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<u>Monticello Nuclear Generating Plant</u>
Operated by Nuclear Management Company, LLC

WITHOLD ENCLOSURES 8 AND 9 FROM PUBLIC DISCLOSURE UNDER 10 CFR 2.390

September 16, 2008

L-MT-08-049
10 CFR 50.90

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

Monticello Nuclear Generating Plant
Docket 50-263
Renewed Facility Operating License No. DPR-22

<u>Response to Requests for Additional Information for License Amendment Request for Power Range Neutron Monitoring System Upgrade (TAC No. MD8064)</u>

On February 6, 2008, the Nuclear Management Company (NMC), LLC submitted a request to revise the Monticello Nuclear Generating Plant Technical Specifications (TS) in conjunction with the installation of the General Electric – Hitachi (GEH) Nuclear Measurement Analysis and Control (NUMAC) Power Range Neutron Monitoring (PRNM) System (Enclosure 1, Reference 1).

Additional information was requested by the U.S. Nuclear Regulatory Commission (NRC) on the basis for this proposed change by three e-mails, dated June 13, 2008 (Enclosure 1, Reference 2), June 25, 2008 (Enclosure 2, Reference 2), and July 1, 2008 (Enclosure 3, Reference 2). Responses to these NRC e-mail requests for additional information (RAI) are provided in Enclosures 1, 2 and 3, respectively. During a telephone discussion with the NRC Project Manager on August 21, 2008, it was indicated that additional information from GEH was required to respond to several of the RAIs, and that a delay in submittal to September 12, 2008, would be acceptable.

Enclosure 4 provides a revised copy of the pertinent pages of the Monticello Nuclear Generating Plant (MNGP) Technical Specifications (TS) including the notes suggested by Regulatory Issue Summary (RIS) 2006-17 (Enclosure 1, Reference 7) for those Limiting Safety System Settings (LSSS) that protect a safety limit in accordance with 10 CFR 50.36(c)(1)(ii)(A). Enclosure 5 provides revised TS Bases pages clarifying the functions which are LSSS that protect a safety limit and also presents a more in depth discussion of the staggered test basis for response time testing.

Enclosure 6 provides a sample calculation for several Average Power Range Monitor non-flow biased PRNM System setpoints illustrating the MNGP application of the General Electric Instrument Setpoint Methodology. Several of the responses to the RAIs within Enclosures 1, 2 and 3, respectively, have a separate version of the response which contains proprietary information as defined by 10 CFR 2.390 that was

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provided by General Electric – Hitachi (GEH). The proprietary RAI responses have been assembled into one proprietary enclosure, Enclosure 8. Enclosure 9 provides a GEH proprietary response clarifying the OPRM Upscale function licensing basis in response to RAI No. 2 of Enclosure 1.

GEH, as the owner of this proprietary information, has executed two affidavits provided in Enclosure 7, which identifies that the enclosed information has been handled and classified as proprietary, is customarily held in confidence, and has been withheld from public disclosure. The proprietary information contained in Enclosures 8 and 9 was provided to the MNGP in a GEH transmittal referenced by the affidavit. The proprietary information has been faithfully reproduced within the RAI responses such that the affidavit remains applicable. GEH requests that the enclosed proprietary information be withheld from public disclosure in accordance with the provisions of 10 CFR 2.390 and 10 CFR 9.17. A non-proprietary version of the RAI responses containing proprietary information is provided within Enclosures 1, 2 and 3, respectively.

The NMC requests that the NRC safety evaluation for this license amendment clearly delineate those TS functions discussed herein determined not to be an LSSS that protects a safety limit, in addition to specifying those determined to be an LSSS that protects a safety limit pursuant to 10 CFR 50.36(c)(1)(ii)(A). This could reduce NRC Staff and NMC resource burdens during final resolution of the LSSS setpoint issue.

The NMC has reviewed the No Significant Hazards Consideration and the Environmental Consideration determinations provided in the February 6, 2008, license amendment request relative to the supplemental information being provided herein and has determined that no changes are required to either determination.

The MNGP Plant Operations Review Committee has reviewed these RAI responses and enclosed revised TS pages. In accordance with 10 CFR 50.91, a copy, without the proprietary enclosures, is being provided to the designated Minnesota Official.

I declare under penalty of perjury that the foregoing is true and correct. Executed on September 16, 2008.

Timothy J. O'Connor
Site Vice President, Monticello Nuclear Generating Plant
Nuclear Management Company, LLC

Enclosures

cc: Administrator, Region III, USNRC (w/o Enclosures 8 and 9)
Project Manager, Monticello, USNRC
Resident Inspector, Monticello, USNRC (w/o Enclosures 8 and 9)
Minnesota Department of Commerce (w/o Enclosures 8 and 9)

ENCLOSURE 1

RESPONSE TO THE JUNE 13, 2008
REQUESTS FOR ADDITIONAL INFORMATION
CONCERNING SETPOINT QUESTIONS

On February 6, 2008, (Reference 1) the Nuclear Management Company, LLC (NMC) submitted a request to revise the Monticello Nuclear Generating Plant (MNGP) Technical Specifications (TS) in conjunction with the installation of the General Electric – Hitachi (GEH) Nuclear Measurement Analysis and Control (NUMAC) Power Range Neutron Monitoring (PRNM) System.

The following requests for additional information (RAI) concerning setpoints and setpoint methodology were received from the U.S. Nuclear Regulatory Commission (NRC) by e-mail, dated June 13, 2008 (Reference 2).

1. **<u>Setpoint Calculation Methodology</u>: Provide documentation (including sample calculations) of the methodology used for establishing the limiting setpoint (or NSP) and the limiting acceptable values for the As-Found and As-Left setpoints as measured in periodic surveillance testing as described below. Indicate the related Analytical Limits and other limiting design values (and the sources of these values) for each setpoint.**

   <u>Response</u>

   As discussed within Section 5.4 of Enclosure 1 to the PRNM System license amendment request (LAR), the MNGP has adopted and incorporated into the site Engineering Standards Manual (ESM) (Reference 3), the MNGP specific implementation of the General Electric – Hitachi (GEH) Instrument Setpoint Methodology (ISM) (References 4 and 5). The ESM provides plant-specific guidance on implementation of the GEH instrument setpoint guidelines and methodology. The GEH ISM has been reviewed and approved by the NRC for use by utilities as a basis for their instrument setpoint programs as discussed within the associated NRC safety evaluation for the methodology (Reference 6).

   The MNGP specific implementation of the GEH ISM was applied in the determination of the setpoints for the various TS functions discussed herein. Conceptually, the GEH method is based on ISA Standard 67.04, Method 2 but leads to more conservative setpoints. According to this approved methodology, the setpoints are calculated from the Analytic Limit (AL) using a top down approach, and the margin is calculated by ISM between the AL and the Allowable Value (AV), and between AV and the Nominal Trip Setpoint (NTSP).

   The AL is a process parameter value used in the safety analysis. The AL represents a limiting value for the automatic initiation of protective actions. From the AL an AV is first calculated which, has margin to the AL, based on all measurement errors except drift. This AL/AV margin includes the Process Measurement Accuracy (PMA), Primary Element Accuracy (PEA), measuring instrument loop accuracy under trip conditions (A_T), and the instrument calibration errors (C). The calibration uncertainty in the GEH ISM contains the

As-Left Tolerance (ALT), so the AV is already made more conservative to account for this allowance. All random errors are combined using Square Root of the Sum of the Squares (SRSS) method, and non-conservative bias errors are added algebraically. The AV represents the limiting value to which a setpoint can drift (as determined from surveillance testing) and still assure that the AL is protected. The approved GEH ISM provides a sufficient margin between the AL and AV to assure with at least 95 percent probability that the AL will not be exceeded if the setpoint has drifted to the AV. The AV is the value specified in the TSs.

The AV/NTSP margin includes instrument loop accuracy under calibration conditions (A_C), instrument calibration errors (C) and instrument drift errors (D). The approved GEH ISM basically calculates two nominal trip setpoints. The first is the setpoint with minimum required margin to the AL based on 95 percent probability of not exceeding the AL. This setpoint is called NTSP1 and the AL/NTSP1 margin is based on all errors (PMA, PEA, A_T, C, and Drift (D)). Therefore NTSP1 is equivalent to the Limiting Trip Setpoint (LSP) referred to in RIS 2006-17 (Reference 7). However, the GEH ISM also calculates a second nominal trip setpoint, referred to as NTSP2, with additional margin to provide high confidence that the setpoint will not drift beyond the AV potentially resulting in a Licensee Event Report (LER). According to the approved GEH ISM, the final NTSP has margin to the AV which provides 90 percent assurance that the AV value specified in the TSs will not be exceeded during surveillance tests. This is known as the LER Avoidance test. The final NTSP is chosen to satisfy both goals (protecting the AL and avoiding LERs) and is equivalent to the Nominal Setpoint (NSP) term used in RIS 2006-17.

Determination of the As-Found Tolerance (AFT) and ALT for the digital NUMAC PRNM System is discussed in Enclosure 6. Enclosure 6 provides a sample MNGP calculation(1) CA-08-050, Revision 0, entitled "Instrument Setpoint Calculation – Average Power Range Monitor (APRM) Non-Flow Biased PRNM Setpoints for CLTP and EPU," illustrating the MNGP specific implementation of the GEH ISM to determine the setpoints for two TS functions.

MNGP procedures require the instrument to be declared inoperable if the AV is exceeded and require that corrective actions be initiated any time the AFT is exceeded. This includes evaluating instrument performance before the channel is returned to service.

By the GEH ISM all setpoints are reset to the NTSP, within the ALT, after calibration. The ALT is a procedural allowance specified by the calibration procedure and its value is generally the same as the instrument accuracy. The

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1. Two GEH setpoint calculations (Attachments 2 and 3) attached to CA-08-050 for convenient reference that contain GEH proprietary information have been removed.

magnitude of ALT is generally less than the target maximum value specified by RIS 2006-17. MNGP procedures consider an instrument channel inoperable if it cannot be restored or calibrated within the specified ALT. Margin allowance for ALT is already incorporated in the calculated margins for the AV and the NTSP values according to the approved GEH ISM, so the ALT used in setpoints calculated by GEH ISM, meets the guidance of RIS 2006-17.

The applicable AFT and ALT depend on the surveillance test and the type and portion of the instrument loop that is being tested or calibrated. For example, the surveillance test for the digital electronics of the PRNM System is not vulnerable to drift or instrument inaccuracy, so the AFT and ALT for the PRNM setpoints is conservatively implemented as zero.

Enclosure 6 provides sample calculation CA-08-050, Revision 0, which illustrates the MNGP specific implementation of the GEH ISM to determine the setpoints for the following two TS functions:

<u>TS Table 3.3.1.1-1</u>

- APRM Neutron Flux – High (Setdown) Scram (2.a)
- APRM Neutron Flux – High Scram (2.c)

Separate from these TS functions, applying the GE ISM for cases involving Limiting Safety System Settings (LSSS) for which AFT or ALT are determined, or for cases where the NTSP or AV was determined, the methodologies would be documented within the MNGP Technical Requirements Manual (TRM).[2] The MNGP TRM is subject to 10 CFR 50.59 evaluation for any changes made to the document.

The NTSP, AV, and AL or the limiting design value, (as applicable) for each setpoint involved with the PRNM System implementation is provided in the response to RAI No. 2 in this enclosure.

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2. TRM Appendix C was created in conjunction with the Improved Standard Technical Specifications conversion to document the methods used to calculate the AFT and ALT for several Emergency Core Cooling System (ECCS) setpoints considered LSSS.

2. **<u>Safety Limit (SL)-Related Determination</u>: Provide a statement as to whether or not the setpoint is a limiting safety system setting (LSSS) for a variable on which a safety limit (SL) has been placed as discussed in 10 CFR 50.36(d)(1)(ii)(A). Such setpoints are described as "SL-Related" in the discussions that follow. In accordance with 10 CFR 50.36(d)(1)(ii)(A), the following guidance is provided for identifying a list of functions to be included in the subset of LSSS specified for variables on which SLs have been placed as defined in Standard Technical Specifications (STS) Sections 2.1.1, Reactor Core SLs and 2.1.2, Reactor Coolant System Pressure SLs. This subset includes automatic protective devices in TS for specified variables on which SLs have been placed that: (1) initiate a reactor trip; or (2) actuate safety systems. As such these variables provide protection against violating reactor core safety limits, or reactor coolant system pressure boundary safety limits.**

Examples of instrument functions that might have LSSS included in this subset in accordance with the plant-specific licensing basis, are pressurizer pressure reactor trip (pressurized water reactors), rod block monitor withdrawal blocks (boiling water reactors), feedwater and main turbine high water level trip (boiling water reactors), and end of cycle recirculation pump trip (boiling water reactors). For each setpoint, or related group of setpoints, that you determined not to be SL-Related, explain the basis for this determination.

<u>Response</u>

As described in Sections 5.5 and 5.1.7 of the PRNM System LAR, the following functions from Specification 3.3.1.1, "Reactor Protection System Instrumentation," and Specification 3.3.2.1, "Control Rod Block Instrumentation," listed below are affected by installation of the PRNM System and require determination of whether they are Limiting Safety System Settings (LSSS) on which a safety limit has been placed in accordance with 10 CFR 50.36(c)(1)(ii)(A).

<u>TS Table 3.3.1.1-1</u>

- APRM Neutron Flux – High (Setdown) (2.a)
- APRM Simulated Thermal Power – High (2.b)
- APRM Neutron Flux – High (2.c)
- OPRM Upscale (2.f)

TS Table 3.3.1.2-1

- Rod Block Monitor – Low Power Range – Upscale (1.a)
- Rod Block Monitor – Intermediate Power Range – Upscale (1.b)
- Rod Block Monitor – High Power Range – Upscale (1.c)

The NMC has reviewed these TS setpoint (or parameter setting) functions versus their associated safety analysis functions and determined which of the above Reactor Protection System (RPS) and Rod Block Monitor (RBM) functions discussed in the LAR are LSSS on which a safety limit has been placed in accordance with 10 CFR 50.36(c)(1)(ii)(A). The safety-limit related LSSS determination evaluations are provided below.

A. APRM Neutron Flux – High (Setdown)

Installation of the PRNM System introduces a new function to the MNGP TS, the APRM Neutron Flux – High (Setdown) scram function. The APRM Neutron Flux – High setdown function provides a redundant scram to the Intermediate Range Monitors (IRMs) for reactivity transients in the startup mode and is discussed in the PRNM System Licensing Topical Report (LTR).

Two BWR Owners Group documents (References 8 and 9) provide guidance on evaluating TS instruments that may be LSSS. They indicate that the APRM Neutron Flux – High (Setdown) scram function is a redundant scram function to that provided by the IRMs. This function is not credited in any design basis safety analysis for the MNGP and does not have an Analytical Limit.

APRM / OPRM Function TS Table 3.3.1.1-1 Name	Nominal Trip Setpoint	Allowable Value	Analytical Limit
APRM Neutron Flux – High (Setdown) (Function 2.a)	≤ 18 % RTP	≤ 20 % RTP	N/A

Consistent with the MNGP licensing basis and the above guidance, the APRM Neutron Flux – High (Setdown) scram function is not a LSSS variable on which a safety limit has been placed in accordance with 10 CFR 50.36(c)(1)(ii)(A).

The TS Bases for the specification state that functions not specifically credited in the accident analysis are retained for overall redundancy and diversity of the RPS as required by the NRC approved licensing basis. This function is being included in the TS since it is part of the PRNM System design and is being added to the MNGP licensing basis.

A sample calculation is provided in Enclosure 6 indicating how this setpoint is determined.

B. APRM Simulated Thermal Power – High

The APRM Simulated Thermal Power (STP) – High scram function monitors neutron flux to approximate the thermal power being transferred to the reactor coolant. The APRM neutron flux is electronically filtered with a time constant representative of the fuel heat transfer dynamics to generate a simulated thermal power signal proportional to the thermal power in the reactor. The trip level is varied as a function of recirculation drive flow (i.e., at lower core flows, the setpoint is reduced proportional to the reduction in power experienced as core flow is reduced with a fixed control rod pattern) but is clamped at an upper limit that is always lower than the APRM Neutron Flux – High function AV.

This setpoint function is different from the current flow-biased APRM Neutron Flux scram function which is based on the unfiltered neutron flux signal. The APRM STP signal responds more slowly to reactivity changes since it is based on a filtered (less than 7-second filter) neutron flux signal. The flow-biased APRM STP – High scram function mitigates slow reactivity transients initiated near the operating map boundary (such as a loss of feedwater heating) by reducing the over-power and delta Critical Power Ratio (CPR) for these events, but is not required to protect the Minimum Critical Power Ratio (MCPR) Safety Limit. As indicated in Table 3-1, "Limiting Safety System Settings for a Typical BWR/4," of Reference 9, this setpoint function has the potential to be an LSSS requiring evaluation. A review of the MNGP design basis indicates that the APRM STP – High scram function does not have an AL and is not credited in the safety analysis.

APRM / OPRM Function TS Table 3.3.1.1-1 Name	Nominal Trip Setpoint	Allowable Value	Analytical Limit
APRM Simulated Thermal Power – High[(4)] (Function 2.b)	$\leq 0.66\ W_d + 59.6$ % RTP, and ≤ 114 % RTP	$\leq 0.66\ W_d + 61.6$ % RTP, and ≤ 116 % RTP	N/A

4. The APRM STP – High NTSP is $\leq 0.66W_d + 54.6$ % RTP and the APRM STP – High AV is $\leq 0.66(W_d - 5.4) + 61.6$ % RTP when reset for single loop operation. Delta W is specified in the Core Operating Limits Report. There is no AL for the APRM STP – High function.

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The NRC in a safety evaluation for ARTS/MELLLA[5] implementation at Susquehanna (Reference 10) states, the "APRM STP - High Function, being revised, is not SL-related, and it does provide defense-in-depth to the APRM Fixed Neutron Flux - High Function. This function is being retained in the TSs since it is part of the RPS design and the NRC-approved licensing basis. ... The NRC staff agrees that the RBM power-dependent setpoints are the only TS functions removed or altered by this LAR that are considered an SL-related LSSS." The MNGP licensing basis also indicates that the APRM STP – High scram function is not a LSSS on which a safety limit has been placed in accordance with 10 CFR 50.36(c)(1)(ii)(A).

As discussed in Item B, the TS include functions not specifically credited in the accident analysis that are retained for overall redundancy and diversity of the RPS. Since this function is part of the PRNM System design it is being included in the TS and is being added to the MNGP licensing basis.

C. APRM Neutron Flux – High (SL Related LSSS)

The APRM Neutron Flux – High scram function protects against all fast reactivity transients. The APRM Neutron Flux – High scram function generates a trip signal to prevent fuel damage or excessive Reactor Coolant System (RCS) pressure in the high power range. For the overpressurization protection analysis, high neutron flux is assumed to terminate the main steam isolation valve (MSIV) closure event and along with the safety/relief valves (S/RVs) limits the peak reactor pressure vessel (RPV) pressure to less than the ASME Code limits. The control rod drop accident (CRDA) analysis takes credit for high neutron flux to terminate the CRDA. The AV is based on the AL assumed in the CRDA analysis.

The APRM Neutron Flux – High scram is based on the unfiltered neutron flux signal. For rapid neutron flux increase events, thermal power lags the neutron flux and the APRM Neutron Flux – High function will provide a scram signal before the flow-biased APRM Simulated Thermal Power – High scram. The APRM Neutron Flux – High scram function AL is not changed with the installation of the PRNM System.

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5. ARTS/MELLLA stands for – Average Power Range Monitor/Rod Block Monitor/Technical Specifications/Maximum Extended Load Line Limit Analysis.

APRM / OPRM Function TS Table 3.3.1.1-1 Name	Nominal Trip Setpoint	Allowable Value	Analytical Limit
APRM Neutron Flux – High (Function 2.c)	≤ 119.5 % RTP	≤ 122 % RTP	≤ 125 % RTP

The APRM Neutron Flux – High scram function is required to be OPERABLE in MODE 1 where the potential consequences of the analyzed transients could result in the Safety Limits (e.g., MCPR and RCS pressure) being exceeded. As indicated in Table 3-1, "Limiting Safety System Settings for a Typical BWR/4," of Reference 9, the APRM Neutron Flux – High scram function is an LSSS on which a safety limit has been placed since it protects both the MCPR Safety Limit and the Reactor Pressure Safety Limit in accordance with 10 CFR 50.36(c)(1)(ii)(A).

The safety-limit related LSSS notes suggested by RIS 2006-17 are applicable and a digital version of the notes, that were approved for ARTS/MELLA implementation at Susquehanna Units 1 and 2 (Reference 10) will be applied (see the revised TS page for this function in Enclosure 4).

A sample calculation is provided in Enclosure 6 indicating how this setpoint is determined.

D. OPRM Upscale

The BWROG Stability Long-Term Solution Option III is implemented utilizing the OPRM system. The period based detection algorithm (PBDA) is one of the three algorithms implemented in the OPRM Upscale function, but is the only algorithm credited in the safety analysis.

The BWR Owners Group developed a methodology (Reference 8) based on the requirements of 10CFR50.36 for identifying SL-LSSS and applied it to the BWR/4 and BWR/6 Improved Technical Specification (ITS) NUREGs. In the BWROG methodology, only the LSSS associated with the analysis of anticipated operational occurrences (AOOs) that have the potential to challenge one of the four SLs are considered SL-LSSS. Accidents and plant capability evaluations (special events) are not included because these categories of events have event limits that typically allow exceeding the safety limits.

The OPRM Upscale function is only credited as part of the reactor stability analysis. Only a Nominal Trip Setpoint is developed as part of the reload analysis which will be specified in the Core Operating Limits Report (COLR). This function does not have an Allowable Value or an Analytical Limit.

APRM / OPRM Function TS Table 3.3.1.1-1 Name	Nominal Trip Setpoint	Allowable Value	Analytical Limit
OPRM Upscale (Function 2.f)	In development for next Cycle.	N/A	N/A

GEH has provided a proprietary discussion and evaluation (see Enclosure 9) which clarifies the OPRM Upscale function licensing basis and use of the Safety Limit Minimum Critical Power Ratio (SLMCPR) as a specified acceptable fuel design limit (SAFDL) in reactor stability analyses in accordance with General Design Criteria (GDC) GDC-10 and 12.[6] The following topics are discussed:

- Review of the different Safety Limits
- Review of Applicable General Design Criteria
- Review of specified acceptable fuel design limits (SAFDL)
- Discussion on the multiple uses of the SLMCPR - as a SAFDL for various analyses
- Discussion on the digital nature of the OPRM
- Unique stability setpoint methodology

1. Safety Limits (SL) and Limiting Safety System Settings: 10 CFR 50.36 defines the SL and LSSS. Two SLs were contained in the initial BWR TS:

   - Fuel Cladding Integrity (Minimum Critical Heat Flux Ratio) – Considered a bounding value to prevent fuel rod burnout.

   - Reactor Coolant System (RCS) Pressure – 1325 psig reactor dome pressure – Based on ASME Code pressure limit for upset conditions, monitored by vessel pressure instrumentation.

6. 10 CFR 50, Appendix A, GDC-10 is "Reactor Design" and GDC-12 is "Suppression of Reactor Power Oscillations."

Later, the fuel cladding integrity SL was split into three SLs:

- Safety Limit Minimum Critical Power Ratio (SLMCPR) – Assure that greater than 99.9 % of fuel rods would not experience boiling transition.
- Low Flow or Low Pressure Limit on Reactor Power – Assure nucleate boiling at conditions for which transition boiling data was not available.
- Safety Limit Water Level – 1 foot above the top of active fuel – Chosen to prevent fuel failure due to heatup following core uncovery.

Based on 10 CFR 50.36(C)(1)(ii)(A), the initial BWR TS issued by the NRC contained sets of LSSS:

- Reactor Protection System (RPS) trips.
- Emergency Core Cooling System initiations.
- ASME Code qualified safety valve opening setpoints.

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The above sets of LSSS were relatively consistently included in BWR TSs until the conversion to Improved Standard TS (ITS) occurred. In the ITS, the LSSS section was removed and the direct tie to the SL was diminished; however, similar requirements were included as Limiting Conditions for Operation (LCOs).

2. GDC-10, Reactor Design and GDC-12, Suppression of Reactor Power Oscillations:

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

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

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3. Specified Acceptable Fuel Design Limits (SAFDLs): The two GDCs clearly separate the types of events to which they apply. SAFDLs associated with GDC-10 apply to events/conditions during normal operation and anticipated operational occurrences (AOOs). GDC-12 states power oscillations which could exceed the SAFDL either are not possible or that the oscillations are able to be reliably and readily detected and suppressed. In other words power oscillations may exceed the SADFL as long as they are detected and suppressed. [[

PROPRIETARY INFORMATION REMOVED]]

By definition, GDC-10 is limited to AOOs, which are defined as conditions of normal operation expected to occur one or more times during the life of a nuclear power unit and include, but are not limited to, loss of power to all recirculation pumps, tripping of the turbine generator set, isolation of the main condenser, and loss of all offsite power. These events are the subject of the transient (or AOO) analyses in Chapter 14 of the MNGP Final Safety Analysis Report (FSAR). The current SAFDLs for AOOs (Sections listed below) from the fuel licensing topical report GESTAR (Reference 11) are:

- MCPR Safety Limit 4.3.1
- Fuel Pellet Centerline Melting 2.2.5
- One Percent Fuel Rod Cladding Plastic Strain 2.2.7
- Fuel Enthalpy Design Limit 2.2.3.1.4

This list of SAFDLs, i.e., fuel design limits, demonstrates that event limits for AOOs are more inclusive than just complying with the SLMCPR. The initial BWR SAFDL for stability was expressed in terms of decay ratio. Because of the technological changes in fuel designs, the current stability analytical limit is actually fuel integrity. [[

PROPRIETARY INFORMATION REMOVED]]

The NRC concluded in the OPRM Technical Evaluation Report (TER) associated with the NRC SE for NEDO-32465-A (Reference 12) that there is a "high-likelihood that fuel integrity will not be compromised by the likely instability events. We must note, however, that this statistical approach allows for a 5% probability that the CPR limit will be reached during an instability event." [[

PROPRIETARY INFORMATION REMOVED]]

Technological Changes: As BWR designs developed, there have been technological advances in fuel design and analyses that have impacted the treatment of both AOOs and stability. These include:

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PROPRIETARY INFORMATION REMOVED

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4. Employing the SLMCPR for Multiple Uses: The association of the SLMCPR with multiple functions can be the source of considerable confusion. The three functions are:

    - The identification of the SLMCPR as a safety limit in TSs.
    - Use of the SLMCPR as one of the SAFDLs in the AOO analyses.
    - Use of the SLMCPR as a SADFL figure of merit in stability analysis.

    SLs are only associated with protection of the fuel cladding and RCS barriers to the release of radioactive material.

    The use of the SLMCPR as a SAFDL in AOO analyses is appropriate for the identification of SL-LSSS. In this analysis, an operating limit minimum critical power ratio (OLMCPR) is identified and established so that the SLMCPR will not be exceeded in the event the limiting AOO occurs. Because the OLMCPR is used analytically to avoid exceeding the SLMCPR, instrument setpoints associated with the instruments assumed to function during AOOs can be identified as SL-LSSS.

    The use of the SLMCPR as a figure-of-merit (SADFL) in reactor stability analysis is also appropriate. In other words because GDC-12 allows power oscillations which may exceed the SADFL as long as they are reliably and readily detected and suppressed [emphasis added], the SLMCPR in this context cannot be a SL. Rather, it is a figure-of-merit used in lieu of other possible parameters. Since the regulation, GDC-12, allows the SADFL (the SLMCPR) to be exceeded, was approved by the NRC as part of reactor stability licensing methodology, the OPRM Upscale function cannot be an LSSS and does not protect a SL. [[

    PROPRIETARY INFORMATION REMOVED

    ]] can be exceeded in stability analyses, the OPRM setpoints are not considered SL-LSSSs.

5. Digital Instrumentation: The OPRM is designed to trip the reactor if power oscillations of sufficient magnitude are detected. The OPRM signal is a relative signal and is obtained by dividing the instantaneous reading, which could oscillate if the local core power is oscillating, by a reading which is strongly filtered and is relatively constant in time. Since the signal is a ratio, it is insensitive to the drift and calibration errors of the signal conditioning electronics that could be present if the equipment was analog. In fact the OPRM electronics are digital and the signal conditioning electronics and setpoints are implemented with digital electronics and software, and do not drift. The OPRM setpoints are not adjusted, and have no as-found and as-left tolerances. Thus the OPRM setpoints are not affected by the requirements in RIS 2006-17 (Reference 7), which is concerned with monitoring the performance of the instrument during calibration to ensure that it has not drifted excessively between calibrations so that the instrument error margins used in the setpoint calculation remain valid.

6. Unique Setpoint Methodology: The OPRM setpoints are not derived from GE ISM (Reference 5), or any other setpoint methodology based on RG 1.105 (Reference 13) and ISA-67.04 (Reference 14). The OPRM setpoint methodology is a comprehensive BWROG methodology for stability analysis approved by the NRC (Reference 12). According to this licensed methodology the stability analysis is based on nominal setpoints. There is no Analytic Limit or Allowable Value with defined instrument error margins to the Nominal Trip Setpoint for the OPRM setpoints. Instrument error was not specifically considered because of conservatisms inherent in the analysis methodology. Thus the OPRM stability setpoints are based on a unique licensing basis methodology.

   Use of nominal setpoints has been more recently addressed in a response to an NRC Request for Additional Information (RAI) (Reference 15) during the licensing of PRNM System at Browns Ferry Unit 1. The NRC approved the implementation of the PRNM System at Browns Ferry Unit 1 and the use of the nominal setpoints (Reference 16).

   Utilization of the SLMCPR as a SAFDL (i.e., a figure-of-merit) in the NRC approved licensing stability methodology in accordance with GDC-12 indicates that the SLMCPR is not a SL when applied in this reactor stability analysis context. Based on the above discussion and review of the regulatory requirements and stability licensing basis the OPRM Upscale Function does not protect a SL. The stability event is treated as a special event in the GEH analysis methodology, not as an AOO. Therefore, consistent with the GEH stability licensing basis being applied to the MNGP and the above discussion and clarifications, the OPRM Upscale scram function is not a LSSS variable on which a safety limit has been placed in accordance with 10 CFR 50.36(c)(1)(ii)(A).

Also, RIS 2006-17 is not applicable to the OPRM Upscale function since the OPRM electronics are digital and the setpoints are not subject to drift. The NRC-approved setpoint methodology is unique to the stability analysis and is not associated with a setpoint methodology, such as, RG 1.105 and ISA-67.04.

A GEH proprietary discussion is provided in Enclosure 9 expands on the discussion presented above.

E. Rod Block Monitor – Low, Intermediate and High Power Ranges – Upscale (SL Related LSSS)

The Rod Block Monitor (RBM) – Low, Intermediate, and High Power Ranges – Upscale functions are designed to prevent violation of the MCPR Safety Limit and the cladding one percent plastic strain fuel design limit that may result from a single control rod withdrawal error (RWE) event. A statistical analysis of RWE events was performed to determine the RBM response for both channels for each event. From these responses, the fuel thermal performance as a function of the RBM AV was determined. The AVs are chosen as a function of power level.

RBM Function TS Table 3.3.1.2-1 Name	Nominal Trip Setpoint	Allowable Value	Analytical Limit
Rod Block Monitor – Low Power Range – Upscale (Function 1.a)	≤ 120 / 125 of full scale (FS)	≤ 120.4 / 125 of FS	≤ 124 / 125 of FS
Rod Block Monitor – Intermediate Power Range – Upscale (Function 1.b)	≤ 115 / 125 of FS	≤ 115.4 / 125 of FS	≤ 119 / 125 of FS
Rod Block Monitor – High Power Range – Upscale (Function 1.c)	≤ 110 / 125 of FS	≤ 110.4 / 125 of FS	≤ 114 / 125 of FS

The RBM setpoints are based on the APRM, RBM and TS improvement (ARTS) program applied to the MNGP (Reference 17). The RBM setpoints are set in accordance with the results of the reload transient analysis verified each cycle as documented in the COLR.

The RBM is a digitally based system. As such, the system and its components are not subject to the setpoint drift attributable to typical analog systems. The applicable AFT and ALT depend on the surveillance test and the type and portion of the instrument loop that is being surveilled. For example the surveillance test for the digital RBM contained in the PRNM System instrument, tests the RBM trip setpoint which is stored digitally. This value does not drift, and is never adjusted, so the AFT and ALT for the test is zero.

Table 3-1 of Reference 9, indicates that due to the generic nature of the RWE analysis applied to the BWR/2-5 that the Rod Block Monitor (RBM) – Low, Intermediate, and High Power Range – Upscale setpoint functions are LSSS on which a safety limit has been placed since they protect the MCPR Safety Limit in accordance with 10 CFR 50.36(c)(1)(ii)(A).

This determination is consistent with results from recent ARTS/MELLLA implementations at Susquehanna Units 1 and 2 (Reference 10) and Nine Mile Point Unit 2. The NRC in the ARTS/MELLLA Susquehanna SE states "The NRC staff agrees that the RBM power-dependent setpoints are the only TS functions removed or altered by this LAR that are considered an SL-related LSSS." Note that this is consistent with the MNGP licensing basis which indicates that the MNGP RBM power-dependent setpoints are LSSS variables on which a safety limit has been placed in accordance with 10 CFR 50.36(c)(1)(ii)(A).

Conclusion

The following instrument setpoints (or setting) functions have been determined by the NMC to be LSSS on which a safety limit has been placed for the MNGP in accordance with 10 CFR 50.36(c)(1)(ii)(A).

a. TS Table 3.3.1.1-1

- APRM Neutron Flux – High (2.c)

b. TS Table 3.3.1.2-1

- Rod Block Monitor – Low Power Range – Upscale (1.a)
- Rod Block Monitor – Intermediate Power Range – Upscale (1.b)
- Rod Block Monitor – High Power Range – Upscale (1.c)

NMC requests that in addition to the NRC SE for the PRNM System license amendment specifying that the above listed functions are LSSS on which a safety limit has been placed, that the SE also clearly delineate that the following functions have been reviewed by the NRC as part of this submittal and that they are not safety-limit LSSS in accordance with 10 CFR 50.36(c)(1)(ii)(A).

TS Table 3.3.1.1-1

- APRM Neutron Flux – High (Setdown) (2.a)
- APRM Simulated Thermal Power – High (2.b)
- OPRM Upscale (2.f)

This action will avoid future repeat reviews for functions already determined by both the NMC and the NRC to not be safety limit related LSSS, reducing the time and effort involved in future resolution of the LSSS setpoint issue.

