CP&L
A Progress Energy Company

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BRUNSWICK STEAM ELECTRIC PLANT, UNIT NOS. 1 AND 2
DOCKET NOS. 50-325 AND 50-324/LICENSE NOS. DPR-71 AND DPR-62
REQUEST FOR LICENSE AMENDMENTS
THERMAL-HYDRAULIC STABILITY OPTION III

Gentlemen:

In response to NRC Generic Letter 94-02, "Long-Term Solutions and Upgrade of Interim Operating Recommendations for Thermal-Hydraulic Instabilities in BWRs," dated July 11, 1994, Carolina Power & Light (CP&L) Company committed to implement the Boiling Water Reactor Owners' Group (BWROG) Enhanced Option I-A Reactor Stability Long-Term Solution. By letter dated November 1, 1996 (Serial: BSEP 96-0406), CP&L requested license amendments for the Brunswick Steam Electric Plant (BSEP), Unit Nos. 1 and 2, that would allow full implementation of the Enhanced Option I-A Reactor Stability Long-Term Solution. These amendment requests were approved by the NRC as part of CP&L's conversion to the Improved Technical Specifications; issued on June 5, 1998, as License Amendment Nos. 203 and 233 for BSEP, Units 1 and 2, respectively.

Enhanced Option I-A places restrictions on permitted operating regions of the power/flow map. Those restrictions have been determined to be unacceptable for efficient plant operation after implementation of the planned extended power uprate at BSEP, Units 1 and 2. Therefore, in accordance with the Code of Federal Regulations, Title 10, Parts 50.90 and 2.101, CP&L is requesting a revision to the Technical Specifications for BSEP, Units 1 and 2, to support a modification that will install a digital Power Range Neutron Monitoring (PRNM) system. The modification will supersede plant modifications previously installed in support of CP&L's implementation of Enhanced Option I-A, and will allow full implementation of the BWROG Option III Reactor Stability Long-Term Solution.

The modification consists of replacing the existing Power Range Monitor (PRM) system, including the Average Power Range Monitor system, the Rod Block Monitor system, and the Local Power Range Monitor system, excluding the detectors and signal cables, with General Electric's (GE's) Nuclear Measurement Analysis and Control (NUMAC) PRNM

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system. The Option III stability solution is integrated into the PRNM system electronics as an Oscillation Power Range Monitor (OPRM), which provides automatic detection and suppression of reactor instabilities.

The PRNM system is scheduled for installation on Unit 1 in March 2002, and installation on Unit 2 in March 2003. As such, to support this schedule, CP&L requests NRC approval of these license amendment requests by February 15, 2002. The OPRM trip function will be fully operational during the first start-up following installation of the new PRNM system, with related Technical Specifications in place. OPRM tuning parameters will be set initially based on the operating experience from several plants that currently have the NUMAC PRNM/OPRM function installed and operational. Final tuning parameter adjustments will be made during or after start-up, if required, based on the OPRM response observed.

Enclosure 1 describes the proposed changes and provides justification for the changes. The changes are consistent with GE 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," and GE LTR NEDC-32410P, Supplement 1, "Nuclear Measurement Analysis and Control Power Range Neutron Monitor (NUMAC-PRNM) Plus Option III Stability Trip Function." These LTRs were approved by the NRC in letters dated September 5, 1995, and August 15, 1997, respectively.

Enclosure 4 provides responses to the plant-specific utility actions required by LTR NEDC-32410P-A, including Supplement 1, and includes descriptions and justifications for deviations from the LTRs as well as changes that are not addressed in the LTRs. Revised Unit 1 Bases pages associated with the proposed amendments are included in Enclosure 10. These pages are provided for information only and do not require issuance by the NRC.

CP&L is providing Mr. Mel Fry of the State of North Carolina a copy of the proposed license amendments in accordance with 10 CFR 50.91(b).

As stated above, CP&L plans to implement the PRNM modification on Unit 1 in March 2002, during refueling outage B114R1, and on Unit 2 in March 2003, during refueling outage B216R1. Therefore, to support this schedule, CP&L requests that the approved amendments be issued with the Unit 1 amendment effective at the start of refueling outage B114R1, and the Unit 2 amendment effective at the start of refueling outage B216R1. To support implementation of the Technical Specification changes associated with these proposed license amendments, CP&L requests an implementation period of 60 days following the license amendments becoming effective.

Please refer any questions regarding this submittal to Mr. David C. DiCello, Manager - Regulatory Affairs, at (910) 457-2235.

Sincerely,

John S. Keenan

KMN/kmn

Enclosures:
1. Basis for Change Request
2. 10 CFR 50.92 Evaluation
3. Environmental Considerations
4. Plant Specific Responses to Required Utility Actions Delineated in Licensing Topical Report NEDC-32410P-A
5. Page Change Instructions
6. Typed Technical Specification Pages - Unit No. 1
7. Typed Technical Specification Pages - Unit No. 2
8. Marked-up Technical Specification Pages - Unit No. 1
9. Marked-up Technical Specification Pages - Unit No. 2
10. Marked-up Technical Specification Bases Pages - Unit No. 1 (For Information Only)

John S. Keenan, having been first duly sworn, did depose and say that the information contained herein is true and correct to the best of his information, knowledge and belief; and the sources of his information are officers, employees, and agents of Carolina Power & Light Company.

Dean S. Mason
Notary (Seal)

My commission expires: 8/29/04

cc (with enclosures):

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ENCLOSURE 1

BRUNSWICK STEAM ELECTRIC PLANT, UNIT NOS. 1 AND 2
DOCKET NOS. 50-325 AND 50-324/LICENSE NOS. DPR-71 AND DPR-62
REQUEST FOR LICENSE AMENDMENTS
THERMAL-HYDRAULIC STABILITY OPTION III

BASIS FOR CHANGE REQUEST

Background

In response to NRC Generic Letter 94-02, "Long-Term Solutions and Upgrade of Interim Operating Recommendations for Thermal-Hydraulic Instabilities in BWRs," dated July 11, 1994, Carolina Power & Light (CP&L) Company committed to implement the Boiling Water Reactor Owners' Group (BWROG) Enhanced Option I-A Reactor Stability Long-Term Solution. Enhanced Option I-A places restrictions on permitted operating regions of the power/flow map. These restrictions are known as the Exclusion Region and Restricted Region and provide an automatic scram or rod block, respectively, if the plant were to operate in these regions. The exclusion region was designed to prohibit operation in those areas that were susceptible to thermal-hydraulic instability. These operational restrictions have been determined to be unacceptable for efficient plant operation after implementation of a planned extended power uprate at the Brunswick Steam Electric Plant (BSEP), Units Nos. 1 and 2. Therefore, it has been concluded that replacement of the Enhanced Option I-A solution with "Reactor Stability Long-Term Solution Option III," as described in NEDO-31960-A, including Supplement 1, "BWR Owners' Group Long-Term Stability Solutions Licensing Methodology" is necessary. As such, CP&L is requesting a revision to the Technical Specifications to support a modification that will install a digital Power Range Neutron Monitoring (PRNM) system. The modification will supersede plant modifications previously installed in support of CP&L's implementation of Enhanced Option I-A, and will allow full implementation of the Option III Reactor Stability Long-Term Solution.

The BWROG Option III stability solution will be implemented as part of the Power Range Monitor (PRM) system replacement. This modification consists of replacing the existing PRM system, including the Average Power Range Monitor (APRM) system, the Rod Block Monitor (RBM) system, the Local Power Range Monitor (LPRM) system, excluding the detectors and signal cables, and the Enhanced Option I-A function with General Electric's (GE's) Nuclear Measurement Analysis and Control (NUMAC) PRNM system. This change includes revisions of setpoints and deletion of existing features that are evaluated as part of the Option III solution. The Option III stability solution is integrated into the PRNM system electronics as an Oscillation Power Range Monitor (OPRM) Upscale trip function, which provides automatic detection and suppression of reactor instabilities.

The PRNM system uses the OPRM detect and suppress function to implement Option III. During the first startup following installation of the new PRNM system, the OPRM trip function will be fully operational with related Technical Specification in place. OPRM tuning parameters will be set initially based on the operating experience from several plants that currently have the PRNM/OPRM function installed and operational. Final tuning parameter adjustments will be made during or after startup, if required, based on the OPRM response observed.

The proposed change will replace the currently installed and NRC approved Enhanced Option I-A long-term stability solution with an NRC approved Option III long-term stability solution. The PRNM hardware incorporates the Option III detect and suppress solution reviewed and approved by the NRC in References 1, 2, 3, and 4. The OPRM meets the General Design Criteria (GDC) 10 and 12 requirements by automatically detecting and suppressing design basis thermal-hydraulic oscillations prior to exceeding the fuel Minimum Critical Power Ratio (MCPR) Safety Limit.

The proposed modification uses digital processing with software (i.e., firmware) control for the main signal processing part of the modification. The remainder of the equipment in the modification uses conventional equipment similar to the current system (e.g., penetrations, cables, and interface panels). The digital equipment has control processing points and software controlled digital processing whereas the current system has analog and discrete component processing. The result is that the specific failures of hardware and potential software common cause failures are different from the current system. The effects of software common cause failures are mitigated by hardware design and system architecture. When these PRNM failures are evaluated at the system level, there are no new effects.

Enhanced Option I-A provided a long-term stability option with limited plant equipment modifications, and as such, developed regions where operation was prohibited with automatic protective actions and included a defense-in-depth option (i.e., Period Based Detection System (PBDS)) for unexpected events outside that region that relied upon a manual scram to terminate the event. As a result of enhanced monitoring capability of the NUMAC PRNM and the automatic detection and suppression of thermal-hydraulic instability afforded by the OPRM, the normal power/flow operating domain can be expanded. The OPRM system is designed to automatically detect and suppress instability events before they could impact the MCPR Safety Limit. Included with the OPRM function are two additional defense-in-depth algorithms that detect and suppress instability events. While these other defenses are not a credited solution, they provide robustness and backup to the Option III solution.

As previously stated, Enhanced Option I-A places restrictions on permitted operating regions of the power/flow map. These restrictions are known as the Exclusion Region and Restricted Region and use an automatic scram or rod block, respectively, to prevent or restrict operation in these regions. The Exclusion Region was designed to prohibit operation in those areas that thermal-hydraulic instability was credible and the Restricted Region where instabilities are possible. These regions were based on the Enhanced Option I-A specific licensing methodology and assumptions, using a combination of conservative calculations and specific restrictions agreed to between licensees and the NRC. Support of the boundaries requires cycle-dependent calculations and the regions are larger or smaller, depending on plant conditions. Interim corrective actions (ICAs), developed by the BWROG to assist utilities in the implementation of the requirements of NRC Bulleting 88-07, Supplement 1, directed in Technical

Specification 3.3.1.1, Required Action I.1, are less conservative than some of the associated Enhanced Option I-A regions which have been calculated in support of Enhanced Option I-A at BSEP. Conditions of reduced Feedwater system temperatures result in the most divergence such that the exclusion region is larger than the three ICA boundaries.

The Enhanced Option I-A solution had no provisions for an alternative method to continue operation with a generic solution problem. However, the NRC-approved Option III solution provides for alternative monitoring through the use of ICAs. The proposed Technical Specification changes are consistent with the Option III solution and industry practices that established the ICAs as suitable boundaries to preclude instability events. Based on experience from plants that have implemented the Option III solution, the anticipated use of these ICAs is infrequent. In addition, the time the plant would operate in areas of the power/flow map that were within the Enhanced Option I-A boundary regions (i.e., between full power operation and shutdown) is also small. Conditions conducive to reactor instability are possible even when operating within the guidance of the ICAs. Operator awareness of this potential when the reactor is in or near the stability regions, and the means to recognize and mitigate any resulting power oscillations are important components of the ICAs. If an instability event were to occur while operating under the ICAs, an immediate manual scram is required to mitigate the power oscillation.

As part of this change, the APRM Downscale RPS trip will be eliminated. The APRM Downscale trip is interlocked with the Intermediate Range Monitor (IRM) trip outputs to enable the IRM Neutron Flux - High or IRM Inop trip if the reactor mode switch is in RUN and the APRM shows a Downscale trip. The primary purpose of the Downscale interlock is to help assure that the APRM trip functions are operable and available before the reactor mode switch is moved to RUN. It also provides backup to assure that the IRM trip functions are available if the reactor power is allowed to go below the APRM calibrated range without moving the reactor mode switch out of RUN.

LPRM count below the normal minimum results in an alarm and rod block only. Therefore, this contribution is deleted from the automatic APRM Inop trip, but retained in the rod block and alarm logic. Consistent with this logic, in the replacement design, detection of fewer than the normally required number of LPRMs per level will result in an automatic rod block and alarm. In the current PRM system, operators must procedurally assure that the minimum number of LPRM detectors per level is maintained.

The net effect of these design aspects is that there are some single failures that can cause a greater loss of sub-functionality than in the current system. Other design and functional aspects, however, have an offsetting effect. Redundant power supplies are used so that a single failure of alternating current power has no effect on the overall PRNM system functions while still resulting in a half-scram as does the current system. Continuous automatic self-test also assures that if a single failure does occur, it is much more likely to be detected immediately. As a result, the reliability of the safety-related functions in the replacement system is equal to or better than the current PRM system.

The proposed Technical Specification changes associated with this modification are described below.

Discussion and Description of the Proposed Changes

The proposed Technical Specification changes are consistent with GE 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," which was approved by the NRC in a letter dated September 5, 1995, and GE LTR NEDC-32410P, Supplement 1, "Nuclear Measurement Analysis and Control Power Range Neutron Monitor (NUMAC-PRNM) Plus Option III Stability Trip Function," which was approved by the NRC in a letter dated August 15, 1997. Enclosure 4 to this letter provides responses to the plant-specific utility actions required by LTR NEDC-32410P-A, including Supplement 1, and includes descriptions and justifications for deviations from the LTRs as well as changes that are not addressed in the LTRs.

A. Technical Specification 3.2.3, "Fraction of Core Boiling Boundary (FCBB)"

Technical Specification 3.2.3 was established to support the implementation of the Enhanced Option I-A stability solution. With the implementation of the NUMAC PRNM system with OPRM, the Option III stability solution, this specification is no longer needed. Technical Specification 3.2.3, along with its associated Bases, have been deleted in their entirety.

B. Technical Specification 3.3.1.1, "Reactor Protection System (RPS) Instrumentation" - APRM Related RPS Functions

B.1 Functions

The APRM "Neutron Flux - High, Startup" scram function will be retained, but the name will be changed to APRM "Neutron Flux - High (Setdown)."

The APRM "Flow Biased Simulated Thermal Power - High" scram function will be retained, but the name will be changed to APRM "Simulated Thermal Power - High."

The APRM "Fixed Neutron Flux - High" scram function will be retained, but the name will be changed to APRM "Neutron Flux - High."

The APRM "Downscale" scram function will be eliminated.

The APRM "Inop" scram function will be retained, but logic of the function will be changed somewhat to reflect the new NUMAC PRNM system and to delete the minimum LPRM detector count from this trip. The minimum LPRM detector count will be retained in the Inop alarm.

A new pseudo APRM function entitled "2-Out-Of-4 Voter" will be added. 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. 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. Two of the 2-Out-Of-4 Voter channels will provide inputs to one RPS trip system and the other two 2-Out-Of-4 Voter channels will provide inputs to the other RPS trip system. As such, each of the inputs to RPS is a voted result of all four APRM channels. Additionally, only one APRM channel out of the four can be bypassed, while none of the voter channels can be bypassed. This assures at least two APRM channels to each of the 2-Out-Of-4 Voter channels in the event of a single APRM channel failure and one APRM channel bypassed. This will in turn result in trip signals to each RPS trip system (i.e., full scram).

A new "OPRM Upscale" scram function will be added. The OPRM Upscale Function provides automatic detection and suppression of anticipated thermal-hydraulic power oscillations, thus providing protection from exceeding the fuel MCPR Safety Limit.

B.2 Minimum Number of Operable APRM Channels

The required minimum number of operable APRM channels will change from four to three channels.

A new requirement for the minimum number of 2-Out-Of-4 Voter channels will be added; all four 2-Out-Of-4 Voter channels must be operable.

The minimum number of operable LPRMs per APRM channel required for APRM channel operability will increase from 11 to 17 per APRM channel and from two to three for each of the four LPRM axial levels.

