ENERGY NORTHWEST

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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**

Reference: NRC to Mark E. Reddemann (Energy Northwest), "Columbia Generating Station – Issuance of Amendment Re: Increased Boron Concentration in Standby Liquid Control System (TAC NO. ME4789)," May 18, 2011 (ADAMS Accession No. ML111170370)

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 Power Distribution Limits, Reactor Protection System Instrumentation, 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 Measurement 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

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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-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 with power and flow-based limits on Minimum Critical Power Ratio (MCPR) and Linear Heat Generation Rate (LHGR) will provide more direct protection of thermal limits.

With the recent approval of the referenced Amendment 221 to the Columbia TS, which increased Boron-10 enrichment in the Standby Liquid Control (SLC) system, analysis now supports Anticipated Transient Without Scram (ATWS) mitigation with one SLC system pump, instead of two. Energy Northwest is requesting NRC approval to incorporate this change to the Columbia license basis as this improves system reliability by increasing redundancy while maintaining margin to the SLC system relief valve setpoint under ARTS / MELLLA conditions. No changes to the TS are required to implement this change; however, changes will be made to the TS Bases.

This License Amendment Request (LAR) has been divided into three enclosures to facilitate the NRC review. Enclosure 1 provides a description of the combined PRNM and ARTS / MELLLA proposed changes to TS. Attachments to Enclosure 1 include the following:

1. TS Page Markups
2. Retyped TS Pages
3. TS Bases Page Markups (for information only)
4. Sample Pages of Proposed COLR Changes (for information only)

Enclosure 2 provides the technical and regulatory evaluation for the PRNM LAR. Included as Attachments to Enclosure 2 are the following:

1. 0000-0101-7647-R3, "Columbia Generating Station Plant-Specific Responses Required by NUMAC PRNM Retrofit Plus Option III Stability Trip Function Topical Report (NEDC-32410P-A)," October 2011- (proprietary version)

2. NEDC-33685P, Revision 1, "Digital I&C-ISG-06 Compliance for Columbia Generating Station NUMAC Power Range Neutron Monitoring Retrofit Plus Option III Stability Trip Function," January 2012 - (proprietary version)

3. NEDC-33690P, Revision 0, "Columbia Generating Station Power Range Neutron Monitoring System Response Time Analysis Report," November 2011 – (proprietary version)

4. NEDC-33694P, Revision 1, "Columbia Generating Station Power Range Neutron Monitoring System Diversity and Defense-in-Depth (D3) Analysis," January 2012 - (proprietary version)

5. NEDC-33696P, Revision 0, "Columbia Generating Station Power Range Neutron Monitoring System Architecture & Theory of Operations Report," November 2011 - (proprietary)

6. NEDC-33697P, Revision 1, "Columbia Generating Station Power Range Neutron Monitoring System Design Analysis Report," January 2012 - (proprietary version)

7. NEDC-33698P, Revision 1, "Columbia Generating Station Power Range Neutron Monitoring System Design Report on Computer Integrity, Test and Calibration, and Fault Detection," January 2012 - (proprietary version)

8. 0000-0101-7647-R3, "Columbia Generating Station Plant-Specific Responses Required by NUMAC PRNM Retrofit Plus Option III Stability Trip Function Topical Report (NEDC-32410P-A)," October 2011 - (non-proprietary version)

9. NEDO-33685, Revision 1, "Digital I&C-ISG-06 Compliance for Columbia Generating Station NUMAC Power Range Neutron Monitoring Retrofit Plus Option III Stability Trip Function," January 2012 - (non-proprietary version)

10. NEDO-33690, Revision 0, "Columbia Generating Station Power Range Neutron Monitoring System Response Time Analysis Report," November 2011 – (non-proprietary version)

11. NEDO-33694, Revision 1, "Columbia Generating Station Power Range Neutron Monitoring System Diversity and Defense-in-Depth (D3) Analysis," January 2012 - (non-proprietary version)

12. NEDO-33697, Revision 1, "Columbia Generating Station Power Range Neutron Monitoring System Design Analysis Report," January 2012 - (non-proprietary version)

13. NEDO-33698, Revision 1, "Columbia Generating Station Power Range Neutron Monitoring System Design Report on Computer Integrity, Test and Calibration, and Fault Detection," January 2012 - (non-proprietary version)

14. List of Commitments

Attachment 1 of Enclosure 2 provides the Columbia Specific Plant Responses required by the NUMAC PRNM Licensing Topical Report (LTR).

Attachments 2 through 7 of Enclosure 2 contain the Phase I information to support a Digital I&C-ISG-06 defined Tier 2 review for a license amendment request referencing a previously approved topical report with deviations to suit the Columbia Generating Station specific application.

GEH considers certain information contained in Attachments 1 through 7 of Enclosure 2 to be proprietary and, therefore, requests that these be withheld from public disclosure in accordance with 10 CFR 2.390. Non-proprietary versions of these documents are provided as Attachments 8 through 13 of Enclosure 2 respectively, except for Attachment 5 which is considered proprietary information in its entirety. Attachments 1 through 7 of Enclosure 2 also contain the associated affidavits, within the first few pages of each document, for the requests to be withheld from public disclosure.

Attachment 14 of Enclosure 2 contains a List of Commitments, including the Digital I&C-ISG-06 Phase II information to be supplied. The Phase II information is expected to be submitted to the NRC no later than June 29, 2012.

Enclosure 3 provides the technical and regulatory evaluation for the ARTS / MELLLA LAR. Included as Attachments to Enclosure 3 are the following:

1. NEDC-33570P, Revision 1, "Columbia Generating Station APRM/RBM/Technical Specifications / Maximum Extended Load Line Limit Analysis (ARTS / MELLLA)," January 2012 (proprietary version)

2. NEDO-33570, Revision 1, "Columbia Generating Station APRM/RBM/Technical Specifications / Maximum Extended Load Line Limit Analysis (ARTS / MELLLA)," January 2012 (non-proprietary version)

GEH considers certain information contained in Enclosure 3 Attachment 1 to be proprietary and, therefore, requests that it be withheld from public disclosure in accordance with 10 CFR 2.390. Included within the proprietary file is the associated affidavit for this request. A non-proprietary version of this document is provided as Enclosure 3 Attachment 2.

Energy Northwest will install the PRNM and ARTS / MELLLA improvements during the next planned refueling outage after NRC approval is received. The next scheduled refueling outage (R21) for Columbia begins in May 2013. If NRC approval is not received by April 15, 2013 to support installation during the R21 refueling outage, then the modifications will be installed in a subsequent outage of sufficient duration, such as the next refueling outage scheduled to begin in the spring of 2015.

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. ZK Dunham, Licensing Supervisor, at (509) 377-4735.

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

Respectfully,

BJ Sawatzke
Vice President, Nuclear Generation & Chief Nuclear Officer

Enclosures and Attachments: As described herein

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 of 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

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Attachments to Enclosure 1

1. TS Page Markups
2. Retyped TS Pages
3. TS Bases Page Markups (for information only)
4. Sample Pages of Proposed COLR Changes (for information only)

1.0 SUMMARY DESCRIPTION

Energy Northwest proposes to revise the Columbia Generating Station (CGS) Technical Specifications (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; and

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).

Included in Attachments 1 and 2 to this enclosure are the markups and retyped pages of the TS, respectively, for the combined PRNM and ARTS / MELLLA changes. The TS Bases Page Markups for the combined changes are provided for information only in Attachment 3 of this enclosure. Attachment 4 of this enclosure includes an information only copy of proposed changes to the Core Operating Limits Report (COLR) in support of this license amendment request.

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.

Enclosure 2 contains the Technical and Regulatory Evaluation by Energy Northwest and GEH of the proposed CGS-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, "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 as Attachment 1 to Enclosure 2. Deviations from the NUMAC PRNM LTR are identified in Table 1 (on page A-2) of this Attachment. Discussion of the deviations to the NUMAC PRNM LTR as proposed for implementation at CGS begins on page A-3 of Attachment 1. Included as Attachments 2 through 7 of Enclosure 2 are the proprietary versions of the GEH documents that contain an evaluation of the CGS PRNM system versus the current regulatory requirements as delineated in ISG-06 (Reference 5) of all changes since approval of the NUMAC PRNM LTR. Attachments 8 through 13 contain the non-proprietary versions of these documents, as applicable. Attachment 14 of Enclosure 2 includes a listing of the commitments for providing the remainder of the Phase II information in support of the PRNM license amendment request.

Implementation of ARTS / MELLLA involves changing the Average Power Range Monitor (APRM) flow-biased Simulated Thermal Power (STP) Allowable Value (AV) to permit operation in the MELLLA operating domain. Implementation of the PRNM hardware in conjunction with the ARTS improvements 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. A specific discussion of the Technical and Regulatory Evaluation for implementation of the ARTS / MELLLA improvements at CGS is provided in Enclosure 3. Included as Attachments to Enclosure 3 are the proprietary and non-proprietary versions of the Safety Analysis in support of ARTS / MELLLA (Attachments 1 and 2 of Enclosure 3 respectively).

Energy Northwest plans to replace the analog APRM and RBM subsystems of the existing Neutron Monitoring System and the OPRM System at CGS with the more reliable digital NUMAC PRNM System during the spring 2013 refueling outage. Implementation of the expanded operating domain using ARTS / MELLLA would occur in the subsequent operating cycle. Approval of these proposed amendments is requested by April 15, 2013 to support implementation of these changes during the scheduled 2013 refueling outage. If approval is not received in time to support installation during the 2013 refueling outage, the changes will not be implemented until a subsequent outage of sufficient duration, such as the scheduled 2015 refueling outage.

2.0 DETAILED DESCRIPTION

This License Amendment Request (LAR) proposes to change TS sections 1.1, 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.

The proposed changes support CGS'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. The replacement PRNM system will provide additional margin to existing setpoints via improved accuracy and drift characteristics over the current NMS.

This LAR addresses changes to the TS Limiting Conditions of Operation (LCOs), Applicability, Required Actions, and Surveillance Requirements (SRs) for Reactor Protection System (RPS) APRM functions as justified in the NUMAC PRNM LTR. The specific changes to the TS are identified below. Technical and Regulatory evaluations of the PRNM related changes are provided in Enclosure 2.

This LAR also addresses the further expansion of the operating domain (i.e., 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 will also be incorporated into the PRNM modification. The TS changes related to ARTS / MELLLA are described below, and the corresponding Technical and Regulatory evaluations are provided in Enclosure 3.

With the recent approval of the use of enriched sodium pentaborate solution at CGS via Amendment 221 to the TS (Reference 6), an item of increased operational flexibility can be supported. The operational flexibility is reflected in a change to the TS Bases that changes the operational requirements of the SLC system from 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. Reducing the required SLC pumps from two to one allows the plant to support required surveillances without challenging SLC system relief valve settings. This improved operational flexibility item is discussed further in Enclosure 3.

In this Enclosure, the following Attachments are provided:

1. Marked-up TS pages. This Attachment includes the mark-ups indicating the proposed change resulting from the combined PRNM and ARTS / MELLLA submittals.

2. Retyped TS pages.

3. TS Bases page markups for information only. This attachment is referenced in Enclosure 2 for related changes with the PRNM submittal where additional information is deemed appropriate.

4. Selected pages of proposed COLR for information only. This attachment provides a version of the changes that are proposed for inclusion in the COLR involving the OPRM and RBM Specifications.

2.1 TS 1.1, Definitions, and 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.

2.2 TS 3.3.1.1, Reactor Protection System (RPS) Instrumentation

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

2.2.1 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."

- 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).

2.2.2 Changes to LCO 3.3.1.1 Actions

- In the Actions for LCO 3.3.1.1, CGS 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 Enclosure 2, Sections 1.5.3 and 1.5.4.

2.2.3 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:

2.2.3.1 Channel Check Surveillance Requirements

- 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.

2.2.3.2 Channel Functional Test Surveillance Requirements

- APRM Function 2.a, "Neutron Flux – High (Setdown)"

  The requirement will be changed from a frequency of every 7 days to every 184 days (6 months). This change is functionally implemented by applying new SR 3.3.1.1.16 vice old SR 3.3.1.1.3. The Note modifying SR 3.3.1.1.3 is included as Note 1 for SR 3.3.1.1.16.

- APRM Function 2.b, "Simulated Thermal Power – High"

  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. This change is functionally implemented by applying new SR 3.3.1.1.16 vice old SR 3.3.1.1.8.

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

  The requirement will be changed from a frequency of every 92 days to every 184 days (6 months). This change is functionally implemented by applying new SR 3.3.1.1.16 vice old SR 3.3.1.1.8.

- APRM Function 2.d, "Inop"

  The requirement will be changed from a frequency of every 92 days to every 184 days (6 months). This change is functionally implemented by applying new SR 3.3.1.1.16 vice old SR 3.3.1.1.8.

- Proposed APRM Function 2.e, "2-Out-of-4 Voter"

  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. This change is functionally implemented by applying new SR 3.3.1.1.16.

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

  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. This change is functionally implemented by applying new SR 3.3.1.1.16.

2.2.3.3 Channel Calibration Surveillance Requirements

- APRM Function 2.a, "Neutron Flux – High (Setdown)"

  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. The notes from SR 3.3.1.1.9 were not carried over to SR 3.3.1.1.10 as they are no longer needed with the new PRNM system.

- APRM Function 2.b, "Simulated Thermal Power – 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). 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). SR 3.3.1.1.7 was removed from the required surveillances for this APRM function, consistent with the approach specified in the NUMAC PRNM LTR. SR 3.3.1.1.7 remains applicable to APRM Functions 2.a, 2.b, and 2.c.

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

  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 channel calibration will include the recirculation flow transmitters that feed the APRMs, which is not specified in the NUMAC PRNM LTR. 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 auto-enable settings will be defined in the COLR, and are discussed further in Enclosure 2, Section 1.5.2.

2.2.3.4 Logic System Functional Test (LSFT) Surveillance Requirements

- The only portion of the PRNM system that is not directly confirmed by other tests is the actual voting logic through and including the voter output relays. Hence, the LSFT SR (SR 3.3.1.1.14) 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 (SR 3.3.1.1.14).

2.2.3.5 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 (SR 3.3.1.1.15).

- A new response time testing requirement for APRM Function 2.e, "2-Out-of-4 Voter," will be added. Note 4 is inserted to SR 3.3.1.1.15 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 Attachment 1 of Enclosure 2, section 8.3.4.4.4.

2.2.4 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 except where noted. Changes related to ARTS / MELLLA are designated where appropriate.

2.2.4.1 Minimum Number of Operable APRM/OPRM Channels

- The required minimum number of operable APRM channels will change from 2 per RPS trip system to three. The applicability is modified by Note (b) described below.

- The required minimum number of operable OPRM channels will change from four channels (specified in current LCO 3.3.1.3) to three channels in new APRM function 2.f, "OPRM Upscale."

- 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).

2.2.4.2 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. APRM Function 2.e also specifies that the Condition referenced from Required Action D.1 is G, the same as the current APRM Inop function.

- New APRM Function 2.f, "OPRM Upscale," proposes that the applicable mode of Operation be "THERMAL POWER greater than or equal to value specified in the COLR." This is a change from 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 Enclosure 2, Section 1.5.2.

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

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

  $\leq 0.63W + 64.0\%$ RTP and $\leq 114.9\%$ 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

2.2.4.3 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 2.2.4.2 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 outside its predefined as-found tolerance, then the channel shall be evaluated to verify that it is functioning as required before returning the channel to service."

- Note (e) – "The instrument channel setpoint shall be reset to a value that is within the as-left tolerance around the Limiting Trip Setpoint (LTSP) at the completion of the surveillance; otherwise, the channel shall be declared inoperable. Setpoints more conservative than the LTSP are acceptable provided that the as-found and as-left tolerances apply to the actual setpoint implemented in the surveillance procedures (Nominal Trip Setpoint) to confirm channel performance. The LTSP and the methodologies used to determine the as-found and as-left tolerances are specified in the Licensee Controlled Specifications." Notes (d) and (e) are applicable to APRM Functions 2.a, 2.b, 2.c and 2.f. These notes are not specified in the NUMAC PRNM LTR. These notes address the annotation of footnotes as described in TSTF-493 (Reference 7) for the functions affected by this proposed change. Energy Northwest is planning for a full implementation of TSTF-493, which will be provided in a separate amendment request. This change is consistent with the proposed inclusion of applicable portions of TSTF-493 in the CGS TS.

- Note (f) – "THERMAL POWER greater than or equal to the 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 Enclosure 2, Section 1.5.2.

2.3 TS 3.3.1.3, Oscillation Power Range Monitor (OPRM) Instrumentation

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:

2.3.1 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, consistent with the NUMAC PRNM LTR, and is relocated 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. Required Actions A.2 and A.3 for LCO 3.3.1.3 are deleted.

- 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 LCO 3.3.1.1 Condition A or Condition C (and associated follow through Condition D) Required Actions and associated Completion Times are not met.

- 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 CGS'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 Enclosure 2, Section 1.5.3.

- 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 Required Action for Condition C of LCO 3.3.1.3 requires a reduction to < 25%

RTP whereas the proposed change Required Action is relocating the specific % RTP value to the COLR. This difference is discussed further in Enclosure 2, Section 1.5.2.

2.3.2 OPRM Surveillance Requirements

Many of the OPRM SRs were relocated to LCO 3.3.1.1 as discussed 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 is redundant with required SR 3.3.1.1.7, which is not changing with this LAR. 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.
- SR 3.3.1.3.5 is relocated to SR 3.3.1.1.17. Specific values of THERMAL POWER and rated core flow are proposed for relocation to the COLR. See section 1.5.2 of Enclosure 2 for further discussion on this SR.

2.4 TS 3.3.2.1, Control Rod Block Instrumentation

2.4.1 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.

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

2.4.2.1 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 8).

2.4.2.2 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 Enclosure 3.

- 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.

- Current notes (b) and (c) would be re-designated (g) and (h), respectively.

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

- New note (d) would be added and states – "If the as-found channel setpoint is outside its predefined as-found tolerance, then the channel shall be evaluated to verify that it is functioning as required before returning the channel to service."

- New note (e) would be added and states – "The instrument channel setpoint shall be reset to a value that is within the as-left tolerance around the Limiting Trip Setpoint (LTSP) at the completion of the surveillance; otherwise, the channel shall be declared inoperable. Setpoints more conservative than the LTSP are acceptable provided that the as-found and as-left tolerances apply to the actual setpoint implemented in the Surveillance procedures (Nominal Trip Setpoint) to confirm channel performance. The LTSP and the methodologies used to determine the as-found and as-left tolerances are specified in the Licensee Controlled Specifications."

- 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.

Notes (d) and (e) 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 annotation of footnotes as described in TSTF-493 for the functions affected by this proposed change (Reference 7). Energy Northwest is planning for a full implementation of TSTF-493, which will be provided in a separate amendment request. This change is consistent with the proposed inclusion of TSTF-493 in the CGS TS.

2.5 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.

2.6 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.

2.7 TS 5.6.3, Core Operating Limits Report (COLR)

2.7.1 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.

2.7.2 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 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.

4.0 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, (TAC No. M90616)," dated September 5, 1995.

4. NRC letter to GE Nuclear Energy, "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 (TAC No. M95746)," dated August 15, 1997.

5. Digital I&C-ISG-06, "Task Working Group #6: Licensing Process Interim Staff Guidance," January 19, 2011 (ADAMS Accession No. ML110140103).

6. NRC letter to Mark E. Reddemman (Energy Northwest) , 'Columbia Generating Station – Issuance of Amendment No. 221, Revise Technical Specification 3.1.7, "Standby Liquid Control (SLC) System," to Support Increase in Boron-10 Enrichment (TAC No ME4789),' May 18, 2011 (ADAMS Accession No. ML111170370)

7. "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).

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

TS Page Markups

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(continued)

1.1 Definitions (continued)

~~MAXIMUM FRACTION OF LIMITING POWER DENSITY (MFLPD)~~	~~The MFLPD shall be the largest value of the fraction of limiting power density (FLPD) in the core. The FLPD shall be the LHGR existing at a given location divided by the specified LHGR limit for that bundle type.~~
MINIMUM CRITICAL POWER RATIO (MCPR)	The MCPR shall be the smallest critical power ratio (CPR) that exists in the core for each class of fuel. The CPR is that power in the assembly that is calculated by application of the appropriate correlation(s) to cause some point in the assembly to experience boiling transition, divided by the actual assembly operating power.
MODE	A MODE shall correspond to any one inclusive combination of mode switch position, average reactor coolant temperature, and reactor vessel head closure bolt tensioning specified in Table 1.1-1 with fuel in the reactor vessel.
OPERABLE – OPERABILITY	A system, subsystem, division, component, or device shall be OPERABLE or have OPERABILITY when it is capable of performing its specified safety function(s) and when all necessary attendant instrumentation, controls, normal or emergency electrical power, cooling and seal water, lubrication, and other auxiliary equipment that are required for the system, subsystem, division, component, or device to perform its specified safety function(s) are also capable of performing their related support function(s).
PHYSICS TESTS	PHYSICS TESTS shall be those tests performed to measure the fundamental nuclear characteristics of the reactor core and related instrumentation. These tests are: a. Described in Chapter 14, Initial Test Program of the FSAR; b. Authorized under the provisions of 10 CFR 50.59; or c. Otherwise approved by the Nuclear Regulatory Commission.

(continued)

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~~3.2 POWER DISTRIBUTION LIMITS~~

~~3.2.4 Average Power Range Monitor (APRM) Gain and Setpoint~~

~~LCO 3.2.4~~

~~a.~~ ~~MFLPD shall be less than or equal to Fraction of RTP (FRTP); or~~

~~b.~~ ~~Each required APRM Flow Biased Simulated Thermal Power — High Function Allowable Value shall be modified by greater than or equal to the ratio of FRTP and the MFLPD; or~~

~~c.~~ ~~Each required APRM gain shall be adjusted such that the APRM readings are ≥ 100% times MFLPD.~~

~~APPLICABILITY:~~ ~~THERMAL POWER ≥ 25% RTP.~~

~~ACTIONS~~

~~CONDITION~~	~~REQUIRED ACTION~~	~~COMPLETION TIME~~
~~A. Requirements of the LCO not met.~~	~~A.1 Satisfy the requirements of the LCO.~~	~~6 hours~~
~~B. Required Action and associated Completion Time not met.~~	~~B.1 Reduce THERMAL POWER to < 25% RTP.~~	~~4 hours~~

Deleted

~~SURVEILLANCE REQUIREMENTS~~

~~SURVEILLANCE~~		~~FREQUENCY~~
~~SR 3.2.4.1~~	~~NOTE~~ ~~Not required to be met if SR 3.2.4.2 is satisfied for LCO 3.2.4.b or LCO 3.2.4.c requirements.~~ ~~Verify MFLPD is within limits~~.	~~Once within 12 hours after ≥ 25% RTP~~ ~~AND~~ ~~24 hours thereafter~~
~~SR 3.2.4.2~~	~~NOTE~~ ~~Not required to be met if SR 3.2.4.1 is satisfied for LCO 3.2.4.a requirements.~~ ~~Verify each required:~~ ~~a.~~ ~~APRM Flow Biased Simulated Thermal Power — High Function Allowable Value is modified by greater than or equal to the ratio of FRTP and the MFLPD; or~~ ~~b.~~ ~~APRM gain is adjusted such that the APRM reading is ≥ 100% times MFLPD.~~	~~12 hours~~

3.3 INSTRUMENTATION

3.3.1.1 Reactor Protection System (RPS) Instrumentation

LCO 3.3.1.1 The RPS instrumentation for each Function in Table 3.3.1.1-1 shall be OPERABLE.

APPLICABILITY: According to Table 3.3.1.1-1.

ACTIONS

-----------------------------------NOTE-----------------------------------
Separate Condition entry is allowed for each channel.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more required channels inoperable. Add note before A.2 & B ---------NOTE-------- Not applicable for Functions 2.a, 2.b, 2.c, 2.d, or 2.f. -------------------------	A.1 Place channel in trip. <u>OR</u> A.2 Place associated trip system in trip.	12 hours 12 hours
B. One or more Functions with one or more required channels inoperable in both trip systems.	B.1 Place channel in one trip system in trip. <u>OR</u> B.2 Place one trip system in trip.	6 hours 6 hours
C. One or more Functions with RPS trip capability not maintained.	C.1 Restore RPS trip capability.	1 hour

(continued)

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
D. Required Action and associated Completion Time of Condition A, B, or C not met.	D.1	Enter the Condition referenced in Table 3.3.1.1-1 for the channel.	Immediately
E. As required by Required Action D.1 and referenced in Table 3.3.1.1-1.	E.1	Reduce THERMAL POWER to < 30% RTP.	4 hours
F. As required by Required Action D.1 and referenced in Table 3.3.1.1-1.	F.1	Be in MODE 2.	6 hours
G. As required by Required Action D.1 and referenced in Table 3.3.1.1-1.	G.1	Be in MODE 3.	12 hours
H. As required by Required Action D.1 and referenced in Table 3.3.1.1-1.	H.1	Initiate action to fully insert all insertable control rods in core cells containing one or more fuel assemblies.	Immediately

Insert A

Insert A

CONDITION	REQUIRED ACTION	COMPLETION TIME
I. As required by Required Action D.1 and referenced in Table 3.3.1.1-1.	I.1 Initiate alternate method to detect and suppress thermal hydraulic instability oscillations.	12 hours
	<u>AND</u>	
	I.2 ------------------ NOTE --------------------- LCO 3.0.4 is not applicable --- Restore required channels to OPERABLE.	120 days
J. Required Action and associated Completion Time of Condition I not met.	J.1 Reduce THERMAL POWER to less than the value specified in the COLR.	4 hours

SURVEILLANCE REQUIREMENTS

------------------------------------NOTES------------------------------------

1. Refer to Table 3.3.1.1-1 to determine which SRs apply for each RPS Function.

2. When a channel is placed in an inoperable status solely for performance of required Surveillances, entry into associated Conditions and Required Actions may be delayed for up to 6 hours provided the associated Function maintains RPS trip capability.

