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LR-N04-0069
LCR H04-02

United States Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

REQUEST FOR CHANGE TO TECHNICAL SPECIFICATIONS
OSCILLATION POWER RANGE MONITOR (OPRM)
HOPE CREEK GENERATING STATION
FACILITY OPERATING LICENSE NPF-57
DOCKET NO. 50-354

References: (1) LR-N00-0429, "Request For Change To Technical Specifications: Oscillation Power Range Monitor (OPRM)," dated November 29, 2000

(2) LR-N01-0247, "Response To Request For Additional Information: Request For Change To Technical Specifications: Oscillation Power Range Monitor (OPRM)," dated August 10, 2001

(3) LR-N01-0279, "Revision to Implementation Schedule and Withdrawal of License Change Request," dated October 19, 2001

(4) "Hope Creek Generating Station, Withdrawal Of An Amendment Request, Oscillation Power Range Monitor (TAC NO. MB0589)," dated November 28, 2001

Pursuant to 10 CFR 50.90, PSEG Nuclear LLC (PSEG) hereby requests a revision to the Technical Specifications for the Hope Creek Generating Station. In accordance with 10 CFR 50.91(b)(1), a copy of this submittal has been sent to the State of New Jersey.

The proposed changes revise the Technical Specifications to include the Oscillation Power Range Monitor (OPRM) system. The OPRM, which was installed at Hope Creek during the seventh refueling outage, is being operated in the "indicate only" mode to evaluate the system's performance. PSEG Nuclear plans to fully enable the OPRM trip function during Hope Creek's twelfth refueling outage (RF12), which is currently

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scheduled for the Fall of 2004. Hope Creek will continue to operate with the interim corrective actions (ICAs) described in our response to Generic Letter 94-02 until the OPRM trip function is enabled and revised Technical Specifications are implemented.

PSEG has evaluated the proposed changes in accordance with 10 CFR 50.91(a)(1), using the criteria in 10 CFR 50.92(c), and has determined this request involves no significant hazards considerations. An evaluation of the requested changes is provided in Attachment 1 to this letter. The marked up Technical Specification pages affected by the proposed changes are provided in Attachment 2. Attachment 3 describes the degree to which the Hope Creek design and implementation conform to the applicable NRC accepted generic topical reports and associated NRC safety evaluation reports.

PSEG previously requested changes to the Technical Specifications to include the OPRM trip function in Reference 1, supplemented by Reference 2. PSEG subsequently withdrew the amendment request in Reference 3. Reference 4 provided a draft Safety Evaluation that documented the completed portions of the NRC staff's review and stated that, upon resubmittal, PSEG may reference the draft SE in order to facilitate the subsequent review.

PSEG requests approval of the proposed License Amendment by September 30, 2004 to be implemented within 60 days of the completion of the Hope Creek Fall 2004 refueling outage.

Should you have any questions regarding this request, please contact Mr. Paul Duke at 856-339-1466.

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

Executed on 31 March 2004
(date)

Michael H. Brothers
Vice President - Site Operations

Attachments (3)

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REQUEST FOR CHANGE TO TECHNICAL SPECIFICATIONS
OSCILLATION POWER RANGE MONITOR (OPRM)

Table of Contents

1. DESCRIPTION

This letter is a request to amend Operating License NPF-57 for the Hope Creek Generating Station (HCGS). The proposed amendment would add Technical Specification (TS) 3.3.11, "Oscillation Power Range Monitor (OPRM)"; revise TS 3.4.1, "Recirculation System," to remove requirements restricting operation consistent with the application of the OPRM Option III as the long term solution to the thermal-hydraulic (T-H) instability issue; and revise TS 6.9.1.9, "Core Operating Limits Report (COLR)," to include the analytical methods used to determine OPRM operating limits. TS 3/4.3.11 delineates the OPRM system Limiting Condition for Operation, Applicability, Actions and Surveillance Requirements.

2. PROPOSED CHANGE

The marked up pages for the proposed changes to the Technical Specifications are included in Attachment 2 of this submittal.

1. New TS 3/4.3.11 is added to delineate the OPRM system Limiting Condition for Operation, Applicability, Actions and Surveillance Requirements. The TS Index is revised to reflect the new TS.

2. TS 3/4.4.1, "Recirculation System," is revised to remove requirements restricting operation consistent with the application of the OPRM Option III as the long term solution to the thermal-hydraulic (T-H) instability issue. Figure 3.4.1.1-1, Thermal Power Versus Core Flow, is deleted together with requirements for monitoring local neutron flux noise and limiting the duration of entry into regions of the power/ flow map associated with the detection, suppression or prevention of thermal-hydraulic instability.

3. TS 6.9.1.9, "Core Operating Limits Report (COLR)," is revised to include the analytical methods used to determine OPRM operating limits. The proposed change to TS 6.9.1.9 assumes NRC approval of changes proposed in PSEG letter LR-N03-0511, "Fuel Vendor Change," dated December 24, 2003.

3. BACKGROUND

General Design Criteria (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, HCGS is currently operating with certain interim corrective actions (ICAs) as described in PSEG's response to NRC Generic Letter (GL) 94-02 (Reference 1). The ICAs include restrictions on plant operation and procedural requirements for operator action in response to instability events. The ICAs supplement existing Technical Specifications requirements applicable when operating with one or more recirculation loops, for monitoring and mitigating the magnitude of average power range monitor (APRM) and local power range monitor (LPRM) noise levels within one defined region of the power/flow map, and to quickly exit a second defined region.

The requirements of the ICAs and existing Technical Specifications limit the probability of an instability event by restricting the duration of any entry into the regions of the power/flow map most susceptible to instability under anticipated entry conditions. Actions are also required by the ICAs when conditions consistent with the onset of T-H 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.

Implementation of the proposed TS revisions would allow the RPS trip function of the OPRM system to be enabled consistent with the Asea Brown Boveri - Combustion Engineering (ABB-CE) Option III long-term solution for the T-H instability issue. The OPRM RPS trip function would provide automatic detection and suppression of conditions which might result in a T-H instability event and would allow elimination of the ICAs. As a result, the burden on the control room operators would be reduced.

The proposed change alleviates the reliance upon the operator by implementing the OPRM system. The OPRM does not require operator action or involvement to suppress conditions which have the potential to develop into anticipated T-H instability events. The OPRM ensures automatic protection of the MCPR safety limit for anticipated oscillations.

PSEG previously requested changes to the Technical Specifications to include the OPRM trip function in Reference 2, supplemented by Reference 3. PSEG subsequently withdrew the amendment request in Reference 4. Reference 5 provided a draft Safety Evaluation (SE) that documented the completed portions of the NRC staff's review and stated that, upon resubmittal, PSEG may reference the draft SE in order to facilitate the subsequent review. The proposed changes are identical in intent to those previously reviewed by the NRC in Reference 5. The proposed OPRM TS is renumbered to account for other TS amendments implemented since the draft SE was issued. Although the staff's draft SE concluded the proposed TS in Reference 2 was acceptable, PSEG has elected to include an additional required TS action in Attachment 2 to restore OPRM trip capability within 120 days in the event OPRM trip capability is not maintained. The required action is consistent with CENPD-400-P, Appendix A. Surveillance Requirement (SR) 4.3.11.6 (OPRM response time testing) is revised to be consistent with the current surveillance interval for RPS time response testing.

4. TECHNICAL ANALYSIS

Consistent with the implementation of the OPRM, TS 3.4.1 (which sets limiting conditions for operation for recirculation loops) and TS 6.9.1.9 (which identifies the analytical methods for determination of limits reported in the COLR) are revised by the proposed change. The revisions to TS 3.4.1 delete Figure 3.4.1.1-1 and eliminate requirements for monitoring local neutron flux noise and limiting the duration of entry into regions of the power/flow map associated with the detection, suppression or prevention of thermal-hydraulic instability. The revisions to TS 6.9.1.9 require the documentation of operating limits for TS 3/4.3.11 in the COLR. The revision also identifies the applicable NRC reviewed and approved analytical methods. The revisions of TS 3.4.1 and 6.9.1.9 are consistent with the application of the OPRM as an Option III long-term solution to the T-H instability issue, as noted in Attachment 3 of this submittal.

