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Attachment 1 contain PROPRIETARY information.

GNRO-2011/00038

May 16, 2011

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

SUBJECT: Responses to NRC Requests for Additional Information Pertaining to License Amendment Request for Power Range Neutron Monitoring System (TAC No. ME2531)

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

REFERENCES:

1. Entergy Operations, Inc. letter to the NRC (GNRO-2009/00054), *License Amendment Request – Power Range Neutron Monitoring System Upgrade*, November 3, 2009 (ADAMS Accession No. ML093140463)

2. NRC e-mail to Entergy Operations, Inc., *Grand Gulf Request for Additional Information Regarding Power Range Neutron Monitoring System License Amendment Request (TAC No. ME2531)*, April 27, 2011 (ADAMS Accession Nos. ML111170424 and ML111170432)

Dear Sir or Madam:

In Reference 1, Entergy Operations, Inc. (Entergy) submitted to the NRC a license amendment request (LAR), which proposes to revise the Grand Gulf Nuclear Station (GGNS) Technical Specifications (TS) to reflect the installation of the digital General Electric-Hitachi (GEH) Nuclear Measurement Analysis and Control (NUMAC) Power Range Neutron Monitoring (PRNM) System.

In Reference 2, the NRC staff transmitted 29 Requests for Additional Information (RAIs) to support their review and approval of Reference 1. Responses to RAIs 3, 5, 6, 12, and 15 are provided in Attachment 1.

GEH considers certain information contained in Attachment 1 to be proprietary and, therefore, requests it be withheld from public disclosure in accordance with 10 CFR 2.390. The associated affidavit is also provided in Attachment 1. A non-proprietary, redacted version of Attachment 1 is provided in Attachment 2.

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

The No Significance Hazards Determination and the Environmental Consideration provided in Reference 1 are not impacted by these responses.

This letter contains no new commitments.

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

I declare under penalty of perjury that the foregoing is true and correct; executed on May 16, 2011.

Sincerely,

MAK/ghd

Attachments:
1. Responses to NRC Requests for Additional Information Pertaining to License Amendment Request – Power Range Neutron Monitoring System Upgrade with Affidavit Supporting Request to Withhold Information from Public Disclosure (Proprietary Version)
2. Responses to NRC Requests for Additional Information Pertaining to License Amendment Request – Power Range Neutron Monitoring System Upgrade (Non-Proprietary Version)

cc: Mr. Elmo E. Collins, Jr.
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NRC Senior Resident Inspector
Grand Gulf Nuclear Station
Port Gibson, MS 39150

GE Hitachi Nuclear Energy Americas LLC

AFFIDAVIT

I, James F. Harrison, state as follows:

(1) I am the Vice President, Fuel Licensing, Regulatory Affairs, 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, GG-PRNM-168777-EC132, "NRC Instrumentation and Controls Branch RAIs 3, 5, 6, 12, & 15," dated May 11, 2011. The GEH proprietary information in Enclosure 1, which is entitled "GEH Responses to GGNS NRC I&CB RAIs 3, 5, 6, 12, & 15" is identified by a dark red dotted underline inside double square brackets. [[This sentence is an example.{3}]] Figures and large tables containing GEH proprietary information are identified with double square brackets before and after the object. 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 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC 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 F2d 871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704 F2d 1280 (DC 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 and/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 and/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 and/or confidentiality agreements.

(8) The information identified in paragraph (2), above, is classified as proprietary because it contains detailed GEH design information of the instrumentation and control equipment used in the design and analysis of the power range neutron monitoring system for the GEH Boiling Water Reactor (BWR). Development of these methods, techniques, and information and their application for the design, modification, and analyses methodologies and processes was 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 major GEH asset.

GE Hitachi Nuclear Energy Americas LLC

(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 11th day of May 2011.