SURVEILLANCE		FREQUENCY
SR 3.3.1.1.1	Perform CHANNEL CHECK.	12 hours
SR 3.3.1.1.2	------------------NOTE------------------ Not required to be performed until 12 hours after THERMAL POWER ≥ 25% RTP. -- Verify the absolute difference between the average power range monitor (APRM) channels and the calculated power ≤ 2% RTP ~~plus any gain adjustment required by LCO 3.2.4, "Average Power Range Monitor (APRM) Gain and Setpoint,"~~ while operating at ≥ 25% RTP.	7 days
SR 3.3.1.1.3	------------------NOTE------------------ Not required to be performed when entering MODE 2 from MODE 1 until 12 hours after entering MODE 2. -- Perform CHANNEL FUNCTIONAL TEST.	7 days
SR 3.3.1.1.4	Perform CHANNEL FUNCTIONAL TEST.	7 days

(continued)

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.3.1.1.5	Verify the source range monitor (SRM) and intermediate range monitor (IRM) channels overlap.	Prior to withdrawing SRMs from the fully inserted position
SR 3.3.1.1.6	-----NOTE----- Only required to be met during entry into MODE 2 from MODE 1. ----- Verify the IRM and APRM channels overlap.	 7 days
SR 3.3.1.1.7	Calibrate the local power range monitors.	1130 MWD/T average core exposure
SR 3.3.1.1.8	Perform CHANNEL FUNCTIONAL TEST.	92 days
SR 3.3.1.1.9	~~NOTES~~ ~~1. Neutron detectors are excluded.~~ ~~2. For Function 2.a, not required to be performed when entering MODE 2 from MODE 1 until 12 hours after entering MODE 2.~~ ~~Perform CHANNEL CALIBRATION~~. Deleted	 ~~184 days~~

(continued)

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.3.1.1.10	-----------------NOTES----------------- 1. Neutron detectors are excluded. 2. For Function 1, not required to be performed when entering MODE 2 from MODE 1 until 12 hours after entering MODE 2. 3. For Functions 2.b and 2.f, the recirculation flow transmitters that feed the APRMs are included. --------------------------------------- Perform CHANNEL CALIBRATION.	18 months for Functions 1, 3, ~~through~~ 4, 6, 7, and 9 through 11 AND 24 months for Functions 2, 5, ~~5~~ and 8
SR 3.3.1.1.11	~~Verify the APRM Flow Biased Simulated Thermal Power - High Function time constant is ≤ 7 seconds.~~ Deleted	~~18 months~~
SR 3.3.1.1.12	Verify Turbine Throttle Valve - Closure, and Turbine Governor Valve Fast Closure Trip Oil Pressure - Low Functions are not bypassed when THERMAL POWER is ≥ 30% RTP.	18 months
SR 3.3.1.1.13	Perform CHANNEL FUNCTIONAL TEST.	24 months
SR 3.3.1.1.14	Perform LOGIC SYSTEM FUNCTIONAL TEST.	24 months

(continued)

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.3.1.1.15	------------------NOTES------------------ 1. Neutron detectors are excluded. 2. Channel sensors for Functions 3 and 4 are excluded. 3. For Function 5, "n" equals 4 channels for the purpose of determining the STAGGERED TEST BASIS Frequency. --------------------------------------- Verify the RPS RESPONSE TIME is within limits.	24 months on a STAGGERED TEST BASIS

Insert B

4. For Function 2.e, "n" equals 8 channels for the purpose of determining the STAGGERED TEST BASIS Frequency. Testing of APRM and OPRM outputs shall alternate.

Insert B

SURVEILLANCE		FREQUENCY
SR 3.3.1.1.16	-------------------------NOTES---------------------------------- 1. For Function 2.a, not required to be performed when entering MODE 2 from MODE 1 until 12 hours after entering MODE 2. 2. For Functions 2.b and 2.f, the CHANNEL FUNCTIONAL TEST includes the recirculation flow input processing, excluding the flow transmitters. -- Perform CHANNEL FUNCTIONAL TEST.	184 days
SR 3.3.1.1.17	Verify the Oscillation Power Range Monitor (OPRM) is not bypassed when APRM Simulated Thermal Power is greater than or equal to the value specified in the COLR and recirculation drive flow is less than the value specified in the COLR.	24 months

Table 3.3.1.1-1 (page 1 of 3)
Reactor Protection System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS PER TRIP SYSTEM	CONDITIONS REFERENCED FROM REQUIRED ACTION D.1	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
1. Intermediate Range Monitors					
a. Neutron Flux – High	2	3	G	SR 3.3.1.1.1 SR 3.3.1.1.3 SR 3.3.1.1.5 SR 3.3.1.1.6 SR 3.3.1.1.10 SR 3.3.1.1.14	≤ 122/125 divisions of full scale
	5$^{(a)}$	3	H	SR 3.3.1.1.1 SR 3.3.1.1.4 SR 3.3.1.1.10 SR 3.3.1.1.14	≤ 122/125 divisions of full scale
b. Inop	2	3	G	SR 3.3.1.1.3 SR 3.3.1.1.14	NA
	5$^{(a)}$	3	H	SR 3.3.1.1.4 SR 3.3.1.1.14	NA
2. Average Power Range Monitors					
a. Neutron Flux – High~~,~~ ~~Setdown~~ (Setdown)	2	~~2~~ 3$^{(b)}$	G	SR 3.3.1.1.1 ~~SR 3.3.1.1.3~~ SR 3.3.1.1.6 SR 3.3.1.1.7 ~~SR 3.3.1.1.9~~ ~~SR 3.3.1.1.14~~ SR 3.3.1.1.10 $^{(d), (e)}$ SR 3.3.1.1.16	≤ 20% RTP
b. ~~Flow Biased~~ Simulated Thermal Power – High	1	~~2~~ 3$^{(b)}$	F	SR 3.3.1.1.1 SR 3.3.1.1.2 SR 3.3.1.1.7 ~~SR 3.3.1.1.8~~ ~~SR 3.3.1.1.9~~ ~~SR 3.3.1.1.11~~ ~~SR 3.3.1.1.14~~ SR 3.3.1.1.10 $^{(d), (e)}$ SR 3.3.1.1.16	≤ 0.63W + 64.0% RTP and ≤ 114.9% RTP $^{(c)}$ ~~≤ 0.58W + 62% RTP and ≤ 114.9% RTP~~
c. ~~Fixed~~ Neutron Flux – High	1	~~2~~ 3$^{(b)}$	F	SR 3.3.1.1.1 SR 3.3.1.1.2 SR 3.3.1.1.7 ~~SR 3.3.1.1.8~~ ~~SR 3.3.1.1.9~~ ~~SR 3.3.1.1.14~~ ~~SR 3.3.1.1.15~~ SR 3.3.1.1.10 $^{(d), (e)}$ SR 3.3.1.1.16	≤ 120% RTP
d. Inop	1,2	~~2~~ 3$^{(b)}$	G	~~SR 3.3.1.1.7~~ ~~SR 3.3.1.1.8~~ ~~SR 3.3.1.1.14~~ SR 3.3.1.1.16	NA
Insert C					
3. Reactor Vessel Steam Dome Pressure – High	1,2	2	G	SR 3.3.1.1.8 SR 3.3.1.1.10 SR 3.3.1.1.14 SR 3.3.1.1.15	≤ 1079 psig

(continued)

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

Insert D

INSERT C

e. 2-Out-of-4 Voter	1,2	2	G	SR 3.3.1.1.1 SR 3.3.1.1.14 SR 3.3.1.1.15 SR 3.3.1.1.16	NA
f. OPRM Upscale	(f)	3(b)	I	SR 3.3.1.1.1 SR 3.3.1.1.7 SR 3.3.1.1.10 (d), (e) SR 3.3.1.1.16 SR 3.3.1.1.17	NA (g)

INSERT D

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

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

(d) If the as-found channel setpoint is outside its predefined as-found tolerance, then the channel shall be evaluated to verify that it is functioning as required before returning the channel to service.

(e) The instrument channel setpoint shall be reset to a value that is within the as-left tolerance around the Limiting Trip Setpoint (LTSP) at the completion of the surveillance; otherwise, the channel shall be declared inoperable. Setpoints more conservative than the LTSP are acceptable provided that the as-found and as-left tolerances apply to the actual setpoint implemented in the surveillance procedures (Nominal Trip Setpoint) to confirm channel performance. The LTSP and the methodologies used to determine the as-found and as-left tolerances are specified in the Licensee Controlled Specifications.

(f) THERMAL POWER greater than or equal to the value specified in the COLR.

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

~~3.3 INSTRUMENTATION~~ Deleted

~~3.3.1.3 Oscillation Power Range Monitor (OPRM) Instrumentation~~

~~LCO 3.3.1.3~~ ~~Four channels of the OPRM instrumentation shall be OPERABLE within the limits as specified in the COLR.~~

~~APPLICABILITY:~~ ~~THERMAL POWER ≥ 25% RTP.~~

~~ACTIONS~~

~~NOTE~~

~~Separate Condition entry is allowed for each channel.~~

~~CONDITION~~	~~REQUIRED ACTION~~	~~COMPLETION TIME~~
~~A. One or more required channels inoperable.~~	~~A.1 Place channel in trip.~~	~~30 days~~
	~~OR~~	
	~~A.2 Place associated RPS trip system in trip.~~	~~30 days~~
	~~OR~~	
	~~A.3 Initiate alternate method to detect and suppress thermal hydraulic instability oscillations.~~	~~30 days~~

~~(continued)~~

Deleted

~~ACTIONS~~

~~CONDITION~~	~~REQUIRED ACTION~~	~~COMPLETION TIME~~
~~B. OPRM trip capability not maintained.~~	~~B.1 Initiate alternate method to detect and suppress thermal hydraulic instability oscillations.~~	~~12 hours~~
~~C. Required Action and associated Completion Time not met.~~	~~C.1 Reduce THERMAL POWER < 25% RTP.~~	~~4 hours~~

~~SURVEILLANCE REQUIREMENTS~~

~~NOTE~~

~~When a channel is placed in an inoperable status solely for performance of required Surveillances, entry into associated Conditions and Required Actions may be delayed for up to 6 hours, provided the OPRM System maintains trip capability.~~

~~SURVEILLANCE~~	~~FREQUENCY~~
~~SR 3.3.1.3.1 Perform CHANNEL FUNCTIONAL TEST.~~	~~184 days~~

~~(continued)~~

Deleted

~~SURVEILLANCE REQUIREMENTS~~

~~SURVEILLANCE~~		~~FREQUENCY~~
~~SR 3.3.1.3.2~~	~~Calibrate the local power range monitors.~~	~~1130 MWD/T average core exposure~~
~~SR 3.3.1.3.3~~	~~NOTE~~ ~~Neutron detectors are excluded.~~ ~~Perform CHANNEL CALIBRATION.~~	~~24 months~~
~~SR 3.3.1.3.4~~	~~Perform LOGIC SYSTEM FUNCTIONAL TEST.~~	~~24 months~~
~~SR 3.3.1.3.5~~	~~Verify OPRM is not bypassed when THERMAL POWER is ≥ 30% RTP and core flow ≤ 60% rated core flow.~~	~~24 months~~
~~SR 3.3.1.3.6~~	~~NOTE~~ ~~Neutron detectors are excluded.~~ ~~Verify the RPS RESPONSE TIME is within limits.~~	~~24 months on a STAGGERED TEST BASIS~~

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
E. One or more Reactor Mode Switch – Shutdown Position channels inoperable.	E.1	Suspend control rod withdrawal.	Immediately
	<u>AND</u>		
	E.2	Initiate action to fully insert all insertable control rods in core cells containing one or more fuel assemblies.	Immediately

SURVEILLANCE REQUIREMENTS

------------------------------------NOTES------------------------------------

1. Refer to Table 3.3.2.1-1 to determine which SRs apply for each Control Rod Block Function.

2. When an RBM channel is placed in an inoperable status solely for performance of required Surveillances, entry into associated Conditions and Required Actions may be delayed for up to 6 hours provided the associated Function maintains control rod block capability.

SURVEILLANCE		FREQUENCY
SR 3.3.2.1.1	Perform CHANNEL FUNCTIONAL TEST.	~~92~~ days $\boxed{184}$

(continued)

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.3.2.1.2	-----NOTE----- Not required to be performed until 1 hour after any control rod is withdrawn at ≤ 10% RTP in MODE 2. ----- Perform CHANNEL FUNCTIONAL TEST.	92 days
SR 3.3.2.1.3	-----NOTE----- Not required to be performed until 1 hour after THERMAL POWER is ≤ 10% RTP in MODE 1. ----- Perform CHANNEL FUNCTIONAL TEST.	92 days
SR 3.3.2.1.4 Insert E	-----NOTE----- Neutron detectors are excluded. ----- Verify the RBM is not bypassed: ~~a. When THERMAL POWER is ≥ 30% RTP; and~~ ~~b. When a peripheral control rod is not selected.~~	24 months ~~92 days~~
SR 3.3.2.1.5	-----NOTE----- Neutron detectors are excluded. ----- Perform CHANNEL CALIBRATION.	24 months ~~92 days~~

(continued)

INSERT E

a. Low Power Range - Upscale Function is not bypassed when APRM Simulated Thermal Power is ≥ 28% and < 63% RTP and a peripheral control rod is not selected.

b. Intermediate Power Range - Upscale Function is not bypassed when APRM Simulated Thermal Power is ≥ 63% and < 83% RTP and a peripheral control rod is not selected.

c. High Power Range - Upscale Function is not bypassed when APRM Simulated Thermal Power is ≥ 83% RTP and a peripheral control rod is not selected.

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

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
1. Rod Block Monitor				
~~a. Upscale~~	~~(a)~~	~~2~~	~~SR 3.3.2.1.1~~ ~~SR 3.3.2.1.4~~ ~~SR 3.3.2.1.5~~	~~≤ 0.58W + 51% RTP~~
Insert F				
d. ~~b.~~ Inop	(a),(b),(c) ~~(a)~~	2	SR 3.3.2.1.1 ~~SR 3.3.2.1.4~~	NA
~~c. Downscale~~	~~(a)~~	~~2~~	~~SR 3.3.2.1.1~~ ~~SR 3.3.2.1.4~~ ~~SR 3.3.2.1.5~~	~~≥ 3% RTP~~
2. Rod Worth Minimizer	1(g) ~~(b)~~, 2(g) ~~(b)~~	1	SR 3.3.2.1.2 SR 3.3.2.1.3 SR 3.3.2.1.6 SR 3.3.2.1.8	NA
3. Reactor Mode Switch — Shutdown Position	~~(c)~~ (h)	2	SR 3.3.2.1.7	NA

Insert G

~~(a) THERMAL POWER ≥ 30% RTP and no peripheral control rod selected.~~

(g) ~~(b)~~ With THERMAL POWER ≤ 10% RTP.

(h) ~~(c)~~ Reactor mode switch in the shutdown position.

INSERT F

a. Low Power Range – Upscale	(a)	2	SR 3.3.2.1.1 SR 3.3.2.1.4 SR 3.3.2.1.5 [(d), (e)]	(f)
b. Intermediate Power Range – Upscale	(b)	2	SR 3.3.2.1.1 SR 3.3.2.1.4 SR 3.3.2.1.5 [(d), (e)]	(f)
c. High Power Range – Upscale	(c)	2	SR 3.3.2.1.1 SR 3.3.2.1.4 SR 3.3.2.1.5 [(d), (e)]	(f)

INSERT G

(a) APRM Simulated Thermal Power is ≥ 28% and < 63% RTP and MCPR is less than the limit specified in the COLR and no peripheral control rod selected.

(b) APRM Simulated Thermal Power is ≥ 63% and < 83% RTP and MCPR is less than the limit specified in the COLR and no peripheral control rod selected.

(c) APRM Simulated Thermal Power is ≥ 83% and MCPR is less than the limit specified in the COLR and no peripheral control rod selected.

(d) If the as-found channel setpoint is outside its predefined as-found tolerance, then the channel shall be evaluated to verify that it is functioning as required before returning the channel to service.

(e) The instrument channel setpoint shall be reset to a value that is within the as-left tolerance around the Limiting Trip Setpoint (LTSP) at the completion of the surveillance; otherwise, the channel shall be declared inoperable. Setpoints more conservative than the LTSP are acceptable provided that the as-found and as-left tolerances apply to the actual setpoint implemented in the surveillance procedures (Nominal Trip Setpoint) to confirm channel performance. The LTSP and the methodologies used to determine the as-found and as-left tolerances are specified in the Licensee Controlled Specifications.

(f) Allowable Value specified in the COLR.

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.1 Recirculation Loops Operating

LCO 3.4.1 Two recirculation loops with matched flows shall be in operation.

OR

One recirculation loop shall be in operation provided that the following limits are applied when the associated LCO is applicable:

a. LCO 3.2.1, "AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR)," single loop operation limits specified in the COLR; ~~and~~

b. LCO 3.2.2, "MINIMUM CRITICAL POWER RATIO (MCPR)," single loop operation limits specified in the COLR~~.~~ ; and

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.

APPLICABILITY: MODES 1 and 2.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Recirculation loop flow mismatch not within limits.	A.1 Declare the recirculation loop with lower flow to be "not in operation."	2 hours
B. Requirements of the LCO not met for reasons other than Condition A.	B.1 Satisfy the requirements of the LCO.	4 hours

(continued)

3.10 SPECIAL OPERATIONS

3.10.8 SHUTDOWN MARGIN (SDM) Test — Refueling

LCO 3.10.8 The reactor mode switch position specified in Table 1.1-1 for MODE 5 may be changed to include the startup/hot standby position, and operation considered not to be in MODE 2, to allow SDM testing, provided the following requirements are met:

a. LCO 3.3.1.1, "Reactor Protection System Instrumentation," MODE 2 requirements for Function 2.a, ~~and~~ 2.d, ~~of~~ Table 3.3.1.1-1; and 2.e

b. 1. LCO 3.3.2.1, "Control Rod Block Instrumentation," MODE 2 requirements for Function 2 of Table 3.3.2.1-1, with banked position withdrawal sequence requirements of SR 3.3.2.1.8 changed to require the control rod sequence to conform to the SDM test sequence,

<u>OR</u>

2. Conformance to the approved control rod sequence for the SDM test is verified by a second licensed operator or other qualified member of the technical staff;

c. Each withdrawn control rod shall be coupled to the associated control rod drive (CRD);

d. All control rod withdrawals during out of sequence control rod moves shall be made in notch out mode;

e. No other CORE ALTERATIONS are in progress; and

f. CRD charging water header pressure ≥ 940 psig.

APPLICABILITY: MODE 5 with the reactor mode switch in startup/hot standby position.

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 3.10.8.1	Perform the MODE 2 applicable SRs for LCO 3.3.1.1, Functions 2.a, ~~and~~ 2.d, and 2.e of Table 3.3.1.1-1.	According to the applicable SRs
SR 3.10.8.2	------------------NOTE------------------- Not required to be met if SR 3.10.8.3 satisfied. --- Perform the MODE 2 applicable SRs for LCO 3.3.2.1, Function 2 of Table 3.3.2.1-1.	According to the applicable SRs
SR 3.10.8.3	------------------NOTE------------------- Not required to be met if SR 3.10.8.2 satisfied. --- Verify movement of control rods is in compliance with the approved control rod sequence for the SDM test by a second licensed operator or other qualified member of the technical staff.	During control rod movement
SR 3.10.8.4	Verify no other CORE ALTERATIONS are in progress.	12 hours

(continued)

5.6 Reporting Requirements (continued)

5.6.3 CORE OPERATING LIMITS REPORT (COLR)

a. Core operating limits shall be established prior to each reload cycle, or prior to any remaining portion of a reload cycle, and shall be documented in the COLR for the following:

1. The APLHGR for Specification 3.2.1;

2. The MCPR for Specification 3.2.2;

3. The LHGR for Specification 3.2.3; ~~and~~

~~4. LCO 3.3.1.3, "Oscillation Power Range Monitor (OPRM) Instrumentation."~~

4. The Oscillation Power Range Monitor (OPRM) Instrumentation for Specification 3.3.1.1; and
5. The Rod Block Monitor Instrumentation for Specification 3.3.2.1.

b. The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC, specifically those described in the following documents:

1. XN-NF-81-58(P)(A), "RODEX2 Fuel Rod Thermal-Mechanical Response Evaluation Model," Exxon Nuclear Company

2. XN-NF-85-67(P)(A), "Generic Mechanical Design for Exxon Nuclear Jet Pump BWR Reload Fuel," Exxon Nuclear Company

3. EMF-85-74(P) Supplement 1(P)(A) and Supplement 2(P)(A), "RODEX2A (BWR) Fuel Rod Thermal-Mechanical Evaluation Model," Siemens Power Corporation

4. ANF-89-98(P)(A), "Generic Mechanical Design Criteria for BWR Fuel Designs," Advanced Nuclear Fuels Corporation

5. XN-NF-80-19(P)(A) Volume 1, "Exxon Nuclear Methodology for Boiling Water Reactors - Neutronic Methods for Design and Analysis," Exxon Nuclear Company

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1.1 Definitions (continued)

MINIMUM CRITICAL POWER RATIO (MCPR)	The MCPR shall be the smallest critical power ratio (CPR) that exists in the core for each class of fuel. The CPR is that power in the assembly that is calculated by application of the appropriate correlation(s) to cause some point in the assembly to experience boiling transition, divided by the actual assembly operating power.
MODE	A MODE shall correspond to any one inclusive combination of mode switch position, average reactor coolant temperature, and reactor vessel head closure bolt tensioning specified in Table 1.1-1 with fuel in the reactor vessel.
OPERABLE – OPERABILITY	A system, subsystem, division, component, or device shall be OPERABLE or have OPERABILITY when it is capable of performing its specified safety function(s) and when all necessary attendant instrumentation, controls, normal or emergency electrical power, cooling and seal water, lubrication, and other auxiliary equipment that are required for the system, subsystem, division, component, or device to perform its specified safety function(s) are also capable of performing their related support function(s).
PHYSICS TESTS	PHYSICS TESTS shall be those tests performed to measure the fundamental nuclear characteristics of the reactor core and related instrumentation. These tests are: a. Described in Chapter 14, Initial Test Program of the FSAR; b. Authorized under the provisions of 10 CFR 50.59; or c. Otherwise approved by the Nuclear Regulatory Commission.

(continued)

3.3 INSTRUMENTATION

3.3.1.1 Reactor Protection System (RPS) Instrumentation

LCO 3.3.1.1 The RPS instrumentation for each Function in Table 3.3.1.1-1 shall be OPERABLE.

APPLICABILITY: According to Table 3.3.1.1-1.

ACTIONS

-----------------------------------NOTE-----------------------------------
Separate Condition entry is allowed for each channel.

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. One or more required channels inoperable.	A.1	Place channel in trip.	12 hours
	<u>OR</u>		
	A.2	--------NOTE-------- Not applicable for Functions 2.a, 2.b, 2.c, 2.d, or 2.f. -------------------	
		Place associated trip system in trip.	12 hours

(continued)

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
B. --------NOTE-------- Not applicable for Functions 2.a, 2.b, 2.c, 2.d, or 2.f. -------------------- One or more Functions with one or more required channels inoperable in both trip systems.	B.1	Place channel in one trip system in trip.	6 hours
	OR		
	B.2	Place one trip system in trip.	6 hours
C. One or more Functions with RPS trip capability not maintained.	C.1	Restore RPS trip capability.	1 hour
D. Required Action and associated Completion Time of Condition A, B, or C not met.	D.1	Enter the Condition referenced in Table 3.3.1.1-1 for the channel.	Immediately
E. As required by Required Action D.1 and referenced in Table 3.3.1.1-1.	E.1	Reduce THERMAL POWER to < 30% RTP.	4 hours
F. As required by Required Action D.1 and referenced in Table 3.3.1.1-1.	F.1	Be in MODE 2.	6 hours

(continued)

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
G. As required by Required Action D.1 and referenced in Table 3.3.1.1-1.	G.1	Be in MODE 3.	12 hours
H. As required by Required Action D.1 and referenced in Table 3.3.1.1-1.	H.1	Initiate action to fully insert all insertable control rods in core cells containing one or more fuel assemblies.	Immediately
I. As required by Required Action D.1 and referenced in Table 3.3.1.1-1.	I.1	Initiate alternate method to detect and suppress thermal hydraulic instability oscillations.	12 hours
	<u>AND</u>		
	I.2	---------NOTE-------- LCO 3.0.4 is not applicable --------------------- Restore required channels to OPERABLE.	120 days
J. Required Action and associated Completion Time of Condition I not met.	J.1	Reduce THERMAL POWER to less than the value specified in the COLR.	4 hours

B. SURVEILLANCE REQUIREMENTS

------------------------------------NOTES------------------------------------

1. Refer to Table 3.3.1.1-1 to determine which SRs apply for each RPS Function.
2. When a channel is placed in an inoperable status solely for performance of required Surveillances, entry into associated Conditions and Required Actions may be delayed for up to 6 hours provided the associated Function maintains RPS trip capability.

