**Bryce L. Shriver**
Senior Vice President and
Chief Nuclear Officer

**PPL Susquehanna, LLC**
769 Salem Boulevard
Berwick, PA 18603
Tel. 570.542.3120 Fax 570.542.1504
blshriver@pplweb.com

ppl™

DEC 2 2 2003

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station OP1-17
Washington, DC 20555

**SUSQUEHANNA STEAM ELECTRIC STATION**
**PROPOSED AMENDMENT NO. 259 TO LICENSE NFP-14**
**AND PROPOSED AMENDMENT NO. 224 TO LICENSE NFP-22:**
**REVISED RESPONSE TO GL 94-02:**
**LONG-TERM STABILITY SOLUTION** **Docket Nos. 50-387**
**PLA-5686** **and 50-388**

*References:* 1) *PLA-5620, B. L. Shriver (PPL) to USNRC, "Proposed Amendment to License NFP-14 and to License NFP-22: Revised Response To GL-94-02: Long-Term Stability Solution," dated May, 06, 2003.*

2) *PLA-4925, R. G. Byram (PPL) to USNRC, "Proposed Amendment to License NPF-14: Final Response to GL 94-02: Long-Term Stability Solution," dated June 19, 1998.*

3) *PLA-4956, R. G. Byram (PPL) to USNRC, "Proposed Amendment to License NPF-22: Final Response to GL 94-02: Long-Term Stability Solution," dated August 05, 1998.*

4) *PLA-5675, B. L. Shriver to USNRC, "Response to Request for Additional Information to Proposed Amendment to License NPF-14 and Proposed Amendment to License NPF-22: Revised Response to GL 94-02: Long-Term Stability Solution," dated September 18, 2003.*

5) *USNRC to B. L. Shriver (PPL), "Susquehanna Steam Electric Station, Units 1 and 2 – Issuance of Amendment Re: Revised Response to GL 94-02 " Long Term Stability Solution", (TAC Nos. MB9008 and MB9009)," dated October 29, 2003.*

Pursuant to 10 CFR 50.90, PPL Susquehanna, LLC (PPL), proposes to amend the Susquehanna Steam Electric Station Units 1 and 2 (SSES) Technical Specifications (TS). The proposed change re-establishes SSES Technical Specification (TS) 3.3.1.3, "Oscillation Power Range Monitor (OPRM) Instrumentation", which was deleted (Unit 1 Amendment 215 and Unit 2 Amendment 190) on October 29, 2003 (Reference 5). We are also proposing to revise TS 3.4.1 "Recirculation Loops Operating" and TS 5.6.5 "Core Operating Limits Report (COLR)".

TS 3.3.1.3 for the OPRM was originally approved as Unit 1 Amendment 184 and Unit 2 Amendment 158. References 2 and 3 are the documented requests for these amendments. As approved by Reference 5, these amendments were not implemented.

A001

On September 18, 2003 PPL committed to submit this Technical Specification Amendment request for the OPRM system by December 30, 2003 (Reference 4). PPL also committed to implement these proposed OPRM changes to the TS by September 30, 2004. Accordingly, we are requesting NRC approval by August 1, 2004.

The need for this amendment request has been discussed with the NRC Project Manager for SSES.

The proposed changes have been approved by the SSES Plant Operations Review Committee and reviewed by the Susquehanna Review Committee. In accordance with 10 CFR 50.91(b)(1), PPL is sending a copy of this letter to the Pennsylvania Department of Environmental Protection.

If you have any questions, please contact Mr. Duane L. Filchner at (610)774-7819.

I declare under penalty of perjury that the foregoing is true and correct.

Sincerely,

Executed on: 12/22/03

B. L. Shriver
Sr. Vice-President and Chief Nuclear Officer

Enclosure:
PPL Evaluation of the Proposed Change

Attachments:

Attachment A - Proposed Technical Specification Change for New Section 3.3.1.3 (Camera Ready)
Attachment B – Proposed Technical Specification Changes for Section 3.4.1, and Section 5.6.5 (Markups)
Attachment C - Proposed Technical Specification Changes for TOC, Section 3.4.1, and Section 5.6.5 (Camera Ready)
Attachment D – Information Only- Technical Specification Bases Changes for Section 3.3.1.3 and Section 3.4.1
Attachment E - List of Regulatory Commitments

copy: NRC Region I
Mr. S. L. Hansell, NRC Sr. Resident Inspector
Mr. R. V. Guzman, NRC Project Manager
Mr. R. Janati, DEP/BRP

# Enclosure to PLA - 5686

# PPL Evaluation of the Proposed Change

# PPL EVALUATION

## 1.0 DESCRIPTION

This change is a request to amend Operating Licenses NPF-14 and NPF-22 for PPL Susquehanna, LLC (PPL), Susquehanna Steam Electric Station Units 1 and 2 (SSES) respectively. The proposed change adds SSES Technical Specification (TS) 3.3.1.3, "Oscillation Power Range Monitor (OPRM) Instrumentation", and revises TS 3.4.1 "Recirculation Loops Operating" and TS 5.6.5 "Core Operating Limits Report (COLR)" to remove specifications and information related to current stability specifications which will no longer be needed.

Presently, SSES is operating under Interim Corrective Actions (ICAs) defined in Technical Specification Section 3.4.1 that define restrictions to plant operation and define expanded regions developed using TS Section 5.6.5 methodology for operator response to instability events. These actions are the interim actions accepted by the NRC for core protection until a permanent protection system is installed. The ICAs are currently incorporated into the SSES Technical Specification Section 3.4.1.

The existing operating restrictions reduce the probability of thermal-hydraulic oscillations by prohibiting operation in defined areas of the Power to Flow Map prone to unstable behavior, and by terminating plant operation when unstable operation is observed. These actions necessarily require heightened vigilance by the Operator and require some amount of interpretation and operational judgement for compliance.

The proposed change alleviates the above described reliance upon the operator by installation of the Oscillating Power Range Monitoring (OPRM) system. This system will not require operator action or involvement for protection of the MCPR safety limit for any expected instability event. The Technical Specifications will continue to forbid operation with no Reactor Recirculation pumps operating.

## 2.0 PROPOSED CHANGE

New TS Section 3.3.1.3 is added to delineate the OPRM System Limiting Conditions for Operation, Applicability, Action Statements, Completion Times for Actions and system Surveillance Requirements.

TS Section 3.4.1 is revised such that all current references to Conditions and Surveillances involving Power/Flow Map Regions I and II are eliminated, as are all stability-related actions to be taken when in either Region I (immediate scram) or Region II (exit region or scram on observed LPRM/APRM oscillations). The requirement to place the reactor mode switch in the shutdown condition when no recirculation pumps are operating while in Mode 1 is not affected.

TS Section 5.6.5.a.6 is modified since there will no longer be regions of the power-to-flow map under the control of TS Section 3.4.1. Also, TS Section 5.6.5.b is revised to add NEDO-32465-A as an NRC approved analytical method to determine the OPRM setpoints.

PPL requests approval of this change prior to August 1, 2004 to support the orderly implementation of the change by September 30, 2004. PPL committed to submit this change to the NRC by December 30, 2003 and to implement the OPRM by September 30, 2004.

## 3.0 BACKGROUND

General Design Criterion (GDC) 10 of Appendix A to 10 CFR Part 50 requires that the reactor core and associated coolant, control, and protection systems be designed with appropriate margin to assure that specified acceptable fuel design limits will not be exceeded during any condition of normal operation, including the effects of anticipated operational occurrences. Additionally, GDC 12 requires that the reactor core and associated coolant, control, and protection systems be designed to assure that power oscillations which can result in conditions exceeding acceptable fuel design limits are either not possible, or can be reliably and readily detected and suppressed.

Under certain conditions, boiling water reactor cores may exhibit thermal hydraulic instabilities. These instabilities are characterized by periodic power and flow oscillations. If the oscillations become large enough, the fuel cladding integrity minimum critical power ratio (MCPR) safety limit and GDC 10 and 12 requirements may be challenged. Based on this possibility, SSES is currently operating with certain interim corrective actions (ICAs) to address the potential for thermal hydraulic instability events, which were originally developed in response to Bulletin 88-07, Supplement 1.

These requirements limit the probability of an instability event by restricting the duration of any entry into the regions of the power to flow map most susceptible to instability under anticipated entry conditions. Operator actions are also required by the ICAs when conditions consistent with the onset of thermal hydraulic oscillations are observed. These actions result in the suppression of conditions required for an instability event and thereby prevent any potential challenge to the MCPR safety limit. The plant operating procedures and operator training pursuant to implementation of the ICAs will continue to remain in place until the OPRM system is declared OPERABLE.

The PPL response to Generic Letter 94-02 provided commitments that incorporated expanded stability region and power distribution control definition to strengthen thermal hydraulic instability prevention. As committed in response to GL 94-02, an OPRM system was installed at SSES consistent with the Asea Brown Boveri Combustion Engineering (ABB-CE) Option III long-term solution for the thermal hydraulic instability issue. The intent of this OPRM system is to provide an RPS trip function to provide automatic detection and suppression of conditions that might result in a thermal hydraulic instability event and provide elimination of the manual ICAs. Implementation of the SSES OPRM system, including RPS trip function, eliminates the ICAs from the Technical Specifications.

Therefore, the intent of this proposed change is identical to Amendments 184 and 158 which were previously approved by the NRC for implementation at SSES, with the single exception that the OPRM Period Based Algorithm Allowable Value and Confirmation Counts has been relocated from the LCO statement to the COLR.

## 4.0 TECHNICAL ANALYSIS

The OPRM system is the SSES permanent automatic long-term solution to the thermal-hydraulic instability issue. The OPRM initiates a Reactor SCRAM via existing RPS trip logic on detection of core power thermal-hydraulic instability oscillation of a magnitude that is in excess of analyzed limits. This action assures automatic protection of the MCPR safety limit under all expected core-wide and regional thermal-hydraulic instability events.

The safety and efficacy of the installed system in meeting the design requirement of detecting and suppressing reactor core thermal-hydraulic instabilities is demonstrated and documented in the following NRC reviewed and approved Licensing Topical Reports:

| | |
|---|---|
| NEDO-32465-A<br>August 1996 | BWROG Reactor Core Stability Detect and Suppress Solutions Licensing Basis Methodology and Reload Applications |
| NEDO-31960-A<br>November 1995 | BWROG Long-Term Stability Solutions Licensing Methodology |
| NEDO-31960-A<br>Supplement 1<br>November 1995 | BWROG Long-Term Stability Solutions Licensing Methodology |
| CENPD-400-P-A<br>Rev. 01 May 1995 | Generic Topical Report for the ABB Option III Oscillation Power Range Monitor (OPRM) |

The four OPRM channels provide inputs to their associated RPS channels via the eight OPRM modules. Each OPRM channel takes amplified LPRM signals from each APRM and unassigned LPRM group. The OPRM modules are installed in available locations in the associated LPRM pages in the Power Range Neutron Monitoring System panels. The LPRM signals are grouped together such that the resulting OPRM response provides adequate coverage of expected oscillation modes. Each OPRM channel (consisting of two modules) contains more than 30 OPRM cells, where an OPRM cell represents a combination of 4 LPRMs in geometrically adjacent areas of the core. The use of instantaneous flux and smaller grouping of LPRMs in cells provides better resolution for the detection of instability oscillations than the APRM system alone. By having many cells, each consisting of multiple LPRMs in very close proximity, the OPRM will not be sensitive to single LPRM failures while still providing adequate sensitivity to protect the MCPR Safety Limit.

NEDO-31960-A and Supplement 1 describe three separate algorithms for detecting stability related oscillations: the Period Based Algorithm (PBA), the Amplitude Based Algorithm (ABA), and the Growth Rate Algorithm (GRA). The OPRM modules execute the algorithms and generate alarms and trips based on these calculations. Either module in the pair can trip the OPRM channel. These trips then actuate the Reactor Protection System when the appropriate RPS trip logic is satisfied. The OPRM's trip function is only enabled when the reactor power is greater than or equal to 30% RTP and the core flow is less than or equal to 60 Mlb/HR.