James F. Harrison
Vice President, Fuel Licensing, Regulatory Affairs
GE Hitachi Nuclear Energy Americas LLC

ATTACHMENT 2

GNRO-2011/00038

RESPONSES TO NRC REQUESTS FOR ADDITIONAL INFORMATION PERTAINING TO LICENSE AMENDMENT REQUEST POWER RANGE NEUTRON MONITORING SYSTEM UPGRADE

(NON-PROPRIETARY VERSION)

NON-PROPRIETARY INFORMATION

RESPONSES TO NRC REQUESTS FOR ADDITIONAL INFORMATION PERTAINING TO LICENSE AMENDMENT REQUEST POWER RANGE NEUTRON MONITORING SYSTEM UPGRADE

By application dated November 3, 2009, Entergy Operations, Inc. (Entergy) requested NRC staff approval of an amendment to the Grand Gulf Nuclear Station, Unit 1 (GGNS) Technical Specifications (TS) to reflect installation of the digital General Electric - Hitachi (GEH) Nuclear Management Analysis and Control (NUMAC) Power Range Neutron Monitoring (PRNM) System.[4]

Entergy received an e-mail from the NRC GGNS Project Manager on April 27, 2011 requesting additional information needed to support their review and approval of the proposed amendment.[5] Responses to Requests for Additional Information (RAIs) 3, 5, 6, 12, and 15 are provided in this attachment.

NRC RAI 3

BTP 7-14 identifies that the Software Development Plan "should require that tools be qualified with a degree of rigor and level of detail appropriate to the safety significance of the software which is to be developed using the tools. Methods, techniques and tools that produce results that cannot be verified or that are not compatible with safety requirements should be prohibited, unless analysis shows that the alternative would be less safe."

Describe the characteristics of the Software Development Plan used to develop and program microprocessor and PLD firmware in sufficient detail for evaluation to satisfy the above criteria or to determine them to be acceptable alternatives.

The following further clarifies the rationale for this RAI but does not include additional information requests. RAI #1's response in Table 1-11 of Attachment 2 to GNRO-2010/00051 (ADAMS Accession No, ML102150028) does not explain the quality of software tools or how the verification and validation activities will detect any defects in microprocessor or PLD firmware that may be introduced by tools. The information associated with software development tools is defined in Enclosure B of the ISG for the Licensing Process of Digital Instrumentation & Controls, Digital I&C-ISG-06, (ADAMS Accession No, ML110140103) for "Software Tool Verification Program" and "Software Tool Analysis Report."

Response

The use of Verification and Validation (V&V) activities to confirm the acceptability of software tools is one of the accepted methods in DI&C-ISG-06 and IEEE Standard 7-4.3.2-2003, and meets the criteria of BTP 7-14, Section B.3.1.2.3. This RAI response addresses three focus areas followed by a summary to demonstrate that the GEH process for software tools meets

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[4] Entergy Operations, Inc. letter to the NRC, *License Amendment Request – Power Range Neutron Monitoring System Upgrade*, dated November 3, 2009 (ADAMS Accession No. ML093140463)

[5] NRC e-mail to Entergy Operations, Inc., *Grand Gulf Request for Additional Information Regarding Power Range Neutron Monitoring System License Amendment Request (TAC No. ME2531)*, April 27, 2011 (ADAMS Accession Nos. ML111170424 and ML111170432)

NON-PROPRIETARY INFORMATION

the listed requirements for tool qualification as specified in DI&C-ISG-06, Section D.10.4.2.3.2; IEEE Standard 7-4.3.2-2003, Clause 5.3.2; and BTP 7-14, Section B.3.1.2.3. The areas of focus and summary are provided under the following headings:

1. Legacy Programmable Logic Device (PLD) Firmware Development
2. V&V Activities
3. Development and Manufacturing/Production Tools
4. Conclusion

1. Legacy Programmable Logic Device (PLD) Firmware Development

All PLD firmware applied to the GGNS PRNM project is from previously released designs. Any future programmable logic changes would be performed in accordance with the NUMAC software development program. This section provides a discussion of the development of legacy PLD firmware applied to GGNS as discussed in the response to RAI 6 provided elsewhere in this attachment.

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2. V&V Activities

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NON-PROPRIETARY INFORMATION

NON-PROPRIETARY INFORMATION

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3. Development and Production Tools

The use of V&V activities to confirm the acceptability of the software tools is one of the accepted methods in DI&C-ISG-06 and IEEE Standard 7-4.3.2-2003, and meets the criteria of BTP 7-14, Section B.3.1.2.3.

