will be required. Implementations on other Option III platforms will require plant-specific reviews."

The GGNS MELLLA+ safety analysis report (SAR), NEDC-33612P (Reference 2.2) documents in Appendix C compliance with this Limitation and Condition because the DSS-CD solution for GGNS is implemented on GEH hardware that is currently installed and approved by the NRC for the Option III solution.

Therefore, the technical information provided for the GGNS PRNM (Reference 2.3) is applicable to the DSS-CD design. Specifically, the PRNM LTR (References 2.4 and 2.5) provided technical information of the approved PRNM system. Reference 2.6 identified the plant-specific differences from the PRNM LTR. Reference 2.7 (RAI 5) provided additional explanation of the PRNM configuration for the GGNS PRNM system. The implementation strategy for the GGNS PRNM is to provide the system with all the required functionalities except that the DSS-CD trip will be inactive (using a jumper) until the implementation of the MELLLA+. Additional information about this approach is provided in Reference 2.8 (RAI 4).

The same software development process was used for the PRNM, Option III, DSS-CD (CDA and ABSP). The NRC approval of the GEH software development process is noted in the SER (Reference 2.3).

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[5] The stability protection for MELLLA+ is DSS-CD which includes Confirmation Density Algorithm (CDA) and Automatic Backup Stability Solution (ABSP). Option III is maintained for defense-in-depth purpose. Unless otherwise specified, the term DSS-CD in this request for supplement information (RSII) response would mean both CDA and ABSP.

The plant-specific differences evaluated in Reference 2.6 were due to the plant-specific configuration and other prior licensing commitments. There was no deviation from the MELLLA to the MELLLA+ algorithm.

References:

2.1 GE Hitachi Nuclear Energy, "GE Hitachi Boiling Water Reactor Detect and Suppression Solution – Confirmation Density," NEDC-33075P-A, Revision 8, November 2013 (ADAMS Accession No, ML111610593).

2.2 GE Hitachi Nuclear Energy, "Safety Analysis Report for Grand Gulf Nuclear Station Maximum Extended Load Line Limit Analysis Plus," NEDC-33612P, September 2013.

2.3 A.Wang (NRC) to VP, Operations (Entergy Operation, Inc), "Grand Gulf Nuclear Station, Unit 1 –Issuance of Amendment RE: Power Range Neutron Monitoring System Replacement (TAC No. ME2531)," March 28, 2012 (ADAMS Accession No. ML120400319).

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

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

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

2.7 M. A. Krupa (Entergy Operations Inc.) to U.S Nuclear Regulatory Commission Document Control Desk, "Response to NRC Request for Additional Information Pertaining to License Amendment Request for Power Range Neutron Monitoring System (TAC No. ME2531)," GNRO-2010/00070, dated December 14, 2010 (ML103490095) – Response to RAI 5.

2.8 M.A. Krupa (Entergy Operations, Inc.) to U.S. Nuclear Regulatory Commission Document Control Desk, "Responses to NRC Requests for Additional Information Pertaining to License Amendment Request for Power Range Neutron Monitoring System (TAC No. ME2531)," GNRO-2011/00032, dated May 3, 2011 (ML111230756) - Response to RAI 4.

RSI #3

Demonstrate the common-cause failure vulnerabilities and the defense-in-depth for the detection algorithms and the backup stability solution. It is unclear if the primary and backup stability trip functions for MELLLA+ use the same software and are therefore subject to software common-cause failure. Please provide a discussion of the postulated Software Common-Cause Failure (SWCCF) with its possible consequences on diversity and defense-in-depth.