The OPRM will provide an alarm to alert the operator when the system is enabled, and provides a pre-trip alarm at the onset of sustained oscillations. The alarm will alert the operator to the plant condition in time for compensatory actions to be taken.

Only the Period Based Algorithm is credited in the safety analysis. The remaining algorithms provide defense-in-depth and additional protection against unanticipated oscillations. The Period Based Algorithm detects a stability related oscillation based on the detection of a sustained oscillation, followed by the relative cell signal amplitude exceeding a specified setpoint. The amplitude and growth rate algorithms provide defense-in-depth protection in the event that an instability grows large, or grows rapidly, without detection by the Period Based Algorithm. Parameters for the ABA and GRA are in the SSES Technical Requirements Manuals.

The OPRM system provides an increase in the reliability of the protection of the margin of safety for the MCPR Safety Limit for any expected thermal-hydraulic instability transient. The OPRM setpoints are determined by analyses based on the NRC approved methodology described in NEDO-32465-A. For future operating cycles the setpoints will be verified as part of the cycle-specific reload analysis. Additionally, the OPRM is designed and installed so as not to degrade the existing APRM, LRPM, and RPS systems.

Eliminating the current operating restrictions will ease the operator burden and increase the plant operating reliability. The OPRM provides improved protection by automating the detection and suppression function, and allows for a controlled exit from the susceptible regions when entered. The automatic protection function is designed to provide protection for expected modes of oscillation. The defense-in-depth afforded by the Amplitude Based Algorithm and Growth Rate Algorithm provide additional protection against unanticipated events. The increased operator awareness that comes from the available alarms and computer displays will enhance the operator's ability to recognize and respond before the oscillations have a chance to grow, making the current operating restrictions unnecessary and redundant.

Retaining the requirement to scram on natural circulation is a prudent action, given the increased probability of an imminent core instability under natural circulation and the clear ability of the operator to determine that this condition exists.

In conclusion, the OPRM system provides an increase in the reliability of the protection of the margin of safety for the MCPR Safety Limit for any expected thermal-hydraulic instability transient. The system is designed and installed so as not to degrade the existing APRM, LPRM, or RPS systems. Operator burden is eased with the elimination of the current operating restrictions.

## 5.0 REGULATORY SAFETY ANALYSIS

### 5.1 No Significant Hazards Consideration

The Commission has provided standards in 10 CFR 50.92(c) for determining whether a significant hazards consideration exists. A proposed amendment to an operating license for a facility involves no significant hazards consideration if operation of the facility in accordance with the proposed amendment would not: (1) involve a significant increase in the probability or consequences of an accident previously evaluated; (2) create the possibility of a new or different kind of accident from any accident previously evaluated; or (3) involve a significant reduction in a margin of safety.

The proposed amendment revises Susquehanna Steam Electric Station Unit 1 and Unit 2 Technical Specifications (TS). The change adds SSES Technical Specification (TS) 3.3.1.3, "Oscillation Power Range Monitor (OPRM) Instrumentation", and revises TS 3.4.1 "Recirculation Loops Operating", and TS 5.6.5 "Core Operating Limits Report (COLR)".

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

**1. Does the proposed change involve a significant increase in the probability of occurrence or consequences of an accident previously evaluated?**

Response: No.

The OPRM most directly affects the APRM and LPRM portions of the Power Range Neutron Monitoring system. Its installation does not affect the operation of these sub-systems. None of the accidents or equipment malfunctions affected by these sub-systems are affected by the presence or operation of the OPRM.

The APRM channels provide the primary indication of neutron flux within the core and respond almost instantaneously to neutron flux changes. The APRM Fixed Neutron Flux-High function is capable of generating a trip signal to prevent fuel damage or excessive reactor pressure. For the ASME overpressurization protection analysis in FSAR Chapter 5, the APRM Fixed Neutron Flux-High function is assumed to terminate the main steam isolation valve closure event. The high flux trip, along with the safety/relief valves, limits the peak reactor pressure vessel pressure to less than the ASME Code limits. The control rod drop accident (CRDA) analysis in Chapter 15 takes credit for the APRM Fixed Neutron Flux-High function to terminate the CRDA. The Recirculation Flow Controller Failure event (pump runup) is also terminated by the high neutron flux trip. The APRM Fixed Neutron Flux-High function is required to be OPERABLE in MODE 1 where the potential consequences of the analyzed transients could result in the Safety Limits (e.g. MCPR and Reactor pressure) being exceeded.

The installation of the OPRM equipment does not increase the consequences of a malfunction of equipment important to safety. The APRM and RPS systems are designed to fail in a tripped (fail safe) condition; the OPRM will have no affect on the consequence of the failure of either system. An inoperative trip signal is received by the RPS any time an APRM mode switch is moved to any position other than Operate, an APRM module is unplugged, the electronic operating voltage is low, or the APRM has too few LPRM inputs. These functions are not specifically credited in the accident analysis, but are retained for the RPS as required by the NRC approved licensing basis.

The OPRM allows operation under operating conditions presently restricted by the current Technical Specifications by providing automatic suppression functions in the area of concern in the event an instability occurs. The consequences of any accident or equipment malfunction are not increased by operating under those conditions. Although protected by the OPRM from thermal-hydraulic core instabilities above 30% core power, operation under natural core circulation conditions is not allowed. No accidents or transients of a type not analyzed in the FSAR are created by operating under these conditions with the protection of the OPRM system.

This change does not increase the probability of an accident as previously evaluated. The OPRM is designed and installed to not degrade the existing APRM, LPRM, and RPS systems. These systems will still perform all of their intended functions. The new equipment is tested and installed to the same or more restrictive environmental and seismic envelopes as the existing systems. The new equipment has been designed and tested to electromagnetic interference (EMI) requirements which assure correct operation of the existing equipment. The new system has been designed to single failure criteria and is electrically isolated from equipment of different electrical divisions and from non-1E equipment. The electrical loading is within the capability of the existing power sources and the heat loads are within the capability of existing cooling systems. The OPRM allows operation under operating conditions presently forbidden or restricted by the current Technical Specifications. No other transient or accident analysis assumes these operating restrictions.

Therefore, this change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

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

Response: No.

This proposal does not create the possibility of a new or different type of accident from any accident previously evaluated. The OPRM system is a monitoring and accident mitigation system that cannot create the possibility for an accident not previously evaluated.

The OPRM will allow operation in conditions restricted by the current Technical Specifications. Although protected by the OPRM from thermal-hydraulic core instabilities above 30% core power, operation under natural circulation conditions is not allowed. No accidents or transients of a type not analyzed in the FSAR are created by operating under these conditions with the protection of the OPRM system. No new failure modes or either the new OPRM equipment or of the existing APRM equipment have been introduced. Quality software design, testing, implementation and module self-health testing provides assurance that no new equipment malfunctions due to software errors are created. The possibility of an accident of a new or different type than any evaluated previously is not created.

The new OPRM equipment is designed and installed to the same system requirements as the existing APRM equipment and is designed and tested to have no impact on the existing functions of the APRM system. Appropriate isolation is provided where new interconnections between redundant separation groups are formed. The OPRM modules have been designed and tested to assure that no new failure modes have been introduced.

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

**3. Does the proposed change involve a significant reduction in a margin of safety?**

Response: No.

There has been no reduction in the margin of safety as defined in the basis for the Technical Specifications. The OPRM system does not negatively impact the existing APRM system. As a result, the margins in the Technical Specifications for the APRM system are not impacted by this addition.

Current operation under the ICAs provides an acceptable margin of safety in the event of an instability event as the result of preventive actions and Technical Specification controlled response by the control room operators. The OPRM system provides an increase in the reliability of the protection of the margin of safety by providing automatic protection of the MCPR safety limit, while the protection burden is significantly reduced for the control room operators. This protection is demonstrated as described above, and in the NRC reviewed and approved Topical Reports NEDO-32465-A and CENPD-400-P-A.

Replacement of the ICA operating restrictions from Technical Specifications with the OPRM system does not affect the margin of safety associated with any other system or fuel design parameter.

Therefore, this change does not involve a reduction in the margin of safety.

5.2 Applicable Regulatory Requirements/Criteria

General Design Criterion (GDC) 10 of Appendix A to 10 CFR Part 50 requires that the reactor core and associated coolant, control, and protection systems be designed with appropriate margin to assure that specified acceptable fuel design limits will not be exceeded during any condition of normal operation, including the effects of anticipated operational occurrences. Additionally, GDC 12 requires that the reactor core and associated coolant, control, and protection systems be designed to assure that power oscillations which can result in conditions exceeding acceptable fuel design limits are either not possible, or can be reliably and readily detected and suppressed.

Under certain conditions, boiling water reactor (BWR) cores may exhibit thermal hydraulic instabilities. These instabilities are characterized by periodic power and flow oscillations. If the oscillations become large enough, the fuel cladding integrity minimum critical power ratio (MCPR) safety limit and GDC 10 and 12 requirements may be challenged. Based on this possibility, SSES is currently operating with certain interim corrective actions (ICAs) to address the potential for thermal hydraulic instability events, which were originally developed in response to Bulletin 88-07, Supplement 1.

Generic Letter 94-02, "Long-Term Solutions and Upgrade of Interim Operating Recommendations for Thermal-Hydraulic Instabilities in Boiling Water Reactors," required further efforts for long term corrective actions. PLA-4195 (Reference 1), is the PPL response to Generic Letter 94-02, which provided commitments that incorporated expanded stability region and power distribution control definition to strengthen thermal hydraulic instability prevention.

SSES FSAR Sections 3.1 and 3.13 provide detailed discussion of SSES compliance with the applicable regulatory requirements and guidance. These sections are not impacted by this amendment. SSES FSAR Section 4.4.4.6 discusses the thermal-hydraulic stability analysis. For reload cores, a confirmatory analysis is performed to demonstrate the continued applicability of the core stability regions, which assure that the ICAs remain valid for each cycle. The analysis is based on comparison of core stability performance (i.e., variations in decay ratio for operating conditions at representative state points near the stability exclusion region) to previously analyzed cycles. SSES FSAR Section 7.2 provides discussion relative to the Reactor Protection System (RPS) Instrumentation and Controls.

## 6.0 ENVIRONMENTAL CONSIDERATIONS

10 CFR 51.22(c)(9) identifies certain licensing and regulatory actions, which are eligible for categorical exclusion from the requirement to perform an environmental assessment. A proposed amendment to an operating license for a facility does not require an environmental assessment if operation of the facility in accordance with the proposed amendment would not: (1) involve a significant hazards consideration; (2) result in a significant change in the types or significant increase in the amounts of any effluents that may be released offsite; or (3) result in a significant increase in individual or cumulative occupational radiation exposure. PPL Susquehanna, LLC has evaluated the proposed change and has determined that the proposed change meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Accordingly, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment needs to be prepared in connection with issuance of the amendment. The basis for this determination, using the above criteria, follows:

**Basis**

As demonstrated in the No Significant Hazards Consideration Evaluation, the proposed amendment does not involve a significant hazards consideration.

There is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite. The proposed change does not impact the effluent portion of the power plant or change any methods which govern normal plant operation.

There is no significant increase in individual or cumulative occupational radiation exposure. The proposed change does not involve any physical alteration of the plant (no new or different type of equipment will be installed) or change in methods governing normal plant operation.

## 7.0 REFERENCES

1. PLA-4195, R. G. Byram (PPL) to USNRC, "Susquehanna Steam Electric Station Response to Generic Letter 94-02: Long Term Solutions and Upgrade of Interim Operating Recommendations for Thermal- Hydraulic Instabilities in Boiling Water Reactors," dated September 12, 1994.

# Attachment A

## Proposed Technical Specification Change
## (Camera Ready)

## New Section 3.3.1.3

## (Units 1 & 2)

## 3.3 INSTRUMENTATION

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

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

APPLICABILITY: THERMAL POWER ≥ 25% RTP.