3. **For the Setpoint that is determined to be SL-Related: The NRC letter to the Nuclear Energy Institute SMTF dated September 7, 2005 (ADAMS Accession Number ML052500004), describes Setpoint-Related TS (SRTS) that are acceptable to the NRC for instrument settings associated with SL-Related setpoints. Specifically: Part "A" of the Enclosure to the letter provides LCO notes to be added to the TS, and Part "B" includes a check list of the information to be provided in the TS Bases related to the proposed TS changes.**

   a. **Describe whether and how you plan to implement the SRTS suggested in the September 7, 2005 letter. If you do not plan to adopt the suggested SRTS, then explain how you will ensure compliance with 10 CFR 50.36 by addressing items 3b and 3c, below.**

   b. **As-Found Setpoint Evaluation: Describe how surveillance test results and associated TS limits are used to establish operability of the safety system. Show that this evaluation is consistent with the assumptions and results of the setpoint calculation methodology. Discuss the plant corrective action processes (including plant procedures) for restoring channels to operable status when channels are determined to be "inoperable" or "operable but degraded." If the criteria for determining operability of the instrument being tested are located in a document other than the TS (e.g., plant test procedure) explain how the requirements of 10 CFR 50.36 are met.**

c. **As-Left Setpoint Control: Describe the controls employed to ensure that the instrument setpoint is, upon completion of surveillance testing, consistent with the assumptions of the associated analyses. If the controls are located in a document other than the TS (e.g., plant test procedure) explain how the requirements of 10 CFR 50.36 are met.**

Response to RAI 3.a

For the setpoints associated with an LSSS that have been determined to be SL-Related listed below, the NMC does plan to implement a digital instrument related version of the LSSS setpoint notes that was approved by the NRC for ARTS/MELLA application at Susquehanna Units 1 and 2 (Reference 10). These notes are similar to those in the September 7, 2005, NRC letter to NEI (Reference 18), but reflect the digital nature of the PRNM System. The notes would be applied to the following TS functions:

TS Table 3.3.1.1-1

- APRM Neutron Flux – High (2.c)

TS Table 3.3.1.2-1

- Rod Block Monitor – Low Power Range – Upscale (1.a)
- Rod Block Monitor – Intermediate Power Range – Upscale (1.b)
- Rod Block Monitor – High Power Range – Upscale (1.c)

The NMC has evaluated the suggested note descriptions within RIS 2006-17 [(7)] (Reference 7), the NRC letter to the Nuclear Energy Institute (NEI) Setpoint Methodology Taskforce (SMTF) dated September 7, 2005 (Reference 19), and draft Technical Specification Task Force (TSTF)-493 – Revision 3 (Reference 20). Also, formats recently approved by the NRC for digital instrument LSSS notes at Susquehanna Units 1 and 2 (Reference 10) and Nine Mile Point Unit 2 (Reference 21) were reviewed.

Appendix C of the TRM was created by NMC in conjunction with the ITS implementation in 2006 to document the methodologies applied to several Emergency Core Cooling System setpoints considered LSSS during the ITS conversion. It is proposed to document the APRM Neutron Flux – High function

7. NMC in several previous approved LARs, including this LAR, committed to evaluate TSTF-493 after issuance. RIS 2006-17 states, "Methods and approaches different from those in this RIS may also be acceptable to the NRC." NMC intends to align the LSSS footnotes, TS Bases and TRM entries after final NRC/industry resolution of this issue.

NTSP and the methodology used in it's determination in Appendix C to the TRM. The MNGP TS state that the Allowable Values for the Rod Block Monitor Low, Intermediate, and High Power Range – Upscale trip setpoints are specified in the COLR. These Rod Block Monitor setpoints will continue to be listed in the COLR (the NTSPs are also listed in the COLR). The methodology used to determine the Rod Block Monitor Low, Intermediate, and High Power Range – Upscale trip setpoints will be located in Appendix C to the TRM. Both the TRM and the COLR receive 10 CFR 50.59 reviews for any changes to their contents.

It is proposed that the following notes reflecting the digital nature of the PRNM System be applied to the four functions listed previously, from TS Tables 3.3.1.1-1 and 3.3.1.2-1 that are affected by this PRNM System installation:

<u>For TS Table 3.3.1.1-1 --- APRM Neutron Flux – High (2.c):</u>

- If the as-found channel setpoint is not the Nominal Trip Setpoint but is conservative with respect to the Allowable Value, then the channel shall be evaluated to verify that it is functioning as required before returning the channel to service.

- The instrument channel setpoint shall be reset to the Nominal Trip Setpoint at the completion of the surveillance; otherwise, the channel shall be declared inoperable. The NTSP and the methodology used to determine the NTSP are specified in the Technical Requirements Manual.

<u>For TS Table 3.3.1.2-1 --- Rod Block Monitor – Upscale Functions (1.a, 1.b & 1.c))</u>

- If the as-found channel setpoint is not the Nominal Trip Setpoint but is conservative with respect to the Allowable Value, then the channel shall be evaluated to verify that it is functioning as required before returning the channel to service.

- The instrument channel setpoint shall be reset to the Nominal Trip Setpoint at the completion of the surveillance; otherwise, the channel shall be declared inoperable. The NTSP shall be specified in the COLR. The methodology used to determine the NTSP is specified in the Technical Requirements Manual.

Note, the only difference between the two sets of notes is that the NTSP for the RBM trip setpoints will continue to be specified within the COLR, reflecting present practice.

Additionally, the TS Bases will describe the application of the notes to the particular TS instrumentation function. Draft, proposed, texts of the corresponding revised inserts to the TS Bases are provided in Enclosure 5.

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Response to 3.b and 3.c

Sections 4.4.11 and 4.4.14 of the MNGP Instrument Control Manual provide guidance on performing instrument surveillance testing and conduct of work completion reviews and closeout.

Data found outside of specified limits during surveillance testing is required to be promptly entered into the corrective action process. When the AFT or ALT data does not meet the requirements the out of tolerance data must be reported to the Supervisor Maintenance (I&C). Attachment 1 to administrative procedure FP-PA-ARP-01, "CAP Action Request Process," requires under Category 13, "Technical Specifications," as part of the severity level determination process that any TS instrument that is outside of its AFT or ALT is considered a condition adverse to quality requiring entry of the condition into the Corrective Action Program (CAP) process.

The Supervisor Maintenance (I&C) (or designee) enters the condition into the CAP and the Shift Manager (or designee) is informed of the condition for review and determination of the impact on operability. The Supervisor Maintenance (I&C) is responsible for making an initial evaluation of any out of tolerance condition reported by the I&C Technician. The process is discussed in more detail below.

Surveillance procedures are assigned to I&C Technicians by the Supervisor Maintenance (I&C) or his designee for performance as required by the surveillance schedule. Prior to starting the surveillance test, the Control Room Supervisor (CRS) must sign the "Approval to Commence" line on the record copy. During surveillance testing there are four possible results:

1. The instrument setpoint is found within the ALT; the results are recorded in the procedure and, from the TS perspective, no further action is required.

2. The setpoint is outside the ALT but within the AFT, the instrument setpoint is reset to within the ALT. From a TS perspective no further action is required.

3. The instrument setpoint is found conservative with respect to the AV but outside the AFT. In this case the setpoint is reset to the LTSP (within the ALT), and the channel's response is evaluated by the Supervisor Maintenance (I&C).

   The Supervisor Maintenance (I&C) makes an initial evaluation of any out of tolerance condition where the channel is outside the AFT. Generally this evaluation requires the I&C technician to attempt to restore the out of tolerance device to within acceptable limits and show that it is capable of performing its design function as provided in the calibration surveillance. When making the initial evaluation, the following items are addressed:

- Does the out of tolerance condition exceed any TS limits?
- Does the out of tolerance condition exceed any Section XI limits?
- Does the out of tolerance condition adversely affect the operability of the associated equipment and/or system? Consultation with Plant Engineering personnel is required if this is unclear.
- Does the out of tolerance device exhibit signs of a degraded/ degrading condition or indicate an unreliable instrument (repeat failures) based on available historical calibration information, maintenance log, System Engineering input, or other site resources?

If the channel is operating as expected, then the channel can be restored to service at the completion of the surveillance. A prompt verification of the channel's condition is performed after the surveillance. The channel's as-found condition is entered into the CAP for further evaluation. If the channel is not operating as expected, the channel is inoperable.

4. The instrument setpoint is found non-conservative with respect to the AV. The Supervisor Maintenance (I&C) makes an initial evaluation of any out of tolerance condition, including a channel outside the AV. This evaluation generally follows the steps outlined above for item 3.

   The MNGP Instrument Control Manual requires when a channel is outside the AV that this be reported to the Shift Manager (or his designee). The Supervisor Maintenance (I&C) informs the Shift Manager who based upon the available information makes an immediate operability determination. The channel's as-found condition is entered into the CAP for evaluation. The surveillance shall not be continued until approved by the Shift Manager (or his designee).

   Evaluations and corrective action (maintenance/testing) is performed to correct the condition allowing the setpoint to be reset to the NTSP (within the ALT) and the channel to be declared OPERABLE and returned to service.

4. **For the Setpoint that is not determined to be SL-Related: Describe the measures to be taken to ensure that the associated instrument channel is capable of performing its specified safety functions in accordance with applicable design requirements and associated analyses. Include in your discussion information on the controls you employ to ensure that the As-Left trip setting after completion of periodic surveillance is consistent with your setpoint methodology. Also, discuss the plant corrective action processes (including plant procedures) for restoring channels to operable status when channels are determined to be "inoperable" or "operable but degraded." If the controls are located in a document other than the TS (e.g., plant test procedure), describe how it is ensured that the controls will be implemented.**

Response

The following new functions proposed to be added as part of this PRNM System installation were determined in the response to RAI No. 2 of this enclosure to be non-SL-Related.

TS Table 3.3.1.1-1

- APRM Neutron Flux – High (Setdown) (2.a)
- APRM Simulated Thermal Power – High (2.b)
- OPRM Upscale (2.f)

The NMC does not plan to implement the setpoint related TSs note changes described in the September 7, 2005 (Reference 19), letter for these functions since they do not meet the criteria for being SL-Related LSSS. Nonetheless, as discussed in the response to RAI No. 3, the exact same processes are applied for setpoints determined to be non-SL-Related as those determined to be SL-Related. Therefore, the same administrative control practices, including entry into the corrective action program are applied for any non-SL-Related channels found to be "inoperable" or "operable but degraded."

5. **OPRM Allowable Values and Setpoints: The LAR markup of TS page 3.3.1.1-5A lists the Allowable Value for Function 2.f, "OPRM Upscale," as "As specified in COLR." However, Section 5.1.5 of Enclosure 1 of the LAR states, "There are no Allowable Values associated with the OPRM Upscale function." Additionally, Section 5.1.5 states, "The PBDA trip setpoints, which can be change with each fuel cycle, will be documented in the COLR." Please resolve this apparent discrepancy.**

Response

As discussed in the NRC approved licensing topical report NEDO-32465-A (Reference 22) and acknowledged in several NRC safety evaluations (References 23 and 24) for licensee's implementing the OPRM system, there are no AVs associated with the OPRM Upscale function. The OPRM period-based detection algorithm (PBDA) Upscale trip setpoints are determined using the Option III licensing methodology described in Reference 22 except that a plant/cycle-specific DIVOM[8] curve slope is used due to the BWROG's resolution of a past GEH Part 21 issue. Since the PBDA trip setpoints are cycle-dependent they will be documented in the COLR.

Some plants have listed the AV for the OPRM Upscale function in TS Table 3.3.1.1-1 as N/A, with a superscript reference to a footnote to the table indicating the OPRM Upscale function values are specified in the COLR. The NMC chose a more direct presentation for the OPRM Upscale function setpoints, since they will be provided in the COLR, that was the same as that applied in the standard technical specifications for the Control Rod RBM function (Specification 3.3.2.1), which simply states that the RBM setpoint values for the Low, Intermediate and High Power Ranges – Upscale are "As specified in COLR". As stated in the draft proposed TS Bases changes submitted with the LAR (Enclosure 4, Insert B1, page B 3.3.1.1-8D, Item 2.f, OPRM Upscale), "There is no allowable value for this function."

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8. DIVOM stands for Delta CPR over Initial MCPR Versus Oscillation Magnitude.

6. **<u>OPRM Monitoring Period</u>: The LAR proposes that TS Table 3.3.1.1-1 Function 2.f, "OPRM Upscale," not be enabled until completion of an abbreviated 90 day OPRM Monitoring Period after the first plant startup following PRNM system installation. The OPRM portion of the PRNM system would operate in an indication only mode during this period. The proposed 90 day OPRM Monitoring Period is a departure from the NRC safety evaluation for NEDC 32410P, dated September 5, 1995, which recommends the OPRM Monitoring Period last for one full fuel cycle. The LAR justification for this abbreviated OPRM Monitoring Period is that Option III OPRM systems have accumulated more than 90 reactor years of operation and based on current industry and vendor experience with the NUMAC PRNM System that the possibility of problems with the algorithms, system performance, or hardware problems with Option III is considered unlikely. Provide a more detailed justification for the proposed reduction of the OPRM Monitoring Period to 90 days. The justification should include discussion of actual plant experience of algorithm problems, system performance, and hardware problems.**

<u>Response</u>

The one cycle monitoring period in the PRNM System LTRs (References 25, 26, and 27) for the OPRM was specified because it was a new feature of the RPS. As such, further testing, monitoring, and evaluation in the normal modes of operation was considered required to ensure that the OPRM performed as designed and did not create any unintended consequences. Since the original introduction of the OPRM, a great deal of operating experience has been obtained and the one cycle trial period is no longer needed and can be shortened to 90 days. GEH PRNM systems with the Option III OPRM have been installed at many plants within the U.S. and overseas. The Option III OPRM systems have accumulated more than 90 reactor years of fully armed operation, with the installations at Brunswick Units 1 and 2 and Browns Ferry Unit 1 being closest to the MNGP design. The MNGP is a BWR-3 plant with jet pumps, similar to Dresden Units 2 and 3 and Quad Cities Units 1 and 2. Based on the operational experience with these installations, GEH supports directly arming the OPRM system after an initial monitoring period of 90 days. Note that operating with the OPRM armed provides automatic stability mitigation. Thus, shortening the trial period with OPRM Option III is appropriate for the MNGP, particularly since experience in operating plants shows that it is acceptable to do so.

The MNGP intends to implement the Option III PRNM System during the next Refueling Outage (RFO). During the initial monitoring period when PRNM System is OPERABLE but the OPRM Upscale function (Function 2.f) is not trip-enabled, the MNGP will implement Backup Stability Protection (BSP)

(Reference 28) as an alternate method for detection and suppression of instabilities proposed in this amendment application.

A non-proprietary summary of the operational problems encountered with OPRM by GEH, and the solutions for these issues relevant to the OPRM implementation at the MNGP, is described below:

1) <u>Nine Mile Unit 2 High Frequency Noise</u>

In July 2003, Nine Mile Point Unit 2 experienced an OPRM scram due to a thermal-hydraulic instability event. The Nine Mile Point Unit 2 event showed that while the OPRM system resulted in an effective scram, there were numerous successive confirmation count resets that were due to the corner frequency. The second-order Butterworth filter with a 3 Hz cutoff frequency setting allowed some residual high-frequency noise from the oscillation signal, and this led to numerous successive confirmation count resets. This successive confirmation count reset condition resulted in a safety communication (Reference 29) in which GEH recommended that the cutoff frequency be set to 1.0 Hz and the period tolerance be set to 100 msec or greater, with allowance to use a different value if applicable, based on additional justification.

The 1.0 Hz cutoff frequency was subsequently adopted at Perry and the OPRM system performed as designed during the Perry thermal-hydraulic instability event in 2004 with effective Safety Limit MCPR protection when the OPRM system generated a scram.

2) <u>Experience with Coherent Noise</u>

A unique feature of the core thermal-hydraulic phenomenon is that reactor noise might become coherent occasionally with an oscillation period in the range of thermal-hydraulic instability events [

] This is a common phenomenon observed by many OPRM plant operators that the current alarm setpoint (which is solely based on counts) may be initiated during normal plant operation. However, it is noted while this noise might become coherent occasionally, and [

the amplitude usually will not grow in the absence of a true thermal-hydraulic instability event. Hence a high amplitude setpoint value [ ] will be effective in preventing a spurious reactor scram.

For the MNGP OPRM implementation, GEH is providing an improved feature [

]

3) Inadvertent Half Scrams at Plants with the ABB System

Half-scrams have occurred at two plants that were using the Asea, Brown Boveri (ABB) based OPRM systems. [ ]

4) Brunswick 2 Inadvertent Scram

An inadvertent reactor scram occurred at Brunswick Unit 2 in 2007 while operating in the Single Loop Operation (SLO) with the remaining recirculation pump operating near maximum capacity. Control rods were pulled to a power/flow state point very close to the MELLLA operating domain boundary. [ ] The high noise level resulted in spiking that met the amplitude requirement of the growth rate algorithm.

As a result of the Brunswick Unit 2 inadvertent scram, GEH recommends that the operating reactor power for SLO operation be restricted to a power level that is at least 5 percent of RTP below the boundary of the EPU/MELLLA operating domain, and where acceptable SLO operation has been previously demonstrated. Also, the growth rate algorithm and amplitude based algorithm setting ranges have been revised to allow for a wider range consistent with the approved LTRs (References 30 and 31). These changes provide acceptable protection against a spurious scram due to power spiking during SLO.

The operational experience with the OPRM summarized above shows that the operational issues are related to the magnitude and coherence of the noise, and can be resolved by adjusting the OPRM system, once the noise is characterized. This noise characterization can be accomplished within the proposed 90 day period. During this time GEH will work with the NMC to measure and characterize the background APRM noise at the plant. It is expected that the MNGP plant noise will be similar to the other BWR-3 plants, [ ]. If the APRM noise level is confirmed to be low [ ] the OPRM system operation will likely not result in a spurious reactor scram. If the APRM noise level is high, then further review of the adequacy of the recommended amplitude setpoint will be performed. As long as the OPRM amplitude setpoint is [ ] the likelihood of an inadvertent reactor scram will be very low. In fact, all spurious trips to date would have been avoided with an amplitude setpoint [.]

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Based on the extensive GEH experience in the PRNM System installations, GEH fully supports arming of the OPRM system at the MNGP after an initial monitoring period of 90 days as this will provide for expeditious automatic stability protection while assuring that the chance of inadvertent scrams is acceptably low.

REFERENCES

1. NMC letter to NRC, "License Amendment Request: Power Range Neutron Monitoring System Upgrade," (L-MT-08-004), dated February 6, 2008.

2. Email from P. Tam (NRC) to R. Loeffler (NMC) dated June 13, 2008, "Monticello – Draft RAI re: Proposed Amendment on PRNM System (TAC MD8064) --- Enclosure 1 RAI Questions 1 through 6.

3. MNGP Engineering Standards Manual ESM-03.02-APP-I, Appendix I (GE Methodology Instrumentation and Controls), Revision 4.

4. GE-NE-901-021-0492, DRF A00-01932-1, Setpoint Calculation Guidelines for the Monticello Nuclear Generating Plant, October 1992.

5. NEDC-31336P-A, Class III, General Electric Instrument Setpoint Methodology, September 1996.

6. NRC letter to the Boiling Water Reactor Owners Group, "Revision to Safety Evaluation Report on NEDC-31366, Instrument Setpoint Methodology (NEDC-31336P)," dated November 6, 1995.

7 U.S. NRC Regulatory Issue Summary 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.

8. GE-NE-0000-0057-2518-R0, BWR Owners Group, "Limiting Safety System Settings for BWR/4 and BWR/6," September 2006.

9. GE-NE-0000-0062-5001--R0, BWR Owners Group, TSTF--493 Implementation Guidance for BWR LSSS Setpoints Developed By GE Setpoint Methodology, January 2007.

10. NRC to PPL Susquehanna, LLC, "Susquehanna Steam Electric Station, Units 1 and 2 - Issuance of Amendment Re: Average Power Range Monitor/Rod Block Monitor/Technical Specifications/Maximum Extended Load Line Limit Analysis (ARTS/MELLLA) Implementation (TAC Nos. MC9040 and MC9041)," dated March 23, 2007.

11. GE Licensing Topical Report General Electric Standard Application for Reactor Fuel (GESTAR) – latest approved amendment.

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12. NEDO-32465-A, “Reactor Stability Detect and Suppress Solutions Licensing basis Methodology for Reload Applications,” August 1996.

13. Regulatory Guide 1.105, "Setpoints for Safety Related Instrumentation", Revision 3, 1999

14. ISA-S67.04, "Setpoints for Nuclear Safety-Related Instrumentation", September 1994

15. TVA to NRC, “Browns Ferry Nuclear Plant (BFN) – Unit 1, Techical Specifications (TS) Change TS-3 – Request for Additional Information (RAI) Regarding Oscillation Power Range Monitor (OPRM) – (TAC No. MC9565), TVA-BFN-TS-443, October 2, 2006.

16. NRC to TVA, Amendment No. 266 to Renewed Facility Operating License No. DPR-33 for the Browns Ferry Nuclear Plant, Unit 1 – Issuance of Amendment Regarding Oscillation Power Range Monitor (TAC No. MC9565) (TS-443), December 29, 2006.

17. GE Licensing Topical Report, NEDC-30492-P, “Average Power Range Monitor, Rod Block Monitor, and Technical Specification Improvement (ARTS) Program for the Monticello Nuclear Generating Plant,” April 1984.

18. MRC to NEI Setpoint Methods Task Force, “Technical Specification for Addressing Issues Related to Setpoint Allowable Values,” dated September 7, 2005. (ADAMS Accession Number ML052500004)

19. NRC to NEI, NEI Setpoint Methods Task Force, “Technical Specification Allowable Values for Addressing Issues Related to Setpoint Allowable Values,” dated September 7, 2005.

20. Technical Specification Task Force, Improved Standard Technical Specifications Change Traveler, TSTF-493, “Clarify Application of Setpoint Methodology for LSSS Functions,” draft, Revision 3.

21. NRC to Nine Mile Point Nuclear Station, LLC, “Nine Mile Point Nuclear Power Station, Unit No. 2 – Issuance of Amendment Re: Implementation of ARTS/MELLA (TAC No. MD5233),” dated February 27, 2008.

22. GE Licensing Topical Report, NEDO-32465-A, "Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Application," August 1996.

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23. NRC to Exelon Nuclear, "Peach Bottom Atomic Power Station, Units 2 and 3 – Issuance of Amendment Re: Activation of Oscillation Power Range Monitor Trip (TAC Nos. MC2219 and MC2220)," dated March 21, 2005.

24. NRC to Exelon Nuclear, "Brunswick Steam Electric Plant, Units 1 and 2 - Issuance of Amendment to Incorporate the General Electric Digital Power Range Neutron Monitoring System (TAC Nos. MB2321 and MB2322)," dated March 8, 2002.

25. 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.

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

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

28. OG 02-0119-260, GE to BWR Owners' Group Detect and Suppress II Committee, "Backup Stability Protection (BSP) for Inoperable Option III Solution," July 2002.

29. GEH Safety Communication 03-20, "Stability Option III Period Based Detection Algorithm Allowable Settings, October 4, 2003.

30. NEDO-31960-A, "BWR Owners' Group Long-Term Stability Solutions Licensing Methodology," November 1995.

31. NEDO-31960-A, Supplement 1, "BWR Owners' Group Long-Term Stability Solutions Licensing Methodology," November 1995.

ENCLOSURE 2

RESPONSE TO THE JUNE 25, 2008 REQUESTS FOR ADDITIONAL INFORMATION TECHNICAL SPECIFICATION BRANCH QUESTIONS

On February 6, 2008, (Reference 1) the Nuclear Management Company, LLC (NMC) submitted a request to revise the Monticello Nuclear Generating Plant (MNGP) Technical Specifications (TS) in conjunction with the installation of General Electric – Hitachi (GEH) Nuclear Measurement Analysis and Control (NUMAC) Power Range Neutron Monitoring (PRNM) System.

The following requests for additional information (RAI) concerning the proposed TS changes were received from the U.S. Nuclear Regulatory Commission (NRC) by e-mail, dated June 25, 2008 (Reference 2).

1. **Page 15 of 168 describes the reason for the LCO 3.0.4 Note in Action I.2 (page 89 of 168). It is unclear if the Note is applied correctly for the reasoning discussed. It is also unclear what removes the Note after the monitoring period.**

   Response

   As described in the last two paragraphs under Section 5.1.4, "Addition of New Conditions I and J" in Reference 1, an exception to LC0 3.0.4 is proposed by the addition of a note to Required Action I.2. This exception was not discussed within the NUMAC PRNM LTR (including the supplement) but was discussed and approved by the NRC in a 2005 Safety Evaluation for activation of the OPRM function at Peach Bottom Units 2 and 3 (Reference 3).

   The NRC states in this Peach Bottom safety evaluation that while not included in the scope of the NUMAC PRNM LTR, the LC0 3.0.4 exception would allow plant restart "in the event of a shutdown during the 120-day completion time of Required Action I.2, consistent with the original intent of NEDC-32410P-A." [emphasis added] The NRC goes on to state that the original intent "was to allow normal plant operations to continue during the recovery time from a hypothesized design problem with the Option III algorithms." As such, this proposed LC0 3.0.4 exception will be a permanent change to the MNGP TS and hence is not planned for removal at the end of the OPRM Monitoring Period.

   The Required Action for Condition I when the OPRM Upscale function channels are inoperable requires the channels be restored to OPERABLE within 120 days. Without the proposed LCO 3.0.4 exception, entry into the MODE or other specified condition in the Applicability would not be permitted for plant startup following PRNM System installation (or following shutdowns during the OPRM Monitoring Period) since the associated ACTIONS do not permit continued operation for an unlimited period of time. Therefore, this LCO 3.0.4 exception is required for these reasons, also.

ENCLOSURE 2

RESPONSE TO THE JUNE 25, 2008 REQUESTS FOR ADDITIONAL INFORMATION TECHNICAL SPECIFICATION BRANCH QUESTIONS

2. Page 92 of 168 contains a Note 2 to SR 3.3.1.1.14 (Response Time Testing). It is unclear how the Note is used. There is reasoning on page 68 and 69 of 168, however it is still unclear.

Response

The response time testing (RTT) proposed in Surveillance Requirement (SR) 3.3.1.1.14 of the MNGP TS will test both of the redundant OPRM or both of the redundant APRM trip outputs from each 2-Out-Of-4 Voter, i.e., Function 2.e, during each performance. This testing rate has been selected to simplify recordkeeping for the SR.

While the NUMAC PRNM LTRs justified reduced RTT, TS mark-ups were not provided to implement an "n" greater than 4 (the total number of Voter channels). This note was added to SR 3.3.1.1.14 to define that "n=8" for Function 2.e. This testing rate results in a test of each APRM related Reactor Protection System (RPS) relay every 4 cycles, twice the rate justified in the LTRs. Without this notation, rigorous interpretation of four voter channels would result in a value of "n=4" for this SR.

The PRNM System modification includes redundant APRM trip and redundant OPRM trip outputs from each 2-Out-Of-4 Voter channel. There are 8 total RPS interface relays. NUMAC PRNM LTR Supplement 1 justified RTT at a rate that tested one RPS Interface relay every plant operating cycle, with tests using the APRM output for one cycle and the OPRM output for the next cycle. This yields a RTT rate of once per 8 operating cycles.

The RTT proposed in the MNGP TS will test both of the redundant OPRM or both of the redundant APRM trip outputs from each Voter during one application of the SR. This testing is consistent with the sequencing described in NUMAC PRNM LTR Supplement 1, but at twice the rate for the components.

Because this sequencing may be confusing, a more detailed description of the RTT sequence for the 2-Out-Of-4 Voter, Function 2.e, in accordance with SR 3.3.1.1.14 is proposed to be added to the TS Bases. A table showing an example of an acceptable test sequence is provided below.

ENCLOSURE 2

RESPONSE TO THE JUNE 25, 2008
REQUESTS FOR ADDITIONAL INFORMATION
TECHNICAL SPECIFICATION BRANCH QUESTIONS

An Acceptable Function 2.e Test Sequence for SR 3.3.1.1.14

		"Staggering"					
24-Month Cycle	Voter Output Tested	Voter AI Output	Voter A2 Output	Voter BI Output	Voter B2 Output	RPS Trip System	Div.
1st	OPRM A1	OPRM				A	1
2nd	APRM B1			APRM		B	1
3rd	OPRM A2		OPRM			A	2
4th	APRM B2				APRM	B	2
5th	APRM A1	APRM				A	1
6th	OPRM B1			OPRM		B	1
7th	APRM A2		APRM			A	2
8th	OPRM B2				OPRM	B	2

After 8 cycles, the sequence repeats.

The pertinent draft TS Bases page has been revised to reflect this change and is provided in Enclosure 5. The specific tests will be defined in MNGP procedures. The NRC approved this same proposed change for Susquehanna Units 1 and 2 to clarify and simplify the testing methodology. This approval is discussed in Section 3.4.3.5, "TS SR 3.3.1.1.17 Response Time Testing," of the NRC safety evaluation for Susquehanna Units 1 and 2 (Reference 4).

3. **Page 94 of 168 has a Note (e) for the SR associated with Function 2.f, OPRM Upscale. There is some uncertainty regarding the Note to Operability of the OPRM, namely whether or not the OPRM is calibrated before it is declared Operable (SR 3.3.1.1.11 or similar test).**

Response

The OPRM will be fully calibrated before it is declared OPERABLE. Before the licensed operators can declare the OPRM system OPERABLE, they must determine that the OPRM system fully meets the definition of OPERABILITY in accordance with the TS, which demands that the applicable Surveillance Requirements, including all required testing be fully met.

ENCLOSURE 2

**RESPONSE TO THE JUNE 25, 2008
REQUESTS FOR ADDITIONAL INFORMATION
TECHNICAL SPECIFICATION BRANCH QUESTIONS**

REFERENCES

1. NMC letter to NRC, "License Amendment Request: Power Range Neutron Monitoring System Upgrade," (L-MT-08-004), dated February 6, 2008.

2. Email from P. Tam (NRC) to R. Loeffler (NMC) dated June 25, 2008, "Monticello – Additional Draft RAI re: Proposed Amendment on PRNM System (TAC MD8064) --- Enclosure 2 RAI Questions 1 through 3.

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

4. NRC to PPL Susquehanna, LLC, "Susquehanna Steam Electric Station, Units 1 and 2 – Issuance Of Amendment Re: Power Range Neutron Monitor System Digital Upgrade (TAC Nos. MC7486 and MC7487)," dated March 3, 2006.

ENCLOSURE 3

RESPONSE TO THE JULY 1, 2008 REQUESTS FOR ADDITIONAL INFORMATION REACTOR SYSTEMS BRANCH QUESTIONS

On February 6, 2008, (Reference 1) the Nuclear Management Company, LLC (NMC) submitted a request to revise the Monticello Nuclear Generating Plant (MNGP) Technical Specifications (TS) in conjunction with the installation of General Electric – Hitachi (GEH) Nuclear Measurement Analysis and Control (NUMAC) Power Range Neutron Monitoring (PRNM) System.

The following requests for additional information (RAI) concerning the proposed TS changes were received from the U.S. Nuclear Regulatory Commission (NRC) by email, dated July 1, 2008 (Reference 2).

1. Please provide:

(1) description of the alternate method for detection and suppression of instabilities proposed in this amendment application;

(2) identification of the differences between the proposed alternate method and the Interim Corrective Actions (ICAs) specified in NRC Bulletin 88-07; and

(3) clarification of the similarity between the alternate method and DSS-CD backup stability protection since the DSS-CD features of NUMAC PRNMS will be implemented for Monticello.

Response to Part 1

The MNGP is planning to implement the Option III PRNM System during the 2009 Refueling Outage (RFO). During the initial monitoring period when PRNM System is operable but the Oscillation Power Range Monitor (OPRM) trip is not enabled, the MNGP will implement Backup Stability Protection (BSP) (Reference 3) as an alternate method for detection and suppression of instabilities. In addition, BSP will be used as a backup stability protection method (i.e., alternative method) for the duration allowed in the proposed revised MNGP Technical Specifications implementing the PRNM System if the OPRM becomes inoperable in the future.

Response to Part 2

The BSP methodology is an enhancement to the original Interim Corrective Action (ICA) methodology. The ICAs define certain regions in the power/flow map that are excluded from planned entry and prescribe specific actions upon unplanned entry (Reference 4). The ICA regions are based upon empirical evaluations and experience, are defined in terms of relative core flow and control rod line, and are uniformly applicable to all GE BWRs. These regions are not defined based on specific stability criteria. The ICA regions were established in

1994 based on original licensed thermal power, generally shorter fuel cycles, and more stable core designs. New energy-intensive core design changes have generally reduced stability margins. As a result, GEH proposed the BSP methodology as an enhancement to the ICA methodology.

A comparison of some of the characteristics between the Option III manual BSP and the ICAs are as follows:

- The size of the base BSP regions is equivalent to the current ICA regions. The BSP regions cannot be smaller than the ICA regions.
- The BSP regions are reduced from three ICA regions (Scram, Exit, Controlled Entry) to two regions (Scram and Controlled Entry).
- Decay ratio criteria are established for plant/cycle specific confirmation and, as necessary, the base BSP regions are adjusted.
- Operator actions in the two BSP regions are similar to the operator actions defined for the ICA Scram and Controlled Entry regions.
- Operator awareness as discussed in Reference 3, is required when operating within 10 percent of rated core flow or power from the BSP Controlled Entry region.

Response to Part 3

As stated in the response to Part 1 of this RAI, the MNGP PRNM System license amendment request (LAR) proposed the use of the Option III PRNM System and not the DSS-CD[(1)] feature. The Option III BSP to be implemented will be similar to the manual BSP solution as in other Option III plants when the OPRM systems are not operable.

2. **Please describe the plan to implement extended power uprate in conjunction with the Maximum Extended Load Line Limit Analysis Plus (MELLLA+) for Monticello.**

Response

As discussed on page 5 of the MNGP LAR, the NMC is not applying for an amendment to operate in the MELLLA+ operating domain by this LAR. That

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1. DSS-CD stands for Detect and Suppress Solution - Confirmation Density. It includes the three BWROG Option III algorithms and the DSS-CD algorithm developed by GEH.

request will occur at a later date (to be determined) as part of a phased extended power uprate (EPU) implementation.