The OPRM is designed to initiate a reactor scram via existing reactor protection system (RPS) trip logic upon detection of conditions consistent with the onset of local oscillations in core power and the approach to conditions required for sustained oscillations and a thermal-hydraulic instability event. This capability will assure protection of the MCPR safety limit under anticipated core-wide and regional T-H instability events.

The design and effectiveness of the OPRM system in meeting the regulatory requirement to detect and suppress conditions necessary to initiate T-H instability is documented in the following NRC accepted topical reports:

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

NEDO-31960-A, November 1995	BWROG Long-Term Stability Solutions Licensing Methodology
NEDO-31960-A, Supplement 1, November 1995	BWROG Long-Term Stability Solutions Licensing Methodology
CENPD-400-P-A, Rev. 1, May 1995	Generic Topical Report for the ABB Option III Oscillation Power Range Monitor (OPRM)

The OPRM system is comprised of four OPRM channels that provide inputs to an associated RPS channel via eight OPRM modules. The OPRM modules are installed in available locations in the associated LPRM pages in the power range neutron monitoring system (PRNMS) panels. Each OPRM channel takes amplified LPRM signals from one APRM group and either another APRM group or one unassigned LPRM group. The LPRM signals are grouped together such that the resulting OPRM response provides adequate coverage of anticipated oscillation modes. Each OPRM channel consists of two OPRM modules and contains more than 30 OPRM cells, where a cell represents a combination of four LPRMs in adjacent areas of the core. The use of instantaneous flux and smaller grouping of LPRMs in cells provides better resolution for the detection of local oscillations than the APRM system alone. With many cells, each consisting of multiple LPRMs in close proximity, the sensitivity of the OPRM is not adversely impacted by single LPRM failures.

The design and implementation of the OPRM does not cause any degradation in the existing APRM, LPRM and RPS systems. The OPRM system conforms to the existing 1 out of 2 taken twice trip input to the Reactor Protection System. The OPRM System does not adversely impact the design basis and operation of the interfacing equipment (i.e., the APRM, RPS, Recirculation Flow Unit and LPRM Systems). Isolator accuracy, response time and performance requirements are included in the design. The OPRM module locations have been assigned consistent with RPS and Neutron Monitoring system separation requirements. Additional considerations to maintain redundancy, diversity, separation, and electrical isolation requirements are as follows:

The APRM power signal in 6 out of 8 cases is derived from within the page; thus, no separation/isolation requirements apply. For the two signals required for the LPRM A and B pages, the signal is derived from APRM E and F consistent with existing APRM subsystem logic. In these cases, analog isolators are provided at the signal originating page to maintain the integrity of the RPS / OPRM interface. Cable separation is provided as required by the use of Siltemp fire wrap. The flow signal is derived with the respective APRM and LPRM page. As in APRM power, the flow signal to LPRM A and B pages is derived from APRM E and F providing the same logic and separation.

Each OPRM module applies the three separate algorithms for detecting local oscillations described in NEDO-31960-A and NEDO-31960-A, Supplement 1: the period based algorithm (PBA), the amplitude based algorithm (ABA) and the growth rate algorithm (GRA). Each OPRM module executes the algorithms on the LPRM signals and cell configurations for that channel and generates alarms and trips based on the results. Either module in a channel can trip the OPRM channel. The OPRM trips actuate the RPS when the appropriate RPS trip logic is satisfied. The OPRM trip function is enabled when APRM power is greater than or equal to 30% of rated thermal power (RTP) and the recirculation drive flow is less than or equal to the value corresponding to approximately 60% of rated core flow.

The OPRM provides annunciation to alert the operator when the system is enabled and also provides a pre-trip alarm upon detection of the imminent onset of local core power oscillations. The alarm is available to alert the operator to the plant condition for those conditions for which instability may be anticipated and may provide time for compensatory actions in the event of a slow-growing oscillation.

The RPS trip provided by the PBA is actuated when oscillation as detected by one or more OPRM cells in each OPRM channel meet certain criteria for period and amplitude. The PBA is the only algorithm that is credited in the analysis of the capability of the OPRM to protect the MCPR safety limit. The remaining algorithms (ABA and GRA) provide defense-in-depth and additional protection for T-H instability events initiated from unanticipated conditions.

Upon implementation of the OPRM and its associated RPS trip function, operation in regions of the power/flow map potentially susceptible to T-H instability is acceptable since the OPRM system provides reliable detection and suppression of conditions necessary for the initiation of T-H instability events. Therefore, Technical Specifications requirements which currently limit operation in specified regions of the power/flow map are deleted.

The OPRM assures maintenance of the margin of safety associated with the MCPR safety limit for instability events initiated from anticipated conditions without relying on operator action. This capability was demonstrated by Hope Creek specific analyses based on the methodology described in NEDO-32465-A and for future operating cycles will be verified as part of the cycle-specific core reload analysis.

The OPRM provides improved protection by automating the detection and suppression function.

Analyses have been performed to confirm the stability boundary defined in Technical Specification Figure 3.4.1.1-1 at several power/flow statepoints and burnups throughout the current operating cycle. Upon removal of Figure 3.4.1.1-1 from the TS, similar analyses will continue to be performed that will ensure the BWR Owners' Group Interim Corrective Action (ICA) regions are applicable to (or must be modified to accommodate) operation of the Hope Creek core for the applicable cycle.

The amplitude trip setpoint S_p for the OPRM system is cycle specific due to its derivation through the methodology found in NEDO-32465. A corresponding value of the confirmation count trip setpoint N_p is also found in Table 3-2 of NEDO-32465.

Using the equation of NEDO-32465 section 4.5.1, final MCPR (FMCPR) can be determined from:

$$FMCPR = IMCPR - IMCPR * \left(\frac{\Delta CPR}{IMCPR} \right)$$

The licensing criteria for OPRM are met provided FMCPR is greater than the MCPR safety limit. The IMCPR is calculated using an NRC approved 3-D nodal simulator. The value of IMCPR is the minimum value that results from two different scenarios:

1. A two recirculation pump trip from rated power on the highest allowable rod line. The IMCPR is the MCPR that exists after coastdown to natural circulation and after feedwater temperature reaches equilibrium. It is assumed that the reactor is operating at the MCPR operating limit just prior to the pump trip.

2. The reactor is operating steady state at 45% core flow on the highest allowable rod line and at the MCPR operating limit applicable to those conditions.

The quantity ΔCPR/IMCPR is derived using the ΔCPR/IMCPR vs. Oscillation Magnitude (DIVOM) curve and a plant specific Hot Bundle Oscillation Magnitude calculation. The Hope Creek Hot Bundle Oscillation Magnitude calculation relates the Hot Bundle Oscillation Magnitude to a corresponding amplitude trip setpoint value (S_p) to be used in the OPRM system. Since the calculation of IMCPR is cycle specific, the corresponding value of S_p (and N_p) becomes cycle specific in order to satisfy the requirement that the FMCPR value is greater than the MCPR safety limit. This evaluation is still ongoing for Cycle 13.

5. REGULATORY SAFETY ANALYSIS

5.1 <u>No Significant Hazards Consideration</u>

PSEG Nuclear (PSEG) 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 or consequences of an accident previously evaluated?

   Response: No.

   The proposed change specifies limiting conditions for operations, required actions and surveillance requirements of the Oscillation Power Range Monitor (OPRM) system and allows operation in regions of the power/flow map currently restricted by the requirements of Interim Corrective Actions (ICAs) and certain limiting conditions of operation of Technical Specifications (TS) 3.4.1. The OPRM system can automatically detect and suppress conditions necessary for thermal-hydraulic (T-H) instability. A T-H instability event has the potential to challenge the Minimum Critical Power Ratio (MCPR) safety limit. The restrictions of the ICAs and TS 3.4.1 were imposed to ensure adequate capability to detect and suppress conditions consistent with the onset of T-H oscillations that may develop into a T-H instability event. With the installation of the OPRM System, these restrictions are no longer required.