A new requirement for the minimum number of operable OPRM channels will be added; three channels must be operable. The OPRM Upscale Function will have operability requirements associated with OPRM cells with a minimum of two LPRMs per cell for a cell to be operable and a minimum of 18 OPRM cells per OPRM channel for channel operability. The specific numerical values for these two parameters are identified as "plant specific" in the NUMAC PRNM LTRs.

B.3 Applicable Modes of Operation

The new APRM 2-Out-Of-4 Voter scram function will be required to be operable in Modes 1 (i.e., Power Operation) and 2 (i.e., Startup).

The new OPRM Upscale scram function will be required to be operable only in Mode 1 (i.e., Power Operation) with Reactor Power $\geq$ 20% Rated Thermal Power (RTP).

B.4 Channel Check Surveillance Requirements

The Channel Check requirement for the APRM scram functions will be the same except the frequency will be reduced from once per 12 hours to once per 24 hours.

The new APRM 2-Out-Of-4 Voter and OPRM Upscale Functions will have Channel Check requirements of the once per 24 hours.

B.5 Channel Functional Test Surveillance Requirements

APRM Neutron Flux - High (Setdown)

The channel functional test requirement will be changed from a frequency of every seven days to every 184 days. The Channel Functional Test will include both the APRM channels and the 2-Out-Of-4 voter channels.

APRM Simulated Thermal Power - High

A Channel Functional Test requirement for testing every 184 days has been added to support a decrease in the Channel Calibration frequency. The Channel Functional Test will include both the APRM channels and the 2-Out-Of-4 Voter channels plus the flow input processing, excluding the flow transmitters.

APRM Neutron Flux - High

A Channel Functional Test requirement for testing every 184 days has been added to support a decrease in the Channel Calibration frequency. The Channel Functional Test shall include both the APRM channels and the 2-Out-Of-4 Voter channels.

APRM Inop

The Channel Functional Test requirement will be changed from a frequency of every 92 days to 184 days. The Channel Functional Test shall include both the APRM channels and the 2-Out-Of-4 Voter channels.

OPRM Upscale

The new OPRM Upscale Function will have a Channel Functional Test requirement with a frequency of every 184 days. The Channel Functional Test includes both the OPRM channels and the 2-Out-Of-4 Voter channels plus the flow input processing, excluding the flow transmitters.

Automatic Scram Contactor Functional Test

The Functional Test of the automatic scram contactors, Surveillance Requirement (SR) 3.3.1.1.5, will continue to apply to the APRM scram functions, and will also be applied to the new OPRM Upscale Function and the new 2-Out-Of-4 Voter Function.

B.6 Channel Calibration Surveillance Requirements

APRM Neutron Flux - High (Setdown)

The Channel Calibration frequency will be changed from every 92 days to every 24 months.

APRM Simulated Thermal Power - High

The Channel Calibration frequency will be changed from every 92 days to every 24 months. Calibration of the flow transmitters that feed the APRMs will be included in overall Channel Calibration of this function at 24 month intervals. The current requirement (i.e., SR 3.3.1.1.14) to verify the APRM Simulated Thermal Power - High time constant is ≤ 7 seconds every 24 months is being deleted, consistent with the PRNM LTR.

APRM Neutron Flux - High

The Channel Calibration frequency will be changed from every 92 days to every 24 months.

APRM Inop

No change in requirement is proposed. No Channel Calibration applies.

OPRM Upscale

The new OPRM Upscale Function will have a Channel Calibration requirement (i.e., SR 3.3.1.1.13) with a frequency of every 24 months. The existing LPRM calibration requirement (i.e., SR 3.3.1.1.8) with a frequency of every 1100 megawatt days per ton (MWD/T) average core exposure will also be applied to the OPRM Upscale Function. Channel Calibration of the recirculation loop flow channel will be included for this function (i.e., flow is an input to the auto-enable logic of the OPRM Upscale Function), the same as the requirement for the APRM Simulated Thermal Power - High Function at 24 month intervals.

The OPRM Upscale Function will have a new SR 3.3.1.1.19 with a frequency of every 24 months to confirm that the OPRM auto-enable setpoints are correctly set.

Recirculation Drive Flow / Reactor Core Flow Alignment

The existing SR 3.3.1.1.18, which requires adjusting the flow control trip reference card to conform to reactor flow will be retained but revised to require only alignment of recirculation drive flow and reactor core flow. SR 3.3.1.1.18

will continue to apply to the APRM Simulated Thermal Power - High Function and will be applied to the new OPRM Upscale Function.

B.7 Response Time Testing Surveillance Requirements

The response time testing requirement for the APRM Neutron Flux - High (Setdown) and Neutron Flux - High Functions will be deleted, and none will be added for the new OPRM Upscale Function. A response time testing requirement for the 2-Out-Of-4 Voter Function will be included. That test will apply a Response Time requirement of 50 milliseconds, measured to include the voter outputs, the RPS logic, and the RPS contactors.

B.8 Logic System Functional Testing (LSFT) Surveillance Requirements

The LSFT requirements for the APRM Neutron Flux - High (Setdown), Simulated Thermal Power - High, Neutron Flux - High, and Inop Functions will be deleted, and none will be added for the new OPRM Upscale Function. A LSFT requirement will be added for the new 2-Out-Of-4 Voter Function with a frequency of every 24 months.

B.9 Limiting Condition for Operation (LCO) Conditions and Actions

LCO 3.3.1.1 Condition A, and the associated Required Actions apply to the new OPRM Upscale Function (i.e., Function 2.f) the same as for the APRM Functions 2.a, 2.b., 2.c, and 2.d in the new PRNM system. Similarly, Required Action A.2 and Condition B do not apply to Function 2.f.

New LCO 3.3.1.1 Conditions I and J will be added with associated Required Actions and Completion Times. These new Conditions apply when the OPRM channel Condition A Required Actions and associated Completion Times are not met, when the OPRM Upscale Function (i.e., Function 2.f) is not available due to less than two operable OPRM Channels, or when the OPRM Upscale Function is not available due to a design problem that renders all OPRM Channels inoperable. Required Action I.1 allows a Completion Time of 12 hours to initiate alternate methods of detecting and suppressing thermal hydraulic instability oscillations. Condition J applies if the Completion Time for Required Action I.1 is not met. The Required Action J.1 will allow four hours to reduce thermal power to less than 20% RTP.

The alternate method for detection and suppression of thermal hydraulic instability oscillations required by Required Action I.1 is intended to be temporary re-establishment of the Interim Corrective Actions (ICAs) specified in NRC Bulletin 88-07, Supplement 1, but controlled by plant procedures rather than Technical Specifications.

B.10 Setpoints and Allowable Values

Where justified by the setpoint calculations and the improved equipment performance specifications, Allowable Values will be adjusted. Those changes are marked in the Technical Specification markups.

There are no allowable values associated with the OPRM Upscale Function. The OPRM period based detection algorithm (PBDA) upscale trip setpoints are determined based on the Option III licensing methodology developed by the BWROG and are described in Reference 4. The PBDA setpoints will be documented in the Core Operating Limits Report (COLR).

The PBDA algorithm includes several "tuning" parameters. These are established in accordance with plant procedures as part of the system setup, and are not defined in Technical Specifications.

There are also Technical Specification related setpoints for the auto-enable (i.e., not-bypassed) region, which are established as nominal setpoints as described in the Technical Specification Bases markup, and which are defined in SR 3.3.1.1.19.

The minimum operable OPRM cells and setpoint is defined by GE analyses based on selection of the OPRM cell assignments for BSEP and a minimum of two LPRMs per cell. The setpoint is established to conform to the licensing bases defined in References 1 and 4. This setpoint, along with the selection of a minimum of two LPRMs per cell, is documented in the Technical Specification Bases as part of the operability requirement for the OPRM Upscale Function 2.f.

Finally, there are also setpoints for the "defense-in-depth" algorithms discussed in the OPRM Upscale Function description in the Technical Specification Bases markup. These are treated as nominal setpoints established by engineering judgment with no formal methodology. They are documented only in the plant procedures. A note will be added to Technical Specification Table 3.3.1.1-1 for the OPRM Upscale Function to state that the OPRM PBDA setpoints limits are defined in the COLR.

C. Technical Specification 3.3.1.3, "Period Based Detection System (PBDS)"

Technical Specification 3.3.1.3 was established to support the implementation of the Enhanced Option I-A stability solution. With the implementation of the NUMAC PRNM system with OPRM, the Option III stability solution, this specification is no longer needed. Technical Specification 3.3.1.3, along with its associated Bases, have been deleted in their entirety.

D. Technical Specification 3.3.2.1, "Control Rod Block Instrumentation"

The thermal power range surveillance limits associated with each RBM upscale function (i.e., Low Power, Intermediate Power, and High Power Ranges) will be modified to specify only the lower limit, rather than both the lower and upper limits, to reduce the risk of potential surveillance compliance problems in the future. These changes have no functional impact. The MCPR limits for RBM functions are being moved to the COLR.

The Channel Functional Test surveillance frequency is being changed from every 92 days to every 184 days for the RBM functions.

The RBM "Downscale" rod block function will be deleted from Technical Specifications.

E. Technical Specification 3.4.1, "Recirculation Loops Operating"

The reference to the APRM "Flow Biased Simulated Thermal Power - High" scram function will be replaced with APRM "Simulated Thermal Power - High" to reflect the change in the name of the function. The statement relating to resetting the APRM Simulated Thermal Power - High Allowable Value for single loop operation is also reworded slightly to recognize that the required value for the single loop operation adjustment is described in a note to Technical Specification 3.3.1.1 Table 3.3.1.1-1.

F. Technical Specification 3.10.8, "Shutdown Margin (SDM) Test - Refueling"

The APRM 2-Out-Of-4 Voter scram function (i.e., Function 2.e) will be added to LCO 3.10.8.a and SR 3.10.8.1 since it is required to be operable in Mode 2 (i.e., Startup).

G. Technical Specification 5.6.5, "Core Operating Limits Report (COLR)"

Requirements for contents of the COLR are being modified to eliminate requirements associated with Enhanced Option I-A by deleting Specification 5.6.5.a.3 associated with the APRM Simulated Thermal Power - High Allowable Values.

A new requirement is being added for the OPRM PBDA setpoint limits associated with Technical Specification 3.3.1.1.

References to the analytical methods used to determine the core operating limits (i.e., Technical Specification 5.6.5.b) are being revised to delete references associated with Enhanced Option I-A. PBDA setpoint methodology is documented by reference in NEDE-24011-P-A, "General Electric Standard Application for Reactor Fuel," which is already listed in Technical Specification 5.6.5.b.

Basis for the Proposed Changes

The basis for the above listed Technical Specification changes are documented in Section 8.0 of the NUMAC PRNM LTR NEDC-32410P-A including Supplement 1, both of which have been approved by the NRC, with the following exceptions.

Technical Specification 3.3.1.1 - APRM Related RPS Instrumentation Functions

Function 2.f, OPRM Upscale

The specific number of LPRMs per OPRM cell, the minimum required number of LPRMs for an OPRM cell to be considered operable, and the minimum number of OPRM cells required to be operable for an OPRM channel to be considered operable are identified as plant specific values in the NUMAC PRNM LTRs, References 2 and 3, with no specific criteria on selection or calculation of the values. In addition, the NUMAC LTRs do not discuss the specific assignment of LPRMs to OPRMs cell or any criteria for those assignments. The NRC approved BWROG LTRs, References 1 and 4, provide the criteria related to determination of those values.

Based on the criteria in the BWROG LTRs, CP&L has selected an LPRM-to-OPRM Cell assignment pattern that includes either three or four LPRMs per OPRM cell. This selection meets the criteria in the BWROG LTRs. Similarly, CP&L has selected two LPRMs as the minimum required per OPRM cell for OPRM cell operability. Based on these two CP&L selected aspects of the OPRM system, cell assignments and minimum number of LPRMs per cell, GE has performed analyses in accordance with the methodology defined in the BWROG LTRs to establish the PBDA setpoint limit criteria. The setpoint values will be documented in the COLR. Also based on CP&L's selected cell assignments and minimum number of LPRMs per cell, GE has performed analyses to establish a minimum of 18 OPRM cells required for OPRM channel operability. The cell assignments, minimum number of LPRMs per cell, and minimum required OPRM cells selections are included in the Technical Specification Bases markups.

The bases description of the OPRM power level for operability (i.e., 20% RTP) and for "trip enable" (i.e., 25% RTP and 60% recirculation drive flow) has been modified somewhat from the NUMAC LTR version for clarity. There is no technical change from the intent. These values are identified as plant-specific in the NUMAC PRNM LTRs. Based on a BWROG letter to the NRC, dated September 17, 1996 (i.e., Reference 5), providing background and guidance, CP&L has selected the above values. The values will be treated as nominal values with no additional margin added to determine the actual setpoints to be entered in the equipment.

Action I.2

Required Action I.2 included in the PRNM LTR Supplement 1, with a Completion Time of 120 days, has not been included in the proposed Technical Specifications. Condition I was included in the PRNM LTRs to address a possible common cause OPRM design problem, which was considered most likely to result either from some unanticipated problem with one or more of the OPRM algorithms or the software design implementing the algorithms. A less likely cause was an unanticipated hardware design problem. It was hypothesized that such a design problem could result either in failure of the algorithms to effectively detect instabilities or to cause spurious trips. The 120 day LCO completion time, for Required Action I.2, recognized that resolution of such a problem would take substantially longer than the 12 hours otherwise allowed by Required

Action I.1. Although the NUMAC PRNM/OPRM has now been in operation at several plants for several years without indication of an OPRM design problem, there have also been no identified instability conditions at those plants. Therefore, it is reasonable to assume that such a design problem may still be identified in the OPRM function. However, industry experience with another OPRM design shows that effective resolution of an OPRM design problem, if it involves a fundamental part of the design, is likely to take substantially longer than 120 days. In that event, the licensee experienced a delay of more than 10 months in solving an OPRM software problem reported in a 10 CFR Part 21 report filed by ABB on June 29, 1999. Therefore, to avoid the risk of an otherwise unnecessary plant shutdown, Required Action I.2 has not been included in the proposed Technical Specifications. The NRC has previously approved a similar change for the Perry Nuclear Power Plant by License Amendment No. 118, dated February 26, 2001. Required Action I.1 will continue to require implementation of alternate methods, which are defined to be procedural establishment of ICAs. Due to the low probability of occurrence of an instability event, operation under ICAs beyond 120 days for a period long enough to resolve an OPRM design problem does not create a safety concern.

Elimination of Required Action I.2 will not significantly reduce the motivation to promptly resolve OPRM design problems that may develop. The plant will be operating in an Active LCO while in Condition I. In addition, any such problem is likely to result in a 10 CFR Part 21 report and full NRC cognizance. Finally, the design problem leading to entry into Condition I would be required to be corrected in a timely fashion by 10 CFR 50 Appendix B Criterion XVI, "Corrective Action," which requires that conditions adverse to quality be promptly identified and corrected.

Required Action I.1 is not intended to be used as a routine alternative to returning failed equipment to operable status as stated in PRNM LTRs and re-stated in the Bases discussion for Required Action I.1. The basic NUMAC PRNM OPRM equipment design provides further assurance that this intent will be met since, with the exception of one added processor module in each APRM channel, all hardware required for the OPRM Upscale Function is the same hardware as that required for the APRM Functions performed by that channel. The single additional hardware module is of identical design as two processor modules already used in each APRM chassis, differing only in the firmware installed on the module. Therefore, any hardware failure in the APRM equipment that results in declaring the OPRM Upscale Function inoperable, other than a specific problem with the firmware design, is likely to also result in inoperability of one or more of the APRM Functions performed by the same chassis. Condition I does not apply to APRM Functions.

Based on the above evaluation, it is concluded that the proposed change from the NUMAC PRNM LTR Supplement 1 to delete Required Action I.2 will avoid unnecessary plant shutdowns or processing of unnecessary Technical Specification changes, while maintaining plant safety, and will not result in unnecessary delays in returning the OPRM Function to operable status.

Channel Functional Test, SR 3.3.1.1.11

A note applicable to Functions 2.b and 2.f has been added to the SR that states that the SR includes the recirculation flow input processing except for the flow transmitters. The note was not included in the NUMAC LTR. The bases description has been modified slightly from that in the NUMAC LTR to include discussion of this note and to clarify that the actual OPRM trip auto-enable setpoints are confirmed by SR 3.3.1.1.19.

