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United States Nuclear Regulatory Commission
Document Control Desk
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Perry Nuclear Power Plant
Docket No. 50-440
License Amendment Request Pursuant to 10CFR50.90:
Activation of Thermal-Hydraulic Stability Monitoring Instrumentation

Ladies and Gentlemen:

Nuclear Regulatory Commission review and approval of a license amendment for the Perry Nuclear Power Plant (PNPP) is requested. The amendment implements Technical Specification changes associated with thermal-hydraulic stability monitoring. A new Specification is added, providing requirements for the new Oscillation Power Range Monitor (OPRM) instrumentation. The change will provide the operability requirements for the OPRM channels, the required actions when they become inoperable, and appropriate surveillance requirements. The change also revises Technical Specification 3.4.1, primarily to remove manual monitoring guidance from the Technical Specifications, which will no longer be necessary due to activation of the automatic OPRM instrumentation functions.

As noted in a letter dated December 14, 1998 (PY-CEI/NRR-2344L), the OPRM scram signals are currently scheduled to be activated during the next refueling outage (RFO8). The OPRMs are being tuned during the current fuel cycle based on data obtained during plant power changes. Consideration is being given to obtaining additional data during the shutdown and subsequent startup from RFO8, before activating the new OPRM scram signal. This would change the activation date for the scram signal, but would provide additional tuning data in the most applicable region of the power to flow map, subsequent to implementation of the software being installed to resolve a recent Part 21 issue for the OPRMs.

Attachment 1 provides a Summary, Description of the Proposed Technical Specification Changes, Background/System Description, Safety Analysis, and Environmental Consideration. Attachment 2 provides the Significant Hazards Consideration. Attachment 3 provides the annotated Technical Specification pages reflecting the proposed change. Attachment 4 provides the annotated Table of Contents and Bases pages, for information, since these Sections are not a formal part of the Technical Specifications.

If you have questions or require additional information, please contact Mr. Gregory A. Dunn, Manager - Regulatory Affairs, at (440) 280-5305.

Very truly yours,

John K. Wood

Attachments

cc: NRC Project Manager
NRC Resident Inspector
NRC Region III
State of Ohio

A001

I, John K. Wood, hereby affirm that (1) I am Vice President - Perry, of the FirstEnergy Nuclear Operating Company, (2) I am duly authorized to execute and file this certification as the duly authorized agent for The Cleveland Electric Illuminating Company, Toledo Edison Company, Duquesne Light Company, Ohio Edison Company, and Pennsylvania Power Company, and (3) the statements set forth herein are true and correct to the best of my knowledge, information and belief.

John K. Wood

John K. Wood

Subscribed to and affirmed before me, the 5th day of April, 2000

Jane E Mott

JANE E. MOTT
Notary Public, State of Ohio
My Commission Expires Feb. 20, 2005
(Recorded in Lake County)

SUMMARY

This amendment implements changes to the Perry Nuclear Power Plant (PNPP) Technical Specifications (TS) associated with thermal-hydraulic stability monitoring. A new Specification is added, TS 3.3.1.3, "Oscillation Power Range Monitor (OPRM) Instrumentation". The change provides the minimum operability requirements for the OPRM channels, the Required Actions when they become inoperable, and appropriate surveillance requirements. The OPRMs will provide automatic "detect and suppress" actions to replace the administrative controls currently in effect through operator training and manual actions. The OPRM instrumentation has already been installed at PNPP, and the scram signals from this instrumentation are currently planned to be activated during the next refueling outage (RFO8). Therefore, this change has been scheduled for implementation during RFO8, although the activation schedule may be extended to perform additional tuning of the new OPRM scram signal. The change also removes monitoring guidance from TS 3.4.1 that will no longer be necessary due to the activation of the automatic OPRM instrumentation, and it updates Specification 5.6.5 to require the applicable setpoints for the OPRMs to be included in the Core Operating Limits Report (COLR).

The Safety Analysis section provided below summarizes plant-specific differences from the Nuclear Regulatory Commission (NRC)-approved generic OPRM design, and provides the plant-specific information requested by the NRC Safety Evaluation on CENPD-400-P-A, Rev. 1, "Generic Topical Report for the ABB Option III Oscillation Power Range Monitor", May 1995.