SURVEILLANCE		FREQUENCY
SR 3.3.1.1.1	Perform CHANNEL CHECK.	12 hours
SR 3.3.1.1.2	------------------NOTE------------------ Not required to be performed until 12 hours after THERMAL POWER $\geq$ 25% RTP. -- Verify the absolute difference between the average power range monitor (APRM) channels and the calculated power $\leq$ 2% RTP while operating at $\geq$ 25% RTP.	7 days
SR 3.3.1.1.3	------------------NOTE------------------ Not required to be performed when entering MODE 2 from MODE 1 until 12 hours after entering MODE 2. -- Perform CHANNEL FUNCTIONAL TEST.	7 days
SR 3.3.1.1.4	Perform CHANNEL FUNCTIONAL TEST.	7 days

(continued)

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.3.1.1.5	Verify the source range monitor (SRM) and intermediate range monitor (IRM) channels overlap.	Prior to withdrawing SRMs from the fully inserted position
SR 3.3.1.1.6	------------------NOTE------------------ Only required to be met during entry into MODE 2 from MODE 1. -- Verify the IRM and APRM channels overlap.	7 days
SR 3.3.1.1.7	Calibrate the local power range monitors.	1130 MWD/T average core exposure
SR 3.3.1.1.8	Perform CHANNEL FUNCTIONAL TEST.	92 days
SR 3.3.1.1.9	Deleted	

(continued)

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.3.1.1.10	------------------NOTES------------------ 1. Neutron detectors are excluded. 2. For Function 1, not required to be performed when entering MODE 2 from MODE 1 until 12 hours after entering MODE 2. 3. For Functions 2.b and 2.f, the recirculation flow transmitters that feed the APRMs are included. --------------------------------------- Perform CHANNEL CALIBRATION.	18 months for Functions 1, 3, 4, 6, 7, and 9 through 11 <u>AND</u> 24 months for Functions 2, 5, and 8
SR 3.3.1.1.11	Deleted.	
SR 3.3.1.1.12	Verify Turbine Throttle Valve—Closure, and Turbine Governor Valve Fast Closure Trip Oil Pressure—Low Functions are not bypassed when THERMAL POWER is $\geq$ 30% RTP.	18 months
SR 3.3.1.1.13	Perform CHANNEL FUNCTIONAL TEST.	24 months

(continued)

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.3.1.1.14	Perform LOGIC SYSTEM FUNCTIONAL TEST.	24 months
SR 3.3.1.1.15	------------------NOTES------------------ 1. Neutron detectors are excluded. 2. Channel sensors for Functions 3 and 4 are excluded. 3. For Function 5, "n" equals 4 channels for the purpose of determining the STAGGERED TEST BASIS Frequency. 4. For Function 2.e, "n" equals 8 channels for the purpose of determining the STAGGERED TEST BASIS Frequency. Testing of APRM and OPRM outputs shall alternate. --- Verify the RPS RESPONSE TIME is within limits.	24 months on a STAGGERED TEST BASIS
SR 3.3.1.1.16	------------------NOTE------------------ 1. For Function 2.a, not required to be performed when entering MODE 2 from MODE 1 until 12 hours after entering MODE 2. 2. For Functions 2.b and 2.f, the CHANNEL FUNCTIONAL TEST includes the recirculation flow input processing, excluding the flow transmitters. --- Perform CHANNEL FUNCTIONAL TEST.	184 days

(continued)

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.3.1.1.17	Verify the Oscillation Power Range Monitor (OPRM) is not bypassed when APRM Simulated Thermal Power is greater than or equal to the value specified in the COLR and recirculation drive flow is less than the value specified in the COLR.	24 months

Table 3.3.1.1-1 (page 1 of 3)
Reactor Protection System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS PER TRIP SYSTEM	CONDITIONS REFERENCED FROM REQUIRED ACTION D.1	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
1. Intermediate Range Monitors					
a. Neutron Flux – High	2	3	G	SR 3.3.1.1.1 SR 3.3.1.1.3 SR 3.3.1.1.5 SR 3.3.1.1.6 SR 3.3.1.1.10 SR 3.3.1.1.14	≤ 122/125 divisions of full scale
	5(a)	3	H	SR 3.3.1.1.1 SR 3.3.1.1.4 SR 3.3.1.1.10 SR 3.3.1.1.14	≤ 122/125 divisions of full scale
b. Inop	2	3	G	SR 3.3.1.1.3 SR 3.3.1.1.14	NA
	5(a)	3	H	SR 3.3.1.1.4 SR 3.3.1.1.14	NA
2. Average Power Range Monitors					
a. Neutron Flux – High (Setdown)	2	3(b)	G	SR 3.3.1.1.1 SR 3.3.1.1.6 SR 3.3.1.1.7(d),(e) SR 3.3.1.1.10(d),(e) SR 3.3.1.1.16	≤ 20% RTP
b. Simulated Thermal Power – High	1	3(b)	F	SR 3.3.1.1.1 SR 3.3.1.1.2 SR 3.3.1.1.7(d),(e) SR 3.3.1.1.10(d),(e) SR 3.3.1.1.16	≤ 0.63W + 64.0% RTP and ≤ 114.9% RTP(c)

(continued)

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

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

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

(d) If the as-found channel setpoint is outside its predefined as-found tolerance, then the channel shall be evaluated to verify that it is functioning as required before returning the channel to service.

(e) The instrument channel setpoint shall be reset to a value that is within the as-left tolerance around the Limiting Trip Setpoint (LTSP) at the completion of the surveillance; otherwise, the channel shall be declared inoperable. Setpoints more conservative than the LTSP are acceptable provided that the as-found and as-left tolerances apply to the actual setpoint implemented in the surveillance procedures (Nominal Trip Setpoint) to confirm channel performance. The LTSP and the methodologies used to determine the as-found and as-left tolerances are specified in the Licensee Controlled Specifications.

Table 3.3.1.1-1 (page 2 of 3)
Reactor Protection System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS PER TRIP SYSTEM	CONDITIONS REFERENCED FROM REQUIRED ACTION D.1	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
2. Average Power Range Monitors (continued)					
c. Neutron Flux – High	1	3(b)	F	SR 3.3.1.1.1 SR 3.3.1.1.2 SR 3.3.1.1.7(d),(e) SR 3.3.1.1.10(d),(e) SR 3.3.1.1.16	≤ 120% RTP
d. Inop	1,2	3(b)	G	SR 3.3.1.1.16	NA
e. 2-Out-of-4 Voter	1,2	2	G	SR 3.3.1.1.1 SR 3.3.1.1.14 SR 3.3.1.1.15 SR 3.3.1.1.16	NA
f. OPRM Upscale	(f)	3(b)	I	SR 3.3.1.1.1 SR 3.3.1.1.7(d),(e) SR 3.3.1.1.10(d),(e) SR 3.3.1.1.16 SR 3.3.1.1.17	NA(g)
3. Reactor Vessel Steam Dome Pressure – High	1,2	2	G	SR 3.3.1.1.8 SR 3.3.1.1.10 SR 3.3.1.1.14 SR 3.3.1.1.15	≤ 1079 psig
4. Reactor Vessel Water Level – Low, Level 3	1,2	2	G	SR 3.3.1.1.1 SR 3.3.1.1.8 SR 3.3.1.1.10 SR 3.3.1.1.14 SR 3.3.1.1.15	≥ 9.5 inches
5. Main Steam Isolation Valve – Closure	1	8	F	SR 3.3.1.1.8 SR 3.3.1.1.10 SR 3.3.1.1.14 SR 3.3.1.1.15	≤ 12.5% closed

(continued)

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

(d) If the as-found channel setpoint is outside its predefined as-found tolerance, then the channel shall be evaluated to verify that it is functioning as required before returning the channel to service.

(e) The instrument channel setpoint shall be reset to a value that is within the as-left tolerance around the Limiting Trip Setpoint (LTSP) at the completion of the surveillance; otherwise, the channel shall be declared inoperable. Setpoints more conservative than the LTSP are acceptable provided that the as-found and as-left tolerances apply to the actual setpoint implemented in the surveillance procedures (Nominal Trip Setpoint) to confirm channel performance. The LTSP and the methodologies used to determine the as-found and as-left tolerances are specified in the Licensee Controlled Specifications.

(f) THERMAL POWER greater than or equal to the value specified in the COLR.

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

Table 3.3.1.1-1 (page 3 of 3)
Reactor Protection System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS PER TRIP SYSTEM	CONDITIONS REFERENCED FROM REQUIRED ACTION D.1	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
6. Primary Containment Pressure – High	1,2	2	G	SR 3.3.1.1.8 SR 3.3.1.1.10 SR 3.3.1.1.14	≤ 1.88 psig
7. Scram Discharge Volume Water Level – High					
a. Transmitter/Trip Unit	1,2	2	G	SR 3.3.1.1.8 SR 3.3.1.1.10 SR 3.3.1.1.14	≤ 529 ft 9 inches elevation
	5[a]	2	H	SR 3.3.1.1.8 SR 3.3.1.1.10 SR 3.3.1.1.14	≤ 529 ft 9 inches elevation
b. Float Switch	1,2	2	G	SR 3.3.1.1.8 SR 3.3.1.1.10 SR 3.3.1.1.14	≤ 529 ft 9 inches elevation
	5[a]	2	H	SR 3.3.1.1.8 SR 3.3.1.1.10 SR 3.3.1.1.14	≤ 529 ft 9 inches elevation
8. Turbine Throttle Valve – Closure	≥ 30% RTP	4	E	SR 3.3.1.1.8 SR 3.3.1.1.10 SR 3.3.1.1.12 SR 3.3.1.1.14 SR 3.3.1.1.15	≤ 7% closed
9. Turbine Governor Valve Fast Closure, Trip Oil Pressure – Low	≥ 30% RTP	2	E	SR 3.3.1.1.8 SR 3.3.1.1.10 SR 3.3.1.1.12 SR 3.3.1.1.14 SR 3.3.1.1.15	≥ 1000 psig
10. Reactor Mode Switch – Shutdown Position	1,2	2	G	SR 3.3.1.1.13 SR 3.3.1.1.14	NA
	5[a]	2	H	SR 3.3.1.1.13 SR 3.3.1.1.14	NA
11. Manual Scram	1,2	2	G	SR 3.3.1.1.4 SR 3.3.1.1.14	NA
	5[a]	2	H	SR 3.3.1.1.4 SR 3.3.1.1.14	NA

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

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
E. One or more Reactor Mode Switch – Shutdown Position channels inoperable.	E.1 Suspend control rod withdrawal.	Immediately
	AND	
	E.2 Initiate action to fully insert all insertable control rods in core cells containing one or more fuel assemblies.	Immediately

SURVEILLANCE REQUIREMENTS

-----NOTES-----

1. Refer to Table 3.3.2.1-1 to determine which SRs apply for each Control Rod Block Function.

2. When an RBM channel is placed in an inoperable status solely for performance of required Surveillances, entry into associated Conditions and Required Actions may be delayed for up to 6 hours provided the associated Function maintains control rod block capability.

SURVEILLANCE	FREQUENCY
SR 3.3.2.1.1 Perform CHANNEL FUNCTIONAL TEST.	184 days

(continued)

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.3.2.1.2	-----NOTE----- Not required to be performed until 1 hour after any control rod is withdrawn at ≤ 10% RTP in MODE 2. ---------- Perform CHANNEL FUNCTIONAL TEST.	92 days
SR 3.3.2.1.3	-----NOTE----- Not required to be performed until 1 hour after THERMAL POWER is ≤ 10% RTP in MODE 1. ---------- Perform CHANNEL FUNCTIONAL TEST.	92 days
SR 3.3.2.1.4	-----NOTE----- Neutron detectors are excluded. ---------- Verify the RBM is not bypassed: a. Low Power Range - Upscale Function is not bypassed when APRM Simulated Thermal Power is ≥ 28% and < 63% RTP and a peripheral control rod is not selected. b. Intermediate Power Range - Upscale Function is not bypassed when APRM Simulated Thermal Power is ≥ 63% and < 83% RTP and a peripheral control rod is not selected. c. High Power Range - Upscale Function is not bypassed when APRM Simulated Thermal Power is ≥ 83% RTP and a peripheral control rod is not selected.	24 months

(continued)

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.3.2.1.5	-----------------NOTE------------------ Neutron detectors are excluded. --------------------------------------- Perform CHANNEL CALIBRATION.	 24 months
SR 3.3.2.1.6	Verify the RWM is not bypassed when THERMAL POWER is $\leq$ 10% RTP.	24 months
SR 3.3.2.1.7	-----------------NOTE------------------ Not required to be performed until 1 hour after reactor mode switch is in the shutdown position. --------------------------------------- Perform CHANNEL FUNCTIONAL TEST.	 24 months
SR 3.3.2.1.8	Verify control rod sequences input to the RWM are in conformance with BPWS.	Prior to declaring RWM OPERABLE following loading of sequence into RWM

Table 3.3.2.1-1 (page 1 of 2)
Control Rod Block Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
1. Rod Block Monitor				
a. Low Power Range - Upscale	(a)	2	SR 3.3.2.1.1 SR 3.3.2.1.4 SR 3.3.2.1.5[(d),(e)]	(f)
b. Intermediate Power Range - Upscale	(b)	2	SR 3.3.2.1.1 SR 3.3.2.1.4 SR 3.3.2.1.5[(d),(e)]	(f)
c. High Power Range - Upscale	(c)	2	SR 3.3.2.1.1 SR 3.3.2.1.4 SR 3.3.2.1.5[(d),(e)]	(f)
d. Inop	(a),(b),(c)	2	SR 3.3.2.1.1	NA

(continued)

(a) APRM Simulated Thermal Power is $\geq$ 28% and < 63% RTP and MCPR is less than the limit specified in the COLR and no peripheral control rod selected.

(b) APRM Simulated Thermal Power is $\geq$ 63% and < 83% RTP and MCPR is less than the limit specified in the COLR and no peripheral control rod selected.

(c) APRM Simulated Thermal Power is $\geq$ 83% and MCPR is less than the limit specified in COLR and no peripheral control rod selected.

(d) If the as-found channel setpoint is outside its predefined as-found tolerance, then the channel shall be evaluated to verify that it is functioning as required before returning the channel to service.

(e) The instrument channel setpoint shall be reset to a value that is within the as-left tolerance around the Limiting Trip Setpoint (LTSP) at the completion of the surveillance; otherwise, the channel shall be declared inoperable. Setpoints more conservative than the LTSP are acceptable provided that the as-found and as-left tolerances apply to the actual setpoint implemented in the surveillance procedures (Nominal Trip Setpoint) to confirm channel performance. The LTSP and the methodologies used to determine the as-found and as-left tolerances are specified in the Licensee Controlled Specifications.

(f) Allowable Value specified in the COLR.

Table 3.3.2.1-1 (page 2 of 2)
Control Rod Block Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
2. Rod Worth Minimizer	1(g), 2(g)	1	SR 3.3.2.1.2 SR 3.3.2.1.3 SR 3.3.2.1.6 SR 3.3.2.1.8	NA
3. Reactor Mode Switch – Shutdown Position	(h)	2	SR 3.3.2.1.7	NA

(g) With THERMAL POWER $\leq$ 10% RTP.

(h) Reactor mode switch in the shutdown position.

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.1 Recirculation Loops Operating

LCO 3.4.1 Two recirculation loops with matched flows shall be in operation.

<u>OR</u>

One recirculation loop shall be in operation provided that the following limits are applied when the associated LCO is applicable:

a. LCO 3.2.1, "AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR)," single loop operation limits specified in the COLR;

b. LCO 3.2.2, "MINIMUM CRITICAL POWER RATIO (MCPR)," single loop operation limits specified in the COLR; and

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.

APPLICABILITY: MODES 1 and 2.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Recirculation loop flow mismatch not within limits.	A.1 Declare the recirculation loop with lower flow to be "not in operation."	2 hours
B. Requirements of the LCO not met for reasons other than Condition A.	B.1 Satisfy the requirements of the LCO.	4 hours

3.10 SPECIAL OPERATIONS

3.10.8 SHUTDOWN MARGIN (SDM) Test – Refueling

LCO 3.10.8 The reactor mode switch position specified in Table 1.1-1 for MODE 5 may be changed to include the startup/hot standby position, and operation considered not to be in MODE 2, to allow SDM testing, provided the following requirements are met:

a. LCO 3.3.1.1, "Reactor Protection System Instrumentation," MODE 2 requirements for Function 2.a, 2.d, and 2.e of Table 3.3.1.1-1;

b. 1. LCO 3.3.2.1, "Control Rod Block Instrumentation," MODE 2 requirements for Function 2 of Table 3.3.2.1-1, with banked position withdrawal sequence requirements of SR 3.3.2.1.8 changed to require the control rod sequence to conform to the SDM test sequence,

<u>OR</u>

2. Conformance to the approved control rod sequence for the SDM test is verified by a second licensed operator or other qualified member of the technical staff;

c. Each withdrawn control rod shall be coupled to the associated control rod drive (CRD);

d. All control rod withdrawals during out of sequence control rod moves shall be made in notch out mode;

e. No other CORE ALTERATIONS are in progress; and

f. CRD charging water header pressure $\geq$ 940 psig.

APPLICABILITY: MODE 5 with the reactor mode switch in startup/hot standby position.

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.10.8.1	Perform the MODE 2 applicable SRs for LCO 3.3.1.1, Functions 2.a, 2.d, and 2.e of Table 3.3.1.1-1.	According to the applicable SRs
SR 3.10.8.2	------------------NOTE------------------ Not required to be met if SR 3.10.8.3 satisfied. -- Perform the MODE 2 applicable SRs for LCO 3.3.2.1, Function 2 of Table 3.3.2.1-1.	According to the applicable SRs
SR 3.10.8.3	------------------NOTE------------------ Not required to be met if SR 3.10.8.2 satisfied. -- Verify movement of control rods is in compliance with the approved control rod sequence for the SDM test by a second licensed operator or other qualified member of the technical staff.	During control rod movement
SR 3.10.8.4	Verify no other CORE ALTERATIONS are in progress.	12 hours

(continued)

5.6 Reporting Requirements (continued)

5.6.3 CORE OPERATING LIMITS REPORT (COLR)

a. Core operating limits shall be established prior to each reload cycle, or prior to any remaining portion of a reload cycle, and shall be documented in the COLR for the following:

1. The APLHGR for Specification 3.2.1;

2. The MCPR for Specification 3.2.2;

3. The LHGR for Specification 3.2.3;

4. The Oscillation Power Range Monitor (OPRM) Instrumentation for Specification 3.3.1.1; and

5. The Rod Block Monitor Instrumentation for Specification 3.3.2.1.

b. The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC, specifically those described in the following documents:

1. XN-NF-81-58(P)(A), "RODEX2 Fuel Rod Thermal-Mechanical Response Evaluation Model," Exxon Nuclear Company

2. XN-NF-85-67(P)(A), "Generic Mechanical Design for Exxon Nuclear Jet Pump BWR Reload Fuel," Exxon Nuclear Company

3. EMF-85-74(P) Supplement 1(P)(A) and Supplement 2(P)(A), "RODEX2A (BWR) Fuel Rod Thermal-Mechanical Evaluation Model," Siemens Power Corporation

4. ANF-89-98(P)(A), "Generic Mechanical Design Criteria for BWR Fuel Designs," Advanced Nuclear Fuels Corporation

5. XN-NF-80-19(P)(A) Volume 1, "Exxon Nuclear Methodology for Boiling Water Reactors - Neutronic Methods for Design and Analysis," Exxon Nuclear Company

(continued)

TS Bases Page Markups (for information only)

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.7 Standby Liquid Control (SLC) System

BASES

BACKGROUND

The SLC System is designed to provide the capability of bringing the reactor, at any time in a fuel cycle, from full power and minimum control rod inventory (which is at the peak of the xenon transient) to a subcritical condition with the reactor in the most reactive xenon free state without taking credit for control rod movement. The SLC System satisfies the requirements of 10 CFR 50.62 (Ref. 1) on anticipated transient without scram (ATWS).

The SLC System is also used to maintain suppression pool pH at or above 7 following a loss of coolant accident (LOCA) involving significant fission product releases. Maintaining suppression pool pH levels at or above 7 following an accident ensures that iodine will be retained in the suppression pool water (Ref. 4).

The SLC System consists of a boron solution storage tank, two positive displacement pumps, two explosive valves, which are provided in parallel for redundancy, and associated piping and valves used to transfer borated water from the storage tank to the reactor pressure vessel (RPV). The borated solution is discharged through the high pressure core spray system sparger.

APPLICABLE SAFETY ANALYSES

The SLC System is manually initiated from the main control room, as directed by the emergency operating procedures, if the operator believes the reactor cannot be shut down, or kept shut down, with the control rods. The SLC System is used in the event that not enough control rods can be inserted to accomplish shutdown and cooldown in the normal manner. The SLC System injects borated water into the reactor core to compensate for all of the various reactivity effects that could occur during plant operation. To meet this objective, it is necessary to inject, using ~~both~~ one SLC pump~~s~~, a quantity of boron equivalent in Boron-10 to a concentration of 780 ppm of natural boron in the reactor core, including recirculation loops, at 70°F and normal reactor water level.

(continued)

BASES

APPLICABILITY (continued)

single control rod can be withdrawn from a core cell containing fuel assemblies. Demonstration of adequate SDM (LCO 3.1.1, "SHUTDOWN MARGIN (SDM)") ensures that the reactor will not become critical. Therefore, the SLC System is not required to perform its ATWS function during MODES 3, 4, or 5.

In MODES 1, 2, and 3, the SLC System must be OPERABLE to ensure that offsite doses remain within 10 CFR 50.67 (Ref. 5) limits following a LOCA involving significant fission product releases. The SLC System is used to maintain suppression pool pH at or above 7 following a LOCA to ensure that iodine will be retained in the suppression pool water (Ref. 4).

ACTIONS

A.1

If one SLC System subsystem is inoperable, the inoperable subsystem must be restored to OPERABLE status within 7 days. In this condition, the remaining OPERABLE subsystem is adequate to perform the original licensing basis shutdown function. ~~However, the overall capability is reduced since the remaining OPERABLE subsystem cannot meet the requirements of Reference 1~~. The 7 day Completion Time is based on the availability of an OPERABLE subsystem capable of performing the original licensing basis SLC System function and the low probability of a Design Basis Accident (DBA) or severe transient occurring concurrent with the failure of the Control Rod Drive System to shut down the plant.

However, the overall reliability is reduced because a single failure in the remaining OPERABLE subsystem could result in reduced SLC System shutdown capability.

B.1

If both SLC subsystems are inoperable, at least one subsystem must be restored to OPERABLE status within 8 hours. The allowed Completion Time of 8 hours is considered acceptable, given the low probability of a DBA or transient occurring concurrent with the failure of the control rods to shut down the reactor.

(continued)

B 3.2 POWER DISTRIBUTION LIMITS

B 3.2.3 LINEAR HEAT GENERATION RATE (LHGR)

BASES

BACKGROUND

The LHGR is a measure of the heat generation rate of a fuel rod in a fuel assembly at any axial location. Limits on the LHGR are specified to ensure that fuel design limits are not exceeded anywhere in the core during normal operation, including anticipated operational occurrences (AOOs). Exceeding the LHGR limit could potentially result in fuel damage and subsequent release of radioactive materials. Fuel design limits are specified to ensure that fuel system damage, fuel rod failure or inability to cool the fuel does not occur during the anticipated operating conditions identified in References 1 and 2.

APPLICABLE SAFETY ANALYSES

The analytical methods and assumptions used in evaluating the fuel system design are presented in References 3, 4, 5, 6, and 7. The fuel assembly is designed to ensure (in conjunction with the core nuclear and thermal hydraulic design, plant equipment, instrumentation, and protection system) that fuel damage will not result in the release of radioactive materials in excess of the guidelines of 10 CFR, Parts 20, 50, and 50.67. The mechanisms that could cause fuel damage during operational transients and that are considered in fuel evaluations are:

a. Rupture of the fuel rod cladding caused by strain from the relative expansion of the UO_2 pellet; and

b. Severe overheating of the fuel rod cladding caused by inadequate cooling.

A value of 1% plastic strain of the fuel cladding has been defined as the limit below which fuel damage caused by overstraining of the fuel cladding is not expected to occur (Ref. 8).

Fuel design evaluations have been performed and demonstrate that the 1% fuel cladding plastic strain design limit is not exceeded during continuous operation with LHGRs up to the operating limit specified in the COLR. The analysis also includes allowances for short term transient operation above the operating limit to account for AOOs.

INSERT A

(continued)

INSERT A:

LHGR limits are developed as a function of exposure, core flow and power to ensure adherence to fuel design limits during the limiting AOOs (Ref. 10). The exposure dependent LHGR limits are reduced by power-dependent ($LHGRFAC_p$) and core flow-dependent ($LHGRFAC_f$) multipliers for operation below rated power and flow. This will result in a lower LHGR thermal limit at reduced power and flow. A step change in the LHGR limit occurs when scram trips are bypassed for turbine throttle valve closure and turbine governor valve fast closure.

$LHGRFAC_f$ multipliers are determined using the three dimensional BWR simulator code (Ref. 11) to analyze slow flow runout transients. $LHGRFAC_f$, is dependent on the maximum core flow runout capability. $LHGRFAC_p$ multipliers are determined based on analyses of limiting plant transients (other than core flow increases) over a range of power and flow conditions. The transient response is sensitive to initial core flow at power levels below those at which turbine throttle valve closure and turbine governor valve fast closure scram trips are bypassed (P_{bypass}). Both high and low core flow $LHGRFAC_p$ multipliers are provided for operation at power levels between 25% RTP and P_{bypass}. A complete discussion of the analysis code is provided in Reference 12. The exposure, core flow and power dependent LHGR limits ensure that all fuel design limits are met for normal operation and AOOs.

BASES (continued)

SURVEILLANCE REQUIREMENTS

SR 3.2.3.1

The LHGRs are required to be initially calculated within 12 hours after THERMAL POWER is ≥ 25% RTP and then every 24 hours thereafter. They are compared with the specified limits in the COLR to ensure that the reactor is operating within the assumptions of the safety analysis. The 24 hour Frequency is based on both engineering judgment and recognition of the slowness of changes in power distribution under normal conditions. The 12 hour allowance after THERMAL POWER ≥ 25% RTP is achieved is acceptable given the large inherent margin to operating limits at lower power levels.

REFERENCES

1. FSAR, Chapter 4.
2. FSAR, Chapter 15.
3. NEDC-32868P, "GE14 Compliance with Amendment 22 of NEDE-24011-P-A (GESTAR)," Revision 2, September 2007.
4. NEDC-33241P, "GE14 Fuel Rod Thermal-Mechanical Design Report," Revision 1, January 2006.
5. NEDC-33236P, "GE14 Fuel Assembly Mechanical Design Report," November 2005.
6. ANF-89-98(P)(A) Revision 1 and Supplement 1, Generic Mechanical Design Criteria for BWR Fuel Designs," Advanced Nuclear Fuels Corporation, May 1995.
7. EMF-85-74(P) Revision 0 Supplement 1 (P)(A) and Supplement 2 (P)(A), "RODEX2A (BWR) Fuel Rod Thermal-Mechanical Evaluation Model," Siemens Nuclear Power Corporation, February 1998.
8. NUREG-0800, Section II A.2(g), Revision 2, July 1981.
9. 10 CFR 50.36(c)(2)(ii).

INSERT A1

INSERT A1:

10. NEDC-33507P, Revision 1, “Energy Northwest Columbia Generating Station APRM/RBM/Technical Specifications / Maximum Extended Load Line Limit Analysis (ARTS/MELLLA),” January 2012.
11. NEDO-30130-A, "Steady State Nuclear Methods," May 1985.
12. NEDO-24154, "Qualification of the One-Dimensional Core Transient Model for Boiling Water Reactors," October 1978.