ACTIONS

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

| CONDITION | REQUIRED ACTION | COMPLETION TIME |
|---|---|---|
| A. One or more required channels inoperable. | A.1 Place channel in trip. | 30 days |
| | <u>OR</u> | |
| | A.2 Place associated RPS trip system in trip | 30 days |
| | <u>OR</u> | |
| | A.3 Initiate alternate method to detect and suppress thermal hydraulic instability oscillations. | 30 days |
| B. OPRM trip capability not maintained. | B.1 Initiate alternate method to detect and suppress thermal hydraulic instability oscillations. | 12 hours |
| | <u>AND</u> | |
| | B.2 Restore OPRM trip capability | 120 days |

(continued)

ACTIONS (continued)

| CONDITION | REQUIRED ACTION | COMPLETION TIME |
|---|---|---|
| C. Required Action and associated Completion Time not met. | C.1 Reduce THERMAL POWER to < 25% RTP. | 4 hours |

SURVEILLANCE REQUIREMENTS

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

| SURVEILLANCE | | FREQUENCY |
|---|---|---|
| SR 3.3.1.3.1 | Perform CHANNEL FUNCTIONAL TEST. | 184 days |
| SR 3.3.1.3.2 | Calibrate the local power range monitors. | 1000 MWD / MT average core exposure |
| SR 3.3.1.3.3 | -----NOTE----- Neutron detectors are excluded. ----- Perform CHANNEL CALIBRATION. | 24 months |
| SR 3.3.1.3.4 | Perform LOGIC SYSTEM FUNCTIONAL TEST. | 24 months |

(continued)

SURVEILLANCE REQUIREMENTS (continued)

| | SURVEILLANCE | FREQUENCY |
|---|---|---|
| SR 3.3.1.3.5 | Verify OPRM is not bypassed when THERMAL POWER is ≥ 30% RTP and core flow ≤ 60 MLb/Hr. | 24 months |
| SR 3.3.1.3.6 | ------------------------------NOTE------------------------------<br>Neutron detectors are excluded.<br>---------------------------------------------------------------------<br>Verify the RPS RESPONSE TIME is within limits. | 24 months on a STAGGERED TEST BASIS |

## 3.3 INSTRUMENTATION

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

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

APPLICABILITY: THERMAL POWER ≥ 25% RTP.

ACTIONS

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

| CONDITION | REQUIRED ACTION | COMPLETION TIME |
|---|---|---|
| A. One or more required channels inoperable. | A.1 Place channel in trip.<br><br>OR<br><br>A.2 Place associated RPS trip system in trip<br><br>OR<br><br>A.3 Initiate alternate method to detect and suppress thermal hydraulic instability oscillations. | 30 days<br><br><br><br>30 days<br><br><br><br>30 days |
| B. OPRM trip capability not maintained. | B.1 Initiate alternate method to detect and suppress thermal hydraulic instability oscillations.<br><br>AND<br><br>B.2 Restore OPRM trip capability | 12 hours<br><br><br><br>120 days |

(continued)

ACTIONS (continued)

| CONDITION | REQUIRED ACTION | COMPLETION TIME |
|---|---|---|
| C. Required Action and associated Completion Time not met. | C.1 Reduce THERMAL POWER to < 25% RTP. | 4 hours |

SURVEILLANCE REQUIREMENTS

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

---

| SURVEILLANCE | | FREQUENCY |
|---|---|---|
| SR 3.3.1.3.1 | Perform CHANNEL FUNCTIONAL TEST. | 184 days |
| SR 3.3.1.3.2 | Calibrate the local power range monitors. | 1000 MWD / MT average core exposure |
| SR 3.3.1.3.3 | -----NOTE----- Neutron detectors are excluded. ----- Perform CHANNEL CALIBRATION. | 24 months |
| SR 3.3.1.3.4 | Perform LOGIC SYSTEM FUNCTIONAL TEST. | 24 months |

(continued)

SURVEILLANCE REQUIREMENTS (continued)

| SURVEILLANCE | | FREQUENCY |
|---|---|---|
| SR 3.3.1.3.5 | Verify OPRM is not bypassed when THERMAL POWER is $\geq$ 30% RTP and core flow $\leq$ 60 MLb/Hr. | 24 months |
| SR 3.3.1.3.6 | -----------------------------NOTE-----------------------------<br>Neutron detectors are excluded.<br>------------------------------------------------------------------<br>Verify the RPS RESPONSE TIME is within limits. | 24 months on a STAGGERED TEST BASIS |

# Attachment B

# Proposed Technical Specification Changes
# (Markups)

# Section 3.4.1
# Section 5.6.5

# (Units 1 & 2)

## 3.4 REACTOR COOLANT SYSTEM (RCS)

### 3.4.1 Recirculation Loops Operating

LCO 3.4.1 Two recirculation loops with matched flows shall be in operation. ~~with a THERMAL POWER/core flow condition outside of Regions I and II of the Power Flow map as specified in the COLR.~~

OR

One recirculation loop may be in operation provided the following limits are applied when the associated LCO is applicable. ~~with a THERMAL POWER/core flow condition outside of Regions I and II of the Power Flow map as specified in the COLR.~~

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

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

c. LCO 3.2.3, "LINEAR HEAT GENERATION RATE (LHGR)," single loop operation limits specified in the COLR, and

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

e. Recirculation pump speed is $\leq$ 80%.

---------------------------------------Note---------------------------------------

Required limit and setpoint resets for single recirculation loop operation may be delayed for up to 12 hours after transition from two recirculation loop operation to single recirculation loop operation.

---

APPLICABILITY: MODES 1 and 2.

ACTIONS

| CONDITION | | REQUIRED ACTION | | COMPLETION TIME |
|---|---|---|---|---|
| A. | Total core flow as a function of THERMAL POWER within Region I of the Power Flow map as specified in the COLR.<br><br>OR<br><br>No recirculation loops operating while in MODE 1 | A.1 | Place reactor mode switch in the shutdown position. | Immediately |
| B. | ----------NOTE----------<br>Only applicable when in Region II of the Power Flow map as specified in the COLR.<br>---------------------------<br><br>Two or more APRM readings oscillating with one or more oscillating ≥ 10% of RTP peak-to-peak<br><br>OR<br><br>Two or more LPRM upscale alarms activating and deactivating with a period ≥ 1 second and ≤ 5 seconds.<br><br>OR<br><br>Sustained LPRM oscillations ≥ 10 w/cm$^2$ peak-to-peak with a period ≥ 1 second and ≤ 5 seconds.<br><br>OR | B.1 | Place the reactor mode switch in the shutdown position. | Immediately |

(continued)

ACTIONS

| CONDITION | REQUIRED ACTION | COMPLETION TIME |
|---|---|---|
| ~~B.~~ ~~(continued~~) ~~Less than 50% of required LPRM upscale alarms OPERABLE~~ | | |
| ~~C. Total core flow as a function of THERMAL POWER within Region II of the Power Flow map as specified in the COLR.~~ | ~~C.1 Initiate action to restore total core flow as a function of THERMAL POWER outside of Region II.~~ | ~~Immediately.~~ |
| B. ~~D.~~ Recirculation loop flow mismatch not within limits. | B.1 ~~D.1~~ Declare the recirculation loop with lower flow to be "not in operation." | 2 hours |
| C. ~~E.~~ No recirculation loops in operation while in MODE 2<br><br>OR<br><br>Single Recirculation Loop required limits and setpoints not established within required time. | C.1 ~~E.1~~ Be in MODE 3. | 12 hours |

SURVEILLANCE REQUIREMENTS

| SURVEILLANCE | | FREQUENCY |
|---|---|---|
| SR 3.4.1.1 | ------------------------NOTE------------------------<br>Not required to be performed until 24 hours after both recirculation loops are in operation.<br>--------------------------------------------------------<br>Verify recirculation loop jet pump flow mismatch with both recirculation loops in operation is:<br>a. ≤ 10 million lbm/hr when operating at < 75 million lbm/hr total core flow; and<br>b. ≤ 5 million lbm/hr when operating at ≥ 75 million lbm/hr total core flow. | 24 hours |
| ~~SR 3.4.1.2~~ | ~~Verify total core flow as a function of THERMAL POWER is outside of Region I and II of the Power Flow map as specified in the COLR.~~ | ~~24 hours~~ |
| SR ~~3.4.1.3~~ 3.4.1.2 | ------------------------NOTE------------------------<br>Only required to be met during single loop operations.<br>--------------------------------------------------------<br>Verify recirculation pump speed is within the limit specified in the LCO. | 24 hours |

**THIS PAGE INTENTIONALLY LEFT BLANK**

5.6 Reporting Requirements (continued)

5.6.4 Monthly Operating Reports

Routine reports of operating statistics and shutdown experience, including documentation of all challenges to the main steam safety/relief valves, shall be submitted on a monthly basis no later than the 15th of each month following the calendar month covered by the report.

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 for Specification 3.2.1;

2. The Minimum Critical Power Ratio for Specification 3.2.2;

3. The Linear Heat Generation Rate for Specification 3.2.3;

4. The Average Power Range Monitor (APRM) Gain and Setpoints for Specification 3.2.4; and

5. The Shutdown Margin for Specification 3.1.1.

6. The OPRM Setpoints ~~Stability related regions of the Power Flow map~~ for Specification ~~3.4.1.~~ 3.3.1.3.

b. The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC.

When an initial assumed power level of 102 percent of rated power is specified in a previously approved method, this refers to the power level associated with the design basis analyses, or 3510 MWt. The power level of 3510 MWt is 100.6% of the rated thermal power level of 3489 MWt. The RTP of 3489 MWt may only be used when feedwater flow measurement (used as input to the reactor thermal power measurement) is provided by the Leading Edge Flow Meter (LEFM✓™) as described in the LEFM✓™ Topical Report and supplement referenced below. When feedwater flow measurements from the LEFM✓™ system are not available, the core thermal power level may not exceed the originally approved RTP of 3441 MWt, but the value of 3510 MWt

(continued)

5.6 Reporting Requirements

5.6.5 COLR (continued)

9. ANF-91-048(P)(A), "Advanced Nuclear Fuels Corporation Methodology for Boiling Water Reactors EXEM BWR Evaluation Model.

10. XN-NF-80-19(P)(A), "Exxon Nuclear Methodology for Boiling Water Reactors.

11. XN-NF-79-71(P)(A), "Exxon Nuclear Plant Transient Methodology for Boiling Water Reactors."

12. EMF-1997(P)(A), "ANFB-10 Critical Power Correlation."

13. Caldon, Inc., "TOPICAL REPORT: Improving Thermal Power Accuracy and Plant Safety While Increasing Operating Power Level Using the LEFM✓™ System," Engineering Report - 80P.

14. Caldon, Inc., "Supplement to Topical Report ER-80P: Basis for a Power Uprate with the LEFM✓™ or LEFM CheckPlus™ System,", Engineering Report ER -160P.

15. EMF-85-74(P), "RODEX 2A (BWR) Fuel Rod Thermal-Mechanical Evaluation Model."

16. ~~EMF-CC-074 (P)(A), Volume 4, "BWR Stability Analysis: Assessment of STAIF with Input from MICROBURN-B2."~~

NEDO-32465-A, "BWROG Reactor Core Stability Detect and Suppress Solutions Licensing Basis Methodology and Reload Applications," August 1996.

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)

# 3.4 REACTOR COOLANT SYSTEM (RCS)

## 3.4.1 Recirculation Loops Operating

LCO 3.4.1

Two recirculation loops with matched flows shall be in operation. ~~with a THERMAL POWER/core flow condition outside of Regions I and II of the Power Flow map as specified in the COLR.~~

OR

One recirculation loop may be in operation ~~with a THERMAL POWER/core flow condition outside of Regions I and II of the Power Flow map as specified in the COLR,~~ provided the following limits are applied when the associated LCO is applicable:

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

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

c. LCO 3.2.3, "LINEAR HEAT GENERATION RATE (LHGR)," single loop operation limits specified in the COLR, and

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

e. Recirculation pump speed is ≤ 80%.

------------------------------------------Note------------------------------------------

Required limit and setpoint resets for single recirculation loop operation may be delayed for up to 12 hours after transition from two recirculation loop operation to single recirculation loop operation.

---------------------------------------------------------------------------------------

APPLICABILITY: MODES 1 and 2.