   The probability of a T-H instability event is most significantly impacted by power/flow conditions such that only during operation inside specific regions of the power/flow map, in combination with power shape and inlet enthalpy conditions, can the occurrence of an instability event be postulated to occur. Operation in these regions may increase the probability that conditions necessary for a T-H instability can occur.

   However, when the OPRM is operable with operating limits as specified in the COLR, the OPRM can automatically detect the imminent onset of local power oscillations and generate a trip signal. Actuation of an RPS trip will suppress conditions necessary for T-H instability and decrease the probability of a T-H instability event. In the event the trip capability of the OPRM is not maintained, the proposed change includes actions which limit the period of time before the affected OPRM channel (or RPS system) must be placed in the trip condition or an alternate method to detect and suppress thermal-hydraulic oscillations must be initiated. In either case the duration of this period of time is limited such that the increase in the probability of a T-H instability event is not significant. Therefore, the proposed change does not result in a significant increase in the probability of an accident previously evaluated.

An unmitigated T-H instability event is postulated to cause a violation of the MCPR safety limit. The proposed change ensures mitigation of T-H instability events prior to challenging the MCPR safety limit if initiated from anticipated conditions by detection of the onset of oscillations and actuation of an RPS trip signal. The OPRM also provides the capability of an RPS trip being generated for T-H instability events initiated from unanticipated but postulated conditions. These mitigating capabilities of the OPRM system would become available as a result of the proposed change and have the potential to reduce the radiological consequences of anticipated and postulated T-H instability events. Therefore, the proposed change does not significantly increase the radiological 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.

The proposed change specifies limiting conditions for operation, required actions and surveillance requirements of the OPRM system and allows operation in regions of the power/flow map currently restricted by the requirements of ICAs and TS 3.4.1. The OPRM system uses input signals shared with APRM and rod block functions to monitor core conditions and generate an RPS trip when required. Quality requirements for software design, testing, implementation and module self-testing of the OPRM system provide assurance that no new equipment malfunctions due to software errors are created. The design of the OPRM system also ensures that neither operation nor malfunction of the OPRM system will adversely impact the operation of other systems and no accident or equipment malfunction of these other systems could cause the OPRM system to malfunction or cause a different kind of accident. Therefore, operation with the OPRM system does not create the possibility of a new or different kind of accident from any accident previously evaluated.

Operation in regions currently restricted by the requirements of ICAs and TS 3.4.1 is within the nominal operating domain and ranges of plant systems and components for which postulated equipment and accidents have been evaluated. Therefore operation within these regions does not create the possibility of a new or different kind of accident from any accident previously evaluated.

The proposed change which specifies limiting condition for operations, required actions and surveillance requirements of the OPRM system and allows operation in certain regions of the power/flow map 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.

The proposed change specifies limiting conditions for operation, required actions and surveillance requirements of the OPRM system and allows operation in regions of the power/flow map currently restricted by the requirements of ICAs and TS 3.4.1.

The OPRM system monitors small groups of LPRM signals for indication of local variations of core power consistent with T-H oscillations and generates an RPS trip when conditions consistent with the onset of oscillations are detected. An unmitigated T-H instability event has the potential to result in a challenge to the MCPR safety limit. The OPRM system provides the capability to automatically detect and suppress conditions which might result in a T-H instability event and thereby maintains the margin of safety by providing automatic protection for the MCPR safety limit while significantly reducing the burden on the control room operators. In the event the trip capability of the OPRM is not maintained, the proposed change includes actions which limit the period of time before the affected OPRM channel (or RPS system) must be placed in the trip condition or an alternate method to detect and suppress thermal-hydraulic oscillations must be initiated. In either case, the duration of this period of time is limited so that the increase in the probability of a T-H instability event is not significant. Operation with the OPRM system does not involve a significant reduction in a margin of safety.

Operation in regions currently restricted by the requirements of ICAs and TS 3.4.1 is within the nominal operating domain assumed for identifying the range of initial conditions considered in the analysis of anticipated operational occurrences and postulated accidents. Therefore, operation in these regions does not involve a significant reduction in a margin of safety.

Based on the above, PSEG concludes that the proposed changes present no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and accordingly, a finding of "no significant hazards consideration" is justified.

5.2 Applicable Regulatory Requirements/Criteria

General Design Criterion (GDC) 10 of Appendix A to 10 CFR 50 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 effects 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.

6. ENVIRONMENTAL CONSIDERATION

PSEG has determined the proposed amendment would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, or would change an inspection or a surveillance requirement. The proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), an environmental assessment of the proposed change is not required.

7. REFERENCES

1. NLR-N94140, "Response to Generic Letter 94-02: BWR Thermal Hydraulic Instabilities," dated September 9, 1994

2. LR-N00-0429, "Request For Change To Technical Specifications: Oscillation Power Range Monitor (OPRM)," dated November 29, 2000

3. LR-N01-0247, "Response To Request For Additional Information: Request For Change To Technical Specifications: Oscillation Power Range Monitor (OPRM)," dated August 10, 2001

4. LR-N01-0279, David F. Garchow (PSEG Nuclear) letter to NRC, "Revision to Implementation Schedule and Withdrawal of License Change Request," dated October 19, 2001

5. "Hope Creek Generating Station, Withdrawal Of An Amendment Request, Oscillation Power Range Monitor (TAC NO. MB0589)," dated November 28, 2001

**HOPE CREEK GENERATING STATION
FACILITY OPERATING LICENSE NPF-57
DOCKET NO. 50-354
REQUEST FOR LICENSE AMENDMENT**

TECHNICAL SPECIFICATION PAGES WITH PROPOSED CHANGES

The following Technical Specifications for Facility Operating License No. NPF-57 are affected by this change request:

Technical Specification	Page
Index	x xviii
3/4.3.11	3/4 3-110 (New Page)
3/4.4.1	3/4 4-1 3/4 4-2 3/4 4-2a
Figure 3.4.1.1.1	3/4 4-3
6.9.1.9	6-20 6-21
Bases 3/4.3.11	B 3/4.3-13 (New Page) B 3/4.3-14 (New Page) B 3/4.3-15 (New Page) B 3/4.3-16 (New Page) B 3/4.3-17 (New Page) B 3/4.3-18 (New Page)
Bases 3/4.4.1	B 3/4 4-1 B 3/4 4-2

3/4.3.11 OSCILLATION POWER RANGE MONITOR 3/4 3-110

LIMITING CONDITIONS FOR OPERATION AND SURVEILLANCE REQUIREMENTS

3/4.3.11 OSCILLATION POWER RANGE MONITOR B3/4 3-13

INDEX

BASES

3/4.3.11 OSCILLATION POWER RANGE MONITOR

LIMITING CONDITION FOR OPERATION

3.3.11 Four channels of the OPRM instrumentation shall be OPERABLE*. Each OPRM channel period based algorithm amplitude trip setpoint (Sp) shall be less than or equal to the Allowable Value as specified in the CORE OPERATING LIMITS REPORT.

APPLICABILITY: OPERATIONAL CONDITION 1, when THERMAL POWER is greater than or equal to 25% of RATED THERMAL POWER.

ACTIONS

a. With one or more required channels inoperable:
   1. Place the inoperable channels in trip within 30 days, or
   2. Place associated RPS trip system in trip within 30 days, or
   3. Initiate an alternate method to detect and suppress thermal hydraulic instability oscillations within 30 days.

b. With OPRM trip capability not maintained:
   1. Initiate alternate method to detect and suppress thermal hydraulic instability oscillations within 12 hours, and
   2. Restore OPRM trip capability within 120 days.

c. Otherwise, reduce THERMAL POWER to less than 25% RTP within 4 hours.

SURVEILLANCE REQUIREMENTS

4.3.11.1 Perform CHANNEL FUNCTIONAL TEST at least once per 184 days.

4.3.11.2 Calibrate the local power range monitor once per 1000 Effective Full Power Hours (EFPH) in accordance with Note f, Table 4.3.1.1-1 of TS 3/4.3.1.

4.3.11.3 Perform CHANNEL CALIBRATION once per 18 months. Neutron detectors are excluded.

4.3.11.4 Perform LOGIC SYSTEM FUNCTIONAL TEST once per 18 months.

4.3.11.5 Verify OPRM is enabled when THERMAL POWER is $\geq$ 30% RTP and recirculation drive flow $\leq$ the value corresponding to 60% of rated core flow once per 18 months.