~~B 3.2 POWER DISTRIBUTION LIMITS~~

~~B 3.2.4 Average Power Range Monitor (APRM) Gain and Setpoint~~

~~BASES~~

~~BACKGROUND~~

~~The OPERABILITY of the APRMs and their setpoints is an initial condition of all safety analyses that assume rod insertion upon reactor scram. Applicable GDCs are GDC 10, "Reactor Design"; GDC 13, "Instrumentation and Control"; GDC 20, "Protection System Functions"; and GDC 29, "Protection against Anticipated Operation Occurrences" (Ref. 1). This LCO is provided to require the APRM gain or APRM flow biased scram setpoints to be adjusted when operating under conditions of excessive power peaking to maintain acceptable margin to the fuel cladding integrity Safety Limit (SL) and the fuel cladding 1% plastic strain limit.~~

~~The condition of excessive power peaking is determined by the ratio of the actual power peaking to the limiting power peaking at RTP. This ratio is equal to the ratio of the core limiting MFLPD to the Fraction of RTP (FRTP) where FRTP is the measured THERMAL POWER divided by the RTP. Excessive power peaking exists when:~~

$$\cancel{\frac{MFLPD}{FRTP} > 1,}$$

~~indicating that MFPLD is not decreasing proportionately to the overall power reduction, or conversely, that power peaking is increasing. To maintain margins similar to those at RTP conditions, the excessive power peaking is compensated by gain adjustment on the APRMs or adjustment of the APRM Flow Biased Simulated Thermal Power - High Function Allowable Value (LCO 3.3.1.1, "Reactor Protection System (RPS) Instrumentation," Function 2.b). Either of these adjustments has effectively the same result as maintaining MFLPD less than or equal to FRTP and thus maintains RTP margins for APLHGR, MCPR, and LHGR.~~

~~The normally selected APRM Flow Biased Simulated Thermal Power - High Function Allowable Value positions the scram above the upper bound of the normal power/flow operating region that has been considered in the design of the fuel rods. The Allowable Value is flow biased with a slope that approximates the upper flow control line. The normally~~

~~(continued)~~

~~BASES~~

~~BACKGROUND (continued)~~

~~selected APRM Allowable Value is supported by the analyses presented in References 1 and 2 that concentrate on events initiated from rated conditions. Design experience has shown that minimum deviations occur within expected margins to operating limits (APLHGR, MCPR, and LHGR), at rated conditions for normal power distributions. However, at other than rated conditions, control rod patterns can be established that significantly reduce the margin to thermal limits. Therefore, the APRM Flow Biased Simulated Thermal Power—High Function Allowable Value may be reduced during operation when the combination of THERMAL POWER and MFLPD indicates an excessive power peaking distribution.~~

~~The APRM neutron flux signal is also adjusted to more closely follow the fuel cladding heat flux during power transients. The APRM neutron flux signal is a measure of the core thermal power during steady state operation. During power transients, the APRM signal leads the actual core thermal power response because of the fuel thermal time constant. Therefore, on power increase transients, the APRM signal provides a conservatively high measure of core thermal power. By passing the APRM signal through an electronic filter with a time constant less than, but approximately equal to, that of the fuel thermal time constant, an APRM transient response that more closely follows actual fuel cladding heat flux is obtained, while a conservative margin is maintained. The delayed response of the filtered APRM signal allows the APRM Flow Biased Simulated Thermal Power—High Function Allowable Value to be positioned closer to the upper bound of the normal power and flow range, without unnecessarily causing reactor scrams during short duration neutron flux spikes. These spikes can be caused by insignificant transients such as performance of main steam line valve surveillances or momentary flow increases of only several percent.~~

~~APPLICABLE SAFETY ANALYSES~~

~~The acceptance criteria for the APRM gain or setpoint adjustments are that acceptable margins (to APLHGR, MCPR, and LHGR) be maintained to the fuel cladding integrity SL and the fuel cladding 1% plastic strain limit.~~

~~FSAR safety analyses (Ref. 2) concentrate on the rated power condition for which the minimum expected margin to the operating limits (APLHGR, MCPR, and LHGR) occurs. LCO 3.2.1, "AVERAGE PLANAR LINEAR HEAT GENERATION RATE~~

~~(continued)~~

~~BASES~~

~~APPLICABLE SAFETY ANALYSES (continued)~~

~~(APLHGR)," LCO 3.2.2, "MINIMUM CRITICAL POWER RATIO (MCPR)," and LCO 3.2.3, "LINEAR HEAT GENERATION RATE (LHGR) limit the initial margins to these operating limits at rated conditions so that specified acceptable fuel design limits are met during transients initiated from rated conditions. At initial power levels less than rated levels, the margin degradation of either the APLHGR, the MCPR, or the LHGR during a transient can be greater than at the rated condition event. This greater margin degradation during the transient is primarily offset by the larger initial margin to limits at the lower than rated power levels. However, power distributions can be hypothesized that would result in reduced margins to the pre transient operating limit. When combined with the increased severity of certain transients at other than rated conditions, the SLs could be approached. At substantially reduced power levels, highly peaked power distributions could be obtained that could reduce thermal margins to the minimum levels required for transient events. To prevent or mitigate such situations, either the APRM gain is adjusted upward by the ratio of the core limiting MFLPD to the FRTP, or the APRM Flow Biased Simulated Thermal Power—High Function Allowable Value is required to be reduced by the ratio of FRTP to the core limiting MFLPD. Either of these adjustments effectively counters the increased severity of some events at other than rated conditions by proportionally increasing the APRM gain or proportionally lowering the APRM Flow Biased Simulated Thermal Power—High Function Allowable Value dependent on the increased peaking that may be encountered.~~

~~The APRM gain and setpoint satisfy Criteria 2 and 3 of Reference 3.~~

~~LCO~~

~~Meeting any one of the following conditions ensures acceptable operating margins for events described above:~~

~~a.~~ ~~Limiting excess power peaking;~~

~~b.~~ ~~Reducing the APRM Flow Biased Simulated Thermal Power—High Function Allowable Value by multiplying the APRM Flow Biased Simulated Thermal Power—High Function Allowable Value by the ratio of FRTP and the core limiting value of MFLPD; or~~

~~(continued)~~

~~BASES~~

~~LCO (continued)~~

~~c. Increasing the APRM gains to cause the APRM to read greater than 100(%) times MFLPD. This condition is to account for the reduction in margin to the fuel cladding integrity SL and the fuel cladding 1% plastic strain limit.~~

~~MFLPD is the ratio of the limiting LHGR to the LHGR limit for the specific bundle type. For Framatome ANP fuel, MFDLRX is the equivalent of MFLPD. As power is reduced, if the design power distribution is maintained, MFLPD is reduced in proportion to the reduction in power. However, if power peaking increases above the design value, the MFLPD is not reduced in proportion to the reduction in power. Under these conditions, the APRM gain is adjusted upward or the APRM Flow Biased Simulated Thermal Power - High Function Allowable Value is reduced accordingly. When the reactor is operating with peaking less than the design value, it is not necessary to modify the APRM Flow Biased Simulated Thermal Power - High Function Allowable Value. Adjusting the APRM gain or modifying the Flow Biased Simulated Thermal Power - High Function Allowable Value is equivalent to maintaining MFLPD less than or equal to FRTP, as stated in the LCO.~~

~~For compliance with LCO Item b (APRM Flow Biased Simulated Thermal Power - High Function Allowable Value modification) or Item c (APRM gain adjustment), only APRMs required to be OPERABLE per LCO 3.3.1.1, Function 2.b, are required to be modified or adjusted. In addition, each APRM may be allowed to have its gain or Allowable Value adjusted or modified independently of other APRMs that are having their gain or Allowable Value adjusted or modified.~~

~~APPLICABILITY~~

~~The MFLPD limit, APRM gain adjustment, or APRM Flow Biased Simulated Thermal Power - High Function Allowable Value modification is provided to ensure that the fuel cladding integrity SL and the fuel cladding 1% plastic strain limit are not violated during design basis transients. As discussed in the Bases for LCO 3.2.1, LCO 3.2.2, and LCO 3.2.3, sufficient margin to these limits exists below 25% RTP and, therefore, these requirements are only necessary when the plant is operating at ≥ 25% RTP.~~

~~(continued)~~

~~BASES (continued)~~

~~ACTIONS~~

~~A.1~~

~~If the APRM gain or Flow Biased Simulated Thermal Power - High Function Allowable Value is not within limits while the MFLPD has exceeded FRTP, the margin to the fuel cladding integrity SL and the fuel cladding 1% plastic strain limit may be reduced. Therefore, prompt action should be taken to restore the MFLPD to within its required limit or make acceptable APRM adjustments such that the plant is operating within the assumed margin of the safety analyses.~~

~~The 6 hour Completion Time is normally sufficient to restore either the MFLPD to within limits or the APRM gain or Flow Biased Simulated Thermal Power - High Function Allowable Value to within limits and is acceptable based on the low probability of a transient or Design Basis Accident occurring simultaneously with the LCO not met.~~

~~B.1~~

~~If the APRM gain or Flow Biased Simulated Thermal Power - High Function Allowable Value cannot be restored to within their required limits within the associated Completion Time, the plant must be brought to a MODE or other specified condition in which the LCO does not apply. To achieve this status, THERMAL POWER must be reduced to < 25% RTP within 4 hours. The allowed Completion Time is reasonable, based on operating experience, to reduce THERMAL POWER to < 25% RTP in an orderly manner and without challenging plant systems.~~

~~SURVEILLANCE REQUIREMENTS~~

~~SR 3.2.4.1 and SR 3.2.4.2~~

~~The MFLPD is required to be calculated and compared to FRTP or APRM gain or Flow Biased Simulated Thermal Power - High Function Allowable Value to ensure that the reactor is operating within the assumptions of the safety analysis. These SRs are required only to determine the MFLPD and, assuming MFLPD is greater than FRTP, the appropriate APRM gain or Flow Biased Simulated Thermal Power - High Function Allowable Value, and is not intended to be a CHANNEL FUNCTIONAL TEST for the APRM gain or APRM Flow Biased Simulated Thermal Power - High Function circuitry. The 24 hour Frequency of SR 3.2.4.1 is chosen to coincide with~~

~~(continued)~~

~~BASES~~

~~SURVEILLANCE REQUIREMENTS~~

~~SR 3.2.4.1 and SR 3.2.4.2~~ ~~(continued)~~

~~the determination of other thermal limits, specifically those for the APLHGR and LHGR (LCO 3.2.1 and LCO 3.2.3, respectively).~~ ~~The 24 hour Frequency is based on both engineering judgment and recognition of the slowness of changes in power distribution during normal operation.~~ ~~The 12 hour allowance after THERMAL POWER $\geq$ 25% RTP is achieved is acceptable given the large inherent margin to operating limits at low power levels.~~

~~The 12 hour Frequency of SR 3.2.4.2 is required when MFLPD is greater than FRTP, because more rapid changes in power distribution are typically expected.~~

~~REFERENCES~~

1. ~~10 CFR 50, Appendix A, GDC 10, GDC 13, GDC 20, and GDC 29.~~
2. ~~FSAR, Chapters 15 and 15.F.~~
3. ~~10 CFR 50.36(c)(2)(ii).~~

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

1.b. Intermediate Range Monitor – Inop

This trip signal provides assurance that a minimum number of IRMs are OPERABLE. Anytime an IRM mode switch is moved to any position other than "Operate," the detector voltage drops below a preset level, loss of the negative DC voltage, or a module is not plugged in, an inoperative trip signal will be received by the RPS unless the IRM is bypassed. Since only one IRM in each trip system may be bypassed, only one IRM in each RPS trip system may be inoperable without resulting in an RPS trip signal.

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

Six channels of Intermediate Range Monitor – Inop with three channels in each trip system are required to be OPERABLE to ensure that no single instrument failure will preclude a scram from this Function on a valid signal.

Since this Function is not assumed in the safety analysis, there is no Allowable Value for this Function.

This Function is required to be OPERABLE when the Intermediate Range Monitor Neutron Flux – High Function is required.

Insert D

2.a. Average Power Range Monitor Neutron Flux – High/ ~~Setdown~~ (Setdown)

~~The APRM channels receive input signals from the local power range monitors (LPRM) within the reactor core, which provide an indication of the power distribution and local power changes. The APRM channels average these LPRM signals to provide a continuous indication of average reactor power from a few percent to greater than RTP.~~ For operation at low power (i.e., MODE 2), the Average Power Range Monitor Neutron Flux – High, ~~Setdown~~ (Setdown) Function is capable of generating a trip signal that prevents fuel damage resulting from abnormal operating transients in this power range. For most operation at low power levels, the Average Power Range Monitor Neutron Flux – High, ~~Setdown~~ (Setdown) Function will provide a secondary scram to the Intermediate Range Monitor Neutron

(continued)

Insert D

2. Average Power Range Monitor (APRM)

The APRM channels provide the primary indication of neutron flux within the core and respond almost instantaneously to neutron flux increases. The APRM channels receive input signals from the local power range monitors (LPRMs) within the reactor core to provide an indication of the power distribution and local power changes. The APRM channels average these LPRM signals to provide a continuous indication of average reactor power from a few percent to greater than RTP. Each APRM also includes an Oscillation Power Range Monitor (OPRM) Upscale Function which monitors small groups of LPRM signals to detect thermal-hydraulic instabilities.

The APRM System is divided into four APRM channels and four 2-Out-of-4 voter channels. Each APRM channel provides inputs to each of the four voter channels. The four voter channels are divided into two groups of two each; with each group of two providing inputs to one RPS trip system. The system is designed to allow one APRM channel, but no voter channels, to be bypassed. A trip from any one unbypassed APRM will result in a "single vote" in all of the voter channels, but no trip inputs to either RPS trip system. Since APRM trip Functions 2.a, 2.b, 2.c and 2.f are implemented in the same hardware, these trip Functions are combined with APRM Inop trip Function 2.d. Any Function 2.a, 2.b, 2.c or 2.d trip from any two unbypassed APRM channels will result in a full trip in each of the four voter channels, which in turn results in two trip inputs into each RPS trip system logic channel (A1, A2, B1, and B2). Similarly, any Function 2.d or 2.f trip from any two unbypassed APRM channels will result in a full trip from each of the four voter channels. Three of the four APRM channels and all four of the voter channels are required to be OPERABLE to ensure that no single failure will preclude a scram on a valid signal. In addition, to provide adequate coverage of the entire core, consistent with the design bases for the APRM Functions 2.a, 2.b, and 2.c, at least 20 LPRM inputs, with at least three LPRM inputs from each of the four axial levels at which the LPRMs are located, must be operable for each APRM channel. For the OPRM Upscale, Function 2.f, LPRMs are assigned to "cells" of 4 detectors. A minimum of 25 cells, each with a minimum of 2 LPRMs, must be OPERABLE for the OPRM Upscale Function 2.f to be OPERABLE.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY

2.a. Average Power Range Monitor Neutron Flux – High, ~~Setdown~~ (continued)

(Setdown)

(Setdown)

Flux – High Function because of the relative setpoints. With the IRMs at Range 9 or 10, it is possible that the Average Power Range Monitor Neutron Flux – High, ~~Setdown~~ Function will provide the primary trip signal for a core-wide increase in power.

(Setdown)

No specific safety analyses take direct credit for the Average Power Range Monitor Neutron Flux – High, ~~Setdown~~ Function. However, this Function indirectly ensures that, before the reactor mode switch is placed in the run position, reactor power does not exceed 25% RTP (SL 2.1.1.1) when operating at low reactor pressure and low core flow. Therefore, it indirectly prevents fuel damage during significant reactivity increases with THERMAL POWER < 25% RTP.

~~The APRM System is divided into two groups of channels with three APRM channel inputs to each trip system. The system is designed to allow one channel in each trip system to be bypassed. Any one APRM channel in a trip system can cause the associated trip system to trip. Four channels of Average Power Range Monitor Neutron Flux – High, Setdown, with two channels in each trip system are required to be OPERABLE to ensure that no single failure will preclude a scram from this Function on a valid signal. In addition, to provide adequate coverage of the entire core, at least 14 LPRM inputs are required for each APRM channel, with at least two LPRM inputs from each of the four axial levels at which the LPRMs are located.~~

The Allowable Value is based on preventing significant increases in power when THERMAL POWER is < 25% RTP.

(Setdown)

The Average Power Range Monitor Neutron Flux – High, ~~Setdown~~ Function must be OPERABLE during MODE 2 when control rods may be withdrawn. In MODE 1, the Average Power Range Monitor Neutron Flux – High Function provides protection against reactivity transients and the RWM and Rod Block Monitor protect against control rod withdrawal error events.

(continued)

See Section 2, Average Power Range Monitor, for additional information.

The APRM calculates the Simulated Thermal Power (STP) level of the reactor core by applying a single-pole infinite impulse response (IIR) filter with a fixed 6.0 second time constant to the average neutron flux level.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

2.b. Average Power Range Monitor ~~Flow Biased~~ Simulated Thermal Power — High

The Average Power Range Monitor ~~Flow Biased~~ Simulated Thermal Power — High 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 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 Average Power Range Monitor ~~Fixed~~ Neutron Flux — High Function Allowable Value. Insert C ~~The Average Power Range Monitor Flow Biased Simulated Thermal Power - High Function~~ provides protection against transients where THERMAL POWER increases slowly (such as the loss of feedwater heating event) and protects the fuel cladding integrity by ensuring that the MCPR SL is not exceeded. During these events, the THERMAL POWER increase does not significantly lag the neutron flux response and, because of a lower trip setpoint, will initiate a scram before the high neutron flux scram. For rapid neutron flux increase events, the THERMAL POWER lags the neutron flux and the Average Power Range Monitor ~~Fixed~~ Neutron Flux — High Function will provide a scram signal before the Average Power Range Monitor ~~Flow Biased~~ Simulated Thermal Power — High Function setpoint is exceeded.

~~The APRM System is divided into two groups of channels with three APRM inputs to each trip system. The system is designed to allow one channel in each trip system to be bypassed. Any one Average Power Range Monitor channel in a trip system can cause the associated trip system to trip. Four channels of Average Power Range Monitor Flow Biased Simulated Thermal Power - High, with two channels in each trip system arranged in one-out-of-two logic, are required to be OPERABLE to ensure that no single instrument failure will preclude a scram from this Function on a valid signal. In addition, to provide adequate coverage of the entire core, at least 14 LPRM inputs are required for each APRM channel, with at least two LPRM inputs from each of the four axial levels at which the LPRMs are located.~~

(continued)

Insert C:

A note is included, applicable when the plant is in single recirculation loop operation per LCO 3.4.1, which requires a change in the Allowable Value equation. The Allowable Value is established to conservatively bound the inaccuracy created in the core flow/drive flow relationship due to back flow in the jet pumps associated with the inactive recirculation loop. This adjusted Allowable Value thus maintains thermal margins essentially unchanged from those for two-loop operation.

No specific safety analyses take credit for the Average Power Range Monitor Simulated Thermal Power – High Function; however, it

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY

2.b. Average Power Range Monitor ~~Flow Biased~~ Simulated Thermal Power – High (continued)

Each APRM channel ~~receives two independent, redundant flow signals representative of~~ uses one total drive flow signal representative of total ~~recirculation driving~~ core flow. The total drive flow signal is generated by the flow processing logic, part of the APRM channel, by summing up the flow calculated from two flow transmitter signal inputs, one from each of the two recirculation loop flows. The flow processing logic OPERABILITY is part of the APRM channel OPERABILITY requirements for this Function. ~~recirculation driving flow signals are generated by four flow units, two of which supply signals to the trip system A APRMs, while the other two supply signals to the trip system B APRMs. Each flow unit signal is provided by summing the flow signals from the two recirculation loops. These redundant flow signals are sensed from four pairs of elbow taps, two in each recirculation loop. To obtain the most conservative reference signals under single failure conditions, the total flow signals from the two flow units (associated with a trip system as described above) are routed to a low auction circuit associated with each APRM. Each APRM's circuit selects the lower of the two flow unit signals for use as the reference for that particular APRM. Each required Average Power Range Monitor Flow Biased Simulated Thermal Power – High channel only requires an input from one OPERABLE flow unit, since the individual APRM channel will perform the intended function with only one OPERABLE flow unit input. However, in order to maintain single failure criteria as described above for the Function, at least one required Average Power Range Monitor Flow Biased Simulated Thermal Power – High channel in each trip system must be capable of maintaining an OPERABLE flow unit signal in the event of a failure of an auction circuit, or a flow unit, in the associated trip system (e.g., if a flow unit is inoperable, one of the two required Average Power Range Monitor Flow Biased Simulated Thermal Power – High channels in the associated trip system must be considered inoperable).~~

No specific safety analyses take direct credit for the Average Power Range Monitor ~~Flow Biased~~ Simulated Thermal Power – High Function. Originally, the clamped Allowable Value was based on analyses that took credit for the Average Power Range Monitor ~~Flow Biased~~ Simulated Thermal Power – High Function for the mitigation of the loss of feedwater heater event. However, the current methodology for this event is based on a steady state analysis that allows power to increase beyond the clamped Allowable Value. Therefore,

(continued)

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY

2.b. Average Power Range Monitor ~~Flow Biased~~ Simulated Thermal Power – High (continued)

applying a clamp is conservative. The THERMAL POWER time constant ~~of ≤ 7 seconds is based on the fuel heat transfer dynamics and provides a signal that is proportional to the THERMAL POWER.~~

6 seconds is based on the fuel heat transfer dynamics and provides a signal that is proportional to the THERMAL POWER. The THERMAL POWER time constant is stored as a digital value in the firmware of the Average Power Range Monitor System.

The Average Power Range Monitor ~~Flow Biased~~ Simulated Thermal Power – High Function is required to be OPERABLE in MODE 1 when there is the possibility of generating excessive THERMAL POWER and potentially exceeding the SL applicable to high pressure and core flow conditions (MCPR SL). During MODES 2 and 5, other IRM and APRM Functions provide protection for fuel cladding integrity.

See Section 2, Average Power Range Monitor, for additional information.

2.c. Average Power Range Monitor ~~Fixed~~ Neutron Flux – High

~~The APRM channels provide the primary indication of neutron flux within the core and respond almost instantaneously to neutron flux increases.~~ The Average Power Range Monitor ~~Fixed~~ Neutron Flux – High Function is capable of generating a trip signal to prevent fuel damage or excessive Reactor Coolant System (RCS) pressure. For the overpressurization protection analyses of References 2 and 3, the Average Power Range Monitor ~~Fixed~~ Neutron Flux – High Function 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 (Ref. 9) takes credit for the Average Power Range Monitor ~~Fixed~~ Neutron Flux – High Function to terminate the CRDA.

~~The APRM System is divided into two groups of channels with three APRM channels inputting to each trip system. The system is designed to allow one channel in each trip system to be bypassed. Any one APRM channel in a trip system can cause the associated trip system to trip. Four channels of Average Power Range Monitor Fixed Neutron Flux – High with two channels in each trip system arranged in a one-out-of-two logic are required to be OPERABLE to ensure that no single instrument failure will preclude a scram from this Function on a valid signal. In addition, to provide~~

(continued)

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY

2.c. Average Power Range Monitor ~~Fixed~~ Neutron Flux—High (continued)

~~adequate coverage of the entire core, at least 14 LPRM inputs are required for each APRM channel, with at least two LPRM inputs from each of the four axial levels at which the LPRMs are located.~~

The Allowable Value is based on the Analytical Limit assumed in the CRDA analyses.

The Average Power Range Monitor ~~Fixed~~ Neutron Flux—High Function is required to be OPERABLE in MODE 1 where the potential consequences of the analyzed transients could result in the SLs (e.g., MCPR and RCS pressure) being exceeded. The Average Power Range Monitor ~~Fixed~~ Neutron Flux—High Function is assumed in the CRDA analysis (Ref. 9) that is applicable in MODE 2. However, the Average Power Range Monitor Neutron Flux—High~~,~~ ~~Setdown~~ Function conservatively bounds the assumed trip and, together with the assumed IRM trips, provides adequate protection. Therefore, the Average Power Monitor ~~Fixed~~ Neutron Flux—High Function is not required in MODE 2.

(Setdown)

Range

See Section 2, Average Power Range Monitor, for additional information.

2.d. Average Power Range Monitor—Inop

This signal provides assurance that a minimum number of APRMs are OPERABLE. Anytime an APRM mode switch is moved to any ~~position~~ other than "Operate," an APRM module is unplugged, ~~or~~ ~~the APRM has too few LPRM inputs (< 14),~~ an ~~inoperative trip signal will be received by the RPS, unless the APRM is bypassed. Since only one APRM in each trip system may be bypassed, only one APRM in each trip system may be inoperable without resulting in an RPS trip signal.~~ This Function was not specifically credited in the accident analysis, but it is retained for the overall redundancy and diversity of the RPS as required by the NRC approved licensing basis.

the automatic self-test system detects a critical fault with the APRM channel, an Inop trip is sent to all four voter channels. Inop trips from two or more non-bypassed APRM channels result in a trip output from all four voter channels to their associated trip system.

~~Four channels of Average Power Range Monitor—Inop with two channels in each trip system are required to be OPERABLE to ensure that no single failure will preclude a scram from this Function on a valid signal~~.

(continued)

See Section 2, Average Power Range Monitor, for additional information.

BASES

APPLICABLE SAFETY ANALYSIS, LCO, and APPLICABILITY

2.d. Average Power Range Monitor – Inop (continued)

There is no Allowable Value for this Function.

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

Insert E

3. Reactor Vessel Steam Dome Pressure – High

An increase in the RPV pressure during reactor operation compresses the steam voids and results in a positive reactivity insertion. This causes the neutron flux and THERMAL POWER transferred to the reactor coolant to increase, which could challenge the integrity of the fuel cladding and the RCPB. No specific safety analysis takes direct credit for this Function. However, the Reactor Vessel Steam Dome Pressure – High Function initiates a scram for transients that result in a pressure increase, counteracting the pressure increase by rapidly reducing core power. For the overpressurization protection analyses of References 2 and 3, the reactor scram (the analyses conservatively assume scram on the Average Power Range Monitor ~~Fixed~~ Neutron Flux – High signal, not the Reactor Vessel Steam Dome Pressure – High signal), along with the SRVs, limits the peak RPV pressure to less than the ASME Section III Code limits.

High reactor pressure signals are initiated from four pressure switches that sense reactor pressure. The Reactor Vessel Steam Dome Pressure – High Allowable Value is chosen to provide a sufficient margin to the ASME Section III Code limits during the event.

Four channels of Reactor Vessel Steam Dome Pressure – High Function, with two channels in each trip system arranged in a one-out-of-two logic, are required to be OPERABLE to ensure that no single instrument failure will preclude a scram from this Function on a valid signal. The Function is required to be OPERABLE in MODES 1 and 2 since the RCS is pressurized and the potential for pressure increase exists.

(continued)

Insert E

2.e. 2-Out-of-4 Voter

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

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

The 2-Out-of-4 Voter Function votes APRM Functions 2.a, 2.b, and 2.c independently of Function 2.f. The voter also includes separate outputs to RPS for the two independently voted sets of Functions, each of which is redundant (four total outputs). The voter Function 2.e must be declared inoperable if any of its functionality is inoperable.