DESCRIPTION OF THE PROPOSED TECHNICAL SPECIFICATION CHANGES

The three Specifications that are being revised are:

Technical Specification 3.3.1.3 "Oscillation Power Range Monitor (OPRM) Instrumentation"

A new Technical Specification (TS) is added for the OPRM instrumentation. This includes the Limiting Condition for Operation (LCO), Applicability, Actions and Surveillance Requirements necessary to define Operability of the OPRM channels, and the actions the plant operators must take when the instruments become inoperable. These controls are consistent with the generic specification provided in Appendix A of CENPD-400-P-A, Rev. 01, "Generic Topical Report for the ABB Option III Oscillation Power Range Monitor", May 1995. Specifically, the LCO, Applicability, Actions, and Surveillance Requirements are identical to the example, except for two items:

1. the description of the enabled region in SR 3.3.1.3.5 is specified as "Thermal Power is > 30% RTP and recirculation drive flow is < the value corresponding to 60% of rated core flow." This minor exception more accurately describes the PNPP-specific enabled region, and is consistent with the analyses in NEDO-32465 entitled "Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications". The description of the flow region is also consistent with the wording adopted by the Hope Creek plant.
2. the 120 day Completion Time for resolving common cause software problems is deleted, based on lessons learned from the current schedule for the 10 CFR Part 21 issue filed by ABB Combustion Engineering Nuclear Power, Inc., on June 29, 1999. The OPRM components are safety related, and therefore 10 CFR 50 Appendix B Section XVI "timeliness of corrective action" controls are adequate to ensure restoration of equipment Operability. Until Operability is restored, the Interim Corrective Actions (see the "Background" section below) must be in place, similar to how plants have been operated for the past 10 years in response to the LaSalle event.

Technical Specification 3.4.1 "Recirculation Loops Operating"

Due to the automatic functions provided by the OPRMs, the manual operator actions specified in TS LCO 3.4.1.a (and its associated Conditions, Actions and Surveillance Requirements) are removed, which were required to be taken upon entry into a specified thermal power/core flow region of the core map.

The removal of these references include elimination of LCO items 3.4.1.a.2 and b.2, as well as SR 3.4.1.2; and replacement of ACTIONS C, D, E, and F with the NUREG-1434 Standard Technical Specification ACTIONS A and B (as PNPP ACTIONS C and D).

The implementation of this OPRM modification permits Specification 3.4.1 to be reformatted to be more consistent with the Standard Technical Specification 3.4.1 provided in NUREG-1434. The proposed PNPP Specification 3.4.1 is modeled after the Standard, and two other precedents; the Specification 3.4.1 approved for the one BWR-6 that has implemented Technical Specifications for a Stability modification (River Bend Station), and the Specification 3.4.1 approved for one BWR that has implemented Technical Specifications for an ABB Option III Stability modification (Susquehanna). The Specification is changed to model the Standard as closely as practicable, with the primary differences from the Standard, the River Bend Specification and the Susquehanna Specification being:

- Two Conditions are retained which are not contained in the Standard but are currently in the existing PNPP Specification 3.4.1. These are:
  1. Condition A, the two (2) hour Required Action to restore the mismatch back to within the specified limits. Retaining this Condition is consistent with the River Bend and Susquehanna approved Specifications, and provides an additional control above that required by the Standard; and
  2. Condition B, the one (1) hour Required Action to reduce thermal power to ≤ 2500 MWt if mismatch cannot be restored. Retaining this Condition is consistent with the River Bend approved Specification, and provides an additional control above that required by the Standard.
- The PNPP Required Action for Condition A is reworded to better reflect the appropriate action to be taken, i.e., it will now require the operator to "declare the recirculation loop with lower flow to be 'not in operation'." This reworded Condition is identical with the requirement implemented at Susquehanna, and is also consistent with the Bases discussion for Condition A of the Standard Technical Specifications.
- The timeframe for implementing appropriate setpoints once the loop has been declared 'not in operation' is revised to be consistent with the River Bend Specification (24 hours). This is also more consistent with Standard Technical Specification 3.4.1, Condition A.