Response

As documented in the response for RSI #2 above, the DSS-CD (Detect and Suppress Solution – Confirmation Density) (Confirmation Density Algorithm (CDA) and Automatic Backup Stability Protection (ABSP)) and Option III are all software modules within the Power Range Neutron Monitoring (PRNM) system that would provide the stability solution. Prior to the implementation of MELLLA+, the Option III is the licensed solution for instability protection. With the implementation of MELLLA+, DSS-CD would become the licensed stability solution. The Option III trips (Period Based Algorithm (PBA), Amplitude Based Algorithm (ABA), and Growth Rate Algorithm (GRA)) are maintained in the PRNM system to provide defense-in-depth capability[6]. However, under the DSS-CD solution the Option III trips are not credited for licensing basis. In the unlikely event that the CDA becomes inoperable, such as not being able to meet the minimum number of cells requirements in more than one channel, the ABSP will be manually activated to provide the stability protection. Therefore, the ABSP is an alternative stability solution to CDA only in those rare instances. As described in the Section 7 and in the Technical Specification (TS) changes documented in the approved DSS-CD licensing topical report (LTR), NEDC-33075P-A (Reference 3.1), there are two Backup Stability Protection (BSP) options that are based on selected elements from three distinct constituents. The three constituents are:

4. BSP Manual Regions that comprise plant-specific scram (Region I) and Controlled Entry (Region II) regions in the licensed power/flow operating domain and associated manual operator actions (Section 7.2 of Reference 3.1).

5. BSP Boundary that defines the operating domain portion where potential instability events can be effectively addressed by specific operator actions (Section 7.3 of Reference 3.1).

6. Automated BSP (ABSP) Scram Region, which comprises an automatic reactor scram region initiated by the APRM flow-biased scram setpoint (Section 7.4 of Reference 3.1).

The two BSP options are:

Option 1: Consists of the BSP Manual Regions, BSP Boundary and associated operator actions.

Option 2: Consists of the ABSP Scram Region, as implemented by the Average Power Range Monitor (APRM) flow-biased scram setpoint, Region II and associated operator actions

The TS changes contained in Reference 3.1 delineate specific implementation requirements for both BSP Options in the unlikely event the Oscillation Power Range Monitor (OPRM) system is declared inoperable. In such instance, the operators have 12 hours to manually implement the ABSP function. In the interim, instability protection is implemented via the

[6] See page 1-3 of NEDC-33075P-A (Reference 3.1). The "defense-in-depth" is meant to be additional algorithms that are not credited in the licensing basis but provide additional protection against unanticipated oscillations. It is not meant to be a diverse stability solution.

Manual BSP regions, which are administratively implemented. In case the ABSP function cannot be implemented or is inoperable, the licensed stability solution becomes the Manual BSP region with the BSP Boundary, which is manually implemented through administrative actions. Therefore, the ABSP function is not meant to provide diversity for the CDA algorithm, but to be an alternative solution to be adopted only in specific instances. In addition to this, even if both the OPRM system (i.e., the CDA) and the ABSP function are inoperable, stability protection is provided through a Manual BSP solution, which only relies on operator actions and plant procedures. This is essentially the same backup approach utilized in Option III for the Period Based Detection Algorithm (PBDA). In Option III solution there is only one BSP Option, which is provided by the Manual BSP Regions and associated operator actions.

The evaluation of the Common-Cause Failure (CCF), including the SWCCF, for the PRNM and Option III trip functions are provided in References 3.2, 3.3 and 3.4. With the implementation of MELLLA+, there is no change to the other PRNM trip functions. The Option III trip functions are still maintained but not credited. Either the DSS-CD or the ABSP trip function will be activated to provide the stability solution. If neither function can be activated the stability protection is provided, per TS, via Manual BSP regions and BSP Boundary. The DSS-CD software is based on the Option III software for Local Power Range Monitor (LPRM) response within the OPRM cells whereas the ABSP software is based on the APRM software for core wide neutron flux and flow responses. In either case, the consequences of a postulated CCF for DSS-CD or ABSP are same as the response postulated CCF for Option III. Specifically, the discussion of "Undetected Power Oscillations" in Reference 3.2 is applicable to DSS-CD. For clarification, the discussion is presented below with additional emphasis on DSS-CD and ABSP.

Undetected Power Oscillations

The OPRM system (supporting either DSS-CD or Option III solution) plays an important role in the detection and suppression of power oscillations. The postulated CCF, assumed to result in comprehensive loss of the PRNM system functionality, would also disable the OPRM system (i.e., CDA for DSS-CD and PBDA for Option III). In addition to this, the loss of PRNM functionality would also disable the ABSP function of DSS-CD because the APRM system would no longer be available.