There is no Allowable Value for this Function.

2.f. Oscillation Power Range Monitor (OPRM) Upscale

The OPRM Upscale Function provides compliance with GDC 10 and GDC 12, thereby providing protection from exceeding the fuel MCPR safety limit (SL) due to anticipated thermal-hydraulic power oscillations.

References 15, 16, and 17 describe three algorithms for detecting thermal-hydraulic instability related neutron flux oscillations: the period based detection algorithm, the amplitude based algorithm, and the growth rate algorithm. All three are implemented in the OPRM Upscale Function, but the safety analysis takes credit only for the period based detection algorithm. The remaining algorithms provide defense in depth and additional protection against unanticipated oscillations. OPRM Upscale Function OPERABILITY for Technical Specification purposes is based only on the period based detection algorithm.

The OPRM Upscale Function receives input signals from the local power range monitors (LPRMs) within the reactor core, which are combined into “cells” for evaluation by the OPRM algorithms. Automatic trip is enabled when THERMAL POWER, as indicated by the APRM Simulated Thermal Power, is greater than or equal to the value specified in the COLR and core flow, as indicated by recirculation drive flow, is less than the value specified in the COLR. Within this operating region actual thermal-hydraulic oscillations may occur.

2.f. Oscillation Power Range Monitor (OPRM) Upscale (continued)

The OPRM Upscale Function is required to be OPERABLE when the power is greater than or equal to the OPRM OPERABLE value specified in the COLR. This is the region of power-flow operation where anticipated events could lead to thermal-hydraulic instability and related neutron flux oscillations. The lower bound, as noted in the COLR, is chosen to provide margin in the unlikely event of loss of feedwater heating while the plant is operating below the automatic OPRM Upscale trip enable point. Loss of feedwater heating is the only identified event that could cause reactor power to increase into the region of concern without operator action.

An OPRM Upscale trip is issued from an APRM channel when the period based detection algorithm in that channel detects oscillatory changes in the neutron flux. This is indicated by the combined signals of the LPRM detectors in a cell, with period confirmations and relative cell amplitude exceeding setpoints specified in the COLR. One or more cells in a channel exceeding the trip conditions will result in a channel trip. An OPRM Upscale trip is also issued from the channel if either the growth rate or amplitude based algorithms detect growing oscillatory changes in the neutron flux for one or more cells in that channel.

Three of the four channels are required to be operable. Each channel is capable of detecting thermal-hydraulic instabilities, by detecting the related neutron flux oscillations, and issuing a trip signal before the MCPR SL is exceeded. There is no allowable value for this function.

The cycle-specific thermal-hydraulic detection algorithms trip settings are nominal settings determined applying the stability analysis licensing methodology (Refs. 15, 16 and 17) developed by the BWR Owners Group and General Electric. There is no Allowable Value for this Function. The settings are not traditional instrumentation setpoints determined under an instrument setpoint methodology. Since the settings may vary cycle-to-cycle, a note indicates the OPRM Upscale Function trip settings, i.e., the period based detection algorithm, are specified in the COLR.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY

5. Main Steam Isolation Valve—Closure (continued)

are completely closed in anticipation of the complete loss of the normal heat sink and subsequent overpressurization transient. However, for the overpressurization protection analyses of References 2 and 3, the Average Power Range Monitor ~~Fixed~~ Neutron Flux—High Function, along with the SRVs, limits the peak RPV pressure to less than the ASME Code limits. That is, the direct scram on position switches for MSIV closure events is not assumed in the overpressurization analysis. Additionally, MSIV closure is assumed in the transients analyzed in Reference 5 (e.g., low steam line pressure, manual closure of MSIVs, high steam line flow). The reactor scram reduces the amount of energy required to be absorbed and, along with the actions of the ECCS, ensures that the fuel peak cladding temperature remains below the limits of 10 CFR 50.46.

MSIV closure signals are initiated from position switches located on each of the eight MSIVs. Each MSIV has two position switches; one inputs to RPS trip system A while the other inputs to RPS trip system B. Thus, each RPS trip system receives an input from eight Main Steam Isolation Valve—Closure channels, each consisting of one position switch. The logic for the Main Steam Isolation Valve—Closure Function is arranged such that either the inboard or outboard valve on three or more of the main steam lines (MSLs) must close in order for a scram to occur. In addition, certain combinations of valves closed in two lines will result in a half-scram.

The Main Steam Isolation Valve—Closure Allowable Value is specified to ensure that a scram occurs prior to a significant reduction in steam flow, thereby reducing the severity of the subsequent pressure transient.

Sixteen channels of the Main Steam Isolation Valve—Closure Function with eight channels in each trip system are required to be OPERABLE to ensure that no single instrument failure will preclude the scram from this Function on a valid signal. This Function is only required in MODE 1 since, with the MSIVs open and the heat generation rate high, a pressurization transient can occur if the MSIVs close. In MODE 2, the heat generation rate is low enough so that the other diverse RPS functions provide sufficient protection.

(continued)

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY

8. Turbine Throttle Valve – Closure (continued)

RPS trip system B. Thus, each RPS trip system receives an input from four Turbine Throttle Valve – Closure channels, each consisting of one valve stem position switch. The logic for the Turbine Throttle Valve – Closure Function is such that three or more TTVs must close to produce a scram. In addition, certain combinations of two valves closed will result in a half-scram.

This Function must be enabled at THERMAL POWER ≥ 30% RTP. This is accomplished automatically by pressure switches sensing turbine first stage pressure; therefore, opening the turbine bypass valves may affect this Function.

The Turbine Throttle Valve – Closure Allowable Value is selected to detect imminent TTV closure thereby reducing the severity of the subsequent pressure transient.

Eight channels of Turbine Throttle Valve – Closure Function, with four channels in each trip system, are required to be OPERABLE to ensure that no single instrument failure will preclude a scram from this Function if any three TTVs should close. This Function is required, consistent with analysis assumptions, whenever THERMAL POWER is ≥ 30% RTP. This Function is not required when THERMAL POWER is < 30% RTP since the Reactor Vessel Steam Dome Pressure – High and the Average Power Range Monitor ~~Fixed~~ Neutron Flux – High Functions are adequate to maintain the necessary safety margins.

9. Turbine Governor Valve Fast Closure, Trip Oil Pressure – Low

Fast closure of the TGVs results in the loss of a heat sink that produces reactor pressure, neutron flux, and heat flux transients that must be limited. Therefore, a reactor scram is initiated on TGV fast closure in anticipation of the transients that would result from the closure of these valves. The Turbine Governor Valve Fast Closure, Trip Oil Pressure – Low Function is the primary scram signal for the generator load rejection event analyzed in Reference 5. For

(continued)

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY

9. Turbine Governor Valve Fast Closure, Trip Oil Pressure – Low (continued)

this event, the reactor scram reduces the amount of energy required to be absorbed and, along with the actions of the EOC-RPT System, ensures that the MCPR SL is not exceeded.

Turbine Governor Valve Fast Closure, Trip Oil Pressure – Low signals are initiated by the digital-electro hydraulic fluid pressure at each governor valve. There is one pressure switch associated with each governor valve, the signal from each switch being assigned to a separate RPS logic channel. This Function must be enabled at THERMAL POWER ≥ 30% RTP. This is normally accomplished automatically by pressure switches sensing turbine first stage pressure; therefore, opening the turbine bypass valves may affect this Function. The basis for the setpoint of this automatic bypass is identical to that described for the Turbine Throttle Valve – Closure Function.

The Turbine Governor Valve Fast Closure, Trip Oil Pressure – Low Allowable Value is selected high enough to detect imminent TGV fast closure.

Four channels of Turbine Governor Valve Fast Closure, Trip Oil Pressure – Low Function, with two channels in each trip system arranged in a one-out-of-two logic, are required to be OPERABLE to ensure that no single instrument failure will preclude a scram from this Function on a valid signal. This Function is required, consistent with the analysis assumptions, whenever THERMAL POWER is ≥ 30% RTP. This Function is not required when THERMAL POWER is < 30% RTP since the Reactor Vessel Steam Dome Pressure – High and the Average Power Range Monitor ~~Fixed~~ Neutron Flux – High Functions are adequate to maintain the necessary safety margins.

10. Reactor Mode Switch – Shutdown Position

The Reactor Mode Switch – Shutdown Position Function provides signals, via the manual scram logic channels, that are redundant to the automatic protective instrumentation channels and provide manual reactor trip capability. This Function was not specifically credited in the accident

(continued)

BASES

APPLICABLE SAFETY ANALYSIS, LCO, and APPLICABILITY

11. Manual Scram (continued)

Four channels of Manual Scram with two channels in each trip system arranged in a one-out-of-two logic, are available and required to be OPERABLE in MODES 1 and 2, and in MODE 5 with any control rod withdrawn from a core cell containing one or more fuel assemblies, since these are the MODES and other specified conditions when control rods are withdrawn.

ACTIONS

A Note has been provided to modify the ACTIONS related to RPS instrumentation channels. Section 1.3, Completion Times, specifies that once a Condition has been entered, subsequent divisions, subsystems, components, or variables expressed in the Condition, discovered to be inoperable or not within limits, will not result in separate entry into the Condition. Section 1.3 also specifies that Required Actions of the Condition continue to apply for each additional failure, with Completion Times based on initial entry into the Condition. However, the Required Actions for inoperable RPS instrumentation channels provide appropriate compensatory measures for separate, inoperable channels. As such, a Note has been provided that allows separate Condition entry for each inoperable RPS instrumentation channel.

and 14

A.1 and A.2

Because of the diversity of sensors available to provide trip signals and the redundancy of the RPS design, an allowable out of service time of 12 hours has been shown to be acceptable (Ref. 11) to permit restoration of any inoperable channel to OPERABLE status. However, this out of service time is only acceptable provided the associated Functions inoperable channel is in one trip system and the Function still maintains RPS trip capability (refer to Required Actions B.1, B.2, and C.1 Bases.) If the inoperable channel cannot be restored to OPERABLE status within the allowable out of service time, the channel or the associated trip system must be placed in the tripped condition per Required Actions A.1 and A.2. Placing the inoperable channel in trip (or the associated trip system in trip) would conservatively compensate for the inoperability, restore capability to accommodate a single failure, and allow operation to continue. Alternately, if it is not

(continued)

BASES

ACTIONS

A.1 and A.2 (continued)

desired to place the channel (or trip system) in trip (e.g., as in the case where placing the inoperable channel in trip would result in a full scram), Condition D must be entered and its Required Action taken.

Insert F

B.1 and B.2

Condition B exists when, for any one or more Functions, at least one required channel is inoperable in each trip system. In this condition, provided at least one channel per trip system is OPERABLE, the RPS still maintains trip capability for that Function, but cannot accommodate a single failure in either trip system.

Required Actions B.1 and B.2 limit the time the RPS scram logic for any Function would not accommodate single failure in both trip systems (e.g., one-out-of-one and one-out-of-one arrangement for a typical four channel Function). The reduced reliability of this logic arrangement was not evaluated in Reference 11 for the 12 hour Completion Time. Within the 6 hour allowance, the associated Function will have all required channels either OPERABLE or in trip (or in any combination) in one trip system.

and 14

Completing one of these Required Actions restores RPS to an equivalent reliability level as that evaluated in Reference 11, which justified a 12 hour allowable out of service time as presented in Condition A. The trip system in the more degraded state should be placed in trip or, alternatively, all the inoperable channels in that trip system should be placed in trip (e.g., a trip system with two inoperable channels could be in a more degraded state than a trip system with four inoperable channels, if the two inoperable channels are in the same Function while the four inoperable channels are all in different Functions). The decision as to which trip system is in the more degraded state should be based on prudent judgment and current plant conditions (i.e., what MODE the plant is in). If this action would result in a scram or recirculation pump trip, it is permissible to place the other trip system or its inoperable channels in trip.

(continued)

Insert F

As noted, Action A.2 is not applicable for APRM Functions 2.a, 2.b, 2.c, 2.d, or 2.f. Inoperability of one required APRM channel affects both trip systems. For that condition, Required Action A.1 must be satisfied, and is the only action (other than restoring OPERABILITY) that will restore capability to accommodate a single failure. Inoperability of more than one required APRM channel of the same trip function results in loss of trip capability and entry into Condition C, as well as entry into Condition A for each channel.

BASES

ACTIONS

B.1 and B.2 (continued)

The 6 hour Completion Time is judged acceptable based on the remaining capability to trip, the diversity of the sensors available to provide the trip signals, the low probability of extensive numbers of inoperabilities affecting all diverse Functions, and the low probability of an event requiring the initiation of a scram.

Alternately, if it is not desired to place the inoperable channels (or one trip system) in trip (e.g., as in the case where placing the inoperable channel or associated trip system in trip would result in a scram or RPT), Condition D must be entered and its Required Action taken.

Insert G →

C.1

Required Action C.1 is intended to ensure that appropriate actions are taken if multiple, inoperable, untripped channels within the same trip system for the same Function result in the Function not maintaining RPS trip capability. A Function is considered to be maintaining RPS trip capability when sufficient channels are OPERABLE or in trip (or the associated trip system is in trip), such that both trip systems will generate a trip signal from the given Function on a valid signal. For the typical Function with one-out-of-two taken twice logic and the IRM and APRM Functions, this would require both trip systems to have one channel OPERABLE or in trip (or the associated trip system in trip). For Function 5 (Main Steam Isolation Valve–Closure), this would require both trip systems to have each channel associated with the MSIVs in three MSLs (not necessarily the same MSLs for both trip systems), OPERABLE or in trip (or the associated trip system in trip).

For Function 8 (Turbine Throttle Valve–Closure), this would require both trip systems to have three channels, each OPERABLE or in trip (or the associated trip system in trip).

The Completion Time is intended to allow the operator time to evaluate and repair any discovered inoperabilities. The 1 hour Completion Time is acceptable because it minimizes risk while allowing time for restoration or tripping of channels.

(continued)

Insert G

As noted, Condition B is not applicable for APRM Functions 2.a, 2.b, 2.c, 2.d, or 2.f. Inoperability of an APRM channel affects both trip systems and is not associated with a specific trip system as are the APRM 2-Out-of-4 Voter and other non-APRM channels for which Condition B applies. For an inoperable APRM channel, Required Action A.1 must be satisfied, and is the only action (other than restoring OPERABILITY) that will restore capability to accommodate a single failure. Inoperability of a Function in more than one required APRM channel results in loss of trip capability for that Function and entry into Condition C, as well as entry into Condition A for each channel. Because Conditions A and C provide Required Actions that are appropriate for the inoperability of APRM Functions 2.a, 2.b, 2.c, 2.d, or 2.f, and these functions are not associated with specific trip systems as are the APRM 2-Out-of-4 Voter and other non-APRM channels, Condition B does not apply.

BASES

ACTIONS (continued)

D.1

Required Action D.1 directs entry into the appropriate Condition referenced in Table 3.3.1.1-1. The applicable Condition specified in the Table is Function and MODE or other specified condition dependent and may change as the Required Action of a previous Condition is completed. Each time an inoperable channel has not met any Required Action of Condition A, B, or C, and the associated Completion Time has expired, Condition D will be entered for that channel and provides for transfer to the appropriate subsequent Condition.

E.1, F.1, ~~and~~ G.1, and J.1

If the channel(s) is not restored to OPERABLE status or placed in trip (or the associated trip system placed in trip) within the allowed Completion Time, the plant must be placed in a MODE or other specified condition in which the LCO does not apply. The Completion Times are reasonable, based on operating experience, to reach the specified condition from full power conditions in an orderly manner and without challenging plant systems. In addition, the Completion ~~Time~~ Times of Required ~~Action E.1 is~~ Actions E.1 and J.1 are consistent with the Completion Time provided in LCO 3.2.2, "MINIMUM CRITICAL POWER RATIO (MCPR)."

H.1

If the channel(s) is not restored to OPERABLE status or placed in trip (or the associated trip system placed in trip) within the allowed Completion Time, the plant must be placed in a MODE or other specified condition in which the LCO does not apply. This is done by immediately initiating action to fully insert all insertable control rods in core cells containing one or more fuel assemblies. Control rods in core cells containing no fuel assemblies do not affect the reactivity of the core and are, therefore, not required to be inserted. Action must continue until all insertable control rods in core cells containing one or more fuel assemblies are fully inserted.

Insert H

(continued)

Insert H

I.1

If OPRM Upscale trip capability is not maintained, Condition I exists. Reference 14 justified use of alternate methods to detect and suppress oscillations for a limited period of time. The alternate methods are procedurally established consistent with the guidelines identified in Reference 18 requiring manual operator action to scram the plant if certain predefined events occur. The 12 hour allowed action time is based on engineering judgment to allow orderly transition to the alternate methods while limiting the period of time during which no automatic or alternate detect and suppress trip capability is formally in place. Based on the small probability of an instability event occurring at all, the 12 hours is judged to be reasonable.

I.2

The alternate method to detect and suppress oscillations implemented in accordance with I.1 was evaluated (Reference 14) based on use up to 120 days only. The evaluation, based on engineering judgment, concluded that the likelihood of an instability event that could not be adequately handled by the alternate methods during this 120 day period was negligibly small. The 120 day period is intended to be an outside limit to allow for the case where design changes or extensive analysis might be required to understand or correct some unanticipated characteristic of the instability detection algorithms or equipment.

A note is provided to indicate that LCO 3.0.4 is not applicable. The intent of that note is to allow plant startup while operating within the 120-day completion time for Action I.2. The primary purpose of this exclusion is to allow an orderly completion of design and verification activities, in the event of a required design change, without undue impact on plant operation.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.3.1.1.1 (continued)

The Frequency is based upon operating experience that demonstrates channel failure is rare. The CHANNEL CHECK supplements less formal, but more frequent, checks of channels during normal operational use of the displays associated with the channels required by the LCO.

SR 3.3.1.1.2

To ensure that the APRMs are accurately indicating the true core average power, the APRMs are calibrated to the reactor power calculated from a heat balance. ~~LCO 3.2.4, "Average Power Range Monitor (APRM) Gain and Setpoint," allows the APRMs to be reading greater than actual THERMAL POWER to compensate for localized power peaking.~~ ~~When this adjustment is made, the requirement for the APRMs to indicate within 2% RTP of calculated power is modified to require the APRMs to indicate within 2% RTP of calculated MFLPD.~~ The Frequency of once per 7 days is based on minor changes in LPRM sensitivity, which could affect the APRM reading between performances of SR 3.3.1.1.7.

A restriction to satisfying this SR when < 25% RTP is provided that requires the SR to be met only at ≥ 25% RTP because it is difficult to accurately maintain APRM indication of core THERMAL POWER consistent with a heat balance when < 25% RTP. At low power levels, a high degree of accuracy is unnecessary because of the large inherent margin to thermal limits (MCPR and APLHGR). At ≥ 25% RTP, the Surveillance is required to have been satisfactorily performed within the last 7 days in accordance with SR 3.0.2. A Note is provided which allows an increase in THERMAL POWER above 25% if the 7 day Frequency is not met per SR 3.0.2. In this event, the SR must be performed within 12 hours after reaching or exceeding 25% RTP. Twelve hours is based on operating experience and in consideration of providing a reasonable time in which to complete the SR.

(continued)

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.1.1.3

A CHANNEL FUNCTIONAL TEST is performed on each required channel to ensure that the entire channel will perform the intended function. Any setpoint adjustment shall be consistent with the assumptions of the current plant specific setpoint methodology.

As noted, SR 3.3.1.1.3 is not required to be performed when entering MODE 2 from MODE 1 since testing of the MODE 2 required IRM ~~and APRM~~ Functions cannot be performed in MODE 1 without utilizing jumpers, lifted leads, or movable links. This allows entry into MODE 2 if the 7 day Frequency is not met per SR 3.0.2. In this event, the SR must be performed within 12 hours after entering MODE 2 from MODE 1. Twelve hours is based on operating experience and in consideration of providing a reasonable time in which to complete the SR.

A Frequency of 7 days provides an acceptable level of system average unavailability over the Frequency interval and is based on reliability analysis (Ref. 11).

SR 3.3.1.1.4

A CHANNEL FUNCTIONAL TEST is performed on each required channel to ensure that the channel will perform the intended Function. A Frequency of 7 days provides an acceptable level of system average availability over the Frequency and is based on the reliability analysis of Reference 11. (The Manual Scram Functions CHANNEL FUNCTIONAL TEST Frequency was credited in the analysis to extend many automatic scram Functions Frequencies.)

SR 3.3.1.1.5 and SR 3.3.1.1.6

These Surveillances are established to ensure that no gaps in neutron flux indication exist from subcritical to power operation for monitoring core reactivity status.

The overlap between SRMs and IRMs is required to be demonstrated to ensure that reactor power will not be increased into a region without adequate neutron flux

(continued)

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.1.1.8 and SR 3.3.1.1.13

A CHANNEL FUNCTIONAL TEST is performed on each required channel to ensure that the channel will perform the intended function. Any setpoint adjustment shall be consistent with the assumptions of the current plant specific setpoint methodology.

~~For Function 2.b, the CHANNEL FUNCTIONAL TEST includes the adjustment of the APRM channel to conform to a calibrated flow signal. This ensures that the total loop drive flow signals from the flow unit used to vary the setpoint are appropriately compared to an injection test flow signal to verify the flow signal trip setpoint and, therefore, the APRM Function accurately reflects the required setpoint as a function of flow. If the flow signal trip setpoint is not within the appropriate limit, the APRMs that receive an input from the inoperable flow unit must be declared inoperable.~~

The 92 day Frequency of SR 3.3.1.1.8 is based on the reliability analysis of Reference 11. The 24 month Frequency of SR 3.3.1.1.13 is based on the need to perform this Surveillance under the conditions that apply during a plant outage and the potential for an unplanned transient if the Surveillance were performed with the reactor at power. Operating experience has shown that these components usually pass the Surveillance when performed at the 24 month Frequency.

SR 3.3.1.1.9 - Not Used.

~~SR 3.3.1.1.9 and~~ SR 3.3.1.1.10

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

For the APRM Simulated Thermal Power - High Function, this SR also includes calibrating the associated recirculation loop flow channel.

Note 1 states that neutron detectors are excluded from CHANNEL CALIBRATION because of the difficulty of simulating a meaningful signal. Changes in neutron detector sensitivity are compensated for by performing the 7 day

(continued)

BASES

SURVEILLANCE REQUIREMENTS

~~SR 3.3.1.1.9 and~~ SR 3.3.1.1.10 (continued)

calorimetric calibration (SR 3.3.1.1.2) and the 1130 MWD/T LPRM calibration against the TIPs (SR 3.3.1.1.7). A second Note is provided that requires the ~~APRM and~~ IRM SRs to be performed within 12 hours of entering MODE 2 from MODE 1. Testing of the MODE 2 ~~APRM and~~ IRM Functions cannot be performed in MODE 1 without utilizing jumpers, lifted leads, or moveable links. This Note allows entry into MODE 2 from MODE 1 if the associated Frequency is not met per SR 3.0.2. Twelve hours is based on operating experience and in consideration of providing a reasonable time in which to complete the SR. ~~The Frequency of SR 3.3.1.1.9 is based upon the assumption of a 184 day calibration interval in the determination of the magnitude of equipment drift in the setpoint analysis.~~ The Frequency of SR 3.3.1.1.10 is based on the assumption of an 18 month calibration interval for Functions 1, 3, 4, ~~1 through 4,~~ 6, 7, and 9 through 11 in the determination of the magnitude of equipment drift in the setpoint analysis.

A Frequency of 24 months is assumed for Functions 2, 5 and 8 because the position switches that perform these Functions are not susceptible to instrument drift.

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

Note (e) requires that the as-left setting for the instrument be returned to within an acceptable as-left tolerance around the LTSP. If the as-left instrument setting cannot be returned to the LTSP, then the instrument channel shall be declared inoperable. The LTSPs are specified in the Licensee Controlled Specifications.

SR 3.3.1.1.11 - Not used.

~~The Average Power Range Monitor Flow Biased Simulated Thermal Power High Function uses an electronic filter circuit to generate a signal proportional to the core THERMAL POWER from the APRM neutron flux signal. This filter circuit is representative of the fuel heat transfer dynamics that produce the relationship between the neutron flux and the core THERMAL POWER. The filter time constant must be verified to ensure that the channel is accurately reflecting the desired parameter.~~

~~The Frequency of 18 months is based on engineering judgment and reliability of the components.~~

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.3.1.1.14 (continued)

Surveillance was performed with the reactor at power. Operating experience has shown that these components usually pass the Surveillance when performed at the 24 month Frequency.

Insert K

SR 3.3.1.1.15

This test may be performed in one measurement or in overlapping segments, with verification that all components are tested.

This SR ensures that the individual channel response times are less than or equal to the maximum values assumed in the accident analysis. The RPS RESPONSE TIME acceptance criteria are included in Reference 12.

As noted (Note 1), neutron detectors for Function 2 are excluded from RPS RESPONSE TIME testing because the principles of detector operation virtually ensure an instantaneous response time. In addition, Note 2 states that channel sensors for Functions 3 and 4 are excluded and therefore, it is not required to quantitatively measure the sensor response time to satisfy the requirement to verify RPS RESPONSE TIME. This is acceptable since the sensor response time can be qualitatively verified by other methods (Ref. 13). If the response time of the sensor is not quantitatively measured, the acceptance criteria must be reduced by the time assumed for sensor response in the design analyses, as verified by statistical analyses or vendor data.

Insert L

RPS RESPONSE TIME tests are conducted on a 24 month STAGGERED TEST BASIS. Note 2 requires STAGGERED TEST BASIS Frequency to be determined based on 4 channels per trip system, in lieu of the 8 channels specified in Table 3.3.1.1-1 for the MSIV Closure Function. This Frequency is based on the logic interrelationships of the various channels required to produce an RPS scram signal. Therefore, staggered testing results in response time verification of these devices every 24 months. The 24 month Frequency is consistent with the typical industry refueling cycle and is based upon plant operating experience, which shows that random failures of instrumentation components causing serious time degradation, but not channel failure, are infrequent.

occurrences

Insert M

(continued)

Insert K

The LOGIC SYSTEM FUNCTIONAL TEST for APRM Function 2.e simulates APRM and OPRM trip conditions at the 2-Out-of-4 Voter channel inputs to check all combinations of two tripped inputs to the 2-Out-of-4 logic in the voter channels and APRM related redundant RPS relays. The initiation of the input to the RPS logic commences in the 2-Out-of-4 Voter as a vote either for the APRM UPSC/Inop or OPRM UPSC/Inop. The APRM modules are not divisional and do not provide a direct input to RPS.