ACTIONS

| CONDITION | REQUIRED ACTION | COMPLETION TIME |
| --- | --- | --- |
| A. Total core flow as a function of THERMAL POWER within Region I of the Power Flow map as specified in the COLR.<br><br>OR<br><br>No recirculation loops operating while in MODE 1 | A.1 Place reactor mode switch in the shutdown position. | Immediately |
| B. ----------NOTE----------<br>Only applicable when in Region II of the Power Flow map as specified in the COLR.<br>----------------------------<br><br>Two or more APRM readings oscillating with one or more oscillating ≥ 10% of RTP peak-to-peak<br><br>OR<br><br>Two or more LPRM upscale alarms activating and deactivating with a period ≥ 1 second and ≤ 5 seconds.<br><br>OR<br><br>Sustained LPRM oscillations > 10 w/cm² peak-to-peak with a period ≥ 1 second and ≤ 5 seconds.<br><br>OR | B.1 Place the reactor mode switch in the shutdown position. | Immediately |

(continued)

ACTIONS

| CONDITION | | REQUIRED ACTION | | COMPLETION TIME |
|---|---|---|---|---|
| ~~B.~~ | ~~(continued)~~<br>~~Less than 50% of required LPRM upscale alarms OPERABLE~~ | | | |
| ~~C.~~ | ~~Total core flow as a function of THERMAL POWER within Region II of the Power Flow map as specified in the COLR.~~ | ~~C.1~~ | ~~Initiate action to restore total core flow as a function of THERMAL POWER outside of Region II.~~ | ~~Immediately.~~ |
| B. ~~D.~~ | Recirculation loop flow mismatch not within limits. | B.1 ~~D.1~~ | Declare the recirculation loop with lower flow to be "not in operation." | 2 hours |
| C. ~~E.~~ | No recirculation loops in operation while in MODE 2<br><br><u>OR</u><br><br>Single Recirculation Loop required limits and setpoints not established within required time. | C.1 ~~E.1~~ | Be in MODE 3. | 12 hours |

SURVEILLANCE REQUIREMENTS

| SURVEILLANCE | | FREQUENCY |
|---|---|---|
| SR 3.4.1.1 | ------------------NOTE------------------<br>Not required to be performed until 24 hours after both recirculation loops are in operation.<br>------------------------------------------<br>Verify recirculation loop jet pump flow mismatch with both recirculation loops in operation is:<br>a. ≤ 10 million lbm/hr when operating at < 75 million lbm/hr total core flow; and<br>b. ≤ 5 million lbm/hr when operating at ≥ 75 million lbm/hr total core flow. | 24 hours |
| ~~SR 3.4.1.2~~ | ~~Verify total core flow as a function of THERMAL POWER is outside of Region I and II of the Power Flow map as specified in the COLR.~~ | ~~24 hours~~ |
| SR 3.4.1.2 ~~3.4.1.3~~ | ------------------NOTE------------------<br>Only required to be met during single loop operations.<br>------------------------------------------<br>Verify recirculation pump speed is within the limit specified in the LCO. | 24 hours |

**THIS PAGE INTENTIONALLY LEFT BLANK**

5.6 Reporting Requirements

5.6.4 Monthly Operating Reports

Routine reports of operating statistics and shutdown experience, including documentation of all challenges to the main steam safety/relief valves, shall be submitted on a monthly basis no later than the 15th of each month following the calendar month covered by the report.

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 for Specification 3.2.1;

2. The Minimum Critical Power Ratio for Specification 3.2.2;

3. The Linear Heat Generation Rate for Specification 3.2.3;

4 The Average Power Range Monitor (APRM) Gain and Setpoints for Specification 3.2.4; and

5. The Shutdown Margin for Specification 3.1.1.

6. The ~~Stability related regions of the Power Flow map~~ OPRM Setpoints for Specification ~~3.4.1.~~ 3.3.1.3.

b. The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC.

When an initial assumed power level of 102 percent of rated power is specified in a previously approved method, this refers to the power level associated with the design basis analyses, or 3510 MWt. The power level of 3510 MWt is 100.6% of the rated thermal power level of 3489 MWt. The RTP of 3489 MWt may only be used when feedwater flow measurement (used as input to the reactor thermal power measurement) is provided by the Leading Edge Flow Meter (LEFM✓™) as described in the LEFM✓™ Topical Report and supplement referenced below. When feedwater flow measurements from the LEFM✓™ system are not available, the

(continued)

5.6.5 COLR (continued)

11. Caldon, Inc., “Supplement to Topical Report ER-80P: Basis for a Power Uprate with the LEFM✓™ or LEFM CheckPlus™ System,” Engineering Report ER-160P.

12. EMF-85-74(P)(A), “RODEX 2A (BWR) Fuel Rod Thermal-Mechanical Evaluation Model.”

13. EMF-2158(P)(A), “Siemens Power Corporation Methodology for Boiling Water Reactors: Evaluation and Validation of CASMO-4/Microburn-B2,” Siemens Power Corporation.

14. ~~EMF-CC-074(P)(A), Volume 4, “BWR Stability Analysis: Assessment of STAIF with Input from MICROBURN-B2.”~~

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.

5.6.6 EDG Failures Report

If an individual emergency diesel generator (EDG) experiences four or more valid failures in the last 25 demands, these failures and any nonvalid failures experienced by that EDG in that time period shall be reported within 30 days. Reports on EDG failures shall include the information recommended in Regulatory Guide 1.9, Revision 3, Regulatory Position C.4.

5.6.7 PAM 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.

NEDO-32465-A, "BWROG Reactor Core Stability Detect and Suppress Solutions Licensing Basis Methodology and Reload Applications," August 1996.

# Attachment C

## Proposed Technical Specification Changes
## (Camera Ready)

## TOC
## Section 3.4.1
## Section 5.6.5

## (Units 1 & 2)

(continued)

(continued)

(continued)

## 3.4 REACTOR COOLANT SYSTEM (RCS)

### 3.4.1 Recirculation Loops Operating

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

OR

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

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

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

c. LCO 3.2.3, "LINEAR HEAT GENERATION RATE (LHGR)," single loop operation limits specified in the COLR, and

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

e. Recirculation pump speed is ≤ 80%.

-----------------------------------Note-----------------------------------
Required limit and setpoint resets for single recirculation loop operation may be delayed for up to 12 hours after transition from two recirculation loop operation to single recirculation loop operation.
---------------------------------------------------------------------------

APPLICABILITY: MODES 1 and 2.

ACTIONS

| CONDITION | REQUIRED ACTION | COMPLETION TIME |
|---|---|---|
| A. No recirculation loops operating while in MODE 1. | A.1 Place reactor mode switch in the shutdown position. | Immediately |
| B. Recirculation loop flow mismatch not within limits. | B.1 Declare the recirculation loop with lower flow to be "not in operation." | 2 hours |
| C. No recirculation loops in operation while in MODE 2.<br><br>OR<br><br>Single Recirculation Loop required limits and setpoints not established within required time. | C.1 Be in MODE 3. | 12 hours |

SURVEILLANCE REQUIREMENTS

| SURVEILLANCE | FREQUENCY |
|---|---|
| SR 3.4.1.1 -------------------------NOTE-------------------------<br>Not required to be performed until 24 hours after both recirculation loops are in operation.<br>--------------------------------------------------------------<br>Verify recirculation loop jet pump flow mismatch with both recirculation loops in operation is:<br>a. ≤ 10 million lbm/hr when operating at < 75 million lbm/hr total core flow; and<br>b. ≤ 5 million lbm/hr when operating at ≥ 75 million lbm/hr total core flow. | 24 hours |
| SR 3.4.1.2 -------------------------NOTE-------------------------<br>Only required to be met during single loop operations.<br>--------------------------------------------------------------<br>Verify recirculation pump speed is within the limit specified in the LCO. | 24 hours |

**THIS PAGE INTENTIONALLY LEFT BLANK**

**THIS PAGE INTENTIONALLY LEFT BLANK**

5.6 Reporting Requirements (continued)

5.6.4 Monthly Operating Reports

Routine reports of operating statistics and shutdown experience, including documentation of all challenges to the main steam safety/relief valves, shall be submitted on a monthly basis no later than the 15th of each month following the calendar month covered by the report.

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 for Specification 3.2.1;

2. The Minimum Critical Power Ratio for Specification 3.2.2;

3. The Linear Heat Generation Rate for Specification 3.2.3;

4. The Average Power Range Monitor (APRM) Gain and Setpoints for Specification 3.2.4; and

5. The Shutdown Margin for Specification 3.1.1.

6. The OPRM setpoints for Specification 3.3.1.3.

b. The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC.

When an initial assumed power level of 102 percent of rated power is specified in a previously approved method, this refers to the power level associated with the design basis analyses, or 3510 MWt. The power level of 3510 MWt is 100.6% of the rated thermal power level of 3489 MWt. The RTP of 3489 MWt may only be used when feedwater flow measurement (used as input to the reactor thermal power measurement) is provided by the Leading Edge Flow Meter (LEFM✓™) as described in the LEFM✓™ Topical Report and supplement referenced below. When feedwater flow measurements from the LEFM✓™ system are not available, the core thermal power level may not exceed the originally approved RTP of 3441 MWt, but the value of 3510 MWt

(continued)

5.6 Reporting Requirements

5.6.5 COLR (continued)

9. ANF-91-048(P)(A), "Advanced Nuclear Fuels Corporation Methodology for Boiling Water Reactors EXEM BWR Evaluation Model.

10. XN-NF-80-19(P)(A), "Exxon Nuclear Methodology for Boiling Water Reactors.

11. XN-NF-79-71(P)(A), "Exxon Nuclear Plant Transient Methodology for Boiling Water Reactors."

12. EMF-1997(P)(A), "ANFB-10 Critical Power Correlation."

13. Caldon, Inc., "TOPICAL REPORT: Improving Thermal Power Accuracy and Plant Safety While Increasing Operating Power Level Using the LEFM✔™ System," Engineering Report - 80P.

14. Caldon, Inc., "Supplement to Topical Report ER-80P: Basis for a Power Uprate with the LEFM✔™ or LEFM CheckPlus™ System,", Engineering Report ER -160P.

15. EMF-85-74(P), "RODEX 2A (BWR) Fuel Rod Thermal-Mechanical Evaluation Model."

16. NEDO-32465-A, "BWROG Reactor Core Stability Detect and Suppress Solutions Licensing Basis Methodology and Related Applications," August 1996.

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)

(continued)

(continued)

(continued)

## 3.4 REACTOR COOLANT SYSTEM (RCS)

### 3.4.1 Recirculation Loops Operating

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

OR

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

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

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

c. LCO 3.2.3, "LINEAR HEAT GENERATION RATE (LHGR)," single loop operation limits specified in the COLR, and

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

e. Recirculation pump speed is ≤ 80%.

------------------------------Note------------------------------

Required limit and setpoint resets for single recirculation loop operation may be delayed for up to 12 hours after transition from two recirculation loop operation to single recirculation loop operation.

---

APPLICABILITY: MODES 1 and 2.

ACTIONS

| CONDITION | REQUIRED ACTION | COMPLETION TIME |
| --- | --- | --- |
| A. No recirculation loops operating while in MODE 1. | A.1 Place reactor mode switch in the shutdown position. | Immediately |
| B. Recirculation loop flow mismatch not within limits. | B.1 Declare the recirculation loop with lower flow to be "not in operation." | 2 hours |
| C. No recirculation loops in operation while in MODE 2.<br><br><u>OR</u><br><br>Single Recirculation Loop required limits and setpoints not established within required time. | C.1 Be in MODE 3. | 12 hours |

SURVEILLANCE REQUIREMENTS

| SURVEILLANCE | FREQUENCY |
|---|---|
| SR 3.4.1.1 ---------------------NOTE--------------------- <br> Not required to be performed until 24 hours after both recirculation loops are in operation. <br> ------------------------------------------------------------ <br> Verify recirculation loop jet pump flow mismatch with both recirculation loops in operation is: <br> a. $\leq$ 10 million lbm/hr when operating at < 75 million lbm/hr total core flow; and <br> b. $\leq$ 5 million lbm/hr when operating at $\geq$ 75 million lbm/hr total core flow. | 24 hours |
| SR 3.4.1.2 ---------------------NOTE--------------------- <br> Only required to be met during single loop operations. <br> ------------------------------------------------------------ <br> Verify recirculation pump speed is within the limit specified in the LCO. | 24 hours |

**THIS PAGE INTENTIONALLY LEFT BLANK**

**THIS PAGE INTENTIONALLY LEFT BLANK**

5.6 Reporting Requirements

5.6.4 Monthly Operating Reports

Routine reports of operating statistics and shutdown experience, including documentation of all challenges to the main steam safety/relief valves, shall be submitted on a monthly basis no later than the 15th of each month following the calendar month covered by the report.