Although the GGNS Final Safety Analysis Report (FSAR) does not include power oscillations among the Anticipated Operational Occurrences (AOO) or Design Basis Accident (DBA), it is appropriate to discuss them. As discussed in Table 8-1 of Reference 3.2, the postulated CCF in the PRNM system results in the system providing valid indications of plant conditions until the transient, at which time they become anomalous. In the case of power oscillations, thus, the PRNM system indications of power and flow would track consistently with other plant indicators as they change to a state point where the potential exists for high growth-rate power oscillations (i.e., the upper left corner of the power/flow map), but somehow fail to provide any protection if large amplitude oscillations begin to occur. Nevertheless, even while maintaining the severity of the postulated CCF, the plant has the ability to cope with it in conjunction with power oscillations.

Non-Proprietary Information – Class I (Public)

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GGNS procedures require immediate action to reduce reactor power in order to mitigate possible high growth-rate power oscillations following unanticipated core flow reduction events, such as [[ ]] The operators would know the statepoint because the status of recirculation pumps is provided independent of the PRNM system; flow information is available from the recirculation flow system, and power level information is available from either the electrical power output or a core thermal power calculation. Furthermore, the reactor recirculation flow system, Rod Control and Information System (RC&IS), and manual scram are unaffected by the CCF. Thus, the plant is able to cope with the CCF because they can determine that defensive steps are necessary and execute those steps via immediate actions, i.e., [[

]] Because the SLMCPR is not exceeded throughout this event, the acceptance criteria provided in BTP 7-19 (Reference 3.5) are automatically met.

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The ABSP is an alternative stability solution in the remote case where CDA becomes inoperable. However, ABSP is designed to prevent the core from operating in regions with high potential for THI. Therefore, a postulated CCF of the ABSP would mean that the automatic scram would not occur when the reactor is operating in the BSP Scram region. The procedures for immediate action to reduce reactor power as discussed above would apply. Thus, the plant would still be able to cope with the CCF.

In summary, GGNS evaluation of the CCF for the PRNM system with DSS-CD was performed to disposition undetected power oscillations using the acceptance criteria provided in BTP 7-19. It was determined that sufficient redundancy and diversity exists so that the plant has the ability to cope with any CCF in the PRNM system with Option III or DSS-CD. The CCF evaluations in References 3.2, 3.3 and 3.4 were reviewed by the NRC and the PRNM system was approved by the NRC (Reference 3.7).

References:

3.1 GE Hitachi Nuclear Energy, GE Hitachi Boiling Water Reactor Detect and Suppression Solution – Confirmation Density, NEDC-33075P-A, Revision 8, November 2013 (ML111610593).

3.2 M. A. Krupa (Entergy Operations Inc.) to U.S Nuclear Regulatory Commission Document Control Desk, "Response to NRC Request for Additional Information Pertaining to License Amendment Request for Power Range Neutron Monitoring System (TAC No. ME2531)," GNRO-2011/00039, dated May 26, 2011 (ML111460590) – Response to RAI 8.

3.3 M. A. Krupa (Entergy Operations Inc.) to U.S Nuclear Regulatory Commission Document Control Desk, "Response to NRC Request for Additional Information Pertaining to License Amendment Request for Power Range Neutron Monitoring System (TAC No. ME2531)," GNRO-2011/00039, dated May 26, 2011 (ML111460590) – Response to RAI 9.

3.4 M. A. Krupa (Entergy Operations Inc.) to U.S Nuclear Regulatory Commission Document Control Desk, "Response to NRC Request for Additional Information Pertaining to License Amendment Request for Power Range Neutron Monitoring System (TAC No. ME2531)," GNRO-2011/00039, dated May 26, 2011 (No, ML111460590) – Response to RAI 10.

3.5 USNRC Standard Review Plan, "Guidance for Evaluation of Diversity and Defense-In-Depth in Digital Computer-Based Instrumentation and Controls Systems," BTP 7-19 (NUREG-0800), Revision 6, July 2012.