The DSS-CD stability solution (see References 5 and 6), an extension of the Option III stability solution methodology, will be necessary, however, to provide stability protection for operation within the MELLLA+ operating domain. The NMC requested in the LAR to install the DSS-CD stability solution operating in an Option III configuration as part of the NUMAC PRNM System retrofit.

One of the requirements for future DSS-CD implementation is the accumulation of operating data. The confirmation density algorithm will run (but will not provide a trip since it is not connected to the RPS trip output relays) to allow operational data to be gathered on its performance.

3. **Provide the schedule to implement Option III stability solution for MNGP. Please correct the typo for Reference 11 which is not an approved LTR at the time submitted.**

Response

Installation of the PRNM System is scheduled to occur during the spring 2009 RFO. On March 16, 2009, the unit is scheduled to shutdown for the RFO. Startup is projected, based on the current outage schedule, for April 18, 2009.

As indicated in the cover letter to the LAR, following installation of the NUMAC PRNM System, the OPRM Upscale function (TS Table 3.3.1.1 Function 2.f), i.e., the Option III stability solution, will operate in an "indicate only" mode for an initial monitoring period, projected to be for 90 days of steady-state operation after startup from the 2009 RFO.[2]

Plant operation during the OPRM 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 manual means. Following NMC review and evaluation of the operating data from the monitoring period, the OPRM Upscale function will be enabled and connected to the Reactor Protection System. The following commitment was made:

> The Oscillation Power Range Monitor (OPRM) Monitoring Period is projected to be from startup following the spring 2009 Refuel Outage to until 90 days of steady-state operation have been achieved after reaching full-power. NMC

2. The OPRM Monitoring Period is conservatively projected to end 90 days after start-up and achievement of steady-state operation, projected for on or about July 18, 2009.

will inform the NRC of any change to the duration of the OPRM Monitoring Period.

In reference to the second part of the RAI, the February 6, 2008, LAR, Reference 11 stated:

> GE Nuclear Energy, Licensing Topical Report (LTR) NEDC-33075-P-A, "General Electric Boiling Water Reactor Detect and Suppress Solution – Confirmation Density (DSS-CD)," dated July 24, 2002.

Reference 12 in the LAR refers to the NRC safety evaluation which approved the latest revision of the LTR NEDC-33075-P-A, Revision 5, for DSS-CD on November 27, 2006.

> NRC letter to GE Nuclear Energy, "Final Safety Evaluation for General Electric Nuclear Energy (GENE) Licensing Topical Report (LTR) NEDC-33075-P-A, Revision 5, "General Electric Boiling Water Reactor Detect and Suppress Solution - Confirmation Density," (TAC No. MC1737) dated November 27, 2006.

The PRNM System LAR was submitted on February 6, 2008. The GE LTR NEDC-33075-P was approved on November 27, 2006.

ENCLOSURE 3

RESPONSE TO THE JULY 1, 2008
REQUESTS FOR ADDITIONAL INFORMATION
CONCERNING SETPOINT QUESTIONS

REFERENCES

1. NMC letter to NRC, "License Amendment Request: Power Range Neutron Monitoring System Upgrade," (L-MT-08-004), dated February 6, 2008.

2. Email from P. Tam (NRC) to R. Loeffler (NMC) dated July 1, 2008, "Monticello – Draft Reactor Systems RAI re. Proposed Amendment on PRNM (TAC MD8064) --- Enclosure 3 RAI Questions 1 through 3.

3. OG 02-0119-260, GE to BWR Owners' Group Detect and Suppress II Committee, "Backup Stability Protection (BSP) for Inoperable Option III Solution," dated July 2002.

4. BWROG-94078, "BWR Owner's Group Guidelines for Stability Interim Corrective Action," dated June 1994.

5. GE Nuclear Energy, Licensing Topical Report (LTR) NEDC-33075-P-A, "General Electric Boiling Water Reactor Detect and Suppress Solution - Confirmation Density (DSS-CD)," dated July 24, 2002.

6. NRC letter to GE Nuclear Energy, "Final Safety Evaluation for General Electric Nuclear Energy (GENE) Licensing Topical Report (LTR) NEDC-33075-P-A, Revision 5, "General Electric Boiling Water Reactor Detect and Suppress Solution - Confirmation Density," (TAC No. MC1737) dated November 27, 2006.

ENCLOSURE 4

MONTICELLO NUCLEAR GENERATING PLANT

RESPONSE TO REQUESTS FOR ADDITIONAL INFORMATION FOR LICENSE AMENDMENT REQUEST FOR POWER RANGE NEUTRON MONITORING SYSTEM UPGRADE (TAC NO. MD8064)

MNGP TECHNICAL SPECIFICATION

REVISION

REPLACEMENT PAGES FOR TS INSERTS

2 Pages Follow

REPLACEMENT INSERT 5: Adds LSSS Notes

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS PER TRIP SYSTEM	CONDITIONS REFERENCED FROM REQUIRED ACTION D.1	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
2. Average Power Range Monitors					
a. Neutron Flux – High, (Setdown)	2	3(c)	G	SR 3.3.1.1.1 SR 3.3.1.1.4 SR 3.3.1.1.6 SR 3.3.1.1.11 SR 3.3.1.1.15	≤ 20% RTP
b. Simulated Thermal Power – High	1	3(c)	F	SR 3.3.1.1.1 SR 3.3.1.1.2 SR 3.3.1.1.4 SR 3.3.1.1.6 SR 3.3.1.1.11 SR 3.3.1.1.15	≤ 0.66 W + 61.6% RTP(b) and ≤ 116% RTP
c. Neutron Flux – High	1	3(c)	F	SR 3.3.1.1.1 SR 3.3.1.1.2 SR 3.3.1.1.4 SR 3.3.1.1.6 SR 3.3.1.1.11(f)(g) SR 3.3.1.1.15	≤ 122% RTP
d. Inop	1, 2	3(c)	G	SR 3.3.1.1.4 SR 3.3.1.1.15	NA
e. 2-Out-Of-4 Voter	1, 2	2	G	SR 3.3.1.1.1 SR 3.3.1.1.4 SR 3.3.1.1.12 SR 3.3.1.1.14 SR 3.3.1.1.15	NA
f. OPRM Upscale	≥ 20% RTP	3(c)	I	SR 3.3.1.1.1(e) SR 3.3.1.1.4(e) SR 3.3.1.1.6(e) SR 3.3.1.1.11(e) SR 3.3.1.1.15(e) SR 3.3.1.1.16(e)	As specified in COLR

(b) ≤ 0.66 (W - Delta W) + 61.6% RTP when reset for single loop operation per LCO 3.4.1, "Recirculation Loops Operating." The cycle-specific value for Delta W is specified in the COLR.

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

(e) During the OPRM Monitoring Period the OPRM Upscale function is inoperable. Upon successful completion of the OPRM Monitoring Period (which includes time for review and acceptance of the OPRM online data by NMC) the OPRM Upscale function will initially be declared OPERABLE on-line.

Initial declaration of OPERABILITY is based upon factory acceptance testing, post-modification testing (including full or partial-surveillance performance during the RFO or during operation, as applicable), and industry experience with the PRNM System.

First performance of these new surveillance requirements is due at the end of the first surveillance interval, which begins on the date the OPRM Upscale function was initially declared OPERABLE following the 2009 RFO.

(f) If the as-found channel setpoint is not the Nominal Trip Setpoint but is conservative with respect to the Allowable Value, then the channel shall be evaluated to verify that it is functioning as required before returning the channel to service.

(g) The instrument channel setpoint shall be reset to the Nominal Trip Setpoint at the completion of the surveillance; otherwise, the channel shall be declared inoperable. The NTSP and the methodology used to determine the NTSP are specified in the Technical Requirements Manual.

Changes Shown in Bubbles KOK

Table 3.3.2.1-1 (page 1 of 1)
Control Rod Block Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
1. Rod Block Monitor				
a. Low Power Range - Upscale	(a)	2	SR 3.3.2.1.1 (h)(i) SR 3.3.2.1.4 (h)(i) SR 3.3.2.1.5	As specified in COLR
b. Intermediate Power Range - Upscale	(b)	2	SR 3.3.2.1.1 (h)(i) SR 3.3.2.1.4 (h)(i) SR 3.3.2.1.5	As specified in COLR
c. High Power Range - Upscale	(c), (d)	2	SR 3.3.2.1.1 (h)(i) SR 3.3.2.1.4 (h)(i) SR 3.3.2.1.5	As specified in COLR
d. Inop	(d), (e)	2	SR 3.3.2.1.1	NA
2. Rod Worth Minimizer	1[(f)], 2[(f)]	1	SR 3.3.2.1.2 SR 3.3.2.1.3 SR 3.3.2.1.6 SR 3.3.2.1.8	NA
3. Reactor Mode Switch - Shutdown Position	(g)	2	SR 3.3.2.1.7	NA

(a) THERMAL POWER ≥ 30% and < 65% RTP and MCPR is below the limit specified in COLR.

(b) THERMAL POWER ≥ 65% and < 85% RTP and MCPR is below the limit specified in COLR.

(c) THERMAL POWER ≥ 85% and < 90% RTP and MCPR is below the limit specified in COLR.

(d) THERMAL POWER ≥ 90% RTP and MCPR is below the limit specified in COLR.

(e) THERMAL POWER ≥ 30% and < 90% RTP and MCPR is below the limit specified in COLR.

(f) With THERMAL POWER ≤ 10% RTP.

(g) Reactor mode switch in the shutdown position.

(h) If the as-found channel setpoint is not the Nominal Trip Setpoint but is conservative with respect to the Allowable Value, then the channel shall be evaluated to verify that it is functioning as required before returning the channel to service.

(i) The instrument channel setpoint shall be reset to the Nominal Trip Setpoint at the completion of the surveillance; otherwise, the channel shall be declared inoperable. The NTSP shall be specified in the COLR. The methodology used to determine the NTSP is specified in the Technical Requirements Manual.

ENCLOSURE 5

MONTICELLO NUCLEAR GENERATING PLANT

RESPONSE TO REQUESTS FOR ADDITIONAL INFORMATION FOR LICENSE AMENDMENT REQUEST FOR POWER RANGE NEUTRON MONITORING SYSTEM UPGRADE (TAC NO. MD8064)

MNGP TECHNICAL SPECIFICATION BASES

REPLACEMENT OR ADDITIONAL INSERTS

16 Pages Follow

2.c. Average Power Range Monitor Neutron Flux - High

The Average Power Range Monitor Neutron Flux—High Function is capable of generating a trip signal to prevent fuel damage or excessive RCS pressure. For the overpressurization protection analysis of Reference 9, high neutron flux is assumed to terminate the main steam isolation valve (MSIV) closure event and, along with the safety/relief valves (S/RVs), limits the peak reactor pressure vessel (RPV) pressure to less than the ASME Code limits. The control rod drop accident (CRDA) analysis (Ref. 10) takes credit for high neutron flux to terminate the CRDA. The Allowable Value is based on the Analytical Limit assumed in the CRDA analyses.
The Average Power Range Monitor Neutron Flux—High Function is required to be OPERABLE in MODE 1 where the potential consequences of the analyzed transients could result in the SLs (e.g., MCPR and RCS pressure) being exceeded. Although the Average Power Range Monitor Neutron Flux—High Function is applicable in MODE 2, the Average Power Range Monitor Neutron Flux—High (Setdown) Function conservatively bounds the assumed trip and, together with the assumed IRM trips, provides adequate protection. Therefore, the Average Power Range Monitor Neutron Flux—High Function is not required in MODE 2.

← Insert RPS A

2.d. Average Power Range Monitor Inop

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

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

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

There is no Allowable Value for this Function.

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

2.e. 2-Out-Of-4 Voter

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

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

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

Changes Shown in Bubbles. KDK

NEW INSERT – RPS A

In accordance with the guidance of Regulatory Issue Summary 2006-17 (Reference 23) Reactor Protection System function APRM Neutron Flux – High (Function 2c) is a Limiting Safety System Setting (LSSS).

Note 3 is added to SR 3.3.1.1.11 to clarify that the recirculation flow transmitters feed the APRMs are included in the Channel Calibration.

SURVEILLANCE REQUIREMENTS (continued)

~~The Note to SR 3.3.1.1.9 and~~ Note 1 to SR 3.3.1.1.11 states that neutron detectors are excluded from CHANNEL CALIBRATION because they are passive devices, with minimal drift, and because of the difficulty of simulating a meaningful signal. Changes in APRM neutron detector sensitivity are compensated for by performing the 7 day calorimetric calibration (SR 3.3.1.1.2) and the 2000 effective full power hours LPRM calibration against the TIPs (SR 3.3.1.1.6). Changes in IRM neutron detector sensitivity are compensated for by periodically evaluating the compensating voltage setting and making adjustments as necessary. Note 2 to SR 3.3.1.1.11 requires the IRM SRs to be performed within 12 hours of entering MODE 2 from MODE 1. Testing of the MODE 2 IRM Functions cannot be performed in MODE 1 without utilizing jumpers, lifted leads, or movable links. This Note allows entry into MODE 2 from MODE 1 if the associated Frequency is not met per SR 3.0.2. Twelve hours is based on operating experience and in consideration of providing a reasonable time in which to complete the SR.

The Frequency of SR 3.3.1.1.9 is based upon the assumption of a 92 day calibration interval in the determination of the magnitude of equipment drift in the setpoint analysis. The Frequency of SR 3.3.1.1.11 is based upon the assumption of a 24 month calibration interval in the determination of the magnitude of equipment drift in the setpoint analysis.

Insert RPS B →

SR 3.3.1.1.12

The LOGIC SYSTEM FUNCTIONAL TEST demonstrates the OPERABILITY of the required trip logic for a specific channel. The functional testing of control rods (LCO 3.1.3, "Control Rod OPERABILITY"), and SDV vent and drain valves (LCO 3.1.8, "Scram Discharge Volume Vent and Drain Valves"), overlaps this Surveillance to provide complete testing of the assumed safety function.

The 24 month Frequency is based on the need to perform this Surveillance under the conditions that apply during a plant outage and the potential for an unplanned transient if the Surveillance were performed with the reactor at power. Operating experience has shown that these components usually pass the Surveillance when performed at the 24 month Frequency.

Add new paragraph: "The LOGIC SYSTEM FUNCTIONAL TEST for APRM Function 2.e simulates APRM and OPRM trip conditions at the 2-out-of-4 voter channel inputs to check all combinations of two tripped inputs to the 2-out-of-4 logic in the voter channels and APRM related redundant RPS relays."

NEW INSERT – RPS B

SR 3.3.1.1.11 for the following RPS function(s) is modified by two Notes as identified in Table 3.3.1.1-1. The function(s) listed below are LSSS for the protection of the reactor core Safety Limits.

Function No.	RPS Function
2.c	APRM Neutron Flux – High

The first Note requires evaluation of channel performance for the condition where the as-found setting for the channel setpoint is not the NTSP but is conservative with respect to the Allowable Value. Evaluation of instrument performance will verify that the instrument will continue to perform in accordance with design basis assumptions. The purpose of the assessment is to ensure confidence in the instrument performance prior to returning the instrument to service. This nonconformance will be entered into the Corrective Action Program. Entry into the Corrective Action Program will ensure required review and documentation of the condition for continued OPERABILITY.

The second Note requires that the as-left setting for the instrument be returned to the NTSP. If the as-left instrument setting cannot be returned to the NTSP, then the instrument channel shall be declared inoperable. The NTSP and the methodology used to determine the NTSP for the APRM Neutron Flux – High Function, (Function 2.c) in Table 3.3.1.1-1 are specified in Appendix C to the Technical Requirements Manual, a document controlled under 10 CFR 50.59.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.1.1.13

This SR ensures that scrams initiated from the Turbine Stop Valve - Closure and Turbine Control Valve Fast Closure, Acceleration Relay Oil Pressure - Low Functions will not be inadvertently bypassed when THERMAL POWER is > 45% RTP. This involves calibration of the bypass channels. Adequate margins for the instrument setpoint methodologies are incorporated into the actual setpoint. Because main turbine bypass flow can affect this setpoint nonconservatively (THERMAL POWER is derived from turbine first stage pressure), the main turbine bypass valves must remain closed during in-service calibration at THERMAL POWER > 45% RTP, if performing the calibration using actual turbine first stage pressure, to ensure that the calibration is valid. The pressure switches are normally adjusted lower (30% RTP) to account for the turbine bypass valves being opened, such that 14% of the THERMAL POWER is being passed directly to the condenser.

If any bypass channel's setpoint is nonconservative (i.e., the Functions are bypassed at > 45% RTP, either due to open main turbine bypass valve(s) or other reasons), then the affected Turbine Stop Valve - Closure and Turbine Control Valve Fast Closure, Acceleration Relay Oil Pressure - Low Functions are considered inoperable. Alternatively, the bypass channel can be placed in the conservative condition (nonbypass). If placed in the nonbypass condition, this SR is met and the channel is considered OPERABLE.

The Frequency of 24 months is based on engineering judgment and reliability of the components.

SR 3.3.1.1.14

This SR ensures that the individual channel response times are less than or equal to the maximum values assumed in the accident analysis. RPS RESPONSE TIME may be verified by actual response time measurements in any series of sequential, overlapping, or total channel measurements.

Add Insert B5 → The RPS RESPONSE TIME acceptance criterion is 50 milliseconds.

RPS RESPONSE TIME tests are conducted on a 24 month STAGGERED TEST BASIS. Note 1 requires STAGGERED TEST BASIS Frequency to be determined based on 4 channels per trip system, in lieu of the 8 channels specified in Table 3.3.1.1-1 for the MSIV - Closure Function. This Frequency is based on the logic interrelationships

Replacement
Add Insert B5A

REPLACEMENT INSERT B5A:

APRM and OPRM RESPONSE TIME tests are conducted on a 24 month STAGGERED TEST BASIS. Note 1 requires the STAGGERED TEST BASIS to be determined based on 4 channels of APRM outputs and 4 channels of OPRM outputs, (total n = 8) being tested on an alternating basis.

This allows the STAGGERED TEST BASIS Frequency for Function 2.e to be determined based on 8 channels rather than the 4 actual 2-Out-Of-4 Voter channels. The redundant outputs from the 2-Out-Of-4 Voter channel (2 for APRM trips and 2 for OPRM trips) are considered part of the same channel, but the OPRM and APRM outputs are considered to be separate channels for application of SR 3.3.1.1.14, so N = 8. The note further requires that testing of OPRM and APRM outputs from a 2-Out-Of-4 Voter be alternated. In addition to these commitments, References 17 and 21 require that the testing of inputs to each RPS Trip System alternate.

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

a. Tests each RPS Trip System interface every other cycle,

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

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

After 8 cycles, the sequence repeats.

Each test of an OPRM or APRM output tests each of the redundant outputs from the 2-Out-Of-4 Voter channel for that Function and each of the corresponding relays in the RPS. Consequently, each of the RPS relays is tested every fourth cycle. The RPS relay testing frequency is twice the frequency justified by References 17 and 21.

BASES

SURVEILLANCE REQUIREMENTS (continued)

of the various channels required to produce an RPS scram signal. The 24 month Frequency is consistent with the typical industry refueling cycle and is based upon plant operating experience, which shows that random failures of instrumentation components causing serious response time degradation, but not channel failure, are infrequent occurrences.

Add Inserts B6 and B7

REFERENCES

1. Regulatory Guide 1.105, Revision 3, "Setpoints for Safety-Related Instrumentation."
2. USAR, Section 7.6.1.2.1.
3. USAR, Section 7.6.1.2.5.
4. USAR, Chapter 14.
5. USAR, Chapter 14A.
6. USAR, Section 7.8.2.1.
7. USAR, Section 7.3.4.3.
8. ~~USAR, Section 14.6.~~ Not used.
9. USAR, Section 14.5.1.
10. USAR, Section 14.7.1.
11. USAR, Section 14.7.2.
12. USAR, Section 14.7.3.
13. P. Check (NRC) letter to G. Lainas (NRC), "BWR Scram Discharge System Safety Evaluation," December 1, 1980.
14. USAR, Section 14.4.5.
15. USAR, Section 14.4.1.
16. NEDC-30851-P-A , "Technical Specification Improvement Analyses for BWR Reactor Protection System," March 1988.

For Information Only

Add Insert B8

INSERT B7

SR 3.3.1.1.16

This SR ensures that scrams initiated from OPRM Upscale Function (Function 2.f) will not be inadvertently bypassed when THERMAL POWER, as indicated by the APRM Simulated Thermal Power, is ≥ 25% RTP and core flow, as indicated by recirculation drive flow, is ≤ 60% rated core flow. This normally involves confirming the bypass setpoints. Adequate margins for the instrument setpoint methodologies are incorporated into the actual setpoint. The actual surveillance ensures that the OPRM Upscale Function is enabled (not bypassed) for the correct values of APRM Simulated Thermal Power and recirculation drive flow. SR 3.3.1.1.11 and the MNGP core flow measurement system calibration procedure ensure that the APRM Simulated Thermal Power and recirculation flow properly correlate with THERMAL POWER and core flow, respectively.

If any bypass setpoint is non-conservative (i.e., the OPRM Upscale Function is bypassed when APRM Simulated Thermal Power ≥ 25% and recirculation drive flow ≤ 60% rated), then the affected channel is considered inoperable for the OPRM Upscale Function. Alternatively, the bypass setpoint may be adjusted to place the channel in a conservative condition (non-bypass). If placed in the non-bypass condition, this SR is met and the channel is considered OPERABLE.

The Frequency of 24 months is based on engineering judgment and reliability of the components.

INSERT B8

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

18. NEDO-31960-A, "BWR Owners' Group Long-Term Stability Solutions Licensing Methodology," November 1995.

19. NEDO-31960-A, Supplement 1, "BWR Owners' Group Long-Term Stability Solutions Licensing Methodology," November 1995.

20. NEDO-32465-A, "BWR Owners' Group Long-Term Stability Detect and Suppress Solutions Licensing Basis Methodology And Reload Applications," August 1996.

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

22. Letter, LA England (BWROG) to MJ Virgilio, "BWR Owners' Group Guidelines for Stability Interim Corrective Action", June 6, 1994.

Insert RPSC →

NEW INSERT – RPS C

23. U.S. NRC Regulatory Issue Summary 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.

BASES

BACKGROUND (continued)

The purpose of the RWM is to control rod patterns during startup, such that only specified control rod sequences and relative positions are allowed over the operating range from all control rods inserted to 10% RTP. The sequences effectively limit the potential amount and rate of reactivity increase during a CRDA. Prescribed control rod sequences are stored in the RWM, which will initiate control rod withdrawal and insert blocks when the actual sequence deviates beyond allowances from the stored sequence. The RWM determines the actual sequence based position indication for each control rod. The RWM also uses steam flow signals to determine when the reactor power is above the preset power level at which the RWM is automatically bypassed (Ref. 2). The RWM is a single channel system that provides input into both RMCS rod block circuits.

With the reactor mode switch in the shutdown position, a control rod withdrawal block is applied to all control rods to ensure that the shutdown condition is maintained. This Function prevents inadvertent criticality as the result of a control rod withdrawal during MODE 3 or 4, or during MODE 5 when the reactor mode switch is required to be in the shutdown position. The reactor mode switch has two channels, each inputting into a separate RMCS rod block circuit. A rod block in either RMCS circuit will provide a control rod block to all control rods.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY

Insert RBM A

1. Rod Block Monitor

The RBM is designed to prevent violation of the MCPR SL and the cladding 1% plastic strain fuel design limit that may result from a single control rod withdrawal error (RWE) event. The analytical methods and assumptions used in evaluating the RWE event are summarized in Reference 3. A statistical analysis of RWE events was performed to determine the RBM response for both channels for each event. From these responses, the fuel thermal performance as a function of RBM NTSP and Allowable Value was determined. The Allowable Values are chosen as a function of power level. Based on the specified Allowable Values, NTSP operating limits are established.

The RBM Function satisfies Criterion 3 of 10 CFR 50.36(c)(2)(ii).

Two channels of the RBM are required to be OPERABLE, with their setpoints within the appropriate Allowable Value for the associated power range, to ensure that no single instrument failure can preclude a rod block from this Function. The actual setpoints are calibrated consistent with applicable setpoint methodology.

NEW INSERT – RBM A

Allowable Values are specified for each applicable Rod Block Function listed in Table 3.3.2.1-1. The NTSPs (actual trip setpoints) are selected to ensure that the setpoints are conservative with respect to the Allowable Value. A channel is inoperable if its actual trip setpoint is non-conservative with respect to its required Allowable Value.

NTSPs are those predetermined values of output at which an action should take place. The setpoints are compared to the actual process parameter (e.g., reactor power), and when the measured output value of the process parameter exceeds the setpoint, the associated device (e.g., trip unit) changes state. The Analytical Limits are derived from the limiting values of the process parameters obtained from the safety analysis. The Allowable Values are derived from the Analytical Limits, corrected for calibration, process, and some of the instrument errors. The NTSPs are then determined, accounting for the remaining channel uncertainties. The trip setpoints derived in this manner provide adequate protection because instrumentation uncertainties, process effects, calibration tolerances, and drift are accounted for. The Limiting Trip Setpoint is the value of the setpoint within its specified as-found tolerance which most closely approaches the Allowed Value. For the Rod Block Monitor, which is a digital system with a zero as-found tolerance, the Limiting Trip Setpoint is the NTSP.

The Rod Block Monitor Low, Intermediate and High Power Range – Upscale functions (Functions 1a, 1b and 1c, respectively) are Limiting Safety System Setting (LSSS).

The specific Applicable Safety Analyses, LCO, and Applicability discussions are listed below on a Function by Function basis.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

Nominal trip setpoints are specified in the setpoint calculations. The nominal setpoints are selected to ensure that the setpoints do not exceed the Allowable Values between successive CHANNEL CALIBRATIONS. Operation with a trip setpoint less conservative than the nominal trip setpoint, but within its Allowable Value, is acceptable. Nominal Trip setpoints are those predetermined values of output at which an action should take place. The setpoints are compared to the actual process parameter (e.g., reactor power), and when the measured output value of the process parameter exceeds the setpoint, the associated device (e.g., trip unit) changes state. Insert RBM B The analytic limits are derived from the limiting values of the process parameters obtained from the safety analysis. The Allowable Values and nominal trip setpoints (NTSP) are derived, using the General Electric setpoint methodology guidance, as specified in the Monticello setpoint methodology. The Allowable Values are derived from the analytic limits. The difference between the analytic limit and the Allowable Value allows for channel instrument accuracy, calibration accuracy, process measurement accuracy, and primary element accuracy. The margin between the Allowable Value and the NTSP allows for instrument drift that might occur during the established surveillance period. Two separate verifications are performed for the calculated NTSP. The first, a Spurious Trip Avoidance Test, evaluates the impact of the NTSP on plant availability. The second verification, an LER Avoidance Test, calculates the probability of avoiding a Licensee Event Report (or exceeding the Allowable Value) due to instrument drift. These two verifications are statistical evaluations to provide additional assurance of the acceptability of the NTSP and may require changes to the NTSP. Use of these methods and verifications provides the assurance that if the setpoint is found conservative to the Allowable Value during surveillance testing, the instrumentation would have provided the required trip function by the time the process reached the analytic limit for the applicable events, thereby protecting the SL. Insert RBM C

The RBM is assumed to mitigate the consequences of an RWE event when operating ≥ 30% RTP. Below this power level, the consequences of an RWE event will not exceed the MCPR SL and, therefore, the RBM is not required to be OPERABLE (Ref. 3). When operating < 90% RTP, analyses have shown that with an initial MCPR ≥ 1.75, no RWE event will result in exceeding the MCPR SL. Also, the analyses demonstrate that when operating at ≥ 90% RTP with MCPR ≥ 1.44, no RWE event will result in exceeding the MCPR SL. Therefore, under these conditions, the RBM is also not required to be OPERABLE.

2. Rod Worth Minimizer

The RWM enforces the banked position withdrawal sequence (BPWS) to ensure that the initial conditions of the CRDA analysis are not violated.

NEW INSERT RBM B

, the calculated RBM flux (RBM channel signal). When the normalized RBM flux value exceeds the applicable trip setpoint, the RBM provides a trip output.

NEW INSERT RBM C

For the digital RBM, there is a normalization process initiated upon rod selection, so that only RBM input signal drift over the interval from the rod selection to rod movement needs to be considered in determining the nominal trip setpoints. The RBM has no drift characteristic with no as-left or as-found tolerances since it only performs digital calculations on the digitized input signals provided by the APRMs.

The NTSP (or Limiting Trip Setpoint) is the Limiting Safety System Setting since the RBM has no drift characteristic. The RBM Allowable Value demonstrates that the analytic limit would not be exceeded, thereby protecting the safety limit. The trip setpoints and Allowable Values determined in this manner provide adequate protection because instrumentation uncertainties, process effects, calibration tolerances, instrument drift, and environment errors are accounted for and appropriately applied for the RBM. There are no margins applied to the RBM nominal trip setpoint calculations which could mask RBM degradation.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.2.1.2 and SR 3.3.2.1.3

A CHANNEL FUNCTIONAL TEST is performed for the RWM to ensure that the entire system will perform the intended function. A successful test of the required contact(s) of a channel relay may be performed by the verification of the change of state of a single contact of the relay. This clarifies what is an acceptable CHANNEL FUNCTIONAL TEST of a relay. This is acceptable because all of the other required contacts of the relay are verified by other Technical Specifications and non-Technical Specifications tests at least once per refueling interval with applicable extensions. The CHANNEL FUNCTIONAL TEST for the RWM is performed by: a) attempting to withdraw a control rod not in compliance with the prescribed sequence and verifying a control rod block occurs; b) verifying proper annunciation of the selection error of at least one out-of-sequence control rod in each fully inserted group; and c) performing a RWM computer on-line diagnostic test. As noted in the SRs, SR 3.3.2.1.2 is not required to be performed until 1 hour after any control rod is withdrawn at ≤ 10% RTP in MODE 2, and SR 3.3.2.1.3 is not required to be performed until 1 hour after THERMAL POWER is ≤ 10% RTP in MODE 1. This allows entry into MODE 2 for SR 3.3.2.1.2, and entry into MODE 1 when THERMAL POWER is ≤ 10% RTP for SR 3.3.2.1.3, to perform the required Surveillance if the 92 day Frequency is not met per SR 3.0.2. The 1 hour allowance is based on operating experience and in consideration of providing a reasonable time in which to complete the SRs. The Frequencies are based on reliability analysis (Ref. 8).

SR 3.3.2.1.4

A CHANNEL CALIBRATION is a complete check of the instrument loop and the sensor. This test verifies the channel responds to the measured parameter within the necessary range and accuracy. CHANNEL CALIBRATION leaves the channel adjusted to account for instrument drifts between successive calibrations consistent with the plant specific setpoint methodology.

As noted, neutron detectors are excluded from the CHANNEL CALIBRATION because they are passive devices, with minimal drift, and because of the difficulty of simulating a meaningful signal. Neutron detectors are adequately tested in SR 3.3.1.1.2 and SR 3.3.1.1.6.

The Frequency is based upon the assumption of a ~~92 day~~ [24 months] calibration interval in the determination of the magnitude of equipment drift in the setpoint analysis.

Insert RBM D

NEW INSERT – RBM D

SR 3.3.2.1.4 for the following RBM functions is modified by two Notes as identified in Table 3.3.2.1-1. These RBM functions are LSSS for the protection of the reactor core Safety Limits.

Function No.	RBM Function
1.a	Low Power Range – Upscale
1.b	Intermediate Power Range – Upscale
1.c	High Power Range – Upscale

The first Note requires evaluation of channel performance for the condition where the as-found setting for the channel setpoint is not the NTSP but is conservative with respect to the Allowable Value. For digital channel components, no as-found tolerance or as-left tolerance can be specified. Evaluation of instrument performance will verify that the instrument will continue to behave in accordance with design basis assumptions. The purpose of the assessment is to ensure confidence in the instrument performance prior to returning the instrument to service. This nonconformance will be entered into the Corrective Action Program. Entry into the Corrective Action Program will ensure required review and documentation of the condition for continued OPERABILITY.

The second Note requires that the as-left setting for the instrument be returned to the NTSP. If the as-left instrument setting cannot be returned to the NTSP, then the instrument channel shall be declared inoperable. The NTSPs and Allowable Values for Rod Block Monitor Functions 1a, 1b and 1c are specified in the COLR. The methodology used to determine the NTSPs are specified in Appendix C to the Technical Requirements Manual, a document controlled under 10 CFR 50.59.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.2.1.5

control rod block

The RBM setpoints are automatically varied as a function of power. Three Allowable Values required in Table 3.3.2.1-1, each within a specific power range, are specified in the COLR. The power at which the control rod block Allowable Values automatically change are based on the APRM signal's input to each RBM channel. Below the minimum power setpoint, the RBM is automatically bypassed. These bypass setpoints must be verified periodically to be less than or equal to the specified values. If any power range setpoint is nonconservative, then the affected RBM channel is considered inoperable. Alternatively, the power range channel can be placed in the conservative condition (i.e., enabling the proper RBM setpoint). If placed in this condition, the SR is met and the RBM channel is not considered inoperable. As noted, neutron detectors are excluded from the Surveillance because they are passive devices, with minimal drift, and because of the difficulty of simulating a meaningful signal. Neutron detectors are adequately tested in SR 3.3.1.1.2 and SR 3.3.1.1.6. The ~~92 day~~ Frequency is based on the actual trip setpoint methodology utilized for these channels.

control rod block

24 months

SR 3.3.2.1.6

The RWM is automatically bypassed when power is above a specified value. The power level is determined from steam flow signals. The automatic bypass setpoint must be verified periodically to be > 10% RTP. If the RWM low power setpoint is nonconservative, then the RWM is considered inoperable. Alternately, the low power setpoint channel can be placed in the conservative condition (nonbypass). If placed in the nonbypassed condition, the SR is met and the RWM is not considered inoperable. The 24 month Frequency is based on engineering judgment considering the reliability of the components, and that indication of whether or not the RWM is bypassed is provided in the control room.