4.3.11.6 Verify the RPS RESPONSE TIME is within limits. Each test shall include at least one channel per trip system such that all channels are tested at least once every N times 18 months where N is the total number of redundant channels in a specific reactor trip system. Neutron detectors are excluded.

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

3/4.4.1 RECIRCULATION SYSTEM

RECIRCULATION LOOPS

LIMITING CONDITION FOR OPERATION

3.4.1.1 Two reactor coolant system recirculation loops shall be in operation. ~~with:~~

~~a. Total core flow greater than or equal to 45% of rated core flow, or~~

~~b. THERMAL POWER less than or equal to the limit specified in Figure 3.4.1.1-1.~~

APPLICABILITY: OPERATIONAL CONDITIONS 1* and 2*.

ACTION:

a. With one reactor coolant system recirculation loop not in operation:

1. Within 4 hours:

   a) Place the recirculation flow control system in the Local Manual mode, and

   b) Reduce THERMAL POWER to ≤ 70% of RATED THERMAL POWER, and

   c) Increase the MINIMUM CRITICAL POWER RATIO (MCPR) Safety Limit per Specification 2.1.2, and

   d) Reduce the Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) limit to a value specified in the CORE OPERATING LIMITS REPORT for single loop operation, and

   e) DELETED.

   f) Limit the speed of the operating recirculation pump to less than or equal to 90% of rated pump speed, and

   g) Perform surveillance requirement 4.4.1.1.2 if THERMAL POWER is ≤ 38% of RATED THERMAL POWER or the recirculation loop flow in the operating loop is ≤ 50% of rated loop flow.

2. Within 4 hours, reduce the Average Power Range Monitor (APRM) Scram Trip Setpoints and Allowable Values to those applicable for single recirculation loop operation per Specifications 2.2.1 and 3.2.2; otherwise, with the Trip Setpoints and Allowable Values associated with one trip system not reduced to those applicable for single recirculation loop operation, place the affected trip system in the tripped condition and within the following 6 hours, reduce the Trip Setpoints and Allowable Values of the affected channels to those applicable for single recirculation loop operation per Specifications 2.2.1 and 3.2.2.

3. Within 4 hours, reduce the APRM Control Rod Block Trip Setpoints and Allowable Values to those applicable for single recirculation loop operation per Specifications 3.2.2 and 3.3.6; otherwise, with the Trip Setpoint and Allowable Values associated with one trip function not reduced to those applicable for single recirculation loop operation, place at least one affected channel

* See Special Test Exception 3.10.4.

ACTION (Continued)

in the tripped condition and within the following 6 hours, reduce the Trip Setpoints and Allowable Values of the affected channels to those applicable for single recirculation loop operation per Specifications 3.2.2 and 3.3.6.

4. Within 4 hours, reduce the Rod Block Monitor Trip Setpoints and Allowable Values to those applicable for single recirculation loop operation per Specification 3.3.6; otherwise, with the Trip Setpoints and Allowable Values associated with one trip function not reduced to those applicable for single recirculation loop operation, place at least one affected channel in the tripped condition and within the following 6 hours, reduce the Trip setpoints and Allowable Values of the remaining channels to those applicable for single recirculation loop operation per Specification 3.3.6.

5. The provisions of Specification 3.0.4 are not applicable.

6. Otherwise be in at least HOT SHUTDOWN within the next 12 hours.

b. With no reactor coolant system recirculation loops in operation, immediately initiate action to reduce THERMAL POWER to less than or equal to the limit specified in Figure 3.4.1.1-1 within 2 hours and initiate measures to place the unit in at least STARTUP within 6 hours and in HOT SHUTDOWN within the next 6 hours.

c. With one or two reactor coolant system recirculation loops in operation and total core flow less than 45% but greater than 40% of rated core flow and THERMAL POWER greater than the limit specified in Figure 3.4.1.1-1:

1. Determine the APRM and LPRM* noise levels (Surveillance 4.4.1.1.4):

   a) At least once per 8 hours, and
   b) Within 30 minutes after the completion of a THERMAL POWER increase of at least 5% of RATED THERMAL POWER.

2. With the APRM or LPRM* neutron flux noise levels greater than three times their established baseline noise levels, within 15 minutes initiate corrective action to restore the noise levels to within the required limits within 2 hours by increasing core flow to greater than 45% of rated core flow or by reducing THERMAL POWER to less than or equal to the limit specified in Figure 3.4.1.1-1.

d. With one or two reactor coolant system recirculation loops in operation and total core flow less than or equal to 40% and THERMAL POWER greater than the limit specified in Figure 3.4.1.1-1, within 15 minutes initiate corrective action to reduce THERMAL POWER to less than or equal to the limit specified in Figure 3.4.1.1-1 or increase core flow to greater than 40% within 4 hours.

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* Detector levels A and C of one LPRM string per core octant plus detectors A and C of one LPRM string in the center of the core should be monitored.

SURVEILLANCE REQUIREMENTS

4.4.1.1.1 With one reactor coolant system recirculation loop not in operation at least once per 12 hours verify that:

a. Reactor THERMAL POWER is ≤ 70% of RATED THERMAL POWER, and

b. The recirculation flow control system is in the Local Manual mode, and

c. The speed of the operating recirculation pump is less than or equal to 90% of rated pump speed, and

d. Core flow is greater than 40% when THERMAL POWER is greater than the limit specified in Figure 3.4.1.1-1.

4.4.1.1.2 With one reactor coolant system recirculation loop not in operation, within no more than 15 minutes prior to either THERMAL POWER increase or recirculation loop flow increase, verify that the following differential temperature requirements are met if THERMAL POWER is ≤ 38% of RATED THERMAL POWER or the recirculation loop flow in the operating recirculation loop is ≤ 50% of rated loop flow:

a. ≤ 145°F between reactor vessel steam space coolant and bottom head drain line coolant, and

b. ≤ 50°F between the reactor coolant within the loop not in operation and the coolant in the reactor pressure vessel, and

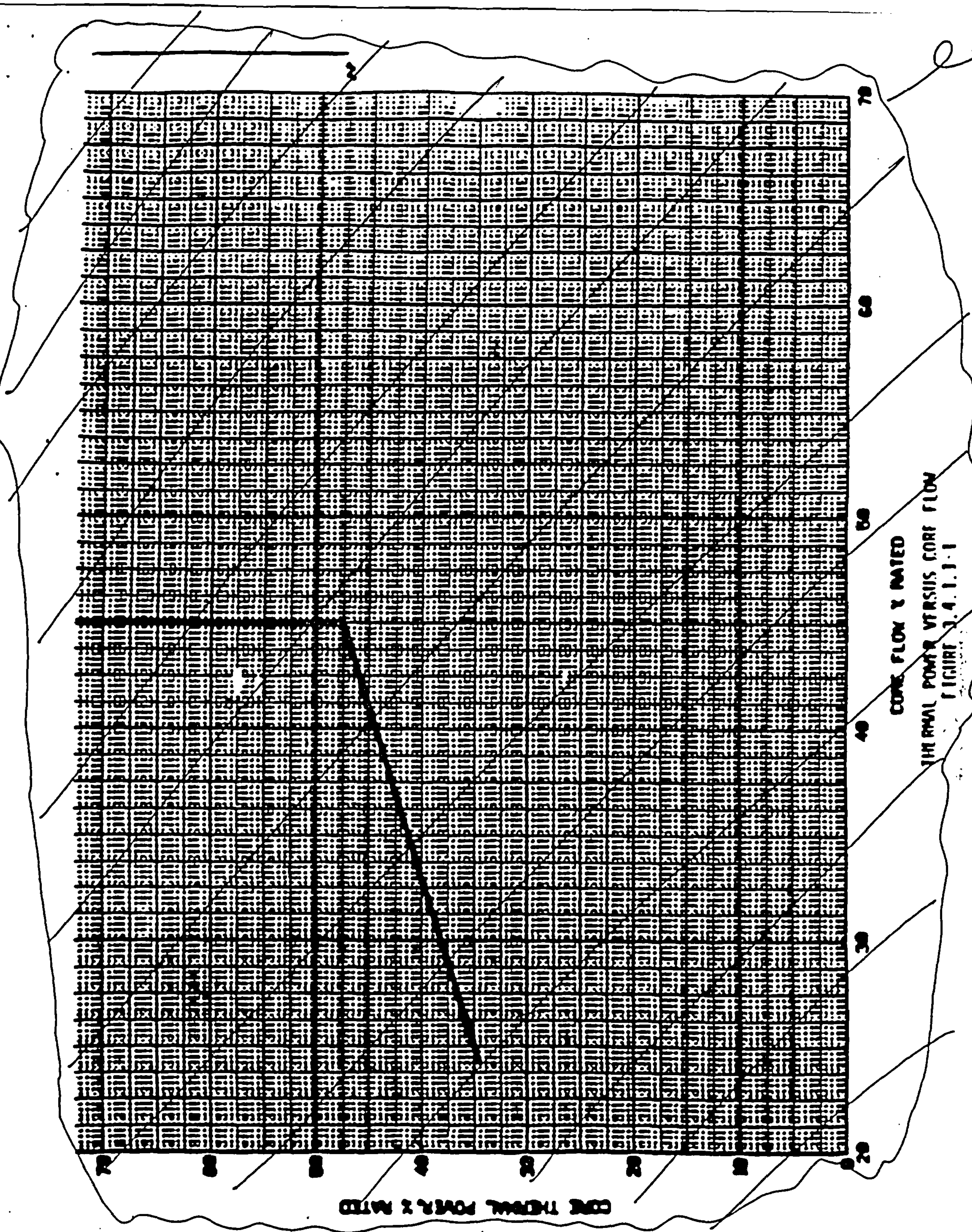
c. ≤ 50°F between the reactor coolant within the loop not in operation and the operating loop.