[[

]]

NUMAC firmware designed for microprocessor and PLD devices utilize a suite of Original Equipment Manufacturer (OEM) development and production tools supplied by vendors from GEH's Qualified Suppliers List who, in many cases, are the same vendors/manufacturers that provide the devices used. IEEE Standard 7-4.3.2-2003 Clause 5.3.2 allows the use of operational history to provide additional confidence of the suitability of the tools. Firmware developed using these tools has been in service for 26 years in safety-related digital instrumentation deployed in nuclear power plants throughout the world. [[

NON-PROPRIETARY INFORMATION

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The following development and production tools are used for GGNS NUMAC PRNM firmware:

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		]]

4. Conclusion

The application of GEH procedures and the NUMAC software development plans ensures the management of software tools used to develop and program NUMAC microprocessor and PLD firmware is in compliance with requirements for tool qualification listed in BTP 7-14 Section B.3.1.2.3, DI&C-ISG-06 Section D.10.4.2.3.2, and IEEE Standard 7-4.3.2-2003 Clause 5.3.2. Mandated V&V activities verify all results produced by software tools used to ensure any defects that may be introduced by them are detected.

References

1. 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-2010/00040, June 3, 2010 (ADAMS Accession No. ML101790436)

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NRC RAI 5

Concisely and consistently describe a sufficiently complete configuration of the equipment where the description addresses, but is not necessarily limited to, the following considerations:

(i) Use of a minimum the number of tables that collocates the information;

(j) Ensuring that a unique descriptive name is consistently used to reference a configuration item and this name unambiguously corresponds to an item identified in the Nuclear Measurement Analysis and Control (NUMAC) PRNMS licensing topical report, wherever applicable;

(k) Ensuring that the configuration does not include some items that are identified as unchanged from the NUMAC PRNMS licensing topical report while excluding others;

(l) Ensuring that the configuration includes all major assembly/module part numbers and revision identifiers along with the firmware and revision identifier for each associated microprocessor or PLD;

(m) Ensuring that each identified PRNMS interface maps to configuration items using consistent nomenclature;

(n) Ensuring that the configuration includes all items and is not limited to only those involved in the Average Power Range Monitor (APRM) and OPRM trip functions;

(o) Ensuring that identified items are consistent with the configuration control processes, which may include GGNS plant-specific data file(s)

(p) Ensuring that updates, which may have occurred since the original RAI response, are included.

The following further clarifies the rationale for this RAI but does not include additional information requests. RAI #6's response in Attachment 6 to GNRO-2010/00040 (ML101790438) did not provide a table or concise set of tables that use consistent hardware names and define the complete configuration of the equipment identified for review in the LAR. An overall configuration of the equipment identified for review in the LAR, with part numbers and revisions, was not provided. The licensee's response to RAI #6 in Attachment 6 to GNRO-2010/00040 (ML101790438) states "The response to RAI #1 provides the information necessary to evaluate the equipment configuration (e.g., identify the revisions/version of hardware, PLD firmware, and microprocessor firmware) for the Grand Gulf PRNM system." However, RAI #1 does not identify all hardware that is identified in RAI #6 (e.g. 2/4 Fiber-Optic Interface Card) even though for other hardware RAI #1 does contain an entry for a non-changed item (e.g. DC-to-DC converter). Also, in the licensee's response to RAI #1, the licensee did not provide a fully defined part number for the "2/4 Logic Card" and Table 1-4 indicated the "2/4 Logic Card" was "Not Complete." This card embeds safety-related PLD firmware whose revision was not identified. Finally, the scope of firmware identified in Table 1-5 was limited to NUMAC APRM/OPRM firmware, does not identify all PLDs' information (i.e. revisions/versions), and excludes Power Range Neutron Monitoring System (PRNMS) Communication Interface (PCI) firmware.