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 for Specification 3.2.1;

2. The Minimum Critical Power Ratio for Specification 3.2.2;

3. The Linear Heat Generation Rate for Specification 3.2.3;

4 The Average Power Range Monitor (APRM) Gain and Setpoints for Specification 3.2.4; and

5. The Shutdown Margin for Specification 3.1.1.

6. The OPRM setpoints for Specification 3.3.1.3.

b. The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC.

When an initial assumed power level of 102 percent of rated power is specified in a previously approved method, this refers to the power level associated with the design basis analyses, or 3510 MWt. The power level of 3510 MWt is 100.6% of the rated thermal power level of 3489 MWt. The RTP of 3489 MWt may only be used when feedwater flow measurement (used as input to the reactor thermal power measurement) is provided by the Leading Edge Flow Meter (LEFM✓™) as described in the LEFM✓™ Topical Report and supplement referenced below. When feedwater flow measurements from the LEFM✓™ system are not available, the

(continued)

5.6.5 COLR (continued)

11. Caldon, Inc., "Supplement to Topical Report ER-80P: Basis for a Power Uprate with the LEFM✓™ or LEFM CheckPlus™ System," Engineering Report ER-160P.

12. EMF-85-74(P)(A), "RODEX 2A (BWR) Fuel Rod Thermal-Mechanical Evaluation Model."

13. EMF-2158(P)(A), "Siemens Power Corporation Methodology for Boiling Water Reactors: Evaluation and Validation of CASMO-4/Microburn-B2," Siemens Power Corporation.

14. NEDO-32465-A, "BWROG Reactor Core Stability Detect and Suppress Solutions Licensing Basis Methodology and Related Applications," August 1996.

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.

5.6.6 EDG Failures Report

If an individual emergency diesel generator (EDG) experiences four or more valid failures in the last 25 demands, these failures and any nonvalid failures experienced by that EDG in that time period shall be reported within 30 days. Reports on EDG failures shall include the information recommended in Regulatory Guide 1.9, Revision 3, Regulatory Position C.4.

5.6.7 PAM 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.

# Attachment D

# Information Only - Technical Specification Bases Changes

# Section 3.3.1.3
# Section 3.4.1

# (Units 1 & 2)

# B 3.3 INSTRUMENTATION

## B.3.3.1.3 Oscillation Power Range Monitor (OPRM)

BASES

BACKGROUND

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

References 1, 2, and 3 describe three separate algorithms for detecting stability related oscillations: the period based detection algorithm, the amplitude based algorithm, and the growth rate algorithm. The OPRM System hardware implements these algorithms in microprocessor based modules. These modules execute the algorithms based on LPRM inputs and generate alarms and trips based on these calculations. These trips result in tripping the Reactor Protection System (RPS) when the appropriate RPS trip logic is satisfied, as described in the Bases for LCO 3.3.1.1. "RPS Instrumentation." Only the period based detection algorithm is used in the safety analysis (Ref. 1, 2, 6, & 7). The remaining algorithms provide defense-in-depth and additional protection against unanticipated oscillations.

(continued)

BASES

BACKGROUND (continued)

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

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

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

APPLICABLE SAFETY ANALYSES

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

The OPRM Instrumentation satisfies Criterion 3 of the NRC Policy Statement.

BASES

LCO

Four channels of the OPRM System are required to be OPERABLE to ensure that stability related oscillations are detected and suppressed prior to exceeding the MCPR safety limit. Only one of the two OPRM modules' ~~period based detection algorithm is~~ is required for OPRM channel OPERABILITY. The minimum number of LPRMs required OPERABLE to maintain an OPRM channel OPERABLE is consistent with the minimum number of LPRMs required to maintain the APRM system OPERABLE per LCO 3.3.1.1.

See Insert TSB1 →

~~The Allowable Value for the OPRM Period Based Algorithm setpoint (Sp) is derived from the analytic limit corrected for instrument and calibration errors (Ref. 9 & 10).~~

APPLICABILITY

The OPRM instrumentation is required to be OPERABLE in order to detect and suppress neutron flux oscillations in the event of thermal-hydraulic instability. As described in References 1, 2, and 3, the power/core flow region protected against anticipated oscillations is defined by THERMAL POWER ≥ 30% RTP and core flow ≤ 60 Mlb/Hr. The OPRM trip is required to be enabled in this region, and the OPRM must be capable of enabling the trip function as a result of anticipated transients that place the core in that power/flow condition. Therefore, the OPRM is required to be OPERABLE with THERMAL POWER ≥ 25% RTP and at all core flows while above that THERMAL POWER. It is not necessary for the OPRM to be operable with THERMAL POWER < 25% RTP because transients from below this THERMAL POWER are not anticipated to result in power that exceeds 30% RTP.

ACTIONS

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

(continued)

# Insert TSB1

The OPRM setpoints are determined by analyses based on the NRC approved methodology described in NEDO-32465-A (Ref. 6). The Allowable Value for the OPRM Period Based Algorithm setpoint (SP) is derived from the analytic limit corrected for instrument and calibration errors as contained in the COLR.

ACTIONS
(continued)

A 1, A 2, and A 3

Because of the reliability and on-line self-testing of the OPRM instrumentation and the redundancy of the RPS design, an allowable out of service time of 30 days has been shown to be acceptable (Ref. 7) to permit restoration of any inoperable channel to OPERABLE status. However, this out of service time is only acceptable provided the OPRM instrumentation still maintains OPRM trip capability (refer to Required Actions B.1 and B.2). The remaining OPERABLE OPRM channels continue to provide trip capability (see Condition B) and provide operator information relative to stability activity. The remaining OPRM modules have high reliability. With this high reliability, there is a low probability of a subsequent channel failure within the allowable out of service time. In addition, the OPRM modules continue to perform on-line self-testing and alert the operator if any further system degradation occurs.

If the inoperable channel cannot be restored to OPERABLE status within the allowable out of service time, the OPRM channel or associated RPS trip system must be placed in the tripped condition per Required Actions A.1 and A.2. Placing the inoperable OPRM channel in trip (or the associated RPS trip system in trip) would conservatively compensate for the inoperability, provide the capability to accommodate a single failure and allow operation to continue. Alternately, if it is not desired to place the OPRM channel (or RPS trip system) in trip (e.g., as in the case where placing the inoperable channel in trip would result in a full scram). the alternate method of detecting and suppressing thermal hydraulic instability oscillations is required (Required Action A.3). This alternate method is described in Reference 5. It consists of increased operator awareness and monitoring for neutron flux oscillations when operating in the region where oscillations are possible. If indications of oscillation, as described in Reference 5 are observed by the operator, the operator will take the actions described by procedures which include initiating a manual scram of the reactor. The power/flow map regions are developed based on methodology in Reference 11. The applicable regions are contained in the COLR.

ACTIONS (continued)

B.1 and B.2

Required action B.1 is intended to ensure that appropriate actions are taken if multiple, inoperable, untripped OPRM channels within the same RPS trip system result in not maintaining OPRM trip capability. OPRM trip capability is considered to be maintained when sufficient OPRM channels are OPERABLE or in trip (or the associated RPS trip system is in trip), such that a valid OPRM signal will generate a trip signal in both RPS trip systems (this would require both RPS trip systems to have at least one OPRM channel OPERABLE or the associated RPS trip system in trip).

Because of the low probability of the occurrence of an instability, 12 hours is an acceptable time to initiate the alternate method of detecting and suppressing thermal hydraulic instability oscillations described in Action A.3 above. The alternate method of detecting and suppressing thermal hydraulic instability oscillations would adequately address detection and mitigation in the event of instability oscillations. Based on industry operating experience with actual instability oscillations, the operator would be able to recognize instabilities during this time and take action to suppress them through a manual scram. In addition, the OPRM System may still be available to provide alarms to the operator if the onset of oscillations were to occur. Since plant operation is minimized in areas where oscillations may occur, operation for 120 days without OPRM trip capability is considered acceptable with implementation of the alternate method of detecting and suppressing thermal hydraulic instability oscillations.

C.1

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

SURVEILLANCE REQUIREMENTS

SR 3.3.1.3.1

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

SR 3.3.1.3.2

LPRM gain settings are determined from the local flux profiles measured by the Traversing Incore Probe (TIP) System. This establishes the relative local flux profile for appropriate representative input to the OPRM System. The 1000 MWD/MT Frequency is based on operating experience with LPRM sensitivity changes.

SR 3.3.1.3.3

A CHANNEL CALIBRATION 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. Calibration of the channel provides a check of the internal reference voltage and the internal processor clock frequency. It also compares the desired trip setpoints with those in processor memory. Since the OPRM is a digital system, the internal reference voltage and processor clock frequency are, in turn, used to automatically calibrate the internal analog to digital converters. As noted, neutron detectors are excluded from CHANNEL CALIBRATION because they are passive devices, with minimal drift, and because of the difficulty of simulating a meaningful signal. Changes in neutron detector sensitivity are compensated for by performing the 1000 MWD/MT LPRM calibration using the TIPs (SR 3.3.1.3.2).

SURVEILLANCE REQUIREMENTS (continued)

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

SR 3.3.1.3.4

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

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

SR 3.3.1.3.5

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

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

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

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.1.3.6

This SR ensures that the individual channel response times are less than or equal to the maximum values assumed in the safety analysis (Ref. 6). The OPRM self-test function may be utilized to perform this testing for those components it is designed to monitor. The LPRM amplifier cards inputting to the OPRM are excluded from the OPRM RESPONSE TIME testing. The RPS RESPONSE TIME acceptance criteria are included in Reference 8.

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

REFERENCES

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

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

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

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

5. BWROG Letter BWROG-9479, "Guidelines for Stability Interim Corrective Action", June 6. 1994.

6. NEDO-32465-A, "BWR Owners Group Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology and Reload Applications", August, 1996.

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

8. FSAR, Table 7.3-28.

9. FSAR Section 4.4.4.6 ~~NFE-1-11-003, "Unit 1 Cycle 11 Stability Option III Analyses"~~

10. FSAR Section 7.2 ~~EC-078-1010, "Oscillation Power Range Monitor (OPRM) Period Based Algorithm (Sp) Technical Specification Limit Value"~~

11. EMF-CC-074(P)(A), Volume 4, "BWR Stability Analysis: Assessment of STAIF with Input from MICROBURN-B2."

## B 3.4 REACTOR COOLANT SYSTEM (RCS)

### B 3.4.1 Recirculation Loops Operating

BASES

BACKGROUND

The Reactor Coolant Recirculation System is designed to provide a forced coolant flow through the core to remove heat from the fuel. The forced coolant flow removes more heat from the fuel than would be possible with just natural circulation. The forced flow, therefore, allows operation at significantly higher power than would otherwise be possible. The recirculation system also controls reactivity over a wide span of reactor power by varying the recirculation flow rate to control the void content of the moderator. The Reactor Coolant Recirculation System consists of two recirculation pump loops external to the reactor vessel. These loops provide the piping path for the driving flow of water to the reactor vessel jet pumps. Each external loop contains one variable speed motor driven recirculation pump, a motor generator (MG) set to control pump speed and associated piping, jet pumps, valves, and instrumentation. The recirculation pump, piping, and valves are part of the reactor coolant pressure boundary and are located inside the drywell structure. The jet pumps are reactor vessel internals.