The differential temperature requirements or Specifications 4.4.1.1.2b and 4.4.1.1.2c do not apply when the loop not in operation is isolated from the reactor pressure vessel.

4.4.1.1.3 Each pump MG set scoop tube mechanical and electrical stop shall be demonstrated OPERABLE with overspeed setpoints less than or equal to 109% and 107%, respectively, of rated core flow, at least once per 18 months.

4.4.1.1.4 Establish a baseline APRM and LPRM* neutron flux noise value within the regions for which monitoring is required (Specification 3.4.1.1, ACTION c) within 2 hours of entering the region for which monitoring is required unless baselining has previously been performed in the region since the last refueling outage.

* Detector levels A and C of one LPRM string per core octant plus detectors A and C of one LPRM string in the center of the core should be monitored.



THERMAL POWER VERSUS CORE FLOW
FIGURE 3.4.1.1-1

MONTHLY OPERATING REPORTS

6.9.1.8 Routine reports of operating statistics and shutdown experience shall be submitted on a monthly basis to the U.S. Nuclear Regulatory Commission, Document Control Desk, Washington, D.C. 20555, with a copy to the USNRC Administrator, Region 1, no later than the 15th of each month following the calendar month covered by the report.

CORE OPERATING LIMITS REPORT

6.9.1.9 Core operating limits shall be established and documented in the PSEG Nuclear LLC generated CORE OPERATING LIMITS REPORT before each reload cycle or any remaining part of a reload cycle for the following Technical Specifications:

3/4.2.1 AVERAGE PLANAR LINEAR HEAT GENERATION RATE
3/4.2.3 MINIMUM CRITICAL POWER RATIO
3/4.2.4 LINEAR HEAT GENERATION RATE
3/4.3.~~10~~ 11 OSCILLATION POWER RANGE MONITOR (OPRM)

CORE OPERATING LIMITS REPORT (Continued)

The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by NRC as applicable in the following documents:

1. NEDE-24011-P-A, "General Electric Standard Application for Reactor Fuel (GESTAR-II)"

2. CENPD-397-P-A, "Improved Flow Measurement Accuracy Using Crossflow Ultrasonic Flow Measurement Technology"

3. NEDO-32465-A, Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications, August 1996

The CORE OPERATING LIMITS REPORT will contain the complete identification for each of the TS referenced topical reports used to prepare the CORE OPERATING LIMITS REPORT (i.e., report number title, revision, date, and any supplements).

The core operating limits shall be determined so that all applicable limits (e.g., fuel thermal-mechanical limits, core thermal-hydraulic limits, ECCS limits, nuclear limits such as shutdown margin, and transient and accident analysis limits) of the safety analysis are met.

The CORE OPERATING LIMITS REPORT, including any mid-cycle revisions or supplements thereto, shall be provided upon issuance, for each reload cycle, to the NRC Document Control Desk with copies to the Regional Administrator and Resident Inspector.

SPECIAL REPORTS

6.9.2 Special reports shall be submitted to the U.S. Nuclear Regulatory Commission, Document Control Desk, Washington, DC 20555, with a copy to the USNRC Administrator, Region 1, within the time period specified for each report.

6.9.3 Violations of the requirements of the fire protection program described in the Final Safety Analysis Report which would have adversely affected the ability to achieve and maintain safe shutdown in the event of a fire shall be submitted to the U.S. Nuclear Regulatory Commission, Document Control Desk, Washington, DC 20555, with a copy to the USNRC Administrator, Region 1, via the Licensee Event Report System within 30 days.

6.10 RECORD RETENTION

6.10.1 In addition to the applicable record retention requirements of Title 10, Code of Federal Regulations, the following records shall be retained for at least the minimum period indicated.

SPECIAL REPORTS

6.10.2 The following records shall be retained for at least 5 years:

a. Records and logs of unit operation covering time interval at each power level.

b. Records and logs of principal maintenance activities, inspections, repair, and replacement of principal items of equipment related to nuclear safety.

c. All REPORTABLE EVENTS submitted to the Commission.

d. Records of surveillance activities, inspections, and calibrations required by these Technical Specifications.

e. Records of changes made to the procedures required by Specification 6.8.1.

f. Records of radioactive shipments.

g. Records of sealed source and fission detector leak tests and results.

3/4.3.11 Oscillation Power Range Monitor (OPRM)

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 effects 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 minimum critical power ratio (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, installed in local power range monitor (LPRM) flux amplifier slots in the Neutron Monitoring System (NMS) cabinets, 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 Specification 3.3.1, "RPS Instrumentation." Only the period based detection algorithm is used in the safety analysis. The remaining algorithms provide defense in depth and additional protection against unanticipated oscillations.

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

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 RPS 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.

The OPRM System generates alarms based on system status and on the detection algorithms. However, this LCO specifies OPERABILITY requirements only for the period-based algorithm trip function.

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, 3/4.3.11 Oscillation Power Range Monitor (OPRM)

APPLICABLE SAFETY ANALYSES (continued)

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 effects of anticipated operational occurrences. GDC 12 requires assurance that power oscillations which can result in conditions exceeding acceptable fuel design limits are either not possible or can be reliably and readily detected and suppressed. The OPRM System provides compliance with GDC 10 and GDC 12 by detecting the onset of oscillations and suppressing them by initiating a reactor scram. This assures that the MCPR safety limit will not be violated for anticipated oscillations.

The OPRM Instrumentation satisfies Criteria 3 of the Final Commission Policy Statement on Technical Specifications Improvements for Nuclear Power Reactors, dated July 22, 1993 (58 FR 39132).

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 highly redundant and low minimum number of required LPRMs in the OPRM cell design ensures that large numbers of cells will remain operable, even with large numbers of LPRMs bypassed.

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 region of anticipated oscillation is defined by THERMAL POWER ≥ 30% RTP and recirculation drive flow ≤ the value corresponding to 60% of rated core flow. Therefore, the OPRM trip is required to be enabled in this region. However, to protect against anticipated transients, the OPRM is required to be OPERABLE with THERMAL POWER ≥ 25% RTP. This provides sufficient margin to potential instabilities as a result of a loss of feedwater heater transient. It is not necessary for the OPRM to be OPERABLE with THERMAL POWER < 25% RTP because instabilities are not anticipated to result from any expected transients below this power.