NON-PROPRIETARY INFORMATION

Response

The Grand Gulf Power Range Neutron Monitoring (PRNM) system consists of four identical channels. Each channel consists of a similar group of instruments as follows:

- Four (4) TWO OUT OF FOUR LOGIC MODULE instruments [see GE Nuclear Licensing Topical Report NEDC-32410P-A Volume 1, "Nuclear Measurement Analysis and Control Power Range Neutron Monitor (NUMAC PRNM) Retrofit Plus Option III Stability Trip Function," (Reference 1), Section 5.3.2.3: TWO-OUT-OF-FOUR LOGIC MODULE]; one per channel.

- Four (4) AVERAGE POWER RANGE MONITOR instruments [Reference 1, Section 5.3.2.1: AVERAGE POWER RANGE MONITOR (APRM) CHASSIS]; one per channel; four (4) LPRM instruments that are identical assemblies to the APRM instrument; one per channel. An LPRM instrument provides LPRM data to its associated APRM instrument.

- Four (4) PRNM COMMUNICATION INTERFACE (PCI) instruments in the PRNM system. Each PCI instrument is associated with one channel and communicates with the APRM and the PCI instruments in the two adjacent channels. (For example, PCI 1 communicates directly with PCI 2 and PCI 4; PCI 2 communicates directly with PCI 1 and PCI 3; PCI 1 communicates with Channel 3 LPRM.)

- Four (4) QUAD LVPS CHASSIS (Reference 1, Section 5.3.2.6: QUAD LOW VOLTAGE POWER SUPPLY CHASSIS); one per channel that supplies redundant low voltage power to the APRM/LPRM instrument in its associated channel

- Two (2) NUMAC INTERFACE COMPUTER (NIC) instruments for interface with the plant process computer. Two PCI instruments communicate with each NIC. In addition, there is a single APRM bypass switch with mutually exclusive positions for each channel.

The information provided in this response is for one PRNM system channel; an NIC and the APRM bypass switch are included in Table 5-1 for completeness.

Table 5-1 shows the functional components for the Grand Gulf PRNM system. It is a structured top-down view from the instrument level down to the program level. The system hardware and software configuration information provided in the table are as follows:

- The name of the instrument, a reference to Reference 1 (where applicable), the assembly drawing and the parts list with the revision number identifying the instrument and the issue date of these documents are listed under Level-1 column.

- Specification documents associated with the instrument and their revision numbers are listed under Level-1 column.

- The identification number of the sub-components, the drawing and revision numbers are listed under Level-2, Level-3A, and Level-3B columns.

- The revision number of the programs used in the specified components is listed under the Program Level (Program File), Part No., and Rev columns.

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- The assembly drawing number for the chip, which includes the program file, and the revision number is listed under Program Level (Hardware Assembly OR Document), Part No., and Rev columns.

Table 5-1 is organized in the following order,

- Level-1: Instrument Top Level Assembly.
- Level-2: Instrument Sub-Assembly with Modules Replaceable.
- Level-3 A: Cards.
- Level-3 B: Cards.
- Level-4: Firmware Assembly.
- Program Level (Hardware Assembly OR Document).
- Program Level (Program File).
- Part No.
- Revision (Rev.)

Table 5-2 shows the communication protocols' specifications for the following communication links:

- PRNM COMMUNICATION INTERFACE to AVG POWER RANGE MONITOR
- AVG POWER RANGE MONITOR to LPRM CHASSIS
- TWO OUT OF FOUR LOGIC MODULE to AVG POWER RANGE MONITOR
- PRNM COMMUNICATION INTERFACE to ROD CONTROL AND INFORMATION SYSTEM (RCIS)
- PRNM COMMUNICATION INTERFACE to NUMAC INTERFACE COMPUTER (NIC)

Figure 5-1 provides a simplified block diagram showing the key components and communication links for the PRNM system. The block diagram also provides references to the communication links in Reference 1.

The following discussions provide additional information that addresses the consideration points stated in the RAI:

(a) Use of a minimum the number of tables that collocates the information;

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Table 5-1 provides a collation of the modules and parts that comprise the PRNM system for a single channel. Figure 5-1 provides a simple block diagram illustrating the interface structure for a channel of the system and the key communication links with other systems.