Technical Specification 5.6.5 "Core Operating Limits Report"

Administrative Control Specification 5.6.5 is revised to require that the Core Operating Limits Report (COLR) include the applicable operating limits for the OPRMs, and to specify the Topical Report that is used for determining the setpoint values.

The detailed requirements for these three Specifications are annotated on pages included in Attachment 3 to this letter. [Note: Annotated Bases pages are also provided, in Attachment 4, for information. The Bases are not part of the Technical Specifications, and are not a formal part of this license amendment package. The Bases are revised under the PNPP Bases Control Program (Technical Specification 5.5.11)]

BACKGROUND/SYSTEM DESCRIPTION

While the OPRM instrumentation was being designed, built, installed and tested, PNPP has operated under Interim Corrective Actions (ICAs). These ICAs were most recently defined in letters to the NRC in response to Generic Letter 94-02 "Long-term Solutions and Upgrade of Interim Operating Recommendations for Thermal-Hydraulic Instabilities in Boiling Water Reactors" (PY-CEI/NRR-1855L dated September 9, 1994, and PY-CEI/NRR-2344L dated December 14, 1998). As noted in the letter dated December 14, 1998, the OPRM instruments were installed during the seventh refueling outage (RFO7), and are currently undergoing testing, without being connected to the Reactor Protection System (RPS). The inputs to the RPS are currently scheduled to be activated during RFO8, and the proposed Technical Specification changes are requested to be issued to support implementation prior to restart from the outage. Until the OPRMs are activated, the ICAs continue to be utilized at PNPP. Following activation of the OPRMs, the long-term corrective actions described in previous correspondence regarding Generic Letter 94-02 will be considered to have been met.

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 Oscillation Power Range Monitor (OPRM) System provides compliance with GDC 10 and GDC 12, thereby providing protection from exceeding the fuel minimum critical power ratio (MCPR) Safety Limit. As noted in the Bases for the Reactor Core Safety Limits (TS 2.1.1), the MCPR safety limit (e.g., current cycle two-loop limit is 1.09) is defined with a margin to the conditions that would produce onset of transition boiling (i.e., MCPR=1.00). Essentially, implementation of the OPRM replaces procedure-driven manual operator actions for protecting the MCPR safety limit, with installed instrumentation providing automatic protection of the limit. It is considered that this preserves the current margin of safety.

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 local power range monitor (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. Therefore, only the period based detection algorithm is required for channel OPERABILITY. 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 Neutron Monitoring System (NMS) average power range monitor (APRM) power and flow signals to automatically enable the trip function of the OPRM module in specific areas of the power to flow map.

Each OPRM module is continuously tested by a self-test function. On detection of any OPRM module failure, either a Trouble light or an INOP alarm are activated. Trouble indicates the OPRM module is still functioning but needs attention, while INOP indicates that the OPRM module may not be capable of meeting its functional requirements.

Four channels of the OPRM period based detection algorithm 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.

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 recirculation drive flow < the value corresponding to 60% of rated core flow. The OPRM trip is required to be enabled in this region, and the OPRM must be capable of enabling the trip function as a result of transients that place the core into that power/flow region. 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 instabilities would not be expected to grow large enough to threaten the MCPR Safety Limit. This expectation is due, in part, to the large MCPR margin that exists at low power.

SAFETY ANALYSIS

OPRM Instrumentation Design

The safety and effectiveness 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; August 1996	Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications
NEDO-31960-A; November 1995	BWR Owners' Group Long-Term Stability Solutions Licensing Methodology
NEDO-31960-A, Suppl. 1; November 1995	BWR Owners' Group Long Term Stability Solutions Licensing Methodology (Supplement 1)
CENPD-400-P-A, Rev. 1; May 1995	Generic Topical Report for the ABB Option III Oscillation Power Range Monitor (OPRM)

The first three reports detail the safety analyses performed to support the development of the long-term solutions for the thermo-hydraulic stability issue. The last report describes the design of the monitors selected for use at PNPP. This CENPD-400-P-A, Rev. 1 report details the extensive controls over the development, implementation, and onsite testing of both the OPRM hardware and software, to ensure that significant oscillations will be detected and suppressed with high reliability.