ACTIONS

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 Action b.1). The remaining OPERABLE OPRM channels continue to provide trip capability 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

3/4.3.11 Oscillation Power Range Monitor (OPRM)

ACTIONS (continued)

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, restore capability to accommodate a single failure, and allow operation to continue. Alternately, if it is not desired to place the OPRM channel (or RPS trip system) in trip (e.g., as in the case where placing the inoperable channel in trip would result in a full scram), the alternate method of detecting and suppressing thermal-hydraulic instability oscillations is required (Required Action a.3). This alternate method is described in Reference 5. It consists of increased operator awareness and monitoring for neutron flux oscillations when operating in the region where oscillations are possible. If indications of oscillation, as described in Reference 5, are observed by the operator, the operator will take the actions described by procedures, which include initiating a manual scram of the reactor.

b.1 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 one OPRM channel OPERABLE or in trip (or the associated RPS trip system in trip).

Because of the low probability of the occurrence of an instability, 12 hours is an acceptable time to initiate the alternate method of detecting and suppressing thermal-hydraulic instability oscillations described in Reference 5. The alternate method of detecting and suppressing thermal-hydraulic instability oscillations would adequately address detection and mitigation in the event of instability oscillations. Based on industry operating experience with actual instability oscillation, the operator would be able to recognize instabilities during this time and take action to suppress them through a manual scram. In addition, the OPRM System may still be available to provide alarms to the operator if the onset of oscillations were to occur. Since plant operation is minimized in areas where oscillations may occur, operation 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

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

3/4.3.11 Oscillation Power Range Monitor (OPRM)

SURVEILLANCE REQUIREMENTS

SR 4.3.11.1

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

SR 4.3.11.2

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 EFPH Frequency is based on operating experience with LPRM sensitivity changes. This surveillance is satisfied in accordance with Note f, Table 4.3.1.1-1 of TS 3/4.3.1.

SR 4.3.11.3

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

Calibration of the channel provides a check of the internal reference voltage and the internal processor clock frequency. It also compares the desired trip setpoints with those in processor memory. Since the OPRM is a digital system, the internal reference voltage and processor clock frequency are, in turn, used to automatically calibrate the internal analog to digital converters. The Allowable Values are specified in the CORE OPERATING LIMITS REPORT.

As noted, neutron detectors are excluded from CHANNEL CALIBRATION because of the difficulty of simulating a meaningful signal. Changes in neutron detector sensitivity are compensated for by performing the 1000 EFPH LPRM calibration using the TIPs (SR 4.3.11.2).

The Frequency of 18 months is based upon the design objective that the OPRM operate over a complete fuel cycle, as a minimum, without requiring calibration.

SR 4.3.11.4

The LOGIC SYSTEM FUNCTIONAL TEST demonstrates the OPERABILITY of the required trip logic for a specific channel. The functional testing of control rods and scram discharge volume (SDV) vent and drain valves in Specification 3.1.3.1, "Control Rod OPERABILITY" 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 18-month Frequency is based on engineering judgment and reliability of the components. Operating experience has shown that these components usually pass the surveillance when performed at the 18 month Frequency.

3/4.3.11 Oscillation Power Range Monitor (OPRM)

SURVEILLANCE REQUIREMENTS (continued)

SR 4.3.11.5

This SR ensures that trips initiated from the OPRM system are not inadvertently bypassed when the capability of the OPRM system to initiate an RPS trip is required. The trip capability of the OPRM system is only required during operation under conditions susceptible to anticipated T-H instability oscillations. The region of anticipated oscillation is defined by THERMAL POWER ≥ 30% RTP and recirculation drive flow ≤ the value corresponding to 60% of rated core flow.

The trip capability of individual OPRM modules are automatically enabled based on the APRM power and flow signals associated with each OPRM channel during normal operation. These channel specific values of APRM power and recirculation drive flow are subject to surveillance requirements associated with other RPS functions such as APRM flux and flow biased simulated thermal power with respect to the accuracy of the signal to the process variable. The OPRM is a digital system with calibration and manually initiated tests to verify digital input including input to the auto-enable calculations. Periodic calibration confirms that the auto-enable function occurs at appropriate values of APRM power and recirculation flow signal. Therefore, verification that OPRM modules are enabled at any time that THERMAL POWER ≥ 30% RTP and recirculation drive flow ≤ the value corresponding to 60% of rated core flow adequately ensures that trips initiated from the OPRM system are not inadvertently bypassed.

The trip capability of individual OPRM modules can also be enabled by placing the module in the non-bypass (Manual Enable) mode. If placed in the non-bypass or Manual Enable mode the trip capability of the module is enabled and this SR is met. The frequency of 18 months is based on engineering judgment and reliability of the components.

SR 4.3.11.6

This SR ensures that the individual channel response times are less than or equal to the maximum values assumed in the accident analysis (Ref. 8). The OPRM self-test function may be utilized to perform this testing for those components it is designed to monitor. 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 such that all channels are tested at least once every N times 18 months where N is the total number of redundant channels in a specific reactor trip system. This Frequency is based upon operating experience, which shows that random failures of instrumentation components causing serious time degradation, but not channel failure, are infrequent.

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3/4.3.11 Oscillation Power Range Monitor (OPRM)

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 and NEDO-31960, Supplement 1, 'BWR Owners Group Long-Term Stability Solutions Licensing Methodology'," July 12, 1993.

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-94078. "Guidelines for Stability Interim Corrective Action," June 6, 1994.

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

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

8. GE-NE-A13-00381-04, "Reactor Long-Term Stability Solution Option III: Licensing Basis Hot Bundle Oscillation Magnitude for Hope Creek, " March 1999.

BASES

3/4.4.1 RECIRCULATION SYSTEM

The impact of single recirculation loop operation upon plant safety is assessed and shows that single loop operation is permitted if the MCPR fuel cladding Safety Limit is increased as noted by Specification 2.1.2, APRM scram and control rod block setpoints are adjusted as noted in Tables 2.2.1-1 and 3.3.6-2 respectively. MAPLHGR limits are decreased by the factor given in Specification 3.2.1, and MCPR operating limits are adjusted per Specification 3/4.2.3.

Additionally, surveillance on the pump speed of the operating recirculation loop is imposed to exclude the possibility of excessive core internals vibration. The surveillance on differential temperatures below 38% THERMAL POWER or 50% rated recirculation loop flow is to mitigate the undue thermal stress on vessel nozzles, recirculating pump and vessel bottom head during the extended operation of the single recirculation loop mode.

An inoperable jet pump is not in itself a sufficient reason to declare a recirculation loop inoperable, but it does, in case of a design-basis-accident, increase the blowdown area and reduce the capability of reflooding the core, thus, the requirement for shutdown of the facility with a jet pump inoperable. Jet pump failure can be detected by monitoring jet pump performance on a prescribed schedule for significant degradation.

Recirculation loop flow mismatch limits are in compliance with the ECCS LOCA analysis design criteria for two recirculation loop operation. The limits will ensure an adequate core flow coastdown from either recirculation loop following a LOCA. In the case where the mismatch limits cannot be maintained during two loop operation, continued operation is permitted in a single recirculation loop mode.

In order to prevent undue stress on the vessel nozzles and bottom head region, the recirculation loop temperatures shall be within 50°F of each other prior to startup of an idle loop. The loop temperature must also be within 50°F of the reactor pressure vessel coolant temperature to prevent thermal shock to the recirculation pump and recirculation nozzles. Sudden equalization of a temperature difference > 145°F between the reactor vessel bottom head coolant and the coolant in the upper region of the reactor vessel by increasing core flow rate would cause undue stress in the reactor vessel bottom head.

The objective of BWR plant and fuel design is to provide stable operation with margin over the normal operating domain. However, at the high power/low flow corner of the operating domain, a small probability of limit cycle neutron flux oscillations exists depending on combinations of operating conditions (e.g., rod pattern, power shape). To provide assurance that neutron flux limit cycle oscillations are detected and suppressed, APRM and LPRM neutron flux noise levels should be monitored while operating in this region.