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

3.7 NRC (A.Wang) to Entergy Operation, Inc (VP, Operations), "Grand Gulf Nuclear Station, Unit 1 – Issuance of Amendment RE: Power Range Neutron Monitoring System Replacement (TAC No. ME2531)," March 28, 2012 (ML120400319).

RSI #4

If a postulated SWCCF condition disables an appropriate response, then what documented diverse means not subject to the same common-cause failure would be available to provide adequate protection? Please discuss the proposed design with respect to how it meets the guidance of Branch Technical Position (BTP) 7-19. Provide a detailed analysis meeting the guidance contained in BTP 7-19.

Response

References 4.1, 4.2, and 4.3 provided the evaluation of the Common-Cause Failure (CCF) for the Power Range Neutron Monitor (PRNM) system. The discussion is applicable to both Option III and Detect and Suppress Solution – Confirmation Density (DSS-CD) solutions with the additional explanation documented in the response to RSI #3 above. The CCF evaluation shows that the PRNM system with Option III and DSS-CD (both Confirmation Density Algorithm (CDA) and Automatic Backup Stability Protection (ABSP)) meets the guidance of Branch Technical Position (BTP) 7-19 (Reference 4.4). A summary of the CCF evaluation is presented below.

BTP 7-19 (Reference 4.4) Criterion	Evaluation of PRNM with DSS-CD
(1) For each anticipated operational occurrence in the design basis occurring in conjunction with each single postulated CCF, the plant response calculated using realistic assumptions (e.g., plant operating at normal power levels, temperatures, pressures, flows, normal alignments of equipment, etc.) analyses should not result in radiation release exceeding 10 percent of the applicable siting dose guideline values or violation of the integrity of the primary coolant pressure boundary. The applicant/licensee should *(1) demonstrate that sufficient diversity exists to achieve these goals, (2) identify the vulnerabilities discovered and the corrective actions taken, or (3) identify the vulnerabilities discovered and provide a documented basis that justifies taking no action.*	Table 8-1 of Reference 4.1 provided an evaluation for each Anticipated Operational Occurrences (AOO) and Design Basis Accident (DBA) in the Grand Gulf UFSAR. Based on the evaluation presented in Table 8-1, the proposed upgrade satisfies Acceptance Criteria (1).
(2) For each postulated accident in the design basis occurring in conjunction with each single postulated CCF, the plant response calculated using realistic assumptions analyses should not result in	Table 8-1 of Reference 4.1 provided an evaluation for each AOO and DBA in the Grand Gulf Nuclear Station (GGNS) Updated Final Safety Analysis Report (UFSAR). Based on the evaluation

BTP 7-19 (Reference 4.4) Criterion	Evaluation of PRNM with DSS-CD
radiation release exceeding the applicable siting dose guideline values, violation of the integrity of the primary coolant pressure boundary, or violation of the integrity of the containment (i.e., exceeding coolant system or containment design limits). The applicant/licensee should (1) demonstrate that sufficient diversity exists to achieve these goals, (2) identify the vulnerabilities discovered and the corrective actions taken, or (3) identify the vulnerabilities discovered and provide a documented basis that justifies taking no action.	presented in Table 8-1, the proposed upgrade satisfies Acceptance Criteria (2).
(3) When a failure of a common element or signal source shared by the control system and reactor trip system (RTS) is postulated and the CCF results in a plant response that requires reactor trip and also impairs the trip function, then diverse means that are not subject to or failed by the postulated failure should be provided to perform the RTS function. The diverse means should assure that the plant response calculated using realistic assumptions analyses does not result in radiation release exceeding 10 percent of the applicable siting dose guideline values or violation of the integrity of the primary coolant pressure boundary.	This criterion requires an evaluation of potential interaction between the Control System and RTS echelons when a postulated CCF results in a plant response that requires a reactor trip and also impairs the trip function. PRNM system is not used for automatic control of plant operations, so if the postulated CCF occurs, it will not result in a plant response that requires a reactor trip. Therefore, the type of CCF described in this criterion cannot occur in the upgrade system. Acceptance Criterion (3) is satisfied.
(4) When a failure of a common element or signal source shared by the control system and ESFAS is postulated and the CCF results in a plant response that requires engineered safety features (ESF) and also impairs the ESF function, then diverse means that are not subject to or failed by the postulated failure should be provided to perform the ESF function. The diverse means should assure that the plant response calculated using realistic assumptions analyses does not result in radiation release exceeding 10 percent of the applicable siting dose guideline values or violation of the integrity of the primary	This criterion requires an evaluation of potential interactions between the Control System and Engineered Safety Features Actuation System (ESFAS) echelons when a postulated CCF results in a plant response that requires an ESF response and also impairs ESF function. PRNM system is not used for automatic control of plant operations, so if the postulated CCF occurs, it will not result in a plant response that requires an ESF response. Furthermore, neither the existing nor replacement PRNM system interface with the ESFAS. Therefore, the type of CCF described in this criterion cannot occur in the upgrade system. Acceptance