The extensive controls described in the CENPD report help to ensure there will not be a significant increase in the number of plant scrams due to the new RPS trip signals that are being activated. It is possible that these monitors may actually reduce the number of scram transients during the life of the plant. Currently, the ICAs require the operator to scram the plant upon entry into the "Manual Scram Required" portion of the power to flow map (high power, low flow), regardless if core oscillation due to thermal-hydraulic instability is present or not. Thus, under current licensing requirements, transients into this high power, low flow region unnecessarily scram the reactor when no oscillation is present. Upon implementation of the OPRM trip, the reactor will only scram in this high power, low flow region if a reactor core oscillation that has sufficient magnitude to threaten the MCPR limit occurs. Thus, the expected frequency of scram transients is reduced when entry is made into this high power, low flow region of the power to flow map.

The ICAs also have a region entitled "Immediate Exit". At PNPP, due to a commitment made in a letter dated September 9, 1994 (PY-CEI/NRR-1855L), this region is actually larger than required by the generic ICAs recommended by the BWR Owners' Group in 1994. At PNPP, the Owners' Group "Controlled Entry" Region was treated as part of the "Immediate Exit" region. The low power end of this region restricts reactor startups and shutdowns. Upon implementation of the OPRM trip, this region could be entered, without requiring immediate exit. However, the likelihood of a scram occurring as a result of the implementation of the OPRM trip in this region is considered to be very low. Also, during the functional test on the OPRMs (184 day frequency), brief periods will exist where a "half-scram" will be generated due to cycling of the OPRM relays that input to the RPS. However, plant conditions are controlled during such testing such that it is extremely unlikely that the logic for a full scram would be completed during the testing process.

Extensive testing of the OPRM algorithms was conducted with operating plant data to demonstrate the sophistication of the algorithm to discriminate signals and assure detection of a stability-related neutron flux oscillation, while maintaining sufficient margin against false signals from other expected plant evolutions. This feature, coupled with the reliability of the design, minimizes the risk of inadvertent scrams. Therefore, balancing the above considerations, the likelihood of plant scrams over the life of the plant is considered to be equal to the current mode of operation under the ICAs.

In the NRC letter accepting CENPD-400-P, Rev. 1, the NRC staff provided their detailed review of the OPRM design. Due to the completion of this detailed review, it was noted that "the staff does not intend to repeat its review of the matters found acceptable in CENPD-400-P when the report is referenced in license-specific applications, except to ensure that the plant-specific issues identified in the enclosed SER have been properly addressed. When submitting plant specific license amendments, licensees should identify and justify any deviations from CENPD-400-P and the associated SER." The information requested by the NRC consists of:

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

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

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

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

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

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

The conclusion of the NRC SER was that "the ABB-CE digital OPRM system functions and design meet the requirements of IEEE Std 279-1971, and 10 CFR 50, Appendix B for digital reactor protection system design. Furthermore, the OPRM system functions meet the requirements of GDC-12, and hence, acceptably address the related requirements of GDC-10 for ensuring reactor safety in the event of power instabilities. The OPRM software development methodology is consistent with the guidance provided in Regulatory Guide (RG) 1.152, which endorses IEEE Std 7-4.3.2-1993 for ensuring software quality. The staff further concludes that the proposed OPRM technical specifications will ensure appropriate system operability. The staff, therefore, finds the ABB-CE OPRM design, as described in CENPD-400-P, to be acceptable with the above plant-specific actions incorporated.".

Therefore, each of these plant-specific actions is addressed below.