SR 3.3.2.1.7

A CHANNEL FUNCTIONAL TEST is performed for the Reactor Mode Switch - Shutdown Position Function to ensure that the entire channel will perform the intended function. A successful test of the required contact(s) of a channel relay may be performed by the verification of the change of state of a single contact of the relay. This clarifies what is an acceptable CHANNEL FUNCTIONAL TEST of a relay. This is acceptable because all of the other required contacts of the relay are verified by other

ENCLOSURE 6

MONTICELLO NUCLEAR GENERATING PLANT

RESPONSE TO REQUESTS FOR ADDITIONAL INFORMATION FOR LICENSE AMENDMENT REQUEST FOR POWER RANGE NEUTRON MONITORING SYSTEM UPGRADE (TAC NO. MD8064)

CA-08-050

REVISION 0

INSTRUMENT SETPOINT CALCULATION – AVERAGE POWER RANGE MONITOR (APRM) NON-FLOW BIASED PRNM SETPOINTS FOR CLTP AND EPU

143 Pages Follow

NMC

Calculation Signature Sheet

Document Information

NMC Calculation (Doc) No: **CA-08-050**	Revision: 0
Title: **Instrument Setpoint Calculation - Average Power Range Monitor (APRM) Non-Flow Biased PRNM Setpoints for CLTP and EPU**	
Facility: ☒ MT ☐ PB ☐ PI ☐ PL ☐ HU/FT	Unit: ☒ 1 ☐ 2
Safety Class: ☒ SR ☐ Aug Q ☐ Non SR	
Special Codes: ☐ Safeguards ☐ Proprietary	
Type: **Calc** Sub-Type:	

NOTE:	Print and sign name in signature blocks, as required.

Major Revisions

EC Number: EC 12899	☐ Vendor Calc
Vendor Name or Code:	Vendor Doc No:
Description of Revision: Original Issue	
Prepared by: Joseph Balitski *Joseph Balitski*	Date: 08/05/08
Reviewed by: *CNelson Charles Nelson*	Date: *8/11/08*
Type of Review: ☒ Design Verification ☐ Tech Review ☐ Vendor Acceptance	
Method Used (For DV Only): ☒ Review ☐ Alternate Calc ☐ Test	
Approved by: *Edward P. Watzl* EDWARD P. WATZL	Date: *8-14-08*

Minor Revisions

EC No:	☐ Vendor Calc:
Minor Rev. No:	
Description of Change:	
Pages Affected:	
Prepared by:	Date:
Reviewed by:	Date:
Type of Review: ☐ Design Verification ☐ Tech Review ☐ Vendor Acceptance	
Method Used (For DV Only): ☐ Review ☐ Alternate Calc ☐ Test	
Approved by:	Date:

(continued on next page)

Record Retention: Retain this form with the associated calculation for the life of the plant.

NMC

Calculation Signature Sheet

Document Information

NMC Calculation (Doc) No: **CA-08-050**	Revision: 0
Title: **Instrument Setpoint Calculation - Average Power Range Monitor (APRM) Non-Flow Biased PRNM Setpoints for CLTP and EPU**	
Facility: ☒ MT ☐ PB ☐ PI ☐ PL ☐ HU/FT	Unit: ☒ 1 ☐ 2
Safety Class: ☒ SR ☐ Aug Q ☐ Non SR	
Special Codes: ☐ Safeguards ☐ Proprietary	
Type: **Calc** Sub-Type:	

NOTE:	Print **and** sign name in signature blocks, as required.

Major Revisions

EC Number: EC 12899	☐ Vendor Calc
Vendor Name or Code:	Vendor Doc No:
Description of Revision: Original Issue	
Prepared by: Joseph Balitski	Date: 08/05/08
Reviewed by:	Date:
Type of Review: ☒ Design Verification ☐ Tech Review ☐ Vendor Acceptance	
Method Used (For DV Only): ☒ Review ☐ Alternate Calc ☐ Test	
Approved by:	Date:

Minor Revisions

EC No:	☐ Vendor Calc:
Minor Rev. No:	
Description of Change:	
Pages Affected:	
Prepared by:	Date:
Reviewed by:	Date:
Type of Review: ☐ Design Verification ☐ Tech Review ☐ Vendor Acceptance	
Method Used (For DV Only): ☐ Review ☐ Alternate Calc ☐ Test	
Approved by:	Date:

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NMC	**Calculation Signature Sheet**

EC No:	☐ Vendor Calc:
Minor Rev. No:	
Description of Change:	
Pages Affected:	
Prepared by:	Date:
Reviewed by:	Date:
Type of Review: ☐ Design Verification ☐ Tech Review ☐ Vendor Acceptance	
Method Used (For DV Only): ☐ Review ☐ Alternate Calc ☐ Test	
Approved by:	Date:

EC No:	☐ Vendor Calc:
Minor Rev. No:	
Description of Change:	
Pages Affected:	
Prepared by:	Date:
Reviewed by:	Date:
Type of Review: ☐ Design Verification ☐ Tech Review ☐ Vendor Acceptance	
Method Used (For DV Only): ☐ Review ☐ Alternate Calc ☐ Test	
Approved by:	Date:

EC No:	☐ Vendor Calc:
Minor Rev. No:	
Description of Change:	
Pages Affected:	
Prepared by:	Date:
Reviewed by:	Date:
Type of Review: ☐ Design Verification ☐ Tech Review ☐ Vendor Acceptance	
Method Used (For DV Only): ☐ Review ☐ Alternate Calc ☐ Test	
Approved by:	Date:

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Calculation Signature Sheet

NOTE:	This reference table is used for data entry into the PassPort Controlled Documents Module, reference tables (C012 Panel). It may also be used as the reference section of the calculation. The input documents, output documents and other references should all be listed here. Add additional lines as needed.

Reference Documents (PassPort C012 Panel from C020)

#	Controlled* Doc? + Type	Document Name	Document Number	Doc Rev	Ref Type** (if known)
1	☒ PROC	Engineering Standards Manual, Appendix I (GE Methodology Instrumentation & Controls)	ESM-03.02-APP-I	4	☒Input ☐Output
2	☐ GDOC	Average Power Range Monitor Selected PRNM Licensing Setpoint – CLTP Operation (NUMAC)	0000-0077-9068	2	☒Input ☐Output
3	☐ GDOC	Average Power Range Monitor Selected PRNM Licensing Setpoint – EPU Operation (NUMAC)	0000-0081-6958	0	☒Input ☐Output
4	☐ GDOC	MNGP PRNM Licensing Setpoints – CLTP Operation	GEH-NE-0000-0076-2388	1	☒Input ☐Output
5	☐ GDOC	Nuclear Measurement Analysis and Control Power Range Nuclear Monitor (NUMAC PRNM) Retrofit Plus Option III Stability Trip Function, Licensing Topical Report	NEDC-32410-A, Volume 1	Oct 1995	☒Input ☐Output
6	☐ GDOC	Nuclear Measurement Analysis and Control Power Range Nuclear Monitor (NUMAC PRNM) Retrofit Plus Option III Stability Trip Function, Licensing Topical Report	NEDC-32410-A, Volume II	Oct 1995	☒Input ☐Output
7	☐ GDOC	Nuclear Measurement Analysis and Control Power Range Nuclear Monitor (NUMAC PRNM) Retrofit Plus Option III Stability Trip Function, Licensing Topical Report	NEDC-32410-A, Supplement 1	Nov 1997	☒Input ☐Output
8	☒ CALC	Instrument Setpoint Calculation - Average Power Range Monitor (APRM) Flow-Biased Upscale Scram and Rod Block	CA-96-224	1	☐Input ☐Output

Record Retention: Retain this form with the associated calculation for the life of the plant.

NMC

Calculation Signature Sheet

9	☒ CALC	Instrument Setpoint Calculation – APRM Downscale CR Block	CA-05-153	0	☐Input ☐Output
10	☐ GDOC	General Electric Instrumentation Setpoint Methodology	NEDC-31336P-A Class III	Oct 1986	☒Input ☐Output
11	☒ PROC	APRM Heat Balance Calibration	0017	25	☐Input ☐Output
12	☐ GDOC	Setpoint Calculation Guidelines for the Monticello Nuclear Generating Plant	GE-NE-901-021-0492, DRF A00-01932-1	Oct 1992	☒Input ☐Output
13	☒ LIC	Monticello Plant Technical Specifications	Tech-Specs	155	☐Input ☐Output
14	☒ LIC	Monticello Technical Requirements Manual	TRM	2	☐Input ☐Output
15	☐ LIS	Instrument Setpoints for Safety-Related Systems	RG 1.105	3	☐Input ☐Output
16	☒ LIS	Project Task Report, MNGP Extended Power Uprate, Technical Specifications Setpoints	Task Report T0506	1	☒Input ☐Output
17	☐ LIS	Clarify Application of Setpoint Methodology for LSSS Functions. Not approved but included as a setpoint reference document	TSTF-493	3	☐Input ☐Output
18	☐ LIS	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	RIS 2006-17	Aug 2006	☐Input ☐Output
19	☒ GDOC	EPU – Mod 4 – Neutron Monitoring System (PRNM)	EC-10856	0	☒Input ☐Output
20	☒ GDOC	PRNMS Setpoint Calculations – 08-050 (Non-Flow Biased Setpoints)	EC-12899	0	☐Input ☒Output
21	☒ PROC	Rod Withdraw Block	C.6-005-A-03	1	☐Input ☒Output
22	☒ PROC	APRM Downscale	C.6-005-A-06	3	☐Input ☒Output
23	☒ PROC	APRM Hi Hi INOP Ch 1, 2, 3	C.6-005-A-22	3	☐Input ☒Output
24	☒ PROC	APRM Hi Hi INOP Ch 4, 5, 6	C.6-005-A-30	3	☐Input ☒Output

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NMC

Calculation Signature Sheet

25	☒ PROC	Operations Manual Section – Plant Protection System	B.05.06-02	18	☐Input ☒Output
26	☒ PROC	Operations Manual Section – Power Range Neutron Monitoring	B.05.01.02-02	6	☐Input ☒Output
27	☒ PROC	Operations Manual Section – Power Range Neutron Monitoring	B.05.01.02-05	16	☐Input ☒Output
28	☒ PROC	Design Bases Document for Neutron Monitoring System	DBD B5.1	C	☐Input ☒Output
29	☒ PROC	APRM Calibration Readjustment for Single Loop	8211	2	☐Input ☒Output
30	☒ PROC	APRM Calibration Readjustment for Single Loop	8212	2	☐Input ☒Output
31	☒ PROC	APRM/Flow Reference Scram Functional Check	0012	41	☐Input ☒Output
32	☐ GDOC	Specification for existing Neutron Monitoring System, 12/03/85	257HA594	1	☒Input ☐Output
33	☐ GDOC	Specification for PRNM MUMAC Power Range Neutron Monitor System	24A5221	14	☐Input ☐Output
34	☐ GDOC	Design Input Request T0500, Neutron Monitoring System	DIR T0500 DRF 0000-0040-9168	3	☒Input ☐Output
35	☐ GDOC	Mathematics of Physics and Modern Engineering, I.S. Sokolnikoff and R. M. Redheffer	n/a	1966	☒Input ☐Output
37	☒ LIC	Monticello Plant Technical Specifications Bases	Bases	8	☐Input ☐Output

*Controlled Doc checkmark means the reference can be entered on the C012 panel in black. Unchecked lines will be yellow. If checked, also list the Doc Type, e.g., CALC, DRAW, VTM, PROC, etc.)

**Corresponds to these PassPort "Ref Type" codes: Inputs/Both = ICALC, Outputs = OCALC, Other/Unknown = blank)

NMC	Calculation Signature Sheet

Other PassPort Data

Associated System (PassPort C011, first three columns) **OR** **Equipment References** (PassPort C025, all five columns):

Facility	Unit	System	Equipment Type	Equipment Number
MT	1	NIP	INDREC	APRM-1
MT	1	NIP	INDREC	APRM-2
MT	1	NIP	INDREC	APRM-3
MT	1	NIP	INDREC	APRM-4
MT	1	NIP	INDREC	LPRM-04-29
MT	1	NIP	INDREC	LPRM-12-13
MT	1	NIP	INDREC	LPRM-12-21
MT	1	NIP	INDREC	LPRM-12-29
MT	1	NIP	INDREC	LPRM-12-37
MT	1	NIP	INDREC	LPRM-20-13
MT	1	NIP	INDREC	LPRM-20-21
MT	1	NIP	INDREC	LPRM-20-29
MT	1	NIP	INDREC	LPRM-20-37
MT	1	NIP	INDREC	LPRM-20-45
MT	1	NIP	INDREC	LPRM-28-05
MT	1	NIP	INDREC	LPRM-28-13
MT	1	NIP	INDREC	LPRM-28-21

Record Retention: Retain this form with the associated calculation for the life of the plant.

NMC

Calculation Signature Sheet

MT	1	NIP	INDREC	LPRM-28-29
MT	1	NIP	INDREC	LPRM-28-37
MT	1	NIP	INDREC	LPRM-28-45
MT	1	NIP	INDREC	LPRM-36-13
MT	1	NIP	INDREC	LPRM-36-21
MT	1	NIP	INDREC	LPRM-36-29
MT	1	NIP	INDREC	LPRM-36-37
MT	1	NIP	INDREC	LPRM-36-45
MT	1	NIP	INDREC	LPRM-44-21
MT	1	NIP	INDREC	LPRM-44-29
MT	1	NIP	INDREC	LPRM-44-37

Superseded Calculations (PassPort C019):

Facility	Calc Document Number	Title
MT	CA-05-153	Instrument Setpoint Calculation – Average Power Range Monitor (APRM) Downscale CR Block. *This calculation is not affected until* the installation of the PRNMS retrofit, EC-10856.
MT	CA-96-224	Instrument Setpoint Calculation – Average Power Range Monitor (APRM) Flow-Biased Upscale Scram and Rod Block. This calculation is not affected until the installation of the PRNMS retrofit, EC-10856.

Record Retention: Retain this form with the associated calculation for the life of the plant.

NMC	**Calculation Signature Sheet**

Description Codes - Optional (PassPort C018):

Code	Description (optional)	Code	Description (optional)

Notes (Nts) - Optional (PassPort X293 from C020):

Topic Notes	Text
☐ Calc Introduction	☐ Copy directly from the calculation Intro Paragraph **or** ☐ See write-up below
☐ (Specify)	

Record Retention: Retain this form with the associated calculation for the life of the plant.

NMC Committed to Nuclear Excellence Fleet Modification Process	**Design Review Checklist**

Document Number/ Title:
CA-08-050 / Instrument Setpoint Calculation Average Power Range Monitor (APRM) Non Flow-Biased PRNM Setpoints for CLTP and EPU

Verifier's Name/ Discipline: Charles E. Nelson, Engineering Projects Support

	DESIGN REVIEW CONSIDERATIONS:	Yes	No	N/A
1.	Were the inputs correctly selected and incorporated into design?	☒	☐	☐
2.	Are assumptions necessary to perform the design activity adequately described and reasonable? Where necessary, are the assumptions identified for subsequent re-verifications when the detailed design activities are completed?	☒	☐	☐
3.	Are the appropriate quality and quality assurance requirements specified?	☒	☐	☐
4.	Are the applicable codes, standards, and regulatory requirements including issue and addends properly identified and are their requirements for design met?	☒	☐	☐
5.	Have applicable construction and operating experience been considered?	☐	☐	☒
6.	Have the design interface requirements been satisfied?	☐	☐	☒
7.	Was an appropriate design method used?	☒	☐	☐
8.	Is the output reasonable compared to inputs?	☒	☐	☐
9.	Are the specified parts, equipment and processes suitable for the required application?	☐	☐	☒
10.	Are the specified materials compatible with each other and the design environmental conditions to which the material will be exposed?	☐	☐	☒
11.	Have adequate maintenance features and requirements been specified?	☐	☐	☒
12.	Are accessibility and other design provisions adequate for performance of needed maintenance and repair?	☐	☐	☒
13.	Has adequate accessibility been provided to perform the in-service inspection expected to be required during the plant life?	☐	☐	☒
14.	Has the design properly considered radiation exposure to the public and plant personnel?	☐	☐	☒
15.	Are the acceptance criteria incorporated in the design documents sufficient to allow verification that design requirements have been satisfactorily accomplished?	☒	☐	☐
16.	Have adequate pre-operational, subsequent periodic test, and inspection requirements been appropriately specified, including acceptance criteria?	☒	☐	☐
17.	Are adequate handling, storage, cleaning, and shipping requirements specified?	☐	☐	☒
18.	Are adequate identification requirements specified?	☐	☐	☒
19.	Are requirements for record preparation, review, approval, and retention adequately specified?	☐	☐	☒

COMMENTS: ☐ None ☒ Attached (Use Form QF-0528)

NMC Committed to Nuclear Excellence Fleet Modification Process	**Design Review Comment Form**

DOCUMENT NUMBER/ TITLE: CA-08-050
Instrument Setpoint Calculation- Average Power Range Monitor (APRM) Non-Flow Biased PRNM Setpoints for CLTP and EPU

REVISION: 0 DATE: 7/9/2008

Note: Following classification of comments is used:
(E) Editorial
(P) Preference/Recommendation
(T) Technical

ITEM #	REVIEWER'S COMMENTS	PREPARER'S RESOLUTION	REVIEWER'S DISPOSITION
1.	Process (T) Preparer not yet in Qualification Matrix, therefore, not yet qualified to prepare calculation in Engineering Qualification Matrix, but paperwork has been submitted to Engineering Director for Approval.	Training matrix now shows qualification	OK
2.	Process (T) 19 CFR 50.59 screening needs to be completed under the Modification EC.	N/A	OK
3.	General (E) Text margins and Page size are not matched in the .pdf version.	Re-formatted, pdf matches Word version	OK
4.	General (P) Add list of Acronyms and Abbreviations	Added list of Acronyms and Abbreviations.	OK
5.	General (P) Comments and Recommendations sections of Inputs 4.2 and 4.3 contain discussions and detailed explanations that may be useful to copy into the calculation.	Added more detail to the calculation based on GEH PRNM documents	OK
6.	General (E) In various places units are listed as %, % Power or % RTP. Define terms if different or standardize usage.	Standardized with % RTP through-out	OK
7.	General (P) Standardize the terms used for the four setpoints. Recommend using the	Used Tech Spec terminology through-out	OK

Design Review Comment Form

	Tech Spec names or names used in NRC approved LTRs.		
8.	QF-0549 p1 (T) EC number incorrect;	Corrected to 10856	OK
9.	QF-0549 p1 (T) Check "Review" under Method Used.	Review checked	OK
10.	QF-0549 p4 (T) RIS-2006-17 and TSTF-493 are discussed in methodology and are referenced in the calculation, but are not used as inputs as indicated here. They probably should not be listed on the QF-0549. Since TSTF is not approved it probably shouldn't be mentioned. NRC issued the RIS and it documents a "method acceptable to the staff" but is not yet a commitment by MNGP.	This remains an open item because decision has not been made on RIS-2006-17 applicability. RIS-2006-17 and TSTF-493 are not indicated as inputs.	OK
11.	QF-0549 pp3,4 (T) Document Types in first Column need to be standard DOC TYPES used in Passport. All entries should have a TYPE. RG, RIS, and TSTF are not defined and should probably be TYPE "LIS." Default TYPE is "GDOC"	Added Passport DOC TYPES to all references listed	OK
12.	QF-0549 p3 (P) Reference documents 2 through 7 appear to meet the definition of "Obscure Reference" and should be uploaded to Sharepoint under the EC or attached to the calculation.	Added entire documents and parts of some documents as Attachments. See TOC	OK
13.	QF-0549 p3 Reference Documents (T) List does not include all of the references listed in section 5 of calculation.	All Section 5 references have been added	OK
14.	QF-0549 p4 (T) Reference Documents 9 and 12 should probably be controlled documents.	GE documents are not are controlled	OK
15.	QF-0549 p5 (T) Add LPRMs.	ID's of all LPRMs added	OK
16.	Form 3494 (T)	Added to Form 3494	

Design Review Comment Form

	Add information in "Other Comments:" per FP-E-CAL-01 Attachment 4 3.b.7).		
17.	1 Purpose p2 (T). Include statement that the calculation provides design basis setpoint calculation for compliance with setpoint control program and NRC commitment.	Added statement to Purpose section	OK
18.	1 Purpose p2 (T). Per FP-E-CAL-01 Attachment 1 1.c. identify calculations being deleted or superseded.	Added calculations being deleted to Purpose	OK
19.	2 Methodology p3 (T) Need MNGP staff agreement to position stated on AFT/ALT being set to zero in surveillance procedures.	Open item. Need staff agreement of using GEH or other basis for AFT/ALT.	OK
20.	4.2 Inputs p4 (E) Spelling should be "Setpoints"	Changed	OK
21.	4.3 Inputs p4 (E) Spelling should be "Setpoints"	Changed	OK
22.	4.8 Inputs p5 (E) Spelling should be "manufacturer"	Changed	OK
23.	4.5, 4.6, and 4.7 Inputs pp 4,5 (E) Document Number should be "NEDC-32410P-A"	Changed	OK
24.	4.9 Inputs (T) FTR T0506 Rev 2 is pending. The revision does not affect the inputs used in this calculation.	N/A	OK
25.	5.1 References p5 (E) Spelling should be "Setpoints"	Changed	OK
26.	5.2 References p5 (E) Spelling should be "Setpoints"	Changed	OK
27.	5.7 References (E) Title of Calculation should be "Instrument Setpoint calculation, Average Power Range Monitor (APRM) Flow-Biased Upscale Scram and Rod Block"	Changed	OK
28.	5.7 References (E) Issue date should be 4/13/07	Deleted issue date due to revision	OK
29.	5.8 References (E)	Deleted issue date	OK

	Issue date should be 12/13/07	due to revision	
30.	5.12 References p6 (E) Title should be "Instrument Setpoints for Safety-Related Instrumentation"	Changed	
31.	5.13 References p6 (T) FTR T0506 Rev 2 is pending. The revision does not affect the inputs used in this calculation.	N/A	OK
32.	5.14 References p6 (E) Document number should be NEDO-31336P-A and date should be September 1996	Changed	OK
33.	5.15 References p6 (E) Add space between % and RTP and delete extraneous comma	Changed	OK
34.	5.16 References p6 (T) Extract appropriate information from this reference and attach to calculation as an obscure reference.	5.15 is also Input 4.12 and Attachment 8	OK
35.	5.18 References p6 (T) Add date of issue (18 Jan 08) and include a note that TSTF is not yet approved.	Added date and stated not approved	OK
36.	6 Assumptions p6 (P) Assumptions may be implied concerning seismic effect, RFI/EMI, environmental temperature conditions, and radiation environment. GE Reports specify some of effects as negligible, but the calculation needs to provide references that these inputs are applicable to MNGP or state these as assumptions.	Added reference to Input 4.2 / 4.3 - Comment 4 in the uncertainty tables. Comment 4 discusses seismic effect, RFI/EMI, radiation, power supply effect and humidity. Table updated temperatures	OK OK
37.	7.1.1 p7 Channel Diagram (P) Indicate that there are multiple LPRMs feeding inputs to the electronics.	Channel Diagram updated to indicate multiple LPRM inputs	OK
38.	7.1.2 p7 Channel Function (T) Per ESM-03.02-APP-I 5.1.2 Channel description should indicate that there are four channels and 2-out-of-4 voter logic determines actual Scram.	Added 2/4 voter logic and other PRNM APRM logic differences	OK

Design Review Comment Form

	Similar discussion for Rod Blocks.		
39.	7.2.1 LPRM Detectors (T) Per DIR T0500 R2 installed detectors are GE NA300 detectors. Device 1 information appears to be for Local Power Range Monitor Electronics not detectors. There are 24 strings of detectors with 4 detectors per string (96 detectors with one amplifier per detector). I believe that all equipment other than the detectors and drywell cabling will be replaced as part of PRNMS. Passport equipment database does not appear to contain information or IDs for detectors. Update IDs and model number with input from modification team. Correct reference since information is not in Passport as indicated. (See DIR T0500 R2.)	Added all 24 LPRM Equipment IDs	OK
40.	7.2.1 LPRM Detector p8 (T) Correct Reference for Process Element should be Section 1 of Input 4.2 and 4.3	Changed	OK
41.	7.2.1 p8 Device 1 (T) LPRM Detector Add data items required per ESM-03.02-APP-I 5.2.1. List as N/A if the data item is not applicable. Definition of Input (neutron flux) and Output signals is required.	Added 5.2.1 parameter list	OK
42.	7.2.1 p8 Device 1 (T) LPRM Detector ESM-03.02-APP-I 5.2.2 requires listing of Process and Physical Interfaces. LPRM detectors are exposed to in-core conditions. Calibration is via TIP monitoring. Provide data or explain why data isn't required for the above requirement.	Added 5.2.2 parameter list	OK
43.	7.2.1 p8 Device 1 (T) LPRM Detector All listed error terms in ESM-03.02-AP-I 5.2.3 are to be explicitly addressed in each calculation. Recommend that the specific	Added 5.2.3 parameters	OK

	abbreviations listed in 5.2.3 be used to demonstrate compliance.		
44.	7.2.2 p8 Power Electronics (T) Refer to NEDC-32410P-A V1 5.3.17.2 and 5.3.17.3 for description of input and output signals.	Added input and output descriptions	OK
45.	7.2.2 p9 Power Electronics (P) Calibration Error discussion in Inputs 4.2 and 4.3 are discussed in Section 4 Comment 11. Incorporate this discussion in the calculation.	Added Comment 11 to Section 7.2.2	OK
46.	7.3.1.1 pp10,11 Loop Accuracy (T) Result is correct, but does not clearly show that all uncertainty terms in ESM-03.02-APPI 5.2.3 equation are considered.	Sections 7.2.1 and 7.2.2 have all the parameters listed from Section 5.2.3.	OK
47.	7.3.1.2 p11 Drift DTE not addressed in the calculation per ESM-03.02-APP-I.	DTE evaluation has been added	OK
48.	7.3.1.3 through 7.3.1.5 pp11-12 (T) Incorporate changes to ALT and AFT to address NRC position on calculating these values for a digital instrument system. Summary of method should also be included in section 2 Methodology. Add Future Needs to update guidelines and procedures to document the method if different from current guidance.	Open item. Decision needs to be made on basis for AFT/ALT. Revised Section 2 to state GEH methodology used for AFT/ALT.	OK
49.	7.3.1.6, and 7.3.1.7 PEA (T) See Comment #34.	Attachments added for several references specified in body of calculation. See TOC	OK
50.	7.3.1.9 and 7.3.2 pp13, 14 Tabulations (P) Abbreviations do not match the rest of 7.3.1 and are confusing	Added description of the abbreviations to the uncertainty tables	
51.	7.4.1.1 p15 Required Margin Computation includes DPEA (.054%) which is incorrect. Should be APEA (0.267%).	Changed	OK
52.	7.4.1.1 p15 Minimum Required Margin	Changed to 1.334	OK

Design Review Comment Form

	Value for C_L in 7.3.1 was 1.334, but this computation used 1.333.		OK
53.	7.4.1.2 p16 NTSP (E) Spelling NPSP should be NTSP in first equation.	Changed	OK
54.	7.4.1.4 p18 STA (T) Incorrect value of C_L. Should be 1.334%.	Changed	
55.	7.4.1.4 p18 STA (T) Per GE guidelines 4.5.4.b. Bias term for APEA should be used in STA evaluation. Drift bias should not be included.	Added Input 4.13, Section 4.5.4.b and 4.5.9.b as basis for bias term added	OK
56.	7.4.1.4. p18 STA Add units for σ_{STA}	Added units	OK
57.	7.4.1.4 p18 STA (T) STA test uses an a value of Operational Limit of 100%. This is not discussed or justified as an entry in the calculation.	Gave reference for Operational Limit	OK
58.	7.4.2 p19 Setdown Scram and Rod Block (E) Delete extraneous paragraph number in the title	Deleted	OK
59.	7.4.2.1 p19 (AL to AV) (E) Awkward wording. Revise similar to 7.4.2.2 or simply state that the "Minimum required margin between the AL and AV can be defined by:" followed by the term equation.	Revised	OK
60.	7.4.2.4 p21 LER Avoidance (E) Add units for σ_{LER}.	Added units	OK
61.	7.4.2.4 p21 LER Avoidance (E) Add Units for $NTSP_2$.	Added units	OK
62.	7.4.2 STA Test An Operational Limit of 11% is identified for the APRM Setdown Scram. Calculation does not perform a STA test for this setpoint.	Added STA calculation for this section	OK
63.	7.4.3 p22 Downscale Rod Block (T) Input 4.3 establishes recommended AV and NTSP for EPU. Statement that this input establishes CLTP value	Revised discussion of the Downscale Rod Block for both CLTP and EPU sections.	OK

Design Review Comment Form

	is incorrect. Input 4.2 did not address Downscale Rod Block. Since EPU has no impact on this setpoint or its uncertainties, it is acceptable to use this as the basis for establishing the CLTP values. Discuss this in the calculation. This also needs to be included in the calculation Purpose.	Revised discussion in Purpose	
64.	7.4.3.4 p24 LER Avoidance (E) Add units for σ_{LER}.	Added units	OK
65.	7.5.1.2 p27 AM table (E) Prevent orphaning the header and body of the table.	Re-formatted section	OK
66.	7.5.1.3 p28 LER Avoidance (E) Add units for σ_{LER}.	Added units	OK
67.	7.5.1.4 p29 STA (T) Per GE guidelines 4.5.4.b. Bias term for APEA should be used in STA evaluation. Drift bias should not be included.	Added GE guidelines 4.5.4.b and 4.5.9.b as basis for drift bias	OK
68.	7.5.1.4 p29 STA (T) STA test uses an a value of Operational Limit of 100%. This is not discussed or justified as an entry in the calculation.	Added reference for Operational Limit of 100 %	OK
69.	7.5.2.1 p30 (AL to AV) (E) Awkward wording. Revise similar to 7.5.2.2 or simply state that the "Minimum required margin between the AL and AV can be defined by:" followed by the term equation.	Revised to clarify wording	OK
70.	7.5.2 p30 STA Test (T) An Operational Limit of 11% is identified for the APRM Setdown Scram. Calculation does not perform a STA test for this setpoint.	Added STA Test for this section	OK
71.	7.5.3 p33 APRM Downscale (T) Add discussion similar to the GEH recommendations for changes to the AV and NTSP for Neutron Glux High. Although GE recommends a change for NTSP from 3.5% to 4%, there is no reason not to leave the setpoint at	Revised calculation to justify 3.5 % EPU Downscale Rod Block setpoint. Added discussion of GEH documents on this subject. .	OK

	the current value of 3.5% which is established in CA-05-153. Revise the calculation accordingly to use NTSP of 3.5%		
72.	7.5.3.4 p35 LER Avoidance (E) Add units for σ_{LER}.	Added units	OK
73.	8.3 p38 EPU Operation (T) Revise NTSP for DOWNSCAL Rod Block to 3.5%	Inserted 3.5% Downscale Rod Block in table	OK
74.	9.1, 9.3 p38 APRM Downscale Rod Block (T) Delete discussion of change to NTSP.	Revised discussion since 3.5 % is setpoint	OK
75.	9.6 (E) Spelling APRN should be APRM.	Corrected	OK
Reviewer: Chuck Nelson Date: ~~07/09/08~~ CMN 8/11/08 [signature]		Preparer: Joseph Balitski Date: ~~07/29/08~~ JB 8/11/08 [signature] 8/11/08	

NMC Committed to Nuclear Excellence Fleet Modification Process	**Design Review Comment Form**

Sheet _1_ of _9_

DOCUMENT NUMBER/ TITLE:
CA-08-050
Instrument Setpoint Calculation – Average Power Range Monitor (APRM) Non-Flow Biased PRNM Setpoints for CLTP and EPU

REVISION: ____0____ DATE: __7/14/08__

E=Editorial
P=Preference
T=Technical

ITEM #	REVIEWER'S COMMENTS	PREPARER'S RESOLUTION	REVIEWER'S DISPOSITION
1.	QF-0549 p.1, Title (E): Minor spacing typo	Corrected	OK
2.	QF-0549 p.1, Major Revisions (T): Isn't the calculation being performed under EC12899?	Changed EC 10856 to EC 12899. EC 12899 is for CA-08-050 impact.	OK
3.	QF-0549 p.1, Major Revisions (P): Description of Revision field should be "Original Issue" for a Rev. 0.	Changed to Original Issue	OK
4.	QF-0549 pp. 3-4, Reference Documents (T): Items 8 through 15 and 18 through 20 are NOT listed as inputs in the calculation so INPUT field should NOT be checked.	Item 8(96-224) Not Input; Item 9 (31336) Changed to Item 10. Item 10 is now referenced in calc for Eqs; Item 11(0017) Not Input; Item 12 (GE) Input now, Attachment 9; Item 13 (TS) Not Input Item 14 (TRM) Not Input Item 15 (1.105)Not Input Item 18 (TSTF)Not Input Item 19 (RIS) Not Input Item 20(12899) Output	OK
5.	QF-0549 p.4, Reference Documents (E): Items 10 and 16 missing – consider renumbering list.	Renumbered reference list	OK
6.	QF-0549 p.4, Reference Documents (T): RG, TSTF, RIS are NOT controlled documents so boxes are	Changed to use Passport names	OK

	not checked. Therefore, these mnemonics should not be listed per "*" note at bottom of page.		
7.	QF-0549 p.4, Reference Documents (T): Item 20 should be EC10856.	Changed to EC 10856	OK
8.	QF-0549 p.4, Reference Documents (T): Should include as PROCs APRM Calibration, ISP-NIP-0588, and APRM Heat Balance, OSP-NIP-0590, as OUTPUT documents (not sure about OSP-NIP-0590 though).	ISP-NIP-0588, OSP-NIP-0590 are not approved yet. Same for ISP-NIP-0589-01, ISP-NIP-0589-02	OK
8.a	QF-0549 p.5, Superseded Calculations (E): Statement that calc is not affected until the installation of the PRMNS retrofit should be in both calculation entries – applies to CA-96-224 too.	Incorporated statement on PRNM installation via EC 10856.	OK
9.	3494 p.1, Title (E): Typo Biased vs. Eiased.	Changed	OK
10.	3494 p.1, 50.59 Screening or Evaluation No (E): This field requires one valid 50.59 screening number. If one is being prepared for EC12899, then that should be listed and EC-10856 should NOT be listed as a reference. (This idea of performing the calculation outside of EC-10856 may be problematic).	Changed to only EC 10856 for screening.	OK
11.	3494 p.1, Other Comments field (E): should be "None."	Added: "Section 9, Future Needs, for list of impacted documents IAW Calc procedure FP-E-CAL-01, Attach 4, step 3.b.7	OK
12.	CA-08-050 All Pages, Title (E): For consistency, should be "...Non-Flow Biased..." Also revise in body of calculation whenever it appears.	Changed to Non-Flow Biased for consistency.	OK
13.	CA-08-050 p.1, TOC (E): QF-0549 has 6 pages and Body has 43 for total of 52 (unless other comments result in different values).	Corrected TOC	OK