(b) *Ensuring that a unique descriptive name is consistently used to reference a configuration item and this name unambiguously corresponds to an item identified in the Nuclear Measurement Analysis and Control (NUMAC) PRNMS licensing topical report, wherever applicable;*

Unique descriptive names are used for the system components in Table 5-1; any differences between the names used in the configuration system and the topical report are identified in the table.

(c) *Ensuring that the configuration does not include some items that are identified as unchanged from the NUMAC PRNMS licensing topical report while excluding others;*

All items are included in Table 5-1.

(d) *Ensuring that the configuration includes all major assembly/module part numbers and revision identifiers along with the firmware and revision identifier for each associated microprocessor or PLD;*

All assembly, module, microprocessor, PLD, and firmware part numbers and revisions are identified in Table 5-1.

(e) *Ensuring that each identified PRNMS interface maps to configuration items using consistent nomenclature;*

Figure 5-1 illustrates the key modules of the PRNM using names and component numbers consistent with those in Table 5-1. Interfaces between the components and with other systems are cross-referenced to sections of Reference 1 for additional information. Table 5-2 also identifies communications protocols specifications for selected interfaces.

(f) *Ensuring that the configuration includes all items and is not limited to only those involved in the Average Power Range Monitor (APRM) and OPRM trip functions;*

All items (except motherboards and instruments' metal parts) are included in Table 5-1.

(g) *Ensuring that identified items are consistent with the configuration control processes, which may include GGNS plant-specific data file(s)*

All configuration items listed in Table 5-1 are issued in the GEH product data management system in accordance with the GEH procedures governing configuration control of these items. The EPROM sets for the APRM and PCI include the Grand Gulf plant-specific firmware configuration and were issued in accordance with GEH procedures and the NUMAC Software Configuration Management Plan.

(h) *Ensuring that updates, which may have occurred since the original RAI response, are included.*

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The configuration provided includes all items whether or not they were changed from the original RAI response. Excluded from the list are motherboards and instruments' metal parts.

Reference

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

Table 5-1

Grand Gulf PRNM Single Channel System Structure

Level-1: Instrument Top Level Assembly	Level-1: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-1: Reference Documents	Level-2: Instrument Sub-Assembly with Modules Replaceable	Level-2: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-3 A: Cards	Level-3 A: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-3 B: Cards	Level-3 B: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-4: Firmware Assembly	Level-4: Dwg # Rev ASM/PL Issue Date ASM-PLA*	Program Level (Hardware Assembly OR Document)	Program Level (Program File)	Part NO.	Rev.

NON-PROPRIETARY INFORMATION

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Grand Gulf PRNM Single Channel System Structure

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Level-1: Instrument Top Level Assembly	Level-1: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-1: Reference Documents	Level-2: Instrument Sub-Assembly with Modules Replaceable	Level-2: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-3 A: Cards	Level-3 A: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-3 B: Cards	Level-3 B: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-4: Firmware Assembly	Level-4: Dwg # Rev ASM/PL Issue Date ASM-PLA*	Program Level (Hardware Assembly OR Document)	Program Level (Program File)	Part NO.	Rev.

NON-PROPRIETARY INFORMATION

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Level-1: Instrument Top Level Assembly	Level-1: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-1: Reference Documents	Level-2: Instrument Sub-Assembly with Modules Replaceable	Level-2: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-3 A: Cards	Level-3 A: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-3 B: Cards	Level-3 B: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-4: Firmware Assembly	Level-4: Dwg # Rev ASM/PL Issue Date ASM-PLA*	Program Level (Hardware Assembly OR Document)	Program Level (Program File)	Part NO.	Rev.

NON-PROPRIETARY INFORMATION

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Grand Gulf PRNM Single Channel System Structure

Level-1: Instrument Top Level Assembly	Level-1: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-1: Reference Documents	Level-2: Instrument Sub-Assembly with Modules Replaceable	Level-2: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-3 A: Cards	Level-3 A: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-3 B: Cards	Level-3 B: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-4: Firmware Assembly	Level-4: Dwg # Rev ASM/PL Issue Date ASM-PLA*	Program Level (Hardware Assembly OR Document)	Program Level (Program File)	Part NO.	Rev.