Channel Calibration, SR 3.3.1.1.13

A note applicable to Functions 2.b and 2.f has been added to the SR that states that the SR includes the recirculation flow transmitters that feed the APRMs. The note was not included in the NUMAC LTR. The Bases description has been modified slightly from that in the NUMAC LTR to include discussion of this note and to reference SR 3.3.1.1.18 for the recirculation drive flow alignment with reactor core flow. The wording of the Bases discussion has been revised somewhat from that in the LTR to improve clarity, and also to recognize that the OPRM Upscale Function requires recirculation flow calibration to support the auto-enable function.

Recirculation Drive Flow Alignment With Reactor Core Flow, SR 3.3.1.1.18

The existing SR 3.3.1.1.18 was added to support Enhanced Option I-A. It is not discussed in the PRNM LTRs. However, while not as critical as for Enhanced Option I-A, recirculation drive flow alignment with reactor core flow is still required for the new PRNM system to support the flow-biased scram setpoint for the Simulated Thermal Power - High Function and for the auto-enable function of the OPRM Upscale Function. Consequently, SR 3.3.1.1.18 has been retained, but modified to reflect the method of adjustment used in the NUMAC PRNM. The corresponding Bases has been similarly modified.

Response Time Testing, SR 3.3.1.1.17

The LTR deletes response time testing requirements except for the 2-Out-Of-4 Voter Function 2.e. The LTR also discusses application of staggered testing as applied to the voter function, but shows no specific changes to the SR or the Bases to define the testing requirements. To address this, the proposed Technical Specification includes a change to SR 3.3.1.1.17 to add a note to define "n" for Function 2.e, and adds discussion to the Bases on how to satisfy the staggered testing requirements. These changes are within, and slightly more conservative than, the limits justified in the LTRs.

Setpoints and Allowable Values

The improved performance specifications for the PRNM system equipment compared to the current equipment provide additional margin between the setpoints or allowable values and the corresponding analytical limits or design basis values. Part of that margin will be "consumed" to offset the effects of increased surveillance intervals. The remaining margin, where available, is used to justify relaxing the Allowable Values.

Technical Specification 3.3.2.1 - APRM Control Rod Block Functions

RBM Upscale Operability Limits

The thermal power range surveillance limits associated with each RBM upscale function (i.e., Low Power, Intermediate Power, and High Power Ranges) will be modified to specify only the lower limit, rather than both the lower and upper limits, to reduce the risk of potential surveillance compliance problems in the future. These changes have no functional impact. As revised, the TS surveillance requirement still accomplishes the same technical objective without the literal compliance problem.

RBM Downscale Trip

Deletion of the RBM Downscale trip from the Technical Specifications is not discussed in the LTR.

The RBM downscale trip function will detect substantial reductions in the RBM local flux after a "null" is completed, which occurs after a new rod selection. This function, in combination with the RBM Inop Function, is intended to detect problems with or abnormal conditions in the RBM equipment and system. However, no credit is taken for the RBM downscale trip function in the establishment of the RBM upscale trip analytical limits or setpoint values.

In the original analog RBM, the inclusion of a downscale function in addition to the inop function had merit in that the analog equipment had some failure modes that could result in a reduction of signal, but not a full failure. Unlike other neutron monitoring system downscale functions (e.g., APRM downscale), there are no normal operating conditions that are intended to be detected by the RBM Downscale Function. Therefore, the RBM Downscale Function was part of the overall RBM Inop Function.

The replacement of the original analog RBM with the NUMAC digital RBM results in the original analog processing being replaced by digital processing. One effect of this is to eliminate the types of failures that can reasonably be detected by the downscale trip function. In addition, the inop function is enhanced in the NUMAC RBM by the use of automatic self-test and internal logic to increase the detectability of abnormal conditions and to directly include these in the RBM Inop Function.

Therefore, in the NUMAC APRM, RBM, and Technical Specification Improvement Program (ARTS) RBM, there is no incremental value or benefit provided by the RBM Downscale Function. Criteria for including items in Technical Specifications are provided in 10 CFR 50.36. The RBM Downscale Function does not meet these criteria, and therefore, is being removed from the Technical Specifications and from the related discussion in the Bases. However, the RBM Inop Function will be retained.

Technical Specification 3.4.1 - Recirculation Loops Operating

The LTR did not include any discussion of the Technical Specification 3.4.1. This Technical Specification must be revised to be consistent with the proposed APRM Technical Specification changes for PRNM.

References

1. Licensing Topical Report NEDO-31960-A (Including Supplement 1), "BWR Owners' Group Long-Term Stability Solutions Licensing Methodology," November 1995.

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

3. 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," November 1997.

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

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

6. General Electric Nuclear Energy Report GENE-C51-00251-00-01, Revision 0, "Reactor Long-Term Stability Solution Option III: Licensing Basis Hot Bundle Oscillation Magnitude for Brunswick 1 and 2," March 2001.

7. General Electric Nuclear Energy Letter NSA 01-212, DRF C51-00251-00, A. Chung (GE) to S. Chakraborty (GE), "Minimum Number of Operable OPRM Cells for Option III Stability at Brunswick 1 and 2," June 8, 2001.

ENCLOSURE 2

BRUNSWICK STEAM ELECTRIC PLANT, UNIT NOS. 1 AND 2
DOCKET NOS. 50-325 AND 50-324/LICENSE NOS. DPR-71 AND DPR-62
REQUEST FOR LICENSE AMENDMENTS
THERMAL-HYDRAULIC STABILITY OPTION III

10 CFR 50.92 EVALUATION

Carolina Power & Light (CP&L) Company has concluded that the proposed changes to the Brunswick Steam Electric Plant (BSEP), Unit Nos. 1 and 2 Technical Specifications supporting installation of a new digital Power Range Neutron Monitoring (PRNM) system which incorporates the Boiling Water Reactor Owners' Group (BWROG) Option III long-term thermal hydraulic stability solution, do not involve a Significant Hazards Consideration. In support of this determination, an evaluation of each of the three (3) standards set forth in 10 CFR 50.92 is provided below.

1. The proposed license amendments do not involve a significant increase in the probability or consequences of an accident previously evaluated.

   The proposed change will replace the currently installed and NRC approved Enhanced Option I-A long-term stability solution, which prohibits operation in areas with the potential for instability, with an NRC approved Option III long-term stability solution. The PRNM hardware meets the General Design Criteria (GDC) 10 and 12 requirements by automatically detecting and suppressing design basis thermal-hydraulic oscillations prior to exceeding the fuel Minimum Critical Power Ratio (MCPR) Safety Limit. The accident probability will not change since the instability is suppressed prior to exceeding the MCPR Safety Limit, the solution has defense-in-depth features, and is of robust design. In addition, the PRNM system does not interact with equipment whose failure could cause an accident, and compliance is retained for regulatory criteria established for PRNM system and associated plant equipment. Scram setpoints in the PRNM system will be established so that analytical limits are met. The reliability of the new system will meet or exceed that of 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.

   Proper operation of the PRNM system does not affect any fission product barrier or Engineered Safety Feature. Thus, the proposed change cannot change the consequences of any accident previously evaluated. As stated above, the PRNM system meets the requirements of GDC 10 and 12 by automatically detecting and suppressing design basis thermal-hydraulic oscillations prior to exceeding the fuel MCPR Safety Limit.

   Based on the above, the operation of the new PRNM system and replacement of the currently installed Enhanced Option I-A stability solution with the Option III Oscillation

Power Range Monitor (OPRM) function will not increase the probability or consequences of an accident previously evaluated.

2. The proposed license amendments will not create the possibility of a new or different kind of accident from any accident previously evaluated.

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 the PRNM system has been evaluated. No new operating mode, safety-related equipment lineup, accident scenario, system interaction, or equipment failure mode was identified. Therefore, the PRNM system will not adversely affect plant equipment.

The current plant design using the Enhanced Option I-A long-term stability solution depends on prohibited operating regions with an automatic scram if the exclusion region of the power/flow map is entered and an automatic rod block if the restricted region of the power/flow map is entered. The current design also relies on operator action to manually scram the plant if automatic monitoring of neutron flux through the period based detection system (PBDS) provides an instability alarm when in a region that has a potential for instability. The modification implementing PRNM replaces these automatic and manual requirements with a fully automatic detect and suppress capability to assure that instability events that occur will be terminated before the MCPR Safety Limit is exceeded. The "scram and rod block enforced" restrictions on the operating region are relaxed. Potential failures in the OPRM Upscale function could result in either failure to take the required mitigating action or an unintended reactor scram, which are the same potential effects of failure of the currently installed Enhanced Option I-A functions.

The PRNM modification and associated changes to the Technical Specifications involve equipment that is designed to detect the symptoms of certain events or accidents and initiate mitigating actions. The worst cast failure of the equipment involved in the modification is a failure to initiate mitigating action (i.e., scram or rod block), but no failure can cause an accident of a new or different kind than any previously evaluated.

Based on the above, the proposed change will not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. The proposed license amendments do not involve a significant reduction in a margin of safety.

The current safety analyses assume that the existing Enhanced Option I-A related Technical Specification requirements are adequate to prevent an instability event. PBDS is provided as part of the design to detect and suppress an instability event as a defense-in-depth feature. As a result, there is currently no impact on the MCPR Safety Limit identified for an instability event.

The Option III OPRM trip function is being implemented to fully automate the detection, via direct measurement of neutron flux, and subsequent suppression, via scram, of an instability event prior to exceeding the MCPR Safety Limit. Other OPRM trip features (i.e., Growth and Amplitude Algorithms) are provided as part of a robust design and defense-in-depth feature for unanticipated oscillations. Currently, the MCPR Safety Limit is not challenged by an instability event since the event is prevented by automatic means or mitigated by automatic and manual means via the Enhanced Option I-A functions. In both methods the margin of safety associated with the MCPR Safety Limit is maintained.

Other changes such as setpoint revisions, removing the Average Power Range Monitor Downscale function from the Reactor Protection System trip logic, removing the number of operable Local Power Range Monitors from the automatic trip logic, and lengthening the Surveillance Requirement frequencies are shown to be acceptable, as documented in 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," October 1995, and LTR NEDC-32410P-A Supplement 1, "Nuclear Measurement Analysis and Control Power Range Neutron Monitor (NUMAC-PRNM) Retrofit Plus Option III Stability Trip Function," November 1997. Both of these LTRs have been reviewed and approved by the NRC.

Based on the above, the proposed change will not involve a significant reduction in the margin of safety.

ENCLOSURE 3

BRUNSWICK STEAM ELECTRIC PLANT, UNIT NOS. 1 AND 2
DOCKET NOS. 50-325 AND 50-324/LICENSE NOS. DPR-71 AND DPR-62
REQUEST FOR LICENSE AMENDMENTS
THERMAL-HYDRAULIC STABILITY OPTION III

ENVIRONMENTAL CONSIDERATIONS

Carolina Power & Light (CP&L) Company has concluded that the proposed changes to the Brunswick Steam Electric Plant (BSEP), Unit Nos. 1 and 2 Technical Specifications supporting installation of a new digital Power Range Neutron Monitoring (PRNM) system which incorporates the Boiling Water Reactor Owners' Group (BWROG) Option III long-term thermal hydraulic stability solution are eligible for categorical exclusion from performing an environmental assessment. In support of this determination, an evaluation of each of the three (3) criteria set forth in 10 CFR 51.22(c)(9) is provided below.

1. The proposed license amendments do not involve a significant hazards consideration, as shown in Enclosure 2.

2. The proposed license amendments do not result in a significant change in the types or a significant increase in the amounts of any effluent that may be released offsite. The NUMAC PRNM modification and associated changes to the Technical Specifications involve equipment that is designed to detect the symptoms of certain events or accidents and initiate mitigating actions. The worst cast failure of the equipment involved in the modification is a failure to initiate mitigating action (i.e., scram or rod block), but no failure can cause an accident or result in a significant change in the types or a significant increase in the amounts of any effluent that may be released offsite. The PRNM replacement system is designed to perform the same operations as the existing Power Range Monitor system and meets or exceeds current operational requirements. The proposed license amendments do not alter the function of existing equipment and will ensure that the consequences of any previously evaluated accident do not increase. Therefore, CP&L has concluded that there will not be a significant increase in the types or amounts of any effluent that may be released offsite and, as such, the changes do not involve irreversible environmental consequences beyond those already associated with normal operation.

3. The proposed license amendments do not result in an increase in individual or cumulative occupational radiation exposure.

ENCLOSURE 4

BRUNSWICK STEAM ELECTRIC PLANT, UNIT NOS. 1 AND 2
DOCKET NOS. 50-325 AND 50-324/LICENSE NOS. DPR-71 AND DPR-62
REQUEST FOR LICENSE AMENDMENTS
THERMAL-HYDRAULIC STABILITY OPTION III

PLANT SPECIFIC RESPONSES TO REQUIRED UTILITY ACTIONS DELINEATED IN LICENSING TOPICAL REPORT NEDC-32410P-A

Additional Information for Section 3.4 - Justification for Safety Classification of Replacement Recirculation Flow Transmitters

The recirculation flow transmitters currently installed at BSEP are 10-50 milliamp output transmitters classified as non-safety-related. The replacement 4-20 milliamp output transmitters will be non-safety-related Rosemount 1151 type, specified to operate in the full range of environments applicable to their mounting location for conditions under which the OPRM Upscale Function or APRM Simulated Thermal Power - High Function are required to operate. The transmitters may not continue to operate under High Energy Line Break or Loss of Coolant Accident conditions, but these conditions do not occur simultaneously with the conditions for which the OPRM Upscale Function or APRM Simulated Thermal Power - High Function are credited with providing a scram trip.

The transmitters will be seismically mounted in the same location as the current transmitters. Signals from the transmitters to the NUMAC APRM are routed in four separate trays or conduits with no other circuits except low energy source range monitor (SRM), intermediate range monitor (IRM), or LPRM inputs from the transmitters to the APRM panel input, unchanged from the current routing. The trays or conduits provide physical separation between both the individual flow circuits and between the flow circuits and other circuits of sufficient energy to damage the flow input circuits.

Although the flow transmitters are not qualified as safety-related and connect directly into the safety-related APRM equipment, no separate isolators are required. The flow transmitters derive all power from the APRM channel. The safety-related APRM channel is designed so that the worst-case transmitter failures (i.e., an open circuit, a short circuit, or a short circuit to ground) cannot damage the APRM hardware. Any transmitter failure will at worst provide an incorrect flow signal input to that APRM channel.

Therefore, since the replacement flow transmitters meet or exceed the capability of the current transmitters relative to the APRM flow-biased scram signals, for which no credit is taken in the plant safety analyses, meet the NRC SER requirements for OPRM, and cannot fail in a manner that will affect other than their own flow input signal, the replacement transmitters meet the application requirements.

Additional Information for Section 8.4.2.4 - Justification for Not Including Required Action I.2, 120-day Limiting Condition for Operation (LCO)

Required Action I.2 included in the PRNM LTR Supplement 1, with a Completion Time of 120 days, has not been included in the proposed Technical Specifications. Condition I is entered, via Required Actions C.1, D.1 and the requirements of Technical Specification Table 3.3.1.1-1, when OPRM trip capability is not maintained. Condition I was included in the PRNM LTRs to address a possible common cause OPRM design problem, which was considered most likely to result either from some unanticipated problem with one or more of the OPRM algorithms or the software design implementing the algorithms. A less likely cause was an unanticipated hardware design problem. It was hypothesized that such a design problem could result either in failure of the algorithms to effectively detect instabilities or to cause spurious trips. The 120 day LCO completion time, for Required Action I.2, recognized that resolution of such a problem would take substantially longer than the 12 hours otherwise allowed by Required Action I.1.

Although the NUMAC PRNM system has now been in operation at several plants for several years without any indication of an OPRM design problem, there have also been no identified instability conditions at any of those plants. Therefore, it is reasonable to assume that such a design problem may still be identified in the OPRM function. However, industry experience with another OPRM design shows that effective resolution of an OPRM design problem, if it involves any fundamental part of the design, is likely to take substantially longer than 120 days. In that event, the licensee experienced a delay of more than 10 months in solving an OPRM software problem reported in a 10 CFR Part 21 report filed by ABB on June 29, 1999. Therefore, to avoid the risk of an otherwise unnecessary plant shutdown, Required Action I.2 has not been included in the proposed Technical Specifications. The NRC has previously approved a similar change for the Perry Nuclear Power Plant by License Amendment No. 118, dated February 26, 2001. Required Action I.1 will continue to require implementation of alternate methods, which are defined to be procedural establishment of Interim Corrective Actions (ICAs). Due to the low probability of occurrence of an instability event, operation under ICAs beyond 120 days for a period long enough to resolve an OPRM design problem does not create a safety concern.