14.	CA-08-050 p.1, TOC (E): Consider including TOC in outline at page 1.	Made TOC a stand alone, page 1 of 1 sheet.	OK
15.	CA-08-050 p.1, PURPOSE (E): Not only does the retrofit change how the point functions but it changes its title too – a small distinction perhaps.	Added setpoint name change along with the function change.	OK
16.	CA-08-050 p.1, PURPOSE (T): Site has determined the RBM Low Power, Intermediate Power, and High Power Setpoints are nominal values in technical specifications and, therefore, will not have uncertainties associated with them. This decision impacts the work in CA-08-051. CA-08-051 should state this position. Will this impact whether those 3 points are considered to be calculated in CA-08-051 and then listed in CA-08-050 Purpose section?	The plan is to address RBM LTSP, ITSP and HTSP in CA-08-051. Persmissive setpoints LPSP, IPSP and HPSP will also be discussed in CA-08-051. Changed listing to LTSP, ITSP and HTSP.	OK
17.	CA-08-050 p.1, Purpose (E): for consistency CA-08-052 should be ...Flow Biased..." (Without the "-").	Changed title to Flow Biased vs Flow Referenced.	OK
18.	CA-08-050 p.3, Purpose (E): procedure 1383 will be renumbered ISP-NIP-1383 under EC10856.	Added the future change to 1383 with regard to ISP-NIP-1383	OK
19.	CA-08-050 p.4, Inputs (T): Item 4.1 the reference numbers are confusing. Either "(Reference 5.)" should be "(Reference 5.9)" or deleted entirely if Reference 5.14 is the only document being referenced.	Changed to Inputs 4.13 and 4.11 because both are referenced in the body of the calculation	OK
20.	CA-08-050 p.5, Inputs (E): Item 4.8 consider referring to the EC AEL instead of the entire passport database.	Deleted original passport database reference (original Input 4.8 deleted).	OK
21.	CA-08-050 pp. 5 and 6, Inputs (E): Why are Items 5.1 through 5.6, and 5.12 through 5.13 listed as references when they are already inputs?	FP-E-CAL-01, Att 1 states Reference Section is to include all Input and Output documents.	OK

22.	CA-08-050 p.6, Inputs (E): Input 5.15 is a procedure and should NOT be used as the bases for the +/-2% setting tolerance.	Moved to Reference section, Ref 5.15, since this is not an input for the calculation.	OK
23.	CA-08-050 p.7, 7.1.2 Channel Function (E): "scram should be Scram" – check throughout document.	Changed scram to Scram for consistency.	OK
24.	CA-08-050 p.8, 7.2.1/7.2.2 Device 1 and Device 2 (T): Make for LPRMs ought to be GEH/Reuter Stokes and for Power Electronics ought to be GE.	Changes made to reference manufacturer.	OK
25.	CA-08-050 p.8, 7.2.1 Device 1 (E): Drift/APEA/DPEA/Min # of LPRM need an extra space in the Reference(s) column.	Reformatted tables in Section 7.2.1 and 7.2.2	OK
26.	CA-08-050 p.8, 7.2.2 Device 2 (T): Should include as Output signals the Flux Recorders, Flow Recorders, Flow Indicators, Computer Points via the fiber optic data link, and the APRM/ODA displays.	APRM analog output is: - 10 to + 10 V dc for various devices. Reference is made in 7.2.2.1	OK
29.	CA-08-050 p.8, 7.2.2 Device 2 (T): Should the reference for the Input and Output signals be the LTR?	LTR is a Input reference, Input 4.5.	OK
30.	CA-08-050 p.9, 7.2.2 Device 2 (P): Input Power Process Measurement Accuracy should be only Process Measurement Accuracy.	Changed to PMA. Deleted "Power"	OK
31.	CA-08-050 p.9, 7.2.2 Device 2 (T): Shouldn't the root basis document for the As Left and As Found tolerance values be something other than GEH's calculation?	The basis documents for AFT/ALT are GEH. Also, Sections 7.3.1.3 and 7.3.1.4 evaluated AFT/ALT for uncertainty and calibration tolerance.	OK
32.	CA-08-050 p.9, 7.2.2 Device 2 (T): Power Supply Effect (LPRM Detector) indicates to see APRM PEA but no discussion of this being included is in section 7.3.1.6.	Added statement to 7.3.1.6 referencing the Power Supply Effect for the LPRM detector.	OK

33.	CA-08-050 p.9, 7.2.2 Device 2 (P): Calibration Error of n/a may be technically correct but we still have not received a minimum specification from GE for the DVM, Oscilloscope, and Frequency Counter required to perform the calibration of the APRM chassis.	GE has not provided specs for calibration instruments.	OK
34.	CA-08-050 p.9, 7.2.2 Device 2 (P): Consider not splitting Plant Data table across 2 pages.	Reformatted	OK
35.	CA-08-050 p.10, 7.3.1.1 Loop Accuracy of Device 1 (E): Refer to item 7.2.1 for the minimum number of LPRMs is 14.	Added Ref 7.2.1.1 to Section 7.3.1.1 to reference the min # of LPRMs	OK
36.	CA-08-050 p.10, 7.3.1.1 (P): Consider an explanation that the maximum accuracy value occurs at the minimum number of operable LPRMs.	Included discussion with numerical calculation that shows accuracy error increases with less LPRMs averaged. Min # LPRM used.	OK
37.	CA-08-050 p.12, 7.3.1.6 (E): There is some confusion between $APEA_L$ as the Loop Primary Element Accuracy $_{ACCURACY}$ and the random component of APEA – both use the same designation; $APEA_L$. The Loop Primary Element Accuracy is made of the random and bias components. Consider changing the random component to something like $APEA_R$. Then carry this through to wherever it is referenced.	Rephrased the APEA section to define the Random and Bias variables. Included discussion of the definition of APEA for this calculation.	OK
38.	CA-08-050 p.12, 7.3.1.7 (E): There is some confusion between $DPEA_L$ as the Loop Primary Element $Accuracy_{DRIFT}$ and the random component of DPEA – both use the same designation; $DPEA_L$. The Loop Primary Element Accuracy is made of the random and bias components. Consider changing the random	Rephrased the DPEA section to define the Random and Bias variables. Included discussion of the definition of DPEA for this calculation	OK

	component to something like $DPEA_R$. Then carry this through to wherever it is referenced.		
39.	CA-08-050 p.12, 7.3.1.7 (E): Underline section heading.	Made change	OK
40.	CA-08-050 p.13, 7.3.1.8 (E): What is the first "A" for in APMA? APRM?	A is acronym for APRM. Added acronym sheet.	OK
41.	CA-08-050 p.13, 7.3.1.9 (E): PMA_L should be $APMA_L$.	Changed to $APMA_L$ for consistency	OK
42.	CA-08-050 p.13, 7.3.1.9 (P): Consider adding a column of reference sections (7.3.1.1, 7.3.1.2, 7.3.1.4, 7.3.1.6, 7.3.1.7, 7.3.1.8, 7.3.1.3, 7.3.1.5, 7.3.1.6, 7.3.1.7).	Added reference column for each uncertainty calculation	OK
43.	CA-08-050 p.14, 7.3.2 (P): Table should be given its own section 7.3.2.1 just like the table in 7.3.1.9.	Added separate section for Table	OK
44.	CA-08-050 p.13, 7.3.2 (E): PMA_L should be $APMA_L$.	Changed to $APMA_L$	OK
45.	CA-08-050 p.13, 7.3.2 (P): Consider adding a column of reference sections (7.3.1.1, 7.3.1.2, 7.3.1.4, 7.3.1.6, 7.3.1.7, 7.3.1.8, 7.3.1.3, 7.3.1.5, 7.3.1.6, 7.3.1.7).	Added Columns for reference sections	OK
46.	CA-08-050 p.15, 7.4.1 (E): Formatting error – text around the table.	Table re-sized	OK
47.	CA-08-050 p.15, 7.4.1.1 (E): Equation should refer to $APEA_L$, not APEA. This is incorrect throughout the document in all AV evaluation sections. See also 7.4.1.2, 7.4.2.1, 7.4.2.2, 7.4.3.1, 7.4.3.2, 7.5.1.1, 7.5.1.2, 7.5.2.1, 7.5.2.2, 7.5.3.1, and 7.5.3.2.	Changed to $APEA_L$, Also changed APMA and DPEA to $APMA_L$ and $DPEA_L$	OK
48.	CA-08-050 p.15, 7.4.1.1 (P): Should the definition of Required Margin be an absolute value to avoid addressing negative results?	Absolute value symbol not required since values are not negative	OK

49.	CA-08-050 p.15, 7.4.1.1 (T): C_L value is incorrect but equation result is correct. Should be 1.334.	Changed to 1.334	OK
50.	CA-08-050 p.15, 7.4.1.1 (T): Incorrect $APEA_L$ value listed but equation result is correct. Should be 0.267.	Corrected. Included $APEA_L$ value of 0.268 (rounded up).	OK
51.	CA-08-050 p.16, 7.4.1.2 (E): NTSP vs. NPSP in equation.	Typo corrected	OK
52.	CA-08-050 p.16, 7.4.1.2 (E): Equation should refer to $DPEA_L$, not D_L. This is incorrect throughout the document in all NTSP evaluation sections. See also 7.4.2.2, 7.4.3.2, 7.5.1.2, 7.5.2.2, and 7.5.3.2.	Agree, Changed to $DPEA_L$ throughout	OK
53.	CA-08-050 p.17, 7.4.1.2 (E): Should say: "(5.5% versus 3.08% power)" to be consistent with other similar sections.	Changed for consistency with other sections	OK
54.	CA-08-050 p.18, 7.4.1.4 (T): C_L value is incorrect but equation result is correct. Should be 1.334.	Changed to 1.334	OK
55.	CA-08-050 p.18, 7.4.1.4 (T): ESM indicates STA calculation should include any bias terms present during normal operation. Therefore, $APEA_B$ of 0.49 should be added. $Sigma_{STA}$ = 1.86 and Z = 9.77 which are still acceptable.	Agree, $APEA_b$ of 0.49 has been added. A Ref to Input 4.12 was added as a basis for the bias term.	OK
56.	CA-08-050 p.19, 7.4.1.4 (T): Z equation should use 1.334 instead of 1.33.	Corrected	OK
57.	CA-08-050 p.19, 7.4.2 (E): Extra section number in title.	Corrected	OK
58.	CA-08-050 p.19, 7.4.2 (E): Missing colon at end of 1st sentence.	Corrected	OK
59.	CA-08-050 p.21, 7.4.2.4 (T): Calculation of Z and $NTSP_2$ should be	Added Z and $NTSP_2$ calculation for the	OK

	documented for the rod block at 15.0% and 13.0% even though the result is identical.	Setdown Rod Block in Sec 7.4.2.4 (LER Avoidance Test)	OK
60.	CA-08-050 p.22, (T) Missing the STA calculation for Setdown Scram and Rod Block.	Added STA for Setdown Scram. Per Input 4.2, Comment 3, GEH states STA evaluations are not performed for Rod Blocks or permissives.	OK
61.	CA-08-050 p.25, (T) Missing the STA calculation for Downscale.	Input 4.2, Comment 3, states STA not performed for Rod Block.	OK
62.	CA-08-050 p.26, 7.5.1.1 (E): Underline section heading.	Corrected	OK
63.	CA-08-050 p.27, 7.5.1.2 (E): Don't allow table to break across pages.	Corrected	OK
64.	CA-08-050 p.29, 7.5.1.4 (T): ESM indicates STA calculation should include any bias terms present during normal operation. Therefore, $APEA_B$ of 0.49 should be added. $Sigma_{STA}$ = 1.86 and Z = 9.77 which are still acceptable.	Added APEA bias term and added Input 4.13 as reference for the basis to include the APEA bias term	OK
65.	CA-08-050 p.31, 7.5.2.2 (E): Should say: "...the NTSP from the AL." instead of "...the AV from the AL."	Corrected	OK
66.	CA-08-050 p.32, 7.5.2.4 (T): Calculation of Z and $NTSP_2$ should be documented for the rod block at 15.0% and 13.0% even though the result is identical.	Added calculation of Z and $NTSP_2$ for Section 7.5.2.4	OK
67.	CA-08-050 p.33, (T): Missing the STA calculation for Setdown Scram and Rod Block.	Added STA for Setdown Scram. Per Input 4.3, Comment 3, GEH states STA evaluations are not performed for Rod Blocks or permissives.	OK
68.	CA-08-050 p.33, 7.5.3 (E): Reference to Input 4.10 should be 4.9.	Revised Inputs. 4.8 is correct reference	OK

69.	CA-08-050 p.36, (T): Missing the STA calculation for Downscale.	Per Input 4.3, Comment 3, GEH states STA evaluations are not performed for Rod Blocks or permissives.	OK
70.	CA-08-050 p.37, 8.1 (E): Given 47 and 52, should table items $APEA_L$ and $DPEA_L$ be revised?	Separated $APEA_L$ and $DPEA_L$ into the Random and bias terms	OK
71.	CA-08-050 p.38, 9 (T): Need to include CAP numbers for 9.1, 9.2, and 9.3.	GARs: 01146760, 01146761 and PCR 01146750 initiated	OK
72.	CA-08-050 p.39, 9.8 (T): Need a tracking number for DBD but it isn't a PCR – see PRNMS Project Engineer.	GAR 1138038 listed for DBD changes.	OK
73.	CA-08-050 p.39, 9.9, 9.10, and 9.11 (T): Need tracking number for licensing documents but it isn't a PCR – see licensing engineer.	LAR 011128839 for TRM, GARs 01146762 and 01146763 for TS and Bases	OK
74.	CA-08-050 p.40, 9.12 and 9.13 (E): Include PCR numbers for B.05.01.02-05.	All Section 9 impact documents have tracking documents listed. B.05. 01.02-05 & PCR listed	OK
75.	CA-08-050 p.41, Attachment 1 (T): Shouldn't APRM High Flux Scram – CLTP and EPU Operation lower As Found/As Left value be 118.2?	119.5 NTSP – 1.34% =118.16 % RTP; Conservative valve would be 118.2	OK
76.	CA-08-050 p.41, Attachment 1 (T): Shouldn't APRM Setdown Scram for CLTP and EPU Operation upper As Found/As Left value be 19.3?	18.0 NTSP + 1.34 = 19.34; 19.3 is more conservative than 19.33.	OK
77.	CA-08-050 p.42, Attachment 1 (T): Shouldn't APRM Downscale Rod Block – CLTP Operation lower As Found/As Left value be 2.2?	3.5 % - 1.34% = 2.16%; 2.2 % is conservative. Changed to 2.2 % RTP	OK

Per Telecon 8/12/08 for [signature]

Reviewer: Randy L Nuelk Date: 7/14/08

[signature] 8/11/08

Preparer: Joseph Balitski Date: ~~08/07/08~~ JB 8/11/08

QF-0528 (FP-E-MOD-07) Rev. 0

NMC
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Fleet Modification Process

Design Review Comment Form

Sheet 1 of 2

DOCUMENT NUMBER/ TITLE: CA-08-050, Instrument Setpoint Calculation – Average Power Range Monitor (APRM) Non Flow Biased PRNM Setpoints for CLTP and EPU.

(Peer Review Comments – Rhon Sanderson) REVISION: 0 DATE: 07-28-08

ITEM #	REVIEWER'S COMMENTS	PREPARER'S RESOLUTION	REVIEWER'S DISPOSITION
1.	Table of Contents has discrepancies vs. actual document with regard to page counts and start pages for calc sections.	Revised TOC Repaginated	OK
2.	Page 3 of 43, Section 2 "NEDC-31336 (Reference 5.7)" change to "....(Reference 5.14)"	Changed to Input 4.11 which is the same as 5.14. Input 4.11 is referenced in Calc	OK
3.	Page 3 of 43, Section 2 "GE-NE-901-021-0492 (Reference 5.6)" change to ".... (Reference 5.9)"	Changed to Input 4.13, which is same as 5.9. Input 4.13 is referenced in Calc.	OK
4.	Page 3 of 43, Section 2 "ESM-03.02-APP-1" change to "ESM-03.02-APP-I"	Changed	OK
5.	Page 10 of 43, Section 7.3.1.1 "+/- 0.252 % Power" is not rounded conservatively	Value is 0.25202, so that should be 0.253. Corrected	OK
6.	Page 12 of 43, Section 7.3.1.6 "0.267 % Power" is not rounded conservatively	Value is 0.26726.., so that should be 0.268. Corrected	OK
7.	Page 13 of 43, Section 7.3.1.8 "+/- 2.287 % Power" is not conservatively rounded	Value is 2.28737.., so that should be 2.289. Corrected	OK
8.	Page 15 of 43, Section 7.4.1.1 Value of "1.333" in RM equation should be "1.334". "(0.054)^2" in RM	Corrected to 1.334	OK

	equation should be "(0.267)^2". It appears that the "2.69 %" results remains correct.		
9.	Page 16 of 43, Section 7.4.1.2 RM equation is missing "(0.054)^2" term. It appears that the "3.08 %" result remains correct. This error shows up in similar RM equations through remainder of the calc body.	Agree $DPEA_L$ (0.054) was as added to all applicable calculations through-out calculation	OK
10.	Page 18 of 43, Section 7.4.1.4 Sigma value of "1.37" is not rounded conservatively. Bias errors should be taken out of the delta between the adjusted NTSP and the Operational Limit prior to evaluating this delta against sigma to determine Z value (for conservatism). This comment applies to the spurious trip avoidance eval. in Section 7.51.4 as well. Note that "(0.054)^2" term is missing from the sigma equation in spurious trip avoidance evals.	Sigma was recalculated to 1.87 by adding bias term $APEA_b$ in accordance with Input 4.13. ~~Input 4.13 pages are included in Attachment 9.~~	OK
11.	Page 3 of 43, Section 2 Eliminate discussion of Excel spreadsheet with regard to calculation of values. Hard equations and numbers in calc need to stand on their own unless Excel computations are attached and independently evaluated, which would not be necessary in this case. Number of significant digits and conservative rounding needs to be cleaned up a little in the calc, although no changes in end results are expected.	Hand calculator checks have been performed to verify rounding is conservative. Deleted discussion of Excel spreadsheet.	OK

Reviewer: [signature] (Rhon Sanderson) Date: 08-11-08

Preparer: Joseph Balitski [signature: Joseph Balitski 08/11/08] Date: ~~07/29/08~~ JB 08/11/08

MONTICELLO NUCLEAR GENERATING PLANT		3494
TITLE:	**CALCULATION COVER SHEET**	Revision 17
		Page 1 of 1

Title *Instrument Setpoint Calculation - Average Power Range Monitor (APRM) Non-Flow Biased PRNM Setpoints for CLTP and EPU* CA- *08* - *050* Rev. *0*

10 CFR50.59 Screening or Evaluation No: *50.59 Screening not required. Calculation is submitted as part of LAR*

Associated Reference(s): *EC 12899 Plant Impact from CA-08-050*

Does this calculation:	YES	NO	Calc No(s), Rev(s), Add(s)
Supercede another calculation?	☒	☐	*Ref QF-0549 (Calculation Signature Page, attached). r*
Augment (credited by) another calculation?	☐	☒	
Affect the Fire Protection Program per Form 3765?	☐	☒	If Yes, attach Form 3765
Affect piping or supports?	☐	☒	If Yes, attach Form 3544
Affect IST Program Valve or Pump Reference Values, and/or Acceptance Criteria?	☐	☒	If Yes, inform IST Coordinator and provide copy of calculation

What systems are affected?

DBD Section (if any): DBD-B.05.01, Neutron Monitoring System

Topic Code (See Form 3805): NIP Power Range Monitors

Structure Code (See Form 3805): RATE - Rerate/Power Uprate

Other Comments: Section 9, Future Needs - List of impacted documents

Prepared by: Joseph Balitski (signature) Date: 8-11-08

Print/Signature Joseph Balitski

M/cah

A_L	Loop Instrument Accuracy
AFT	As-Found Tolerance
AFT_L	Loop As-Found Tolerance
AGAF	APRM Gain Adjustment Factor
AL	Analytical Limit
ALT	As-Left Tolerance
ALT_L	Loop As-Left Tolerance
$APEA_L$	Loop APRM Primary Element Accuracy
$APEA_R$	Loop APRM Primary Element Accuracy Random
$APEA_b$	APRM Primary Element Accuracy bias
$APMA_L$	Loop APRM Process Measurement Accuracy
APRM	Average Power Range Monitor
AV	Allowable Valve
C_L	Loop Calibration Accuracy Error
CLTP	Current Limiting Thermal Power
D_L	Loop Instrument Drift
$DPEA_L$	Loop Drift Primary Element Accuracy
$DPEA_R$	Loop Drift Primary Element Accuracy Random
DTE	Drift Temperature Effect
$DPEA_b$	Drift Primary Element Accuracy bias
EPU	Expanded Power Uprate
FS	Full Span
GEH	GE-Hitachi Nuclear Energy
IRM	Intermediate Range Monitor
LER	Licensee Event Report
LPRM	Local Power Range Monitor
NMS	Neutron Monitoring System
NTSP	Nominal Trip Setpoint
NUMAC	Nuclear Measurement Analysis and Control
OL	Operational Limit
P/C	Plant Process Computer
PEA	Primary Element Accuracy
PMA	Process Measurement Accuracy
PRNM	Power Range Neutron Monitoring
PRNMS	Power Range Neutron Monitoring System
RTP	Rated Thermal Power
SRM	Startup Range Monitor
STP	Simulated Thermal Power
STA	Spurious Trip Avoidance

1. PURPOSE

This calculation provides design basis setpoint analysis for the Allowable Values (AV) and Nominal Trip Setpoints (NTSP) for the Power Range Neutron Monitoring (PRNM) APRM setpoints associated with the installation of EC 10856. EC-12899 documents the plant impact and configuration changes from the calculation. The following setpoints are evaluated for PRNM CLTP and EPU operation in accordance with setpoint control program and NRC commitment M87051A:

- APRM Neutron Flux - High Scram
- APRM Neutron Flux - High (Setdown) Scram
- APRM Neutron Flux - High (Setdown) Rod Block
- APRM Downscale Rod Block

The NUMAC PRNM retrofit is a digital neutron monitoring system that replaces the analog NIP System - Power Range Monitoring System. This calculation evaluates the above setpoints and determines the available margin based on PRNM retrofit uncertainty parameters for CLTP and EPU operation. The PRNM retrofit affects the above setpoints as follows:

1. PRNM adds two new neutron monitoring setpoints for CLTP and EPU operation. These are identified above as the APRM Neutron Flux – High (Setdown) Scram and APRM Neutron Flux – High (Setdown) Control Rod Block. The function of the setpoints is described in Section 7.1.2.

2. The PRNM retrofit changes how the current APRM Flow Referenced Neutron Flux - High High setpoint functions and changes the setpoint name. The existing APRM Flow Referenced Neutron Flux – High High setpoint is changed to a non-flow biased setpoint identified as APRM Neutron Flux - High Scram, which is independent of core recirculation flow. The function is described in Section 7.1.2.

3. The APRM Downscale Rod Block is an existing CLTP setpoint. The setpoint does not change for PRNM CLTP and EPU operation. GEH setpoint documentation, Input 4.3, recommended a NTSP setpoint of 4.0 % RTP for EPU operation. This calculation provides the design bases to use the existing CLTP NTSP setpoint of 3.5 % RPT.

This PRNM based neutron monitoring system (NMS) calculation supersedes calculations CA-05-153 (Reference 5.8) and CA-96-224 (Reference 5.7). Section 9 (Future Needs) describes the affect on these calculations due to PRNM implementation.

In addition to the PRNM non-flow bias neutron monitoring setpoints identified above, the PRNM retrofit also creates new or changes other neutron monitoring setpoints. For completeness of the PRNM affected NMS setpoints, the following neutron monitoring setpoints will be evaluated in other calculations:

A. Calculation CA-08-051, Instrument Setpoint Calculation – Rod Block Monitor (RBM) PRNM Setpoints for CLTP and EPU Operation, which includes the following sub-calculations:
   - RBM Low Trip Setpoint (LTSP)
   - RBM Intermediate Trip Setpoint (ITSP)
   - RBM High Trip Setpoint (HTSP)

B. Calculation CA-08-052, Instrument Setpoint Calculation – Average Power Range Monitor (APRM) Flow Biased PRNM Setpoints for CLTP and EPU, which includes the following sub-calculations for Two Loop Operation (TLO) and Single Loop Operation (SLO):
   - APRM Simulated Thermal Power – High Scram (TLO)
   - APRM Simulated Thermal Power – High Scram (SLO)
   - APRM Simulated Thermal Power – High Rod Block (TLO)
   - APRM Simulated Thermal Power – High Rod Block (SLO)

C. Calculation CA-08-053, Average Power Range Monitor (APRM) Recirc Flow Instrumentation Calibration for PRNM CLTP and EPU, which includes the following subsections:
   - Recirc Flow transmitter Gain Scaling
   - NUMAC Recirc Flow Grain Factor Equation for Procedure 1383 (Core Flow Measurement System Calibration). Note: Procedure 1383 is to be renumbered to ISP-NIP-1383 under EC 10856.

2. METHODOLOGY

This calculation is performed in accordance with ESM-03.02-APP-I (Input 4.1). ESM-03-02-APP-I setpoint methodology is based on the following documents: General Electric Instrument Setpoint Methodology NEDC-31336 (Input 4.11) and Setpoint Calculation Guidelines for the Monticello Nuclear Generating Plant, GE-NE-901-021-0492 (Input 4.13). The General Electric Setpoint Methodology is a statistically based methodology. It recognizes that most of the uncertainties that affect instrument performance are subject to random behavior, and utilizes statistical (probability) estimates of the various uncertainties to achieve conservative, but reasonable, predictions of instrument channel uncertainties. The objective of the statistical approach to setpoint calculations is to achieve a workable compromise between the need to ensure instrument trips when appropriate, and the need to avoid spurious trips that may unnecessarily challenge safety systems or disrupt plant operation.

Drift Analysis: This calculation uses GE specified drift parameters for the applicable PRNM equipment and for the existing LPRM detectors.

The uncertainties associated with the overall PRNMS including the LPRMs, APRMs and associated hardware are appropriately considered and consistent with NRC approved GE methodology in establishing the APRM setpoints. The calculation uses GEH specified ALT and AFT tolerances to calculate loop uncertainty. These parameters are specified in Inputs 4.2 and 4.3 (GE PRNM documentation) and were converted to a 2σ value in accordance with Engineering Standards Manual ESM-03.02-APP-I, Rev 4 (Input 4.1). In addition to ALT and AFT tolerances for loop uncertainty, Sections 7.3.1.3 and 7.3.1.4 evaluated AFT/ALT for digital PRNMS surveillance calibration. The setpoints are numerical values stored in the digital hardware and not subject to drift. The ALT and AFT values for the setpoint are the same as the trip setpoint. Therefore, there is no tolerance band for the surveillance calibration test. Attachment 1, Setpoint Diagrams, states AFT/ALT tolerance will not be applied to surveillance calibration of the setpoints because PRNMS setpoints are digital and stored in PRNMS database.

3. ACCEPTANCE CRITERIA

The Scram Setpoint and Allowable Values should be such that the Analytical Limit (AL) will not be exceeded when all applicable instrumentation uncertainties are considered. For the Allowable Value (AV), the minimum required margin is calculated and compared to the available margin, which is AL minus AV. For the Nominal Trip Setpoint (NTSP) evaluation, the minimum required margin is calculated and compared to the available margin, which is AL minus NTSP.

For parameters that do not have AL, such as Setdown Scram and Rod block and Downscale Rod Block, the difference between the minimum required margins (AL to AV and AL to NTSP) constitute the minimum required margin between AV and NTSP. This minimum required margin is compared to the available margin, which is AV minus NTSP.

For the Licensee Event Report (LER) Avoidance Test setpoint evaluation, sufficient margin is verified between the NTSP and AV setpoints to prevent an LER condition. A Spurious Trip Avoidance (STA) setpoint evaluation is performed where applicable to assure that there is a reasonable probability that spurious trips will not occur using the selected setpoints.

4. INPUTS

4.1 Engineering Standards Manual ESM-03.02-APP-I, Appendix I (GE Methodology Instrumentation & Controls), Revision 4. The ESM provides plant specific guidance on the implementation of the General Electric guidelines (Input 4.13) and methodology (Input 4.11).

4.2 GEH: 0000-0077-9068 MNGP-PRNMS-APRM Calc-2008, Revision 2, DRF: 0000-0076-1670, March 2008, Average Power Range Monitor Selected PRNM Licensing Setpoints - CLTP Operation (NUMAC). This is a GEH basis document for the digital PRNM equipment and includes setpoint functions and instrument uncertainties for PRNM CLTP operation. This document is Attachment 2.

4.3 GEH: 0000-0081-6958 MNGP-PRNMS-APRM Calc 2008, Revision 0, DRF: 0000-0081-4903, March 2008, Average Power Range Monitor Selected PRNM Licensing Setpoints - EPU Operation (NUMAC). This is a GEH basis document for the digital PRNM equipment and includes setpoint functions and instrument uncertainties for PRNM EPU operation. This document is Attachment 3.

4.4 GEH-NE-0000-0076-2388, DRF 0000-0076-2387, Revision 1, MNGP PRNM Licensing Setpoints - CLTP Operation, December 2007. This document discusses the setpoint changes needed to license PRNM for CLTP operation.

4.5 NEDC-32410P-A, Volume 1 – Nuclear Measurement Analysis and Control Power Range Neutron Monitor (NUMAC PRNM) Retrofit Plus Option III Stability Trip Function, Licensing Topical Report, October 1995. The LTR was used to provide descriptions of the PRNM equipment. Input and output signal data was obtained from this document.

4.6 NEDC-32410P-A, Volume 2 – Nuclear Measurement Analysis and Control Power Range Neutron Monitor (NUMAC PRNM) Retrofit Plus Option III Stability Trip Function, Licensing Topical Report, October 1995. The LTR was used to provide description of the PRNM equipment.

4.7 NEDC-32410P-A, Supplement 1 – Nuclear Measurement Analysis and Control Power Range Neutron Monitor (NUMAC PRNM) Retrofit Plus Option III Stability Trip Function, Licensing Topical Report, Supplement 1, November 1997. The LTR was used to provide description of the PRNM equipment.

4.8 Task Report T0506, Revision 1, Project Task Report, NMC Monticello Nuclear Generating Plant Extended Power Uprate, Technical Specifications Setpoints, March 2008. This document provides PRNM CLTP and EPU setpoints addressed in this calculation.

4.9 Design Input Request (DIR) T0500, Rev 2, DRF 000-0040-9168, Neutron Monitoring System. This DIR provides design information on the LPRMs used for input to the PRNM equipment.

4.10 Specification 257HA594, Rev 1, Neutron Monitoring System, 12/3/85. Specification provides information on LPRM detectors and the existing analog neutron monitoring system. This document provides design specifications for the LPRMs.

4.11 NEDC-31336P-A, Class III, General Electric Instrument Setpoint Methodology, September 1996. Setpoint equations are referenced from this document.

4.12 I.S. Sokolnikoff and R.M. Redheffer, Mathematics of Physics and Modern Engineering, 1966. The equation for statistical averaging of inputs is referenced from this book. Pages are contained in Attachment 4.

4.13 GE-NE-901-021-0492, DRF A00-01932-1, Setpoint Calculation Guidelines for the Monticello Nuclear Generating Plant, October 1992. This calculation references this document for the inclusion of bias for the Spurious Trip Avoidance (STA) calculation.

5. REFERENCES

5.1 GEH: 0000-0077-9068 MNGP-PRNMS-APRM Calc-2008, Revision 2, DRF: 0000-0076-1670, March 2008, Average Power Range Monitor Selected PRNM Licensing Setpoints - CLTP Operation (NUMAC)

5.2 GEH: 0000-0081-6958 MNGP-PRNMS-APRM Calc 2008, Revision 0, DRF: 0000-0081-4903, March 2008, Average Power Range Monitor Selected PRNM Licensing Setpoints - EPU Operation (NUMAC)

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

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

5.5 NEDC-32410-A, Supplement 1 – Nuclear Measurement Analysis and Control Power Range Neutron Monitor (NUMAC PRNM) Retrofit Plus Option III Stability Trip Function, Licensing Topical Report, Supplement 1, November 1997

5.6 GEH-NE-0000-0076-2388, Revision 1, MNGP PRNM Licensing Setpoints - CLTP Operation, December 2007

5.7 CA-96-224, Rev 1, Instrument Setpoint Calculation - Average Power Range Monitor (APRM) Flow-Biased Upscale Scram and Rod Block.

5.8 CA-96-153, Revision 0, Instrumentation Setpoint Calculation – Average Power Range Monitor (APRM) Downscale CR Block..

5.9 GE-NE-901-021-0492, DRF A00-01932-1, Setpoint Calculation Guidelines for the Monticello Nuclear Generating Plant, October 1992.

5.10 Monticello Nuclear Generating Plant Technical Specifications, as revised through Amendment 155. GAR 01146762 initiated to update Technical Specification in accordance with EC 10856 and calculation CA-08-050.

5.11 Monticello Nuclear Generating Plant Technical Requirements Manual (TRM), as revised through Revision 2. LAR 01128839 updates TRM in accordance with EC 10856 and calculation CA-08-050.

5.12 Regulation Guide 1.105, R3 – Instrument Setpoints for Safety-Related Instrumentation.

5.13 Task Report T0506, Revision 1, Project Task Report, NMC Monticello Nuclear Generating Plant Extended Power Uprate, Technical Specifications Setpoints, March 2008.

5.14 NEDC-31336P-A, Class III, General Electric Instrument Setpoint Methodology, September 1996.

5.15 Procedure 0017, Revision 25, "APRM Heat Balance Calibration." This procedure is used to calibrate the APRM gains such that the absolute difference between the Average Power Range Monitor (APRM) channels and the calculated power is ≤ 2 % RTP while operating at ≥ 25 % RTP.

5.16 I.S. Sokolnikoff and R.M. Redheffer, Mathematics of Physics and Modern Engineering, 1966

5.17 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, August 24, 2006

5.18 TSTF-493, Rev 3, Clarify Application of Setpoint Methodology for LSSS Functions. Date of issue 18 Jan 08. Rev 3 is not approved. Included as a reference document.

