W. Scott Oxenford
Columbia Generating Station
P.O. Box 968, PE08
Richland, WA 99352-0968
Ph. 509.377.4300 | F. 509.377.4150
soxenford@energy-northwest.com

ENERGY NORTHWEST

May 11, 2010
GO2-10-071

10 CFR 50.90

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

Subject: **COLUMBIA GENERATING STATION, DOCKET NO. 50-397 LICENSE AMENDMENT REQUEST TO CHANGE TECHNICAL SPECIFICATIONS IN SUPPORT OF PRNM / ARTS / MELLLA IMPLEMENTATION**

Dear Sir or Madam:

Pursuant to 10 CFR 50.90, Energy Northwest hereby requests an amendment to the Technical Specifications (TS) for Columbia Generating Station Operating License NPF-21. Energy Northwest has reviewed the proposed amendment in accordance with 10 CFR 50.92 and concludes it does not involve a significant hazards consideration.

The proposed amendment would modify TS for Standby Liquid Control System, Reactor Protection System, Control Rod Block Instrumentation, Oscillation Power Range Monitor (OPRM) Instrumentation, Recirculation Loops Operating, Shutdown Margin Test – Refueling, and the Core Operating Limits Report (COLR).

The proposed changes are needed to allow modifications of the Neutron Monitoring System (NMS) by installation of the General Electric Hitachi (GEH) Nuclear Monitoring Analysis and Control (NUMAC) Power Range Neutron Monitor (PRNM) system. The existing OPRM system hardware would be replaced. The OPRM trip function would be integrated into the NUMAC PRNM system. The modification of the PRNM system replaces analog technology with a more reliable digital upgrade and simplifies the management and maintenance of the system.

The proposed amendment would also provide an expanded operating domain resulting from the implementation of Average Power Range Monitor/Rod Block Monitor/Technical Specifications/Maximum Extended Load Line Limit Analysis (ARTS/MELLLA). The Average Power Range Monitor (APRM) flow-biased simulated thermal power scram Allowable Value would be revised to permit operation in the MELLLA region. The current flow biased Rod Block Monitor (RBM) would also be replaced by a power dependent RBM which also would require new Allowable Values. In addition, the flow-

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biased APRM simulated thermal power setdown requirements would be replaced by more direct power and flow dependent thermal limits to reduce the need for manual APRM gain adjustments and to provide more direct thermal limits administration during operation at other than rated conditions. Operation in the MELLLA region will provide improved power ascension capability by extending plant operation at rated power with less than rated flow. Operation in the MELLLA region can result in the need for fewer control rod manipulations to maintain rated power during the fuel cycle. Replacement of the flow-biased APRM simulated thermal power setdown requirement will improve reliability and provide more direct protection of thermal limits.

An increase in the boron enrichment for the Standby Liquid Control System (SLCS) is also proposed with this amendment. Boron-10 enrichment in the SLCS solution is increased to support Anticipated Transient Without Scram (ATWS) mitigation with one SLCS pump, instead of two. This improves system reliability by increasing redundancy and maintaining margin to the SLCS relief valve setpoint under ARTS/MELLLA conditions.

The enclosure provides a description and evaluation of the proposed TS changes. Attachments to the enclosure include the following:

1. Columbia Generating Station Plant-Specific Responses Required by NUMAC PRNM Retrofit Plus Option III Stability Trip Function Topical Report (NEDC-32410P-A)
2. TS page markups
3. TS Bases page markups (for information only)
4. Retyped TS pages
5. Sample pages of proposed COLR changes (for information only)
6. Affidavit to withhold proprietary information
7. Safety Analysis in support of ARTS/MELLLA (proprietary version)
8. Safety Analysis in support of ARTS/MELLLA (non-proprietary version)
9. Summary of Commitments

Approval of the proposed amendment is requested by April 6, 2011, the start of the spring 2011 refueling outage, to support implementation during that outage. Once approved, the amendment shall be implemented prior to startup from the outage in which the PRNM modification is installed.

The proposed changes will maintain safe operation of Columbia Generating Station. The staff has approved similar license amendment requests for Nine Mile Point Nuclear Station Unit 2, Brunswick Steam Electric Plant Units 1 & 2, Susquehanna Steam Electric Station Units 1 & 2, and Monticello Nuclear Generating Plant.

The list of regulatory commitments included in this submittal is summarized in Attachment 9 to the enclosure.

In accordance with 10 CFR 50.91, a copy of this application, with attachments, is being provided to the designated Washington State Official.

Should you have any questions or require additional information regarding this matter, please contact Mr. D.W. Coleman, Manager, Regulatory Programs, at (509) 377-4342.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the date of this letter.

Respectfully,

W.S. Oxenford
Vice President, Nuclear Generation & Chief Nuclear Officer

Enclosure: Description and Evaluation of the Proposed TS Changes

Attachments to the Enclosure:

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cc: Regional Administrator – NRC RIV
Project Manager – NRC NRR
NRC Senior Resident Inspector/988C
R.N. Sherman – BPA/1399
W.A. Horin – Winston & Strawn
J.O. Luce – EFSEC
R.R. Cowley – WDOH

Description and Evaluation of the Proposed TS Changes

Subject: License Amendment Request to Change Technical Specifications (TS) in Support of:

1) Power Range Neutron Monitoring (PRNM) System Upgrade

2) APRM / RBM / Technical Specifications (ARTS) / Maximum Extended Load Line Limit Analysis (MELLLA) Implementation

3) Increase in Boron-10 Enrichment for Standby Liquid Control System (SLC)

ATTACHMENTS:

1. Columbia Generating Station Plant-Specific Responses Required by NUMAC PRNM Retrofit Plus Option III Stability Trip Function Topical Report (NEDC-32410P-A)
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1.0 SUMMARY DESCRIPTION

Pursuant to 10 CFR 50.90, Energy Northwest proposes to revise the Columbia Generating Station (Columbia) TS to:

1) Reflect the installation of the digital General Electric - Hitachi (GEH) Nuclear Measurement Analysis and Control (NUMAC) Power Range Neutron Monitoring (PRNM) System.

2) Reflect an expanded operating domain resulting from implementation of Average Power Range Monitor/Rod Block Monitor/Technical Specifications (ARTS) and Maximum Extended Load Line Limit Analysis (MELLLA).

3) Increase the enrichment of Boron-10 in the Standby Liquid Control System (SLC).

The proposed changes for the installation of the PRNM System are consistent with the NRC-approved GEH Licensing Topical Report (LTR) NEDC-32410P-A, "Nuclear Measurement Analysis and Control Power Range Neutron Monitor (NUMAC PRNM) Retrofit Plus Option III Stability Trip Function," Volumes 1 and 2, including Supplement 1 (References 1 and 2), referred to herein collectively as the NUMAC PRNM LTR. For implementation of 1) above, the NUMAC PRNM LTR provides the primary technical basis for the proposed changes. The NRC approved the design and application of NUMAC PRNM LTR via References 3 and 4.

Energy Northwest and GEH evaluated the proposed Columbia-specific PRNM System against the requirements of the NUMAC PRNM LTR and associated NRC Safety Evaluations (SEs). GEH developed a plant-specific comparison report 0000-0101-7647-R1, "Columbia Generating Station Plant-Specific Responses Required by NUMAC PRNM Retrofit Plus Option III Stability Trip Function Topical Report (NEDC-32410P-A)," which is provided in Attachment 1. One deviation from the NUMAC PRNM LTR is identified and discussed in Appendix A of Attachment 1.

Implementation of ARTS/MELLLA involves changing the Average Power Range Monitor (APRM) flow-biased STP Allowable Value (AV) to permit operation in the MELLLA operating domain. Implementation of the PRNM hardware allows the current flow-biased Rod Block Monitor (RBM) to be replaced by a power dependent RBM which would require new AVs. The flow-biased APRM total peaking setdown requirement would be replaced by more direct power and flow dependent thermal limits administration.

Energy Northwest proposes to use an enriched sodium pentaborate solution. With the replacement of the existing SLC solution, system operation can change from operation requiring both pumps, to operation requiring only a single pump. This allows a reduction in the required system flow and pump discharge pressure, due to reduced system back pressure. The enrichment is also increased to support the required shutdown concentration of boron for planned reloads of GE14 fuel.

Energy Northwest plans to replace the analog APRM and RBM subsystems of the existing Neutron Monitoring System and the OPRM System at Columbia with the more reliable digital NUMAC PRNM System during the spring 2011 refueling outage. The SLC Boron-10 enrichment will also be increased during the spring 2011 refueling outage. Implementation of the expanded operating domain using ARTS/MELLLA would occur in the subsequent operating cycle.

2.0 DETAILED DESCRIPTION

This LAR would change TS sections 3.1.7, 3.2.4, 3.3.1.1, 3.3.1.3, 3.3.2.1, 3.4.1, 3.10.8, 5.6.3, and their associated TS Bases, allowing modification of the APRM and RBM subsystems of the Neutron Monitoring System (NMS), and the OPRM System by installation of a digital PRNM system. The TS changes above also reflect the proposed expansion of the operating domain via application of the ARTS/MELLLA improvements and a proposed increase in the SLC Boron-10 enrichment. A Columbia specific evaluation was performed for the PRNM system in accordance with the NUMAC PRNM LTR, and is included as Attachment 1.

The proposed changes support Columbia's replacement of the existing analog APRM and RBM subsystems, and the OPRM System, excluding the associated Local Power Range Monitor (LPRM) detectors and cables, with the NUMAC microprocessor-based PRNM System. The NUMAC PRNM system will perform the same functions as the currently installed APRM, RBM, and OPRM systems.

The planned modification involves replacing the existing six APRM instrument channel modules of power range monitor electronics with four channels of NUMAC PRNM System hardware. The modification provides redundancy to the LPRM detector power supply hardware and also upgrades electronics. Unlike the analog instrumentation, the new digital instrumentation is not vulnerable to instrument setpoint drift.

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

This LAR also addresses the further expansion of the operating domain (MELLLA) and implementation of ARTS to allow for more efficient reactor operations. ARTS/MELLLA will allow rated power to be maintained over a wider core flow range, thereby reducing the frequency of control rod manipulations. Expansion of the operating domain for the current Power/Flow (P/F) map requires changes to the APRM and RBM trip functions which are incorporated into the PRNM modification and discussed below.

Boron-10 enrichment in the SLC solution is increased to support Anticipated Transient Without Scram (ATWS) mitigation with one SLC pump, instead of two. This improves system reliability by increasing redundancy and maintaining margin to the SLC relief valve setpoint under ARTS/MELLLA conditions. The increase in Boron-10 enrichment for the SLC system is also proposed to support future reloads of GE14 fuel, to provide additional margin for preserving the shutdown objective of the SLC system.

Attachment 2 provides the marked up TS pages indicating the proposed changes. Attachment 3 provides the associated TS Bases page markups for information only. Some reference to the TS Bases changes is made in Section 2.3.4.1 where additional information is deemed appropriate. Attachment 4 provides the retyped TS pages. Attachment 5 provides an information only version of the changes that are proposed for inclusion in the COLR.

The safety analysis in support of the proposed ARTS/MELLLA changes (proprietary version) is provided in Attachment 7. Attachment 7 is considered by GEH to contain proprietary information exempt from disclosure pursuant to 10 CFR 2.390. Therefore, on behalf of GEH, Energy Northwest hereby makes application to withhold this document from public disclosure in accordance with 10 CFR 2.390(b)(1). An affidavit executed by GEH detailing the reasons for the request to withhold the proprietary information is provided in Attachment 6. A non-proprietary version of the safety analysis is provided in Attachment 8. Attachment 9 provides the list of commitments made in this submittal.

2.1 TS 3.1.7, Standby Liquid Control (SLC) System

New SR 3.1.7.9 is added to "Verify sodium pentaborate enrichment is ≥ 44.0 atom percent B-10." This Surveillance Requirement (SR) is consistent with improved Standard Technical Specifications, NUREG-1433 (Reference 22), and is being added to reflect the increase in Boron-10 enrichment assumed in the supporting analyses.

2.2 TS 3.2.4, Average Power Range Monitor (APRM) Gain and Setpoint

As part of the ARTS/MELLLA implementation, this TS section, which includes requirements for flow-biased APRM simulated thermal power (STP) setdown, would be deleted. The following additional changes would be made to reflect the deletion of TS 3.2.4:

- The TS Table of Contents would be revised.
- The definition for Maximum Fraction of Limiting Power Density (MFLPD) would be deleted from TS Section 1.1.
- References to TS 3.2.4 would be deleted from SR 3.3.1.1.2.

2.3 TS 3.3.1.1, Reactor Protection System (RPS) Instrumentation

To support implementation of the digital PRNM system the following TS changes are proposed:

2.3.1 Changes to TS APRM Functions

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

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

Proposed changes to these functions are consistent with the NUMAC PRNM LTR and include the following:

- Function 2.a, "Neutron Flux – High, Setdown" scram is retained but the name is changed to "Neutron Flux – High (Setdown)."
- Function 2.b, "Flow Biased Simulated Thermal Power – High" scram is retained but the name is changed to "Simulated Thermal Power – High." This change is also consistent with the introduction of ARTS which changes the flow biased APRM setpoints to power based setpoints.
- Function 2.c, "Fixed Neutron Flux – High" scram is retained but the name is changed to "Neutron Flux – High."
- Function 2.d, "Inop" trip is retained but is changed to reflect the new NUMAC PRNM system equipment and to delete the minimum number of LPRM detector count from this trip. The minimum number of LPRM detector count will be retained in the APRM "Trouble" alarm function.
- A new Function 2.e is proposed, and is entitled "2-out-of-4 Voter." This new function is added to the TS to facilitate minimum operable channel definition and associated actions.

- A new Function 2.f is proposed, and entitled "OPRM Upscale." This OPRM trip function is added to the TS under APRM Functions. This function is relocated from Limiting Condition of Operation (LCO) 3.3.1.3 to this section of the TS (LCO 3.3.1.1).