Elimination of Required Action I.2 will not significantly reduce the motivation to promptly resolve any OPRM design problem that may develop. The plant will be operating in an Active LCO while in Condition I. In addition, any such problem is likely to result in a 10 CFR Part 21 report and full NRC cognizance. Finally, the design problem leading to entry into Condition I will be required to be corrected in a timely fashion by the 10 CFR 50 Appendix B Criterion XVI, "Corrective Action," which requires that conditions adverse to quality be promptly identified and corrected.

Required Action I.1 is not intended to be used as a routine alternative to returning failed equipment to operable status as stated in PRNM LTRs and re-stated in the Bases discussion for Required Action I.1. The basic NUMAC PRNM OPRM equipment design provides further assurance that this intent will be met since, with the exception of one added processor module in each APRM channel, all hardware required for the OPRM Upscale Function is the same hardware as that required for the APRM Functions performed by that channel. The single additional hardware module is of identical design as two processor modules already used in each APRM chassis, differing only in the firmware installed on the module. Therefore, any hardware failure in the APRM equipment that results in declaring the OPRM Upscale Function inoperable, other than a specific problem with the firmware design, is likely to also result in inoperability of one or more of the APRM Functions performed by the same chassis. Condition I does not apply to APRM Functions.

Based on the above evaluation, it is concluded that the proposed change from the NUMAC PRNM LTR Supplement 1 to delete Required Action I.2 will avoid unnecessary plant shutdowns or processing of unnecessary Technical Specification changes, while maintaining plant safety, and will not result in unnecessary delays in returning the OPRM Function to operable status.

Additional Information for Section 8.5.1.4 - Justification for Deletion of Rod Block Monitor Downscale Function 1.e

The effect of the differences between the original analog equipment and the replacement digital equipment on the RBM Downscale Function was not recognized at the time the NUMAC PRNM LTR was prepared, so this deletion was not addressed in the LTR.

The RBM Downscale Function will detect substantial reductions in the RBM local flux after a "null" is completed, which occurs after a new rod selection. This Function, in combination with the RBM Inop Function, was intended in the original system to detect problems with or abnormal conditions in the RBM equipment and system. However, no credit is taken for the RBM Downscale Function in the establishment of the RBM upscale trip setpoints or AVs.

Unlike other neutron monitoring system downscale Functions (e.g., APRM Downscale), there are no normal operating conditions that are intended to be detected by the Downscale Function. In the original analog RBM, the inclusion of the Downscale Function in addition to the Inop Function had some merit in that the analog equipment had some failure modes that could result in a reduction of signal, but not a full failure. Therefore, the RBM Downscale Function is part of the overall inop condition detection function.

The replacement of the original analog RBM equipment with the NUMAC digital RBM results in the original analog processing being replaced by digital processing. One effect of this change is to eliminate the types of failures that can reasonably be detected by a Downscale Function. In addition, the Inop Function is enhanced in the NUMAC RBM by the use of automatic self-test and other internal logic to increase the detectability of failures and abnormal conditions that can occur in the digital equipment, and to directly include these in the RBM Inop Function.

Therefore, in the NUMAC ARTS RBM, there is no incremental value or benefit provided by the RBM Downscale Function. Criteria for including items in Technical Specifications are provided in 10 CFR 50.36. The RBM Downscale Function does not meet these criteria and, therefore, is being removed from the Technical Specifications and from the related discussion in the Bases. The RBM Inop Function is being retained.

OPRM Corner Frequency, Period Tolerance, and Maximum Period Discussion, Proposed Setpoint Range Revisions, and Associated Justifications

Background

LTR NEDO-32465-A, "Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications," describes the licensing basis methodology for the Option III long-term stability solution. The licensing basis for this solution is the period based algorithm (PBA) which relies on the fact that OPRM "cells," composed of closely spaced LPRMs, can be used to distinguish between thermal-hydraulic instabilities and stable reactor operation. During normal, steady state reactor operation, LPRM signals are comprised of a broad range of frequencies that are typically present in a boiling water reactor (BWR). These LPRM signals become more coherent displaying a characteristic frequency in the 0.3 to 0.7 Hertz (Hz) range with the onset of thermal-hydraulic instability. The PBA uses the difference in LPRM signal coherence to detect instabilities. The coherence persists when signals from closely spaced LPRMs are combined in OPRM cells.

Specifically, the OPRM combines signals from LPRMs assigned to the OPRM cell and determines each successive pair of OPRM cell maxima and minima. If the maxima/minima occur at a frequency in the range of 0.3 to 0.7 Hz, the base period is set. If the subsequent maxima/minima occur within a specified tolerance band of the base period, the oscillation is considered to be a single period confirmation. Subsequent maxima/minima that fall within the specified base period tolerance range cause the PBA continuous period confirmation (CPC) counter to be incremented by one. This process continues until a maxima/minima is found to be outside the specified base period tolerance range, at which time the CPC counter is reset to zero. The last CPC count prior to resetting is termed the maximum continuous period confirmation (MCPC) count.

The CPC for each OPRM cell is evaluated simultaneously. During normal plant operation with large stability margin, non-zero CPC count values are expected due to the random nature of normal core neutron-flux noise. Based on basic principles and confirmed by the results of OPRM "tuning" studies at plants that have previously installed the NUMAC OPRM function, largest frequency of occurrence is a MCPC of 1, with rapidly decreasing frequency of occurrence of higher MCPC counts. The OPRM tuning process is intended to optimize the setting values of various OPRM tuning parameters so that the PBA is sufficiently sensitive to detect actual core oscillations while not unnecessarily tripping on normal core neutron-flux noise.

Section 3.4.1 of LTR NEDO-32465-A describes the acceptable range of values for two OPRM parameters, period tolerance and corner frequency. Both of these parameters can be independently adjusted to tune the OPRM to each plant's unique LPRM noise characteristics. Within the ranges defined for these parameters, the OPRM will provide sufficient CPCs to detect thermal-hydraulic instabilities prior to reaching the PBA amplitude trip setpoint. The ranges presented in NEDO-32465-A were based upon testing the PBA using data taken with analog LPRM signals from several different plants. Data was taken at a 50 millisecond sample rate during stable and unstable reactor operation. A range for each OPRM setpoint value was defined to ensure that the OPRM is sensitive enough to detect an instability as it develops at low amplitudes while allowing utilities the flexibility to adjust the OPRM response to their plant's noise characteristics during steady-state operation. The adjustments to account for noise characteristics are necessary to avoid spurious alarms and reactor scrams. Normal operational LPRM signals are viewed by the OPRM as a distribution of MCPCs. The OPRM is tuned based on the MCPC distribution under plant operating conditions that have significant stability margin (i.e., near or at rated conditions).

Planned BSEP Settings

Based on OPRM data collected during the "monitoring period" following PRNM installation, all plants that have installed the NUMAC PRNM/OPRM have concluded that at least some of the OPRM channels are too sensitive when the least sensitive setpoints defined in Table 3-1 of LTR NEDO-32465-A are used (i.e., period tolerance of 100 milliseconds and corner frequency of 2.5 Hz). However, the OPRM design of the PRNM system allows the OPRM period tolerance and corner frequency to be set to less sensitive values than those defined in the LTR (i.e., the hardware allows values from 50 to 300 millisecond and 1.0 to 3.0 Hz) compared to 100 to 300 millisecond and 1.0 to 2.5 Hz in the LTR. Testing at other plants with NUMAC PRNM systems installed consistently indicates that the OPRM channels can be tuned to more closely meet the GE tuning criteria under normal operating conditions if a period tolerance of 50 milliseconds and corner frequency of 3.0 Hz are used.

The following factors contribute to the OPRM Upscale Function being more sensitive than originally anticipated:

1. The plant data used to develop the OPRM detection algorithm had a sample interval of 50 milliseconds. The NUMAC PRNM provides LPRM data to the OPRM algorithm every 25 milliseconds. This increased sampling rate tends to increase OPRM sensitivity.

2. LPRM noise characteristics in the data from the reference plants, which was used to test the detection algorithm, differ from the noise characteristics in the LPRM signals in the NUMAC PRNM. Specifically, the NUMAC PRNM system has improved accuracy, noise immunity, and LPRM signal filtering. The additional LPRM filtering tends to increase OPRM sensitivity, thus producing higher MCPC counts when the plant is operating with a large stability margin.

The maximum oscillation period (T_{max}) is the largest expected period that the OPRM would sense if a reactor instability was present. The minimum oscillation period (T_{min}) is the smallest expected period that the OPRM would sense if a reactor instability was present. For example, if the time between successive LPRM signal maxima/minima is greater than T_{max}, or less than T_{min}, the oscillation is not indicative of an anticipated reactor instability. Section 4.3.2.4 of LTR NEDO-32465-A states that studies of actual instability events indicate that the expected period is approximately 1.8 to 2.0 seconds (0.5 to 0.56 Hz), but that it is desirable to consider a wider band of oscillation frequencies between 0.3 Hz (T_{max} = 3.3 seconds) and 0.7 Hz

(T_{min} = 1.4 seconds). The OPRM design allows T_{max} to be set in the range of 3.0 to 5.0 seconds (0.33 to 0.2 Hz). A review of the online test data from other plants with a NUMAC OPRM operating indicates that setting T_{max} at its lower design limit of 3.0 seconds (frequency of 0.33 Hz) may help to avoid spurious OPRM alarms and trips. Based on Figure 4-5 of LTR NEDO-32465-A, allowing T_{max} to be set down to 3.0 seconds does not significantly alter the probability of detecting core instability.

Based on the experience to date at other plants, BSEP OPRM tuning procedures will allow T_{max} settings down to the hardware limit of 3.0 seconds, period tolerance settings of 50 milliseconds, and corner frequency settings of 3.0 Hz. To minimize the risk of spurious OPRM alarms and trips during the first startup following installation of the PRNM system, these least sensitive settings of the tuning parameters will be used as the initial values. OPRM tuning measurements will be conducted at BSEP during and shortly after startup to confirm that the BSEP system behavior is consistent with that observed at other plants. If warranted based on compliance with the GE defined tuning criteria, adjustments of the tuning parameter settings, within the above limits, will be made.

<u>Summary</u>

The OPRM is fully expected to produce enough MCPCs to exceed the alarm and trip setpoints if a thermal-hydraulic instability should occur. Using the full range of tuning parameters allowed by the OPRM equipment design, including the allowance to set the corner frequency up to the limiting value of 3.0 Hz, the period tolerance down to the limiting value of 50 milliseconds, and the maximum period down to the limiting value of 3.0 seconds, will provide acceptable OPRM sensitivity based on the foregoing discussions. These setpoint values are slightly outside the ranges described in LTR NEDO-32465-A, which were based on data from a few plants with different power range monitoring system designs. However, the values are consistent with the original definition of the PBA in NEDO-31960-A, Supplement 1. The proposed tuning setpoint range changes provide margin to spurious alarms and trips during stable reactor operation and do not compromise the ability of the OPRM to detect instabilities and initiate an automatic reactor scram prior to violating the MCPR Safety Limit for anticipated reactor instabilities.

ENCLOSURE 6

BRUNSWICK STEAM ELECTRIC PLANT, UNIT NOS. 1 AND 2
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THERMAL-HYDRAULIC STABILITY OPTION III

TYPED TECHNICAL SPECIFICATION PAGES - UNIT NO. 1

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 Functions 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 the 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 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.

5.6 Reporting Requirements (continued)

5.6.5 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 AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR) for Specification 3.2.1;

   2. The MINIMUM CRITICAL POWER RATIO (MCPR) for Specification 3.2.2;

   3. The period based detection algorithm (PBDA) setpoint for Function 2.f, Oscillation Power Range Monitor (OPRM) Upscale, for Specification 3.3.1.1; and

   4. The Allowable Values and power range setpoints for Rod Block Monitor Upscale Functions 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. NEDE-24011-P-A, "General Electric Standard Application for Reactor Fuel" (latest approved version).

c. The core operating limits shall be determined such that all applicable limits (e.g., fuel thermal mechanical limits, core thermal hydraulic limits, Emergency Core Cooling Systems (ECCS) limits, nuclear limits such as SDM, transient analysis limits, and accident analysis limits) of the safety analysis are met.

d. The COLR, including any midcycle revisions or supplements, shall be provided upon issuance for each reload cycle to the NRC.

(continued)

5.6 Reporting Requirements (continued)

5.6.6 Post Accident Monitoring (PAM) Instrumentation Report

When a report is required by Condition B or F of LCO 3.3.3.1, "Post Accident Monitoring (PAM) Instrumentation," a report shall be submitted within the following 14 days. The report shall outline the preplanned alternate method of monitoring, the cause of the inoperability, and the plans and schedule for restoring the instrumentation channels of the Function to OPERABLE status.

ENCLOSURE 7

BRUNSWICK STEAM ELECTRIC PLANT, UNIT NOS. 1 AND 2
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TYPED TECHNICAL SPECIFICATION PAGES - UNIT NO. 2

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 Functions 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 the 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 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.

5.6 Reporting Requirements (continued)

5.6.5 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 AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR) for Specification 3.2.1;

2. The MINIMUM CRITICAL POWER RATIO (MCPR) for Specification 3.2.2;

3. The period based detection algorithm (PBDA) setpoint for Function 2.f, Oscillation Power Range Monitor (OPRM) Upscale, for Specification 3.3.1.1; and

4. The Allowable Values and power range setpoints for Rod Block Monitor Upscale Functions 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. NEDE-24011-P-A, "General Electric Standard Application for Reactor Fuel" (latest approved version).

c. The core operating limits shall be determined such that all applicable limits (e.g., fuel thermal mechanical limits, core thermal hydraulic limits, Emergency Core Cooling Systems (ECCS) limits, nuclear limits such as SDM, transient analysis limits, and accident analysis limits) of the safety analysis are met.

d. The COLR, including any midcycle revisions or supplements, shall be provided upon issuance for each reload cycle to the NRC.

(continued)

5.6 Reporting Requirements (continued)

5.6.6 Post Accident Monitoring (PAM) Instrumentation Report

When a report is required by Condition B or F of LCO 3.3.3.1, "Post Accident Monitoring (PAM) Instrumentation," a report shall be submitted within the following 14 days. The report shall outline the preplanned alternate method of monitoring, the cause of the inoperability, and the plans and schedule for restoring the instrumentation channels of the Function to OPERABLE status.

ENCLOSURE 8

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MARKED-UP TECHNICAL SPECIFICATION PAGES - UNIT NO. 1

Inserts Associated With Technical Specification Markups

Insert A

A.2 ----------NOTE----------
Not applicable for Functions 2.a, 2.b, 2.c, 2.d, or 2.f.

Place associated trip system in trip.

Insert B

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.

Inserts Associated With Technical Specification Markups

Insert D

2. For Functions 2.b and 2.f, the CHANNEL FUNCTIONAL TEST includes the recirculation flow input processing, excluding the flow transmitters.

Inserts Associated With Technical Specification Markups

Insert E

3. For Functions 2.b and 2.f, the recirculation flow transmitters that feed the APRMs are included.

Inserts Associated With Technical Specification Markups

Insert F

SR 3.3.1.1.19	Verify OPRM is not bypassed when APRM Simulated Thermal Power is $\geq$ 25% and recirculation drive flow is $\leq$ 60%.	24 months

Inserts Associated With Technical Specification Markups

Insert G

$\leq$ 0.66W + 62.0% RTP[(b)]
and $\leq$ 117.1% RTP

Insert H

(b) $\leq$ [0.66(W - ΔW) + 62.0% RTP] when reset for single loop operation per LCO 3.4.1, "Recirculation Loops Operating." The value of ΔW is defined in plant procedures.