Insert L

RPS RESPONSE TIME for the APRM 2-Out-of-4 Voter function (Function 2.e) includes the output relays of the voter and the associated RPS relays and contactors. (The digital portion of the APRM and 2-Out-of-4 Voter channels are excluded from RPS RESPONSE TIME testing because self-testing and calibration checks the time base of the digital electronics. Confirmation of the time base is adequate to assure required response times are met. Neutron detectors are excluded from RPS RESPONSE TIME testing because the principles of detector operation virtually ensure an instantaneous response time.) The staggered test basis will test both the APRM and the OPRM outputs of the 2-Out-of-4 voter during each iteration of the surveillance. Each iteration will also test both the "X" and "Y" outputs of the voter. Each successive test will alternate the RPS divisions. Each successive test on the specific voter, every 4th test, will test the opposite "X" and "Y" output from the voter. This will accomplish alternating APRM and OPRM and "X" and "Y" outputs of the voter in a specific test while alternating RPS divisions during subsequent tests.

Insert M

SR 3.3.1.1.16

A CHANNEL FUNCTIONAL TEST is performed on each required channel to ensure that the entire channel will perform the intended function. For the APRM Functions, this test supplements the automatic self-test functions that operate continuously in the APRM and voter channels. The APRM CHANNEL FUNCTIONAL TEST covers the APRM channels (including recirculation flow processing – applicable to Functions 2.b and 2.f only), the 2-Out-of-4 Voter channels, and the interface connections into the RPS trip system from the voter channels. Any setpoint adjustment shall be consistent with the assumptions of the current plant specific setpoint methodology. The 184 day Frequency of SR 3.3.1.1.16 is based on the reliability analysis of Reference 14. (NOTE: The actual voting logic of the 2-Out-of-4 Voter Function is tested as part of SR 3.3.1.1.14.)

A Note is provided for Function 2.a that requires this SR to be performed within 12 hours of entering MODE 2 from MODE 1. Testing of the MODE 2 APRM Function cannot be performed in MODE 1 without utilizing jumpers or lifted leads. This Note allows entry into MODE 2 from MODE 1 if the associated frequency is not met per SR 3.0.2.

SR 3.3.1.1.17

This SR ensures that scrams initiated from OPRM Upscale Function (Function 2.f) will not be inadvertently bypassed when APRM Simulated Thermal Power is greater than or equal to the value specified in the COLR and recirculation drive flow is less than the value specified in the COLR. This normally involves confirming the bypass setpoints, which are considered to be nominal values as discussed in Reference 21. The actual surveillance ensures that the OPRM Upscale Function is enabled (not bypassed) for the correct values of APRM Simulated Thermal Power and recirculation drive flow. Other surveillances ensure that the APRM Simulated Thermal Power and recirculation flow properly correlate with THERMAL POWER (SR 3.3.1.1.2) and core flow (SR 3.3.1.1.10), respectively.

If any bypass setpoint is non-conservative (i.e., the OPRM Upscale Function is bypassed when APRM Simulated Thermal Power is greater than or equal to and recirculation drive flow is less than the values in the COLR), then the affected channel is considered inoperable for the OPRM Upscale Function. Alternatively, the bypass setpoint may be adjusted to place the channel in a conservative condition (non-bypass). If placed in the non-bypass condition, this SR is met and the channel is considered OPERABLE.

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

BASES (continued)

REFERENCES

1. FSAR, Section 7.2.

2. FSAR, Section 5.2.2.

3. Columbia Generating Station Calculation NE-02-94-66, Revision 0, November 13, 1995.

4. FSAR, Section 6.3.3.

5. FSAR, Chapter 15.

6. 10 CFR 50.36(c)(2)(ii).

7. FSAR, Section 15.4.1.

8. NEDO-23842, "Continuous Control Rod Withdrawal in the Startup Range," April 18, 1978.

9. FSAR, Section 15.4.9.

10. Letter, P. Check (NRC) to G. Lainas (NRC), "BWR Scram Discharge System Safety Evaluation," December 1, 1980.

11. NEDO-30851-P-A, "Technical Specification Improvement Analyses for BWR Reactor Protection System," March 1988.

12. Licensee Controlled Specifications Manual.

13. NEDO 32291-A, "System Analyses for Elimination of Selected Response Time Testing Requirements, October 1995.

Insert C1

Insert C1:

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

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

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

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

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

19. 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.

BASES

APPLICABLE SAFETY ANALYSES (continued)

System (RPS) Instrumentation," Intermediate Range Monitor (IRM) Neutron Flux High and Average Power Range Monitor (Setdown) (APRM) Neutron Flux – High, ~~Setdown~~ Functions; and LCO 3.3.2.1, "Control Rod Block Instrumentation."

The SRMs have no safety function and are not assumed to function during any design basis accident or transient analysis. However, the SRMs provide the only on scale monitoring of neutron flux levels during startup and refueling. Therefore, they are being retained in the Technical Specifications.

LCO

During startup in MODE 2, three of the four SRM channels are required to be OPERABLE to monitor the reactor flux level prior to and during control rod withdrawal, to monitor subcritical multiplication and reactor criticality, and to monitor neutron flux level and reactor period until the flux level is sufficient to maintain the IRMs on Range 3 or above. All channels but one are required in order to provide a representation of the overall core response during those periods when reactivity changes are occurring throughout the core.

In MODES 3 and 4, with the reactor shut down, two SRM channels provide redundant monitoring of flux levels in the core.

In MODE 5, during a spiral offload or reload, an SRM outside the fueled region is not required to be OPERABLE, since it is not capable of monitoring neutron flux in the fueled region of the core. Thus, CORE ALTERATIONS are allowed in a quadrant with no OPERABLE SRM in an adjacent quadrant, provided the Table 3.3.1.2-1, footnote (b), requirement that the bundles being spiral reloaded or spiral offloaded are all in a single fueled region containing at least one OPERABLE SRM is met. Spiral reloading and offloading encompass reloading or offloading a cell on the edges of a continuous fueled region (the cell can be reloaded or offloaded in any sequence).

In nonspiral routine operations, two SRMs are required to be OPERABLE to provide redundant monitoring of reactivity changes occurring in the reactor core. Because of the local nature of reactivity changes during refueling, adequate coverage is provided by requiring one SRM to be OPERABLE in

(continued)

B 3.3 ~~INSTRUMENTATION~~ Deleted

~~B 3.3.1.3 Oscillation Power Range Monitor (OPRM)~~

~~BASES~~

~~BACKGROUND~~

~~General Design Criterion 10 (GDC 10) requires the reactor core and associated coolant, control, and protection systems to be designed with appropriate margin to assure that acceptable fuel design limits are not exceeded during any condition of normal operation, including the affects of anticipated operational occurrences. Additionally, GDC 12 requires the reactor core and associated coolant, control, and protection systems to be designed to assure that power oscillations which can result in conditions exceeding acceptable fuel design limits are either not possible or can be reliably and readily detected and suppressed. The OPRM System provides compliance with GDC 10 and GDC 12, thereby providing protection from exceeding the fuel MCPR safety limit.~~

~~References 1, 2, and 3 describe three separate algorithms for detecting stability related oscillations: the period based detection algorithm, the amplitude based algorithm, and the growth rate algorithm. The OPRM System hardware implements these algorithms in microprocessor based modules. These modules execute the algorithms based on LPRM inputs and generate alarms and trips based on these calculations. These trips result in tripping the Reactor Protection System (RPS) when the appropriate RPS trip logic is satisfied, as described in the Bases for LCO 3.3.1.1, "RPS Instrumentation." Only the period based detection algorithm is used in the safety analysis. The remaining algorithms provide defense in depth and additional protection against unanticipated oscillations.~~

~~The period based detection algorithm detects a stability related oscillation based on the occurrence of a fixed number of consecutive LPRM signal period confirmations followed by the LPRM signal amplitude exceeding a specified setpoint. Upon detection of a stability related oscillation, a trip is generated for that OPRM channel.~~

~~(continued)~~

~~BASES~~

~~BACKGROUND (continued)~~

~~The OPRM System consits of 4 OPRM trip channels, each channel consisting of two OPRM modules. Each OPRM module receives input from LPRMs. Each OPRM module also receives input from the Neutron Monitoring System (NMS) average power range monitor (APRM) power and flow signals to automatically enable the trip function of the OPRM module.~~

~~Each OPRM module is continuously tested by a self-test function. On detection of any OPRM module failure, either a trouble alarm or INOP alarm is activated. The OPRM module provides an INOP alarm when the self-test feature indicates that the OPRM module may not be capable of meeting its functional requirements.~~

~~APPLICABLE SAFETY ANALYSES~~

~~It has been shown that BWR cores may exhibit thermal-hydraulic reactor instabilities in high power and low flow portions of the core power to flow operating domain. GDC 10 requires the reactor core and associated coolant, control, and protection systems to be designed with appropriate margin to assure that acceptable fuel design limits are not exceeded during any condition of normal operation, including the affects of anticipated operational occurrences. GDC 12 requires assurance that power oscillations which can result in conditions exceeding acceptable fuel design limits are either not possible or can be reliably and readily detected and suppressed. The OPRM System provides compliance with GDC 10 and GDC 12 by detecting the onset of oscillations and suppressing them by initiating a reactor scram. This assures that the MCPR safety limit will not be violated for anticipated oscillations.~~

~~The OPRM Instrumentation satisfies Criteria 3 of the NRC Policy Statement.~~

~~LCO~~

~~Four channels of the OPRM System are required to be OPERABLE to ensure that stability related oscillations are detected and suppressed prior to exceeding the MCPR safety limit. Only one of the two OPRM modules' period based detection algorithm is required for OPRM channel OPERABILITY. The minimum number of LPRMs required OPERABLE to maintain an OPRM channel OPERABLE is consistent with the minimum number of LPRMs required to maintain the APRM system OPERABLE per~~

~~(continued)~~

~~BASES~~

~~LCO (continued)~~	~~LCO 3.3.1.1. The Allowable Value for the OPRM Period Based Algorithm setpoint (Sp) is derived from Analytic Limit corrected for the instrument and calibration errors.~~
~~APPLICABILITY~~	~~The OPRM instrumentation is required to be OPERABLE in order to detect and suppress neutron flux oscillations in the event of thermal-hydraulic instability. As described in References 1, 2, and 3, the power/core flow region protected against anticipated oscillations is defined by THERMAL POWER ≥ 30% RTP and core flow ≤ 60% rated core flow. The OPRM trip is required to be enabled in this region and the OPRM must be capable of enabling the trip function as a result of anticipated transients. Therefore, the OPRM is required to be OPERABLE with THERMAL POWER ≥ 25% RTP. It is not necessary for the OPRM to be OPERABLE with THERMAL POWER < 25% RTP because transients from below this THERMAL POWER are not anticipated to result in power that exceeds 30% RTP.~~
~~ACTIONS~~	~~A Note has been provided to modify the ACTIONS related to the OPRM instrumentation channels. Section 1.3, Completion Times, specifies that once a Condition has been entered, subsequent divisions, subsystems, components, or variables expressed in the Condition discovered to be inoperable or not within limits will not result in separate entry into the Condition. Section 1.3 also specifies that Required Actions of the Condition continue to apply for each additional failure, with Completion Times base on initial entry into the Condition. However, the Required Actions for inoperable OPRM instrumentation channels provide appropriate compensatory measures for separate inoperable channels. As such, a Note has been provided that allows separate Condition entry for each inoperable OPRM instrumentation channel.~~ ~~A.1, A.2, and A.3~~ ~~Because of the reliability and on-line self-testing of the OPRM instrumentation and the redundancy of the RPS design, an allowable out of service time of 30 days has been shown to be acceptable (Reference 7) to permit restoration of any inoperable channel to OPERABLE status. However, this out of~~

~~(continued)~~

~~BASES~~

~~ACTIONS~~

~~A.1, A.2, and A.3 (continued)~~

~~service time is only acceptable provided the OPRM Instrumentation still maintains OPRM trip capability (refer to Required Actions B.1 and B.2). The remaining OPERABLE OPRM channels continue to provide trip capability (see Condition B) and provide operator information relative to stability activity. The remaining OPRM modules have high reliability. With this high reliability, there is a low probability of a subsequent channel failure within the allowable out of service time. In addition, the OPRM modules continue to perform on-line self-testing and alert the operator if any further system degradation occurs.~~

~~If the inoperable channel cannot be restored to OPERABLE status within the allowable out of service time, the OPRM channel or associated RPS trip system must be place in the tripped condition per Required Actions A.1 and A.2. Placing the inoperable OPRM channel in trip (or the associated RPS trip system in trip) would conservatively compensate for the inoperability, restore capability to accommodate a single failure, and allow operation to continue. Alternately, if it is not desired to place the OPRM channel (or RPS trip system) in trip (e.g., as in the case where placing the inoperable channel in trip would result in a full scram), the alternate method of detecting and suppressing thermal hydraulic instability oscillations is required (Required Action A.3). This alternate method is described in Reference 5. It consists of increased operator awareness and monitoring for neutron flux oscillations when operating in the region where oscillations are possible. If indications of oscillation, as described in Reference 5, are observed by the operator, the operator will take the actions described by procedures, which include initiating a manual scram of the reactor.~~

~~B.1~~

~~Required Action B.1 is intended to ensure that appropriate actions are taken if multiple, inoperable, untripped OPRM channels within the same RPS trip system result in not maintaining OPRM trip capability. OPRM trip capability is considered to be maintained when sufficient OPRM channels are OPERABLE or in trip (or the associated RPS trip system is in trip), such that a valid OPRM signal will generate a~~

~~(continued)~~

~~BASES~~

~~ACTIONS~~

~~B.1 (continued)~~

~~trip signal in both RPS trip systems. This would require both RPS trip systems to have one OPRM channel OPERABLE or in trip (or the associated RPS trip system in trip).~~

~~Because of the low probability of the occurrence of an instability, 12 hours is an acceptable time to initiate the alternate method of detecting and suppressing thermal hydraulic instability oscillations described in Action A.3 above. The alternate method of detecting and suppressing thermal hydraulic instability oscillations would adequately address detection and mitigation in the event of instability oscillations. Based on industry operating experience with actual instability oscillation, the operator would be able to recognize instabilities during this time and take action to suppress them through a manual scram. In addition, the OPRM System may still be available to provide alarms to the operator if the onset of oscillations were to occur. Since plant operation is minimized in areas where oscillations may occur, operation without OPRM trip capability is considered acceptable with implementation of the alternate method of detecting and suppressing thermal hydraulic instability oscillations during the period when corrective actions are underway to resolve the inoperability that led to entry into Condition B. One reason this Condition may be used is to provide time to implement a software upgrade in the plant if a common cause software problem is identified.~~

~~C.1~~

~~With any Required Action and associated Completion Time not met, THERMAL POWER must be reduced to $<$ 25% RTP within 4 hours. Reducing THERMAL POWER to $<$ 25% RTP places the plant in a region where instabilities cannot occur. The 4 hours is reasonable, based on operating experience, to reduce THERMAL POWER $<$ 25% RTP from full power conditions in an orderly manner and without challenging plant systems.~~

~~(continued)~~

~~BASES (continued)~~

~~SURVEILLANCE REQUIREMENTS~~

~~SR 3.3.1.3.1~~

~~A CHANNEL FUNCTIONAL TEST is performed on each required channel to ensure that the entire channel will perform the intended function. A Frequency of 184 days provides an acceptable level of system average availability over the Frequency and is based on the reliability of the channel (Reference 7).~~

~~SR 3.3.1.3.2~~

~~LPRM gain settings are determined from the local flux profiles measured by the Traversing Incore Probe (TIP) System. This establishes the relative local flux profile for appropriate representative input to the OPRM System. The 1130 MWD/T Frequency is based on operating experience with LPRM sensitivity changes.~~

~~SR 3.3.1.3.3~~

~~The CHANNEL CALIBRATION is a complete check of the instrument loop. This test verifies the channel responds to the measured parameter within the necessary range and accuracy. CHANNEL CALIBRATION leaves the channel adjusted to account for instrument drifts between successive calibrations, consistent with the plant specific setpoint methodology. Calibration of the channel provides a check of the internal reference voltage and the internal processor clock frequency. It also compares the desired trip setpoints with those in processor memory. Since the OPRM is a digital system, the internal reference voltage and processor clock frequency are, in turn, used to automatically calibrate the internal analog to digital converters. The Allowable Values are specified in the (COLR). As noted, neutron detectors are excluded from CHANNEL CALIBRATION because they are passive devices, with minimal drift, and because of the difficulty of simulating a meaningful signal. Changes in neutron detector sensitivity are compensated for by performing the 1130 MWD/T LPRM calibration using the TIPs (SR 3.3.1.3.2).~~

~~The Frequency of 24 months is based upon the assumption of the magnitude of equipment drift provided by the equipment supplier (Reference 7).~~

~~(continued)~~

~~BASES~~

~~SURVEILLANCE REQUIREMENTS (continued)~~

~~SR 3.3.1.3.4~~

~~The LOGIC SYSTEM FUNCTIONAL TEST demonstrates the OPERABILITY of the required trip logic for a specific channel. The functional testing of control rods, in LCO 3.1.3, "Control Rod Operability," and in LCO 3.1.8, "Scram Discharge Volume (SDV) Vent and Drain Valves," overlaps this Surveillance to provide complete testing of the assumed safety function. The OPRM self-test function may be utilized to perform this testing for those components that it is designed to monitor.~~

~~The 24 month Frequency is based on engineering judgment and reliability of the components and Operating experience.~~

~~SR 3.3.1.3.5~~

~~This SR ensures that trips initiated from the OPRM System will not be inadvertently bypassed when THERMAL POWER is ≥ 30% RTP and core flow is ≤ 60% rated core flow. This normally involves calibration of the bypass channels. Adequate margins for the instrument setpoint methodology are incorporated into the actual setpoints (Reference 7).~~

~~If any bypass channel setpoint is nonconservative (i.e., the OPRM module is bypassed at ≥ 30% RTP and core flow ≤ 60% rated core flow),then the affected OPRM module is considered inoperable. Alternatively, the bypass channel can be placed in the conservative condition (Manual Enable). If placed in the Manual Enable condition, this SR is met and the module is considered OPERABLE.~~

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

~~SR 3.3.1.3.6~~

~~This SR ensures that the individual channel response times are less than or equal to the maximum values assumed in the accident analysis (Reference 6). The OPRM self-test function may be utilized to perform this testing for those components it is designed to monitor. The LPRM amplifier~~

~~(continued)~~

~~BASES~~

~~SURVEILLANCE REQUIREMENTS~~

~~SR 3.3.1.3.6 (continued)~~

~~cards inputting to the OPRM are excluded from the OPRM response time testing. The RPS RESPONSE TIME acceptance criteria are included in Reference 8.~~

~~As noted, neutron detectors are excluded from RPS RESPONSE TIME testing because the principles of detector operation virtually ensure an instantaneous response time. RPS RESPONSE TIME tests are conducted on a 24 month STAGGERED TEST BASIS. This Frequency is based upon operating experience, which shows that random failures of instrumentation components causing serious time degradation, but not channel failure, are infrequent.~~

~~REFERENCES~~

1. ~~NEDO-31960-A, "BWR Owners Group Long-Term Stability Solutions Licensing Methodology," November 1995 (Sus) June 1991.~~

2. ~~NEDO 31960-A, Supplement 1" BWR Owners Group Long-Term Stability Solutions Licensing Methodology," November 1995 (Sus) March 1992.~~

3. ~~NRC Letter, A. Thadani to L.A. England, "Acceptance for Referencing of Topical Reports NEDO-31960, Supplement 1, 'BWR Owners Group Long-Term Stability Solutions Licensing Methodology,'" July 12, 1994.~~

4. ~~Generic Letter 94-02, "Long-Term Solutions and Upgrade of Interim Operating Recommendations for Thermal-Hydraulic Instabilities in Boiling Water Reactors," July 11, 1994.~~

5. ~~BWROG Letter BWROG-94079, "Guidelines for Stability Interim Corrective Action," June 6, 1994.~~

6. ~~NEDO 32465-A, "BWR Owners' Group Reactor Stability Detect and Suppress Solution Licensing Basis Methodology and Reload Application," August 1996 & May 1995.~~

7. ~~CENPD-400-P, Rev 01, "Generic Topical Report for the ABB Option III Oscillation Power Range Monitor (OPRM)," May 1995.~~

8. ~~Licensee Controlled Specification Table 1.3.1.1-1~~

B 3.3 INSTRUMENTATION

B 3.3.2.1 Control Rod Block Instrumentation

BASES

BACKGROUND

Control rods provide the primary means for control of reactivity changes. Control rod block instrumentation includes channel sensors, logic circuitry, switches, and relays that are designed to ensure that specified fuel design limits are not exceeded for postulated transients and accidents. During high power operation, the rod block monitor (RBM) provides protection for control rod withdrawal error events. During low power operations, control rod blocks from the rod worth minimizer (RWM) enforce specific control rod sequences designed to mitigate the consequences of the control rod drop accident (CRDA). During shutdown conditions, control rod blocks from the Reactor Mode Switch — Shutdown Position Function ensure that all control rods remain inserted to prevent inadvertent criticalities.

setpoint or an RBM inop condition exists.

Insert I:

The purpose of the RBM is to limit control rod withdrawal if localized neutron flux exceeds a predetermined setpoint during control rod manipulations (Ref. 1). It is assumed to function to block further control rod withdrawal to preclude a MCPR Safety Limit (SL) violation. The RBM supplies a trip signal to the Reactor Manual Control System (RMCS) to appropriately inhibit control rod withdrawal during power operation above the low power range setpoint. The RBM has two channels, either of which can initiate a control rod block when the channel output exceeds the control rod block ~~setpoint.~~ One RBM channel inputs into one RMCS rod block circuit and the other RBM channel inputs into the second RMCS rod block circuit. ~~The RBM channel signal is generated by averaging a set of local power range monitor (LPRM) signals. One RBM channel averages the signals from LPRM detectors at the A and C positions in the assigned LPRM assemblies, while the other RBM channel averages the signals from LPRM detectors at the B and D positions. Alignment of LPRM assemblies to be used in RBM averaging is controlled by the selection of control rods. The RBM is automatically bypassed and the output set to zero if a peripheral rod is selected or the APRM used to normalize the RBM reading is ≤ 30% RTP. If any LPRM detector assigned to an RBM is bypassed, the computed average signal is automatically adjusted to compensate for the number of LPRM input signals. The minimum number of LPRM inputs required for each RBM~~

(continued)

INSERT I:

The RBM channel signal is generated by averaging a set of local power range monitor (LPRM) signals at various core heights surrounding the control rod being withdrawn. Each RBM uses all available C level LPRM inputs and half of the available B and D level LPRM inputs for the rod selected. RBM channel A uses the opposite B and D level LPRM inputs from RBM channel B. A simulated thermal power signal from one of the four redundant average power range monitor (APRM) channels supplies a reference signal for one of the RBM channels and a simulated thermal power signal from another of the APRM channels supplies the reference signal to the second RBM channel. This reference signal is used to determine which RBM range setpoint (low, intermediate, or high) is enabled. If the APRM simulated thermal power is indicating less than the low power range setpoint, the RBM is automatically bypassed. The RBM is also automatically bypassed if a peripheral control rod is selected (Ref. 1). When a control rod is selected the initial RBM LPRM averaged value is set and held constant until another rod is selected. Each subsequent RBM LPRM averaged value is normalized to the initial RBM LPRM averaged value (RBM flux). The RBM flux, in percent, is used to provide indication and actuation of automatic functions based on the change in the relative local power level.

BASES

BACKGROUND (continued)

~~channel to prevent an instrument inoperative alarm is four when using four LPRM assemblies, three when using three LPRM assemblies, and two when using two LPRM assemblies. Each RBM also receives a recirculation loop flow signal from the APRM flow converters.~~

~~When a control rod is selected, the gain of each RBM channel output is normalized to an assigned APRM channel. The assigned APRM channel is on the same RPS trip system as the RBM channel. The gain setting is held constant during the movement of that particular control rod to provide an indication of the change in the relative local power level. If the indicated power increases above the preset limit, a rod block will occur. In addition, to preclude rod movement with an inoperable RBM, a downscale trip and an inoperable trip are provided.~~

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

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

(continued)

BASES (continued)

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY

1. Rod Block Monitor

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

Insert I.1

Insert I.2

The RBM Function satisfies Criterion 3 of Reference 4.

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

~~Nominal trip setpoints are specified in the setpoint calculations. The nominal setpoints are selected to ensure that the setpoints do not exceed the Allowable Values between successive CHANNEL CALIBRATIONS. Operation with a trip setpoint less conservative than the nominal trip setpoint, but within its Allowable Value, is acceptable~~. ~~Trip setpoints are those predetermined values of output at which an action should take place. The setpoints are compared to the actual process parameter (e.g., reactor power), and when the measured output value of the process parameter exceeds the setpoint, the associated device (e.g., trip unit) changes state. The analytic limits are derived from the limiting values of the process parameters obtained from the safety analysis. The Allowable Values are derived from the analytic limits, corrected for process and all instrument uncertainties, except drift and calibration. The trip setpoints are derived from the analytic limits, corrected for process and all instrument uncertainties, including drift and calibration. The trip setpoints derived in this manner provide adequate protection because all instrumentation uncertainties and process effects are taken into account.~~

Insert I.3

(continued)

INSERT I.1:

The Allowable Values and nominal trip setpoints are established in the COLR because they are confirmed or modified on a cycle-specific basis to support the operating limits established in the COLR.

INSERT I.2:

The Rod Block Monitor Low, Intermediate and High Power Range – Upscale functions (Functions 1.a, 1.b, and 1.c, respectively) are Limiting Safety System Settings (LSSS) as they protect the MCPR SL during a postulated Rod Withdrawal Error (RWE) event.