2.3.2 Changes to LCO 3.3.1.1 Actions

- In the Actions for TS 3.3.1.1, Columbia proposes to add a note before Required Action A.2 and Condition B. These notes indicate that neither Required Action A.2 nor Condition B apply to new and existing APRM Functions 2.a, 2.b, 2.c, 2.d or 2.f. This change is consistent with the NUMAC PRNM LTR.

- New Conditions "I" and "J" are added to support the incorporation of new APRM Function 2.f, "OPRM Upscale." This change is consistent with the NUMAC PRNM LTR. There are some differences in the licensing approach for the proposed incorporation of the OPRM function into the PRNM System from the existing OPRM LCO that are discussed further in Section 3.5.3 below.

2.3.3 Changes to Surveillance Requirements (SRs)

The following changes proposed to the SRs in LCO 3.3.1.1 are consistent with the NUMAC PRNM LTR, with any differences noted:

2.3.3.1 Channel Check Surveillance Requirements

- The Channel Check requirement for the APRM scram functions will be the same.

- The new APRM Function 2.e, "2-out-of-4 Voter," will have a Channel Check frequency of once per 12 hours.

- A Channel Check requirement for APRM Function 2.f, "OPRM Upscale," at a frequency of once per 12 hours will be included. The current OPRM System has no Channel Check requirement.

2.3.3.2 Channel Functional Test Surveillance Requirements

- <u>APRM Function 2.a, "Neutron Flux – High (Setdown)"</u>

  The requirement will be changed from a frequency of every 7 days to every 184 days (6 months).

- <u>APRM Function 2.b, "Simulated Thermal Power – High"</u>

  The requirement will be changed from a frequency of every 92 days to every 184 days (6 months). The Channel Functional Test includes the recirculation flow input processing, excluding the flow transmitters.

- <u>APRM Function 2.c, "Neutron Flux – High"</u>

  The requirement will be changed from a frequency of every 92 days to every 184 days (6 months).

- <u>APRM Function 2.d, "Inop"</u>

  The requirement will be changed from a frequency of every 92 days to every 184 days (6 months).

- <u>Proposed APRM Function 2.e, "2-Out-of-4 Voter"</u>

  The requirement for a frequency of every 184 days (6 months) is included, the same rate as for the APRM and OPRM functions supported by the Voter.

- <u>Proposed APRM Function 2.f, "OPRM Upscale"</u>

  The OPRM Upscale will have a Channel Functional Test requirement with a frequency of every 184 days (6 months) and is the same as the frequency for the current OPRM System. The Channel Functional Test for the OPRM Upscale includes the recirculation flow input processing function, excluding the flow transmitters. Inclusion of the recirculation input flow processing for this function is not discussed in the NUMAC PRNM LTR.

2.3.3.3 Channel Calibration Surveillance Requirements

- <u>APRM Function 2.a, "Neutron Flux – High (Setdown)"</u>

  The Channel Calibration frequency will be changed from every 184 days to every 24 months. This change is functionally implemented by deleting SR 3.3.1.1.9 and incorporating the Channel Calibration for APRM Function 2 into SR 3.3.1.1.10 in the 24 months frequency list.

- <u>APRM Function 2.b, "Simulated Thermal Power – High"</u>

  The Channel Calibration frequency will be changed from every 184 days to every 24 months (SR 3.3.1.1.9 replaced with SR 3.3.1.1.10 as described above). Calibration of the recirculation flow hardware will be included in the overall Channel Calibration of this function at 24-month intervals. The current requirement (i.e. SR 3.3.1.1.11) to verify the APRM Flow Biased Simulated Thermal Power – High Function time constant is ≤ 7 seconds is being deleted.

- APRM Function 2.c, "Neutron Flux – High"

  The Channel Calibration frequency will be changed from every 184 days to every 24 months (SR 3.3.1.1.9 replaced with SR 3.3.1.1.10 as described above).

- APRM Function 2.d, "Inop"

  No change in requirement (i.e., no calibration applies).

- Proposed APRM Function 2.f, "OPRM Upscale"

  The OPRM Upscale trip function will have a Channel Calibration requirement with a frequency of every 24 months and is the same as the frequency for the current OPRM System. The OPRM Upscale trip function will have a SR with a frequency of every 24 months to confirm the OPRM auto-enable settings and is the same as the current OPRM System. The channel calibration will include the recirculation flow transmitters that feed the APRMs, which is an expansion of the requirements specified in the NUMAC PRNM LTR. The auto-enable settings will be defined in the COLR, and are discussed further in Section 3.5.2.

2.3.3.4 Logic System Functional Test (LSFT) Surveillance Requirements

- The LSFT SRs for APRM Functions 2.a, 2.b, 2.c, and 2.d will be deleted. The proposed APRM Function 2.f, "OPRM Upscale," will not require an LSFT SR, which would also be considered a deletion of the current OPRM SR 3.3.1.3.4.

- The proposed APRM Function 2.e, "2-out-of-4 Voter," will include an LSFT requirement with a frequency of every 24 months.

2.3.3.5 Response Time Testing Surveillance Requirements

- The LPRM detectors, APRM channels, OPRM channels, and 2-out-of-4 Voter channels digital electronics are exempt from response time testing. The requirement for response time testing of the RPS logic and RPS contactors will be retained by including a response time testing requirement for the new APRM Function 2.e, "2-out-of-4 Voter."

- The response time testing requirement for existing APRM Function 2.c, "Neutron Flux – High" will be deleted.

- A new response time testing requirement for APRM Function 2.e, "2-out-of-4 Voter," will be added. Note 4 is inserted to this SR to identify for Function 2.e that "n" equals 8 channels and that testing of the APRM and OPRM outputs shall alternate. The NUMAC PRNM LTR provides justification for the frequency of response time testing of the PRNM System but does not explicitly discuss this proposed note. Inclusion of this note is discussed in section 8.3.4.4.4 of Attachment 1.

2.3.4 Changes involving Table 3.3.1.1-1, Reactor Protection System Instrumentation

In addition to the new Functions discussed above, the following changes to TS Table 3.3.1.1-1 are proposed. These changes are consistent with the NUMAC PRNM LTR with any differences noted. Changes related to ARTS/MELLLA are designated where appropriate.

2.3.4.1 Minimum Number of Operable APRM/OPRM Channels

- The required minimum number of operable APRM channels will change from four (2 per RPS trip system) to three channels.
- The required minimum number of operable OPRM channels will change from four channels (specified in current LCO 3.3.1.3) to three channels.
- Proposed new APRM Function 2.e, "2-out-of-4 Voter," will have a requirement that all four Voter channels must be operable (2 per RPS trip system).

Note: The following three bullets are TS Bases information provided as additional detail and described in the NUMAC PRNM LTR. This information was previously moved to the TS Bases as part of the improved Standard Technical Specification program which was reviewed and approved by the NRC.

- The minimum number of operable LPRMs per APRM channel required for APRM channel operability will increase from 14 to 20 per APRM channel and from 2 to 3 for each of the four LPRM axial levels per APRM channel. The number of inoperable LPRMs is managed administratively.
- A new maximum number of LPRMs per APRM channel that may become inoperable (and bypassed) between APRM gain calibrations will be added. The new limit is 9 LPRMs per APRM channel. This is an administrative limit.
- The required minimum number of operable OPRM cells is 24 with each cell requiring a minimum of 2 operable LPRMs. The PRNM hardware provides an inoperative alarm when the number of operating OPRM cells is less than the required minimum.

2.3.4.2 Applicable Modes of Operation, Setpoints, and Allowable Values

- New APRM Function 2.e, "2-out-of-4 Voter," will be required to be operable in Modes 1 (RUN) and 2 (STARTUP), the same as the current APRM Inop function.

- The applicable Modes of operation for the remainder of the APRM functions will be unchanged from the current design.

- New APRM Function 2.f, "OPRM Upscale," proposes that the applicable mode of Operation be "Mode 1 when greater than the RTP [Rated Thermal Power] value specified in the COLR." This is a change in the current licensing presentation of LCO 3.3.1.3 which specifies that the OPRM Instrumentation shall be operable when "THERMAL POWER ≥ 25% RTP." This difference is discussed further in Section 3.5.2.

- The proposed changes related to ARTS/MELLLA will change the AV for Function, 2.b, "Simulated Thermal Power – High," for dual loop operations to:

  ≤ 0.63W + 64.0% RTP and ≤ 114.9% RTP

  This change will necessitate that a note be added to this AV to define a different value to be applied for single loop operations, which was previously the same as the dual loop value. Note (c) will be added to define the single loop AV as:

  ≤ 0.63W + 60.8% RTP and ≤ 114.9% RTP

2.3.4.3 Table 3.3.1.1-1 Notes

The following notes are added to Table 3.3.1.1-1:

- Note (b) – Each APRM/OPRM channel provides inputs to both trip systems.

Note (b) is applicable to APRM Functions 2.a, 2.b, 2.c, 2.d, and 2.f.

- Note (c) – ≤ 0.63W + 60.8% RTP and ≤ 114.9% RTP when reset for single loop operation per LCO 3.4.1, "Recirculation Loops Operating."

As described in 2.3.4.2 above, note (c) is being added to define the single loop operations AV for APRM Function 2.b, which is different from the dual loop operation value with the implementation of ARTS/MELLLA.

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

- Note (e) – 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 Nominal Trip Setpoint, and the methodology used to determine this value, is specified in the Licensee Controlled Specifications.

Notes (d) and (e) are applicable to Function 2.c and are not specified in the NUMAC PRNM LTR. These notes address the documentation of Limiting Safety System Settings (LSSS) in TS as discussed in References 16 through 19. This issue is discussed further in Section 3.7 below.

- Note (f) – When greater than the RTP value specified in the COLR.

- Note (g) - The OPRM Upscale does not have an Allowable Value. The Period Based Detection Algorithm (PBDA) trip setpoints are specified in the COLR.

The NUMAC PRNM LTR Section 8.4.6.1 requires that the PBDA setpoints be documented in the appropriate document and does not provide for them in the sample TS markups. Current LCO 3.3.1.3 requires documentation of the PBDA setpoints in the COLR. This difference is discussed further in Section 3.5.2 below.

2.4 <u>TS 3.3.1.3, Oscillation Power Range Monitor (OPRM) Instrumentation</u>

LCO 3.3.1.3 is deleted and the trip function is added to LCO 3.3.1.1 as APRM Function 2.f, "OPRM Upscale," to remain consistent with the OPRM implementation in the NUMAC PRNM LTR.

The specific changes involved with the relocation of LCO 3.3.1.3 elements to LCO 3.3.1.1 include the following:

2.4.1 OPRM LCO 3.3.1.3 Conditions and Required Actions

- The completion time for LCO 3.3.1.3 Condition A has been changed from 30 days to 12 hours as a result of the relocation to LCO 3.3.1.1 Condition A. The associated Required Actions of LCO 3.3.1.1 Condition A will be applied to APRM Function 2.f, "OPRM Upscale," the same as for current APRM Functions 2.a, 2.b, 2.c, and 2.d.

- As discussed in Section 2.3.2 above, LCO 3.3.1.1 Required Action A.2 and Condition B do not apply to the APRM Function 2.f, "OPRM Upscale," trip function.

- Current LCO 3.3.1.3 Conditions B and C will be replaced with LCO 3.3.1.1 Conditions I and J. These conditions apply when OPRM channel LCO 3.3.1.1 Condition A (and associated follow through Condition D) Required Actions and associated Completion Times are not met, or when the OPRM Upscale trip function is not available due to less than three operable OPRM Channels.

- Required Action B.1 of LCO 3.3.1.3 is relocated to Required Action I.1 of LCO 3.3.1.1 and retains the allowed Completion Time of 12 hours to initiate alternate methods of detecting and suppressing instabilities.

- A new requirement is proposed with Required Action I.2 of LCO 3.3.1.1 which allows a Completion Time of 120 days to restore the OPRM operability. This action is consistent with the NUMAC PRNM LTR. There is no equivalent requirement in Columbia's current LCO 3.3.1.3. This Required Action is modified by a Note that states that LCO 3.0.4 is not applicable, which is not specifically addressed in the NUMAC PRNM LTR. Further discussion of this note is provided in Section 3.5.3.

- Condition C of LCO 3.3.1.3 is relocated to Condition J of LCO 3.3.1.1 and retains the allowed Completion Time of 4 hours to reduce THERMAL POWER to less than the value specified in the COLR. Condition J applies if the Completion Times for Required Actions I.1 or I.2 are not met. The current Completion Time for Condition C of LCO 3.3.1.3 requires a reduction to < 25% RTP whereas the proposed change is relocating the specific value for the Completion Time to the COLR. This difference is discussed further in Section 3.5.2.

2.4.2 OPRM Surveillance Requirements

Many of the OPRM SRs were relocated to LCO 3.3.1.1 and are discussed in Section 2.3.3 above. SRs that are currently located in LCO 3.3.1.3 that were not previously discussed include the following:

- SR 3.3.1.3.2 is deleted. The calibration of the LPRMs occur with SR 3.3.1.1.7. This change is consistent with the NUMAC PRNM LTR.

- SR 3.3.1.3.6 which verifies the RPS RESPONSE TIME is within limits is deleted. This change is consistent with the NUMAC PRNM LTR.

2.5 TS 3.3.2.1, Control Rod Block Instrumentation

2.5.1 The following changes are proposed for surveillances affecting the RBM function, and are consistent with the NUMAC PRNM LTR:

- The frequency for performing the Channel Functional Test for SR 3.3.2.1.1 is being changed from every 92 days to every 184 days.

- The frequency for verifying that the RBM is not bypassed for SR 3.3.2.1.4 is being changed from every 92 days to every 24 months.

- The frequency for performing the Channel Calibration for SR 3.3.2.1.5 is being changed from every 92 days to every 24 months.