The recirculated coolant consists of saturated water from the steam separators and dryers that has been subcooled by incoming feedwater. This water passes down the annulus between the reactor vessel wall and the core shroud. A portion of the coolant flows from the vessel, through the two external recirculation loops, and becomes the driving flow for the jet pumps. Each of the two external recirculation loops discharges high pressure flow into an external manifold, from which individual recirculation inlet lines are routed to the jet pump risers within the reactor vessel. The remaining portion of the coolant mixture in the annulus becomes the suction flow for the jet pumps. This flow enters the jet pump at suction inlets and is accelerated by the driving flow. The drive flow and suction flow are mixed in the jet pump throat section. The total flow then passes through the jet pump diffuser section into the area below the core (lower plenum), gaining sufficient head in the process to drive the required flow upward through the core. The subcooled water enters the bottom of the fuel channels and contacts the fuel cladding, where heat

(continued)

BASES

BACKGROUND (continued)

is transferred to the coolant. As it rises, the coolant begins to boil, creating steam voids within the fuel channel that continue until the coolant exits the core. Because of reduced moderation, the steam voiding introduces negative reactivity that must be compensated for to maintain or to increase reactor power. The recirculation flow control allows operators to increase recirculation flow and sweep some of the voids from the fuel channel, overcoming the negative reactivity void effect. Thus, the reason for having variable recirculation flow is to compensate for reactivity effects of boiling over a wide range of power generation without having to move control rods and disturb desirable flux patterns.

Each recirculation loop is manually started from the control room. The MG set provides regulation of individual recirculation loop drive flows. The flow in each loop is manually controlled.

APPLICABLE SAFETY ANALYSES

The operation of the Reactor Coolant Recirculation System is an initial condition assumed in the design basis loss of coolant accident (LOCA) (Ref. 1). During a LOCA caused by a recirculation loop pipe break, the intact loop is assumed to provide coolant flow during the first few seconds of the accident. The initial core flow decrease is rapid because the recirculation pump in the broken loop ceases to pump reactor coolant to the vessel almost immediately. The pump in the intact loop coasts down relatively slowly. This pump coastdown governs the core flow response for the next several seconds until the jet pump suction is uncovered (Ref. 1). The analyses assume that both loops are operating at the same flow prior to the accident. However, the LOCA analysis was reviewed for the case with a flow mismatch between the two loops, with the pipe break assumed to be in the loop with the higher flow. While the flow coastdown and core response are potentially more severe in this assumed case (since the intact loop starts at a lower flow rate and the core response is the same as if both loops were operating at a lower flow rate), a small mismatch has been determined to be acceptable based on engineering judgement. The recirculation system is also assumed to have sufficient flow coastdown characteristics to maintain fuel thermal margins during abnormal operational transients (Ref. 2), which are analyzed in Chapter 15 of the FSAR.

(continued)

BASES

APPLICABLE SAFETY ANALYSES (continued)

Plant specific LOCA analyses have been performed assuming only one operating recirculation loop. These analyses have demonstrated that, in the event of a LOCA caused by a pipe break in the operating recirculation loop, the Emergency Core Cooling System response will provide adequate core cooling, provided that the APLHGR limit for SPC ATRIUM™-10 fuel is modified.

The transient analyses of Chapter 15 of the FSAR have also been performed for single recirculation loop operation and demonstrate sufficient flow coastdown characteristics to maintain fuel thermal margins during the abnormal operational transients analyzed provided the MCPR requirements are modified. During single recirculation loop operation, modification to the Reactor Protection System (RPS) average power range monitor (APRM) instrument setpoints is also required to account for the different relationships between recirculation drive flow and reactor core flow. The APLHGR, LHGR, and MCPR limits for single loop operation are specified in the COLR. The APRM flow biased simulated THERMAL POWER setpoint is in LCO 3.3.1.1, "Reactor Protection System (RPS) Instrumentation." In addition, a restriction on recirculation pump speed is incorporated to address reactor vessel internals vibration concerns and assumptions in the event analysis.

General Design Criterion 10 (GDC 10) requires that the reactor core be designed with appropriate margin to assure that fuel design limits will not be exceeded during any condition of normal operation including anticipated operational occurrences. GDC 12 requires assurance that power oscillations which can result in conditions exceeding specified acceptable fuel design limits are either not possible or can be reliably and readily detected and suppressed. The ACTIONS in this section ensure compliance with GDC 12, thereby providing protection from exceeding the fuel MCPR safety limit.

BWR cores may exhibit thermal-hydraulic reactor instabilities in high power and low flow portions of the core power to flow operating domain. GDC 12 requires

(continued)

BASES

APPLICABLE SAFETY ANALYSIS (continued)

assurance that power oscillations which can result in conditions exceeding specified acceptable fuel design limits are either not possible or can be reliably and readily detected and suppressed. This LCO and associated ACTIONS ensure compliance with GDC 12 by establishing conservative boundaries that limit the impact of thermal-hydraulic boundaries that limit the impact of thermal-hydraulic instabilities.

This LCO and ACTIONS establish power/flow regions and associated requirements and restrictions consistent with references 3 and 4 and provide a conservative boundary for plant operation to ensure compliance with GDC 12 and that thermal-hydraulic instabilities are avoided.

Recirculation loops operating satisfies Criterion 2 of the NRC Policy Statement (Ref. 5).

LCO

Two recirculation loops are required to be in operation with their flows matched within the limits specified in SR 3.4.1.1 to ensure that during a LOCA caused by a break of the piping of one recirculation loop the assumptions of the LOCA analysis are satisfied. With the limits specified in SR 3.4.1.1 not met, the recirculation loop with the lower flow must be considered not in operation. With only one recirculation loop in operation, modifications to the required APLGHR limits (LCO 3.2.1, "AVERAGE PLANAR LINEAR HEAT GENERATION RATE"), LHGR limits (LCO 3.2.3, "LINEAR HEAT GENERATION RATE (LHGR)"), 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) may be applied to allow continued operation consistent with the safety analysis assumptions. Furthermore, restrictions are placed on recirculation pump speed to ensure the initial assumption of the event analysis are maintained.

In addition, during two-loop and single-loop operation, the combination of core flow and THERMAL POWER must be outside of LCO Region I or II of Figure 3.4.1-1 to limit the impact of core thermal hydraulic oscillations. The plant is operated in conformance with the recommendations in NRC Bulletin 88-07, Supplement 1, (Ref. 4). These operating restrictions provide a high degree of confidence that reactor instabilities will not occur or will not be of sufficient severity to violate the MCPR safety limit.

(continued)

BASES

LCO (continued)

The LCO is modified by a Note that allows up to 12 hours to establish the required limits and setpoints after a change from two recirculation loops operation to single recirculation loop operation. If the limits and setpoints are not in compliance with the applicable requirements at the end of the this period, the ACTIONS required by the applicable specifications must be implemented. This time is provided to stabilize operation with one recirculation loop by: limiting flow in the operating loop, limiting total THERMAL POWER, monitor APRM and local power range monitor (LPRM) neutron flux noise levels; and, fully implementing and confirming the required limit and setpoint modifications.

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

When operating ~~in Region I of Figure 3.4.1-1 or~~ with no recirculation loops operating in MODE 1, the potential for thermal-hydraulic oscillations is greatly increased. ~~and sufficient margin may not be available for operator response to suppress potential thermal-hydraulic oscillations. Therefore, the reactor mode switch must be immediately placed in the shutdown position. Action is taken immediately to place the plant in a condition where any potential for thermal hydraulic instabilities will be terminated. The requirements are consistent to those of Reference 4.~~ Although this transient is protected for expected modes of oscillation by the OPRM system, when OPERABLE per LCO 3.3.1.3 (Reference 3,4), the prudent response to the natural circulation condition is to preclude potential thermal-hydraulic oscillations by immediately placing the mode switch in the shutdown position.

(continued)

BASES

ACTIONS (continued)

B.1

When operating in Region II of Figure 3.4.1-1 with indications that thermal hydraulic oscillations are occurring as defined in the ACTION, or when less than 50% of the required LPRM upscale alarms are OPERABLE the potential for thermal-hydraulic oscillations is greatly increased and sufficient margin may not be available for operator response to suppress potential thermal-hydraulic oscillations. The number and location of LPRM strings in each zone assure that with 50% or more of the associated LPRM upscale alarms OPERABLE sufficient monitoring capability is available to detect core wide and regional oscillations.

LPRM upscale alarms are required to detect reactor core thermal-hydraulic instability events. The criteria for determining which LPRM upscale alarms are required is based on assignment of these alarms to designated core zones. These core zones consist of the level A, B, and C alarms in 4 or 5 adjacent LPRM strings. The number and location of LPRM strings in each zone assure that with 50% or more of the associated LPRM upscale alarms OPERABLE sufficient monitoring capability is available to detect core wide and regional oscillations. Operating plant instability data is used to determine the specific LPRM strings assigned to each zone.

The ACTION to place the reactor mode switch in shutdown immediately is necessary since the probability of thermal-hydraulic oscillations is greatly increased if in CONDITION B. Without the monitoring capability, control rods must be inserted to terminate any potential for undetected thermal-hydraulic instabilities.

C.1

When operating in Region II of Figure 3.4.1-1, the potential for thermal-hydraulic oscillations is increased and sufficient margin may not be available for operator response to suppress potential thermal-hydraulic oscillations. Therefore, action must be initiated immediately to restore operation outside of Regions II of Figure 3.4.1-1. This can be accomplished by either decreasing THERMAL POWER with control rod insertion or increasing core flow by increasing recirculation pump speed. The starting of a recirculation

(continued)

BASES

ACTIONS

~~C.1 (continued)~~

~~pump will not be used as a means to enter the required Regions because the starting of a recirculation pump with the plant operating above the 80% rod line is prohibited due to potential instability problems.~~

B.1
[redacted]
~~D.1~~

Recirculation loop flow must match within required limits when both recirculation loops are in operation. If flow mismatch is not within required limits, matched flow must be restored within 2 hours. If matched flows are not restored, the recirculation loop with lower flow must be declared "not in operation." Should a LOCA occur with recirculation loop flow not matched, the core flow coastdown and resultant core response may not be bounded by the LOCA analyses. Therefore, only a limited time is allowed prior to imposing restrictions associated with single loop operation. Operation with only one recirculation loop satisfies the requirements of the LCO and the initial conditions of the accident sequence.

The 2 hour Completion Time is based on the low probability of an accident occurring during this time period, providing a reasonable time to complete the Required Action, and considering that frequent core monitoring by operators allows abrupt changes in core flow conditions to be quickly detected.

These Required Actions do not require tripping the recirculation pump in the lowest flow loop when the mismatch between total jet pump flows of the two loops is greater than the required limits. However, in cases where large flow mismatches occur, low flow or reverse flow can occur in the low flow loop jet pumps, causing vibration of the jet pumps. If zero or reverse flow is detected, the condition should be alleviated by changing recirculation pump speed to re-establish forward flow or by tripping the pump.

C.1
~~E.1~~

With no recirculation loops in operation while in MODE 2 or if after going to single loop operations the required limits and setpoints cannot be established, the plant must be brought to MODE 3, where the LCO does not apply within

(continued)

BASES

ACTIONS

~~E.1~~ C.1 (continued)

12 hours. In this condition, the recirculation loops are not required to be operating because of the reduced severity of DBAs and minimal dependence on the recirculation loop coastdown characteristics. The allowed Completion Time of 12 hours is reasonable to reach MODE 3 from full power conditions in an orderly manner without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.4.1.1

This SR ensures the recirculation loops are within the allowable limits for mismatch. At low core flow (i.e., < 75 million lbm/hr), the MCPR requirements provide larger margins to the fuel cladding integrity Safety Limit such that the potential adverse effect of early boiling transition during a LOCA is reduced. A larger flow mismatch can therefore be allowed when core flow is < 75 million lbm/hr. The recirculation loop jet pump flow, as used in this Surveillance, is the summation of the flows from all of the jet pumps associated with a single recirculation loop.

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

~~SR 3.4.1.2~~

~~This SR ensures the combination of core flow and THERMAL POWER are within required limits to prevent uncontrolled thermal hydraulic oscillations by ensuring the recirculation loops are within the limits established by Figure 3.4.1-1. At low recirculation flows and high reactor power,~~

(continued)

BASES

SURVEILLANCE REQUIREMENTS

~~SR 3.4.1.2 (continued)~~

~~the reactor exhibits increased susceptibility to thermal-hydraulic instability. Figure 3.4.1-1 is based on guidance provided in References 3 and 4 which also provided the guidance on how to respond to operation in these conditions. The 24 hour Frequency is based on operating experience and the operator's inherent knowledge of the current reactor status, including significant changes in THERMAL POWER and core flow to ensure the requirements are constantly met.~~

SR 3.4.1.2
~~SR 3.4.1.3~~

As noted, this SR is only applicable when in single loop operation. This SR ensures the recirculation pump limit is maintained. The 24 hour Frequency is based on operating experience and the operators inherent knowledge of the current reactor status.