INSERT I.3:

The Analytical Limits are derived from the limiting values determined from the safety analysis. The Allowable Values are derived from the Analytical Limits correcting for all process and instrument uncertainties, excluding drift and calibration, using the setpoint methodology specified in the Licensee Controlled Specifications. The Limiting Trip Setpoints (LTSPs) are derived from the Analytical Limits in the same way as the Allowable Values except the LTSPs include drift and calibration uncertainties. The LTSPs thus ensure the setpoints don't exceed the Allowable Values between successive CHANNEL CALIBRATIONS. Operation with a trip setpoint less conservative than the LTSP but within its Allowable Value, is acceptable. For the RBM system there is no drift characteristic since it only performs digital calculations on the digitized input signals from the APRMs. Therefore the LTSP is the LSSS. The RBM also undergoes a normalization process after each rod selection. Therefore the only instrument signal variation that is considered in the setpoint methodology which determines the LTSP for the RBM is the actual process changes that take place between rod selection and rod movement. The RBM is assumed to mitigate the consequences of an RWE event when operating ≥ 28% RTP. Below this power level, the consequences of an RWE event will not exceed the MCPR SL and, therefore, the RBM is not required to be OPERABLE (Ref. 3). When operating with the MCPR greater than or equal to the RBM MCPR Limits specified in the COLR, analyses have shown that no RWE event will result in exceeding the MCPR SL. Therefore, under these conditions, the RBM is also not required to be OPERABLE.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY

~~1. Rod Block Monitor~~ ~~(continued)~~

~~The RBM is assumed to mitigate the consequences of an RWE event when operating ≥ 30% RTP and a peripheral control rod is not selected.~~ ~~Below this power level, or if a peripheral control rod is selected, the consequences of an RWE event will not exceed the MCPR SL and, therefore, the RBM is not required to be OPERABLE (Ref. 3)~~.

2. Rod Worth Minimizer

The RWM enforces the banked position withdrawal sequence (BPWS) to ensure that the initial conditions of the CRDA analysis are not violated. The analytical methods and assumptions used in evaluating the CRDA are summarized in Reference 5. The BPWS requires that control rods be moved in groups, with all control rods assigned to a specific group required to be within specified banked positions. Requirements that the control rod sequence is in compliance with the BPWS are specified in LCO 3.1.6, "Rod Pattern Control."

The RWM Function satisfies Criterion 3 of Reference 4.

Since the RWM is a system designed to act as a backup to operator control of the rod sequences, only one channel of the RWM is available and required to be OPERABLE (Ref. 6). Special circumstances provided for in the Required Action of LCO 3.1.3, "Control Rod OPERABILITY," and LCO 3.1.6 may necessitate bypassing the RWM to allow continued operation with inoperable control rods, or to allow correction of a control rod pattern not in compliance with the BPWS. The RWM may be bypassed as required by these conditions, but then it must be considered inoperable and the Required Actions of this LCO followed.

Compliance with the BPWS, and therefore OPERABILITY of the RWM, is required in MODES 1 and 2 when THERMAL POWER is ≤ 10% RTP. When THERMAL POWER is > 10% RTP, there is no possible control rod configuration that results in a control rod worth that could exceed the 280 cal/gm fuel damage limit during a CRDA (Ref. 5). In MODES 3 and 4, all control rods are required to be inserted into the core; therefore, a CRDA cannot occur. In MODE 5, since only a single control rod

(continued)

BASES

ACTIONS

E.1 and E.2 (continued)

subcritical with adequate SDM ensured by LCO 3.1.1. Control rods in core cells containing no fuel assemblies do not affect the reactivity of the core and are therefore not required to be inserted. Action must continue until all insertable control rods in core cells containing one or more fuel assemblies are fully inserted.

SURVEILLANCE REQUIREMENTS

As noted at the beginning of the SRs, the SRs for each Control Rod Block instrumentation Function are found in the SRs column of Table 3.3.2.1-1.

The Surveillances are modified by a second Note to indicate that when an RBM channel is placed in an inoperable status solely for performance of required Surveillances, entry into associated Conditions and Required Actions may be delayed for up to 6 hours provided the associated Function maintains control rod block capability. Upon completion of the Surveillance, or expiration of the 6 hour allowance, the channel must be returned to OPERABLE status or the applicable Condition entered and Required Actions taken. This Note is based on the reliability analysis (Ref. 7) assumption of the average time required to perform channel Surveillance. That analysis demonstrated that the 6 hour testing allowance does not significantly reduce the probability that a control rod block will be initiated when necessary.

SR 3.3.2.1.1

A CHANNEL FUNCTIONAL TEST is performed for each RBM channel to ensure that the channel will perform the intended function. It includes the Reactor Manual Control Multiplexing System input.

Any setpoint adjustment shall be consistent with the assumptions of the current plant specific setpoint methodology. The Frequency of ~~92~~ 184 days is based on reliability analyses (Ref. ~~8~~ 9).

(continued)

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.2.1.2 and SR 3.3.2.1.3

A CHANNEL FUNCTIONAL TEST is performed for the RWM to ensure that the entire system will perform the intended function. The CHANNEL FUNCTIONAL TEST for the RWM is performed by attempting to withdraw a control rod not in compliance with the prescribed sequence and verifying a control rod block occurs and, for SR 3.3.2.1.2 only, by attempting to select a control rod not in compliance with the prescribed sequence and verifying a selection error occurs. As noted in the SRs, SR 3.3.2.1.2 is not required to be performed until 1 hour after any control rod is withdrawn at ≤ 10% RTP in MODE 2, and SR 3.3.2.1.3 is not required to be performed until 1 hour after THERMAL POWER is ≤ 10% RTP in MODE 1. This allows entry into MODE 2 (and if entering during a shutdown, concurrent power reduction to ≤ 10% RTP) for SR 3.3.2.1.2, and THERMAL POWER reduction to ≤ 10% RTP in MODE 1 for SR 3.3.2.1.3, to perform the required Surveillances if the 92 day Frequency is not met per SR 3.0.2. The 1 hour allowance is based on operating experience and in consideration of providing a reasonable time in which to complete the SRs. The 92 day Frequencies are based on reliability analysis (Ref. 8).

SR 3.3.2.1.4

Insert 1.4

~~The RBM is automatically bypassed when power is below a specified value or if a peripheral control rod is selected. The power level is determined from the APRM signals input to each RBM channel. The automatic bypass setpoint must be verified periodically to be < 30% RTP. In addition, it must also be verified that the RBM is not bypassed when a control rod that is not a peripheral control rod is selected (only one non-peripheral control rod is required to be verified). If any bypass setpoint is nonconservative, then the affected RBM channel is considered inoperable. Alternatively, the APRM channel can be placed in the conservative condition (non-bypass). If placed in this condition, the SR is met and the RBM channel is not considered inoperable. As noted, neutron detectors are excluded from the Surveillance because~~

(continued)

INSERT I.4:

The RBM setpoints are automatically varied as a function of power. The RBM Allowable Values required in Table 3.3.2.1-1, each within a specific power range, are specified in the COLR. The power at which the control rod block Allowable Values automatically change are based on the APRM simulated thermal power input to each RBM channel. Below the minimum power setpoint, the RBM is automatically bypassed. These control rod block bypass setpoints must be verified periodically to be less than or equal to the specified values. If any power range setpoint is nonconservative, then the affected RBM channel is considered inoperable. Alternatively, the power range channel can be placed in the conservative condition (i.e., enabling the proper RBM setpoint). If placed in this condition, the SR is met and the RBM channel is not considered inoperable. As noted, neutron detectors are excluded from the Surveillance because they are passive devices, with minimal drift, and because of the difficulty of simulating a meaningful signal. Neutron detectors are adequately tested in SR 3.3.1.1.2 and SR 3.3.1.1.7. The 24 month Frequency is based on the actual trip setpoint methodology utilized for these channels.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.3.2.1.4 (continued)

~~they are passive devices, with minimal drift, and because of the difficulty of simulating a meaningful signal. Neutron detectors are adequately tested in SR 3.3.1.1.2 and SR 3.3.1.1.7. The 92 day Frequency is based on the actual trip setpoint methodology utilized for these channels.~~

SR 3.3.2.1.5

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

As noted, neutron detectors are excluded from the CHANNEL CALIBRATION because they are passive devices, with minimal drift, and because of the difficulty of simulating a meaningful signal. Neutron detectors are adequately tested in SR 3.3.1.1.2 and SR 3.3.1.1.7.

24 month

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

Insert I.5

(Ref. 9)

SR 3.3.2.1.6

The RWM is automatically bypassed when power is above a specified value. The power level is determined from a steam flow signal. The automatic bypass setpoint must be verified periodically to be > 10% RTP. If the RWM low power setpoint is nonconservative, then the RWM is considered inoperable. Alternately, the low power setpoint channel can be placed in the conservative condition (nonbypass). If placed in the nonbypassed condition, the SR is met and the RWM is not considered inoperable. The Frequency is based on instrument drift analysis and the trip setpoint methodology utilized for the low power setpoint channel.

(continued)

INSERT I.5:

SR 3.3.2.1.5 for RBM Functions 1.a, 1.b and 1.c is modified by two Notes as identified in Table 3.3.2.1-1. Note (d) requires evaluation of channel performance for the condition where the as-found setting for the channel setpoint is not the Limiting Trip Setpoint (LTSP) but is conservative with respect to the Allowable Value. For digital channel components, no as-found tolerance or as-left tolerance can be specified. Evaluation of instrument performance will verify that the instrument will continue to behave in accordance with design basis assumptions. The purpose of the assessment is to ensure confidence in the instrument performance prior to returning the instrument to service. Any nonconformance will be entered into the Corrective Action Program which will ensure required review and documentation of the condition for continued OPERABILITY.

Note (e) requires that the as-left setting for the instrument be returned to within an acceptable as-left tolerance around the LTSP. If the as-left instrument setting cannot be returned to the LTSP, then the instrument channel shall be declared inoperable. The Allowable Values for Rod Block Monitor Functions 1.a, 1.b and 1.c are specified in the COLR. The LTSPs are specified in the Licensee Controlled Specifications.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.2.1.7

A CHANNEL FUNCTIONAL TEST is performed for the Reactor Mode Switch – Shutdown Position Function to ensure that the entire channel will perform the intended function. The CHANNEL FUNCTIONAL TEST for the Reactor Mode Switch – Shutdown Position Function is performed by attempting to withdraw any control rod with the reactor mode switch in the shutdown position and verifying a control rod block occurs.

As noted in the SR, the Surveillance is not required to be performed until 1 hour after the reactor mode switch is in the shutdown position, since testing of this interlock with the reactor mode switch in any other position cannot be performed without using jumpers, lifted leads, or movable links. This allows entry into MODES 3 and 4 if the 24 month Frequency is not met per SR 3.0.2. The 1 hour allowance is based on operating experience and in consideration of providing a reasonable time in which to complete the SRs.

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

SR 3.3.2.1.8

The RWM will only enforce the proper control rod sequence if the rod sequence is properly input into the RWM computer. This SR ensures that the proper sequence is loaded into the RWM so that it can perform its intended function. The Surveillance is performed once prior to declaring RWM OPERABLE following loading of sequence into RWM, since this is when rod sequence input errors are possible.

REFERENCES

1. FSAR, Section 7.7.1.8.

2. FSAR, Section 7.7.1.10.

3. ~~FSAR, Sections 15.4.1 and 15.4.2~~.

NEDC-33507P, Revision 1, “Energy Northwest Columbia Generating Station APRM/RBM/Technical Specifications / Maximum Extended Load Line Limit Analysis (ARTS/MELLLA),” January 2012.

BASES

REFERENCES (continued)

4. 10 CFR 50.36(c)(2)(ii).

5. FSAR, Section 15.4.9.

6. NRC SER, "Acceptance of Referencing of Licensing Topical Report NEDE-24011-P-A," "General Electric Standard Application for Reactor Fuel, Revision 8, Amendment 17," December 27, 1987.

7. GENE-770-06-1-A, "Addendum to Bases for Changes to Surveillance Test Intervals and Allowed Out-of-Service Times for Selected Instrumentation Technical Specifications," December 1992.

8. NEDC-30851-P-A, "Technical Specification Improvement Analysis for BWR Control Rod Block Instrumentation," October 1988.

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

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY

Turbine Throttle Valve – Closure (continued)

Closure of the TTVs is determined by measuring the position of each throttle valve. While there are two separate position switches associated with each throttle valve, only the signal from one switch for each TTV is used, with each of the four channels being assigned to a separate trip channel. The logic for the TTV – Closure Function is such that two or more TTVs must be closed to produce an EOC-RPT. This Function must be enabled at THERMAL POWER ≥ 30% RTP. This is normally accomplished automatically by pressure switches sensing turbine first stage pressure; therefore, opening of the turbine bypass valves may affect this Function. Four channels of TTV – Closure, with two channels in each trip system, are available and required to be OPERABLE to ensure that no single instrument failure will preclude an EOC-RPT from this Function on a valid signal. The TTV – Closure Allowable Value is selected to detect imminent TTV closure.

This protection is required, consistent with the safety analysis assumptions, whenever THERMAL POWER is ≥ 30% RTP. Below 30% RTP, the Reactor Vessel Steam Dome Pressure – High and the Average Power Range Monitor (APRM) ~~Fixed~~ Neutron Flux – High Functions of the Reactor Protection System (RPS) are adequate to maintain the necessary safety margins.

TGV Fast Closure, Trip Oil Pressure – Low

Fast closure of the TGVs during a generator load rejection results in the loss of a heat sink that produces reactor pressure, neutron flux, and heat flux transients that must be limited. Therefore, an RPT is initiated on TGV Fast Closure, Trip Oil Pressure – Low in anticipation of the transients that would result from the closure of these valves. The EOC-RPT decreases reactor power and aids the reactor scram in ensuring that the MCPR SL is not exceeded during the worst case transient.

Fast closure of the TGVs is determined by measuring the DEH fluid pressure at each control valve. There is one pressure switch associated with each control valve, and the signal from each switch is assigned to a separate trip channel. The logic for the TGV Fast Closure, Trip Oil Pressure – Low Function is such that two or more TGVs must be closed

(continued)

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY

TGV Fast Closure, Trip Oil Pressure - Low (continued)

(pressure switch trips) to produce an EOC-RPT. This Function must be enabled at THERMAL POWER $\geq$ 30% RTP. This is normally accomplished automatically by pressure switches sensing turbine first stage pressure; therefore, opening of the turbine bypass valves may affect this Function. Four channels of TGV Fast Closure, Trip Oil Pressure - Low, with two channels in each trip system, are available and required to be OPERABLE to ensure that no single instrument failure will preclude an EOC-RPT from this Function on a valid signal. The TGV Fast Closure, Trip Oil Pressure - Low Allowable Value is selected high enough to detect imminent TGV fast closure.

This protection is required consistent with the analysis, whenever the THERMAL POWER is $\geq$ 30% RTP. Below 30% RTP, the Reactor Vessel Steam Dome Pressure - High and the APRM ~~Fixed~~ Neutron Flux - High Functions of the RPS are adequate to maintain the necessary safety margins. The turbine first stage pressure/reactor power relationship for the setpoint of the automatic enable is identical to that described for TTV closure.

ACTIONS

A Note has been provided to modify the ACTIONS related to EOC-RPT instrumentation channels. Section 1.3, Completion Times, specifies that once a Condition has been entered, subsequent divisions, subsystems, components, or variables expressed in the Condition, discovered to be inoperable or not within limits, will not result in separate entry into the Condition. Section 1.3 also specifies that Required Actions of the Condition continue to apply for each additional failure, with Completion Times based on initial entry into the Condition. However, the Required Actions for inoperable EOC-RPT instrumentation channels provide appropriate compensatory measures for separate inoperable channels. As such, a Note has been provided that allows separate Condition entry for each inoperable EOC-RPT instrumentation channel.

(continued)

BASES

APPLICABLE SAFETY ANALYSES (continued)	the higher flow. While the flow coastdown and core response are potentially more severe in this assumed case (since the intact loop starts at a lower flow rate and the core response is the same as if both loops were operating at a lower flow rate), a small mismatch has been determined to be acceptable (Ref. 2). The recirculation system is also assumed to have sufficient flow coastdown characteristics to maintain fuel thermal margins during abnormal operational transients (Ref. 3), which are analyzed in Chapter 15 of the FSAR.
	A plant specific LOCA analysis has been performed assuming only one operating recirculation loop. This analysis has demonstrated that, in the event of a LOCA caused by a pipe break in the operating recirculation loop, the Emergency Core Cooling System response will provide adequate core cooling, provided the APLHGR requirements are modified accordingly (Ref. 4).
Insert J	The transient analyses in Chapter 15 of the FSAR have also been performed for single recirculation loop operation (Ref. 4) and demonstrate sufficient flow coastdown characteristics to maintain fuel thermal margins during the abnormal operational transients analyzed provided the MCPR requirements are modified. ~~The APLHGR and MCPR setpoints for single loop operation are specified in the COLR. The APRM flow biased simulated thermal power setpoint is in LCO 3.3.1.1, "Reactor Protection System (RPS) Instrumentation."~~
	Recirculation loops operating satisfies Criterion 2 of Reference 5.
LCO	Two recirculation loops are normally required to be in operation with their flows matched within the limits specified in SR 3.4.1.1 to ensure that during a LOCA caused by a break of the piping of one recirculation loop the assumptions of the LOCA analysis are satisfied.

(continued)

INSERT J:

The APLHGR and MCPR limits for single loop operation are specified in the COLR. During single recirculation loop operation, modification to the Reactor Protection System (RPS) average power range monitor (APRM) instrument setpoints is also required to account for the different relationships between recirculation drive flow and reactor core flow. The APRM Simulated Thermal Power - High Allowable Value is in LCO 3.3.1.1, "Reactor Protection System (RPS) Instrumentation."

BASES

LCO (continued)

Alternately, with only one recirculation loop in operation, modifications to the required APLHGR limits (LCO 3.2.1, "AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR)"), ~~and~~ MCPR limits (LCO 3.2.2, "MINIMUM CRITICAL POWER RATIO ~~(MCPR)")~~ must be applied to allow continued operation.

Insert J.1

APPLICABILITY

In MODES 1 and 2, requirements for operation of the Reactor Coolant Recirculation System are necessary since there is considerable energy in the reactor core and the limiting design basis transients and accidents are assumed to occur.

In MODES 3, 4, and 5, the consequences of an accident are reduced and the coastdown characteristics of the recirculation loops are not important.

ACTIONS

A.1 and B.1

With both recirculation loops operating but the flows not matched, the recirculation loops must be restored to operation within 2 hours. If matched flows are not restored, the recirculation loop with lower flow must be declared "not in operation," as required by Required Action A.1. This Required Action does not require tripping the recirculation pump in the lowest flow loop when the mismatch between total jet pump flows of the two loops is greater than the required limits. However, in cases where large flow mismatches occur, low flow or reverse flow can occur in the low flow loop jet pumps, causing vibration of the jet pumps. If zero or reverse flow is detected, the condition should be alleviated by changing pump speeds to re-establish forward flow or by tripping the pump.

(continued)

INSERT J.1:

(MCPR)"), and APRM Simulated Thermal Power - Upscale Allowable Value (LCO 3.3.1.1)

BASES

ACTIONS

A.1 and B.1 (continued)

With the requirements of the LCO not met for reasons other than Condition A (e.g., one loop is "not in operation"), the recirculation loops must be restored to operation with matched flows within 4 hours. A recirculation loop is considered not in operation when the pump in that loop is idle or when the mismatch between total jet pump flows of the two loops is greater than required limits for greater than 2 hours (i.e., Required Action A.1 has been taken). Should a LOCA occur with one recirculation loop not in operation, the core flow coastdown and resultant core response may not be bounded by the LOCA analyses. Therefore, only a limited time is allowed to restore the inoperable loop to operating status.

Alternatively, if the single loop requirements of the LCO are applied to operating ~~limits,~~ limits and RPS setpoints, operation with only one recirculation loop would satisfy the requirements of the LCO and the initial conditions of the accident sequence.

The 2 and 4 hour Completion Times are based on the low probability of an accident occurring during this time period, on a reasonable time to complete the Required Action, and on frequent core monitoring by operators allowing abrupt changes in core flow conditions to be quickly detected.

C.1

With the Required Action and associated Completion Time of Condition A or B not met, the unit is required to be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to MODE 3 within 12 hours. In this condition, the recirculation loops are not required to be operating because of the reduced severity of DBAs and minimal dependence on the recirculation loop coastdown characteristics. The allowed Completion Time of 12 hours is reasonable, based on operating experience, to reach MODE 3 from full power conditions in an orderly manner and without challenging plant systems.

(continued)

BASES (continued)

SURVEILLANCE REQUIREMENTS

SR 3.4.1.1

This SR ensures the recirculation loop flows are within the allowable limits for mismatch. At low core flow (i.e., < 70% of rated core flow, 75.95 x 10^6 lbm/hr), the MCPR requirements provide larger margins to the fuel cladding integrity Safety Limit such that the potential adverse effect of early boiling transition during a LOCA is reduced. A larger flow mismatch can therefore be allowed when core flow is < 70% of rated core flow.

The mismatch is measured in terms of percent of rated recirculation loop drive flow. If the flow mismatch exceeds the specified limits, the loop with the lower flow is considered not in operation. This SR is not required when both loops are not in operation since the mismatch limits are meaningless during single loop or natural circulation operation. The Surveillance must be performed within 24 hours after both loops are in operation. The 24 hour Frequency is consistent with the Frequency for jet pump OPERABILITY verification and has been shown by operating experience to be adequate to detect off normal jet pump loop flows in a timely manner.

REFERENCES

1. FSAR, Sections 6.3 and 15.6.
2. FSAR, Section 6.3.3.7.2.
3. FSAR, Section 5.4.1.
4. FSAR, Section ~~6.A.~~ 6.3.3.8 and 15.0.2.1
5. 10 CFR 50.36(c)(2)(ii).

BASES

APPLICABLE SAFETY ANALYSES (continued)

CRDA analyses assume that the reactor operator follows prescribed withdrawal sequences. For SDM tests performed within these defined sequences, the analysis of Reference 1 is applicable. However, for some sequences developed for the SDM testing, the control rod patterns assumed in the safety analysis of Reference 1 may not be met. Therefore, special CRDA analyses, performed in accordance with an NRC approved methodology, are required to demonstrate that the SDM test sequence will not result in unacceptable consequences should a CRDA occur during the testing. For the purpose of this test, the protection provided by the normally required MODE 5 applicable LCOs, in addition to the requirements of this LCO, will maintain normal test operations as well as postulated accidents within the bounds of the appropriate safety analysis (Ref. 1). In addition to the added requirements for the Rod Worth Minimizer (RWM), APRM, and control rod coupling, the notch out mode is specified for out of sequence withdrawals. Requiring the notch out mode limits withdrawal steps to a single notch, which limits inserted reactivity, and allows adequate monitoring of changes in neutron flux, which may occur during the test.

As described in LCO 3.0.7, compliance with Special Operations LCOs is optional, and therefore, no criteria of Reference 2 apply. Special Operations LCOs provide flexibility to perform certain operations by appropriately modifying requirements of other LCOs. A discussion of the criteria satisfied for the other LCOs is provided in their respective Bases.

LCO

As described in LCO 3.0.7, compliance with this Special Operations LCO is optional. SDM tests may be performed while in MODE 2, in accordance with Table 1.1-1, without meeting this Special Operations LCO or its ACTIONS. For SDM tests performed while in MODE 5, additional requirements must be met to ensure that adequate protection against potential reactivity excursions is available. To provide additional scram protection, beyond the normally required IRMs, the APRMs are also required to be OPERABLE (LCO 3.3.1.1, Functions ~~2.a and 2.d~~ 2.a, 2.d, and 2.e,) as though the reactor were in MODE 2. Because multiple control rods will be withdrawn and the reactor will potentially become critical, the approved control rod withdrawal sequence must be enforced by the RWM (LCO 3.3.2.1, Function 2, MODE 2), or

(continued)

BASES (continued)

SURVEILLANCE REQUIREMENTS

SR 3.10.8.1, SR 3.10.8.2, and SR 3.10.8.3

LCO 3.3.1.1, Functions ~~2.a and 2.d,~~ 2.a, 2.d, and 2.e, made applicable in this Special Operations LCO, are required to have applicable Surveillances met to establish that this Special Operations LCO is being met (SR 3.10.8.1). However, the control rod withdrawal sequences during the SDM tests may be enforced by the RWM (LCO 3.3.2.1, Function 2, MODE 2 requirements) or by a second licensed operator (Reactor Operator or Senior Reactor Operator) or other qualified member of the technical staff. As noted, either the applicable SRs for the RWM (LCO 3.3.2.1) must be satisfied according to the applicable Frequencies (SR 3.10.8.2), or the proper movement of control rods must be verified (SR 3.10.8.3). This latter verification (i.e., SR 3.10.8.3) must be performed during control rod movement to prevent deviations from the specified sequence. These Surveillances provide adequate assurance that the specified test sequence is being followed.

SR 3.10.8.4

Periodic verification of the administrative controls established by this LCO will ensure that the reactor is operated within the bounds of the safety analysis. The 12 hour Frequency is intended to provide appropriate assurance that each operating shift is aware of and verifies compliance with these Special Operations LCO requirements.

SR 3.10.8.5

Coupling verification is performed to ensure the control rod is connected to the control rod drive mechanism and will perform its intended function when necessary. The verification is required to be performed any time a control rod is withdrawn to the "full-out" notch position or prior to declaring the control rod OPERABLE after work on the control rod or CRD System that could affect coupling. This Frequency is acceptable, considering the low probability that a control rod will become uncoupled when it is not being moved as well as operating experience related to uncoupling events.

(continued)

Sample Pages of Proposed COLR Changes (for information only)

5.0 Oscillation Power Range Monitor (OPRM) Instrumentation Limits for Use in LCO 3.3.1.1

5.1 Reactor Protection System (RPS) Instrumentation Setpoints for the OPRM Period Based Detection Algorithm (PBDA) support OPERABILITY for LCO 3.3.1.1. See Technical Specification 3.3.1.1 and the applicable Bases for further application details.

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	TRIP SETPOINT
2 Average Power Range Monitors		
f. OPRM Upscale	(f)	
Amplitude Trip (Sp)		1.11 Peak/Average
Confirmation Count (N2)		14

(f) THERMAL POWER ≥ 20% RTP

5.2 THERMAL POWER for Use in Technical Specification 3.3.1.1, Required Action J.1:

THERMAL POWER < 20% RTP

5.3 OPRM Trip Enable Values for Use in SR 3.3.1.1.17

APRM Simulated Thermal Power (Pb)	≥ 25% RTP
Recirculation Drive Flow (Wb)	< 60% rated recirculation drive flow

6.0 **Control Rod Block Instrumentation Limits for Use in LCO 3.3.2.1**

6.1 Rod Block Monitor instrument setpoints support OPERABILITY for LCO 3.3.2.1. See Technical Specification 3.3.2.1 and the applicable Bases for further application details.