2.5.2 The following changes are related to implementation of ARTS/MELLLA:

2.5.2.1 SR 3.3.2.1.4 would be revised to require verification that the ARTS based power dependent RBM Power Range – Upscale Functions are not bypassed at the appropriate power levels. This change is consistent with improved Standard Technical Specifications, NUREG-1433 (Reference 22).

2.5.2.2 Table 3.3.2.1-1, "Control Rod Block Instrumentation," would be revised as follows:

- Current RBM Functions 1.a, "Upscale," and 1.c, "Downscale" would be deleted. Deletion of Function 1.c, "Downscale" is supported by the conversion to the digital PRNM System, and is discussed further in Section 3.5.6.1.

- Current RBM Function 1.b, "Inop," would be re-designated Function 1.d.

- New power dependent RBM Functions 1.a, "Low Power Range – Upscale," 1.b, "Intermediate Power Range – Upscale," and 1.c, "High Power Range – Upscale," would be added. Appropriate requirements for the Applicable Modes or Other Specified Conditions, Required Channels, Surveillance Requirements, and Allowable Value columns of the table would be added for these new functions.

- Current note (a) would be deleted.

- New notes (a) through (c) would be added. These notes identify the Applicable Modes or Other Specified Conditions for the new RBM Functions 1.a through 1.c and for the re-designated Function 1.d.

- A new note (f) would be added. This note would specify that the Allowable Values for RBM Functions 1.a, 1.b, and 1.c are identified in the COLR.

- The applicability of SR 3.3.2.1.4 would be deleted for re-designated Function 1.d.

- Current notes (b) and (c) would be re-designated (d) and (e), respectively.

- New note (g) would be added and states – "If the as-found channel setpoint is not the Nominal Trip Setpoint but is conservative to the

Allowable Value, then the channel shall be evaluated to verify that it is functioning as required before returning the channel to service."

- New note (h) would be added and states – "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 Nominal Trip Setpoint, and the methodology used to determine this value, is specified in the Licensee Controlled Specifications."

Notes (g) and (h) are applicable to new Functions 1.a, 1.b, and 1.c and are not specified in the NUMAC PRNM LTR. These notes address the documentation of LSSS in TS as discussed in References 16 through 19. This topic is discussed further in Section 3.7.

2.6 TS 3.4.1, Reactor Coolant System (RCS)

With the introduction of ARTS/MELLLA, a new statement is proposed for addition to LCO 3.4.1 as follows:

c. LCO 3.3.1.1, "Reactor Protection System (RPS) Instrumentation," Function 2.b (Average Power Range Monitors, Simulated Thermal Power – High), Allowable Value of Table 3.3.1.1-1 is reset for single loop operation.

2.7 TS 3.10.8, Shutdown Margin (SDM) Test – Refueling

In the LCO statement and in SR 3.10.8.1, LCO 3.3.1.1 APRM Function 2.e, "2-out-of-4 Voter," is added to recognize that the Voter Function needs to be operable. This has no effect on LCO 3.10.8 logic or requirements. This change is consistent with the NUMAC PRNM LTR.

2.8 TS 5.6.3, Core Operating Limits Report (COLR)

2.8.1 In support of the removal of current LCO 3.3.1.3 for the PRNM System incorporation of the OPRM System, TS 5.6.3.a.4 is revised to reflect that the COLR will document OPRM limits and setpoints to support LCO 3.3.1.1.

2.8.2 Changes for the ARTS/MELLLA improvement include the addition of TS 5.6.3.a.5 to reflect that the COLR will specify the Allowable Values and MCPR conditions for the RBM Upscale Functions to support LCO 3.3.2.1.

3.0 Technical Evaluation

Energy Northwest is planning a modification to upgrade the Columbia APRM subsystem of the NMS and the OPRM System. With the modification, the existing APRM subsystem and OPRM System hardware will be replaced with GEH's NUMAC PRNM System, which will perform the same functions as the currently installed systems, including the OPRM Stability Option III functions. The NUMAC PRNM System also incorporates the functions of the RBM and LPRM systems. The digital PRNM modification replaces analog technology with a more reliable digital upgrade and simplifies management and maintenance of the system. The digital upgrade, combined with the upgrade to ARTS/MELLLA, provides the capability for re-assignment of LPRM inputs to the RBM. This would improve RBM responsiveness to a design basis control rod withdrawal error event, resulting in improved fuel operating margins. The planned modification consists of replacing the existing APRM, RBM, LPRM, OPRM, and recirculation flow processing equipment, all part of the existing NMS and OPRM systems. The modification excludes the LPRM detectors and signal cables, which will be retained with the NUMAC PRNM replacement. The NUMAC PRNM LTR (References 1 and 2) describes in detail the generic NUMAC PRNM design including the OPRM functions (Stability Option III) and several plant specific variations and plant specific actions.

The current OPRM System implements the "Reactor Stability Long Term Solution Option III" as described in NEDO-31960-A (Reference 5). The current OPRM System has some separate hardware, but functions logically with the APRM System and receives inputs from the NMS. With the replacement NUMAC PRNM System, the existing OPRM hardware is removed and the function is digitally integrated within the PRNM equipment. The NUMAC PRNM LTR discusses implementation of the OPRM functions within the PRNM equipment.

FSAR Section 7, “Instrumentation and Control Systems,” contains a description of the current NMS and OPRM systems in the following Sections:

- 7.1, “Introduction"
- 7.2, "Reactor Protection (Trip) System"
- 7.6, "All Other Instrumentation Systems Required for Safety"
- 7.7, "Control Systems Not Required for Safety"

Precedent licensing submittals have been approved by NRC for Nine Mile Point Unit 2, Brunswick Units 1 and 2, Susquehanna Units 1 and 2, and Monticello.

Of these precedents, Nine Mile Point Unit 2, Brunswick Units 1 and 2, as well as Susquehanna Units 1 and 2 had a similar APRM design. Nine Mile Point Unit 2 has a similar Reactor Vessel and Core Geometry as Columbia.

Attachment 1 to this enclosure specifies how the NUMAC PRNM LTR applies to Columbia, identifies which configurations discussed in the NUMAC PRNM LTR apply to Columbia, identifies Columbia-specific variations from the descriptions in the NUMAC PRNM LTR, and provides additional justification, where necessary, for differences between the Columbia design and the generic design.

3.1 Neutron Monitoring System Functions:

All NMS functions are retained, including LPRM detector signal processing, LPRM averaging, and APRM trips. In some cases, the existing functions will be improved with additional filtering or modified processing. These include LPRM filtering and, for some functions, APRM filtering. The LPRM signal input filtering is improved using advanced digital processing methods. The digital filtering provides improved noise rejection for AC power related noise and some non-nuclear type transients without affecting the system response to real neutron flux signals. For the APRM, a filtered APRM flux signal called "simulated thermal power (STP)" is generated using a six second (nominal value) first order filter. The APRM flow biased scram trip (and the associated clamp) will continue to operate from STP to provide the same response characteristics as the current system. STP will continue to be used for APRM calibration against core thermal power to provide a better indication of actual average flux. The PRNM System will use STP for the APRM upscale rod block trips which is different from the current system which used unfiltered flux. The current RBM system normalizes the LPRM signals to APRM STP. The proposed PRNM System RBM functions normalize the LPRM signals to a fixed reference signal. With the PRNM System, if STP is indicating less than the low power range setpoint, the RBM is automatically bypassed. The APRM neutron flux - high scram trip will continue to operate from unfiltered APRM flux to meet the trip response time assumptions in the safety analyses. Both filtered APRM flux (STP) and unfiltered APRM flux are displayed for the operator. The filtered APRM flux provides the best indication of true average power while the unfiltered flux provides a real-time indication of APRM flux changes.

The current six APRM channel configuration is replaced with four APRM channels, each using one quarter of the total LPRM detectors. The outputs from all four APRM channels go to four independent 2-out-of-4 Voter channels. Two of the four Voter channels are assigned to RPS trip system A and two to RPS trip system B. The APRM Neutron Flux – High trip function will be retained, but four 2-out-of-4 Voter channels are added between the APRM channels and the input to the RPS. The trip outputs from all four APRM channels are sent to each 2-out-of-4 Voter channel, so that each of the inputs to the RPS is a voted result of all four APRM channels.

Recirculation flow signal processing, previously accomplished using separate hardware within the existing NMS control panels, is integrated into the APRM chassis in the new PRNM System. The existing four channel recirculation flow processing system (four flow transmitters on each recirculation loop) is retained. In the current system, two flow channels provide inputs to the three APRM channels in one RPS trip system while the other two flow channels provide inputs to the APRM channels in the other RPS trip system. In the replacement PRNM system, each flow channel provides inputs to one of the four APRM channels. Therefore, each APRM channel also provides the signal processing for one flow channel in the replacement PRNM. The APRM hardware also performs the recirculation upscale flow alarm function.

The current RBM automatically limits the local thermal power changes from control rod withdrawal by allowing the local average neutron flux indications to increase to a setting value. If the change is too large, the rod withdrawal permissive is removed. Only one of the two RBM channels is required to trip to prevent rod motion. The RBM has three recirculation flow-biased trip levels (rod withdrawal permissive removed). The trip levels may be adjusted and are nominally 8% of reactor power apart. Current Columbia settings are 106%, 98%, and 90% of current licensed thermal power (CLTP) at 100% flow. Each trip level is automatically varied with recirculation system flow to protect against fuel overpower at lower flows. The operator may encounter any number (up to three) of the trip points, depending on the starting power of a given control rod withdrawal. The lower two points may be successively bypassed (acknowledged) by manual operation of a pushbutton. The reset permissive is actuated (and indicated by a light) when the RBM indicates a power within the reset band of the trip point. The operator then assesses the local power and either acknowledges or selects a new rod. The highest trip point cannot be bypassed.

The proposed incorporation of ARTS limits into the PRNM System implements a more direct trip logic (see Figure 4-4 of Attachment 7). Instead of calibrating to the APRM, the RBM signals are calibrated to a fixed (constant) reference signal. As in the original system, an RBM downscale trip level is defined to detect abnormally low signal levels. The upscale trip levels are set at a fixed level above the reference and will vary as step functions of core power. This will allow longer withdrawals at low power where thermal margins are high and allow only short withdrawals at high power. Once tripped, recalibration is allowed only by deselecting the rod, typically accomplished by selecting another rod, and reselecting the rod. Reselection will result in a recalibration to the reference signal.

The NUMAC RBM chassis provides some additional surveillance capability that allows testing of functions in all plant conditions. The same hardware, which performs the RBM logic (the RBM chassis), will also perform the recirculation flow comparison alarm function in the replacement system. In the replacement system, this function compares the recirculation flow values from each of the four flow channels.

Low voltage power supply (LVPS) functions are retained except that the post modification configuration provides additional redundancy against loss of RPS AC power. In the current NMS, each APRM and RBM channel is powered by a single channel of RPS AC power busses, either channel A or channel B. In the replacement PRNM System, each APRM channel and each RBM channel is powered from independent (from the other channels), redundant LVPS units, operating from each of the RPS AC busses. Therefore, if one RPS AC power input is lost, full APRM and RBM signal processing and indication continues to be available. Further, if an individual LVPS power supply fails, the associated channel continues to operate normally on the second LVPS. The final trip outputs from the APRM and RBM to the RPS and reactor manual control systems, however, still operate from one RPS AC input, so loss of one RPS AC input will still result in RPS half scram and rod block inputs the same as the current NMS.

The existing level of electrical separation, between components and redundant channels, is maintained or improved through extensive use of fiber-optic cables for inter-channel communications and optically coupled relay devices for interface connections to other systems.

Interface functions between the PRNM System and other systems are unchanged from the current design, except for data to the plant process and core monitoring system computers and data to the plant operator's panel. The plant operator's panel will use the digital display outputs for most information displays. The interface with external computer systems is described further in Section 3.3.

3.2 OPRM Function:

The OPRM Option III Stability Trip Function is digitally incorporated into the PRNM System. The OPRM function continues to satisfy the same regulatory requirements as the currently installed OPRM equipment. Changes from the existing OPRM are the assignment of LPRM inputs to new OPRM cell assignments and trip logic from the 2-out-of-4 Voter module. The current OPRM cell assignments are selected for compatibility with the current NMS's six APRM, two LPRM channel configuration. The replacement system's OPRM cell assignments are selected for compatibility with the four APRM configuration of the NUMAC PRNM. Both configurations are included in the NRC reviewed and approved BWROG Licensing Topical Reports, applicable to the OPRM Stability Option III (References 5 and 6). The existing OPRM trip logic is the 1-out-of-2 taken twice which is being revised to input to the 2-out-of-4 Voter logic. This logic is in accordance with and discussed in the NUMAC PRNM LTR.

3.3 External Systems Impact (Plant Process Computer and Core Monitoring System Computer):

The new PRNM System will modify the means by which the system's data is transmitted to external computer systems; however all existing information will be maintained. The current system sends analog data to external computer systems through a direct connection and/or through the RBM module. The new system will transmit digital data to external systems. Utilizing guidance from NEI 08-09 (Reference 23) and Regulatory Guide 5.71 (Reference 32), pathways and configurations for data transmission will be in compliance with requirements to protect digital communication systems and networks per 10 CFR 73.54. Modifications to the data transmission pathways will be performed through the new system to be in compliance with regulatory requirements. External calculation processes will also be modified to be in alignment with 10 CFR 73.54 protection requirements. Any systems located on cyber security defensive architecture level 3 or 4 will be protected as recommended by the regulatory guidance discussed above.

3.4 Interface function for APRM inputs and outputs to systems other than the RPS:

The APRM interface function of the Voter Logic Module is provided to match the existing plant circuits to the replacement PRNM. It is included in the Voter Logic Module to simplify overall equipment packaging. The following functions are provided:

- Acts as an electrical connector adapter between field cables or panel wiring and compact APRM chassis connectors, and provides electrical isolation.
- Provides a mounting location for solid-state relays that interface between the APRM and the equipment outside the PRNM System panel.
- Implements and maintains the trip, rod block, and alarm bypass states independent of the associated APRM chassis.