REFERENCES

1. FSAR, Section 6.3.3.7.

2. FSAR, Section 5.4.1.4.

3. ~~GE Service Information Letter No. 380, "BWR Core Thermal Hydraulic Stability," Revision 1, February 10, 1984.~~ GE NEDO-31960-A "BWROG Long Term Stability Solutions Licensing Methodology," November, 1995.

4. ~~NRC Bulletin 88-07, Supplement 1, "Power Oscillations in Boiling Water Reactors (BWRs)," December 30, 1988.~~ GE NEDO-31960-A "BWROG Long Term Stability Solutions Licensing Methodology, Supplement 1," November, 1995.

5. Final Policy Statement on Technical Specifications Improvements, July 22, 1993 (58 FR 39132).

B 3.3 INSTRUMENTATION

B.3.3.1.3 Oscillation Power Range Monitor (OPRM)

BASES

---

BACKGROUND

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

References 1, 2, and 3 describe three separate algorithms for detecting stability related oscillations: the period based detection algorithm, the amplitude based algorithm, and the growth rate algorithm. The OPRM System hardware implements these algorithms in microprocessor based modules. These modules execute the algorithms based on LPRM inputs and generate alarms and trips based on these calculations. These trips result in tripping the Reactor Protection System (RPS) when the appropriate RPS trip logic is satisfied, as described in the Bases for LCO 3.3.1.1. "RPS Instrumentation." Only the period based detection algorithm is used in the safety analysis (Ref. 1, 2, 6, & 7). The remaining algorithms provide defense-in-depth and additional protection against unanticipated oscillations.

(continued)

BASES

BACKGROUND (continued)

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

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

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

APPLICABLE SAFETY ANALYSES

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

The OPRM Instrumentation satisfies Criterion 3 of the NRC Policy Statement.

BASES

LCO

Four channels of the OPRM System are required to be OPERABLE to ensure that stability related oscillations are detected and suppressed prior to exceeding the MCPR safety limit. Only one of the two OPRM modules' ~~period based detection algorithm~~ is required for OPRM channel OPERABILITY. The minimum number of LPRMs required OPERABLE to maintain an OPRM channel OPERABLE is consistent with the minimum number of LPRMs required to maintain the APRM system OPERABLE per LCO 3.3.1.1.

See Insert TSB1

~~The Allowable Value for the OPRM Period Based Algorithm setpoint (Sp) is derived from the analytic limit corrected for instrument and calibration errors (Ref. 9 & 10).~~

APPLICABILITY

The OPRM instrumentation is required to be OPERABLE in order to detect and suppress neutron flux oscillations in the event of thermal-hydraulic instability. As described in References 1, 2, and 3, the power/core flow region protected against anticipated oscillations is defined by THERMAL POWER ≥ 30% RTP and core flow ≤ 60 Mlb/Hr. The OPRM trip is required to be enabled in this region, and the OPRM must be capable of enabling the trip function as a result of anticipated transients that place the core in that power/flow condition. Therefore, the OPRM is required to be OPERABLE with THERMAL POWER ≥ 25% RTP and at all core flows while above that THERMAL POWER. It is not necessary for the OPRM to be operable with THERMAL POWER < 25% RTP because transients from below this THERMAL POWER are not anticipated to result in power that exceeds 30% RTP.

ACTIONS

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

(continued)

## Insert TSB1

The OPRM setpoints are determined by analyses based on the NRC approved methodology described in NEDO-32465-A (Ref. 6). The Allowable Value for the OPRM Period Based Algorithm setpoint (SP) is derived from the analytic limit corrected for instrument and calibration errors as contained in the COLR.

ACTIONS
(continued)

A.1, A.2, and A.3

Because of the reliability and on-line self-testing of the OPRM instrumentation and the redundancy of the RPS design, an allowable out of service time of 30 days has been shown to be acceptable (Ref. 7) to permit restoration of any inoperable channel to OPERABLE status. However, this out of service time is only acceptable provided the OPRM instrumentation still maintains OPRM trip capability (refer to Required Actions B.1 and B.2). The remaining OPERABLE OPRM channels continue to provide trip capability (see Condition B) and provide operator information relative to stability activity. The remaining OPRM modules have high reliability. With this high reliability, there is a low probability of a subsequent channel failure within the allowable out of service time. In addition, the OPRM modules continue to perform on-line self-testing and alert the operator if any further system degradation occurs.

If the inoperable channel cannot be restored to OPERABLE status within the allowable out of service time, the OPRM channel or associated RPS trip system must be placed in the tripped condition per Required Actions A.1 and A.2. Placing the inoperable OPRM channel in trip (or the associated RPS trip system in trip) would conservatively compensate for the inoperability, provide the capability to accommodate a single failure and allow operation to continue. Alternately, if it is not desired to place the OPRM channel (or RPS trip system) in trip (e.g., as in the case where placing the inoperable channel in trip would result in a full scram), the alternate method of detecting and suppressing thermal hydraulic instability oscillations is required (Required Action A.3). This alternate method is described in Reference 5. It consists of increased operator awareness and monitoring for neutron flux oscillations when operating in the region where oscillations are possible. If indications of oscillation, as described in Reference 5 are observed by the operator, the operator will take the actions described by procedures which include initiating a manual scram of the reactor. The power/flow map regions are developed based on methodology in Reference 11. The applicable regions are contained in the COLR.

ACTIONS (continued)

B.1 and B.2

Required action B.1 is intended to ensure that appropriate actions are taken if multiple, inoperable, untripped OPRM channels within the same RPS trip system result in not maintaining OPRM trip capability. OPRM trip capability is considered to be maintained when sufficient OPRM channels are OPERABLE or in trip (or the associated RPS trip system is in trip), such that a valid OPRM signal will generate a trip signal in both RPS trip systems (this would require both RPS trip systems to have at least one OPRM channel OPERABLE or the associated RPS trip system in trip).

Because of the low probability of the occurrence of an instability, 12 hours is an acceptable time to initiate the alternate method of detecting and suppressing thermal hydraulic instability oscillations described in Action A.3 above. The alternate method of detecting and suppressing thermal hydraulic instability oscillations would adequately address detection and mitigation in the event of instability oscillations. Based on industry operating experience with actual instability oscillations, the operator would be able to recognize instabilities during this time and take action to suppress them through a manual scram. In addition, the OPRM System may still be available to provide alarms to the operator if the onset of oscillations were to occur. Since plant operation is minimized in areas where oscillations may occur, operation for 120 days without OPRM trip capability is considered acceptable with implementation of the alternate method of detecting and suppressing thermal hydraulic instability oscillations.

C.1

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

SURVEILLANCE REQUIREMENTS

SR 3.3.1.3.1

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

SR 3.3.1.3.2

LPRM gain settings are determined from the local flux profiles measured by the Traversing Incore Probe (TIP) System. This establishes the relative local flux profile for appropriate representative input to the OPRM System. The 1000 MWD/MT Frequency is based on operating experience with LPRM sensitivity changes.

SR 3.3.1.3.3

A CHANNEL CALIBRATION 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. Calibration of the channel provides a check of the internal reference voltage and the internal processor clock frequency. It also compares the desired trip setpoints with those in processor memory. Since the OPRM is a digital system, the internal reference voltage and processor clock frequency are, in turn, used to automatically calibrate the internal analog to digital converters. As noted, neutron detectors are excluded from CHANNEL CALIBRATION because they are passive devices, with minimal drift, and because of the difficulty of simulating a meaningful signal. Changes in neutron detector sensitivity are compensated for by performing the 1000 MWD/MT LPRM calibration using the TIPs (SR 3.3.1.3.2).

SURVEILLANCE REQUIREMENTS (continued)

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

SR 3.3.1.3.4

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

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

SR 3.3.1.3.5

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

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

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

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.1.3.6

This SR ensures that the individual channel response times are less than or equal to the maximum values assumed in the safety analysis (Ref. 6). The OPRM self-test function may be utilized to perform this testing for those components it is designed to monitor. The LPRM amplifier cards inputting to the OPRM are excluded from the OPRM RESPONSE TIME testing. The RPS RESPONSE TIME acceptance criteria are included in Reference 8.

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

REFERENCES

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

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

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

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

5. BWROG Letter BWROG-9479, "Guidelines for Stability Interim Corrective Action", June 6. 1994.

6. NEDO-32465-A, "BWR Owners Group Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology and Reload Applications", August, 1996.

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

8. FSAR, Table 7.3-28.

9. FSAR Section 4.4.4.6 ~~NFE-1-11-003, "Unit 1 Cycle 11 Stability Option III Analyses"~~

10. FSAR Section 7.2 ~~EC-078-1010, "Oscillation Power Range Monitor (OPRM) Period Based Algorithm (Sp) Technical Specification Limit Value"~~

11. EMF-CC-074(P)(A), Volume 4, "BWR Stability Analysis: Assessment of STAIF with Input from MICROBURN-B2."

# B 3.4 REACTOR COOLANT SYSTEM (RCS)

## B 3.4.1 Recirculation Loops Operating

BASES

BACKGROUND

The Reactor Coolant Recirculation System is designed to provide a forced coolant flow through the core to remove heat from the fuel. The forced coolant flow removes more heat from the fuel than would be possible with just natural circulation. The forced flow, therefore, allows operation at significantly higher power than would otherwise be possible. The recirculation system also controls reactivity over a wide span of reactor power by varying the recirculation flow rate to control the void content of the moderator. The Reactor Coolant Recirculation System consists of two recirculation pump loops external to the reactor vessel. These loops provide the piping path for the driving flow of water to the reactor vessel jet pumps. Each external loop contains one variable speed motor driven recirculation pump, a motor generator (MG) set to control pump speed and associated piping, jet pumps, valves, and instrumentation. The recirculation pump, piping, and valves are part of the reactor coolant pressure boundary and are located inside the drywell structure. The jet pumps are reactor vessel internals.

The recirculated coolant consists of saturated water from the steam separators and dryers that has been subcooled by incoming feedwater. This water passes down the annulus between the reactor vessel wall and the core shroud. A portion of the coolant flows from the vessel, through the two external recirculation loops, and becomes the driving flow for the jet pumps. Each of the two external recirculation loops discharges high pressure flow into an external manifold, from which individual recirculation inlet lines are routed to the jet pump risers within the reactor vessel. The remaining portion of the coolant mixture in the annulus becomes the suction flow for the jet pumps. This flow enters the jet pump at suction inlets and is accelerated by the driving flow. The drive flow and suction flow are mixed in the jet pump throat section. The total flow then passes through the jet pump diffuser section into the area below the core (lower plenum), gaining sufficient head in the process to drive the required flow upward through the core. The subcooled water enters the bottom of the fuel channels and contacts the fuel

(continued)

BASES

BACKGROUND (continued)

cladding, where heat is transferred to the coolant. As it rises, the coolant begins to boil, creating steam voids within the fuel channel that continue until the coolant exits the core. Because of reduced moderation, the steam voiding introduces negative reactivity that must be compensated for to maintain or to increase reactor power. The recirculation flow control allows operators to increase recirculation flow and sweep some of the voids from the fuel channel, overcoming the negative reactivity void effect. Thus, the reason for having variable recirculation flow is to compensate for reactivity effects of boiling over a wide range of power generation without having to move control rods and disturb desirable flux patterns.

Each recirculation loop is manually started from the control room. The MG set provides regulation of individual recirculation loop drive flows. The flow in each loop is manually controlled.