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

Response: PNPP has reviewed the specific plant design against the Generic Topical Report CENPD-400-P-A and confirmed that the document describes the plant specific design for the items appearing in CENPD-400-P-A with the following exceptions:

- Several functions described in CENPD-400-P-A were determined to be not necessary at PNPP. None of these items adversely impact the safety related functions of the OPRM:
  a) The "Manual Enable" function (used to force enabling of the detect-suppress function)
  b) The Trouble annunciator output of the OPRM (however, the INOP alarm and Trouble light on the OPRM modules are used)
  c) The plant computer interface
- The low end of the generic OPRM qualified humidity range is 40% relative humidity (RH). The PNPP "Mild environment" equipment qualification range, which applies to the Control Room where the modules are installed, extends to 20% RH. The vendor (ABB Combustion Engineering) in letter TIC-97-632, dated Sept 16, 1997, states that operation at humidity levels lower than 40% (down to 10%) are justified. The letter notes that the primary concern at low humidity conditions is the chance for damage from electro-static discharge (ESD). The OPRM equipment has been tested for ESD. Also, for added protection, all the circuit cards were coated. This isolates the electronic components from direct contact with a low humidity environment. Thus, the OPRM equipment will continue

to operate properly at 10% RH, which bounds the 20% RH mild environment conditions at PNPP.

Several other items which are not actually different than the design descriptions in the topical report, but which could be considered plant-specific since they describe the plant-specific installation of the monitors, are provided later in this attachment.

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

Response: NEDO-32465 and NEDO-31960 were reviewed to determine their applicability:

NEDO-32465-A

NEDO-32465-A is considered to be applicable to PNPP.

NEDO-31960-A

NEDO-31960-A and Supplement 1 are considered to be applicable to PNPP, as discussed further below. In the NRC staff SER for NEDO-31960 and Supplement 1, it was requested that several items be addressed:

(i) "All three algorithms described in NEDO-31960 and Supplement 1 should be used in Option III or III-A. These three algorithms are high LPRM oscillation amplitude, high-low detection algorithm, and period-based algorithm."

Response: All three algorithms are included in the Option III design. Automatic protection is actuated if any of the three algorithms meet their trip conditions. Only the period based algorithm, however, is used to demonstrate protection of the MCPR Safety Limit for anticipated reactor instabilities. The other two algorithms are included as defense-in-depth features. Only the period-based algorithm is required for Technical Specification Operability of the OPRM instrumentation.

(ii) "The validity of the scram setpoints selected should be demonstrated by analysis. These analyses may be performed for a generic representative plant when applicable, but should include an uncertainty treatment that accounts for the number of failed sensors permitted by the Technical Specifications of the plant's applicant."

Response: For the period based algorithm, the methodology as described in NEDO-32465-A was followed. The analysis consisted of three parts:

a) The generic analysis contained within NEDO-32465-A, which produced the DIVOM curves discussed in Section 4.4.4 of NEDO-32465-A.
b) The plant specific analysis which produced the Hot Bundle Oscillation Magnitude for PNPP (ref. GENE A13-00381-14, "Licensing Basis Hot Bundle Oscillation Magnitude for Perry").
c) The cycle specific analysis which developed the cycle specific OPRM Setpoint versus Operating Limit MCPR relationship (Note: this analysis is contained in the

cycle specific PNPP Supplemental Reload Licensing Report, and reported in the PNPP Core Operating Limits Report).

Option III algorithms are generically specified based on engineering judgement to provide a level of defense-in-depth. The setpoints are selected to assure that a trip will occur for a reactor instability.

The analysis contained within NEDO-32465-A considered the effects of instruments out of service. The analysis demonstrated it was more conservative to assume all LPRMs were OPERABLE because as LPRMs fail, the OPRMs become more responsive and provide better protection. The analysis also assumed the failure of the most responsive OPRM and random failures of APRM channels. This failure analysis showed that random failures had little effect on the hot bundle oscillation magnitude.

(iii) **"Implementation of Option III or III-A will require that the selected bypass region outside of which the detect and suppress action is deactivated be defined in the Technical Specifications."**

Response: This region is included in Surveillance Requirement 3.3.1.3.5 (see Attachment 3). The exclusion region methodology (safety analyses contained in NEDO-31960) would define a curved region on the power to flow operating map cutting across the corner of the map near the intersection of the natural circulation line and the highest flow control line. The proximity of the line to the corner would depend upon plant-specific stability characteristics. To ease implementation of the solution in the Perry design, conservative, squared off boundaries at <60% rated core flow and >30% rated power will be used. This is consistent with the boundaries discussed in NEDO-32465, Section 2.2 "Licensing Compliance", which states "the trip function will be enabled when both the power level is greater than 30% of rated and the core flow is less than 60%." Also, since the actual flow input to the OPRMs is taken from the recirculation pump drive flow instrumentation, the "flow" wording used in SR 3.3.1.3.5 is "recirculation drive flow is < the value corresponding to 60% of rated core flow."