Stability tests at operating BWRs were reviewed to determine a generic region of the power/flow map in which surveillance of neutron flux noise levels should be performed. A conservation decay ratio of 0.6 was chosen as the bases for determining the generic region for surveillance to account for the plant to plant variability of decay ratio with core and fuel designs. This generic region has been determined to correspond to a core flow of less than or equal to 45% of rated core flow and a THERMAL POWER greater than that specified in Figure 3.4.1.1-1.

Plant specific calculations can be performed to determine an applicable region for monitoring neutron flux noise levels. In this case the degree of conservatism can be reduced since plant to plant variability would be eliminated. In this case, adequate margin will be assured by monitoring the region which has a decay ratio greater than or equal to 0.8.

Neutron flux noise limits are also established to ensure early detection of limit cycle neutron flux oscillations. BWR cores typically operate with neutron flux noise caused by random boiling and flow noise. Typical neutron flux noise levels of 1-12% of rated power (peak-to-peak) have been reported for the range of low to high recirculation loop flow during both single and dual recirculation loop operation. Neutron flux noise levels which significantly bound these values are considered in the thermal/mechanical design of BWR fuel and are found to be of negligible consequence. In addition, stability tests at operating BWRs have demonstrated that when stability related neutron flux limit cycle oscillations occur they result in peak-to-peak neutron flux limit cycles of 5-10 times the typical values. Therefore, actions taken to reduce neutron flux noise levels exceeding three (3) times the typical value are sufficient to ensure early detection of limit cycle neutron flux oscillations.

Typically, neutron flux noise levels show a gradual increase in absolute magnitude as core flow is increased (constant control rod pattern) with two reactor recirculation loops in operation. Therefore, the baseline neutron flux noise level obtained at a specific core flow can be applied over a range of core flows. To maintain a reasonable variation between the low flow and high flow end of the flow range, the range over which a specific baseline is applied should not exceed 20% of rated core flow with two recirculation loops in operation. Data from tests and operating plants indicate that a range of 20% of rated core flow will result in approximately a 50% increase in neutron flux noise level during operation with two recirculation loops. Baseline data should be taken near the maximum rod line at which the majority of operation will occur. However, baseline date taken at lower rod lines (i.e., lower power) will result in a conservative value since the neutron flux noise level is proportional to the power level at a given core flow.

3/4.4.2 SAFETY/RELIEF VALVES

The safety valve function of the safety/relief valves operates to prevent the reactor coolant system from being pressurized above the Safety Limit of 1375 psig in accordance with the ASME Code. A total of 13 OPERABLE safety/relief valves is required to limit reactor pressure to within ASME III allowable values for the worst case transient.

Demonstration of the safety relief valve lift settings occurs only during shutdown. The safety relief valve pilot stage assemblies are set pressure tested in accordance with the recommendations of General Electric SIL No. 196, Supplement 14 (April 23, 1984), "Target Rock 2-Stage SRV Set-Point Drift." Set pressure tests of the safety relief valve main (mechanical) stage are conducted at least once every 5 years.

The low-low set system ensures that safety/relief valve discharges are minimized for a second opening of these valves, following any overpressure transient. This is achieved by automatically lowering the closing setpoint of two valves and lowering the opening setpoint of two valves following the initial opening. In this way, the frequency and magnitude of the containment blowdown duty cycle is substantially reduced. Sufficient redundancy is provided for the low-low set system such that failure of any one valve to open or close at its reduced setpoint does not violate the design basis.

HOPE CREEK GENERATING STATION
FACILITY OPERATING LICENSE NPF-57
DOCKET NO. 50-354
REVISIONS TO THE TECHNICAL SPECIFICATIONS (TS)

CONFORMANCE WITH NRC ACCEPTED TOPICAL REPORTS AND ASSOCIATED NRC SAFETY EVALUATION REPORTS

The NRC, in their letter (Bruce A. Boger Director Division of Reactor Controls and Human Factors to Robert A. Pinelli, BWROG, dated August 16, 1995) which transmitted the Safety Evaluation Report accepting the Asea Brown Boveri Combustion Engineering (ABB-CE) Option III OPRM system as a permanent long term solution for the thermal-hydraulic stability issue, required each licensee referencing the OPRM system licensing topical report, CENPD-400-P, to address the plant specific issues identified in the SER and to identify and justify any deviations from CENPD-400-P and the associated SER.

The plant specific items as stated in Section 5.0 of the SER are restated below along with PSEG Nuclear's response.

1) Confirm the applicability of CENPD-400-P, including clarifications and reconciled differences between the specific plant design and the topical report design descriptions.

The Hope Creek OPRM conforms with the Safety Evaluation Report by the Office of Nuclear Reactor Regulation, CENPD-400-P, Generic Topical Report for the ABB Option III Oscillation Power Range Monitor. The Hope Creek installation and implementation of OPRM are consistent with CENPD-400-P and the associated SER. There are no deviations from Topical Report Sections 2.3 and 3.0.

At Hope Creek, the "plant process computer", as used in the context of the SER is the Control Room Information Display System (CRIDS).

2) Confirm the applicability of BWROG topical reports that address the OPRM and associated instability function, set points and margins.

The Boiling Water Reactor Owners' Group (BWROG) topical reports which address the OPRM and associated instability functions, set points and margins are NEDO-31960 "Long Term Stability Solutions Licensing Methodology" and its supplement and NEDO-32465 "Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications" (References 1, 2 and 5 of CENPD-400-P).

In the Safety Evaluation Report (SER) accepting NEDO-31960, the NRC specified five conditions required for implementation of Option III in any type of BWR. Each of these five conditions has been reviewed and the following confirmations of the applicability of NEDO-31960 and its supplement to the proposed implementation of the Option III solution at Hope Creek are provided.

i) All three algorithms described in NEDO 31960 and its supplement are used. These algorithms are the amplitude based or high-low detection algorithm; the growth rate or high oscillation amplitude algorithm and the period based algorithm. The OPRM executes these algorithms and generate alarms and RPS trips based on the results.

ii) The validity of the selected scram set points will be confirmed using the initial application and reload review methodology described in NEDO-32465. This methodology uses a combination of generic representative plant and plant specific analyses and includes an uncertainty treatment that accounts for the number of failed sensors.

iii) The selected bypass region outside of which the detect and suppress action is deactivated is defined in the proposed Technical Specifications in Attachment 2.

iv) The automatic protective function of the OPRM when fully implemented will be a full reactor scram.

v) The LPRM assignment grouping proposed to be implemented conforms with LPRM assignments shown in Appendix D of NEDO-32465. The NRC SER concluded that the Initial Application and Reload Review methodologies of NEDO-32465 are acceptable. These methodologies specify that the LPRM assignment is a key assumption. The discussion of the initial application methodology in section 5 of NEDO-32465 specifically identifies the LPRM assignments in Appendix D as examples of the expected LPRM assignments a utility may choose. Therefore, it is concluded that since the LPRM assignment proposed to be implemented at Hope Creek is consistent with an example presented in Appendix D of NEDO-32465, and Appendix D LPRM assignments were cited as possible LPRM assignments in the initial application methodology which the NRC found acceptable, the proposed LPRM assignment for Hope Creek is acceptable. No changes to current requirements for a minimum operable number of LPRM detectors for accurate power distribution monitoring and APRM operability were proposed in NEDO-31960 and found acceptable by the NRC in the associated SER. The proposed implementation at Hope Creek is consistent with this accepted NRC position.

In the Safety Evaluation Report (SER) accepting the Boiling Water Reactor Owners' Group (BWROG) "Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications" (NEDO-32465), the NRC concluded that the proposed methodology should produce set point values that will result in a very low likelihood of exceeding CPR safety limits during anticipated instability events. The description of the confirmation set points of the period based algorithm in Section 3.4 of NEDO-32465 identifies that a range of values for the period tolerance and corner frequency was established to allow the OPRM system to be tuned for the unique LPRM noise characteristics of each plant. A specific range of values of the period tolerance and corner frequency demonstrated against available plant data was listed in Table 3-1 of NEDO-32465. Based upon a review of available plant data, and taking into account recent safety communications from GE Nuclear Energy, it has been determined that a tolerance of 100 milliseconds should be used for the OPRM system at Hope Creek.

3) Provide a plant-specific Technical Specification (TS) for the OPRM functions consistent with CENPD-400-P, Appendix A.