The APRM interface functions are associated directly with one APRM. Electrical signals are received from or sent to the associated APRM. Local logic in the Voter Logic Module controls the state of outputs to annunciators, Reactor Manual Control System (RMCS), and other interfaces when an APRM chassis is removed from service.

3.5 Evaluation of NUMAC PRNM LTR for Columbia specific requirements and differences from generic design

The proposed TS changes to Columbia are consistent with the NUMAC PRNM LTR. Attachment 1 to this enclosure provides an evaluation of the plant-specific actions required by the NUMAC PRNM LTR.

The methods, standards, data, and results, as described in the NUMAC PRNM LTR for a GE BWR/5 larger core plant, are applicable to Columbia. The bases for the TS changes found in Attachment 2 of this enclosure are documented in Section 8.0 of NUMAC PRNM LTR. Deviations, exceptions, or additional clarifying information to the NUMAC PRNM LTR are as follows:

3.5.1 Deviation from NEDC-32410P-A, Supplement 1 (Reference 2) Section 8.4.1.3

Included in Appendix A to Attachment 1 is a description and justification for a Columbia specific deviation from the NUMAC PRNM LTR, involving the OPRM

Upscale function being voted with the APRM Inop function. Section 8.4.1.3 of the NUMAC PRNM LTR describes the logic wherein the OPRM Upscale function is voted separately from the APRM Inop function.

Based on lessons learned from other installations of the PRNM System, GEH has modified the NUMAC PRNM System design from the above description to have the APRM/OPRM channel send an OPRM Upscale trip and an APRM Inop trip to all 2-out-of-4 Voters when the associated channel key switch is placed in the "INOP" position. As a result, an OPRM Upscale trip in one channel and an APRM Inop trip in another channel results in RPS trip outputs from all four of the 2-out-of-4 Voter channels. This change provides for greater operational flexibility. The NRC approved this modified NUMAC PRNM System for Monticello (Reference 9).

3.5.2 LCO 3.3.1.1, RPS Instrumentation, Addition of Notes to Clarify Requirements for APRM Functions in Table 3.3.1.1-1

As discussed in Section 2.3.4.3 above, notes have been added to Table 3.3.1.1-1 as follows:

- Note (b) has been added for APRM/OPRM channel input clarification and is consistent with the NUMAC PRNM LTR.

- Note (c) has been added to denote a difference in the dual loop and single loop AVs as supported by the ARTS/MELLLA analysis. This approach is consistent with the improved Standard Technical Specifications (STS), NUREG-1433 (Reference 22), and approved by the NRC for Monticello (Reference 9).

- Notes (d) and (e) reflect application of actions to address the industry setpoint methodology issue as documented in RIS-2006-17 (Reference 16) and TSTF-493 (Reference 19). This issue is not addressed in the NUMAC PRNM LTR. See Section 3.7 for discussion on application of TSTF-493 to the proposed PRNM System upgrade and related TS changes.

- In accordance with Section 8.4.6.1 of the NUMAC PRNM LTR, setpoints related to the OPRM trip function will need to be added to either TS or other appropriate documents. Notes (f) and (g) have been added to specify that the OPRM Upscale parameters are defined in the COLR. Note (f) refers to a thermal power threshold, the value for which is defined in the COLR. Note (g) identifies that the Period Based Detection Algorithm (PBDA) confirmation count and amplitude setpoints are specified in the COLR.

Columbia's current LCO 3.3.1.3 specifies that the OPRM instrumentation shall be OPERABLE within the limits as specified in the COLR. The current COLR contains the PBDA confirmation counts and amplitude setpoints. Relocation of the OPRM Instrumentation requirements from the current LCO 3.3.1.3 to the proposed LCO 3.3.1.1 as Function 2.f, OPRM Upscale would not change the current licensing approach with regards to documentation in the COLR for the PBDA setpoints. This approach satisfies the NUMAC PRNM LTR documentation requirements, and was also approved by the NRC for Monticello (Reference 9).

The OPRM trip enable settings on thermal power and core flow are relocated from SR 3.3.1.3.5 to SR 3.3.1.1.17. "THERMAL POWER" is changed to "APRM Simulated Thermal Power" and "core flow" is changed to "recirculation drive flow" to be consistent with the NUMAC PRNM LTR. Reference 14 clarifies that settings are nominal values. The specific values are relocated to the COLR because they are confirmed during each fuel reload, the calculation of which is consistent with the methodologies listed in the COLR TS (5.6.3). The current OPRM System at Columbia is required by LCO 3.3.1.3 to be OPERABLE whenever thermal power is greater than or equal to 25%. In the proposed TS, with note (f) placed in the "Applicable Modes or Other Specified Conditions" column for Function 2.f, Columbia is proposing to relocate this value to the COLR. As discussed in the proposed TS Bases for APRM Function 2.f, included in the information only copy provided in Attachment 3, the OPRM OPERABLE value is selected to provide margin in the unlikely event of loss of feedwater heating while the plant is operating below the automatic OPRM trip enable power level. Loss of feedwater heating is the only identified event that could cause reactor power to increase into the region of concern without operator action. This OPRM OPERABLE value is selected to provide 5% margin to the required OPRM trip enable power level which is confirmed during each fuel reload, the calculation of which is consistent with the methodologies listed in the COLR TS (5.6.3). Relocation of this value to the COLR is supported by the justification above, and remains consistent with the intent of the NUMAC PRNM LTR for inclusion of OPRM setpoints in the appropriate document.

3.5.3 Note for Proposed Required Action I.2

Proposed Required Action I.2 of LCO 3.3.1.1, which requires restoration of required OPRM channels to OPERABLE status with a Completion Time of 120 days, is modified by a note that states "LCO 3.0.4 is not applicable." An exception to LCO 3.0.4 was not included within the NUMAC PRNM LTR, but has been approved in the NRC SE for activating the OPRM Upscale function at Peach Bottom Units 2 and 3 (Reference 12). Current LCO 3.3.1.3 has no equivalent Completion Time limit.

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

3.5.4 TS 3.3.1.3 OPRM Instrumentation

The proposed change will replace the currently installed and NRC approved OPRM Option III long-term stability solution with an NRC approved Option III long-term stability solution digitally integrated into the PRNM equipment. The PRNM hardware incorporates the OPRM Option III detect and suppress solution reviewed and approved by the NRC in the References 1, 2, 5, and 6 LTRs, the same as the current OPRM System. The replacement OPRM meets the GDC 10, "Reactor Design," and 12, "Suppression of Reactor Power Oscillations," requirements by automatically detecting and suppressing design basis thermal-hydraulic oscillations prior to exceeding the fuel MCPR Safety Limit (SL).

TS 3.3.1.3 was established to support the implementation of the current OPRM Stability Option III System. As described in Section 3.2, with the implementation of the NUMAC PRNM with OPRM, the Option III stability solution is digitally integrated within the APRM functions in LCO 3.3.1.1 and corresponding TS Bases, so this specification is no longer needed. Specification 3.3.1.3, along with the associated TS Bases, is proposed for deletion.

The major change associated with relocation of OPRM requirements from LCO 3.3.1.3 to LCO 3.3.1.1 is the completion time for Condition A. In the replacement OPRM System, the allowed Completion Time for the Required Action with a Condition of one or more required OPRM channels not operable but with trip capability still maintained is 12 hours (LCO 3.3.1.1, Condition A) compared to the 30 days for the similar Condition for the currently installed OPRM System (LCO 3.3.1.3, Condition A). However, for the replacement OPRM System, one OPRM channel can be bypassed and this condition would not normally occur until a second OPRM channel became inoperable. This change for the current LCO 3.3.1.3 requirement is conservative relative to safety, is judged to have no adverse impact on plant operations, and maintains consistency between the replacement OPRM System TS requirements and those reviewed and approved by the NRC via the NUMAC PRNM LTR.

SR 3.3.1.3.6, "Verify the RPS Response Time is within limits," is deleted and not relocated for the OPRM. The NUMAC PRNM LTR (Supplement 1), sections 3.3.2 and 8.4.4.4.3, provide discussion and justification for deleting the response time testing for the OPRM. In Attachment 1 to this enclosure, justification is provided for adding a note to SR 3.3.1.1.15, "Verify the RPS Response Time is within limits," to define the frequency of the Staggered Test Basis for APRM

Function 2.e, 2-out-of-4 Voter. While the justification was provided for changing the response time testing of the OPRM, the related TS markup was not properly characterized in the NUMAC PRNM LTR. Inclusion of Note 4 to SR 3.3.1.1.15, to specify the number of voter channels, "n=8," and alternation of testing between APRM and OPRM outputs, aligns the proposed TS with the justification provided in the NUMAC PRNM LTR. This approach was approved by the NRC for Susquehanna (Reference 8).

The NUMAC PRNM LTR, Section 8.4, "OPRM Related RPS Trip Functions," describes a transition period between installation of an initial OPRM System to when the system is "armed" and operational. This transition period is intended to allow an initial period of operation with the first use of the OPRM function in order to validate its conformance with design basis and confirm initial design assumptions. The initial startup period for the current OPRM System demonstrated the algorithm to be robust and not sensitive to system settings within the range of values described in NEDO-32465-A (Reference 13). Based on the data received during the transition period for the currently "armed" and operating digital OPRM System, and review of the design and operating experience of the GEH NUMAC OPRM, Columbia is proposing that the replacement OPRM be installed and activated without the transition period for evaluation recommended by the NUMAC PRNM LTR. This approach was approved by the NRC for Susquehanna (Reference 8).

3.5.5 TS 5.6.3, Core Operating Limits Report (COLR)

- The change to TS 5.6.3.a.4 identifies the requirements of TS 3.3.1.3 (OPRM) were removed and relocated to TS 3.3.1.1 (RPS). The licensing approach of specifying OPRM PBDA limits in the COLR is being retained with this change, and is consistent with the NUMAC PRNM LTR Section 8.4.6.1 requirements to place the OPRM setpoints in the appropriate plant document. This approach was approved by the NRC for Susquehanna (Reference 8).

- TS 5.6.3.a.5 has been added to include the RBM setpoints that are based on cycle specific MCPR calculations. These values are confirmed for each reload cycle and hence are appropriate for inclusion in the COLR. This approach was approved by the NRC for Monticello (Reference 9).

3.5.6 TS 3.3.2.1, Control Rod Block Instrumentation

The proposed change replaces the flow-biased RBM rod blocks with power-based rod blocks, consistent with the implementation of the ARTS in the PRNM System. To implement this change, the RBM rod block LCO 3.3.2.1 Function 1 is modified as follows:

Current RBM rod block functions:

1.a Upscale
1.b Inop
1.c Downscale

For the proposed change, the following functions will replace the current RBM functions:

1.a Low Power Range – Upscale
1.b Intermediate Power Range – Upscale
1.c High Power Range – Upscale
1.d Inop

The selection of setpoints in the ARTS logic in the RBM is based on APRM STP. This change reduces the risk of spurious rod block signals and assures a clean transition between RBM setpoints as power increases or decreases. The proposed TS changes to the RBM Functions are consistent with those shown in the NUMAC PRNM LTR except for the deletion of the RBM Downscale Function and is discussed further in Section 3.5.6.1.

With the implementation of the ARTS logic in the RBM, the AVs for the RBM setpoints will be located in the COLR rather than in LCO 3.3.2.1. This change is being made because the RBM power dependent setpoints must be confirmed or modified on a cycle-specific basis.

In addition, the surveillance and operability requirements for each RBM "power range" Function are simplified from that shown in the NUMAC PRNM LTR (for ARTS) by revision to the notes to TS Table 3.3.2.1-1 and SR 3.3.2.1.4. The surveillance and operability requirements for each RBM power range are being modified from those shown in the NUMAC PRNM LTR to clarify that the SR and operability requirements do not apply when a peripheral control rod is selected. This is a current feature of the RBM that is not being modified by the proposed changes. The SR and operability requirements are also written based on APRM STP input, the digital signal that is actually used in the NUMAC RBM. These additional SR and operability requirement clarifications are consistent with the NUMAC PRNM LTR and result in no functional changes in equipment performance or operational limits.

3.5.6.1 Deletion of RBM Downscale Function

The deletion of the RBM Downscale Function is intended to simplify the TS by deleting a Function that has no significant value due to differences between the original analog equipment and the replacement digital system.

The effect of the differences between analog equipment and the digital equipment on the RBM Downscale Function was not addressed at the time the NUMAC PRNM LTR was prepared, so this deletion was not addressed in the LTR. The originally intended RBM Downscale Function would detect substantial reductions in the RBM local flux after a "null" is completed (a "null" occurs after a new rod selection). This function, in combination with the RBM Inop Function, was intended in the original system to detect problems with or abnormal conditions in the RBM equipment and system. However, no credit is taken for the RBM Downscale Function in the establishment of the RBM upscale trip setpoints or AVs. Unlike other neutron monitoring system downscale functions (e.g., the APRM downscale) there are no normal operating conditions that are intended to be detected by the RBM Downscale Function. In an analog RBM, the inclusion of the Downscale Function in addition to the Inop Function had some merit in that the analog equipment had some failure modes that could result in a reduction of signal, but not a full failure. Therefore, the RBM Downscale Function was in fact part of the overall Inop condition detection function. The replacement of the original analog RBM equipment with the NUMAC digital RBM will result in all of the original analog processing being replaced by digital processing. One effect of this change is to eliminate the types of failures that can be detected by a Downscale Function. In addition, the Inop Function is enhanced in the NUMAC RBM by the use of automatic self-test and other internal logic to increase the ability to detect failures and abnormal conditions that can occur in the digital equipment, and to directly include these in the RBM Inop Function.