BTP 7-19 (Reference 4.4) Criterion	Evaluation of PRNM with DSS-CD
coolant pressure boundary.	Criterion (4) is satisfied.
(5) No failure of monitoring or display systems should influence the functioning of the RTS or ESFAS. If a plant monitoring system failure induces operators to attempt to operate the plant outside safety limits or in violation of the limiting conditions of operation, the analysis should demonstrate that such operator-induced transients will be compensated by protection system function.	This criterion requires that a failure in the monitoring and display echelon will not adversely affect the RTS or ESFAS echelons. PRNM system does not rely on or receive any input from the monitoring and display echelon; therefore, a failure in the monitoring and display systems will not propagate to PRNM system. If the failure in the monitoring and display system results in an operator-induced transient, the automatic protective functions of PRNM system are available for compensation. Acceptance Criterion (5) is satisfied.
(6) For safety systems to satisfy IEEE Std. 603–1991 Clauses 6.2 and 7.2, which are incorporated by reference in 10 CFR 50.55a(h), a safety-related means shall be provided in the control room to implement manual initiation at the division level of the RTS and ESFAS functions. The means provided shall minimize the number of discrete operator manual manipulations and shall depend on operation of a minimum of equipment. If the means is independent and diverse from the safety-related automatically initiated RTS and ESFAS functions, the design meets the system-level actuation criterion in Point 4 of this BTP. If credit is taken for a manual actuation method that meets both the IEEE Std.603–1991, Clauses 6.2 and 7.2 requirements and a need for a diverse manual backup, then the applicant/licensee should demonstrate that the criteria are satisfied and sufficient diversity exists.	This criterion requires a safety-related means for manual initiation of the RTS and ESFAS functions. This criterion is not applicable to the PRNM system upgrade. The evaluation performed for Acceptance Criteria (1) and (2) demonstrates that if a CCF occurs in PRNM system, the plant is able to cope without relying on a manual scram or ESF actuation. It is noted that the manual scram and ESF actuation are retained, if needed for other reasons, because they are totally separate from PRNM system and not affected by the proposed upgrade in any way.
(7) If the D3 assessment reveals a potential for a CCF, then the method for accomplishing the independent and diverse means of actuating the protective safety functions can be accomplished via either an automated system (see Section 3.4, "Use of Automation in Diverse Backup Safety	These criteria require evaluations of the methods for accomplishing the independent and diverse means of actuating the protective safety function when the Defense-In-Depth (D3) analysis reveals the potential for a CCF.