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

Inserts Associated With Technical Specification Markups

Insert I

e.	2-Out-Of-4 Voter	1,2	2	G	SR 3.3.1.1.2 SR 3.3.1.1.5 SR 3.3.1.1.11 SR 3.3.1.1.15 SR 3.3.1.1.17	NA
f.	OPRM Upscale	≥ 20% RTP	3[(c)]	I	SR 3.3.1.1.2 SR 3.3.1.1.5 SR 3.3.1.1.8 SR 3.3.1.1.11 SR 3.3.1.1.13 SR 3.3.1.1.18 SR 3.3.1.1.19	NA[(d)]

Insert J

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

(d) See COLR for OPRM period based detection algorithm (PBDA) setpoint limits.

Inserts Associated With Technical Specification Markups

Insert K

a. Low Power Range – Upscale Function OR Intermediate Power Range – Upscale Function OR High Power Range – Upscale Function is enabled (not bypassed) when APRM Simulated Thermal Power is ≥ 29%.

b. Intermediate Power Range – Upscale Function OR High Power Range – Upscale Function is enabled (not bypassed) when APRM Simulated Thermal Power is ≥ Intermediate Power Range Setpoint specified in the COLR.

c. High Power Range – Upscale Function is enabled (not bypassed) when APRM Simulated Thermal Power is ≥ High Power Range Setpoint specified in the COLR.

Inserts Associated With Technical Specification Markups

<u>Insert L</u>

(a) THERMAL POWER is ≥ 29% RTP and MCPR less than the limit specified in the COLR except not required to be OPERABLE if the Intermediate Power Range – Upscale Function or High Power Range – Upscale Function is OPERABLE.

(b) THERMAL POWER is ≥ Intermediate Power Range Setpoint specified in the COLR and MCPR less than the limit specified in the COLR except not required to be OPERABLE if the High Power Range – Upscale Function is OPERABLE.

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 Functions 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 the 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 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.

Inserts Associated With Technical Specification Markups

Insert M

3. The period based detection algorithm (PBDA) setpoint for Function 2.f, Oscillation Power Range Monitor (OPRM) Upscale, for Specification 3.3.1.1; and

ENCLOSURE 9

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MARKED-UP TECHNICAL SPECIFICATION PAGES - UNIT NO. 2

Inserts Associated With Technical Specification Markups

Insert A

A.2 ----------NOTE----------
Not applicable for
Functions 2.a, 2.b,
2.c, 2.d, or 2.f.

Place associated trip
system in trip.

Insert B

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.

Inserts Associated With Technical Specification Markups

Insert D

2. For Functions 2.b and 2.f, the CHANNEL FUNCTIONAL TEST includes the recirculation flow input processing, excluding the flow transmitters.

Inserts Associated With Technical Specification Markups

Insert E

3. For Functions 2.b and 2.f, the recirculation flow transmitters that feed the APRMs are included.

Inserts Associated With Technical Specification Markups

Insert G

$\leq 0.66W + 62.0\%$ RTP(b)
and $\leq 117.1\%$ RTP

Insert H

(b) $\leq [0.66(W - \Delta W) + 62.0\%$ RTP] when reset for single loop operation per LCO 3.4.1, "Recirculation Loops Operating." The value of ΔW is defined in plant procedures.

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

Inserts Associated With Technical Specification Markups

Insert K

a. Low Power Range – Upscale Function OR Intermediate Power Range – Upscale Function OR High Power Range – Upscale Function is enabled (not bypassed) when APRM Simulated Thermal Power is ≥ 29%.

b. Intermediate Power Range – Upscale Function OR High Power Range – Upscale Function is enabled (not bypassed) when APRM Simulated Thermal Power is ≥ Intermediate Power Range Setpoint specified in the COLR.

c. High Power Range – Upscale Function is enabled (not bypassed) when APRM Simulated Thermal Power is ≥ High Power Range Setpoint specified in the COLR.

Inserts Associated With Technical Specification Markups

Insert L

(a) THERMAL POWER is ≥ 29% RTP and MCPR less than the limit specified in the COLR except not required to be OPERABLE if the Intermediate Power Range – Upscale Function or High Power Range – Upscale Function is OPERABLE.

(b) THERMAL POWER is ≥ Intermediate Power Range Setpoint specified in the COLR and MCPR less than the limit specified in the COLR except not required to be OPERABLE if the High Power Range – Upscale Function is OPERABLE.

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 Functions 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 the 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 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.

Inserts Associated With Technical Specification Markups

Insert M

3. The period based detection algorithm (PBDA) setpoint for Function 2.f, Oscillation Power Range Monitor (OPRM) Upscale, for Specification 3.3.1.1; and

ENCLOSURE 10

BRUNSWICK STEAM ELECTRIC PLANT, UNIT NOS. 1 AND 2
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MARKED-UP TECHNICAL SPECIFICATION BASES PAGES - UNIT NO. 1
(FOR INFORMATION ONLY)

Inserts Associated With Technical Specification Bases Markups

Insert A

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 channel 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 "half-trip" in all four of the voter channels, but no trip inputs to either RPS trip system.

APRM trip Functions 2.a, 2.b, 2.c, and 2.d are voted independently from OPRM Upscale Function 2.f. Therefore, 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), thus resulting in a full scram signal. Similarily, a Function 2.f trip from any two unbypassed APRM channels will result in a full trip from each of the four voter chanñels.

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 17 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, each LPRM in an APRM channel is assigned to one, two or four OPRM "cells," forming a total of 24 separate OPRM cells per APRM channel, each with either three or four detectors. LPRMs near the edge of the core are assigned to either one or two OPRM cells. A minimum of 18 OPRM cells in an APRM channel must have at least two OPERABLE LPRMs for the OPRM Upscale Function 2.f to be OPERABLE (Ref. 22).

Inserts Associated With Technical Specification Bases Markups

Insert B

A note is included, applicable when the plant is in single recirculation loop operation per LCO 3.4.1, which requires reducing by ΔW the flow value used in the Allowable Value equation. The value of ΔW is defined in plant procedures. The value of ΔW is established to conservatively bound the inaccuracy created in the core flow/drive flow correlation due to back flow (i.e., reverse flow) in the jet pumps associated with the inactive recirculation loop. Inaccuracy of the core flow/drive flow correlation results when in single loop operation a higher drive flow is required to produce a specified core flow in comparison to two-loop operation. This difference exists because the single loop drive flow must compensate for back flow through the inactive jet pumps, which does not occur in two-loop operation. The correlation factor ΔW was implemented to maintain the flow-biased trips at the same position, relative to the power/flow map, for single loop operation as they are for two-loop operation. This adjusted Allowable Value thus maintains thermal margins essentially unchanged from those for two-loop operation. The allowable value equation for single loop operation is only valid for flows down to $W = \Delta W$. No correction is required for single loop operation for drive flows less than ΔW (the value of ΔW will always be less than about 15%). Back flow in the inactive recirculation loop does not occur at core flows less than approximately 30 to 40% rated core flow, which corresponds to approximately 30 to 40% drive flow.

Inserts Associated With Technical Specification Bases Markups

Insert C

Each APRM channel uses one total recirculation drive flow signal representative of total core flow. The total drive flow signal is generated by the flow processing logic, part of the APRM channel, by summing the flow calculated from two flow transmitter signal inputs, one from each of the two recirculation loops. The flow processing logic OPERABILITY is part of the APRM channel OPERABILITY requirements for this Function.

Inserts Associated With Technical Specification Bases Markups

Insert D

The proper representation of drive flow as a representation of core flow is ensured through drive flow alignment, accomplished by SR 3.3.1.1.18.

Inserts Associated With Technical Specification Bases Markups

Insert E

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

For any APRM channel, any time its mode switch is not in the "Operate" position, an APRM module required to issue a trip is unplugged, or the automatic self-test system detects a critical fault with the APRM channel, an Inop trip is sent to all four voter channels. Inop trips from two or more unbypassed APRM channels result in a trip output from each of the four voter channels to its associated trip system.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY

2.e. 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 F

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. The Reactor Vessel Steam Dome Pressure—High Function initiates a scram for transients that results in a pressure increase, counteracting the pressure increase by rapidly reducing core power. For the overpressurization protection analyses of References 4, 7, and 8, reactor scram, 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 transmitters 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 Reactor Coolant System (RCS) is pressurized and the potential for pressure increase exists.

4. Reactor Vessel Water Level—Low Level 1

Low RPV water level indicates the capability to cool the fuel may be threatened. Should RPV water level decrease too far, fuel damage could result. Therefore, a reactor scram is initiated at Low Level 1 to substantially reduce the heat generated in the fuel from fission. The Reactor Vessel

(continued)

Inserts Associated With Technical Specification Bases Markups

Insert F

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 Two-Out-Of-Four Logic Module includes both the 2-Out-Of-4 Voter hardware and the APRM Interface hardware (the non-safety-related portion of the Two-Out-Of-Four Logic Module including annunciator output relays, status lights, etc.). The 2-Out-Of-4 Voter Function 2.e votes APRM Functions 2.a, 2.b, 2.c, and 2.d independently of Function 2.f. This voting is accomplished by the 2-Out-Of-4 Voter hardware in the Two-Out-Of-Four Logic Module. 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 analysis in Reference 15 took credit for this redundancy in the justification of the 12-hour Completion Time for Condition A, so the voter Function 2.e must be declared inoperable if any of its functionality is inoperable. The voter Function 2.e does not need to be declared inoperable due to any failure affecting only the APRM Interface hardware portion of the Two-Out-Of-Four Logic Module.

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 17, 18 and 19 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 Specificaton 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. Each channel is capable of detecting thermal-hydraulic instabilities, by detecting the

Insert F (continued)

related neutron flux oscillations, and issuing a trip signal before the MCPR SL is exceeded. Three of the four channels are required to be OPERABLE.

The OPRM Upscale trip is automatically enabled (bypass removed) when THERMAL POWER is ≥ 25% RTP, as indicated by the APRM Simulated Thermal Power, and reactor core flow is ≤ 60% of rated flow, as indicated by APRM measured recirculation drive flow. This is the operating region where actual thermal-hydraulic instability and related neutron flux oscillations may occur. See Reference 21 for additional discussion of OPRM Upscale trip enable region limits. The 25% RTP lower boundary of the enabled region was established by scaling the 30% value in Reference 21 for uprated power to correspond to 30% of original plant RTP. This scaling is not required by Reference 21, but has been done for conservatism.

These setpoints, which are sometimes referred to as the "auto-bypass" setpoints, establish the boundaries of the OPRM Upscale trip enabled region. The APRM Simulated Thermal Power auto-enable setpoint has 1% deadband while the drive flow setpoint has a 2% deadband. The deadband for these setpoints is established so that it increased the enabled region.

The OPRM Upscale Function is required to be OPERABLE when the plant is at ≥ 20% RPT. The 20% RTP level is selected to provide margin in the unlikely event that a reactor power increase transient occurring while the plant is operating below 25% RTP causes a power increase to or beyond the 25% APRM Simulated Thermal Power OPRM Upscale trip auto-enable setpoint without operator action. This OPERABILITY requirement assures that the OPRM Upscale trip auto-enable function will be OPERABLE when required.

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, indicated by the combined signals of the LPRM detectors in a cell, with period confirmations and relative cell amplitude exceeding specified setpoints. 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. (Note: To facilitate placing the OPRM Upscale Function 2.f in one APRM channel in a "tripped" state, if necessary to satisfy a Required Action, the APRM equipment is conservatively designed to force an OPRM Upscale trip output from the APRM channel if an APRM Inop condition occurs, such as when the APRM chassis keylock switch is placed in the Inop position.)

There are four "sets" of OPRM related setpoints or adjustment parameters: (a) OPRM trip auto-enable setpoints for STP (25%) and drive flow (60%); (b) period based detection algorithm (PBDA) confirmation count and amplitude setpoints; (c) period based detection algorithm tuning parameters; and (d) growth rate algorithm (GRA) and amplitude based algorithm (ABA) setpoints.

The first set, the OPRM auto-enable region setpoints, as discussed in the SR 3.3.1.1.19 Bases, are treated as nominal setpoints with no additional margins added. The settings, 25% APRM

Insert F (continued)

Simulated Thermal Power and 60% drive flow, are defined (limit values) in and confirmed by SR 3.3.1.1.19. The second set, the OPRM PBDA trip setpoints, are established in accordance with methodologies defined in Reference 23, and are documented in the COLR. There are no allowable values for these setpoints. The third set, the OPRM PBDA "tuning" parameters, are established, adjusted, and controlled by plant procedures. The fourth set, the GRA and ABA setpoints, in accordance with References 15 and 16, are established as nominal values only, and controlled by plant procedures.

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY

5. Main Steam Isolation Valve—Closure (continued)

Main Steam Isolation Valve—Closure signal before the MSIVs 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 4, 7, and 8, 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 2.

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 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 Stop Valve—Closure (continued)

Turbine Stop Valve—Closure signals are initiated from position switches located on each of the four TSVs. Two independent position switches are associated with each stop valve. One of the two switches provides input to RPS trip system A; the other, to RPS trip system B. Thus, each RPS trip system receives an input from four Turbine Stop Valve—Closure channels, each consisting of one position switch. The logic for the Turbine Stop Valve—Closure Function is such that three or more TSVs must be closed 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 of the turbine bypass valves may affect this Function.

The Turbine Stop Valve—Closure Allowable Value is selected to be high enough to detect imminent TSV closure, thereby reducing the severity of the subsequent pressure transient.

Eight channels of Turbine Stop 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 TSVs 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 Control Valve Fast Closure, Control Oil Pressure—Low

Fast closure of the TCVs 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 TCV fast closure in anticipation of the transients that would result from the closure of these valves. The Turbine Control Valve Fast Closure, Control Oil Pressure—Low Function is the primary scram signal for the generator load rejection event analyzed in Reference 2. For

(continued)

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY

9. Turbine Control Valve Fast Closure, Control Oil Pressure—Low (continued)

this event, the reactor scram reduces the amount of energy required to be absorbed and ensures that the MCPR SL is not exceeded.

Turbine Control Valve Fast Closure, Control Oil Pressure—Low signals are initiated by the electrohydraulic control (EHC) fluid pressure at each control valve. One pressure switch is associated with each control valve, and the signal from each switch is assigned to a separate RPS logic channel. This Function must be enabled at THERMAL POWER ≥ 30% RTP. This is accomplished automatically by pressure switches sensing turbine first stage pressure; therefore, opening of the turbine bypass valves may affect this Function.

The Turbine Control Valve Fast Closure, Control Oil Pressure—Low Allowable Value is selected high enough to detect imminent TCV fast closure.

Four channels of Turbine Control Valve Fast Closure, Control 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, to two RPS logic channels, which are redundant to the automatic protective instrumentation channels and provide manual reactor trip capability. 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.

(continued)

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY

11. Manual Scram (continued)

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.

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) (Refs. 11, 15, and 16) to permit restoration of any inoperable channel to OPERABLE status. However, this out of service time is only acceptable provided the associated Function's 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. Alternatively, if it is not 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 G

(continued)

Inserts Associated With Technical Specification Bases Markups

Insert G

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 (continued)

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 [handwritten: References 11, 15, or 16] for the 12 hour Completion Time. Within the 6 hour allowance, the associated Function will have all required channels OPERABLE or in trip (or any combination) in one trip system. This is accomplished by either placing all inoperable channels in trip or tripping the trip system.

Completing one of these Required Actions restores RPS to a reliability level equivalent to that evaluated in Reference 11 [handwritten: References 11, 15, and 16], 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 of which trip system is in the more degraded state should be based on prudent judgment and take into account current plant conditions (i.e., what MODE the plant is in). If this action would result in a scram, it is permissible to place the other trip system or its inoperable channels in trip.

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.

(continued)

BASES

ACTIONS

B.1 and B.2 (continued)

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, Condition D must be entered and its Required Action taken.

INSERT H

C.1

APRM/Noter

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 main steam lines (not necessarily the same main steam lines for both trip systems) OPERABLE or in trip (or the associated trip system in trip). For Function 8 (Turbine Stop Valve—Closure), this would require both trip systems to have three channels, each OPERABLE or in trip (or the associated trip system in trip). For Function 10 (Reactor Mode Switch—Shutdown Position) and Function 11 (Manual Scram), this would require both trip systems to have one channel, 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)

For Functions 2.a, 2.b, 2.c, 2.d, and 2.f, this would require that two of the four channels be OPERABLE or in the trip condition.

Inserts Associated With Technical Specification Bases Markups

Insert H

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 because 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.