Therefore, in the NUMAC PRNM ARTS RBM, there is no incremental value or benefit provided by the RBM Downscale Function. Consistent with the overall thrust of the improved Standard Technical Specifications to eliminate "no value" requirements, the RBM Downscale Function is being removed from the TSs and from the related discussion in the Bases. The RBM Inop Function is being retained in TSs. Removal of the RBM Downscale function was approved by the NRC for implementation of ARTS/MELLLA at Nine Mile Point 2 (Reference 24).

3.5.6.2 Additional Discussion of TS Table 3.3.2.1-1 Changes

This table would be modified to change from a flow-biased RBM to a power dependent RBM consistent with the ARTS improvement. NUREG-1433, (Reference 22), reflects specifications that include ARTS RBM limits, and the changes proposed for Columbia are modeled after the NUREG. Deviations from the NUREG format would include specifying the RBM AVs for Low Power Range - Upscale, Intermediate Power Range - Upscale, and High Power Range - Upscale in the COLR. The relocation to the COLR would also include the MCPR limits which define when the RBM is required to be operable, as a function of power level.

Consistent with the implementation of the ARTS improvement, the RBM AVs are modified to reflect ARTS limits. With the implementation of ARTS logic in the RBM, the AVs for the RBM will be located in the COLR, rather than the TS Table 3.3.2.1-1 to allow for these values to be modified on a cycle specific basis as needed. These changes are similar to those previously approved for Peach Bottom Units 2 and 3 (Reference 12).

The current exception contained within note (a) listed in the APPLICABLE MODE OR OTHER SPECIFIED CONDITIONS column of Table 3.3.2.1-1, for when a peripheral control rod is selected, will be maintained in the new applicability notes (a) through (c) for the RBM Functions. The RBM will continue to be automatically bypassed if a peripheral control rod is selected. This exception is consistent with the ARTS based RBM applicability notes previously approved for Cooper (Reference 35). Additionally, notes (a) through (c) have been written based on APRM STP input, the digital signal that is actually used in the NUMAC RBM, not thermal power as specified in the NUREG.

Notes (g) and (h) reflect application of actions to address the industry setpoint methodology issue as documented in References 16 through 19. This issue is not addressed in the NUMAC PRNM LTR. See Section 3.7 for discussion on application of TSTF-493 to the proposed PRNM System upgrade and related TS changes.

<u>Deletion of Applicability of SR 3.3.2.1.4 to RBM Inop Function in TS Table 3.3.2.1-1</u>

The RBM Inop Function is not affected by the proposed implementation of ARTS/MELLLA. As discussed in Section 4.2 of Attachment 7, a count of active LPRMs is made automatically and the RBM channel is declared inoperable if too few detectors are available.

The current Columbia TS Table 3.3.2.1-1 note (a), requires the RBM Inop Function 1.b to be operable when thermal power is ≥ 30% RTP and no peripheral control rod is selected. The current SR 3.3.2.1.4 requires verification that the RBM Inop Function is not bypassed when THERMAL POWER is ≥ 30% RTP and when a peripheral control rod is not selected. Under the conditions where the RBM Inop Function is allowed to be bypassed, the RBM is not required to be operable, and hence no surveillance is needed to demonstrate the system is operable.

Consistent with the changes described above, the Columbia ARTS/MELLLA application proposes a revised SR 3.3.2.1.4 and revised Table 3.3.2.1-1 function applicability notes. The revised SR is worded such that that the SR excludes the RBM Inop Function. The revised function applicability notes in Table 3.3.2.1-1 require that the RBM Inop Function is not bypassed at APRM

Simulated Thermal Power ≥ 28% RTP with MCPR less than the limits specified in the COLR and no peripheral control rod selected.

The deletion of the applicability of SR 3.3.2.1.4 to the RBM Inop Function is consistent with the improved Standard Technical Specifications presented in Reference 22. These proposed changes are consistent with the changes approved for Nine Mile Point 2 (Reference 24).

3.6 ARTS/MELLLA

Many factors restrict the flexibility of a Boiling Water Reactor (BWR) during power ascension from the low-power/low-core flow condition to the high-power/high-core flow condition. Some of the factors at Columbia that restrict plant flexibility are:

- The current operating power/flow (P/F) map,
- The APRM flow-biased STP setdown requirement, and
- The RBM flow-referenced rod block trip.

Once rated power is achieved, periodic control rod and flow adjustments must be made to compensate for reactivity changes due to xenon effects and fuel burn-up.

Columbia currently operates in the Extended Load Line Limit Analysis (ELLLA) region up to approximately 108% rod line based on the current licensed thermal power (CLTP) and Increased Core Flow (ICF) region up to 106% core flow, which results in a core flow window of 88% to 106% at rated thermal power (RTP).

A further expansion of the operating domain (MELLLA) and implementation of ARTS would allow for more efficient power ascensions and would allow rated power to be maintained over a wider core flow range, thereby reducing the frequency of control rod manipulations that require power maneuvers to implement. Expansion of the operating domain beyond the current P/F map requires changes to the APRM and RBM trip functions described below.

3.6.1 ARTS/MELLLA Implementation

The expanded operating domain includes changes for ARTS/MELLLA consistent with approved operating domain improvements at other BWRs. The current ELLLA power-flow upper boundary is modified to include the operating region bounded by the MELLLA boundary line which passes through the 100% CLTP and 80.7% rated core flow point (see Figure 1-1 of Attachment 7). The power-flow region that is above the current ELLLA boundary is referred to as the MELLLA region. As part of ARTS/MELLLA, the current flow-biased RBM would be replaced by a power dependent RBM with the upgrade to the digital PRNM System discussed above. The change from the flow-biased RBM to the power dependent RBM would also require new AVs.

The ARTS/MELLLA application is evaluated on a plant-specific basis via a safety and system response analysis for meeting thermal and reactivity margins for BWR plants. When compared to the existing power/flow operating domain, operation in the MELLLA region results in plant operation along a higher rod line, which at off-rated operation allows for higher core power at a given core flow. This increases the fluid subcooling in the downcomer region of the reactor vessel and alters the power distribution in the core in a manner that can potentially affect steady-state operating thermal limits and transient/accident performance. The effect of this operating mode relative to fuel dependent analyses has been evaluated to confirm compliance with the required fuel thermal margins during plant operation. For subsequent reload cycles, Columbia will include the ARTS/MELLLA operating condition in the reload analysis. Attachment 7 presents the results of the safety analyses and system response evaluations for the non-fuel dependent tasks. The attachment also presents the assumptions and conclusions that will be validated or updated for the fuel dependent tasks performed for operation of Columbia in the region above the current ELLLA and up to the MELLLA boundary line.

With the proposed power/flow map expansion to include the MELLLA region, the upper boundary of the operating domain would be extended to 80.7% flow at rated power for two loop operation. To accommodate this expanded operating domain, the APRM flow biased STP AV would be revised. The APRM clamp will be unchanged. The MELLLA region would not be used for single loop operation.

Although it is part of the Columbia design configuration and TSs, the APRM flow biased STP AV is not credited in any specific Columbia safety analysis. The proposed AV change would permit operation in the MELLLA region for operational flexibility purposes.

Representative results of the Rod Withdrawal Error (RWE) event (with the ARTS based power dependent RBM hardware) demonstrate that the MCPR SL and fuel thermal-mechanical design limits are not exceeded, when appropriate power dependent trip setpoints are used in the RBM.

The improvements associated with ARTS include:

- Existing power and flow dependent MCPR thermal limits, similar to that used by BWR/6 plants, are validated for ARTS.

- The APRM trip setdown and Total Peaking Factor (TPF) are replaced by more direct power-dependent and flow-dependent Linear Heat Generation Rate (LHGR) thermal limits to reduce the need for manual setpoint adjustments and to provide more direct thermal limits administration. This improves human/machine interface, improves thermal limits administration, increases reliability, and provides more direct protection of plant operating limits.

- The flow-biased RBM trips are replaced by power-dependent trips. The RBM inputs are reassigned to improve response characteristics of the system, improve the response predictability, and reduce the frequency of nonessential alarms.

- The Rod Withdrawal Error (RWE) analysis is performed in a manner that more accurately reflects actual plant operating conditions, and is consistent with the system changes.

The following criteria were applied to support removal of the APRM trip setdown requirement (TS 3.2.4, APRM Gain and Setpoint):

- MCPR SL shall not be violated as a result of any AOO.

- All fuel thermal-mechanical design bases shall remain within the licensing limits.

- Peak cladding temperature and maximum cladding oxidation fraction following a Loss of Coolant Accident (LOCA) shall remain within the limits specified in 10 CFR 50.46.

3.6.2 APRM and RBM AVs

The APRM flow-biased STP AV varies as a function of reactor recirculation loop flow, but is clamped such that it is always less than the APRM neutron flux-high AV. The proposed change is described further in Section 3.7.2. Justification for making this change is provided in Section 4.0 of Attachment 7.

The flow-biased RBM AVs will be replaced by power dependent AVs. The RBM is designed to prohibit erroneous withdrawal of a control rod during operation at high power levels. This prevents local fuel damage during a single rod withdrawal error. The proposed change is described further in Section 3.7.5. Justification for making this change is provided in Section 4.0 of Attachment 7.

3.6.3 APRM Allowable Value Setdown Requirement

LCO 3.2.4 currently requires the APRM flow-biased STP AV to be reduced when the Fraction of Rated Thermal Power (FRTP) is less than the Maximum Fraction of Limiting Power Density (MFLPD). The setdown requirement ensures that margins to the fuel cladding safety limit are preserved during operation at other than rated conditions. As an alternative to adjusting the APRM flow-biased STP AV, the APRM gains may be adjusted such that the APRM readings are greater than or equal to 100% times MFLPD. The Columbia normal operating practice is to adjust APRM gains when required to meet LCO 3.2.4. Each APRM channel is typically bypassed while the required gain adjustment is made.

The basis for this setdown requirement originated from the Hench-Levy Minimum Critical Heat Flux Ratio (MCHFR) thermal limit criterion. The GE Critical Quality - Boiling Length correlation (GEXL) Critical Power Ratio has since replaced the Hench-Levy Critical Heat Flux Ratio as the approved means of determining departure from nucleate boiling.

Power and flow dependent adjustments to the MCPR and LHGR thermal limits have been determined using NRC approved analytical methods identified in TS 5.6.3. These adjustments will ensure that the three criteria discussed in Section 3.6.1 above are met during operation at other than rated conditions without the APRM trip setdown. Justification for making this change is provided in Sections 3.0 and 7.0 of Attachment 7.

3.6.4 Summary of Safety Analyses Included in Attachment 7

Safety analyses performed in support of the proposed changes are described in Attachment 7. These changes include fuel performance event evaluations (Sections 3.0 and 4.0), an evaluation of vessel overpressure protection (Section 5.0), an evaluation of thermal-hydraulic stability (Section 6.0), an evaluation of the loss-of-coolant accident (Section 7.0), containment response evaluations (Section 8.0), reactor internals integrity evaluations (Section 9.0), an evaluation of an anticipated transient without scram (Section 10.0), an evaluation of steam dryer and separator performance (Section 11.0), and high energy line break evaluations (Section 12.0). A description of planned testing is included in Section 13.0. The following technical analysis summarizes or supplements the information in Attachment 7.

Attachment 7, Section 1.0, Introduction, and Section 2.0, Overall Analysis Approach, provide a description and background for the implementation of ARTS/MELLLA at Columbia. The content of Sections 1.0 and 2.0, relative to fuel dependent evaluations, describes the approach Columbia is taking to justify and implement the ARTS/MELLLA bases. The assumptions and conclusions described in Section 1.0 and 2.0 for fuel dependent evaluations are based upon the current Columbia Cycle 20 core design using GE14 and ATRIUM-10 fuel and in some cases on existing analyses for plants similar to Columbia.

The content of Attachment 7, Sections 1.0 and 2.0, relative to non-fuel dependent evaluations, describes the approach Energy Northwest is taking to justify and implement the ARTS/MELLLA bases and reflect the Columbia configuration. The assumptions and conclusions described in Sections 1.0 and 2.0 relative to non-fuel dependent evaluations are applicable for Columbia.

Attachment 7, Sections 3.0 - Fuel Thermal Limits, 4.0 - Rod Block Monitor System Improvements, 5.0 - Vessel Overpressure Protection, and 6.0 - Thermal-Hydraulic Stability, describe particular aspects of the implementation of ARTS/MELLLA for Columbia Cycle 20. These sections describe fuel dependent evaluations which summarize the approach taken to justify and implement the

ARTS/MELLLA bases. The assumptions and conclusions for the fuel dependent evaluations are based upon Columbia Cycle 20 core design using GE14 and ATRIUM-10 fuel.

Attachment 7, Section 7.0, Loss-of-Coolant Accident Analysis, describes a fuel-dependent evaluation. Analysis in this section is based on a full core of GE14 fuel, which was determined to be conservative with respect to ATRIUM-10 fuel for Emergency Core Cooling Systems (ECCS) LOCA analysis and will be representative of the Columbia Cycle 20 core. The content of this section describes the approach Energy Northwest is taking to justify and implement the ARTS/MELLLA bases and reflects the Columbia plant configuration.

Attachment 7, Section 8.0, Containment Response, describes a non-fuel dependent evaluation. This section describes the approach Energy Northwest is taking to justify and implement the ARTS/MELLLA bases and reflects the Columbia plant configuration. The assumptions and conclusions described are applicable for Columbia.

Attachment 7, Section 9.0, Reactor Internals Integrity, describes non-fuel dependent evaluations with the exception of Section 9.1, Reactor Internal Pressure Differences, which contains some fuel-dependent aspects. Section 9.0 describes the approach Energy Northwest is taking to justify and implement the ARTS/MELLLA bases and reflects the current Columbia plant configuration. The assumptions and conclusions described are applicable for Columbia. Evaluation of the results from Section 9.1 indicates that the existing non-fuel dependent Columbia ICF bases are bounding relative to the MELLLA application and therefore no fuel-dependent evaluations will be required to justify the ARTS/MELLLA bases.