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BTP 7-19 (Reference 4.4) Criterion	Evaluation of PRNM with DSS-CD
Functions" below), or manual operator actions that meet HFE acceptability criteria (see Section 3.5, "Use of Manual Action in Diverse Backup Safety Functions" below).	The Nuclear Measurement Analysis and Control (NUMAC) platform is not present in any part of RTS except the PRNM system, and is not present in the ESFAS. Their designs are not affected by the proposed upgrade, and these systems are not vulnerable to the postulated CCF in PRNMS. Therefore, Acceptance Criterion (7) is not applicable to the PRNMS upgrade.
(8) If the D3 assessment reveals a potential for a CCF, then the method for accomplishing the independent and diverse means of actuating the protective safety functions should meet the following criteria: The independent and diverse means should be: *a) at the division level;* *b) initiated from the control room;* *c) capable of responding with sufficient time available for the operators to determine the need for protective actions even with malfunctioning indicators, if credited in the D3 coping analysis;* *d) appropriate for the event;* *e) supported by sufficient instrumentation that indicates:* *1. the protective function is needed,* *2. the safety-related automated system did not perform the protective function, and* *3. the automated backup or manual action is successful in performing the safety function.*	These criteria require evaluations of the methods for accomplishing the independent and diverse means of actuating the protective safety function when the D3 analysis reveals the potential for a CCF. The NUMAC platform is not present in any part of RTS except the PRNM system, and is not present in the ESFAS. Their designs are not affected by the proposed upgrade, and these systems are not vulnerable to the postulated CCF in PRNMS. Therefore, Acceptance Criterion (8) is not applicable to the PRNMS upgrade.
(9) If the D3 assessment reveals a potential for a CCF, then, in accordance with the augmented quality guidance for the	These criteria require evaluations of the methods for accomplishing the independent and diverse means of actuating the

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BTP 7-19 (Reference 4.4) Criterion	Evaluation of PRNM with DSS-CD
independent and diverse backup system used to cope with a CCF, the design of a diverse automated or diverse manual backup actuation system should address how to minimize the potential for a spurious actuation of the protective system caused by the diverse system. Use of design techniques (for example: redundancy, conservative setpoint selection, and use of quality components) to mitigate these concerns is recommended.	protective safety function when the D3 analysis reveals the potential for a CCF. The NUMAC platform is not present in any part of RTS except the PRNM system, and is not present in the ESFAS. Their designs are not affected by the proposed upgrade, and these systems are not vulnerable to the postulated CCF in PRNM system. Therefore, Acceptance Criterion (9) is not applicable to the PRNM system upgrade.

In summary, the proposed upgrade was evaluated using the acceptance criteria provided in BTP 7-19 (Reference 4.4). The GGNS specific disposition of a CCF for the PRNMS with DSS-CD is documented in the response to RSI #3 above and it is not repeated in this response. It was confirmed with the additional explanation documented for DSS-CD (provided in the response to RSI #3) that sufficient redundancy and diversity exists so that the plant has the ability to cope with any CCF in PRNMS with Option III or DSS-CD. The CCF evaluation (References 4.1, 4.2, and 4.3) was reviewed by the NRC and the PRNM system was approved by the NRC (Reference 4.5).

References:

4.1 M. A. Krupa (Entergy Operations, Inc.) to U.S. Nuclear Regulatory Commission Document Control Desk, "Response to NRC Request for Additional Information Pertaining to License Amendment Request for Power Range Neutron Monitoring System (TAC No. ME2531)," GNRO-2011/00039, dated May 26, 2011 (ML111460590) – Response to RAI 8.

4.2 M. A. Krupa (Entergy Operations, Inc.) to U.S. Nuclear Regulatory Commission Document Control Desk, "Response to NRC Request for Additional Information Pertaining to License Amendment Request for Power Range Neutron Monitoring System (TAC No. ME2531)," GNRO-2011/00039, dated May 26, 2011 (ML111460590) – Response to RAI 9.

4.3 M. A. Krupa (Entergy Operations, Inc.) to U.S. Nuclear Regulatory Commission Document Control Desk, "Response to NRC Request for Additional Information Pertaining to License Amendment Request for Power Range Neutron Monitoring System (TAC No. ME2531)," GNRO-2011/00039, dated May 26, 2011 (ML111460590) – Response to RAI 10.

4.4 USNRC Standard Review Plan, "Guidance for Evaluation of Diversity and Defense-In-Depth in Digital Computer-Based Instrumentation and Control Systems," NUREG 0800, BTP 7-19, Revision 6, July 2012.

4.5 NRC (A.Wang) to Entergy Operations, Inc. (VP, Operations), "Grand Gulf Nuclear Station, Unit 1 – Issuance of Amendment RE: Power Range Neutron Monitoring System Replacement (TAC No. ME2531)," March 28, 2012 (ML120400319).