, and J.1

E.1, F.1, and G.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 allowed 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 of Required Action E.1 is consistent with the Completion Time provided in LCO 3.2.2, "MINIMUM CRITICAL POWER RATIO (MCPR)."

Actions E.1 and J.1 are

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 I

(continued)

Inserts Associated With Technical Specification Bases Markups

Insert I

I.1

Condition I exists when the OPRM Upscale trip capability has been lost for all APRM channels due to unanticipated equipment design or instability detection algorithm problems. References 15 and 16 justified use of alternate methods to detect and suppress oscillations under limited conditions. The alternate methods are procedurally established consistent with the guidelines identified in Reference 20. The alternate methods procedures require operating outside a "restricted zone" in the power-flow map and manual operator action to scram the plant if certain predefined events occur. The 12-hour allowed Completion Time for Required Action I.1 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.

This Required Action is intended to allow continued plant operation under limited conditions when an unanticipated equipment design or instability detection algorithm problem causes OPRM Upscale Function inoperability in all APRM channels. This Required Action is not intended and was not evaluated as a routine alternative to return failed or inoperable equipment to OPERABLE status. Correction of routine equipment failure or inoperability is expected to be accomplished within the completion times allowed for Required Actions for Condition A. The alternate method to detect and suppress oscillations implemented in accordance with I.1 is intended to be applied only as long as is necessary to implement corrective action to resolve the unanticipated equipment design or instability detection algorithm problem.

BASES (continued)

SURVEILLANCE REQUIREMENTS

As noted at the beginning of the SRs, the SRs for each RPS instrumentation Function are located in the SRs column of Table 3.3.1.1-1.

The Surveillances are modified by a Note to indicate that 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. 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. 11) 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 the RPS will trip when necessary.

(Refs. 11, 15, and 16)

SR 3.3.1.1.1 and SR 3.3.1.1.2

SR 3.3.1.1.1 (Not used.)

Performance of the CHANNEL CHECK once every 12 hours for APRM channels and once every 24 hours for all other applicable channels ensures that a gross failure of instrumentation has not occurred. A CHANNEL CHECK is normally a comparison of the parameter indicated on one channel to a similar parameter on other channels. It is based on the assumption that instrument channels monitoring the same parameter should read approximately the same value. Significant deviations between instrument channels could be an indication of excessive instrument drift in one of the channels or something even more serious. A CHANNEL CHECK will detect gross channel failure; thus, it is key to verifying the instrumentation continues to operate properly between each CHANNEL CALIBRATION.

The CHANNEL CHECK for APRM functions includes a step to confirm that the automatic self-test functions for the APRM and RBM chassis are still operating.

Agreement criteria are determined by the plant staff based on a combination of the channel instrument uncertainties, including indication and readability. If a channel is outside the criteria, it may be an indication that the instrument has drifted outside its limit.

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.3.1.1.1 and SR 3.3.1.1.2 (continued)

The Frequencies are 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 3.3.1.1.3

To ensure that the APRMs are accurately indicating the true core average power, the APRMs are adjusted to conform to the reactor power calculated from a heat balance. 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 3.3.1.1.8.

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.

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. Any setpoint adjustment shall be consistent with the assumptions of the current plant specific setpoint methodology.

As noted, SR 3.3.1.1.4 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

(continued)

BASES

SURVEILLANCE REQUIREMENTS (continued)

INSERT K

SR 3.3.1.1.11 and SR 3.3.1.1.13

A CHANNEL CALIBRATION is a complete check of the instrument loop and the sensor. This test verifies that 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. The CHANNEL CALIBRATION for Functions 5 and 8 should consist of a physical inspection and actuation of the associated position switches.

Note 1 states that neutron detectors are excluded from CHANNEL CALIBRATION because they are passive devices, with minimal drift, and because of the difficulty of simulating a meaningful signal. Changes in neutron detector sensitivity are compensated for by performing the 7 day calorimetric calibration (SR 3.3.1.1.3) and the 1100 MWD/T LPRM calibration against the TIPs (SR 3.3.1.1.8). ¶ 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 movable links. This Note allows entry into MODE 2 from MODE 1 if the associated Frequency is not met per SR 3.0.2. Twelve hours is based on operating experience and in consideration of providing a reasonable time in which to complete the SR. Note 3 to SR 3.3.1.1.11 states that the digital components of the flow control trip reference card are excluded from CHANNEL CALIBRATION of Function 2.b, Average Power Range Monitor Flow Biased Simulated Thermal Power—High. The analog output potentiometers of the flow control trip reference card are not excluded from this test. The flow control trip reference card has an automatic self-test feature which periodically tests the hardware that performs the digital algorithm. Exclusion of the digital components of the flow control trip reference card from CHANNEL CALIBRATION of Function 2.b is based on conditions required to perform the test and the small likelihood of a change in the status of these components not being detected.

INSERT J

The Frequency of SR 3.3.1.1.11 is based upon the assumption of a 92 day calibration interval in the determination of the magnitude of equipment drift in the setpoint analysis. The Frequency of SR 3.3.1.1.13 is based upon the assumption of a 24 month calibration interval in the determination of the magnitude of equipment drift in the setpoint analysis.

(continued)

Inserts Associated With Technical Specification Bases Markups

Insert J

A third note is provided that requires that the recirculation flow (drive flow) transmitters, which supply the flow signal to the APRMs, be included in the SR for Functions 2.b and 2.f. The APRM Simulated Thermal Power - High Function (Function 2.b) and the OPRM Upscale Function (Function 2.f) both require a valid drive flow signal. The APRM Simulated Thermal Power - High Function uses drive flow to automatically enable or bypass the OPRM Upscale trip output to RPS. A CHANNEL CALIBRATION of the APRM drive flow signal requires both calibrating the drive flow transmitters and the processing hardware in the APRM equipment. SR 3.3.1.1.18 establishes a valid drive flow/core flow relationship. Changes throughout the cycle in the drive flow/core flow relationship due to the changing thermal hydraulic operating conditions of the core are accounted for in the margins included in the bases or analyses used to establish the setpoints for the APRM Simulated Thermal Power - High Function and the OPRM Upscale Function.

Insert K

SR 3.3.1.1.11

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 scope of the APRM CHANNEL FUNCTIONAL TEST is that which is necessary to test the hardware. Software controlled functions are tested only incidentally. Automatic self-test functions check the EPROMs in which the software-controlled logic is defined. Changes in the EPROMs will be detected by the self-test function and alarmed via the APRM trouble alarm. SR 3.3.1.1.2 for the APRM functions includes a step to confirm that the automatic self-test function is still operating.

The APRM CHANNEL FUNCTIONAL TEST covers the APRM channels (including recirculation flow processing -- applicable to Function 2.b and the auto-enable portion of Function 2.f only), the 2-Out-Of-4 Voter channels, and the interface connections into the RPS trip systems 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 3.3.1.1.11 is based on the reliability analyses of References 15 and 16. (NOTE: The actual voting logic of the 2-Out-Of-4 Voter Function is tested as part of SR 3.3.1.1.15. The auto-enable setpoints for the OPRM Upscale trip are confirmed by SR 3.3.1.1.19.)

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 of lifted leads. This Note allows entry into MODE 2 from MODE 1 if the associated Frequency is not met per SR 3.0.2.

Insert K (continued)

A second Note is provided for Functions 2.b and 2.f that clarifies that the CHANNEL FUNCTIONAL TEST for Functions 2.b and 2.f includes testing of the recirculation flow processing electronics, excluding the flow transmitters.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.1.1.14

(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 be ≤ 7 seconds to ensure that the channel is accurately reflecting the desired parameter.

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

SR 3.3.1.1.15

The LOGIC SYSTEM FUNCTIONAL TEST demonstrates the OPERABILITY of the required trip logic and simulated automatic operation for a specific channel. The functional testing of control rods (LCO 3.1.3), and SDV vent and drain valves (LCO 3.1.8), overlaps this Surveillance to provide complete testing of the assumed safety function.

INSERT L

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 demonstrated that these components will usually pass the Surveillance when performed at the 24 month Frequency.

SR 3.3.1.1.16

This SR ensures that scrams initiated from the Turbine Stop Valve—Closure and Turbine Control Valve Fast Closure, Control Oil Pressure—Low Functions will not be inadvertently bypassed when THERMAL POWER is ≥ 30% RTP. This is satisfied by calibration of the bypass channels. Adequate margins for the instrument setpoint methodologies are incorporated into the Allowable Value and the actual setpoint. Because main turbine bypass flow can affect this setpoint nonconservatively (THERMAL POWER is derived from turbine first stage pressure), the main turbine bypass

(continued)

Inserts Associated With Technical Specification Bases Markups

Insert L

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.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.3.1.1.16 (continued)

valves must remain closed during an in-service calibration at THERMAL POWER ≥ 30% RTP to ensure that the calibration is valid.

If any bypass channel setpoint is nonconservative (i.e., the Functions are bypassed at ≥ 30% RTP, either due to open main turbine bypass valve(s) or other reasons), then the affected Turbine Stop Valve—Closure and Turbine Control Valve Fast Closure, Control Oil Pressure—Low Functions are considered inoperable. Alternatively, the bypass channel can be placed in the 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.

SR 3.3.1.1.17

This SR ensures that the individual channel response times are less than or equal to the maximum values assumed in the accident analysis. This test may be performed in one measurement or in overlapping segments, with verification that all components are tested. The RPS RESPONSE TIME acceptance criteria are included in Reference 13.

INSERT M1

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 the response time of the sensors for Functions 3 and 4 may be assumed in the RPS RESPONSE TIME test to be the design sensor response time. This is allowed since the sensor response time is a small part of the overall RPS RESPONSE TIME (Ref. 14).

RPS RESPONSE TIME tests are conducted on a 24 month STAGGERED TEST BASIS. Note 3 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.

INSERT M2

(continued)

Inserts Associated With Technical Specification Bases Markups

Insert N

The APRM Simulated Thermal Power - High Function (Function 2.b) uses drive flow to vary the trip setpoint. The OPRM Upscale Function (Function 2.f) uses drive flow to automatically enable or bypass the OPRM Upscale trip output to RPS. Both of these Functions use drive flow as a representation of reactor core flow. SR 3.3.1.1.13 assures that the drive flow transmitters and processing electronics are calibrated. This SR adjusts the recirculation drive flow scaling factors in each APRM channel to provide the appropriate drive flow/core flow alignment.

Insert O

engineering judgment of the time required to enter and check the applicable scaling factors in each of the APRM channels. The 7-day time period after reaching equilibrium conditions is acceptable based on the relatively small alignment errors expected, and the margins already included in the APRM Simulated Thermal Power - High and OPRM Upscale Function trip-enable setpoints.

SR 3.3.1.1.19

This surveillance involves confirming the OPRM Upscale trip auto-enable setpoints. The auto-enable setpoint values are considered to be nominal values as discussed in Reference 21. This surveillance ensures that the OPRM Upscale trip 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 drive flow properly correlate with THERMAL POWER (SR 3.3.1.1.3) and core flow (SR 3.3.1.1.18), respectively.

If any auto-enable setpoint is nonconservative (i.e., the OPRM Upscale trip is bypassed when APRM Simulated Thermal Power $\geq$ 25% and recirculation drive flow $\leq$ 60%), then the affected channel is considered inoperable for the OPRM Upscale Function. Alternatively, the OPRM Upscale trip auto-enable setpoint(s) may be adjusted to place the channel in a conservative condition (not bypassed). If the OPRM Upscale trip is placed in the not-bypassed 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

REFERENCES (continued)

4. NEDC-32466P, Power Uprate Safety Analysis Report for Brunswick Steam Electric Plant Units 1 and 2, September 1995.

5. 10 CFR 50.36(c)(2)(ii).

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

7. UFSAR, Section 5.2.2.

8. UFSAR, Appendix 5.2A.

9. UFSAR, Section 6.3.1.

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

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

12. MDE-81-0485, Technical Specification Improvement Analysis for the Reactor Protection System for Brunswick Steam Electric Plant, Units 1 and 2, April 1985.

13. UFSAR, Table 7.2.1-3.

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

INSERT P

Inserts Associated With Technical Specification Bases Markups

Insert P

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

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

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

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

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

20. Letter, L. A. England (BWROG) to M. J. Virgilio, BWR Owners' Group Guidelines for Stability Interim Corrective Action, June 6, 1994.

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

22. General Electric Nuclear Energy Letter NSA 01-212, DRF C51-00251-00, A. Chung (GE) to S. Chakraborty (GE), "Minimum Number of Operable OPRM Cells for Option III Stability at Brunswick 1 and 2," June 8, 2001.

23. NEDE-24011-P-A, General Electric Standard Application for Reload Fuel, (latest approved version).

BASES (continued)

APPLICABLE SAFETY ANALYSES

Prevention and mitigation of prompt reactivity excursions during refueling and low power operation is provided by LCO 3.9.1, "Refueling Equipment Interlocks"; LCO 3.1.1, "SHUTDOWN MARGIN (SDM)"; LCO 3.3.1.1, "Reactor Protection System (RPS) Instrumentation"; IRM Neutron Flux—High and Average Power Range Monitor (APRM) Neutron Flux—High, ~~Startup~~ (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 UFSAR 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 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, subcritical multiplication and reactor criticality, and neutron flux level and reactor period until the flux level is sufficient to maintain the IRM on Range 3 or above. All but one of the channels 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, 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 the quadrant of the reactor core where CORE ALTERATIONS are being performed, and the other SRM to be OPERABLE in an adjacent quadrant containing fuel. These requirements ensure that the reactivity of the core will be continuously monitored during CORE ALTERATIONS.

Special movable detectors, according to footnote (b) of Table 3.3.1.2-1, may be used in MODE 5 in place of the normal SRM nuclear detectors. These special detectors must be connected to the normal SRM circuits in the NMS, such

(continued)

B 3.3 INSTRUMENTATION

B 3.3.1.3 Period Based Detection System (PBDS)

BASES

BACKGROUND

General Design Criteria 12 requires protection of fuel thermal safety limits from conditions caused by neutronic/thermal hydraulic instability. Neutronic/thermal hydraulic instabilities can result in power oscillations which could result in exceeding the MCPR Safety Limit (SL). The MCPR SL ensures that at least 99.9% of the fuel rods avoid boiling transition during normal operation and during an anticipated operational occurrence (AOO) (refer to the Bases for SL 2.1.1.2).

The PBDS provides the operator with an indication that conditions consistent with a significant degradation in the stability performance of the reactor core has occurred and the potential for imminent onset of neutronic/thermal hydraulic instability may exist. Indication of such degradation is cause for the operator to initiate an immediate reactor scram if the reactor is being operated in either the Restricted Region or Monitored Region. The Restricted Region and Monitored Region are defined in the COLR.

The PBDS instrumentation of the Neutron Monitoring System (NMS) consists of two channels. PBDS channel A includes input from 13 local power range monitors (LPRMs) within the reactor core and PBDS channel B includes input from 11 LPRMs within the reactor core. All LPRMs are utilized from each of the axial levels except for the D level detectors. These inputs are continually monitored by the PBDS for variations in the neutron flux consistent with the onset of neutronic/thermal hydraulic instability. Each channel includes separate local indication and separate control room High—High Alarms. While, this LCO specifies OPERABILITY requirements only for one monitoring and indication channel of the PBDS, if both are OPERABLE, a High—High Alarm from either channel results in the need for the operator to take actions.

The primary PBDS component is a card in the NMS with analog inputs and digital processing. The PBDS card has an automatic self-test feature to periodically test the hardware circuit. The self-test functions are executed during their allocated portion of the executive loop

(continued)

BASES

BACKGROUND (continued)

sequence. Any self-test failure indicating loss of critical function results in a common control room "Inoperative" alarm. The inoperable condition is also displayed by an indicating light on the card front panel. A manually initiated internal test sequence can be actuated via a recessed push button. This internal test consists of simulating alarm and inoperable conditions to verify card OPERABILITY. Further descriptions of the PBDS are provided in References 1 and 2.