APPLICABLE SAFETY ANALYSES

The operation of the Reactor Coolant Recirculation System is an initial condition assumed in the design basis loss of coolant accident (LOCA) (Ref. 1). During a LOCA caused by a recirculation loop pipe break, the intact loop is assumed to provide coolant flow during the first few seconds of the accident. The initial core flow decrease is rapid because the recirculation pump in the broken loop ceases to pump reactor coolant to the vessel almost immediately. The pump in the intact loop coasts down relatively slowly. This pump coastdown governs the core flow response for the next several seconds until the jet pump suction is uncovered (Ref. 1). The analyses assume that both loops are operating at the same flow prior to the accident. However, the LOCA analysis was reviewed for the case with a flow mismatch between the two loops, with the pipe break assumed to be in the loop with the higher flow. While the flow coastdown and core response are potentially more severe in this assumed case (since the intact loop starts at a lower flow rate and the core response is the same as if both loops were operating at a lower flow rate), a small mismatch has been determined to be acceptable based on engineering judgement. The recirculation system is also assumed to have sufficient flow coastdown characteristics to maintain fuel thermal margins during abnormal operational transients (Ref. 2), which are analyzed in Chapter 15 of the FSAR.

(continued)

BASES

APPLICABLE SAFETY ANALYSES (continued)

plant specific LOCA analyses have been performed assuming only one operating recirculation loop. These analyses have demonstrated that, in the event of a LOCA caused by a pipe break in the operating recirculation loop, the Emergency Core Cooling System response will provide adequate core cooling, provided that the APLHGR limit for SPC ATRIUM™-10 fuel is modified.

The transient analyses of Chapter 15 of the FSAR have also been performed for single recirculation loop operation and demonstrate sufficient flow coastdown characteristics to maintain fuel thermal margins during the abnormal operational transients analyzed provided the MCPR requirements are modified. During single recirculation loop operation, modification to the Reactor Protection System (RPS) average power range monitor (APRM) instrument setpoints is also required to account for the different relationships between recirculation drive flow and reactor core flow. The APLHGR, LHGR and MCPR setpoints for single loop operation are specified in the COLR. The APRM flow biased simulated THERMAL POWER setpoint is in LCO 3.3.1.1, "Reactor Protection System (RPS) Instrumentation." In addition, a restriction on recirculation pump speed is incorporated to address Reactor Vessel Internals vibration concerns and assumptions in the event analysis.

General Design Criterion 10 (GDC 10) requires that the reactor core be designed with appropriate margin to assure that fuel design limits will not be exceeded during any condition of normal operation including anticipated operational occurrences. GDC 12 requires assurance that power oscillations which can result in conditions exceeding specified acceptable fuel design limits are either not possible or can be reliably and readily detected and suppressed. The ACTIONS in this section ensure compliance with GDC 12, thereby providing protection from exceeding the fuel MCPR safety limit.

BWR cores may exhibit thermal-hydraulic reactor instabilities in high power and low flow portions of the core power to flow operating domain. GDC 12 requires assurance that power oscillations which can result in conditions exceeding specified acceptable fuel design limits are either not possible or

(continued)

BASES

APPLICABLE SAFETY ANALYSIS (continued)

can be reliably and readily detected and suppressed. This LCO and associated ACTIONS ensure compliance with GDC 12 by establishing conservative boundaries that limit the impact of thermal-hydraulic instabilities.

This LCO and ACTIONS establish power/flow regions and associated requirements and restrictions consistent with references 3 and 4 and provide a conservative boundary for plant operation to ensure compliance with GDC 12 and that thermal-hydraulic instabilities are avoided.

Recirculation loops operating satisfies Criterion 2 of the NRC Policy Statement (Ref. 5).

LCO

Two recirculation loops are required to be in operation with their flows matched within the limits specified in SR 3.4.1.1 to ensure that during a LOCA caused by a break of the piping of one recirculation loop the assumptions of the LOCA analysis are satisfied. With the limits specified in SR 3.4.1.1 not met, the recirculation loop with the lower flow must be considered not in operation. With only one recirculation loop in operation, modifications to the required APLHGR limits (LCO 3.2.1, "AVERAGE PLANAR LINEAR HEAT GENERATION RATE"), LHGR limits (LCO 3.2.3, "LINEAR HEAT GENERATION RATE (LHGR)"), 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) may be applied to allow continued operation consistent with the safety analysis assumptions. Furthermore, restrictions are placed on recirculation pump speed to assure the initial assumptions of the event analysis are maintained.

In addition, during two-loop and single-loop operation, the combination of core flow and THERMAL POWER must be outside of Region I of II of Figure 3.4.1-1 to limit the impact of core thermal hydraulic oscillations.

The plant is operated in conformance with the recommendations in NRC Bulletin 88-07, Supplement 1, (Ref. 4). These operating restrictions provide a high degree of confidence that reactor instabilities will not occur or will not be of sufficient severity to violate the MCPR safety limit.

(continued)

BASES

LCO (continued)

The LCO is modified by a Note that allows up to 12 hours to establish the required limits and setpoints after a change from two recirculation loops operation to single recirculation loop operation. If the limits and setpoints are not in compliance with the applicable requirements at the end of this period, the ACTIONS required by the applicable specifications must be implemented. This time is provided to stabilize operation with one recirculation loop by: limiting flow in the operating loop, limiting total THERMAL POWER, monitor APRM and local power range monitor (LPRM) neutron flux noise levels; and, fully implementing and confirming the required limit and setpoint modifications.

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

When operating ~~in Region I of Figure 3.4.1-1 or~~ with no recirculation loops operating in MODE 1, the potential for thermal-hydraulic oscillations is greatly increased. ~~and sufficient margin may not be available for operator response to suppress potential thermal-hydraulic oscillations. Therefore, the reactor mode switch must be immediately placed in the shutdown position. Action is taken immediately to place the plant in a condition where any potential for thermal-hydraulic instabilities will be terminated. The requirements are consistent to those of Reference 4.~~ Although this transient is protected for expected modes of oscillation by the OPRM system, when OPERABLE per LCO 3.3.1.3 (Reference 3, 4), the prudent response to the natural circulation condition is to preclude potential thermal-hydraulic oscillations by immediately placing the mode switch in the shutdown position.

(continued)

BASES

ACTIONS (continued)

B.1

When operating in Region II of Figure 3.4.1-1 with indications that thermal hydraulic oscillations are occurring as defined in the ACTION, or when less than 50% of the required LPRM upscale alarms are OPERABLE the potential for thermal-hydraulic oscillations is greatly increased and sufficient margin may not be available for operator response to suppress potential thermal-hydraulic oscillations. The number and location of LPRM strings in each zone assure that with 50% or more of the associated LPRM upscale alarms OPERABLE sufficient monitoring capability is available to detect core wide and regional oscillations.

LPRM upscale alarms are required to detect reactor core thermal-hydraulic instability events. The criteria for determining which LPRM upscale alarms are required is based on assignment of these alarms to designated core zones. These core zones consist of the level A, B, and C alarms in 4 or 5 adjacent LPRM strings. The number and location of LPRM strings in each zone assure that with 50% or more of the associated LPRM upscale alarms OPERABLE sufficient monitoring capability is available to detect core wide and regional oscillations. Operating plant instability data is used to determine the specific LPRM strings assigned to each zone.

The ACTION to place the reactor mode switch in shutdown immediately is necessary since the probability of thermal-hydraulic oscillations is greatly increased if in CONDITION B. Without the monitoring capability, control rods must be inserted to terminate any potential for undetected thermal-hydraulic instabilities.

C.1

When operating in Region II of Figure 3.4.1-1, the potential for thermal-hydraulic oscillations is increased and sufficient margin may not be available for operator response to suppress potential thermal-hydraulic oscillations. Therefore, action must be initiated immediately to restore operation outside of Regions II of Figure 3.4.1-1. This can be accomplished by either decreasing THERMAL POWER with control rod insertion or increasing core flow by increasing recirculation pump speed. The starting of a recirculation

(continued)

BASES

ACTIONS

~~C.1~~ (continued)

~~pump will not be used as a means to enter the required Regions because the starting of a recirculation pump with the plant operating above the 80% rod line is prohibited due to potential instability problems.~~

B.1
~~D.1~~

Recirculation loop flow must match within required limits when both recirculation loops are in operation. If flow mismatch is not within required limits, matched flow must be restored within 2 hours. If matched flows are not restored, the recirculation loop with lower flow must be declared "not in operation." Should a LOCA occur with recirculation loop flow not matched, the core flow coastdown and resultant core response may not be bounded by the LOCA analyses. Therefore, only a limited time is allowed prior to imposing restrictions associated with single loop operation. Operation with only one recirculation loop satisfies the requirements of the LCO and the initial conditions of the accident sequence.

The 2 hour Completion Time is based on the low probability of an accident occurring during this time period, providing a reasonable time to complete the Required Action, and considering that frequent core monitoring by operators allows abrupt changes in core flow conditions to be quickly detected.

These Required Actions do not require tripping the recirculation pump in the lowest flow loop when the mismatch between total jet pump flows of the two loops is greater than the required limits. However, in cases where large flow mismatches occur, low flow or reverse flow can occur in the low flow loop jet pumps, causing vibration of the jet pumps. If zero or reverse flow is detected, the condition should be alleviated by changing recirculation pump speed to re-establish forward flow or by tripping the pump.

C.1
~~E.1~~

With no recirculation loops in operation while in MODE 2 or if after going to single loop operations the required limits and setpoints cannot be

(continued)

BASES

ACTIONS

~~E.1~~ C.1 (continued)

established, the plant must be brought to MODE 3, where the LCO does not apply within 12 hours. In this condition, the recirculation loops are not required to be operating because of the reduced severity of DBAs and minimal dependence on the recirculation loop coastdown characteristics. The allowed Completion Time of 12 hours is reasonable to reach MODE 3 from full power conditions in an orderly manner without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.4.1.1

This SR ensures the recirculation loops are within the allowable limits for mismatch. At low core flow (i.e., < 75 million lbm/hr), the MCPR requirements provide larger margins to the fuel cladding integrity Safety Limit such that the potential adverse effect of early boiling transition during a LOCA is reduced. A larger flow mismatch can therefore be allowed when core flow is < 75 million lbm/hr. The recirculation loop jet pump flow, as used in this Surveillance, is the summation of the flows from all of the jet pumps associated with a single recirculation loop.

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

~~SR 3.4.1.2~~

~~This SR ensures the combination of core flow and THERMAL POWER are within required limits to prevent uncontrolled thermal hydraulic oscillations by ensuring the recirculation loops are within the limits established by Figure 3.4.1-1. At low recirculation flows and high reactor power, the reactor~~

(continued)

BASES

SURVEILLANCE REQUIREMENTS

~~SR 3.4.1.2 (continued)~~

~~exhibits increased susceptibility to thermal-hydraulic instability. Figure 3.4.1-1 is based on guidance provided in References 3 and 4 which also provided the guidance on how to respond to operation in these conditions. The 24 hour Frequency is based on operating experience and the operator's inherent knowledge of the current reactor status, including significant changes in THERMAL POWER and core flow to ensure the requirements are constantly met.~~

SR 3.4.1.2
~~SR 3.4.1.3~~

As noted, this SR is only applicable when in single loop operation. This SR ensures the recirculation pump limit is maintained. The 24 hour Frequency is based on operating experience and the operators inherent knowledge of the current reactor status.

REFERENCES

1. FSAR, Section 6.3.3.7.
2. FSAR, Section 5.4.1.4.
3. ~~GE Service Information Letter No. 380, "BWR Core Thermal Hydraulic Stability," Revision 1, February 10, 1984.~~ GE NEDO-31960-A "BWROG Long Term Stability Solutions Licensing Methodology," November 1995.
4. ~~NRC Bulletin 88-07, Supplement 1, "Power Oscillations in Boiling Water Reactors (BWRs)," December 30, 1988.~~ GE NEDO-31960-A "BWROG Long Term Stability Solutions Licensing Methodology, Supplement 1," November, 1995.
5. Final Policy Statement on Technical Specifications Improvements, July 22, 1993 (58 FR 39132).

# Attachment E

# List of Regulatory Commitments

# (Units 1 & 2)

# LIST OF REGULATORY COMMITMENTS

| REGULATORY COMMITMENTS | Due Date/Event |
|---|---|
| Implementation of the OPRM License Amendments for Unit 1 and Unit 2 | 9/30/2004 |