Attachment 7, Section 10.0, Anticipated Transient Without Scram (ATWS), describes an evaluation that can be considered fuel dependent. The ATWS evaluation described in Section 10.0 is a Columbia plant specific evaluation using inputs related to the Columbia Cycle 20 core. The contents of this section describe the approach Energy Northwest is taking to justify and implement the ARTS/MELLLA bases, and is discussed further in Section 3.6.5 below.

Attachment 7, Sections 11.0, Steam Dryer and Separator Performance, and 12.0, High Energy Line Break, describe non-fuel dependent evaluations relative to the effects of the ARTS/MELLLA bases. These sections describe the approach Energy Northwest is taking to justify and implement the ARTS/MELLLA bases and reflect the Columbia plant configuration. The assumptions and conclusions described are applicable for Columbia.

Attachment 7, Section 13.0, Testing, describes the planned testing which will be performed in support of the ARTS/MELLLA implementation.

3.6.5 ATWS Analysis in consideration of Information Notice 2001-13 and impact on Standby Liquid Control (SLC) System

For ARTS/MELLLA, the ATWS analysis is revised to reduce the number of pumps required for ATWS mitigation from two pumps to one. LCO 3.1.7, "Standby Liquid Control (SLC) System," will continue to require both pumps to be operable. ATWS analysis for MELLLA conditions shows that the pump flow rate of 82.4 gpm (two pump flow) can be reduced to 41.2 gpm (one pump flow) if the enrichment of Boron-10 in the SLC solution is increased. This change is being made to improve reliability (one pump credited compared to two) and to maintain margin to the SLC relief valve setpoint. The original SLC design criterion for the maximum pump discharge pressure was based on the lowest relief valve setpoint for the main steam Safety Relief Valves (SRVs) operating in the relief mode. This has been generally replaced by the use of plant specific ATWS transient pressure results occurring during the time the SLC system is analyzed to be in operation in consideration of NRC Information Notice 2001-13 (Reference 28).

For ARTS/MELLLA operation, the maximum reactor upper plenum pressure during the limiting transient is 1155 psig, resulting in a two-pump SLC system discharge pressure of 1322 psig. This would reduce margin to the SLC system relief valve setpoint. To maintain relief valve margin, Energy Northwest intends to use only one SLC pump for ATWS mitigation. The single-pump flow rate is lower than two-pump, resulting in lower pipe line flow losses. The single-pump discharge pressure of 1220 psig supports the ATWS transient reactor pressure of 1155 psig. These values reflect the implementation of Reference 28 assumptions. This reactor vessel pressure is within the previously analyzed pump design pressure of 1365 psig. The pump discharge pressure for ARTS/MELLLA remains within the design capability of the SLC pumps.

The SLC pump relief valve setpoint margin is calculated as the difference between the relief valve setpoint and the maximum SLC pump discharge pressure. Generally, a margin of 75 psig provides sufficient margin against inadvertent relief valve lifting. The 75 psig is based on an allowance for a 3% relief valve setpoint drift (1400 psig setpoint) and a 30 psig allowance for a SLC pump pressure pulse. For ARTS/MELLLA operation during the limiting ATWS event, the maximum single-pump SLC discharge pressure is less than 1220 psig. This results in a minimum relief valve setpoint margin of 180 psig, which meets the required margin of greater or equal to 75 psig. Therefore, there is adequate margin to prevent the SLC relief valve from lifting during SLC system operation to address the lessons learned in NRC Information Notice 2001-13 (Reference 28).

In the event that the SLC system is initiated before the time that the reactor pressure recovers from the first transient peak, resulting in opening of the SLC pump relief valves, the reactor pressure must reduce sufficiently to ensure SLC pump relief valve closure. The analysis indicates that the reactor pressure reduces sufficiently from the first transient peak to allow the SLC pump relief valves to close.

Attachment 7, Section 10.0, discusses the results of the ATWS analysis performed for ARTS/MELLLA conditions. The ATWS analysis resulted in a peak upper plenum pressure that is 102 psig greater than the current analysis. The increased upper plenum pressure is offset by the reduced system pressure losses from injection with one SLC pump instead of two. The net result is no change in the pump discharge pressure (which is specified in SR 3.1.7.9). The increase in peak upper plenum pressure is not due to implementation of ARTS/MELLLA, but rather to differences in the modeling assumptions used in the revised ATWS analysis as discussed above.

The current and proposed changes to the SLC system parameters are shown below.

	Current Parameter	Proposed Parameter
SLC Flow Rate (gpm)	82.4 (two-pump)	41.2 (one-pump)
Minimum Boron Concentration (weight percent)	13.6	13.6
*Boron-10 Enrichment (atom percent)	19.8	44

* See Section 3.8 below

The ATWS analysis results for ARTS/MELLLA show acceptable suppression pool temperatures for SLC injection with one pump if the enrichment of Boron-10 in the sodium-pentaborate solution is increased to 44 atom percent. Peak suppression pool temperature increases to 187.4°F, which is less than the design limit of 204.5°F.

The SLC continues to meet the requirements contained in 10 CFR 50.62(c)(4) for SLC injection capability for ATWS events. The combination of the neutron absorber boron enrichment of 44 atom percent, minimum solution concentration of 13.6 weight percent, and minimum SLC pump flow rate of 41.2 gpm exceeds the equivalency in control capacity of 86 gallons per minute of 13 weight percent sodium-pentaborate solution for a 251-inch inside diameter reactor vessel contained in 10 CFR 50.62(c)(4). Section 3.8 provides additional discussion of compliance with the equivalency requirement contained in 10 CFR 50.62(c)(4).

Columbia has implemented Alternative Source Term in accordance with 10 CFR 50.67. SLC system is credited to inject sodium pentaborate solution into the RPV in response to a LOCA to control the pH in the suppression pool for dose mitigation. The LOCA analysis only credits one SLC pump for injection and is therefore not affected by the change in pump flow rate credited in the ATWS analysis. The pH of sodium pentaborate is determined by the concentration of the solution, which remains at least 13.6 weight percent, so the change in Boron-10 enrichment has no impact on the LOCA analysis. The changes to SLC described above do not affect its ability to meet its design function.

In order to implement this change Energy Northwest will ensure the initial SLC tank boron enrichment level meets analytical requirements prior to startup from the refueling outage.

3.7 Application of TSTF-493 to Proposed Changes

Over the past several years, the NRC and the nuclear industry have participated in various forums to address the setpoint methodology issue. On September 7, 2005, the NRC transmitted a letter to the NEI Setpoint Methods Task Force (Reference 25) that described setpoint-related TS that are acceptable for instrument settings associated with SL-related setpoints. On August 24, 2006, the NRC issued Regulatory Issue Summary (RIS) 2006-17 (Reference 16) to provide guidance and information pertaining to the requirements of 10 CFR 50.36 with respect to LSSSs assessed during periodic instrument testing and calibration.

The NRC and industry have been working together on a Technical Specifications Task Force (TSTF) proposal, TSTF-493, "Clarify Application of Setpoint Methodology for LSSS Functions," to address the setpoint methodology issue as discussed further in References 16 through 19. The results of these efforts have been incorporated into Revision 4 of TSTF-493 which the NRC has approved via issuance of a model application for adoption on April 30, 2010 (Reference 36).

Appendix A of TSTF-493 identified several potential LSSSs that are applicable to this LAR. The following current and proposed 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 LSSS on which a SL has been placed 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)
- 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)

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

In order to implement this change, Energy Northwest will revise the Licensee Controlled Specifications (LCS) to include the Nominal Trip Setpoint values and the methodology for determining these setpoints for the functions that are identified as LSSS below.

3.7.1 APRM Neutron Flux - High (Setdown)

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 NUMAC PRNM LTR.

Two BWR Owners' Group documents (References 20 and 26) provide guidance on evaluating TS instruments that may be LSSS. These references indicate that the APRM Neutron Flux - High (Setdown) scram function is redundant to the IRM scram function. This function is not credited in any design basis safety analysis for Columbia and does not have an Analytical Limit (AL).

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

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

The TS Bases 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 Columbia licensing basis since it is part of the PRNM System design.

3.7.2 APRM Simulated Thermal Power – High

The APRM Simulated Thermal Power - 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 STP 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 similar to the current Flow-Biased APRM Simulated Thermal Power - High scram function which is also based on the filtered neutron flux signal. The APRM STP signal is generated by applying a six second (nominal value) filter to the 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 MCPR SL. As indicated in the Reference 26 Table, "BWR/4 Safety Limits and Limiting Safety System Settings Evaluation," this setpoint function has the potential to be an LSSS requiring evaluation for slow power excursions.

APRM / OPRM Function TS Table 3.3.1.1-1 Name	Nominal Trip Setpoint	Allowable Value	Analytical Limit
2.b APRM Simulated Thermal Power - High	≤ 0.63W + 62% RTP and ≤ 112.9% RTP	≤ 0.63W + 64% RTP and ≤ 114.9% RTP	NA

The NRC in a SE for ARTS/MELLLA implementation at Susquehanna (Reference 21) recognized that the APRM STP - High Function, was not SL-related, and provided defense-in-depth to the APRM Fixed Neutron Flux - High Function. This function was retained in the TSs since it was part of the RPS design and the NRC-approved licensing basis. The NRC specified further in the Susquehanna SE that the RBM power-dependent setpoints were the only TS functions removed or altered by that LAR that were considered SL-related LSSS. A review of the Columbia design basis indicates that the APRM STP - High scram function does not have an AL and is not credited in the safety analysis and hence, is not a LSSS on which a SL has been placed in accordance with 10 CFR 50.36(c)(1)(ii)(A).

As discussed in 3.7.1 above, 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 retained in the Columbia licensing basis.

3.7.3 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 over-pressurization protection analysis, high neutron flux is assumed to terminate the main steam isolation valve (MSIV) closure event and, along with the safety/relief valves (SRVs), 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.

APRM / OPRM Function TS Table 3.3.1.1-1 Name	Nominal Trip Setpoint	Allowable Value	Analytical Limit
2.c APRM Neutron Flux High	≤ 118% RTP	≤ 120% RTP	≤ 123% 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 SLs (e.g., MCPR and RCS pressure) being exceeded. As indicated in Reference 26 Table, "BWR/4 Safety Limits and Limiting Safety System Settings Evaluation," the APRM Neutron Flux - High scram function is an LSSS on which a SL has been placed since it protects both the MCPR SL and the Reactor Pressure SL in accordance with 10 CFR 50.36(c)(1)(ii)(A).

The SL related LSSS notes suggested by RIS 2006-17 are applicable and a version of the notes appropriate for digital applications, similar to that approved for ARTS/MELLLA implementation at Susquehanna Units 1 and 2 (Reference 21) has been applied.

3.7.4 OPRM Upscale

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 16), 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.

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 26) based on the requirements of 10 CFR 50.36 for identifying SL-LSSS and applied it to the BWR/4 and BWR/6 improved Standard Technical Specification NUREGs. In the BWROG methodology, only the LSSS associated with the analysis of 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 COLR. This function does not have an AV or an AL.

APRM / OPRM Function TS Table 3.3.1.1-1 Name	Nominal Trip Setpoint	Allowable Value	Analytical Limit
2.f OPRM Upscale	Specified in COLR*	N/A	N/A

* An information only version of the COLR has been provided in Attachment 5 and contains example fuel cycle limits for the OPRM.

GEH provided a proprietary evaluation that clarified the licensing basis of the Columbia OPRM Upscale function (Reference 27). The conclusion of this evaluation is that the OPRM Upscale function is not an LSSS variable on which a SL has been placed in accordance with 10 CFR 50.36(c)(1)(ii)(A) based on the following:

- For the Option III stability solution, the Upscale Function setpoint is established to protect fuel cladding integrity. The Upscale Function setpoint is not designed to protect the SLMCPR; it is designed using the SLMCPR as a point of reference for determining the effects of entering boiling transition for a limited period of time.

- The LSSS Classifications by the Boiling Water Reactor Owners' Group (BWROG) based on the NUREG improved STS indicate that the OPRM setpoint is not an LSSS.

- LSSSs apply to setpoints that mitigate AOOs. The OPRM upscale setpoint addresses stability events, which are not classified as AOOs, but rather as "special events."

- Previous PRNM applications have not required that the OPRM setpoints be classified as LSSSs. Changing the setpoint methodology is inconsistent with the already approved OPRM licensing basis.

- The setpoints for stability mitigation were not derived from GEH setpoint methodology (or any other setpoint methodology based on RG 1.105 and ISA-67.04), but on a separate licensing basis developed by the BWROG and approved by the NRC. The stability analysis is based on nominal setpoints consistent with conservatisms inherent in the methodology, and this has been accepted by the NRC.

- The OPRM setpoints are based on relative signal measurements, and are implemented with digital electronics and software, and are not subject to calibration error or 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.

In response to an NRC Request for Additional Information (RAI), Monticello provided to the NRC (Reference 10) a summary of a GEH proprietary evaluation that clarified the licensing basis of the OPRM Upscale function. The conclusion of the Monticello evaluation, which is the same as the Columbia evaluation described above, is that the OPRM Upscale function is not an LSSS. The NRC acknowledged and accepted this determination for Monticello in the associated SE for the PRNM amendment (Reference 9).

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

The RBM - Low, Intermediate, and High Power Ranges - Upscale functions are designed to prevent violation of the MCPR SL 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 3.3.2.1-1 Name	Nominal Trip Setpoint	Allowable Value	Analytical Limit
	Unfiltered / Filtered (% of Reference Level)		
RBM – Low Power Range – Upscale (Function 1.a)	124.0 / 122.8	124.6 / 123.4	127.0 / 125.8
RBM – Intermediate Power Range – Upscale (Function 1.b)	119.0 / 118.0	119.6 / 118.6	122.0 / 121.0
RBM – High Power Range – Upscale (Function 1.c)	114.0 / 113.0	114.6 / 113.6	117.0 / 116.0

The RBM setpoints are based on the ARTS improvement program applied to Columbia, see Section 3.6 above. The RBM setpoints are set in accordance with the results of the reload transient analysis verified each cycle as documented in the COLR.