Plant specific TS are presented in Attachment 2. The proposed TS are consistent with CENPD-400-P, Appendix A. The interval for Surveillance Requirement (SR) 4.3.11.6 (OPRM response time testing) is revised to be consistent with the current surveillance interval for RPS time response testing.

The period based algorithm amplitude trip setpoint Sp and confirmation counts will be documented in the COLR. Section 6.0 of NEDO-32465 describes the Reload Review, which confirms that the OPRM setpoints and initial MCPR value (IMCPR) will provide high confidence that the MCPR safety limit will not be violated for anticipated stability related oscillations.

4) Confirm that the plant-specific environmental (temperature, humidity, radiation, electromagnetic and seismic) conditions are enveloped by the OPRM equipment environmental qualification values.

The Hope Creek installation and implementation of OPRM is consistent with the Equipment Qualification described in section 3.3 of the SER. The OPRM components are those subject to the ABB-CE environmental qualification program. The OPRM equipment is installed in the main control room. The OPRM System, along with the Replacement Bulk Power Supply and the Dual Voltage regulator are qualified to perform their Class 1E safety function for continuous operation for the following Environmental conditions in the Hope Creek main control room as listed in the HCGS Environmental Design Criteria, D7.5, Table 6:

<u>Normal Operating Conditions:</u>

Temperature: Maximum 78 °F; Average 72 °F; Minimum 66 °F

Relative Humidity: Maximum 60% Minimum 20%

Radiation: 2x10E2 RADS TID

<u>Abnormal Conditions</u>

Temperature 78 °F

Relative Humidity: Maximum 50%; Minimum 40%

Pressure .25/-.25 in WC

Temperature and humidity qualification of the OPRM module was performed by test. The OPRM is designed to continuously operate in the following environment, while meeting all performance requirements:

Normal Ambient Temperature: 40 °F to 120 °F

Abnormal Ambient Temperature: 140 °F for 48 hours

Humidity: 30% to 95% RH non-condensing

Voltage: 90 to 140 VAC

Frequency: 47.5 to 63 Hz.

The tested Relative Humidity range does not envelope the lower end of the normal control room humidity range. PSEG will complete its evaluation of this deviation and any required corrective actions before enabling the OPRM trip function.

The OPRM system is designed to provide a high degree of immunity from electro-magnetic interference/radio frequency interference (EMI/RFI) and to minimize generated EMI/RFI that may interfere with devices connected to it, devices that share a common AC supply, and devices located in the same enclosure. The OPRM system is designed and tested to meet the Electrostatic Discharges (ESD) requirements of IEC 801-2, Level 4. Fast transient withstand capability is demonstrated for all power input and output and all process input and output circuits, signal common and protective earth connections based on IEC 801-4, Level 4 (4 kV on power and ground, 2kV on process signals) as described in IEC 801-4, Sections 7.3.1 and 7.3.2. OPRM circuitry is located inside a metal enclosure. All external power, inputs and outputs, pass through filters which, together with the metal enclosure, provide an EMI boundary. These features, when combined with grounding and cable separation in accordance with PSEG Nuclear standards and restrictions on welding and portable transceiver use in the main control room area, ensure the OPRM system is protected from the effects of electromagnetic interference.

The OPRM equipment has been qualified for electromagnetic interference (EMI) and radio frequency interference (RFI) susceptibility based on the generic levels identified by the EMI susceptibility guide (EPRI TR-102323 revision 1). The equipment was designed and tested to meet the requirements of MIL-STD-461C. These tests met the frequency limits in EPRI TR-102323, revision 1, Appendix B with the exception of the radiated susceptibility (RS03) test which was conducted over the range from 14 kHz to 1 GHz in accordance with MIL-STD 461C. The range specified in the EMI susceptibility guide is slightly wider (10 kHz to 1 GHz). The difference is considered negligible for the OPRM equipment based on the small magnitude of the difference, the OPRM equipment's construction in a metal enclosure, and the fact that strong sources of magnetic fields are largely absent from the area in which the OPRM is installed.

The following two devices were seismically qualified as documented in Document No. R1581, Seismic Simulation Test for the Oscillation Power Range monitor (OPRM), PN11426-1, -2 and the Digital Isolation Block (DIB), PN 11427- 1, Wyle Laboratories Seismic Simulation Test Report No. 44758-1, Revision A. This test used Required Response Spectra (RRS) which envelope and satisfy the requirements of the base testing reported for other OPRM devices in Document No. 0000-ICE-37700, Rev. 0. The Safe Shutdown Earthquake (SSE) RRS (5% damping) run from 4.5 g (rigid range) to 10g (resonant response range) with the transition at 35 Hz. The Operating Basis Earthquake (OBE) RRS (5% damping) run from 3g (rigid range) to 5g to 5.6g (resonant response range) with a transition at 35 Hz. The devices were tested on the same test-mounting frame as used for the first group of devices noted above. The OPRM module is rack mounted and the DIB is DIN rail mounted.

Four TEC isolators are mounted on Unistrut (two per span) located very low (6" above the base) spanning bays 1 and 5. This device is being dynamically qualified in accordance with a Design Basis Earthquake (DBE) Test Response Spectrum peaking at 9 g at 2% damping. The requirements for this device are not as severe as other devices because of the low and rigid mounting configuration. Seismic data for testing of the TEC isolator is based upon the generic RRS indicated in the Qualification Test Report (Non-OPRM Equipment), Document Number 00000-ICE-37700, Rev.0.

Buchanan Terminal blocks are mounted on Unistrut and located very low (6" above the base) spanning bays 1 and 5. The terminal blocks are generally considered to be seismically insensitive and rugged (See EPRI report TR105849, Generic Seismic Technical Evaluation of Replacement Items for Nuclear Power Plants).

DIN rail and Unistrut mounting is utilized in the power range monitor cabinet (10-C-P608). The panel is 150" wide by 36" deep by 90" high. Each of the five bays is 30" wide. The total panel weight is approximately 4500 lbs. It is anchored to the floor with a minimum tie down of 20 5/8" diameter bolts (or full plug weld for all twenty holes). With the exception of the OPRM module and switch, all devices are mounted on new Unistrut (N3300) or DIN (35/15) rail (or combinations). The longest Unistrut support beam is less than 30" (the width of a single bay). A simply supported beam, conservatively center loaded with 10 pounds (more than any device combination on any beam) will have a strong axis fundamental frequency of 84 Hz and a weak axis fundamental frequency of 44 Hz. This rigidity assures against local amplification of seismic inputs for such internally mounted devices.

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

The Hope Creek OPRM installation and implementation is consistent with the SER. Hope Creek procedures provide administrative control for placing individual OPRM modules in manual bypass. When the OPRM modules are not in manual bypass, the power/flow map to require automatic bypass or activation respectively. The OPRM as installed and implemented automatically enables its pre- trip and trip alarm outputs upon entry into the high power, low core flow region of the power/flow operating map.

6) Confirm that any changes to the plant operator's main control room panel have received human factor reviews per plant-specific procedures.

The Hope Creek OPRM installation and implementation includes activation of the main control room overhead annunciator if the OPRM has been manually bypassed or deliberately rendered inoperative. Keylock access is necessary to manually bypass an OPRM module. Changes to OPRM software require both keylock access and a password. Procedural requirements control placing an OPRM module in bypass and verifying restoration.

The Hope Creek OPRM installation and implementation includes an operator interface via the CRIDS computer, Control Room annunciators that signal system status and/or problems, and the OPRM front panel LEDs. Alarms which are wired to the Annunciator Logic Cabinet and displayed on the Control Room Overhead Annunciator Panel (window boxes) include the TRIP ENABLE, ALARM, TRIP, and BYPASS/INOP/TROUBLE. Human Factor Engineering principles consistent with the HCGS Annunciator System Study have been applied in selecting the annunciator location and groupings. In addition, OPRM modules are provided with local indicators. Local LED indicators provide indication for ALARM, TROUBLE, INOP, TRIP, TRIP ENABLED, and READY. ALARM, TRIP, and TROUBLE LEDs are latched until reset locally.

Other than the plant specific items addressed above, there are no deviations from CENPD-400-P and the associated SER.