5.19 EC 10856, Rev 0, EPU – Mod 4 – Neutron Monitoring System (PRNM)

5.20 EC 12899, Rev 0, PRNMS Setpoint Calculations – 08-050 (Non-Flow Biased Setpoints)

5.21 Specification 257HA594, Rev 1, Neutron Monitoring System, 12/3/85. Specification provides information on LPRM detectors and the existing analog neutron monitoring system

5.22 Engineering Standards Manual ESM-03.02-APP-I, Appendix I (GE Methodology Instrumentation & Controls), Revision 4

5.23 Procedure C.6-005-A-22, Rev 3, APRM Hi Hi INOP CH 1, 2, 3, is a flow-bias APRM Neutron Flux Hi Hi setpoint. PRNM retrofit converts this setpoint to a non-flow bias APRM Neutron Flux High setpoint. The PRNM APRM Neutron Flux High setpoint is part of this calculation. C.6-005-A-22 will be revised under EC-10856. PCR 01129100.

5.24 Procedure C.6-005-A-30, Rev 3, APRM Hi Hi INOP CH 4, 5, 6, is a flow-bias APRM Neutron Flux Hi Hi setpoint. PRNM retrofit converts this setpoint to a non-flow bias APRM Neutron Flux High setpoint. The PRNM APRM Neutron Flux High setpoint is part of this calculation. C.6-005-A-30 will be revised under EC-10856. PCR 01133816.

5.25 Procedure C.6-005-A-06, Rev 3, APRM Downscale, states a NTSP setpoint of 3.5 % RTP. This is correct for the present neutron monitoring system. Even though the PRNM CLTP and EPU operation NTSP setpoints are 3.5 % RTP, the procedure does not address that the PRNM retrofit NTSP setpoints remain the same for CLTP and EPU operation. PCR 01146778 initiated to revise procedure for EC 10856 and calculation CA-08-050.

5.26 Procedure C.6-005-A-03, Rev 1, Annunciator procedure for window 5-A-3. PRNMS adds a new rod withdraw block setpoint: APRM Neutron Flux – High (Setdown) Rod Block. PCR 01146750 initiated to revise procedure for EC 10856 and calculation CA-08-050.

5.27 Procedure B.05.06-02, Rev 18, Operations Manual Section - Plant Protection System, specifies APRM Hi Hi and APRM Downscale and other setpoints. This calculation evaluates the APRM Downscale Rod Block setpoints and documents the PRNM EPU change in this setpoint. The APRM Hi Hi setpoint is flow biased and is PRNM changes this setpoint to non-flow bias APRM Neutron Flux High. B.05.06-02 will be revised under EC-10856 by PCR 01133455.

5.28 DBD B5.1, Rev C, Design Bases Document for Neutron Monitoring System, discusses NMS setpoints, margin, uncertainty parameters such as drift, etc. This calculation validated certain NMS setpoints using the PRNM parameter uncertainties specified in GE documentation. Changes will be made under GAR 1138038.

5.29 Procedure 8211, Rev 2, APRM Calibration Readjustment for Single Loop, discusses APRM setpoint voltage adjustments including Downscale Rod Block, Hi-Hi Scram, etc. Changes have been made by PRNM and this calculation evaluates the non-flow biased PRNM setpoints. Procedure 8211 will be deleted under EC-10856 by PCR 01133437 and replaced with directions in B.05.01.02-05 by PCR 01133449.

5.30 Procedure 8212, Rev 2, APRM Calibration Readjustment for Two Loop, discusses APRM setpoint voltage adjustments including Downscale Rod Block, Hi-Hi Scram, etc. Changes have been made by PRNM and this calculation evaluates the non-flow biased PRNM setpoints. Procedure 8212 will be deleted under EC-10856 by PCR 01133445 and replaced with directions in B.05.01.02-05 by PCR 01133449.

5.31 Procedure 0012, Rev 41 APRM/Flow Reference Scram Functional Check, performs the calibration of the APRM including the Neutron Flux High Scram, Setdown Scram, Setdown Rod Block, and Downscale Rod Block setpoints. Setpoints are revised as a result of this calculation. 0012 will be deleted under EC-10856, PCR 01133332. Procedures ISP-NIP-0588, ISP-NIP-0588-01, ISP-NIP-0589-02 will be developed to replace Procedure 0012 by PCRs 01129124, 01129125, and 01129126.

5.32 MNGP Technical Specifications Bases, Rev 8, Bases will be revised to discuss the PRNM APRM Neutron Flux High setpoint, which is non-flow bias, in place of the existing Flow Referenced Neutron Flux-High High setpoint. GAR 01146762 initiated to update Technical Specification Bases in accordance with EC 10856 and calculation CA-08-050.

5.33 Specification 24A5221, Specification for PRNM MUMAC Power Range Neutron Monitoring System.

5.34 B.05.01.02-02, Rev 6, Operations Manual Section - Power Range Neutron Monitoring, specifies NMS trip setpoints, which are being changed due to PRNMS. B.05.01.02-02 will be revised under EC-10856 by PCR 01137808.

5.35 B.05.01.02-05, Rev 16, Operations Manual Section – Power Range Neutron Monitoring, System Operation. B.05.01.02-05, Rev 16 refers to the six APRM channels, which applies to the existing NMS. PRNMS has four APRM channels as stated is Section 7.2.2.1 of this calculation. PCR 01146778 issued to revise B.05.01.02-05, Rev 16, upon implementation of EC 10856.

5.36 Design Input Request (DIR) T0500, Neutron Monitoring System, DRF 000-0040-9168. This DIR provides design information on the LPRMs used for input to the PRNM equipment.

5.37 Engineering Standards Manual ESM-03.02-APP-I, Appendix I (GE Methodology Instrumentation & Controls), Revision 4.

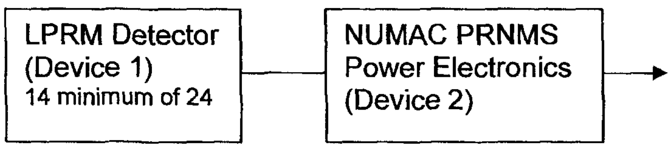
6. ASSUMPTIONS

None.

7. ANALYSIS

7.1 APRM Non-Flow Biased PRNM Licensing Setpoints

7.1.1 Channel Diagram for APRM Neutron Flux Setpoints



Output Channels:

APRM Neutron Flux - High Scram
APRM Neutron Flux - High (Setdown) Scram
APRM Neutron Flux – (Setdown) Rod Block
APRM Downscale Rod Block

7.1.2 Channel Function:

The APRM system calculates an average of the incore Local Power Range Monitor (LPRM) chamber signals. The LPRMs are averaged such that the APRM signal is proportional to the core average neutron flux and can be calibrated as a means of measuring core thermal power. The number of APRM channels is reduced to four from six and the LPRM's are re-assigned to increase the number of LPRM's in the APRM average. The logic of the trip output signals from the APRM channels is modified from the original design to implement a Two-out-of-Four (2/4) trip logic that eliminates half Scrams resulting from a single PRNM channel failure. A neutron flux trip in any two APRM channels will cause a Scram.

The APRM Neutron Flux High Scram is capable of generating a trip signal to prevent fuel damage or excessive RCS pressure in high power range. For rapid neutron flux increase events, the thermal power lags the neutron flux and APRM Neutron Flux High Scram will provide a Scram signal before the APRM Flow Biased Simulated Thermal Power (STP) Scram. The APRM Neutron Flux High Scram is based on unfiltered neutron flux signal.

The APRM Setdown Scram is capable of generating a trip signal that prevents fuel damage resulting from abnormal operating transients in the low power range. The APRM Setdown Rod Block is a precursor to the APRM Setdown Scram. The setdown Scram is a redundant Scram, which overlaps the IRM region, for reactivity transients in the startup mode. This provides defense-in-depth for reactivity transients in the startup mode.

The APRM Downscale Rod Block initiation ensures that there is sufficient overlap of the operating regions of the APRMs and IRMs with the IRM detectors fully inserted. APRM Downscale Rod Block function provides indication of instrument failure or insensitivity.

7.2 Instrument Definition and Device Uncertainty Terms

The APRM Non-Flow Biased Loop is composed of LPRM Detectors (Device 1) and NUMAC PRNMS Power Electronics (Device 2).

7.2.1 Device 1: LPRM Detector Data

7.2.1.1 Instrument Definition:

Device 1 – LPRM Detectors

Component IDs:

:

Total: 24 LPRM Detector strings containing 4 detectors each = 96 LPRM Detectors

INDREC LPRM-04-29	INDREC LPRM-12-13	INDREC LPRM-12-21	INDREC LPRM-12-29
INDREC LPRM-12-37	INDREC LPRM-20-13	INDREC LPRM-20-21	INDREC LPRM-20-29
INDREC LPRM-20-37	INDREC LPRM-20-45	INDREC LPRM-28-05	INDREC LPRM-28-13
INDREC LPRM-28-21	INDREC LPRM-28-29	INDREC LPRM-28-37	INDREC LPRM-28-45
INDREC LPRM-36-13	INDREC LPRM-36-21	INDREC LPRM-36-29	INDREC LPRM-36-37
INDREC LPRM-36-45	INDREC LPRM-44-21	INDREC LPRM-44-29	INDREC LPRM-44-37

		Sigma	Reference(s)
Location	Drywell	n/a	Input 4.9, Item 2
Make	GE/Reuter Stokes	n/a	Input 4.9, Item 22
Model	GE NA300	n/a	Input 4.9, Item 22
Process Element	Local Power Range Monitor (LPRM) Neutron detector	n/a	Input 4.2, Section 1-CLTP Input 4.3, Section 1-EPU
Upper Range Limit (UR)	n/a	n/a	n/a
Calibrated Span (SP)	n/a	n/a	n/a
Input (neutron flux)	Design maximum neutron flux of 2.3E14 nv	n/a	Input 4.9, Item 23
Output (LPRM electronics)	0.0 to 3 ma	n/a	Input 4.5, Section 5.3.17.6
Minimum # of LPRMs per APRM	14 of 24	n/a	Input 4.2,Section 2.3-CLTP Input 4.3,Section 2.3-EPU

7.2.1.2 Process and Physical Interfaces:

Device 1 – LPRM Detectors Process and Physical Interfaces		Sigma	Reference(s)
Calibration Temperature Range	n/a for LPRM detector due to in-core location	n/a	n/a
Calibration/Surveillance Interval	7 Days	n/a	Technical Specifications
Normal Plant Conditions: • Temperature • Radiation • Pressure • Humidity at Assembly Connector	LPRM detectors are exposed to reactor operating conditions: • Design Temperature 546 deg F • Gamma 2.4 R/hr; Neutrons 10 R/hr • Design Pressure 1250 psig • Condensation Dripping water is present	n/a	Input 4.10
Trip Environment Conditions	Not applicable for setpoint calculation	n/a	n/a
Long Term Post Accident Conditions	Not applicable for setpoint calculation	n/a	n/a
Seismic Conditions	Not applicable for setpoint calculation	n/a	n/a
Process Conditions: During Calibration Worst Case During Function	Not applicable for setpoint calculation	n/a	n/a

7.2.1.3 Individual Device Accuracy

LPRM Detectors				
Symbol	Term	Value (% RTP)	Sigma	Reference
A_1	Instrument Accuracy – LPRM Detector	0 %, LPRM detector accuracy is included in APEA	n/a	Input 4.2, Section 2.3-CLTP Input 4.3, Section 2.3-EPU
D_1	LPRM Drift	0 %, LPRM detector drift in included in DPEA	n/a	Input 4.2, Section 2.3-CLTP Input 4.3, Section 2.3-EPU
APEA	APEA - Accuracy per LPRM detector	$= \pm APEA_R + APEA_b$ ± 1.00 % RTP + bias 0.49 % RTP	2	Input 4.2, Section 1-CLTP Input 4.3, Section 1-EPU
DPEA	DPEA – Drift per LPRM detector	$= \pm DPEA_R + DPEA_b$ ± 0.2 % RTP/ 7days + bias 0.33 % RTP	2	Input 4.2, Section 1-CLTP Input 4.3, Section 1-EPU
ATE	Accuracy Temperature Effect	0 %, Design temperature is normal in-core temperature of 546 deg F. LPRM electronics temperature effect is included in accuracy	n/a	Input 4.9, Item 2 Input 4.2, Section 2.3-CLTP Input 4.3, Section 2.3-EPU
OPE	Overpressure Effect	n/a – Overpressure effect is not applicable for LPRM Detector accuracy. Detector is designed for 1250 psig.	n/a	Input 4.9, Item 2
SPE	Static Pressure Effect	n/a – Static pressure effect is not applicable for LPRM Detector accuracy due to in-core location.	n/a	n/a
SE	Seismic Effect	n/a – Seismic effect is not applicable because APRM Scram and rod block are only required during normal operating conditions.	n/a	n/a
RE	Radiation Effect	n/a – Radiation effect is not applicable because LPRM detector is designed for a lifetime nv of 1.2E14 nv @ 1E9 Rem/hr.	n/a	Input 4.9, Item 2
HE	Humidity	n/a – Humidity is not applicable because LPRM detector is located in-core.	n/a	n/a
PSE	Power Supply Effect	Negligible for LPRM detector	n/a	Input 4.2, Section 1-CLTP Input 4.3, Section 1-EPU Comment 16 in each of the above Inputs.
REE	RFI/EMI Effect	n/a - RFI/EMI effect is not applicable because LPRM detector is located in-core.	n/a	n/a

7.2.2 Device 2: NUMAC PRNMS Power Electronic Data (LRPM, APRM, Trip Circuits)

7.2.2.1 Instrument Definition

Device 2 – NUMAC PRNMS Power Electronic Data

Component ID's: INDREC APRM 1	INDREC APRM 2	INDREC APRM 3	INDREC APRM 4

Device 2 – NUMAC PRNMS Power Electronic Data		**Sigma**	**Reference(s)**
Location	Power Electronics: Admin Building, El 951'	n/a	Input 4.2, Section 2.3-CLTP Input 4.3, Section 2.3-EPU
Make	GE	n/a	Input 4.2, Section 2.3-CLTP Input 4.3, Section 2.3 –EPU
Model	NUMAC	n/a	Input 4.2, Section 2.3-CLTP Input 4.3, Section 2.3-EPU
Calibration Scale	Full Scale = 125 % RTP	n/a	Input 4.2, Section 2.3-CLTP Input 4.3, Section 2.3-EPU
Upper Range Limit	n/a	n/a	Input 4.2, Section 2.3-CLTP Input 4.3, Section 2.3-EPU
Input signal	0 – 3 ma from each LPRM	n/a	Input 4.5, Section 5.3.17.6
Analog Output signal: Outputs to: Flux Recorders, Flow Recorders, Flow Indicatiors, Computer Points	- 10 to + 10 VDC (maximum)	n/a	Input 4.5, Section 5.3.17.7

7.2.2.2 Process and Physical Interfaces

Device 2 - NUMAC PRNMS Power Electronic Data		Sigma	Reference(s)
Calibration Temperature Range	72 to 78 deg F	n/a	Input 4.2, Section 2.3-CLTP Input 4.3, Section 2.3-EPU
Calibration/Surveillance Interval	700 hours	2	Input 4.2, Section 2.3-CLTP Input 4.3, Section 2.3-EPU
Normal Plant Conditions: Temperature Radiation Pressure Humidity	 72 to 78 deg F Negligible n/a Included in Accuracy	 n/a 2 2 2	Input 4.2, Section 2.3-CLTP Input 4.3, Section 2.3-EPU
Trip Environment Conditions	72 to 78 deg F Same as Normal Plant Conditions	n/a	Input 4.2, Section 2.3-CLTP Input 4.3, Section 2.3-EPU
Long Term Post Accident Conditions	n/a – Scram and Rod Block functions are only required during normal conditions.	n/a	n/a
Seismic Conditions	Included in Accuracy	2	Input 4.2, Section 2.3-CLTP, Comment 4 Input 4.3, Section 2.3-EPU, Comment 4
Process Conditions: During Calibration Worst Case During Function	n/a for APRM calibration	n/a	n/a

7.2.2.3 Individual Device Accuracy

Device 2 – NUMAC PRNMS Power Electronic Data

Symbol	Term	Value (% RTP)	Sigma	Reference
A_2	Instrument Accuracy of LPRM flux channel electronics	± 0.943 % RTP	2	Input 4.2, Section 2.3-CLTP Input 4.3, Section 2.3-EPU
D_2	Power Electronics Drift	± 0.50 RTP FS/700 Hours	2	Input 4.2, Section 2.3-CLTP Input 4.3, Section 2.3-EPU
APMA a. tracking b. noise	Process Measure Accuracy	a. ± 1.11 % RTP b. ± 2.00 % RTP	2	Input 4.2, Section 1-CLTP Input 4.3, Section 1-EPU
C_L	Loop Calibration Accuracy Error	ALT specified by the AGAF process = ± 2.0 % RTP	3	Input 4.2, Section 2.3-CLTP and Comment 11 Input 4.3, Section 2.3-EPU and Comment 11
ALT_L	As-Left Tolerance	± 2.0% RTP based on APRM Gain Adjustment Factor (AGAF)	3	Input 4.2, Section 2.3-CLTP Input 4.3, Section 2.3-EPU
AFT_L	As-Found Tolerance	= ALT, = ± 2.0 % RTP	3	Input 4.2, Section 2.3-CLTP Input 4.3, Section 2.3-EPU
ATE	Accuracy Temperature Effect	Included in Accuracy	2	Input 4.2, Section 2.3-CLTP Input 4.3, Section 2.3-EPU
OPE	Overpressure Effect	n/a for APRM Power electronic	n/a	Input 4.2, Section 2.3-CLTP and Comment 5; Input 4.3, Section 2.3-EPU and Comment 5
SPE	Static Pressure Effect	n/a for APRM Power electronic	n/a	Input 4.2, Section 2.3-CLTP and Comment 5; Input 4.3, Section 2.3-EPU and Comment 5
SE	Seismic Effect	Included in Accuracy	2	Input 4.2, Section 2.3-CLTP and Comment 4; Input 4.3, Section 2.3-EPU and Comment 4
RE	Radiation Effect	Negligible	2	Input 4.2, Section 2.3-CLTP and Comment 4; Input 4.3, Section 2.3-EPU and Comment 4
HE	Humidity	Included in Accuracy	2	Input 4.2, Section 2.3-CLTP and Comment 4; Input 4.3, Section 2.3-EPU and Comment 4
PSE	Power Supply Effect (LPRM Detector)	Negligible	2	Input 4.2, Sections 1 and 2.3-CLTP, Comment 4&16; Input 4.3, Sections 1 and 2.3, Comment 4&16-EPU
REE	RFI/EMI Effect	Negligible	2	Input 4.2, Section 2.3-CLTP and Comment 4; Input 4.3, Section 2.3-EPU and Comment 4

7.3 Loop Instrument Uncertainty Evaluation

7.3.1 CLTP Operation Loop Instrument Uncertainty:
The loop uncertainty associated with the replacement of analog neutron monitoring system with the digital NUMAC PRNMS for CLTP operation is discussed and calculated in this section.

7.3.1.1 Loop Instrument Accuracy (A_L)

Loop Instrument Accuracy (A_L) is defined as the accuracy of the LPRM flux channel electronics. The GEH Input documents, Input 4.2 and 4.3, for the digital PRNMS specify a LPRM flux channel electronic accuracy for PRNM chassis. The accuracy of the LPRM detector is specified as APRM PEA or APEA (Accuracy) as defined in Section 7.2.1.3. Since the accuracy of the LPRM detector is included in APEA (Accuracy), it will be used in the calculation of Loop Primary Element Accuracy ($APEA_L$). Calculation of Loop Accuracy (A_L) will use the LPRM Electronics accuracy value.

Loop Instrument Accuracy depends on number of LPRMs averaged by the PRNM APRM. As indicated below, the statistical average is based on Input 4.12, which is shown in Attachment 4. The fewer LPRMs averaged, the greater the accuracy error. Averaging the minimum number of LPRM detectors (14) versus a larger number (24) equals the following accuracy errors:

Averaging Calculation Example:
The following shows how number of LPRM detectors affects the accuracy error. For example, the APEA for each LPRM is $\pm 1.0\%RTP$ $\pm$ bias of 0.49 % RTP as indicated in Section 7.1.2.3.

Input 4.12 (Attachment 4) can be interrupted as the following:

Accuracy Error = $\dfrac{Accuracy(perLPRM)}{\sqrt{n}}$ n = number of LPRM detectors used

14 LPRM Detectors: Accuracy Error = $\pm \dfrac{1.0\%RTP}{\sqrt{14}}$ = $\pm$ 0.267 % RPT

24 LPRM Detectors: Accuracy Error = $\pm \dfrac{1.0\%RTP}{\sqrt{24}}$ =$\pm$ 0.204 % RPT

For conservatism, the minimum number of LPRM detectors (14) is used in the accuracy calculations.

Individual Device Accuracy

Device 1: LPRM Detector (A_1)

As stated above, the LPRM Detector accuracy is included in APRM PEA (APEA) term. Section 7.3.1.6 calculates Loop Primary Element Accuracy ($APEA_L$) using this term. Therefore, LPRM flux channel electronics accuracy for Device 1 will be considered 0 % RPT.

A_1 = LPRM flux channel electronics accuracy for LPRM Detector
A_1 = 0 % RPT since it is included in APEA term. Section 7.2.1.3

Device 2: Power Electronics (NUMAC PRNMS) (A_2)

As stated above, the PRNM chassis electronics for the flux generated analog signal is the term below for one LPRM detector.

Accuracy (LPRM Electronics) = ± 0.943 % RTP. (Section 7.2.2.3)

GEH does not breakdown the components of the LPRM flux channel electronics accuracy in their submitted PRNM documents. The calculation of the LPRM electronics accuracy is considered proprietary. The LPRM module, which receives analog input from the LPRM detector, is part of the new PRNM chassis. Another component is the digital processing of the LPRM detector signal. The LPRM electronics accuracy specified applies to one LPRM detector.

The APRM averages the LPRM signals to obtain reactor power indication. The minimum number of LPRMs is 14 in accordance Section 7.2.1.1.

Per Input 4.12, the accuracy will be 1/14 of the square root of the sum of the squares of the 14 LPRMs as expressed by:

A_2 = Overall (mean) accuracy for the LPRM flux channel Electronics

$$A_2 = \pm \frac{1}{14}\sqrt{0.943^2 \times 14}$$

A_2 = ± 0.253 % RTP

Loop Instrument Accuracy (A_L)

A_1 = ± 0.00 % RTP
A_2 = ± 0.253 % RTP

$A_L = \pm\sqrt{(A_1)^2 + (A_2)^2}$

$A_L = \pm\sqrt{(0.000)^2 + (0.0253)^2}$

$A_L = \pm 0.253$ % RTP

7.3.1.2 Loop Instrument Drift (D_L)

Loop Instrument Drift (D_L) is defined as the Square Root of the Sum of the Squares (SRSS) of the individual Device drifts.

For this calculation, Section 7.2.1.3 states the drift of the LPRM detectors (Device 1) is included in DPEA. Discussions with GE Instrument Engineers confirmed that the total drift error for GE LPRM detectors is known and is accurate for the LPRM detector Random drift error and the Bias drift error components.

For Device 2, Section 7.2.2.3 states the NUMAC PRNM Power Electronics drift is 0.5 % RTP Full Span when calibration every 700 hours. The source of this drift value is Input 4.2.

Methodology, Section 2, states that this calculation uses GE specified drift parameters for the applicable PRNM equipment and for the existing LPRM detectors. Standards Manual ESM-03.02-APP-I, Section 5.2.4, shows a alternate methodology for determination of individual device drift. For this application, it is considered more accurate to use GE specified device drift values since both PRNM equipment and LPRM detectors are provided by the manufacturer.

Individual Device Drift

Device 1

Drift of Device 1 = $D_1 = \pm 0.00$ % RTP (FS) / 700 days because the LPRM (Device 1) drift is included in DPEA as specified in Section 7.2.1.3.

Device 2

Drift of Device 2 = $D_2 = \pm 0.50$ % RTP FS / 700 Hours (Section 7.2.2.3)

Since the APRMs will be calibrated against the reactor heat balance every 7 days, 700 hours drift value is conservative. Converting percent full span (FS) to the percent power yields:

$D_2 = \pm 0.50 \times (125$ % RTP/ 100 % RTP FS)

D_2 = ± 0.625 % RTP

Loop Instrument Drift (D_L)
D_1 = ± 0.000 % RTP
D_2 = ± 0.625 % RTP

Loop Instrument Drift = $D_L = \pm\sqrt{(D_1)^2 + (D_2)^2}$

$D_L = \pm\sqrt{(0.000)^2 + (0.625)^2}$ = ± 0.625 % RTP

7.3.1.3 Loop As-Left Tolerance (ALT_L)

The loop As-Left tolerance (ALT_L) is being evaluated from two perspectives. The first is based on GEH Input 4.2, Section 2.3 and Comment 11. Input 4.2 states that the As-Left Tolerance is equal to the Auto Gain Adjustment Factor (AGAF), which is ± 2.00 % RTP at 3σ. Input 4.2, Comment 11, states the basis for AGAF equaling ± 2.00 % RTP is as follows:

The APRM subsystem is calibrated every 7 days using the AGAF process, where the gain of the APRMs is adjusted to read the Rated Thermal Power (RTP), also called Core Thermal Power, determined by the Process Computer (P/C), within a specified As-Left Tolerance. This is equivalent to a standard calibration of the APRM electronics sub-loop (consisting of the LPRM and APRM signal conditioning electronics), where the P/C is the calibration tool and standard. The P/C and heat balance error is already accounted for in the transient analyses. Thus, the only calibration error to consider for the APRM electronics sub-loop is the As-Left Tolerance specified by the AGAF process.

A. Loop As-Left Tolerance (ALT_L) used in uncertainty calculations is determined by the AGAF process:
   As described above, the basis for this ALT_L calculation is GEH Input 4.2, Section 2.3.

   ALT_L = AGAF which is equal to: ± 2.00 % RTP at 3σ. (Section 7.2.2.3)

   The tolerance is normalized to a 2σ confidence level in accordance with ESM-03.02- APP-I, Section 4.3 (Input 4.1),
   Converting to 2 σ:

   ALT_L = ± 2.00 x (2/3) % RTP at 2σ.
   ALT_L = ± 1.334 % RTP for use in uncertainty calculations

The second analysis of ALT_L is based on PRNM surveillance calibration of PRNM electronics. The LPRM detector loop is not involved. The electronics being calibration checked is PRNM digital equipment. The setpoints being checked are numerical values stored in the digital hardware and are not subject to drift.

B. ALT_L used for PRNM surveillance calibration procedures:

ALT_L = 0.00 % RTP based on PRNM digital hardware without LPRM detectors

7.3.1.4 Loop As-Found Tolerance (AFT_L)

The As-Found Tolerance (AFT_L) is being evaluated from two perspectives similar to ALT_L, Section 7.3.1.3. The results are indicated below:

A. Loop As-Found Tolerance (AFT_L), used in loop uncertainty calculations, is determined by GEH Input 4.2, Section 2.3, which states:

$AFT_L = ALT_L$ (Section 7.2.2.3)
$ALT_L = \pm$ 2.00 % RTP at 3σ as defined in Section 7.3.1.3.

The tolerance is normalized to a 2σ confidence level In accordance with ESM-03.02-APP-1, Section 4.3 (Input 4.1).

$AFT_L = \pm$ 2.00 % x (2/3) % RTP at 2σ
$AFT_L = \pm$ 1.334 % RTP for use in uncertainty calculations

The tolerance is normalized to a 2σ confidence level in accordance with ESM-03.02- APP-I, Section 4.3 (Input 4.1),
Converting to 2σ:

$AFT_L = \pm$ 2.00 x (2/3) % RTP at 2σ.
$AFT_L = \pm$ 1.334 % RTP used for uncertainty calculations

The second analysis of AFT_L is based on PRNM surveillance calibration of only PRNM electronics. The LPRM detector loop is not involved. The setpoints being checked are numerical values stored in the digital hardware and are not subject to drift.

B. AFT_L used for PRNM surveillance calibration procedures:

AFT_L = 0.00 % RTP based on PRNM digital hardware without LPRM detectors

7.3.1.5 Loop Calibration Accuracy Error (C_L)

In accordance with GEH specification in Input 4.2, Comment 11, the only calibration error to consider for the APRM electronics sub-loop is the loop As-Left Tolerance (ALT_L) specified by the AGAF process. Calibration Accuracy Error (C_L) is the As-Left Tolerance (AFT_L) defined for uncertainty calculations.

Loop Calibration Accuracy Error = C_L
$C_L = ALT_L = \pm$ 1.334 % RTP (Section 7.3.1.3)

7.3.1.6 Loop Primary Element Accuracy ($APEA_L$)

APEA is equal to the Random Accuracy per LPRM detector plus the Bias Accuracy Error per LPRM detector. Section 7.2.1.3 indicates that the Power Supply Effect of the LPRM Detector in included in the APEA. This is in accordance with Inputs 4.2 and 4.3.

APEA = Random Accuracy Error/LPRM detector + Bias Accuracy/LPRM Detector

Random Accuracy Error = ± $APEA_R$ = ± 1.00 % RTP/ LPRM (Section 7.2.1.3)
Bias Accuracy Error = $APEA_b$ = 0.49 % RTP bias

APEA = ± 1.00 % RTP/ LPRM + 0.49% RTP bias/ LPRM (Section 7.2.1.3)

Loop Primary Element Accuracy ($APEA_L$) = overall (mean) accuracy

$APEA_L$ is equal to the Random Accuracy per LPRM detector divided by the square root of the minimum number of LPRM detectors plus the Bias Accuracy Error per LPRM detector.

$$APEA_L = \frac{\pm 1.0\% RTP}{\sqrt{14}} \pm 0.49\% RTPbias$$ (Input 4.12)

For conservatism, Bias terms are positive.

$APEA_L$ = ± 0.268 % RTP + 0.49 % RTP bias

7.3.1.7 Loop Drift Primary Element Accuracy ($DPEA_L$)

DPEA is equal to the Random Drift Error per LPRM detector plus the Bias Drift Error per LPRM detector. (Section 7.2.1.3)

Therefore, DPEA is defined as:
DPEA = Random Drift Error/LPRM detector + Bias Drift Error/LPRM Detector

Random Drift Error = $DPEA_R$ = ± 0.20 % RTP/ LPRM (Section 7.2.1.3)
Bias Drift Error = $DPEA_b$ = 0.33 % RTP bias

DPEA = ± 0.20 % RTP/ LPRM + 0.33 % RTP bias/ LPRM (Section 7.2.1)

Loop Drift Primary Element Accuracy ($DPEA_L$) = overall (mean) accuracy

$DPEA_L$ is equal to the Random Drift Error per LPRM detector divided by the square root of the minimum number of LPRM detectors plus the Bias Drift Error per LPRM detector.

$DPEA_L = \frac{\pm 0.20\% RTP}{\sqrt{14}} \pm 0.33\% RTPbias$ (Input 4.12)

For conservatism, the Bias terms are positive.
$APEA_L$ = ± 0.054 % RTP + 0.33 % RTP bias

7.3.1.8 Loop APRM Process Measurement Accuracy ($APMA_L$)

$APMA_{tracking}$ = ± 1.11 % RTP (Section 7.2.2.3)
$APMA_{noise}$ = ± 2.00 % RTP (Section 7.2.2.3)

$APMA_L = \pm\sqrt{(APMA_{tracking})^2 + (APMA_{noise})^2}$

$APMA_L = \pm\sqrt{(1.11\%)^2 + (2.00\%)^2}$

$APMA_L$ = ± 2.288 % RTP

7.3.1.9 Tabulation of Loop Uncertainties - PRNM CLTP Operation

Uncertainty Type	Term	Random ± % RTP	Bias + % RTP	Section
A_L	Loop Instrument Accuracy	0.253		7.3.1.1
D_L	Loop Instrument Drift	0.625		7.3.1.2
ALT_L (uncertainty)	Loop As-Left Tolerance for uncertainty calculations	1.334		7.3.1.3
ALT_L (calibration)	Loop As-Left Tolerance for electronic calibrations	0.00		7.3.1.3
AFT_L (uncertainty)	Loop As-Found Tolerance for uncertainty calculations	1.334		7.4.1.4
AFT_L (calibration)	Loop As-Found Tolerance for electronic calibrations	0.00		7.3.1.4
C_L	Loop Calibration Accuracy Error	1.334		7.3.1.5
$APEA_L$	Loop APRM Primary Element Accuracy	0.268		7.3.1.6
$DPEA_L$	Loop Drift Primary Element Accuracy	0.054		7.3.1.7
$APMA_L$	Loop APRM Process Measurement Accuracy	2.288		7.3.1.8
$APEA_b$	APRM Primary Element Accuracy Bias		0.49	7.3.1.6
$DPEA_b$	Drift Primary Element Accuracy Bias		0.33	7.3.1.7

7.3.2 EPU Operation Loop Uncertainty

The comparison of Inputs 4.2 and 4.3 shows the individual device uncertainties associated with the EPU operation are identical to the individual device uncertainties associated with the CPTP operation. The uncertainty terms tabulated in Sections 7.2.1 and 7.2.2 list both CLTP (Input 4.2) and EPU (Input 4.3) references. Operating at EPU condition will not change the methodology used to combine the individual device uncertainties to produce the loop uncertainties. Therefore, the loop uncertainties calculated for the PRNM CLTP operation (Section 7.3.1) will be applicable to the PRNM EPU Operation (Section 7.3.2). The EPU uncertainties are tabulated in the table below:

7.3.2.1 Tabulation of Loop Uncertainties – PRNM EPU Operation

Tabulation of Loop Uncertainties – PRNM EPU Operation

Uncertainty Type	Term	Random ± % RTP	Bias + % RTP	Section
A_L	Loop Instrument Accuracy	0.253		7.3.1.1
D_L	Loop Instrument Drift	0.625		7.3.1.2
ALT_L (uncertainty)	Loop As-Left Tolerance for uncertainty calculations	1.334		7.3.1.3
ALT_L (calibration)	Loop As-Left Tolerance for electronic calibrations	0.00		7.3.1.3
AFT_L (uncertainty)	Loop As-Found Tolerance for uncertainty calculations	1.334		7.3.1.4
AFT_L (calibration)	Loop As-Found Tolerance for electronic calibrations	0.00		7.3.1.4
C_L	Loop Calibration Accuracy Error	1.334		7.3.1.5
$APEA_L$	Loop APRM Primary Element Accuracy	0.268		7.3.1.6
$DPEA_L$	Loop Drift Primary Element Accuracy	0.054		7.3.1.7
$APMA_L$	Loop APRM Process Measurement Accuracy	2.288		7.3.1.8
$APEA_b$	APRM Primary Element Accuracy Bias		0.49	7.3.1.6
$DPEA_b$	Drift Primary Element Accuracy Bias		0.33	7.3.1.7

7.4 PRNM CLTP Operation Setpoint Evaluation

7.4.1 PRNM CLTP APRM Neutron Flux – High Scram

Input 4.2, Section 3, states the following Analytical Limit (AL), the recommended Allowable Value (AV) and the Nominal Trip Setpoint (NTSP) for CLTP operation with NUMAC - PRNM equipment installed.