Actuation of the PBDS High—High Alarm is not postulated to occur due to neutronic/thermal hydraulic instability during operation outside the Restricted Region and the Monitored Region. Periodic perturbations can be introduced into the thermal hydraulic behavior of the reactor core from external sources such as recirculation system components and the pressure and feedwater control systems. These perturbations can potentially drive the neutron flux to oscillate within a frequency range expected for neutronic/thermal hydraulic instability. The presence of such oscillations may be recognized by the period based algorithm of the PBDS and could result in a High—High Alarm. Actuation of the PBDS High—High Alarm outside the Restricted Region and the Monitored Region indicate the presence of a source external to the reactor core and are not indications of neutronic/thermal hydraulic instability.

APPLICABLE SAFETY ANALYSES

Analysis, as described in Section 4 of Reference 1, confirms that AOOs initiated from outside the Restricted Region without stability control and from within the Restricted Region with stability control are not expected to result in neutronic/thermal hydraulic instability. The stability control applied in the Restricted Region (refer to LCO 3.2.3, "Fraction of Core Boiling Boundary (FCBB)") is established to prevent neutronic/thermal hydraulic instability during operation in the Restricted Region. Operation in the Monitored Region is only susceptible to instability under operating conditions beyond those analyzed in Reference 1. The types of transients specifically evaluated are loss of flow and coolant temperature decrease which are limiting for the onset of instability.

The initial conditions assumed in the analysis are reasonably conservative and the immediate post-event reactor conditions are significantly stable. However, these assumed initial conditions do not bound each individual parameter

(continued)

BASES

APPLICABLE SAFETY ANALYSES (continued)

which impacts stability performance (Ref. 1). The PBDS instrumentation provides the operator with an indication that conditions consistent with a significant degradation in the stability performance of the reactor core has occurred and the potential for imminent onset of neutronic/thermal hydraulic instability may exist. Such conditions are only postulated to result from events initiated from initial conditions beyond the conditions assumed in the safety analysis (refer to Section 4, Ref. 1).

The PBDS has no safety function and is not assumed to function during any UFSAR design basis accident or transient analysis. However, the PBDS provides the only indication of the imminent onset of neutronic/thermal hydraulic instability during operation in regions of the operating domain potentially susceptible to instability. Therefore, the PBDS is included in the Technical Specifications.

LCO

One PBDS channel is required to be OPERABLE with a minimum of eight LPRM inputs to monitor reactor neutron flux for indications of imminent onset of neutronic/thermal hydraulic instability. A PBDS channel may be considered OPERABLE with six LPRM inputs when the distribution of OPERABLE LPRMs provides: a) at least one OPERABLE LPRM in each core quadrant or b) at least two OPERABLE LPRMs in the core quadrant opposite any core quadrant with no OPERABLE LPRMs. The required distribution of the LPRMs when a PBDS channel is considered OPERABLE with as few as six OPERABLE LPRMs ensures a minimum of two OPERABLE LPRMs in opposite core quadrants. This distribution ensures that, for all postulated orientations and modes of oscillation, there are at least two OPERABLE LPRMs in the core quadrants in which the local neutron flux will oscillate with a frequency within the range monitored by the PBDS. OPERABILITY requires the ability for the operator to be immediately alerted to a High—High Alarm. This is accomplished by the instrument channel control room alarm. The LCO also requires reactor operation be such that the High—High Alarm is not actuated by any OPERABLE PBDS instrumentation channel.

APPLICABILITY

At least one of two PBDS instrumentation channels is required to be OPERABLE during operation in either the Restricted Region or the Monitored Region specified in the

(continued)

BASES

APPLICABILITY (continued)

COLR. Similarly, operation with the PBDS High—High Alarm of any OPERABLE PBDS instrumentation channel is not allowed in the Restricted Region or the Monitored Region. Operation in these regions is susceptible to instability (refer to the Bases for LCO 3.2.3 and Section 4 of Ref. 1). OPERABILITY of at least one PBDS instrumentation channel and operation with no indication of a PBDS High—High Alarm from any OPERABLE PBDS instrumentation channel is therefore required during operation in these regions.

The boundary of the Restricted Region in the Applicability of this LCO is analytically established in terms of thermal power and core flow. The Restricted Region is defined by the APRM Flow Biased Simulated Thermal Power—High Control Rod Block setpoints, which are a function of reactor recirculation drive flow. The Restricted Region Entry Alarm (RREA) signal is generated by the Flow Control Trip Reference (FCTR) card using the APRM Flow Biased Simulated Thermal Power—High Control Rod Block setpoints. As a result, the RREA is coincident with the Restricted Region boundary under all anticipated operating conditions when the setpoints are not "Setup," and provides the indication regarding entry into the Restricted Region. However, APRM Flow Biased Simulated Thermal Power—High Control Rod Block signals provided by the FCTR card, that are not coincident with the Restricted Region boundary, do not generate a valid RREA. The Restricted Region boundary for this LCO Applicability is specified in the COLR.

When the APRM Flow Biased Simulated Thermal Power—High Control Rod Block setpoints are "Setup" the applicable setpoints used to generate the RREA are moved to the interior boundary of the Restricted Region to allow controlled operation within the Restricted Region. While the setpoints are "Setup" the Restricted Region boundary remains defined by the normal APRM Flow Biased Simulated Thermal Power—High Control Rod Block setpoints. Parameters such as reactor power and core flow available at the reactor controls, may be used to provide immediate confirmation that entry into the Restricted Region could reasonably have occurred. The Monitored Region in the Applicability of this LCO is analytically established in terms of thermal power and core flow. However, unlike the Restricted Region boundary the Monitored Region is not specifically monitored by plant instrumentation to provide automatic indication of entry into the region. Therefore, the Monitored Region

(continued)

BASES

APPLICABILITY (continued)

boundary is defined solely in terms of thermal power and core flow. The Monitored Region boundary for this LCO Applicability is specified in the COLR.

Operation outside the Restricted Region and the Monitored Region is not susceptible to neutronic/thermal hydraulic instability even under extreme postulated conditions.

ACTIONS

A.1

If at any time while in the Restricted Region or Monitored Region, an OPERABLE PBDS instrumentation channel indicates a High—High Alarm, the operator is required to initiate an immediate reactor scram. Verification that the High—High Alarm is valid may be performed without delay against another output from a PBDS card observable from the reactor controls in the control room prior to the manual reactor scram. This provides assurance that core conditions leading to neutronic/thermal hydraulic instability will be mitigated. This Required Action and associated Completion Time does not allow for evaluation of circumstances leading to the High—High Alarm prior to manual initiation of reactor scram.

B.1 and B.2

Operation with the APRM Flow Biased Simulated Thermal Power—High Function (refer to LCO 3.3.1.1, Table 3.3.1.1-1, Function 2.b) "Setup" requires the stability control applied in the Restricted Region (refer to LCO 3.2.3) to be met. Requirements for operation with the stability control met are established to prevent reactor thermal hydraulic instability during operation in the Restricted Region. When the APRM Flow Biased Simulated Thermal Power—High Control Rod Block setpoints are not "Setup" uncontrolled entry into the Restricted Region is identified by receipt of a valid RREA. Immediate confirmation that the RREA is valid and indicates an actual entry into the Restricted Region may be performed without delay. Immediate confirmation constitutes observation that plant parameters immediately available at the reactor controls (e.g., core power and core flow) are reasonably consistent with entry into the Restricted Region. This immediate confirmation may also constitute recognition that plant parameters are rapidly changing during a

(continued)

BASES

ACTIONS

B.1 and B.2 (continued)

transient (e.g., a recirculation pump trip) which could reasonably result in entry into the Restricted Region. While the APRM Flow Biased Simulated Thermal Power—High Control Rod Block setpoints are "Setup," operation in the Restricted Region may be confirmed by use of plant parameters such as reactor power and core flow available at the reactor controls. With the required PBDS channel inoperable while in the Restricted Region, the ability to monitor conditions indicating the potential for imminent onset of neutronic/thermal hydraulic instability as a result of unexpected transients is lost. Therefore, action must be immediately initiated to exit the Restricted Region.

Exit of the Restricted Region can be accomplished by control rod insertion and/or recirculation flow increases. Actions to restart an idle recirculation loop, withdraw control rods or reduce recirculation flow may result in unstable reactor conditions and are not allowed to be used to comply with this Required Action.

The time required to exit the Restricted Region will depend on existing plant conditions. Provided efforts are begun without delay and continued until the Restricted Region is exited, operation is acceptable based on the low probability of a transient which degrades stability performance occurring simultaneously with the required PBDS channel inoperable.

Required Action B.1 is modified by a Note that specifies that initiation of action to exit the Restricted Region only applies if the APRM Flow Biased Simulated Thermal Power—High Function is "Setup". Operation in the Restricted Region without the APRM Flow Biased Simulated Thermal Power—High Function "Setup" indicates uncontrolled entry into the Restricted Region. Uncontrolled entry is consistent with the occurrence of unexpected transients, which, in combination with the absence of stability controls being met may result in significant degradation of stability performance. Under these conditions with the required PBDS instrumentation channel inoperable, the ability to monitor conditions indicating the potential for imminent onset of neutronic/thermal hydraulic instability is lost and continued operation is not justified. Therefore, Required Action B.2 requires immediate reactor scram.

(continued)

BASES

ACTIONS (continued)

C.1

In the Monitored Region the PBDS High—High Alarm provides indication of degraded stability performance. Although not anticipated, operation in the Monitored Region is susceptible to neutronic/thermal hydraulic instability under postulated conditions exceeding those previously assumed in the safety analysis. With the required PBDS channel inoperable while in the Monitored Region, the ability to monitor conditions indicating the potential for imminent onset of neutronic/thermal hydraulic instability is lost. Therefore, action must be initiated to exit the Monitored Region.

Actions to restart an idle recirculation loop, withdraw control rods or reduce recirculation flow may result in approaching unstable reactor conditions and are not allowed to be used to comply with this Required Action. Exit of the Monitored Region is accomplished by control rod insertion and/or recirculation flow increases. However, actions which reduce recirculation flow are allowed provided the FCBB is recently (within 15 minutes) verified to be ≤ 1.0. Recent verification of FCBB being met, provides assurance that with the PBDS inoperable, planned decreases in recirculation drive flow should not result in significant degradation of core stability performance.

The Completion Time of 15 minutes ensures timely operator action to exit the region consistent with the low probability that reactor conditions exceed the initial conditions assumed in the safety analysis. The time required to exit the Monitored Region will depend on existing plant conditions. Provided efforts are begun within 15 minutes and continued until the Monitored Region is exited, operation is acceptable based on the low probability of a transient which degrades stability performance occurring simultaneously with the required PBDS channel inoperable.

SURVEILLANCE REQUIREMENTS

SR 3.3.1.3.1

During operation in the Restricted Region or the Monitored Region the PBDS High—High Alarm is relied upon to indicate conditions consistent with the onset of neutronic/thermal hydraulic instability. Verification that each OPERABLE

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.3.1.3.1 (continued)

channel of PBDS instrumentation is not in High—High Alarm every 12 hours provides assurance of the proper indication of the alarm during operation in the Restricted Region or the Monitored Region. The 12 hour Frequency supplements less formal, but more frequent, checks of alarm status during operation.

SR 3.3.1.3.2

Performance of the CHANNEL CHECK every 12 hours ensures that a gross failure of instrumentation has not occurred. This CHANNEL CHECK is normally a comparison of the PBDS indication to the state of the annunciator, as well as comparison to the same parameter on the other channel if it is available. It is based on the assumption that the instrument channel indication agrees with the immediate indication available to the operator, and that instrument channels monitoring the same parameter should read similarly. Deviations between the instrument channels could be an indication of instrument component failure. A CHANNEL CHECK will detect gross channel failure; thus, it is key to verifying the instrumentation continues to operate properly between each CHANNEL FUNCTIONAL TEST. Agreement criteria are determined by the plant staff based on a combination of the channel instrument uncertainties, including indication and readability.

The 12 hour Frequency is based on the CHANNEL CHECK Frequency requirement of similar Neutron Monitoring System components. 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 3.3.1.3.3

A CHANNEL FUNCTIONAL TEST is performed for each required PBDS channel to ensure that the system will perform the intended function. The CHANNEL FUNCTIONAL TEST for the PBDS includes manual initiation of an internal test sequence and verification of appropriate alarms and inop conditions being reported.

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.3.1.3.3 (continued)

Performance of a CHANNEL FUNCTIONAL TEST at a Frequency of 24 months verifies the performance of the PBDS and associated circuitry. The Frequency considers the plant conditions required to perform the test, the ease of performing the test, and the likelihood of a change in the system or component status. The alarm circuit is designed to operate for over 24 months with sufficient accuracy on signal amplitude and signal timing considering environment, initial calibration, and accuracy drift (Ref. 2).

REFERENCES

1. NEDO 32339-A, Reactor Stability Long Term Solution: Enhanced Option I-A, July 1994.

2. NEDC-32339, Supplement 2, Reactor Stability Long Term Solution: Enhanced Option I-A Solution Design. April 1995.

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.

The purpose of the RBM is to limit control rod withdrawal if localized neutron flux exceeds a predetermined setpoint during control rod manipulations. 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 specified in the COLR. 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 at various core heights surrounding the control rod being withdrawn. A signal from one average power range monitor (APRM) channel assigned to each Reactor Protection System (RPS) trip system supplies a reference signal for the RBM channel in the same trip system. This reference signal is used to determine which RBM range setpoint (low, intermediate, or high) is enabled. If the APRM 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). A rod block signal is also generated if an RBM downscale trip or an inoperable trip occurs, since this could indicate a problem with the RBM channel. The downscale trip will

(continued)

Inserts Associated With Technical Specification Bases Markups

Insert P1

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.

BASES

BACKGROUND (continued)

occur if the RBM channel signal decreases below the downscale trip setpoint after the RBM channel has been normalized. The inoperable trip will occur during the nulling (normalization) sequence, if the RBM channel fails to null, too few LPRM inputs are available, if a module is not plugged in, or the function switch is moved to any position other than "Operate."

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. Prescribed control rod sequences are stored in the RWM, which will initiate control rod withdrawal and insert blocks when the actual sequence deviates beyond allowances from the stored sequence. The RWM determines the actual sequence based position indication for each control rod. The RWM also uses steam flow signals to determine when the reactor power is above the preset power level at which the RWM is automatically bypassed. The RWM is a single channel system that provides input into the RMCS rod withdraw permissive 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.

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 2. A statistical analysis of RWE events was performed to determine the RBM response for both channels for each event.

(continued)

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY

1. Rod Block Monitor (continued)

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.

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

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

Trip setpoints are specified in the setpoint calculations. The setpoints are selected to ensure that the trip settings do not exceed the Allowable Values between successive CHANNEL CALIBRATIONS. Operation with a trip setting less conservative than the trip setpoint, but within its Allowable Value, is acceptable. A channel is inoperable if its actual trip setting is not within its required Allowable Value. 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 trip setpoints are determined from the analytic limits corrected for defined process, calibration, and instrument errors. The Allowable Values are then determined, based on the trip setpoint value, by accounting for calibration based errors. These calibration based instrument errors are limited to instrument drift, errors associated with measurement and test equipment, and calibration tolerance of loop components. The trip setpoints and Allowable Values determined in this manner provide adequate protection because instrumentation uncertainties, process effects, calibration tolerances, instrument drift, and severe environment errors (for channels that must function in harsh environments as defined by 10 CFR 50.49) are accounted for and appropriately applied for the instrumentation.

#
INSERT P2

(continued)

Inserts Associated With Technical Specification Bases Markups

Insert P2

Trip setpoints are those predetermined values of output at which an action should take place. The setpoints are compared to the actual process parameter, the calculated RBM flux (RBM channel signal). When the RBM flux value exceeds the applicable setpoint, the RBM provides a trip output. The analytic limits are derived from the limiting values of the process parameters obtained from the safety analysis. The trip setpoints are determined from the analytic limits corrected for defined process, calibration, and instrument errors. The Allowable Values are then determined, based on the trip setpoint value, by accounting for calibration based errors. These calibration based instrument errors are limited to instrument drift, errors associated with measurement and test equipment, and calibration tolerance of LPRM input processing in the average power range monitor (APRM) equipment. The RBM performs only digital calculations on digitized LPRM signals received from the APRM equipment. The trip setpoints and Allowable Values determined in this manner provide adequate protection because instrumentation uncertainties, process effects, calibration tolerances, instrument drift, and environment errors are accounted for and appropriately applied for the instrumentation.