Table 5-1

Grand Gulf PRNM Single Channel System Structure

Level-1: Instrument Top Level Assembly	Level-1: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-1: Reference Documents	Level-2: Instrument Sub-Assembly with Modules Replaceable	Level-2: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-3 A: Cards	Level-3 A: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-3 B: Cards	Level-3 B: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-4: Firmware Assembly	Level-4: Dwg # Rev ASM/PL Issue Date ASM-PLA*	Program Level (Hardware Assembly OR Document)	Program Level (Program File)	Part NO.	Rev.

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Level-1: Instrument Top Level Assembly	Level-1: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-1: Reference Documents	Level-2: Instrument Sub-Assembly with Modules Replaceable	Level-2: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-3 A: Cards	Level-3 A: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-3 B: Cards	Level-3 B: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-4: Firmware Assembly	Level-4: Dwg # Rev ASM/PL Issue Date ASM-PLA*	Program Level (Hardware Assembly OR Document)	Program Level (Program File)	Part NO.	Rev.

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Level-1: Instrument Top Level Assembly	Level-1: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-1: Reference Documents	Level-2: Instrument Sub-Assembly with Modules Replaceable	Level-2: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-3 A: Cards	Level-3 A: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-3 B: Cards	Level-3 B: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-4: Firmware Assembly	Level-4: Dwg # Rev ASM/PL Issue Date ASM-PLA*	Program Level (Hardware Assembly OR Document)	Program Level (Program File)	Part NO.	Rev.

NON-PROPRIETARY INFORMATION

Table 5-1

Grand Gulf PRNM Single Channel System Structure

Level-1: Instrument Top Level Assembly	Level-1: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-1: Reference Documents	Level-2: Instrument Sub-Assembly with Modules Replaceable	Level-2: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-3 A: Cards	Level-3 A: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-3 B: Cards	Level-3 B: Dwg # Rev ASM/PL Issue Date ASM-PLA *	Level-4: Firmware Assembly	Level-4: Dwg # Rev ASM/PL Issue Date ASM-PLA*	Program Level (Hardware Assembly OR Document)	Program Level (Program File)	Part NO.	Rev.
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Table 5-2

Grand Gulf PRNM Single Channel System Structure

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Appendix C: Grand Gulf PRNM Single Channel System Block Diagram

Figure 5-1

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Figure 5-1 Notes:

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NRC RAI 6

Describe any further changes to the equipment since the original RAI responses including any that resulted from the testing that has been performed.

Response

This response provides documentation of technical changes made to the NUMAC Power Range Neutron Monitoring (PRNM) Requirement Specification 24A5221WA/REV2 since May 4, 2010, except the changes of an administrative nature. Changes before this date were included in the response to RAI 6 provided in Attachment 6 to GNRO-2010/00040 (ML101790436).

Because the PRNM Requirement Specification 24A5221WA is the high-level controlling document, changes made to this document have affected all lower-level documentation accordingly. As part of the independent design verification, changes were reviewed to ensure they do not affect the safety functions of the PRNM system (PRNMS).

PRNM Requirement Specification 24A5221WA revisions included in this response are:

Identification Number / REV	Issue Date
24A5221WA / REV3	09/03/2010
24A5221WA / REV4	10/12/2010
24A5221WA / REV5	01/19/2011
24A5221WA / REV6	04/22/2011

Table 6-1 lists the technical changes made and classifies the changes whether safety or non-safety. The table was structured from left to right to include the following:

- **Document Title – Identification Number/REV – Issue Date**
- **Change Summary:** Provides description of the equipment changes.
- **Section Summary:** Provides description of the section affected by change, it is not intended to replace the section verbatim.
- **Reason for Change:** Provides the reason for the change and whether the change is affecting a safety function or not.
- **Change Safety Classification:** Provides classification of the change safety impact.

The changes were either to the final software design or to reflect the current hardware design. Therefore, qualification done to Grand Gulf NUMAC PRNMS hardware is not affected by these changes.