PRNM CLTP Setpoint (% RTP)	AL	AV	NTSP
APRM Neutron Flux – High Scram	125.0	122.0	119.5

The following calculations will determine the minimum required margin between the specified AL of 125.0 % RTP, AV of 122.0 % RTP and NTSP of 119.5 % RTP.

7.4.1.1 Allowable Value (AV) Evaluation

Input 4.11, Section 1.2.3.2, provides the following formulas for calculating the AV from the AL:

$$AV \le AL - \left(\frac{1.645}{2}\right)\sqrt{(A_L)^2 + (C_L)^2 + (PMA)^2 + (PEA)^2} \pm bias$$

Minimum required margin between AL and AV can be defined by:

$$\left(\frac{1.645}{2}\right)\sqrt{(A_L)^2 + (C_L)^2 + (APMA_L)^2 + (APEA_L)^2} \pm APEA_b$$

Minimum Required Margin (AL-AV) = RM = AL – AV

$$RM = AL - AV = \left(\frac{1.645}{2}\right)\sqrt{(0.253)^2 + (1.334)^2 + (2.288)^2 + (0.268)^2} + (0.490)$$

RM = AL - AV = 2.69 % RTP

Available Margin (AL - AV) =AM = AL - AV

AM = AL - AV = (125.0 - 122.0) % RTP
AM = AL - AV = 3.00 % RTP

PRNM CLTP Setpoint (% RTP)	AL	AV	Available Margin (AL - AV)	Minimum Required Margin	AV Acceptable
APRM Neutron Flux – High Scram	125.0	122.0	3.0	2.69	Yes

Since the available margin is greater than the minimum required margin (3.0 % RTP versus 2.69 % RTP), the recommended AV is acceptable.

7.4.1.2 Nominal Trip Setpoint (NTSP) Evaluation

Input 4.11, Section 1.2.3.3 provides the following formula for calculating the NTSP from the AL:

$$NTSP \leq AL - \left(\frac{1.645}{2}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2 + (PMA)^2 + (PEA)^2} \pm bias$$

Minimum required margin between AL and NTSP can be defined by:

$$\left(\frac{1.645}{2}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2 + (APMA_L)^2 + (APEA_L)^2 + (DPEA_L)^2} + APEA_b + DPEA_b$$

Minimum Required Margin (AL- NTSP) = RM = AL - NTSP

RM = AL – NTSP =

$$\left(\frac{1.645}{2}\right)\sqrt{(0.253)^2 + (1.334)^2 + (0.625)^2 + (2.288)^2 + (0.268)^2 + (0.054)^2} + 0.49 + 0.33$$

RM = AL - NTSP = 3.08 % RTP

Available Margin (AL - NTSP) = AM = AL - NTSP

AM = AL - NTSP = (125.0 - 119.5) % RTP = 5.50 % RTP

PRNM CLTP Setpoint (% RTP)	AL	NTSP	Available Margin (AL-NTSP)	Minimum Required Margin	NTSP Acceptable
APRM Neutron Flux - High Scram	125.0	119.5	5.5	3.08	Yes

Since the available margin is greater than the minimum required margin (5.5 % RTP versus 3.08 % RTP), the recommended NTSP is acceptable.

7.4.1.3 Licensee Event Report (LER) Avoidance Test

The purpose of the LER Avoidance Test is to assure that there is sufficient margin between the AV and NTSP to reasonably avoid violations of the AV.

Input 4.11, Section 1.2.3.5, provides the following formula for determining LER avoidance criteria.

$$\sigma_{LER} = \left(\frac{1}{n}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2}$$

Where n is the number of standard deviations used (2σ)

$$\sigma_{LER} = \left(\frac{1}{2}\right)\sqrt{(0.253)^2 + (1.334)^2 + (0.625)^2}$$

σ_{LER} = 0.75 % RTP

For multiple instrument channels, a Z value of greater than 0.81 provides sufficient margin between NTSP and AV as specified in ESM-03.02-APP-I, Section 5.6.3 (Input 4.1).

In accordance with Input 4.1, Section 5.6.3, Z is defined as:

$$Z = \frac{|AV - NTSP|}{\sigma_{LER}} = \frac{|(122.0 - 119.5)\%RTP|}{(0.75)\%RTP} = 3.33$$

Since Z is greater than 0.81, sufficient margin exists between the specified AV and NTSP.

Minimum margin $NTSP_2$ will be calculated using the minimum Z value of 0.81. Minimum margin $NTSP_2$ will be compared with the current NTSP of 119.5 % RTP. This will indicate the amount of conservatism for the NTSP.

$NTSP_2$ Offset is defined as the minimum margin (% RTP) between AV and $NTSP_2$ with Z of 0.81 used.

$NTSP_2$ Offset = Z x σ_{LER}
$NTSP_2$ Offset = (0.81 x 0.75) % RTP = 0.61 % RTP

$NTSP_2$ is calculated to provide an NTSP based on the minimum LER avoidance criteria:
$NTSP_2 \leq$ AV - $NTSP_2$ Offset
$NTSP_2 \leq$ 122.0 % RTP - 0.61 % RTP
$NTSP_2 \leq$ 121.4 % RTP

For the minimum valve of Z equal to 0.81, $NTSP_2$, which is defined as the LER Avoidance NTSP, is to be less than 121.4 % RTP.

A conservative NTSP of 119.5 % RTP is used. Attachment 1, Setpoint Diagrams, shows margin for the APRM Neutron Flux – High Scram setpoint.

7.4.1.4 Spurious Trip Avoidance (STA) Test

A Spurious Trip Avoidance test is performed to assure that there is a reasonable probability that spurious trips will not occur using the selected setpoint.

Input 4.11, Section 1.2.3.4, provides the following formula for determining Spurious Trip avoidance. Input 4.13, Sections 4.5.4.b and 4.5.9.b, state that any bias associated with PMA or PEA should also be included. Therefore, $APEA_b$ shown in CLTP Loop Uncertainty table in Section 7.3.1.9 is being included.

$$\sigma_{STA} = \left(\frac{1}{n}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2 + (PMA)^2 + (PEA)^2} + APEA_b$$

Where n is the number of standard deviations used (2σ)

$DPEA_L$ and $DPEA_b$ were defined and evaluated in Section 7.3.1.7. These terms are to be included in the above σ_{STA} equation as follows:

$$\sigma_{STA} = \left(\frac{1}{n}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2 + (PMA)^2 + (PEA)^2 + (DPEA_L)^2} + APEA_b + DPEA_b$$

Using APRM terms, σ_{STA} is defined as:

$$\sigma_{STA} = \left(\frac{1}{n}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2 + (APMA)^2 + (APEA)^2 + (DPEA_L)^2} + APEA_b + DPEA_b$$

$$\sigma_{STA} = \left(\frac{1}{2}\right)\sqrt{(0.253)^2 + (1.334)^2 + (0.625)^2 + (2.288)^2 + (0.268)^2 + (0.054)^2} + 0.49 + 0.33$$

σ_{STA} = 2.20 % RTP

Input 4.1, STA Section 5.6.8, states Z is equal to the following:

$$Z = \frac{|(Adjusted\_NTSP) - (Operational\_Limit)|}{(\sigma_{STA})}$$

Input 4.1, Section 5.6.8, states that Adjusted NTSP is the selected setpoint minus ALT_L (more conservative). Since Adjusted NTSP is ($NTSP-ALT_L$), Z is equal to the following:

$$Z = \frac{NTSP - ALT - (Operational\_Limit)}{(\sigma_{STA})}$$

In Input 4.2, Sections 1.3 and 1.7, GEH defines the Operational Limit (OL) as 100 % RTP for MNGP. Therefore:

$$Z = \frac{(119.5 - 1.334 - 100.0)\%RTP}{(2.20)\%RTP}$$

Z= 8.25

As specified in Input 4.1, Section 5.6.8, Z should be equal to or greater that 1.65 for the setpoint to be adequately separated from the Operational Limit to reasonably avoid Spurious trip conditions.

Since the actual value of 8.25 is greater than the required value of 1.65, an adequate separation exists between the NTSP and the Operational Limit (OL), and the STA criterion is satisfied.

7.4.2 PRNM CLTP: APRM Neutron Flux – High (Setdown) Scram and APRM Neutron Flux – High (Setdown) Rod Block

Input 4.2, Section 3, states that the following Analytical Limit (AL) and the following recommended Allowable Valve (AV) and the Nominal Trip Setpoint (NTSP):

PRNM CLTP Setpoints (% RTP)	AL	AV	NTSP
APRM Neutron Flux – High (Setdown) Scram	N/A	20.0	18.0
APRM Neutron Flux – High (Setdown) Rod Block	N/A	15.0	13.0

Input 4.2 shows that Setdown Scram and Setdown Rod Block functions do not have AL. These functions only have AV and NTSP. This calculation will determine the minimum required margin for AL to AV, and AL to NTSP. The difference between the minimum required margins for AL to AV, and AL to NTSP becomes the minimum required margin for AV to NTSP.

7.4.2.1 Minimum Required Margin (AL to AV) Evaluation

Input 4.11, Section 1.2.3.2, provides the following formula for calculation the AV from the AL.

$$AV \le AL - \left(\frac{1.645}{2}\right)\sqrt{(A_L)^2 + (C_L)^2 + (PMA)^2 + (PEA)^2} \pm bias$$

Minimum required margin between the AL and AV and be defined by:

$$\left(\frac{1.645}{2}\right)\sqrt{(A_L)^2 + (C_L)^2 + (APMA_L)^2 + (APEA_L)^2} + APEA_b$$

Minimum Required Margin (AL - AV) = RM = AL - AV

RM = AL - AV = $\left(\frac{1.645}{2}\right)\sqrt{(0.253)^2 + (1.334)^2 + (2.288)^2 + (0.268)^2} + (0.490)$

RM = AL - AV = 2.69 % RTP

7.4.2.2 Minimum Required Margin (AL to NTSP) Evaluation

Input 4.11, Section 1.2.3.3, provides the following formula for calculating the AV from the AL:

$$NPSP \le AL - \left(\frac{1.645}{2}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2 + (PMA)^2 + (PEA)^2} \pm bias$$

Minimum required margin between AL and NTSP can be defined by:

$$\left(\frac{1.645}{2}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2 + (APMA_L)^2 + (APEA_L)^2 + (DPEA_L)^2} + APEA_b + DPEA_b$$

Minimum Required Margin (AL - NTSP) = RM = AL - NTSP

RM = AL – NTSP =

$$\left(\frac{1.645}{2}\right)\sqrt{(0.253)^2 + (1.334)^2 + (0.625)^2 + (2.288)^2 + (0.268)^2 + (0.054)^2} + 0.49 + 0.33$$

RM = AL – NTSP = 3.08 % RTP

7.4.2.3 Minimum Required Margin (AV to NTSP) Evaluation

RM = AV – NTSP =
Minimum Required Margin (AL to NTSP) - Minimum Required Margin (AL to AV)

RM = AV to NTSP = (3.08 - 2.69) % RTP
RM = AV to NTSP = 0.39 % RTP

PRNM CLTP Setpoints (% RTP)	AV	NTSP	Available Margin (AV-NTSP)	Minimum Required Margin	AV Acceptable
APRM Neutron Flux – (Setdown) Scram	20.0	18.0	2.0	0.39	Yes
APRM Neutron Flux – (Setdown) Rod Block	15.0	13.0	2.0	0.39	Yes

Since the available margin is greater than the minimum required margin (2.0 % RTP versus 0.39 % RTP), the recommended NTSP is acceptable.

7.4.2.4 Licensee Event Report (LER) Avoidance Test

The purpose of the LER Avoidance Test is to assure that there is sufficient margin between the AV and NTSP to reasonably avoid violation of the AV.

Input 4.11, Section 1.2.3.5, provides the following formula for determining LER avoidance criteria.

$$\sigma_{LER} = \left(\frac{1}{n}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2}$$

where n is the number of the standard deviations used (2σ)

$$\sigma_{LER} = \left(\frac{1}{2}\right)\sqrt{(0.253)^2 + (1.334)^2 + (0.625)^2}$$

σ_{LER} = 0.75 % RTP

For multiple instrument channels, a Z value of greater than 0.81 provides sufficient margin between the NTSP and AV as specified in ESM-03.02-APP-I, Section 5.6.3 (Input 4.1).

In accordance with Input 4.1, Section 5.6.3, Z is defined as:

$$Z = \frac{|AV - NTSP|}{\sigma_{LER}}$$

For APRM Neutron Flux – High (Setdown) Scram setpoint:

$$Z = \frac{|(20.0 - 18.0)\%RTP|}{(0.75)\%RTP} = 2.66$$

For APRM Neutron Flux – High (Setdown) Rod Block setpoint:

$$Z = \frac{|(15.0 - 13.0)\%RTP|}{(0.75)\%RTP} = 2.66$$

Since Z is greater than 0.81, sufficient margin exists between the specified AV and NTSP.

Minimum margin $NTSP_2$ will be calculated using the minimum Z value of 0.81. Minimum margin $NTSP_2$ will be compared with the current NTSP of 18.0 % RTP. This will indicate the amount of conservatism for the NTSP.

$NTSP_2$ Offset is defined as the minimum required margin between AV and NTSP with Z of 0.81 used.

$NTSP_2$ Offset = Z x σ_{LER}
$NTSP_2$ Offset = (0.81 x 0.75) % RTP = 0.61 % RTP

APRM Neutron Flux – High (Setdown) Scram Setpoint

For APRM Neutron Flux – High (Setdown) Scram setpoint: $NTSP_2$ is calculated to provide a NTSP based on the minimum LER avoidance criteria:

$NTSP_2 \leq AV - NTSP_2$ Offset
$NTSP_{2(\text{Setdown Scram})} \leq (20.0 - 0.61)$ % RTP
$NTSP_{2(\text{Setdown Scram})} \leq 19.4$ % RTP

For the minimum valve of Z equal to 0.81, $NTSP_2$, which is defined as the LER Avoidance NTSP, is to be less than 19.4 % RTP.

Therefore, a conservative NTSP of 18.0 % RTP is used for the APRM Neutron Flux – High (Setdown) Scram setpoint.

APRM Neutron Flux – High (Setdown) Rod Block Setpoint

For APRM Neutron Flux – High (Setdown) Rod Block setpoint: $NTSP_2$ is calculated below to indicate margin of the recommended NTSP:

$NTSP_2 \leq AV - NTSP_2$ Offset
$NTSP_{2(\text{Setdown Rod Block})} \leq (15.0 - 0.61)$ % RTP
$NTSP_{2(\text{Setdown Rod Block})} \leq 14.4$ % RTP

For the minimum valve of Z equal to 0.81, $NTSP_2$, which is defined as the LER Avoidance NTSP, is to be less than 14.4 % RTP.

Therefore, a conservative NTSP of 13.0 % RTP is used for the APRM Neutron Flux – High (Setdown) Rod Block setpoint.

Attachment 1, Setpoint Diagrams, shows the setpoint margin for CLTP APRM Neutron Flux – High (Setdown) Scram and APRM Neutron Flux – High (Setdown) Rod Block setpoints.

7.4.2.5 Spurious Trip Avoidance (STA) Test

A Spurious Trip Avoidance test is performed to assure that there is a reasonable probability that spurious trips will not occur using the selected setpoint.

Input 4.11, Section 1.2.3.4, provides the following formula for determining Spurious Trip avoidance. Input 4.13, Sections 4.5.4.b and 4.5.9.b, provides setpoint guidance to add bias term for APEA.

$$\sigma_{STA} = \left(\frac{1}{n}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2 + (PMA)^2 + (PEA)^2} + APEA_b$$

Where n is the number of standard deviations used (2σ)

Terms $DPEA_L$ and $DPEA_b$ were defined and evaluated in Section 7.3.1.7. These terms are to be included in the above σ_{STA} equation as follows:

$$\sigma_{STA} = \left(\frac{1}{n}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2 + (PMA)^2 + (PEA)^2 + (DPEA_L)^2} + APEA_b + DPEA_b$$

Using APRM terms, σ_{STA} is defined as:

$$\sigma_{STA} = \left(\frac{1}{n}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2 + (APMA)^2 + (APEA)^2 + (DPEA_L)^2} + APEA_b + DPEA_b$$

$$\sigma_{STA} = \left(\frac{1}{2}\right)\sqrt{(0.253)^2 + (1.334)^2 + (0.625)^2 + (2.288)^2 + (0.268)^2 + (0.054)^2} + 0.49 + 0.33$$

σ_{STA} = 2.20 % RTP

Input 4.1, STA Section 5.6.8, states Z is equal to the following:

$$Z = \frac{|(Adjusted\_NTSP) - (Operational\_Limit)|}{\sigma_{STA}}$$

Input 4.1, Section 5.6.8, states that Adjusted NTSP is the selected setpoint minus ALT_L (more conservative). Since Adjusted NTSP is ($NTSP-ALT_L$), Z is equal to the following:

$$Z = \frac{[NTSP - ALT - (Operational\_Limit)]}{\sigma_{STA}}$$

Input 4.2, Section 1.1, defines the Operational Limit for the APRM Neutron Flux – High (Setdown) Scram as 11.0 % RTP.

$$Z = \frac{(18.0 - 1.334 - 11.0)\%RTP}{(2.20)\%RTP}$$

Z= 2.57

As specified in Input 4.1, Section 5.6.8, Z should be equal to or greater that 1.65 for the setpoint to be adequately separated from the Operational Limit to reasonably avoid Spurious trip conditions.

Since the actual value of 2.57 is greater than the required value of 1.65, an adequate separation exists between the NTSP and the Operational Limit (OL), and the STA criterion is satisfied.

7.4.3 PRNM CLTP - APRM Downscale Rod Block

Input 4.2 for PRNM CLTP setpoints does not address the Downscale Rod Block setpoint for PRNM CLTP operation. Input 4.8, Item 12, provides recommended AV and NTSP setpoints indicated below.

The PRNM CLTP APRM Downscale Rod Block setpoint is the same as the current CLTP setpoint.

PRNM CLTP Setpoint % RTP	AL	AV	NTSP
APRM Downscale Rod Block	N/A	2.0	3.5

Input 4.8, Item 12, indicates that the APRM Downscale Rod Block function does not have an AL. This calculation will determine the minimum required margin for AL to AV, and AL to NTSP. The difference between the minimum required margins for AL to AV, and AL to NTSP becomes the minimum required margin for AV to NTSP.

7.4.3.1 Minimum Required Margin (AL to AV) Evaluation

Input 4.11, Section 1.2.3.2, provides the following formula for calculation the AV from the AL.

$$AV \leq AL - \left(\frac{1.645}{2}\right)\sqrt{(A_L)^2 + (C_L)^2 + (PMA)^2 + (PEA)^2} \pm bias$$

Minimum required margin between AL and AV can be defined by:

$$\left(\frac{1.645}{2}\right)\sqrt{(A_L)^2 + (C_L)^2 + (APMA_L)^2 + (APEA_L)^2} + APEA_b$$

Minimum Required Margin (AL - AV) = RM = AL - AV

$$RM = AL - AV = \left(\frac{1.645}{2}\right)\sqrt{(0.253)^2 + (1.334)^2 + (2.288)^2 + (0.268)^2} + (0.490)$$

RM = AL - AV = 2.69 % RTP

7.4.3.2 Minimum Required Margin (AL to NTSP) Evaluation

Input 4.11, Section 1.2.3.3, provides the following formula for calculating the AV from the AL:

$$NPSP \leq AL - \left(\frac{1.645}{2}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2 + (PMA)^2 + (PEA)^2} \pm bias$$

Minimum required margin between AL and NTSP can be defined by:

$$\left(\frac{1.645}{2}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2 + (APMA_L)^2 + (APEA_L)^2 + (DPEA_L)^2} + APEA_b + DPEA_b$$

Minimum Required Margin (AL - NTSP) = RM = AL - NTSP

RM = AL - NTSP =

$$\left(\frac{1.645}{2}\right)\sqrt{(0.253)^2 + (1.334)^2 + (0.625)^2 + (2.288)^2 + (0.268)^2 + (0.054)^2} + 0.49 + 0.33$$

RM = AL - NTSP = 3.08 % RTP

7.4.3.3 Minimum Required Margin (AV to NTSP) Evaluation = RM = AV to NTSP

RM = AV to NTSP =
Minimum Required Margin (AL to NTSP) - Minimum Required Margin (AL to AV)

RM = AV to NTSP = 3.08 % - 2.69 % % RTP
RM = AV to NTSP = 0.39 % RTP

PRNM CLTP Setpoint (% RTP)	AV	NTSP	Available Margin (NTSP-AV)	Minimum Required Margin	AV Acceptable
APRM Downscale Rod Block	2.0	3.5	1.5	0.39	Yes

Since the available margin is greater than the minimum required margin (1.5 % RTP versus 0.39 % RTP), the recommended NTSP is acceptable.

7.4.3.4 Licensee Event Report (LER) Avoidance Test

The purpose of the LER Avoidance Test is to assure that there is sufficient margin between the AV and NTSP to reasonably avoid violation of the AV.

Input 4.11, Section 1.2.3.5, provides the following formula for determining LER avoidance criteria.

$$\sigma_{LER} = \left(\frac{1}{n}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2}$$

where n is the number of the standard deviations used (2σ)

$$\sigma_{LER} = \left(\frac{1}{2}\right)\sqrt{(0.253)^2 + (1.334)^2 + (0.625)^2}$$

σ_{LER} = 0.75 % RTP

For multiple instrument channels, a Z value of greater than 0.81 provides sufficient margin between the NTSP and AV as specified in ESM-03.02-APP-I, Section 5.6.3 (Input 4.1).

In accordance with Input 4.1, Section 5.6.3, Z is defined as:

$$Z = \frac{|AV - NTSP|}{\sigma_{LER}} = \frac{|(2.0 - 3.5)\%RTP|}{(0.75)\%RTP} = 2.0$$

Since Z is greater than 0.81, sufficient margin exists between the specified AV and NTSP.

Minimum margin $NTSP_2$ will be calculated using the minimum Z value of 0.81. Minimum margin $NTSP_2$ will be compared with the current NTSP of 3.5 % RTP. This will indicate the amount of conservatism for the NTSP.

$NTSP_2$ Offset is defined as the minimum margin (% RTP) between AV and $NTSP_2$ with Z of 0.81.

$NTSP_2$ Offset = Z x σ_{LER}
$NTSP_2$ Offset = (0.81 x 0.75) % RTP = 0.61 % RTP

$NTSP_2$ is calculated to provide an NTSP based on the minimum LER avoidance criteria:
$NTSP_2 \geq$ AV + $NTSP_2$ Offset
$NTSP_2 \geq$ 2.0 % RTP + 0.61 % RTP
$NTSP_2 \geq$ 2.61 % RTP

For the minimum valve of Z equal to 0.81, $NTSP_2$, which is defined as the LER Avoidance NTSP, is to be greater than 2.61 % RTP.

Therefore, a conservative NTSP of 3.5 % RTP is used. Attachment 1, Setpoint Diagrams, shows the setpoint margin for CLTP APRM Downscale Rod Block setpoint.

7.5 PRNM EPU Operation Setpoint evaluation

7.5.1 PRNM EPU APRM Neutron Flux – High Scram

The setpoints that will be implemented for APRM Neutron Flux - High are defined in Input 4.8, Item 8. Input 4.3, GE's recommended setpoint document, has slight differences in the setpoints. As shown in the table below, Input 4.8 specifies slightly more conservative values for AV and NTSP. These EPU setpoints are the same values being used for PRNM CLTP operation.

PRNM EPU Setpoints (% RTP)	AL	AV	NTSP
APRM Neutron Flux – High Scram Input 4.8, Item 8	125.0	122.0	119.5
GE Recommended Setpoints (not used)			
APRM Neutron Flux – High Scram Input 4.3	125.0	122.3	120.3

7.5.1.1 Allowable Value (AV) Evaluation

Input 4.11, Section 1.2.3.2, provides the following formula for calculating the AV from the AL.

$$AV \le AL - \left(\frac{1.645}{2}\right)\sqrt{(A_L)^2 + (C_L)^2 + (PMA)^2 + (PEA)^2} \pm bias$$

Minimum required margin between AL and AV can be defined by:

$$\left(\frac{1.645}{2}\right)\sqrt{(A_L)^2 + (C_L)^2 + (APMA_L)^2 + (APEA_L)^2} + APEA_b$$

Minimum Required Margin (AL - AV) = RM = AL - AV

$$RM = AL - AV = \left(\frac{1.645}{2}\right)\sqrt{(0.253)^2 + (1.334)^2 + (2.288)^2 + (0.268)^2} + (0.490)$$

RM = AL - AV = 2.69 % RTP

Available Margin (AL - AV) = AM = AL - AV

AM = AL - AV = (125.0 - 122.0) % RTP
AM = AL - AV = 3.0 % RTP

EPU Setpoint (% RTP)	AL	AV	Available Margin (AL- AV)	Minimum Required Margin	AV Acceptable
APRM Neutron Flux – High Scram	125.0	122.0	3.0	2.69	Yes

Since the available margin is greater than the minimum required margin (3.0 % RTP versus 2.69 % RTP), the recommended AV is acceptable.

7.5.1.2 Nominal Trip Setpoint (NTSP) Evaluation

Input 4.11, Section 1.2.3.3, provides the following formula for calculating the AV from the AL.

$$NPSP \leq AL - \left(\frac{1.645}{2}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2 + (PMA)^2 + (PEA)^2} \pm bias$$

Minimum required margin between AL and NTSP can be defined by:

$$\left(\frac{1.645}{2}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2 + (APMA_L)^2 + (APEA_L)^2 + (DPEA_L)^2} + APEA_b + DPEA_b$$

Minimum Required Margin (AL - NTSP) = RM = AL - NTSP

RM = AL – NTSP =

$$\left(\frac{1.645}{2}\right)\sqrt{(0.253)^2 + (1.334)^2 + (0.625)^2 + (2.288)^2 + (0.268)^2 + (0.054)^2} + 0.49 + 0.33$$

RM = AL - NTSP = 3.08 % RTP

Available Margin (AL - NTSP) = AM = AL - NTSP

AM = AL - NTSP = (125.0 - 119.5) % RTP
AM = AL - NTSP = 5.5 % RTP

PRNM EPU Setpoint (% RTP)	AL	NTSP	Available Margin (AL- NTSP)	Minimum Required Margin	AV Acceptable
APRM Neutron Flux – High Scram	125.0	119.5	5.5	3.08	Yes

Since the available margin is greater than the minimum required margin (5.5 % RTP versus 3.08 % RTP), the recommended the NTSP is acceptable.

7.5.1.3 Licensee Event Report (LER) Avoidance Test

The purpose of the LER Avoidance Test is to assure that there is sufficient margin between the AV and NTSP to reasonably avoid violations of the AV.

Input 4.11, Section 1.2.3.5, provides the following formula for determining LER avoidance criteria.

$$\sigma_{LER} = \left(\frac{1}{n}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2}$$

where n is the number of the standard deviations used (2σ)

$$\sigma_{LER} = \left(\frac{1}{2}\right)\sqrt{(0.253)^2 + (1.334)^2 + (0.625)^2}$$

σ_{LER} = 0.75 % RTP

For multiple instrument channels, a Z value of greater than 0.81 provides sufficient margin between NTSP and AV as specified in ESM-03.02-APP-1, Section 5.6.3 (Input 4.1).

In accordance with Input 4.1, Section 5.6.3, Z is defined as:

$$Z = \frac{|AV - NTSP|}{\sigma_{LER}} = \frac{|(122.0 - 119.5)\%RTP|}{(0.75)\%RTP} = 3.33$$

Since Z is greater than 0.81, sufficient margin exists between the specified AV and NTSP.

Minimum margin $NTSP_2$ will be calculated using the minimum Z value of 0.81. Minimum margin $NTSP_2$ will be compared with the current NTSP of 119.5 % RTP. This will indicate the amount of conservatism for the NTSP.

$NTSP_2$ Offset is defined as the minimum margin (% RTP) between AV and $NTSP_2$ with Z of 0.81 used.

$NTSP_2$ Offset = Z x σ_{LER}
$NTSP_2$ Offset = (0.81 x 0.75) % RTP = 0.61 % RTP

$NTSP_2$ is calculated to provide an NTSP based on the minimum LER avoidance criteria:
$NTSP_2 \leq$ AV - $NTSP_2$ Offset
$NTSP_2 \leq$ 122.0 % RTP - 0.61 % RTP
$NTSP_2 \leq$ 121.4 % RTP

For the minimum valve of Z equal to 0.81, $NTSP_2$, which is defined as the LER Avoidance NTSP, is to be less than 121.4 % RTP.

A conservative NTSP of 119.5 % RTP is used.

7.5.1.4 Spurious Trip Avoidance (STA) Test

A spurious trip avoidance test is performed to assure that there is a reasonable probability that spurious trips will not occur using the selected setpoint.

Input 4.11, Section 1.2.3.4, provides the following formula for determining Spurious Trip avoidance. Input 4.13, Sections 4.5.4.b and 4.5.9.b, state that any bias associated with PMA or PEA should also be included. Therefore, $APEA_b$ shown in EPU Loop Uncertainty table in Section 7.3.2 is being included.

$$\sigma_{STA} = \left(\frac{1}{n}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2 + (PMA)^2 + (PEA)^2} + APEA_b$$

where n is the number of standard deviations used (2σ)

Terms $DPEA_L$ and $DPEA_b$ were defined and evaluated in Section 7.3.1.7 for CLTP operation but also apply to EPU operation as discussed in Sections 7.3.2 and 7.3.2.1. These terms are to be included in the above σ_{STA} equation as follows:

$$\sigma_{STA} = \left(\frac{1}{n}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2 + (PMA)^2 + (PEA)^2 + (DPEA_L)^2} + APEA_b + DPEA_b$$

Using APRM terms, σ_{STA} is defined as:

$$\sigma_{STA} = \left(\frac{1}{n}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2 + (APMA)^2 + (APEA)^2 + (DPEA_L)^2} + APEA_b + DPEA_b$$

$$\sigma_{STA} = \left(\frac{1}{2}\right)\sqrt{(0.253)^2 + (1.334)^2 + (0.625)^2 + (2.288)^2 + (0.268)^2 + (0.054)^2} + 0.49 + 0.33$$

σ_{STA} = 2.20 % RTP

Input 4.1, Section 5.6.8, states Z is equal to the following:

$$Z = \frac{|(Adjusted\_NTSP) - (Operational\_Limit)|}{\sigma_{STA}},$$

Input 4.1, Section 5.6.8, states that Adjusted NTSP is the selected setpoint minus ALT_L (more conservative). Since Adjusted NTSP is ($NTSP-ALT_L$), Z is equal to the following:

$$Z = \frac{NTSP - ALT - (Operational\_Limit)}{\sigma_{STA}}$$

In Input 4.3, Sections 1.3 and 1.7, GEH defines the Operational Limit for MNGP as 100%

$$Z = \frac{(119.5 - 1.334 - 100.0)\%RTP}{(2.20)\%RPT}$$

Z = 8.25

In accordance with Input 4.1, a minimum value of Z is to be 1.65. Since the actual value of 8.25 is greater than the required value of 1.65, adequate separation exists between the NTSP and the Operational Limit (OL), and the STA criterion is satisfied.

7.5.2 EPU APRM Neutron Flux - High (Setdown) Scram and APRM Neutron Flux – High (Setdown) Rod Block

Input 4.3, Section 3, specifies the following Analytical Limit (AL) and the following recommended Allowable Value (AV) and the Nominal Trip Setpoint (NTSP):

PRNM EPU Setpoints (% RTP)	AL	AV	NTSP
APRM Neutron Flux - High (Setdown) Scram	N/A	20.0	18.0
APRM Neutron Flux – High (Setdown) Rod Block	N/A	15.0	13.0

Input 4.3 indicates that Setdown Scram and Setdown Rod Block functions do not have AL. These functions only have AV and NTSP. This calculation will determine the minimum required margin for AL to AV, and AL to NTSP. The difference between the minimum required margins for AL to AV, and AL to NTSP becomes the minimum required margin for AV to NTSP.

7.5.2.1 Minimum Required Margin (AL to AV) Evaluation

Input 4.11, Section 1.2.3.2, provides the following formula for calculating the AV from the AL.

$$AV \leq AL - \left(\frac{1.645}{2}\right)\sqrt{(A_L)^2 + (C_L)^2 + (PMA)^2 + (PEA)^2} \pm bias$$

Minimum required margin between AL and AV can be defined by:

$$\left(\frac{1.645}{2}\right)\sqrt{(A_L)^2 + (C_L)^2 + (APMA_L)^2 + (APEA_L)^2} + APEA_b$$

Minimum Required Margin (AL - AV) = RM = AL - AV

$$RM = AL - AV = \left(\frac{1.645}{2}\right)\sqrt{(0.253)^2 + (1.334)^2 + (2.288)^2 + (0.268)^2} + (0.490)$$

RM = AL - AV = 2.69 % RTP

7.5.2.2 Minimum Required Margin (AL to NTSP) Evaluation

Input 4.11, Section 1.2.3.3, provides the following formula for calculating the NTSP from the AL.

$$NTSP \leq AL - \left(\frac{1.645}{2}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2 + (PMA)^2 + (PEA)^2} \pm bias$$

Minimum required margin between AL and NTSP can be expressed as:

$$\left(\frac{1.645}{2}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2 + (APMA_L)^2 + (APEA_L)^2 + (DPEA_L)^2} + APEA_b + DPEA_b$$

Minimum Required Margin (AL - NTSP) = RM = AL - NTSP

RM = AL - NTSP =

$$\left(\frac{1.645}{2}\right)\sqrt{(0.253)^2 + (1.334)^2 + (0.625)^2 + (2.288)^2 + (0.268)^2 + (0.054)^2} + 0.49 + 0.33$$

RM = AL - NTSP = 3.08 % RTP

7.5.2.3 Minimum Required Margin (AV to NTSP) Evaluation

RM = AV to NTSP =
Minimum Required Margin (AL to NTSP) - Minimum Required Margin (AL to AV)

RM = AV to NTSP = 3.08 % RTP – 2.69 % RTP
RM = AV to NTSP = 0.39 % RTP

PRNM EPU Setpoint (% RTP)	AV	NTSP	Available Margin (AV- NTSP)	Minimum Required Margin	AV Acceptable
APRM Neutron Flux - High (Setdown) Scram	20.0	18.0	2.0	0.39	Yes
APRM Neutron Flux – High (Setdown) Rod Block	15.0	13.0	2.0	0.39	Yes

Since the available margin is greater than the minimum required margin (2.0 % RTP versus 0.39 % RTP), the recommended NTSP is acceptable.