FUNCTION		TRIP SETPOINT	ALLOWABLE VALUE
1 Rod Block Monitor			
a. Low Power Range—Upscale			
	Unfiltered	124.2	124.6
	Filtered	123.0	123.4
b. Intermediate Power Range—Upscale			
	Unfiltered	119.2	119.6
	Filtered	118.2	118.6
c. High Power Range—Upscale			
	Unfiltered	114.2	114.6
	Filtered	113.2	113.6

6.2 Rod Block Monitor (RBM) MCPR limits for use in Technical Specification Table 3.3.2.1-1, Footnotes (a), (b) and (c). See Technical Specification 3.3.2.1 and the applicable Bases for further application details.

THERMAL POWER (% RTP)	RBM MCPR Limit
≥ 28 and < 90	1.73
≥ 90	1.43

Technical and Regulatory Evaluation of the Proposed TS Changes Involving PRNM

Subject: Technical and Regulatory Evaluation of License Amendment Request to Change Technical Specifications (TS) in Support of Power Range Neutron Monitoring (PRNM) System Upgrade

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ATTACHMENTS to Enclosure 2:

1. 0000-0101-7647-R3, "Columbia Generating Station Plant-Specific Responses Required by NUMAC PRNM Retrofit Plus Option III Stability Trip Function Topical Report (NEDC-32410P-A)," October 2011- (proprietary version)

2. NEDC-33685P, Revision 1, "Digital I&C-ISG-06 Compliance for Columbia Generating Station NUMAC Power Range Neutron Monitoring Retrofit Plus Option III Stability Trip Function," January 2012 - (proprietary version)

3. NEDC-33690P, Revision 0, "Columbia Generating Station Power Range Neutron Monitoring System Response Time Analysis Report," November 2011 – (proprietary version)

ATTACHMENTS to Enclosure 2 (continued)

4. NEDC-33694P, Revision 1, "Columbia Generating Station Power Range Neutron Monitoring System Diversity and Defense-in-Depth (D3) Analysis," January 2012 - (proprietary version)

5. NEDC-33696P, Revision 0, "Columbia Generating Station Power Range Neutron Monitoring System Architecture & Theory of Operations Report," November 2011 - (proprietary)

6. NEDC-33697P, Revision 1, "Columbia Generating Station Power Range Neutron Monitoring System Design Analysis Report," January 2012 - (proprietary version)

7. NEDC-33698P, Revision 1, "Columbia Generating Station Power Range Neutron Monitoring System Design Report on Computer Integrity, Test and Calibration, and Fault Detection," January 2012 - (proprietary version)

8. 0000-0101-7647-R3, "Columbia Generating Station Plant-Specific Responses Required by NUMAC PRNM Retrofit Plus Option III Stability Trip Function Topical Report (NEDC-32410P-A)," October 2011 - (non-proprietary version)

9. NEDO-33685, Revision 1, "Digital I&C-ISG-06 Compliance for Columbia Generating Station NUMAC Power Range Neutron Monitoring Retrofit Plus Option III Stability Trip Function," January 2012 - (non-proprietary version)

10. NEDO-33690, Revision 0, "Columbia Generating Station Power Range Neutron Monitoring System Response Time Analysis Report," November 2011 – (non-proprietary version)

11. NEDO-33694, Revision 1, "Columbia Generating Station Power Range Neutron Monitoring System Diversity and Defense-in-Depth (D3) Analysis," January 2012 - (non-proprietary version)

12. NEDO-33697, Revision 1, "Columbia Generating Station Power Range Neutron Monitoring System Design Analysis Report," January 2012 - (non-proprietary version)

13. NEDO-33698, Revision 1, "Columbia Generating Station Power Range Neutron Monitoring System Design Report on Computer Integrity, Test and Calibration, and Fault Detection," January 2012 - (non-proprietary version)

14. List of Commitments

1.0 TECHNICAL EVALUATION

Energy Northwest is planning a modification to upgrade the existing Average Power Range Monitor (APRM), Rod Block Monitor (RBM), Local Power Range Monitor (LPRM), Oscillation Power Range Monitor (OPRM), and recirculation flow processing equipment, all part of the existing Neutron Monitoring System (NMS) and OPRM systems for the Columbia Generating Station (CGS). With the modification, the existing APRM subsystem and OPRM system hardware will be replaced with General Electric Hitachi's (GEH's) Nuclear Measurement Analysis and Control (NUMAC) Power Range Neutron Monitoring (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 modification excludes the LPRM detectors and signal cables, which will be retained with the NUMAC PRNM replacement. The NUMAC PRNM License Topical Report (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 3). 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.

Final Safety Analysis Report (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 (Reference 13), Brunswick Units 1 and 2 (Reference 14), Susquehanna Units 1 and 2 (Reference 5), and Monticello (Reference 6).

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 CGS.

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

1.1 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 Reactor Protection System (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 NUMAC PRNM LTR describes various plant specific configurations for the RBM system that the PRNM system can support, including setpoints that are based on either "non-ARTS" or "ARTS" values. ARTS is an acronym for **A**verage Power Range Monitor / **R**od Block Monitor / **T**echnical **S**pecifications. CGS currently is a "non-ARTS" plant, but is planning to implement "ARTS" in conjunction with the PRNM installation. Justification for the ARTS improvement is provided in Enclosure 3 of this combined submittal. The remainder of this Enclosure will discuss the details related to installation of the PRNM system with the proposed RBM licensing basis of an "ARTS" configuration.

The basic RBM function will remain the same as in the current system (with the new ARTS setpoints applied). The LPRM signals and recirculation flow signals will be provided digitally from the APRM channels. 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 Alternating Current (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 System (RMCS), 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. This is discussed further in NUMAC PRNM LTR Section 5.3.5.

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 1.3 below.

1.2 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/OPRM configuration of the NUMAC PRNM. Both configurations are included in the NRC reviewed and approved Licensing Topical Reports, applicable to the OPRM Stability Option III (References 3 and 4). 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.

1.3 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 9) and Regulatory Guide 5.71 (Reference 10), 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.

1.4 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.

1.5 Evaluation of NUMAC PRNM LTR for CGS Specific Requirements and Differences from Generic Design

The proposed TS changes to CGS are consistent with the NUMAC PRNM LTR, with exceptions discussed below. 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 CGS. The basis for the TS changes found in Attachment 1 of Enclosure 1 are documented in Section 8.0 of NUMAC PRNM LTR. Deviations, exceptions, or additional clarifying information to the NUMAC PRNM LTR are as follows:

1.5.1 Deviations from NEDC-32410P-A, Supplement 1 (Reference 2) Section 8.4.1.3

Included in Appendix A to Attachment 1 of this Enclosure is a description and justification for the CGS specific deviations from the NUMAC PRNM LTR. One of the deviations involves 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 6).

The other two deviations discussed in Appendix A of Attachment 1 to this enclosure involve clarifications of information provided in the original NUMAC PRNM LTR for the Time to Calculate Flow-biased Trip Setpoint and the Abnormal Conditions Leading to Inoperative Status.

1.5.2 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 2.2.4.3 of Enclosure 1, 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 reflect that the current restrictions for the Extended Load Line Limit Analysis (ELLLA) will be retained for single recirculation loop operations. CGS is not proposing to utilize MELLLA limits for operations in single loop.

- Notes (d) and (e) reflect inclusion of notes to be consistent with implementation of TSTF-493 (Reference 11). This issue is not addressed in the NUMAC PRNM LTR. Application of TSTF-493 notes to these setpoints is discussed further in section 1.6 below.

- 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 Core Operating Limits Report (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.

CGS'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 6).

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. Boiling Water Reactor Owners Group (BWROG) Letter 96113 to the NRC (Reference 8) 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 CGS 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, CGS 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 of Enclosure 1, 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.

1.5.3 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 Safety Evaluation (SE) for activating the OPRM Upscale function at Peach Bottom Units 2 and 3 (Reference 7). 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."

1.5.4 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, 3, and 4 LTRs, the same as the current OPRM System. The replacement OPRM meets the 10 CFR

50 Appendix A, General Design Criteria (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 Minimum Critical Power Ration (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 Enclosure 1, 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 A would not normally occur until a second OPRM channel became inoperable. This change from 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 5).

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 4). 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, CGS 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 5).

1.5.5 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 5).

1.6 Application of TSTF-493 and Impact to Setpoints for Proposed PRNM Changes

The NRC approved Revision 4 of TSTF-493 via issuance of a model application for adoption on April 30, 2010 (Reference 11). Using the guidance of Appendix A of TSTF-493, Energy Northwest has applied the actions identified to this LAR; the results being that the two notes specified in the TSTF are applied to channel calibration SR 3.3.1.1.10 for the following APRM functions listed in TS Table 3.3.1.1-1 as follows:

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

In order to implement this change, Energy Northwest will revise the Licensee Controlled Specifications (LCS) to include the Limiting Trip Setpoint values and the methodologies used for determining these setpoints prior to the startup from the refueling outage that this modification is installed.

As identified in Appendix A of TSTF-493 the Inop Function 2.d is excluded from footnotes. New Notes (d) and (e) are not applicable to the proposed 2-out-of-4 Voter Function 2.e since it meets the following criterion for exclusion provided in TSTF-493:

1. The two Notes are not applied to Functions which utilize manual actuation circuits, automatic actuation logic circuits or to instrument functions that derive input from contacts which have no associated sensor or adjustable device, e.g., limit switches, breaker position switches, manual actuation

switches, float switches, proximity detectors, etc. **In addition, the two Notes do not apply to those permissives and interlocks that derive input from a sensor or adjustable device that is tested as part of another TS function** (emphasis added).

The Bases for TS 3.3.1.1 describe the application of the notes to SR 3.3.1.1.10 as applied to APRM Functions 2.a, 2.b, 2.c, and 2.f. Draft marked-up pages of the affected TS Bases are provided in Attachment 3 of Enclosure 1, for information only. In addition, Energy Northwest calibration procedures for these APRM and RBM functions will be revised to reflect the instruction given in the above notes.

1.7 Evaluation Against Regulatory Requirements Identified by ISG-06

GEH and Energy Northwest conducted a review for all changes to the PRNM system from that approved by the NRC against the regulatory requirements identified in ISG-06 (Reference 12). This evaluation is provided in Attachments 2 through 7 of this Enclosure. The following table provides a conformance roadmap for Tier 2 documents specified in Enclosure B of ISG-06 for the Phase 1 and Phase 2 documents provided with this submittal.

ISG-06 Roadmap Table

ISG-06 Enclosure B Item #	Title	Phase 1 Document
1.1	Hardware Architecture Descriptions (D.1.2)	Attachment 5 (NEDC-33696P)
1.2	Quality Assurance Plan for Digital Hardware (D.2.2)	N/A – Only required for a Tier 3 submittal
1.3	Software Architecture Descriptions (D.3.2, D.4.4.3.2)	Attachment 5 (NEDC-33696P)
1.4	Software Management Plan (D.4.4.1.1)	Appendix A of Attachment 2 (NEDC-33685P)
1.5	Software Development Plan (D.4.4.1.2)	Discussed in Table 4.4-1 of Attachment 2 (NEDC-33685P) as comprised of: SMP – Software Management Plan SCMP – Software Configuration Management Plan SVVP – Software Verification & Validation Plan These documents are included in Appendix A of Attachment 2 (NEDC-33685P)

ISG-06 Enclosure B Item #	Title	Phase 1 Document
1.6	Software QA Plan (D.4.4.1.3, D.10.4.2.3.1)	Described in Sections 4 and 10.3.3.1 of Attachment 2 (NEDC-33685P)
1.7	Software Integration Plan (D.4.4.1.4)	Discussed in Table 4.4-1 of Attachment 2 (NEDC-33685P) as comprised of: SMP & SVVP These documents are included in Appendix A of Attachment 2 (NEDC-33685P)
1.8	Software Safety Plan (D.4.4.1.9)	Described in Section 4 of Attachment 2 (NEDC-33685P)
1.9	Software V&V Plan (D.4.4.1.10)	Included in Appendix A of Attachment 2 (NEDC-33685P)
1.10	Software Configuration Management Plan (D.4.4.1.11)	Included in Appendix A of Attachment 2 (NEDC-33685P)
1.11	Software Test Plan (D.4.4.1.12)	Discussed in Table 4.4-1 of Attachment 2 (NEDC-33685P) as comprised of: SMP & SVVP These documents are included in Appendix A of Attachment 2 (NEDC-33685P)
1.12	Software Requirements Specification (D.4.4.3.1)	Included in Appendix A of Attachment 2 (NEDC-33685P)
1.13	Software Design Specification (D.4.4.3.3)	Included in Appendix A of Attachment 2 (NEDC-33685P)
1.14	Equipment Qualification Testing Plans (Including EMI, Temperature, Humidity, and Seismic) (D.5.2)	Described in Section 5 of Attachment 2 (NEDC-33685P)
1.15	D3 Analysis (D.6.2)	Attachment 4 (NEDC-33694P)
1.16	Design Analysis Reports (D.7.2, D.8.2, D.9.4.2.6, D.10.4.2.6)	Attachment 6 (NEDC-33697P)
1.17	System Description (To block diagram level) (D.9.2, D.10.2)	Attachment 5 (NEDC-33696P)

ISG-06 Enclosure B Item #	Title	Phase 1 Document
1.18	Design Report on Computer integrity, Test and Calibration, and Fault Detection (D.9.4.2.5, D.9.4.2.7, D.9.4.2.10, D.9.4.3.5, D.10.4.2.5, D.10.4.2.7)	Attachment 7 (NEDC-33698P)
1.19	System Response Time Analysis Report (D.9.4.2.4)	Attachment 3 (NEDC-33690P)
1.20	Theory of Operation Description (D.9.4.2.8, D.9.4.2.9, D.9.4.2.10, D.9.4.2.11, D.9.4.2.13, D.9.4.2.14, D.9.4.3.2, D.9.4.3.5, D.9.4.3.6, D.9.4.3.7, D.9.4.4)	D.9.4.2.11 is discussed in Sections 4.4.7 and 9.2.11 of Attachment 2 (NEDC-33685P) D.9.4.2.10 is discussed in Attachment 7 (NEDC-33698P) The other items are discussed in Attachment 5 (NEDC-33696P)
1.21	Setpoint Methodology (D.9.4.3.8, D.11)	Described in Section 9.3.8 of Attachment 2 (NEDC-33685P)
1.22	Vendor Software Plan (D.10.4.2.3.1)	N/A – Only required for a Tier 3 submittal
1.23	Software Tool Verification Program (D.10.4.2.3.2)	Described in Section 10 of Attachment 2 (NEDC-33685P)
1.24	Software Project Risk Management Program (D.10.4.2.3.6)	Described in Section 10 of Attachment 2 (NEDC-33685P)
1.25	Commercial Grade Dedication Plan (D.10.4.2.4.2)	Described in Section 10 of Attachment 2 (NEDC-33685P)
1.26	Vulnerability Assessment (D.12.4.1)	Described in Section 11.4 of Attachment 2 (NEDC-33685P)
1.27	Secure Development and Operational Environment Controls (D.12.2)	Described in Section 11.5 of Attachment 2 (NEDC-33685P)

ISG-06 Enclosure B Item #	Title	Phase 2 Document
2.11	Qualification Test Methodologies (D.5.2)	Described in Section 5 of Attachment 2 (NEDC-33685P)
2.12	Summary of Digital EMI, Temp., Humidity, and Seismic Testing Results (D.5.2)	Described in Section 5 of Attachment 2 (NEDC-33685P)
2.13	As-Manufactured Logic Diagrams (D.9.2)	Attachment 5 (NEDC-33696P)

1.8 Conclusion

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

2.0 Regulatory Evaluation

2.1 Applicable Regulatory Requirements / Criteria

2.1.1 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, LCOs, Required Actions and Completion Times, as applicable, for each change in APRM, OPRM, and RBM functions.

The CGS 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 24 – "Separation of protection and control systems." The protection system shall be separated from control systems to the extent that failure of any single control system component or channel, or failure or removal from service of any single protection system component or channel which is common to the control and protection systems leaves intact a system satisfying all reliability, redundancy, and independence requirements of the protection system. Interconnection of the protection and control systems shall be limited so as to assure that safety is not significantly impaired.

- Criterion 25 – "Protection system requirements for reactivity control malfunctions." The protection system shall be designed to assure that specified acceptable fuel design limits are not exceeded for any single malfunction of the reactivity control systems, such as accidental withdrawal (not ejection or dropout) of control rods.

- 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.

Other applicable Regulations and Guidance:

- In 10 CFR 50.36(c)(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 will be within safety limits, and that the limiting conditions for operation will 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.

- Digital I&C-ISG-06 (Reference 12). This interim staff guidance document describes the licensing process that may be used in the review of license amendment requests associated with digital I&C system modifications in operating plants.

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 1.0 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. 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.

2.1.2 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. A response to each NRC staff requirement is provided below:

1. Confirm the applicability of the NUMAC PRNM LTR (NEDC-32410P-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 CGS-specific PRNM system installation against the requirements of the NUMAC PRNM LTR and associated NRC SEs; the resulting document is provided in Attachment 1 of this Enclosure. Clarifications and reconciled differences between the plant-specific design and the NUMAC PRNM LTR design descriptions are identified in Section 1 of this Enclosure.

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.

   One aspect identified in the NUMAC PRNM LTR that is not addressed elsewhere is the CGS-specific analysis of a common cause failure of the PRNM system. The CGS Final Safety Analysis Report (FSAR) has been compared to the design basis accidents and anticipated operational occurrences evaluated in the NUMAC PRNM LTR. Events evaluated for the

NUMAC PRNM LTR encompass the events analyzed for CGS and the configuration of the PRNM is within the limits of the NUMAC PRNM LTR. A further discussion of this topic is provided in Attachment 4 of this Enclosure.

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 1 of Enclosure 1, 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 Section 5.0 of Attachment 2 of this Enclosure. 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. The administrative controls that provide access to and allow for manual bypassing of the PRNM functions is described further in Section 1.4.6 of Attachment 2 to this Enclosure.

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

   RESPONSE

   The PRNM system design is analyzed in accordance with NUREG-0700 (Reference 16) and the CGS Design Specification 204 for Human Factors. The discussion is generic to the RBM, APRM, OPRM, and LPRM components, which are all a NUMAC design.

Human Factors considerations for panel H13/P608 (Main Control Room Operator Panel):

The design for the new PRNM system replacement complies with NUREG-0700 requirements as applicable to panel H13/P608. The following human factors requirements were met by the new PRNM system:

- Functional layout considerations when determining control panel dimensions have been met. The new hardware for the replacement system is mounted in the existing panel after removal of the currently installed APRM hardware. This configuration complies with requirements of NUREG-0700.
- Labeling of control panels and instrument racks are in compliance with CGS Design Specification 204, "Design Specification for Division 200 Section 204 Human Factors."
- The new PRNM system provides new indications (in bar-graph format and Liquid Crystal Displays) and annunciations of alarms. The PRNM annunciator changes were made to be consistent with the design and terminology of the current NMS.
- The addition of the displays to panel H13/P608 provides the Operators with quick access to APRM, LPRM, OPRM, and RBM information that is currently unavailable or requires extensive investigation and troubleshooting. The menus may be scrolled to display different groups of information. The top of each menu display is reserved for critical information and channel status, including INOP, Bypass, Trouble, and Alarm indications to ensure that the Operator is always aware of the status of the chassis. Additional controls are discussed further in Section 1.4.6 of Attachment 2 to this Enclosure. Taken in the aggregate, the above described controls minimize the risk of operator error. The changes to the human machine interfaces at panel H13/P608 are equivalent to or better than the existing interface. The changes are consistent with CGS Design Specification 204 and NUREG-0700 human factors.
- The new PRNM system is designed to facilitate the recognition, location, replacement, repair, and/or adjustment of malfunctioning components or modules. The self-test features provide fault information at the chassis panel display that allows the Operators and Maintenance personnel to determine the exact fault location and type. The self-test provides alarms and indications to alert operators of a fault condition. The existence of a fault is displayed on the top of all displays, including the respective ODA, as a trouble indication. Additionally, an audible trouble alarm is provided. A critical fault will also result in an INOP vote (and rod block) from the respective APRM chassis, or rod block from the RBM Chassis. The design of the panel display is consistent with NUREG-0700 requirements, sections 1.2, 1.3, and 1.4.

- Keys and firmware passwords will be required to be retained and controlled for access to the system for calibration and testing, including bypassing and un-bypassing LPRM detectors. This design conforms to the requirements of Capability for Test and Calibration as per IEEE-279-1971 Paragraph 4.10 and conforms to the requirements of Access to Set Point Adjustment, Calibration, and Test Points as per IEEE-279-1971 Paragraph 4.18. This design is consistent with sections 2.9 (System Security) and 12.1.1.11-5 (User-Configuration Displays) of the NUREG-0700.

The base design for panel H13/P603, (Control Room Back Panel housing PRNM components/chassis) uses identical operator interface devices as specified in the NUMAC PRNM LTR, so there is no effect on the plant human factors evaluation as stated on NEDC-32410P-A. Human Factors considerations for Control Room Panel H13/P603 include the following:

- One of the major changes in this panel is the introduction of Operator Display Assemblies (ODAs) per the new PRNM system design. Four ODAs will be installed in this panel to replace the existing four groups of four (total = sixteen) LPRM analog meter displays. Location of ODAs and switches have been reviewed and approved by CGS Operations and meet NUREG-0700 requirements. The ODAs are self-contained graphics displays with four menu soft-keys below the display. The ODAs provide alphanumeric indication of system parameters, and can be scrolled by the operator to provide additional information. There is an ODA provided for each RBM (A and B), and two ODAs for the four APRM channels. APRM ODAs provide OPRM status information, indication of bypasses, and conventional APRM and LPRM data. This simplifies data presentation to the operators by the removal of existing selector switches.
  - The display is divided into upper, mid, and lower display sections that provide critical information to the operator. This meets the requirement of Data Presentation as per CGS Design Specification 204 in accordance with NUREG-0700.
  - The controls (bypassing) and displays (ODAs) are readily available and provide the operating personnel with logical arrangement of indications to allow rapid assessment of plant conditions and for operator actions if required. This complies with the requirements of CGS Design Specification 204 and NUREG-0700. Additionally, this design conforms to the requirements of "*Indication of Bypasses*" per IEEE-279-1971 Paragraph 4.13.
  - Data displays are designed such that optical reflections, ambient noise, and control room environmental factors do not interfere with the ability of the operators to perceive and comprehend the data provided by the new PRNM system. This complies with the requirements of CGS and is in accordance with NUREG-0700 sections 1.5 (DISPLAY PAGES) and 1.6 (DISPLAY DEVICES).

- o Adequate levels of illumination are part of the new ODAs and ensure that visual effectiveness is sufficient for task performance. This complies with the requirements of CGS Design Specification 204, and is in accordance with NUREG-0700 section 7.2 (INFORMATION DISPLAY).
- o The location and alarm setpoint information provided by the ODAs makes the APRM "push-to-record" switches APRM-RMS-1A, 1B, 1C, and 1D no longer necessary. The infrequently used switches are removed by this modification. The switches are used infrequently due to the difficulty in obtaining an accurate value off of the recorder's plotting paper. The digital alphanumeric display of the APRM setpoints is superior to using *"push-to-record"* switches. The removal of unnecessary switches meets the intent of CGS Design Specification 204 and NUREG-0700 for human factors.

- The two recirculation Flow Unit bypass switches (C52B-S7 and C52B-S8) will be removed. The function of the Flow Unit bypass switches is integrated into the single APRM bypass switch. A single bypass switch minimizes operator movement as there is only one switch instead of two. This improves operations and improves the ability of Operating staff to take appropriate corrective actions from a centralized point. This complies with the requirements of CGS Design Specification 204, and is in accordance with NUREG-0700.
- The eight IRM/APRM selector switches are removed from panel H13/P603 as these are no longer needed due to the addition of multi-channel Yokogawa recorders.
- Labeling meets requirements of CGS Design Specification 204 in accordance with NUREG-0700.

Human Factors considerations for Panel C91/P610 (Main Control Room interface panel with Process Computer):

- As mentioned in the previous sections, all functions from the previous NMS continue to be supported. The criteria established for the new PRNM system not only incorporates the minimum design criteria to be applied for maintaining the safety functions of the system, but also includes requirements applicable to digital computer based safety systems. The following Human Factors have been identified and met in panel C91/P610:
  - o Layout considerations for determining the location for controls and displays on this panel have been considered. The interface computers external to the PRNM system have also been designed such that optical reflections, ambient noise, and control room environmental factors do not interfere with the ability of the operators to perceive and comprehend the displayed data. This meets the intent of CGS Design Specification 204 in accordance with NUREG-0700.

- Monitor light levels are adequate to ensure visual effectiveness as required by CGS Design Specification 204.
- Glare is almost non-existent and displays are not shadowed. Surface colors are recognizable under both normal and emergency lighting conditions. This meets the intent of CGS Design Specification 204 in accordance with NUREG-0700.

Data submitted by GEH and the C3-ilex vendor about Human Factors requirements has been reviewed, checked, and accepted by CGS. The requirements pertaining to Human Factors for panel H13/P608, panel H13/P603 and panel C91/P610 have been met. Therefore, the requirements imposed by CGS *"Design Specification for Division 200 Section 204 Human Factors"*, in accordance with NUREG-0700 have been met by this design.

2.2 Precedent

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

2.3 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:

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

Response: No.

The probability (frequency of occurrence) of Design Basis Accidents occurring is not affected by the PRNM system, as the PRNM system does not interact with equipment whose failure could cause an accident. The regulatory criteria established for plant equipment such as the APRM, OPRM, and RBM systems 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 consequences 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, 3, and 4 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.

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

Response: No.

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.

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

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

Response: No.

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.

2.4 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.

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

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

5. 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).

6. 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).

7. 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).

8. 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.

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

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

11. "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).

12. Digital I&C-ISG-06, "Task Working Group #6: Licensing Process Interim Staff Guidance," January 19, 2011 (ADAMS Accession No. ML110140103).

13. NRC Letter to NMP2, "Issuance of Amendment for Nine Mile Point Nuclear Station, Unit No. 2 (TAC NO. MA0150)," dated March 31, 1998 (ADAMS Accession No. ML011140046).

14. 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 (ADAMS Accession No. ML020720742)

15. 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).

16. NUREG-0700 Rev. 2, "Human-System Interface Design Review Guidelines"