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Table 6-1

GGNS Requirement Specification Changes

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NRC RAI 12

Staff Position 1.11 of DI&C-ISG-04 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." Staff Position 1.12 of DI&C-ISG-04 states, in part, that "Communication faults should not adversely affect the performance of required safety functions in any way."

Describe in detail how firmware within the OPRM/APRM chassis, which is considered safety-related ensures the integrity of all data processed within the OPRM/APRM (e.g. valid message formats and ranges) to satisfy the above criteria or to determine the proposed approach is an acceptable alternative.

The following further clarifies the rationale for this RAI but does not include additional information requests. The information provided has not described data flows or the communication protocol by which non-safety system data is provided to each redundant OPRM/APRM channel for processing. No description of the processing is provided to identify whether the data directly affects the safety processor for either safety function or support software, and whether this data processing is limited to a channel in INOP or BYPASS as determined by the safety processor. The meaning of the RAI response in the DI&C-ISG-04 compliance matrix in Attachment 3 to GNRO-2010/00040, item #42, to Staff Position 1.11 of DI&C-ISG-04 is not clear. The meanings of the RAI responses in the DI&C-ISG-04 compliance matrix in Attachment 3 to GNRO-2010/00040, items #43 and #51, to Staff Position 1.12 of DI&C-ISG-04 are not clear. This RAI response need not address the previously described hardware-based integrity checks associated with the communication protocol and data buffering that have not changed since the PRNMS LTR.

Response

The following response details the alternative approach of the APRM to Staff Position 1.11 and explains how the APRM satisfies the criteria of Staff Position 1.12.

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No communication fault will adversely affect the performance of required safety functions and the APRM meets the criteria of Staff Position 1.12.

NRC RAI 15

DI&C-ISG-04 Position 1.13 states for communications that are needed to support a safety function, the effectiveness of error detection/correction should not affect the operation of the safety-function. Furthermore DI&C-ISG-04 Position 1.19 states that communications throughput thresholds and safety system sensitivity to communications throughput issues should be confirmed by testing.

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Describe in detail the methods used to test that each safety processor within PRNMS upgrade cannot be adversely influenced by the non-safety or inter-divisional communications activities for each of the following five (5) interfaces to satisfy the above criteria or to determine the proposed approach is an acceptable alternative:

i) between the PCI and APRM/LPRM

ii) between the PCI and RC&IS

iii) between the 2-out-of-4 voter and RC&IS

iv) inter-divisional between PCIs

v) inter-divisional between 2-out-of-4 voters.

Response

The NUMAC PRNM Upgrade system includes the following instruments: PCI, APRM/LPRM, and the 2-Out-Of-4 logic module. Of these instruments, only the APRM/LRPM contains safety-processors. The PCI is classified as a non-safety instrument, and the 2-Out-Of-4 logic module, while classified as safety-related, contains programmable logic without a processor.

Regardless of the use of a [micro] processor or the safety classification of a particular instrument, all NUMAC instruments provide provisions for ensuring that received messages are correct and are correctly understood as described by DI&C-ISG-04 Position 1.13. These provisions include error-detection and a method for dealing with corrupt, invalid, untimely, or otherwise questionable data.

The method NUMAC employs begins with specification of specific and deterministic data rates to ensure that communication bandwidth is sufficient for the proper performance of all functions as described by DI&C-ISG-04 Position 1.19. The implementation of communication protocols, including throughput, on all NUMAC instruments containing a processor (both safety and non-safety) are then subjected to multiple echelons of testing to validate the data rate and throughput while evaluating the effect to the safety functions.

For instruments that contain a processor, these echelons are defined by the NUMAC Software Management Plan as Module, Integration, and Validation testing. Module testing is performed to validate low level and design level requirements. Integration testing is performed to validate integration of low-level modules to each other, to the hardware, and to external instrumentation. Validation testing is performed to validate the user and performance level requirements.

Specific details on the methods used to test and validate communication data rates, error detection, and processor bandwidth between various PRNM instruments (that use a communication protocol) are provided for the five (5) interfaces, which are identified and discussed below.

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