The Reference 26 Table, "BWR/4 Safety Limits and Limiting Safety System Settings Evaluation," indicates that the Rod Withdrawal Error (RWE) analysis applies to the RBM - Low, Intermediate, and High Power Range - Upscale setpoint functions, and are LSSS on which a SL has been placed since they protect the MCPR SL 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 21) and Nine Mile Point Unit 2 (Reference 24). The NRC in the ARTS/MELLLA Susquehanna SE states "The NRC staff agrees that the RBM power-dependent setpoints ... are considered an SL-related LSSS." Energy Northwest has reviewed the referenced information, and has concluded that the Columbia RBM power-dependent setpoints are LSSS variables on which a SL has been placed in accordance with 10 CFR 50.36(c)(1)(ii)(A).

The RBM trip setpoints are determined by use of the NRC approved setpoint methodology. Using the GEH setpoint methodology based on Instrument Society of America (ISA) setpoint calculation method 2, the RBM AVs are determined from the AL, corrected for RBM input signal calibration error, process measurement error, primary element accuracy and instrument accuracy under trip conditions. The error due to the neutron flux measurement is accounted for in the non-linearity error from the LPRM detectors and is referred to in the setpoint calculation as the APRM Primary Element Accuracy. There is both a bias and random component to this APRM Primary Element Accuracy error. There is also an error due to tracking and neutron flux noise, and that is labeled as Process Measurement Accuracy (PMA). The RBM trip setpoint has no drift characteristic with no as-left or as-found tolerances because it only performs digital calculations on digitized input signals. The Nominal Trip Setpoint (NTSP) includes a drift allowance over the interval from rod selection to rod movement, which is not the surveillance interval. Drift of RBM channel components between surveillance intervals does not apply to the normalized RBM reading.

The SL related LSSS notes suggested by RIS 2006-17 are applicable and a version of the notes appropriate for digital applications, similar to that approved for ARTS/MELLLA implementation at Susquehanna Units 1 and 2 (Reference 21) has been applied.

3.8 Standby Liquid Control (SLC) Boron-10 enrichment Increase

The SLC is designed to shut down the reactor from rated power conditions to cold shutdown in the postulated situation that some or all of the control rods cannot be inserted. This manually operated system pumps a sodium pentaborate solution into the vessel, to provide neutron absorption and achieve a sub-critical reactor condition. The SLC system is designed to inject over a wide range of reactor operating pressures.

SLC shutdown capability (in terms of the required reactor boron concentration) is evaluated for each fuel reload and is reported in the cycle-specific Supplemental Reload Licensing Report (SRLR). Reload core design analyses are performed on a cycle specific basis to ensure that required reactivity margins are maintained. The planned increase in enrichment of Boron-10 provides additional margin for planned reloads of GE14 fuel and continues to preserve the shutdown objective of the SLC system. The average concentration of boron in the reactor core is being raised from the current minimum value of 660 ppm to 780 ppm natural boron equivalent. This concentration was determined by Global Nuclear Fuel (GNF) using the approved methods described in NEDE-24011-P-A (Reference 31) and will assure sufficient shutdown margin is maintained in the reactor so that the SLC design function of bringing the reactor to a subcritical condition is achieved.

Natural boron contains 19.8 atom percent of the Boron-10 isotope. Boron-10, with its large neutron absorption capability, is the active component in sodium pentaborate. In order to achieve the increased neutron absorber concentration equivalent to 780 ppm natural boron, Energy Northwest intends to use sodium pentaborate solution enriched with the Boron-10 isotope, which is chemically and physically similar to the current solution. The use of sodium pentaborate enriched with the Boron-10 isotope provides a faster negative reactivity insertion rate than the same quantity of sodium pentaborate with natural boron. A sodium pentaborate solution enrichment of 22 atom percent Boron-10 results in an equivalent concentration of 780 ppm natural boron in the reactor.

A further increase in Boron-10 enrichment is required to support the change from two-pump to one-pump SLC system operation for the ATWS analysis described in

Section 3.6.5. Since credited flow rate is reduced in half (from 82.4 to 41.2 gpm), Boron-10 enrichment doubles (from 22 to 44 atom percent). 10 CFR 50.62(c)(4) requires that each BWR have a SLC system with a minimum flow capacity and boron content equivalent in control capacity to 86 gpm of 13 weight percent sodium pentaborate solution. NEDE-31096-P-A (Reference 33) provides guidance for boron equivalency determinations. Equation 1-1 of that document was used to demonstrate injection capacity equivalency as follows:

$$\frac{Q}{86} * \frac{M_{251}}{M} * \frac{C}{13} * \frac{E}{19.8} \geq 1$$

where:

Q = SLC system flow rate, gpm;

M_{251} = the mass of water in the reactor vessel and recirculation system at rated conditions for the reference plant (a 251 inch diameter reactor vessel), lbm;

M = the mass of water in the reactor vessel and recirculation system at rated conditions, lbm;

C = expected sodium pentaborate solution concentration, weight percent; and

E = minimum expected Boron-10 isotope enrichment, atom percent.

Since Columbia has a 251 inch diameter reactor vessel, the value of M_{251}/M is equal to 1. Applying the values of the remaining parameters, which were assumed in the ATWS analysis, yields:

$$\frac{41.2}{86} * 1 * \frac{13.6}{13} * \frac{44.0}{19.8} = 1.11 \geq 1$$

Thus, this requirement of 10 CFR 50.62 is satisfied.

Accordingly, a new TS SR 3.1.7.9 is added to verify that sodium pentaborate enrichment is ≥ 44 atom percent Boron-10 prior to addition to the SLC tank. This change does not have any impact on SLC operation or the ability of the system to perform its shutdown function. Operation within the Acceptable Operation region of TS Figure 3.1.7-1, with a sodium pentaborate enrichment of ≥ 44 atom percent Boron-10 in accordance with SR 3.1.7.9, will achieve the required concentration equivalent to 780 ppm natural boron in the reactor core.

There are no significant impacts of the new sodium pentaborate solution on the mechanical and electrical aspects of the SLC system. The SLC pump, motor, and system valves are capable of delivering the required minimum flow rate to the reactor vessel under worst case postulated operating conditions. Since operation of only one pump is required, the margin between the maximum pump discharge pressure and the nominal setpoint of the pump discharge relief valve is maintained. This is mainly due to the reduced system back pressure resulting from the lower pipe line flow losses for one-pump compared to two-pump operation.

The existing SLC system design requires injection of a quantity of boron that includes an additional 25 percent above that needed for an in-vessel boron concentration of 660 ppm, to allow for imperfect mixing and leakage. As part of this proposed change, an additional 25 percent above that needed for an in-vessel boron concentration equivalent to 780 ppm natural boron will also be injected. This change is consistent with the Bases for TS 3.1.7 contained in NUREG-1433 (Reference 22). The NRC has previously approved similar changes regarding Susquehanna to the number of SLC pumps required for ATWS mitigation (Reference 34) and similar changes regarding Brunswick to the required boron concentration for GE14 fuel (Reference 7).

3.9 Conclusion

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

Incorporation of the ARTS/MELLLA improvements as described above will increase operating flexibility in power ascension and operation at rated power. Replacement of the APRM setdown requirement with more direct power and flow dependent thermal limits will reduce the need for manual AV or gain adjustments and allow for more direct thermal limits administration. This will improve the human/machine interface, update thermal limits administration, and provide more direct protection of plant limits.

Increasing the Boron-10 enrichment levels will continue to ensure that the SLC system satisfies 10 CFR 50.62 requirements for all future proposed core reloads.

4.0 Regulatory Evaluation

4.1 Applicable Regulatory Requirements / Criteria

4.1.1 10 CFR Part 50

10 CFR 50.36, "Technical Specifications," provides the regulatory requirements required in the TS. As stated in 10 CFR 50.36, TS include SRs to assure that the LCOs are met. The proposed TS changes would revise SRs and the LCO actions and completion times, as applicable, for each change in APRM functions and related LCOs.
The Columbia Neutron Monitoring System was designed and licensed to the General Design Criteria (GDC) specified in CFR 50 Appendix A. The GDCs related to the proposed changes are discussed below.

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

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

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

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

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

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

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

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

The SLC system was designed and licensed to the following reactivity control related GDCs:

Criterion 26 - "Reactivity control system redundancy and capability." Two independent reactivity control systems of different design principles shall be provided....The second reactivity control system shall be capable of reliably controlling the rate of reactivity changes resulting from planned, normal power changes (including xenon burnout) to assure acceptable fuel design limits are not exceeded. One of the systems shall be capable of holding the reactor core subcritical under cold conditions.

Criterion 27 - "Combined reactivity control systems capability." The reactivity control system shall be designed to have a combined capability, in conjunction with poison addition by the emergency core cooling system, of reliably controlling reactivity change to assure that under postulated accident conditions and with appropriate margin for stuck rods the capability to cool the core is maintained.

Other applicable Regulations:

In 10 CFR 50.62, requirements for reduction of risk from ATWS events are specified. Paragraph (c)(4) of 10 CFR 50.62 states, in part that "Each boiling water reactor must have a standby liquid control (SLC) system with the capability of injecting into the reactor pressure vessel a borated water solution at such a flow rate, level of boron concentration and boron-10 isotope enrichment, and accounting for reactor pressure vessel volume, that the resulting reactivity control is at least equivalent to that resulting from injection of 86 gallons per minute of 13 weight percent sodium pentaborate decahydrate solution at the natural boron-10 isotope abundance into a 251-inch inside diameter reactor pressure vessel for a given core design."

In 10 CFR 50.36(d)(1)(ii)(A), the NRC states, in part, that "where a limiting safety system setting (LSSS) is specified for a variable on which a SL has been placed, the setting must be so chosen that automatic protective action will correct the abnormal situation before a safety limit is exceeded."

In 10 CFR 50.36(c)(3), the NRC states, "Surveillance requirements are requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation would be within safety limits, and that the limiting conditions for operation would be met."

Regulatory Guide (RG) 1.105, "Setpoints for Safety-Related Instrumentation," describes a method that the NRC staff finds acceptable for use in complying with the NRC's regulations for ensuring that setpoints for safety-related instrumentation are initially within, and will remain within the TS limits.

Regulatory Issue Summary (RIS) 2006-17, "NRC Staff Position on the Requirements of 10 CFR 50.36, 'Technical Specifications,' Regarding Limiting Safety System Settings during Periodic Testing and Calibration of Instrument Channels," dated August 24, 2006, discusses issues that could occur during the testing of LSSS and that may, therefore, have an adverse effect on equipment operability.

Energy Northwest has evaluated the proposed changes against the applicable regulatory requirements and acceptance criteria and finds the design of the NUMAC PRNM System complies with the applicable regulatory criteria described above. The technical analysis in Section 3.0 above, concludes that, for the proposed changes to install and implement the NUMAC PRNM System, all requirements and acceptance criteria of the RPS are met. Implementation of ARTS/MELLLA and increasing the Boron-10 enrichment of the SLC system continue to meet all regulatory requirements. The proposed TS amendment:

1. Does not alter the design or function of any reactivity control system;
2. Does not result in any change in the qualifications of any component; and
3. Does not result in the reclassification of any component's status in the areas of shared, safety related, independent, redundant, and physical or electrical separation.

4.1.2 NRC Safety Evaluation and NUMAC PRNM LTR Requirements

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

To demonstrate conformance, Energy Northwest has evaluated the proposed Columbia-specific PRNM System installation against the requirements of the NUMAC PRNM LTR and associated NRC SEs. Attachment 1 provides a plant-specific comparison matrix entitled, Columbia Generating Station Plant-Specific Responses Required by NUMAC PRNM Retrofit Plus Option III Stability Trip Function Topical Report (NEDC-32410P-A). A response to each NRC staff requirement is provided below:

1. Confirm the applicability of the NUMAC PRNM LTR (NEDC-3241OP-A and its supplement), including clarifications and reconciled differences between the specific plant design and the topical report design descriptions.

   RESPONSE

   GEH and Energy Northwest performed an evaluation of the proposed Columbia-specific PRNM System installation against the requirements of the NUMAC PRNM LTR and associated NRC SEs; the resulting document is provided in Attachment 1. Clarifications and reconciled differences between the plant-specific design and the NUMAC PRNM LTR design descriptions are identified in Section 3 of this LAR.

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

   RESPONSE

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

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

   RESPONSE

   Energy Northwest confirms the plant-specific TS changes to implement the NUMAC PRNM System (including the OPRM Option III stability solution), which are provided in Attachment 2, are consistent with the requirements of the NUMAC PRNM LTR.

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

   RESPONSE

   The analysis of the plant-specific environmental conditions to the NUMAC PRNM System equipment qualification (EQ) values is discussed in Attachment 1. The results of this analysis confirm the plant-specific environmental conditions are enveloped by the NUMAC PRNM System EQ values.

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

RESPONSE

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

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

RESPONSE

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

4.2 Precedents

Precedents are discussed in the relevant sections above where the specific changes are described.

4.3 Significant Hazards Consideration

Energy Northwest has evaluated whether or not a significant hazards consideration is involved with the proposed change, by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

4.3.1 Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No.
PRNM Discussion:

The probability (frequency of occurrence) of DBAs occurring is not affected by the PRNM System, as the PRNM System does not interact with equipment whose failure could cause an accident. Compliance with the regulatory criteria established for plant equipment will be maintained with the installation of the upgraded PRNM System. Scram setpoints in the PRNM System will be established so that all analytical limits are met.