(iv) **"If the algorithms detect oscillations, an automatic protective action should be initiated. This action may be a full scram or an SRI. If an SRI is implemented with Option III or III-A, a backup full scram must take effect if the oscillations do not disappear in a reasonable period of time or if they reappear before control rod positions and operating conditions have been adjusted in accordance with appropriate procedural requirements to permit reset of the SRI protective action."**

Response: The automatic protective action of the OPRMs at PNPP (when they are fully activated) will be a full reactor scram, rather than a select rod insert (SRI).

(v) **"The LPRM groupings defined in NEDO-31960 to provide input to the Option III or III-A algorithms are acceptable for the intended oscillation detection function. These LPRM groupings are the oscillation power range monitor for Option III or the octant-based arrangements for Option III-A. The requirements for a minimum OPERABLE number of LPRM detectors set forth in NEDO-31960 are acceptable."**

Response: As described in NEDO-31960, NEDO-32465-A, and specified in the PNPP Licensing Basis Hot Bundle Oscillation Magnitude analysis, the "Four LPRMs per OPRM Cell - 4BL" configuration is used at PNPP.

(vi) Page 10 of the NRC SE states that "the recirculation drive flow channel should comply with the requirements of IEEE-279...". The SE also says that the plant-specific submittal should include the specification documentation for the isolation devices.

Response: The PNPP recirculation drive flow sub-system for the APRMs is designed and installed to Class 1E standards and resides in the Neutron Monitoring System cabinets. No isolation is required between the recirculation drive flow and APRM circuitry. Therefore, this item is not applicable at PNPP.

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

Response: The PNPP-specific Technical Specification for the OPRM function is contained in Attachment 3 to this letter. New Specification 3.3.1.3 is consistent with CENPD-400-P, Appendix A. Specific differences are described elsewhere in this submittal.

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

Response: The OPRM System components are mounted in Control Room cabinets, which are located in a Mild environmental zone. The OPRM components are qualified in accordance with IEEE 323-1974, which is part of the PNPP licensing basis.

Temperature/Heat Loading: The net change in the Control Room heat load has not increased as a result of this modification. The additional power requirement for the OPRM hardware was offset by the replacement of two power supplies with more efficient supplies. The heat generated in the Neutron Monitoring System cabinets housing the OPRM system is less than or equal to the previous cabinet heat load.

Humidity: See discussion on humidity above.

Radiation: The OPRM is designed to operate and meet its performance requirements after a total integrated Co-60 gamma dose of less than $1X10^4$ RAD. The plant specific total integrated dose condition at the OPRM installation location of $1.8X10^2$ RAD is less than the tested configuration. Therefore, the OPRM is acceptable for use at PNPP.

ElectroMagnetic Interference (EMI): EMI testing of the OPRM equipment was performed to ensure it would not be adversely affected by the plant EMI environment (susceptibility), and to ensure the OPRMs would not be detrimental to the existing plant EMI environment (emissions). These tests were performed per the standards listed in the Electric Power Research Institute (EPRI) document TR 102323 "Guidelines for Electromagnetic Interference (EMI) Testing in Power Plants". The OPRM modules were tested to CE01, CE03, CE07, RE02, CS01, CS02, CS06, RS02, and RS03 of Mil Std-461C and 462 for radiated and conducted susceptibility.

In addition, the OPRM modules are designed and tested to meet the electrostatic discharge and surge withstand capability requirements of IEC 801-2 and IEC 801-4 respectively. The electromagnetic environment at PNPP was confirmed to be similar to that identified in EPRI TR 102323. New equipment qualified for use at PNPP must be capable of withstanding the EMI levels identified in the EPRI standard. The EMI Report was reviewed to ensure that the guidelines of EPRI TR 102323 were met. Assurance that there is no EMI impact on the existing plant equipment is provided by appropriate design standards stated in CENPD-400-P-A. Design and testing the OPRM to these standards ensures compliance with EPRI TR 102323 guidelines. The PNPP design evaluation verified the plant's environment would not be adversely affected by the addition of the OPRM equipment. Therefore, the OPRM equipment is acceptable for use at PNPP.