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 ≥ 29% 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. 2). When operating < 90% RTP, analyses (Ref. 2) have shown that with an initial MCPR ≥ 1.70, no RWE event will result in exceeding the MCPR SL. Also, the analyses demonstrate that when operating at ≥ 90% RTP with MCPR ≥ 1.40, no RWE event will result in exceeding the MCPR SL (Ref. 2). Therefore, under these conditions, the RBM is also not required to be OPERABLE.

INSERT P3

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 References 4, 5, and 6. 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 10 CFR 50.36(c)(2)(ii) (Ref. 3).

The RWM is a microprocessor-based system with the principle task to reinforce procedural control to limit the reactivity worth of control rods under lower power conditions. Only one channel of the RWM is available and required to be OPERABLE. 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. As required by these conditions, one or more control rods may be bypassed in the RWM or the RWM may be bypassed. However, the RWM must be considered inoperable and the Required Actions of this LCO followed since the RWM can no longer enforce compliance with the BPWS.

(continued)

Inserts Associated With Technical Specification Bases Markups

Insert P3

The RBM selects one of three different RBM flux trip setpoints to be applied based on the current value of THERMAL POWER. THERMAL POWER is indicated to each RBM channel by a simulated thermal power (STP) reference signal input from an associated reference APRM channel. The OPERABLE range is divided into three "power ranges," a "low power range," an "intermediate power range," and a "high power range." The RBM flux trip setpoint applied within each of these three power ranges is, respectively, the "low trip setpoint," the "intermediate trip setpoint," and the "high trip setpoint" (Allowable Values for which are defined in the COLR). To determine the current power range, each RBM channel compares its current STP input value to three power setpoints, the "low power setpoint" (29%), the "intermediate power setpoint" (current value defined in the COLR), and the "high power setpoint" (current value defined in the COLR), which define, respectively, the lower limit of the low power range, the lower limit of the intermediate power range, and the lower limit of the high power range. The trip setpoint applicable for each power range is more restrictive than the corresponding setpoint for the lower power range(s). When STP is below the low power setpoint, the RBM flux trip outputs are automatically bypassed but the low trip setpoint continues to be applied to indicate the RBM flux setpoint on the NUMAC RBM displays.

The calculated (required) setpoints and applicable power ranges are bounding values. In the equipment implementation, it is necessary to apply a "deadband" to each setpoint. The deadband is applied to the RBM trip setpoint selection logic and the RBM trip automatic bypass logic such that the setpoint being applied is always equal to or more conservative than the required setpoint. Since the RBM flux trip setpoint applicable to the higher power ranges are more conservative than the corresponding trip setpoints for lower power ranges, the trip setpoint applicable to the higher power range (high power range or intermediate power range) continues to be applied when STP decreases below the lower limit of that range until STP is below the power range setpoint by a value exceeding the deadband. Similarly, when STP decreases below the low power setpoint, the automatic bypass of RBM flux trip outputs will not be applied until STP decreases below the trip setpoint a value exceeding the deadband.

The RBM channel uses THERMAL POWER, as represented by the STP input value from its reference APRM channel, to automatically enable RBM flux trip outputs (remove the automatic bypass) and to select the RBM flux trip setpoint to be applied. However, the RBM Upscale function is only required to be OPERABLE when the MCPR values are less than either 1.40 or 1.70, depending on the THERMAL POWER level. Therefore, even though the RBM Upscale Function is implemented in each RBM channel as a single trip function with a selected trip setpoint, it is characterized in Table 3.3.2.1-1 as three Functions, the Low Power Range - Upscale Function, the Intermediate Power Range - Upscale Function, and the High Power Range - Upscale Function, to facilitate correct definition of the OPERABILITY requirements for the functions. Each Function corresponds to one of the RBM power ranges. Due to the deadband effects on the determination of the current power range, the transition between these three Functions will occur at slightly different THERMAL POWER levels for increasing power versus decreasing power. Since the RBM flux trip setpoints applied for the higher power ranges are more conservative, the OPERABILITY requirement for the Low Power Range – Upscale Function is satisfied if the Intermediate Power Range – Upscale Function or the High Power

Insert P3 (continued)

Range – Upscale Function is OPERABLE. Similarly, the OPERABILITY requirement for the Intermediate Power Range – Upscale Function is satisfied if the High Power Range – Upscale Function is OPERABLE.

BASES

ACTIONS

E.1 and E.2 (continued)

consistent with the normal action of an OPERABLE Reactor Mode Switch—Shutdown Position Function (i.e., maintaining all control rods inserted), there is no distinction between having one or two channels inoperable.

In both cases (one or both channels inoperable), suspending all control rod withdrawal and initiating action to fully insert all insertable control rods in core cells containing one or more fuel assemblies will ensure that the core is 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 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 System

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.3.2.1.1 (continued)

input. Any setpoint adjustment shall be consistent with the assumptions of the current plant specific setpoint methodology.

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The Frequency of 92 days is based on reliability analyses (Ref. 8).

(Refs. 8, 9, and 10)

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 system will perform the intended function. The CHANNEL FUNCTIONAL TEST for the RWM is performed by selecting a control rod not in compliance with the prescribed sequence and verifying proper annunciation of the selection error, and by attempting to withdraw a control rod not in compliance with the prescribed sequence and verifying a control rod block 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 in MODE 2. As noted, SR 3.3.2.1.3 is not required to be performed until 1 hour after THERMAL POWER is ≤ 10% RTP in MODE 1. This allows entry into MODE 2 for SR 3.3.2.1.2, and entry into MODE 1 when THERMAL POWER is ≤ 10% RTP for SR 3.3.2.1.3, to perform the required Surveillance if the 92 day Frequency is not met per SR 3.0.2. The 1 hour allowance is based on operating experience and in consideration of providing a reasonable time in which to complete the SRs. Operating experience has demonstrated these components will usually pass the Surveillances when performed at the 92 day Frequency. Therefore, the Frequency is acceptable from a reliability standpoint.

SR 3.3.2.1.4

INSERT P4

The RBM setpoints are automatically varied as a function of power. Three Allowable Values are specified in Table 3.3.2.1-1, each within a specific power range. The power at which the control rod block Allowable Values automatically change are based on the APRM signal's input to each RBM channel. Below the minimum power range setpoint, the RBM is automatically bypassed. These power range setpoints (low power range setpoint, intermediate power range setpoint, and high power range setpoint) must be

(continued)

Inserts Associated With Technical Specification Bases Markups

Insert P4

The RBM setpoints are automatically varied as a function of power. Three Allowable Values are specified in Table 3.3.2.1-1, one corresponding to each specific power range. The purpose of this SR is to assure that for each RBM power range, the RBM flux trip rod block outputs are enabled (not bypassed) and that the RBM flux trip setpoint being applied is equal to or more conservative than the specified Allowable Values in the COLR. If any power range setpoint is non-conservative, then the affected RBM channel is considered inoperable.

The Low Power Range – Upscale Function is enabled when the RBM flux trip setpoint being applied is equal to or less than the Allowable Value for low trip setpoint defined in the COLR, and the RBM flux trip rod block outputs are enabled (not bypassed). The Intermediate Power Range – Upscale Function is enabled when the RBM flux trip setpoint being applied is equal to or less than the Allowable Value for intermediate trip setpoint defined in the COLR, and the RBM flux trip rod block outputs are enabled (not bypassed). The High Power Range – Upscale Function is enabled when the RBM flux trip setpoint being applied is equal to or less than the Allowable Value for high trip setpoint defined in the COLR, and the RBM flux trip rod block outputs are enabled (not bypassed).

The SR is performed by varying the APRM Simulated Thermal Power input to the RBM from the reference APRM channel, and confirming that the criteria in the SR is met for both increasing and decreasing values of Simulated Thermal Power.

SR 3.3.2.1.4.a is satisfied if, for an APRM Simulated Thermal Power level ≥ 29%, the RBM flux trip rod block outputs are not bypassed and the RBM flux trip setpoint being applied is less than or equal to the low trip setpoint Allowable Value defined in the COLR. (Note that the intermediate trip setpoint and the high trip setpoint Allowable Values are less than the low trip setpoint Allowable Value.)

SR 3.3.2.1.4.b is satisfied if, for an APRM Simulated Thermal Power level ≥ the intermediate power level setpoint Allowable Value defined in the COLR, the RBM flux trip rod block outputs are not bypassed and the RBM flux trip setpoint being applied is less than or equal to the intermediate trip setpoint Allowable Value defined in the COLR. (Note that the high trip setpoint Allowable Value is less than the intermediate trip setpoint Allowable Value.)

SR 3.3.2.1.4.c is satisfied if, for an APRM Simulated Thermal Power level ≥ the high power level setpoint Allowable Value defined in the COLR, the RBM flux trip rod block outputs are not bypassed and the RBM flux trip setpoint being applied is less than or equal to the high trip setpoint Allowable Value defined in the COLR.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.3.2.1.4 (continued)

verified periodically to be less than or equal to the specified Allowable Values in the COLR. If any power range setpoint is nonconservative, then the affected RBM channel is considered inoperable. Alternatively, the RBM 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 3.3.1.1.3 and SR 3.3.1.1.8. The 24 month Frequency is based on the actual trip setpoint methodology utilized for these channels.

SR 3.3.2.1.5

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

SR 3.3.2.1.6

A CHANNEL FUNCTIONAL TEST is performed for the Reactor Mode Switch—Shutdown Position Function to ensure that the 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

(continued)

BASES (continued)

REFERENCES

1. UFSAR, Section 7.6.1.1.5.

2. NEDC-31654P, Maximum Extended Operating Domain Analysis For Brunswick Steam Electric Plant, February 1989.

3. 10 CFR 50.36(c)(2)(ii).

4. NEDC-32466P, Power Uprate Safety Analysis Report for Brunswick Steam Electric Plant Unit 1 and 2, September 1995.

5. UFSAR Section 15.4.

6. NRC SER, Acceptance for 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, Bases for Changes to Surveillance Test Intervals and Allowed Out-of-Service Times for Selected Instrumentation Technical Specifications, December 1992.

8. NEDC-30851P-A, Supplement 1, Technical Specification Improvement Analysis for BWR Control Rod Block Instrumentation, October 1988.

INSERT Q

Inserts Associated With Technical Specification Bases Markups

Insert Q

9. NEDC-32410P-A, Nuclear Measurement Analysis and Control Power Range Neutron Monitor (NUMAC PRNM) Retrofit Plus Option III Stability Trip Function, October 1995.
10. NEDC-32410P-A Supplement 1, Nuclear Measurement Analysis and Control Power Range Neutron Monitor (NUMAC PRNM) Retrofit Plus Option III Stability Trip Function, November 1997.

BASES

APPLICABLE SAFETY ANALYSES (continued)

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, without the requirement to modify the APLHGR requirements (Ref. 3). However, the COLR may require APLHGR limits to restrict the peak clad temperature for a LOCA with a single recirculation loop operating below the corresponding temperature for both loops operating.

The transient analyses of Chapter 15 of the UFSAR have also been performed for single recirculation loop operation (Ref. 3) and demonstrate sufficient flow coastdown characteristics to maintain fuel thermal margins during the abnormal operational transients analyzed without the requirement to modify the MCPR requirements. During single recirculation loop operation, modification to the Reactor Protection System (RPS) average power range monitor (APRM) instrument setpoints may be required to account for the different relationships between recirculation drive flow and reactor core flow by depressing a switch on the flow control trip reference cards of the APRM Flow Biased Simulated Thermal Power—High instrumentation. This manual action will adjust the flow control trip reference card to the setpoint map for single recirculation loop operation. However, in accordance with Reference 3, no modifications to the APRM Flow Biased Simulated Thermal Power—High setpoint are currently required.

INSERT R

Recirculation loops operating satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii) (Ref. 4).

LCO

Two recirculation loops are normally required to be in operation with their recirculation pump speeds 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. 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)"), MCPR limits (LCO 3.2.2, "MINIMUM CRITICAL POWER RATIO (MCPR)"), and APRM Flow Biased Simulated Thermal Power—High setpoint (LCO 3.3.1.1), as applicable, must be applied to allow continued operation. However, based on the

Allowable Value

(continued)

INSERT S

Inserts Associated With Technical Specification Bases Markups

Insert R

Simulated Thermal Power - High Allowable Value is required to account for the different relationships between recirculation drive flow and reactor core flow. The APRM channel subtracts the ΔW value from the measured recirculation drive flow and uses the adjusted recirculation drive flow value to determine the APRM Simulated Thermal Power - High Function trip setpoint.

Insert S

The COLR defines adjustments or modifications required for the APLHGR and MCPR limits for the current operating cycle.

BASES

LCO (continued)

analyses in Reference 3, no modifications to the MCPR limits or APRM Flow Biased Simulated Thermal Power—High setpoint are required for the current operating cycle. For the current cycle, APLHGR power- and flow-dependent multipliers are required to be applied as described in the COLR.

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

With the requirements of the LCO not met, the recirculation loops must be restored to operation with matched recirculation pump speeds within 6 hours. A recirculation loop is considered not in operation when the pump in that loop is idle or when the difference in pump speeds of the two recirculation pumps is greater than the match criteria. The loop with the lower recirculation pump speed must be considered not in operation. 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 and RPS setpoints, as applicable, operation with only one recirculation loop would satisfy the requirements of the LCO and the initial conditions of the accident sequence.

The 6 hour Completion Time is based on the low probability of an accident occurring during this time period, on a reasonable time to complete the Required Action (i.e., reset the applicable limits or setpoints for single recirculation loop operation), and on frequent core monitoring by operators allowing abrupt changes in core flow conditions to be quickly detected.

(continued)

BASES

SURVEILLANCE REQUIREMENTS	SR 3.4.1.1 (continued)

20% match criterion in terms of recirculation pump speed conservatively equates to the 10% match criterion in terms of recirculation loop flow. The generator speed associated with the recirculation pump motor-generator set may be used to measure recirculation pump speed.

The match criteria are measured in terms of the percent difference between recirculation pump speeds. If the difference between the recirculation pump speeds exceeds the match criteria, the loop with the lower recirculation pump speed is considered not in operation. The SR is not required when both loops are not in operation since the match criteria 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 Surveillance Frequency for jet pump OPERABILITY verification and has been shown by operating experience to be adequate to detect off normal recirculation pump speeds in a timely manner.

REFERENCES

1. UFSAR, Section 5.4.1.3.
2. UFSAR, Chapter 15.
3. NEDC-31766P, Brunswick Steam Electric Plant Units 1 and 2 Single Loop Operation, February 1990.
4. 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 analyses of Reference 1 are 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 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 analyses (Ref. 1). In addition to the added requirements for the 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 10 CFR 50.36(c)(2)(ii) (Ref. 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.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 must be verified by a second licensed operator or other qualified member of the technical staff. To provide additional

(continued)

BASES

ACTIONS

A.1 (continued)

not adversely affected. The control rod is disarmed to prevent inadvertent withdrawal during subsequent operations. The control rods can be hydraulically disarmed by closing the drive water and exhaust water isolation valves. Electrically the control rods can be disarmed by disconnecting power from all four directional control valve solenoids. Required Action A.1 is modified by a Note that allows the inoperable control rods to be bypassed or the RWM to be bypassed if required to allow insertion of the inoperable control rods and continued operation. LCO 3.3.2.1, "Control Rod Block Instrumentation," Actions provide additional requirements when the RWM is bypassed to ensure compliance with the CRDA analysis.

The allowed Completion Times are reasonable, considering the small number of allowed inoperable control rods, and provide time to insert and disarm the control rods in an orderly manner and without challenging plant systems.

Condition A is modified by a Note allowing separate Condition entry for each uncoupled control rod. This is acceptable since the Required Actions for this Condition provide appropriate compensatory actions for each uncoupled control rod. Complying with the Required Actions may allow for continued operation. Subsequent uncoupled control rods are governed by subsequent entry into the Condition and application of the Required Actions.

B.1

With one or more of the requirements of this LCO not met for reasons other than an uncoupled control rod, the testing should be immediately stopped by placing the reactor mode switch in the shutdown or refuel position. This results in a condition that is consistent with the requirements for MODE 5 where the provisions of this Special Operations LCO are no longer required.

SURVEILLANCE REQUIREMENTS

SR 3.10.8.1, SR 3.10.8.2, and SR 3.10.8.3

, 2.d,

LCO 3.3.1.1, Functions 2.a and 2.e, made applicable in this Special Operations LCO, are required to have applicable Surveillances met to establish that this Special Operations

(continued)