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

The proposed change will replace the currently installed and NRC approved OPRM Option III long-term stability solution with an NRC approved Option III long-term stability solution digitally integrated into the PRNM equipment. The PRNM hardware incorporates the OPRM Option III detect and suppress solution reviewed and approved by the NRC in References 1, 2, 5, and 6 Licensing Topical Reports, the same as the currently installed separate OPRM System. The OPRM meets the GDC 10, "Reactor Design," and 12, "Suppression of Reactor Power Oscillations," requirements by automatically detecting and suppressing design basis thermal hydraulic oscillations to protect specified fuel design limits. Therefore, the proposed change does not involve a significant increase in the consequences of an accident previously evaluated.

Based on the above, the operation of the new PRNM System and replacement of the currently installed OPRM Option III stability solution with the Option III OPRM function integrated into the PRNM equipment will not increase the probability or consequences of an accident previously evaluated.

ARTS/MELLLA Discussion:

The proposed change eliminates the APRM flow-biased STP setdown requirement and substitutes power and flow dependent adjustments to the MCPR and Linear Heat Generation Rate (LHGR) thermal limits. Thermal limits will be determined using NRC approved analytical methods. The proposed change will have no effect upon any accident initiating mechanism. The power and flow dependent adjustments will ensure that the MCPR SL will not be violated as a result of any AOO, and that the fuel thermal and mechanical design bases will be maintained.

The proposed change also expands the power and flow operating domain by relaxing the restrictions imposed by the formulation of the APRM flow-biased STP AV and by the replacement of the current flow-biased RBM with a new power dependent RBM. The APRM and RBM are not involved in the initiation of any accident, and the APRM flow-biased STP function is not credited in any Columbia safety analyses. The proposed change will not introduce any initial conditions that would result in NRC approved criteria being exceeded and the APRM and RBM will remain capable of performing their design functions.

The SLC system is provided to shutdown the reactor without reliance on control rod movement, to mitigate anticipated transients without scram

(ATWS) events and provide suppression pool pH control following a LOCA. As such, SLC is not considered an initiator of an ATWS event, LOCA or any other analyzed accident. The revised SLC pump flow rate and increased Boron-10 enrichment continue to meet the shutdown requirement of SLC. The changes do not reduce the ability of the SLC system to respond to or mitigate an ATWS event or LOCA. Nor do these changes increase the likelihood of a system malfunction that could increase the consequences of an accident.

SLC Boron-10 Enrichment Increase Discussion:

The SLC system is designed to provide sufficient negative reactivity to bring the reactor from full power to a subcritical condition at any time in a fuel cycle, without taking credit for control rod movement. The proposed changes to the SLC sodium pentaborate solution requirements maintain the capability of the SLC to perform this reactivity control function, and assure continued compliance with the requirements of 10 CFR 50.62 for ATWS. The proposed changes do not impact the LOCA suppression pool pH control function of SLC because single-pump minimum flow and sodium pentaborate solution concentration (weight percent) are not changed from the level credited in the LOCA analysis. The SLC is provided to mitigate ATWS events and LOCA and, as such, is not considered to be an initiator of the ATWS event, LOCA or any other analyzed accident. The use of sodium pentaborate solution enriched with the Boron-10 isotope, which is chemically and physically similar to the current solution, does not alter the design or operation of the SLC or increase the likelihood of a system malfunction that could increase the consequences of an accident.

Based on the above discussion, it is concluded that the proposed changes do not involve a significant increase in the probability or consequences of an accident previously evaluated.

4.3.2 Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?

Response: No.

PRNM Discussion:

The components of the PRNM System will be supplied to equivalent or better design and qualification criteria than is currently required for the plant. Equipment that could be affected by PRNM System has been evaluated. No new operating mode, safety-related equipment lineup, accident scenario, or system interaction mode was identified. Therefore, the upgraded PRNM System will not adversely affect plant equipment.

The new PRNM System uses digital equipment that has "control" processing points and software controlled digital processing compared to the existing PRNM System that uses mostly analog and discrete component processing (excluding the existing OPRM). Specific failures of hardware and potential software common cause failures are different from the existing system. The effects of potential software common cause failure are mitigated by specific hardware design and system architecture as discussed in Section 6.0 of the NUMAC PRNM LTR. Failure(s) of the system have the same overall effect as the present design. No new or different kind of accident is introduced. Therefore, the PRNM System will not adversely affect plant equipment.

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

ARTS/MELLLA Discussion:

The proposed change eliminates the APRM flow-biased STP setdown requirement and substitutes power and flow dependent adjustments to the MCPR and LHGR thermal limits. Because the thermal limits will continue to be met, no analyzed transient event will escalate into a new or different type of accident due to the initial starting conditions permitted by the adjusted thermal limits.

The proposed change also expands the power and flow operating domain by relaxing the restrictions imposed by the formulation of the APRM flow-biased STP AV and the replacement of the current flow-biased RBM with a new power dependent RBM. Changing the formulation for the APRM flow-biased STP AV and changing from a flow-biased RBM to a power dependent RBM does not change their respective functions and manner of operation. The change does not introduce a sequence of events or introduce a new failure mode that would create a new or different type of accident. While not credited, the APRM flow-biased STP AV and associated scram trip setpoint will continue to initiate a scram to protect the MCPR SL. The power dependent RBM will prevent rod withdrawal when the power dependent RBM rod block setpoint is reached. No new failure mechanisms, malfunctions, or accident initiators are being introduced by the proposed change. In addition, operating within the expanded power flow map will not require any systems, structures or components to function differently than previously evaluated and will not create initial conditions that would result in a new or different kind of accident from any accident previously evaluated.

The proposed change to the SLC pump flow rate credited in the ATWS analysis is consistent with the functional requirements of the ATWS rule (10 CFR 50.62). These proposed changes do not involve the installation of any new or different type of equipment, do not introduce any new modes of plant operation, and do not change any methods governing normal plant operation.

SLC Boron-10 Enrichment Increase Discussion:

Injection of sodium pentaborate solution into the reactor vessel has been considered in the plant design. The proposed changes revise the SLC boron solution requirements such that the capability of the SLC system to bring the reactor to a subcritical condition without taking credit for control rod movement is maintained, considering operation with an equilibrium core of GE14 fuel. The use of sodium pentaborate solution enriched with the Boron-10 isotope, which is chemically and physically similar to the current solution, does not alter the design, function, or operation of the SLC system. The correct Boron-10 enrichment is assured by the proposed revisions to the TS SRs. The solution concentration and volume are not changed; thus, the existing minimum volume and solution and piping temperature specified in the TS will ensure that the boron remains in solution and does not precipitate out in the SLC storage tank or in the SLC pump suction piping. The minimum volume and concentration specified in the TS ensure that the LOCA suppression pool pH control function is not impacted.

Therefore, the proposed changes do not create the possibility of a new or different kind of accident from any accident previously evaluated.

4.3.3 Does the proposed change involve a significant reduction in a margin of safety?

Response: No.
PRNM Discussion:

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

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

ARTS/MELLLA Discussion:

The proposed change eliminates the APRM flow-biased STP setdown requirement and substitutes power and flow dependent adjustments to the MCPR and LHGR thermal limits. Replacement of the APRM setdown requirement with power and flow dependent adjustments to the MCPR and LHGR thermal limits will continue to ensure that margins to the fuel cladding SL are preserved during operation at other than rated conditions. Thermal limits will be determined using NRC approved analytical methods. The power and flow dependent adjustments will ensure that the MCPR SL will not be violated as a result of any AOO, and that the fuel thermal and mechanical design bases will be maintained.

The proposed change also expands the power and flow operating domain by relaxing the restrictions imposed by the formulation of the APRM flow-biased STP AV and the replacement of the current flow-biased RBM with a new power dependent RBM. The APRM flow-biased STP AV and associated scram trip setpoint will continue to initiate a scram to protect the MCPR SL. The RBM will continue to prevent rod withdrawal when the power dependent RBM rod block setpoint is reached. The MCPR and LHGR thermal limits will be developed to ensure that fuel thermal mechanical design bases remain within the licensing limits during a control rod withdrawal error event and to ensure that the MCPR SL will not be violated as a result of a control rod withdrawal error event. Operation in the expanded operating domain will not alter the manner in which SLs, LSSS, or limiting conditions for operation are determined. AOOs and postulated accidents within the expanded operating domain will continue to be evaluated using NRC approved methods. The 10 CFR 50.46 acceptance criteria for the performance of the ECCS following postulated LOCAs will continue to be met.

The proposed change to the SLC flow rate credited in the ATWS analysis continues to meet accident analyses limits. The proposed change is consistent with the functional requirements of the ATWS rule (10 CFR 50.62) and the flow rate credited for LOCA suppression pool pH control. The ability of the SLC system to respond to and mitigate an ATWS event or LOCA is not affected.

SLC Boron-10 Enrichment Increase Discussion:

The proposed changes revise the SLC boron solution requirements to maintain the capability of the SLC system to bring the reactor to a subcritical condition without taking credit for control rod movement. These changes support operation with an equilibrium core of GE14 fuel and assure continued compliance with the requirements of 10 CFR 50.62. The minimum required average boron-10 concentration in the reactor core, resulting from the injection of sodium pentaborate solution by the SLC system, has been determined using approved analytical methods. The analysis demonstrates that sufficient shutdown margin is maintained in the reactor such that the reactivity control function of the SLC system is assured. The additional quantity of boron included to allow for imperfect mixing and leakage is maintained at 25 percent. No change in the solution pH or volume is made. Thus, the safety margin is maintained to bring the reactor subcritical in the event of an ATWS and to control suppression pool pH in the event of a LOCA.

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

4.4 Conclusions

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

5.0 ENVIRONMENTAL CONSIDERATION

A review has determined that the proposed changes would change a requirement with respect to the installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed changes do not involve: (i) a significant hazards consideration; (ii) a significant change in the types or significant increase in the amounts of any effluents that may be released offsite; or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed changes meet the eligibility criterion for categorical exclusion set for in 10 CFR 51.22(c)(9).

Therefore, pursuant to 10 CFR 51.22(b), an environmental assessment of the proposed change is not required.

6.0 REFERENCES

1. Licensing Topical Report NEDC-32410P-A Volumes 1 and 2, "Nuclear Measurement Analysis and Control Power Range Neutron Monitor (NUMAC PRNM) Retrofit Plus Option III Stability Trip Function," dated October 1995.

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

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

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

5. Licensing Topical Report NEDO-31960-A including Supplement 1, "BWR Owners' Group Long-Term Stability Solutions Licensing Methodology," dated November 1995.

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

7. NRC letter to the Carolina Power and Light Company, "Brunswick Steam Electric Plant, Units 1 and 2 - Issuance of Amendments Re: Standby Liquid Control Sodium Pentaborate Solution Concentration and Requirements (TAC Nos. MB5680 AND MB5681)," dated March 25, 2003.

8. NRC letter to PPL Susquehanna, "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 (ADAMS Accession No. ML060540429).

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

10. Northern States Power Company letter to NRC, "Response to Requests for Additional Information for License Amendment Request for Power Range Neutron Monitoring System Upgrade (TAC No. MD8064)," dated September 16, 2008 (ADAMS Accession No. ML082620582).

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

12. NRC letter to Exelon Nuclear, "Peach Bottom Atomic Power Station, Units 2 and 3 – Issuance of Amendment Re: Activation of Oscillation Power Range Monitor Trip (TAC Nos. MC2219 and MC 2220)," dated March 21, 2005 (page 4 of SE) (ADAMS Accession No. ML050270020).

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

14. BWROG Letter 96113, K. P. Donovan (BWROG) to L.E. Phillips (NRC), "Guidelines for Stability Option III 'Enable Region' (TAC M92882)," dated September 17, 1996.

15. NEDC-30851P-A, "Technical Specification Improvement Analysis for BWR Reactor Protection System," Licensing Topical Report, GE Nuclear Energy, Class III (proprietary), dated March 1988. (Referred to as 'Reference 11 of the NUMAC PRNM LTR').

16. NRC Regulatory Issue Summary (RIS) 2006-17, "NRC Staff Position on the Requirements of 10 CFR 50.36, 'Technical Specifications,' Regarding Limiting Safety System Settings During Periodic Testing and Calibration of Instrument Channels," dated August 24, 2006.

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

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

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

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

21. 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.

22. NUREG-1433, Rev. 3, "Standard Technical Specifications General Electric Plants, BWR/4," dated March 2004.

23. NEI-08-09, Revision 3, "Cyber Security Plan for Nuclear Power Reactors," dated September 2009.

24. NRC Letter to NMP2, "Nine Mile Point Nuclear Station, Unit No. 2 – Issuance of Amendment Re: Implementation of ARTS/MELLLA (TAC No. MD5233)," dated February 27, 2008 (ADAMS Accession No ML080230230).

25. NRC letter to the NEI Setpoints Methods Task Force, "Technical Specification for Issues Related to Setpoint Allowable Values," dated September 7, 2005 (ADAMS Accession No. ML 052500004).

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

27. GEH document 0000-0116-1321, "OPRM Setpoint and RIS Requirements," dated April 6, 2010.

28. NRC Information Notice 2001-13, "Inadequate Standby Liquid Control System Relief Valve Margin," dated August 10, 2001.

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30. 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.

31. NEDE-24011-P-A and NEDE-24011-P-A-US, Revision 16, "General Electric Standard Application for Reactor Fuel (GESTAR II) and Supplement for the United States," dated October 2007.

32. Regulatory Guide 5.71, "Cyber Security Programs for Nuclear Facilities," dated January 2010.

33. NEDE-31096-P-A, "Anticipated Transients Without Scram; Response to NRC ATWS Rule 10 CFR 50.62," dated February 1987.

34. NRC to PPL Susquehanna, LLC, " Susquehanna Steam Electric Station, Units 1 and 2 - Issuance of Amendment Re: Standby Liquid Control System (TAC Nos. MD1424 AND MD1425)," dated February 28, 2007.

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36. "Model Application for Adoption of TSTF Traveler TSTF-493, Revision 4, 'Clarify Application of Setpoint Methodology for LSSS Functions' Option A, Addition of Surveillance Notes," April 30, 2010 (ADAMS Accession No. ML100710442).