7.5.2.4 Licensee Event Report (LER) Avoidance Test

The purpose of the LER Avoidance Test is to assure that there is sufficient margin between the AV and NTSP to reasonably avoid violation of the AV.

Input 4.11, Section 1.2.3.5, provides the following formula for determining LER avoidance criteria.

$$\sigma_{LER} = \left(\frac{1}{n}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2}$$

where n is the number of the standard deviations used (2σ).

$$\sigma_{LER} = \left(\frac{1}{2}\right)\sqrt{(0.253)^2 + (1.334)^2 + (0.625)^2}$$

σ_{LER} = 0.75 % RTP

For multiple instrument channels, a Z value of greater than 0.81 provides sufficient margin between NTSP and AV as specified in ESM-03.02-APP-1, Section 5.6.3 (Input 4.1).

In accordance with Input 4.1, Section 5.6.3, Z is defined as:

$$Z = \frac{|AV - NTSP|}{\sigma_{LER}}$$

For APRM Neutron Flux – High (Setdown) Scram setpoint:

$$Z = \frac{|(20.0 - 18.0)\%RTP|}{(0.75)\%RTP} = 2.66$$

For APRM Neutron Flux – High (Setdown) Rod Block setpoint:

$$Z = \frac{|(15.0 - 13.0)\%RTP|}{(0.75)\%RTP} = 2.66$$

Since Z is greater than 0.81, sufficient margin exists between the specified AV and NTSP.

Minimum margin $NTSP_2$ will be calculated using the minimum Z value of 0.81. Minimum margin $NTSP_2$ will be compared with the current NTSP of 18.0 % RTP. This will indicate the amount of conservatism for the NTSP.

$NTSP_2$ Offset is defined as the minimum required margin between AV and NTSP with Z of 0.81 used.

$NTSP_2$ Offset = Z x σ_{LER}
$NTSP_2$ Offset = (0.81 x 0.75) % RTP = 0.61 % RTP

APRM Neutron Flux – High (Setdown) Scram Setpoint

For APRM Neutron Flux – High (Setdown) Scram setpoint: $NTSP_2$ is calculated to provide a NTSP based on the minimum LER avoidance criteria:

$NTSP_2 \leq$ AV - $NTSP_2$ Offset
$NTSP_{2(Setdown\ Scram)} \leq (20.0 - 0.61)$ % RTP
$NTSP_{2(Setdown\ Scram)} \leq 19.4$ % RTP

For the minimum valve of Z equal to 0.81, $NTSP_2$, which is defined as the LER Avoidance NTSP, is to be less than 19.4 % RTP.

Therefore, a conservative NTSP of 18.0 % RTP is used for the APRM Neutron Flux – High (Setdown) Scram setpoint.

APRM Neutron Flux – High (Setdown) Rod Block Setpoint

For APRM Neutron Flux – High (Setdown) Rod Block setpoint:
$NTSP_2$ is calculated below to indicate margin of the recommended NTSP:

$NTSP_2 \leq$ AV - $NTSP_2$ Offset
$NTSP_{2(Setdown\ Rod\ Block)} \leq (15.0 - 0.61)$ % RTP
$NTSP_{2(Setdown\ Rod\ Block)} \leq 14.4$ % RTP

For the minimum valve of Z equal to 0.81, $NTSP_2$, which is defined as the LER Avoidance NTSP, is to be less than 14.4 % RTP.

Therefore, a conservative NTSP of 13.0 % RTP is used for the APRM Neutron Flux – High (Setdown) Rod Block setpoint

7.5.2.5 Spurious Trip Avoidance (STA) Test

A Spurious Trip Avoidance test is performed to assure that there is a reasonable probability that spurious trips will not occur using the selected setpoint.

Input 4.11, Section 1.2.3.4, provides the following formula for determining Spurious Trip avoidance. Input 4.13, Sections 4.5.4.b and 4.5.9.b, provides setpoint guidance to add bias term for APEA.

$$\sigma_{STA} = \left(\frac{1}{n}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2 + (PMA)^2 + (PEA)^2} + APEA_b$$

Where n is the number of standard deviations used (2σ).
Terms $DPEA_L$ and $DPEA_b$ were defined and evaluated in Section 7.3.1.7 for CLTP operation but also applies to EPU operation as discussed in Section 7.3.2 and 7.3.2.1. These terms are to be included in the above σ_{STA} equation as follows:

$$\sigma_{STA} = \left(\frac{1}{n}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2 + (PMA)^2 + (PEA)^2 + (DPEA_L)^2} + APEA_b + DPEA_b$$

Using APRM terms, σ_{STA} is defined as:

$$\sigma_{STA} = \left(\frac{1}{n}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2 + (APMA)^2 + (APEA)^2 + (DPEA_L)^2} + APEA_b + DPEA_b$$

$$\sigma_{STA} = \left(\frac{1}{2}\right)\sqrt{(0.253)^2 + (1.334)^2 + (0.625)^2 + (2.288)^2 + (0.268)^2 + (0.054)^2} + 0.49 + 0.33$$

σ_{STA} = 2.20 % RTP

Input 4.1, STA Section 5.6.8, states Z is equal to the following:

$$Z = \frac{|(Adjusted\_NTSP) - (Operational\_Limit)|}{\sigma_{STA}}$$

Input 4.1, Section 5.6.8, states that Adjusted NTSP is the selected setpoint minus ALT_L (more conservative). Since Adjusted NTSP is ($NTSP-ALT_L$), Z is equal to the following:

$$Z = \frac{NTSP - ALT - (Operational\_Limit)}{\sigma_{STA}}$$

Input 4.3, Section 1.1, states the Operational Limit is 11.0%

$$Z = \frac{(18.0 - 1.334 - 11.0)\%RTP}{(2.20)\%RTP}$$

Z= 2.57

As specified in Input 4.1, Section 5.6.8, Z should be equal to or greater that 1.65 for the setpoint to be adequately separated from the Operational Limit to reasonably avoid Spurious trip conditions.

Since the actual value of 2.57 is greater than the required value of 1.65, an adequate separation exists between the NTSP and the Operational Limit (OL), and the STA criterion is satisfied.

7.5.3 PRNM EPU APRM Downscale Rod Block

This section of the calculation provides the basis for the NTSP setpoint to be 3.5 % RTP. The existing CLTP and PRNM CLTP NTSP setpoints (Section 7.4.3) are also 3.5 % RTP. EPU Input 4.3, Section 1.8, indicates the recommended NTSP setpoint is 4.0 % RTP. This section shows there is sufficient margin to keep the NTSP setpoint at 3.5 % RTP. Input 4.8, Item 12, also indicates the NTSP setpoint as 4.0 % RPT for EPU. This calculation provides the design basis to keep the setpoint at 3.5 % RTP.

Input 4.3 and Input 4.8 indicate the APRM Downscale Rod Block does not have an Analytical Limit (AL) setpoint. Both Inputs state the recommended value for the Allowable Valve (AV) is 2.0 % RTP. This section will evaluate the following Setpoints:

PRNM EPU Setpoint (% RTP)	AL	AV	NTSP
APRM Downscale Rod Block	N/A	2.0	3.5

This calculation will determine the minimum required margin for AL to AV, and AL to NTSP. The difference between the minimum required margins for AL to AV, and AL to NTSP becomes the minimum required margin for AV to NTSP.

7.5.3.1 Minimum Required Margin (AL to AV) Evaluation

Input 4.11, Section 1.2.3.2, provides the following formula for calculation the AV from the AL.

$$AV \le AL - \left(\frac{1.645}{2}\right)\sqrt{(A_L)^2 + (C_L)^2 + (PMA)^2 + (PEA)^2} \pm bias$$

Minimum required margin between AL and AV can be defined by:

$$\left(\frac{1.645}{2}\right)\sqrt{(A_L)^2+(C_L)^2+(APMA_L)^2+(APEA_L)^2}+APEA_b$$

Minimum Required Margin (AL - AV) = RM = AL - AV

RM = AL - AV = $\left(\frac{1.645}{2}\right)\sqrt{(0.253)^2+(1.334)^2+(2.288)^2+(0.268)^2}+(0.490)$

RM = AL - AV = 2.69 % RTP

7.5.3.2 Minimum Required Margin (AL to NTSP) Evaluation

Input 4.11, Section 1.2.3.3, provides the following formula for calculating the AV from the AL:

$$NPSP \le AL-\left(\frac{1.645}{2}\right)\sqrt{(A_L)^2+(C_L)^2+(D_L)^2+(PMA)^2+(PEA)^2}\pm bias$$

Minimum required margin between AL and NTSP can be defined by::

$$\left(\frac{1.645}{2}\right)\sqrt{(A_L)^2+(C_L)^2+(D_L)^2+(APMA_L)^2+(APEA_L)^2+(DPEA_L)^2}+APEA_b+DPEA_b$$

Minimum Required Margin (AL - NTSP) = RM = AL - NTSP

RM = AL - NTSP =

$$\left(\frac{1.645}{2}\right)\sqrt{(0.253)^2+(1.334)^2+(0.625)^2+(2.288)^2+(0.268)^2+(0.054)^2}+0.49+0.33$$

RM = AL - NTSP = 3.08 % RTP

7.5.3.3 Minimum Required Margin (AV to NTSP) Evaluation = RM = AV to NTSP

RM = AV to NTSP =
Minimum Required Margin (AL to NTSP) - Minimum Required Margin (AL to AV)

RM = AV to NTSP = 3.08 % RTP – 2.69 % RTP
RM = AV to NTSP = 0.39 % RTP

EPU Setpoint (% RTP)	AV	NTSP	Available Margin (AV-NTSP)	Minimum Required Margin	AV Acceptable
APRM Downscale Rod Block	2.0	3.5	1.5	0.39	Yes

Since the available margin is greater than the minimum required margin (1.5 % RTP versus 0.39 % RTP), the recommended NTSP is acceptable.

7.5.3.4 Licensee Event Report (LER) Avoidance Test

The purpose of the LER Avoidance Test is to assure that there is sufficient margin between the AV and NTSP to reasonably avoid violation of the AV.

Input 4.11, Section 1.2.3.5, provides the following formula for determining LER avoidance criteria.

$$\sigma_{LER} = \left(\frac{1}{n}\right)\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2}$$

where n is the number of the standard deviations used (2σ)

$$\sigma_{LER} = \left(\frac{1}{2}\right)\sqrt{(0.253)^2 + (1.334)^2 + (0.625)^2}$$

σ_{LER} = 0.75 % RTP

For multiple instrument channels, a Z value of greater than 0.81 provides sufficient margin between the NTSP and AV as specified in ESM-03.02-APP-I, Section 5.6.3 (Input 4.1).

In accordance with Input 4.1, Section 5.6.3, Z is defined as:

$$Z = \frac{|AV - NTSP|}{\sigma_{LER}} = \frac{|(2.0 - 3.5)|\%RTP}{(0.75)\%RTP} = 2.0$$

Since Z is greater than 0.81, sufficient margin exists between the specified AV and NTSP.

Minimum margin $NTSP_2$ will be calculated using the minimum Z value of 0.81. Minimum margin $NTSP_2$ will be compared with the current NTSP of 3.5 % RTP. This will indicate the amount of conservatism for the NTSP.

$NTSP_2$ Offset is defined as the minimum margin (% RTP) between AV and $NTSP_2$ with Z of 0.81.

$NTSP_2$ Offset = Z x σ_{LER}

$NTSP_2$ Offset = (0.81 x 0.75) % RTP = 0.61 % RTP

$NTSP_2$ is calculated to provide an NTSP based on the minimum LER avoidance criteria:

$NTSP_2 \geq AV + NTSP_2$ Offset

$NTSP_2 \geq 2.0$ % RTP + 0.61 % RTP

$NTSP_2 \geq 2.61$ % RTP

For the minimum valve of Z equal to 0.81, $NTSP_2$, which is defined as the LER Avoidance NTSP, is to be greater than 2.61 % RTP.

Therefore, a conservative APRM Downscale Rod Block NTSP setpoint of 3.5 % RTP is to be used.

8. CONCLUSIONS

The Analytical Limits (AL), Allowable Values (AV), and Nominal Trip Setpoints (NTSP), for APRM Neutron Flux High Scram, Setdown Scram, Setdown Rod Block and APRM Downscale Rod Block are listed below for EC-10856, which includes NUMAC PRNMS setpoints at CLTP and EPU conditions.

8.1 Loop Uncertainties for PRNM CLTP and EPU Operation

Term	Value	Section
A_L – Loop Instrument Accuracy	± 0.253 % RTP	7.3.1.1
D_L - Loop Instrument Drift	± 0.625 % RTP	7.3.1.2
ALT_L - Loop As-Left Tolerance for uncertainty calculations	± 1.334 % RTP	7.3.1.3
ALT_L - Loop As-Left Tolerance for PRNM electronic calibration	0.00 % RTP	7.3.1.3
AFT_L - Loop As-Found Tolerance for uncertainty calculations	± 1.334 % RTP	7.3.1.4
AFT_L - Loop As-Found Tolerance for PRNM electronic calibration	0.00 % RTP	7.3.1.4
C_L - Loop Calibration Accuracy Error	± 1.334 % RTP	7.3.1.5
$APEA_L$ - Loop APRM Primary Element Accuracy	± 0.268 % RTP	7.3.1.6
$DPEA_L$ - Loop Drift Primary Element Accuracy	± 0.054% RTP	7.3.1.7
$APMA_L$ - Loop APRM Process Measurement Accuracy	± 2.288 % RTP	7.3.1.8
$APEA_b$ – APRM Primary Element Accuracy bias	+0.49 % RTP bias	7.3.1.6
$DPEA_b$ - Drift Primary Element Accuracy bias	+ 0.33 % RTP bias	7.3.1.7

8.2 PRNM - CLTP Operation Setpoint (EC-10856)

PRNM CLTP Setpoint	Setpoint, % RTP		
	AL	AV	NTSP
APRM Neutron Flux - High Scram	125.0	122.0	119.5
APRM Neutron Flux – High (Setdown) Scram	N/A	20.0	18.0
APRM Neutron Flux – High (Setdown) Rod Block	N/A	15.0	13.0
APRM Downscale Rod Block	N/A	2.0	3.5

8.3 PRNM - EPU Operation Setpoint (EC-10856)

PRNM EPU Setpoint	Setpoint, % RTP		
	AL	AV	NTSP
APRM Neutron Flux - High Scram	125.0	122.0	119.5
APRM Neutron Flux – High (Setdown) Scram	N/A	20.0	18.0
APRM Neutron Flux – High (Setdown) Rod Block	N/A	15.0	13.0
APRM Downscale Rod Block	N/A	2.0	3.5

9. FUTURE NEEDS

This calculation impacts the following documents, which are listed in EC-10856:

9.1 Calculation CA-05-153, Rev 0, *Instrument Setpoint Calculation - APRM Downscale CR Block*, calculated the APRM Downscale CR Block NTSP setpoint of 3.5 % RTP for ITS and CLTP operation. PRNM CLTP operation does not change this setpoint. For PRNM EPU operation, NTSP setpoint of 3.5 % RTP has also been evaluated in accordance with Section 7.5.3. CA-05-153 will be superseded when PRNM retrofit is installed because the PRNM uncertainties are used as the basis for the APRM Downscale Rod Block setpoint. GAR 01146760 was initiated to track calculation CA-05-0153 be superseded due to EC 10856.

9.2 Calculation CA-96-224, Rev 1, *Instrument Setpoint calculation - APRM Flow-Biased Upscale Scram and Rod Block*, includes the APRM Flow-Referenced Neutron Flux - High High setpoint. PRNM changes this setpoint to non-flow bias APRM Neutron Flux High. The current setpoint of 0.66W + 67.6 % RTP clamped at 122 % RTP is being changed to 122 % RTP. This applies to PRNM CLTP and EPU operation. GAR 01146761 was initiated to track calculation CA-96-224 be superseded due to EC 10856.

9.3 Procedure C.6-005-A-03, Rev 1, *Rod Withdraw Block*. This is the annunciator procedure for window 5-A-3. PRNMS adds a new rod withdraw block setpoint: APRM Neutron Flux – High (Setdown) Rod Block. Sections 7.4.2 and 7.5.2 evaluate the setpoint. This annunciator procedure will be changed to add the new rod withdraw block setpoint. PCR 01146750 has been initiated to track changes to C.6-005-A-03 due to EC 10856 PRNM retrofit.

9.4 Procedure C.6-005-A-06, Rev 3, *APRM Downscale*, states a NTSP setpoint of 3.5 % RTP. This is correct for the present neutron monitoring system. Even though the PRNM CLTP and EPU operation NTSP setpoints are 3.5 % RTP, the procedure does not address that the PRNM retrofit NTSP setpoints remain the same for APRM Downscale Rod Block. PCR 01146778 was initiated to revise C.6-005-A-03, Rev 1, when EC 10856 PRNM retrofit is installed.

9.5 Procedure C.6-005-A-22, Rev 3, *APRM Hi Hi INOP CH 1, 2, 3*, is a flow-bias APRM Neutron Flux Hi Hi setpoint. PRNM retrofit converts this setpoint to a non-flow bias APRM Neutron Flux High setpoint. The PRNM APRM Neutron Flux High setpoint is part of this calculation. C.6-005-A-22 will be revised under EC-10856 and PCR 01129100.

9.6 Procedure C.6-005-A-30, Rev 3, *APRM Hi Hi INOP CH 4, 5, 6*, is a flow-bias APRM Neutron Flux Hi Hi setpoint. PRNM retrofit converts this setpoint to a non-flow bias APRM Neutron Flux High setpoint. The PRNM APRM Neutron Flux High setpoint is part of this calculation. C.6-005-A-30 will be revised under EC-10856 and PCR 01133816.

9.7 Procedure B.05.06-02, Rev 18, *Operations Manual Section - Plant Protection System*, specifies APRM Hi Hi and APRM Downscale and other setpoints. This calculation evaluates the APRM Downscale Rod Block setpoints and documents the PRNM EPU change in this setpoint. The APRM Hi Hi setpoint is flow biased and is PRNM changes this setpoint to non-flow bias APRM Neutron Flux High. B.05.06-02 will be revised under EC-10856 and PCR 01133455.

9.8 Procedure B.05.01.02-02, Rev 6, *Operations Manual Section - Power Range Neutron Monitoring*, specifies NMS trip setpoints, which are being changed due to PRNMS. B.05.01.02-02 will be revised under EC-10856 and PCR 01137808.

9.9 B.05.01.02-05, Rev 16, Operations Manual Section – Power Range Neutron Monitoring, System Operation. B.05.01.02-05, Rev 16 refers to the six APRM channels, which applies to the existing NMS. PRNMS has four APRM channels as stated is Section 7.2.2.1 of this calculation. PCR 01146778 issued to revise B.05.01.02-05, Rev 16, upon implementation of EC 10856.

9.10 DBD B5.1, Rev C, *Design Bases Document for Neutron Monitoring System*, discusses NMS setpoints, margin, uncertainty parameters such as drift, etc. This calculation validated certain NMS setpoints using the PRNM parameter uncertainties specified in GE documentation. DBD B5.1 will be revised under EC 10856. GAR 1138038 tracks revision to DBD B5.1 for EC 10856 PRNM setpoint changes.

9.11 *MNGP Technical Specification*, Amendment 155, Table 3.3.1.1-1, for APRM Flow Referenced Neutron Flux High High is replaced by PRNM APRM Neutron Flux High. New setpoint PRNM Neutron Flux-High (Setdown) is added. APRM Downscale Rod Block is being removed from Tech Specs when PRNM retrofit is installed. GAR 01146762 was initiated to track changes to the Technical Specifications due to EC 10856.

9.12 *MNGP Technical Specifications Bases*, Rev 8, Bases will be revised to discuss the PRNM APRM Neutron Flux High setpoint, which is non-flow bias, in place of the existing Flow Referenced Neutron Flux-High High setpoint. PRNM Neutron Flux-High (Setdown) setpoint to being added. GAR 01146763 has been initiated to track changes to the Technical Specification Bases due to EC 10856.

9.13 *MNGP Technical Requirements Manual* (TRM), Rev 2, New PRNM Setdown Rod Block setpoint is to be discussed in the TRM. The APRM Downscale Rod Block setpoint is being removed from the Tech Specs and will be added to the TRM. APRM Downscale Rod Block setpoint is the same for CLTP and EPU. This calculation provides the design basis for the EPU APRM Downscale Rod Block NTSP setpoint because the GEH Input documents have a slightly different value. LAR 01128839 has been initiated to track PRNM setpoint changes to the TRM due to EC 10856.

9.14 Procedure 8211, Rev 2, *APRM Calibration Readjustment for Single Loop*, discusses APRM setpoint voltage adjustments including Downscale Rod Block, Hi-Hi Scram, etc. Changes have been made by PRNM and this calculation evaluates the non-flow biased PRNM setpoints. Procedure 8211 will be deleted under EC-10856, PCR 01133437. SLO operation will be enabled under Operations procedure in B.05.01.02-05. PCR 1133449 has been initiated to track these procedure changes.

9.15 Procedure 8212, Rev 2, *APRM Calibration Readjustment for Two Loop*, discusses APRM setpoint voltage adjustments including Downscale Rod Block, Hi-Hi Scram, etc. Changes have been made by PRNM and this calculation evaluates the non-flow biased PRNM setpoints. Procedure 8212 will be deleted under EC-10856, PCR 01133445. TLO operation will be enabled under Operations procedure in B.05.01.02-05. PCR 1133449 has been initiated to track these procedure changes.

9.16 Procedure 0012, *APRM/Flow Reference Scram Functional Check*, performs the calibration of the APRM including the Neutron Flux High Scram, Setdown Scram, Setdown Rod Block, and Downscale Rod Block setpoints. Setpoints are revised as a result of this calculation. 0012 will be deleted under EC-10856, PCR 01133332. Procedures ISP-NIP-0588, ISP-NIP-0589-01, ISP-NIP-0589-02 will be developed to replace 0012. APRM Calibration will be created under EC-10856. PCR 01129124 has been initiated to track these procedure changes.

APRM Neutron Flux - High Scram – CLTP and EPU Operation

		% RTP		
		125.0	AL	
	LER Avoidance (122.0 to 121.4)	122.0	AV	
		121.4	$NTSP_2$	
See Note 1	As Found/ As Left Tolerance (120.8 to 118.2)	120.8	As Found/As Left	
		119.5	NTSP	ALT = AFT ± 1.34%
		118.2	As Found/As Left	

APRM Neutron Flux (Setdown) Scram for CLTP and EPU Operation

		% RTP		
		n/a	AL	
	LER Avoidance (20.0 to 19.4)	20.0	AV	
		19.4	$NTSP_2$	
See Note 1	As Found/ As Left Tolerance (19.3 to 16.7)	19.3	As Found/As Left	
		18.0	NTSP	ALT = AFT ± 1.34%
		16.7	As Found/As Left	

APRM Neutron Flux (Setdown) Rod Block – CLTP and EPU Operation

	% RTP		
	n/a	AL	
	15.0	AV	
See Note 1 As Found/ As Left Tolerance	14.3	As Found/As Left	
	13.0	NTSP	ALT = AFT ± 1.34 %
	11.7	As Found/As Left	

APRM Downscale Rod Block – CLTP and EPU Operation

	% RTP		
See Note 1 As Found/ As Left Tolerance	4.8	As Found/As Left	
	3.5	NTSP	ALT = AFT ± 1.34 %
	2.2	As Found/As Left	
LER Avoidance	2.61	$NTSP_2$	
	2.0	AV	
	n/a	AL	

Note 1: The As-Left and As-Found uncertainty tolerances are specified as 1.34 % RTP because GEH Inputs 4.2 and 4.3 state tolerance of 2 % RTP, 3σ. Converting AFT/ALT to 2σ confidence level results in 1.34 % RTP. However, AFT/ALT tolerances are 0.00 % RTP when used for PRNM surveillance calibration. PRNMS is a digital system and the setpoint is a single number in the database not susceptible to drift. Sections 7.3.1.3 and 7.3.1.4 evaluate the uncertainty and calibration tolerances for AFT and ALT.

ATTACHMENTS 2 AND 3

TO MNGP CALCULATION CA-08-050

ARE NOT INCLUDED

THEY ARE GEH PROPRIETARY CALCULATIONS

(Included for ease of reference in the calculation.)

Mathematics of Physics and Modern Engineering

I. S. SOKOLNIKOFF
Professor of Mathematics
University of California, Los Angeles

R. M. REDHEFFER
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Second Edition

McGRAW-HILL BOOK COMPANY
NEW YORK ST. LOUIS SAN FRANCISCO
TORONTO LONDON SYDNEY

3. Three coins are tossed. Let x be the number of heads shown by the first coin, whereas y is the number of heads shown by all the coins. Compute the correlation coefficient. Your result should be smaller than the value (13-10). Why?

4. Two continuous variables x and y are said to be *independent* if their joint density $f(x,y)$ has the form $f(x)g(y)$. Verify the theorem of compound probability for independent events, in the form

$$\Pr(a < x < b, c < y < d) = \Pr(a < x < b)\Pr(c < y < d).$$

Also verify the equation $E(xy) = E(x)E(y)$, assuming convergence of the relevant integrals.

5. Referring to (12-9) and (12-10), express the variance, covariance, and correlation coefficient in integral form, when x and y are continuous variables with joint density $f(x,y)$. By using the result of Prob. 4, show that the covariance is 0 if the variables are independent.

6. (*Chebychev's lemma.*) Let t be a random variable which does not assume negative values, and let $E(t) = \tau$. Prove that the probability of the inequality $t \leq \tau h$ is at least $1 - 1/h$, for every positive constant h. *Outline of solution:* The probability of the contrary event, $t > \tau h$, is

$$\int_{\tau h}^{\infty} f(t)\,dt \leq \int_{\tau h}^{\infty} \frac{t}{\tau h} f(t)\,dt \leq \frac{1}{\tau h}\int_0^{\infty} t f(t)\,dt = \frac{1}{h}.$$

7. (*Chebychev's inequality.*) Let x be a random variable with mean μ and variance σ^2. By Prob. 6 with $t = (x - \mu)^2$, prove that the probability of the inequality $|x - \mu| \leq \sqrt{h}\,\sigma$ is at least $1 - 1/h$, for every positive constant h.

8. Plot the probability of the inequality $|x - \mu| \leq k\sigma$ as a function of k when x is normally distributed with mean μ and variance σ. On the same axes, plot the minimum probability of this inequality as given by Prob. 7. (Specific distributions such as the Gauss, Poisson, or Maxwell-Boltzmann distributions depend on a few parameters. A method of estimation which does not assume a specific type of distribution function is called a *nonparametric method.* Since non-parametric methods assume less about the random process, they give less information.)

---

14. Arithmetic Means. The Theory of Errors. In many applications one does not consider a single value alone, but one obtains a mean of a large number of values. For example, if m denotes the measured value of the length of a rod one would make several measurements $m_1, m_2, \ldots, m_n$ and use the *arithmetic mean*

$$\bar{m} = \frac{m_1 + m_2 + \cdots + m_n}{n}.$$

If the true value of the length is v, the errors in measurement are

$$x_i = m_i - v.$$

By adding and dividing by n we get

$$\bar{x} = \bar{m} - v \tag{14-1}$$

where $\bar{x}$ is the mean of the x_i:

$$\bar{x} = \frac{x_1 + x_2 + \cdots + x_n}{n}. \tag{14-2}$$

According to (14-1), the *mean of the errors is equal to the error of the mean.* It is likely to be smaller than the error in a single measurement, because positive and negative errors tend to cancel in Σx_i.

So far we have taken the view that the x_i's are independent observations of a single random variable x, so that $\bar{x}$ is the *observed mean* or the *sample mean.* However, we can also take the view that the x_i are independent variables[1] and that $\bar{x}$ is another random variable whose value is the mean of the values of x_i. With this view it is possible to get a precise description of the improvement in accuracy as the number of measurements increases. The result is:

THEOREM. If the variables x_i are independent, if they have the same expectation $E(x_i) = \mu$ and the same variance σ_x^2, then

$$\sigma_{\bar{x}} = \frac{\sigma_x}{\sqrt{n}}.$$

Here σ_x denotes the standard deviation of the variable x, and $\sigma_{\bar{x}}$ denotes the standard deviation of $\bar{x}$. To prove the theorem, observe that

$$E(x_1 + \cdots + x_n) = E(x_1) + \cdots + E(x_n) = n\mu.$$

The variance of $x_1 + \cdots + x_n$ is therefore

$$E(x_1 + \cdots + x_n - n\mu)^2$$

which can be written

$$E[(x_1 - \mu) + (x_2 - \mu) + \cdots + (x_n - \mu)]^2.$$

Expanding the term in brackets we obtain

$$E\left[\sum_i (x_i - \mu)^2 + \sum_{i \neq j} (x_i - \mu)(x_j - \mu)\right]. \tag{14-3}$$

Since the variables are independent, the covariance of x_i and x_j is zero for $i \neq j$; that is,

$$E(x_i - \mu)(x_j - \mu) = 0.$$

Also the definition of σ_x gives

$$\sigma_x^2 = E(x_i - \mu)^2.$$

Hence, taking the expectation in (14-3) yields

$$E(x_1 + \cdots + x_n - n\mu)^2 = n\sigma_x^2.$$

Dividing by n^2 we have

$$E\left(\frac{x_1 + \cdots + x_n}{n} - \mu\right)^2 = \frac{\sigma_x^2}{n}$$

which gives the conclusion upon taking the square root.

The intuitive meaning of this result is approximately as follows: Suppose a single measurement varies over an interval of length l about the true value, so that l measures the scatter or spread. Then the mean of n independent measurements will have a spread of the order of $l/\sqrt{n}$ about the true value. This shows that the improvement of accuracy due to cancellation of positive and negative errors is of the order of $\sqrt{n}$, where n is the number of measurements. The most important consideration justifying the analysis in practice is that systematic errors must be eliminated.

The foregoing conclusions are independent of the density function $f(x)$ that governs the statistical distribution of the errors. However, in a great variety of cases the errors have a Gaussian density

$$f(x) = \frac{h}{\sqrt{\pi}} e^{-h^2x^2}. \tag{14-4}$$

This result, known as the *Gaussian law of error*, states that the variable $\sqrt{2}\,hx$ is normally distributed. Specifically, the probability of

[1] The use of lower-case letters to denote variables is customary in statistical literature. However, the x_i here are analogous to the X_i of Sec. 12, not to the x_i of Secs. 4 and 5.

ENCLOSURE 7

MONTICELLO NUCLEAR GENERATING PLANT

RESPONSE TO REQUESTS FOR ADDITIONAL INFORMATION FOR LICENSE AMENDMENT REQUEST FOR POWER RANGE NEUTRON MONITORING SYSTEM UPGRADE (TAC NO. MD8064)

GEH PROPRIETARY INFORMATION AFFIDAVITS

2 AFFIDAVITS ENCLOSED

DATED

JUNE 13, 2008

SEPTEMBER 10, 2008

6 Pages Follow

GE-Hitachi Nuclear Energy Americas LLC

AFFIDAVIT

I, Robert E. Brown, state as follows:

(1) I am Senior Vice President, Regulatory Affairs, Regulatory Affairs, GE-Hitachi Nuclear Energy Americas LLC ("GEH"), 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 GEH letter, GE-MNGP-AEP-766, *Monticello PRNM - GEH Responses to RAIs 1 and 6 - June 13, 2008*, dated August 13, 2008. The proprietary information in Enclosure 1 entitled, *GEH Responses to RAIs 1 and 6 - June 13, 2008*, 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 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 qualify 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, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).

(4) Some examples of categories of information which 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 which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product;

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

d. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs (4)a. and (4)b. above.

(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, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties, including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.

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

(8) The information identified in paragraph (2), above, is classified as proprietary because it contains detailed results of GEH's analysis and evaluations of various stability events and the performance of the stability detection and suppression capability of the APRM-based detection algorithm for the BWR. The analysis is based on analytical models, methods and processes, including computer codes, which GE has developed, and applied to perform stability evaluations for the BWR. The development of the detection and suppression capability of the APRM-based detection algorithm for the BWR was achieved at a significant cost to GE.

The development of the evaluation process along with the interpretation and application of the analytical results is derived from the extensive experience database that constitutes a major GE 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 13th day of August 2008.

R. E. Brown

Robert E. Brown
GE-Hitachi Nuclear Energy Americas LLC

GE-Hitachi Nuclear Energy Americas LLC

AFFIDAVIT

I, **Tim E. Abney,** state as follows:

(1) I am Vice President, Services Licensing, Regulatory Affairs, GE-Hitachi Nuclear Energy Americas LLC ("GEH"), 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 GEH letter, GE-MNGP-AEP-805, *Monticello PRNM - GEH Response to RAI 2 June 13, 2008*, dated September 8, 2008. The proprietary information in Enclosure 1 entitled, *GEH Response to RAI 2 - June 13, 2008*, 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 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 qualify 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, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).

(4) Some examples of categories of information which 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 which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product;

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

d. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs (4)a. and (4)b. above.

(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, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties, including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.

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

(8) The information identified in paragraph (2) above is classified as proprietary because it contains results of a GEH evaluation of instrumentation used at Boiling Water Reactors (BWR) to protect fuel integrity, which was developed by GEH for evaluations of Monticello's Power Range Neutron Monitor license application. The basis of the evaluation includes GEH's analysis of stability events at BWRs. Development of these analyses, techniques, and information and their application to the design, modification, and analyses methodologies and processes for the Monticello's Power Range Neutron Monitor license application was achieved at a significant cost to GEH.

The development of the evaluation process along with the interpretation and application of the analytical results is derived from the extensive experience database that constitutes 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 8th day of September 2008.

Tim E. Abney
Vice President, Services Licensing
GE-Hitachi Nuclear Energy Americas LLC