To minimize the potential for impacting plant equipment due to electromagnetic emissions during use of the OPRM Maintenance Terminal (MT), procedural controls are in place. The procedural controls prohibit the Maintenance Terminal from sharing a power source with vital equipment. They also require the use of power surge protection and prohibit the placement of the MT at opened APRM cabinet doors. This is in accordance with recommendations documented in an EMI report specific to the MT, developed by the BWR Owners Group (BWROGTYF-97-017 entitled "OPRM Maintenance Terminal Electromagnetic Emission Investigation", dated April 10, 1997), and plant design documentation.

Seismic Interaction/Qualification: A design review was performed to verify the existing qualification of safety related devices and components which remain in the modified panels are not affected by the addition of the OPRM system. The modified panels were found to remain seismically qualified after the new installation. The modification does not create any seismic clearance/falldown concerns since the changes are inside or on the face of the panels. There is no impact on the floor anchorage or floor loading. The OPRM hardware is seismically tested in accordance with IEEE 344-1987. PNPP is committed to test to IEEE 344-1975 for replacement or installation of new equipment. The seismic report was reviewed for compliance against this 1975 guidance, and was found to be acceptable.

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

Response: Each OPRM module bypass is independent of all others. The module bypass is controlled via a local key locked switch. A common BYPASS annunciator exists at the control room operator's main console to notify the operator that an OPRM has been placed in bypass. Access to the OPRM functions are controlled via the Operate / Test keylock switch on the front of the module. Both Bypass and Function keylock switches are under Operations control and administratively controlled per Operations Administrative Procedures. These controls comply with Updated Safety Analysis Report (USAR) Section 7.2.2.2.a.14 entitled "Access to Means for Bypassing (IEEE Standard 279, Paragraph 4.14)", which states:

> "Access to means of bypassing any safety action or function for the RPS is under the administrative control of the control room operator. The operator is alerted to bypasses as described in Section 7.1.2.4.g (Regulatory Guide 1.47).
>
> Control switches which allow system bypasses are keylocked. All keylock switches in the control room are designed such that their key can only be removed when the

switch is in the safe position. All keys will normally be removed from their respective switches during operation and maintained under the control of the shift supervisor."

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

Response: This modification was reviewed by the PNPP Human Factors Group to ensure Human Factors considerations were part of the design. The modification was found not to violate Human Factors commitments as described in the USAR, and that it incorporates adequate Human Factors principles consistent with the PNPP Human Factors Standards for annunciators and controls.

In addition to the above items specified in the NRC Safety Evaluation for CENPD-400-P-A, the following areas which address the PNPP-specific installation were evaluated, and found to be acceptable and within the current PNPP design criteria:

- The OPRM installation will not cause a change to the existing analog APRM design or trip philosophy.
- Signal buffering between the LPRMs and the associated OPRM is not practical due to existing system design and EMI concerns. Therefore, certain electrical faults affecting the OPRM module may also affect the input LPRMs. However, the existing APRM single failure tolerant design assures that the APRM protective function is not affected by a worst case OPRM failure.
- The existing Neutron Monitoring System LPRM and APRM circuits have been analyzed to show there is no adverse impact due to the additional electrical load from the OPRMs.
- The existing Reactor Recirculation Drive Flow cards have been analyzed to show there is no adverse impact due to the additional electrical load from the OPRMs.
- Online testing of the LPRMs will not require bypassing of the OPRMs.
- The new bulk power supplies have been designed and tested to standards IEEE-344, Regulatory Guide 1.29, Regulatory Guide 1.89, and Regulatory Guide 1.100.
- The OPRM system addition does not impact the existing power feed to the Neutron Monitoring System, and the new power supplies are capable of handling the existing electrical load and the added OPRM load.
- The instrument power source description in the generic topical report does not specifically address the instrument power source for the Neutron Monitoring System and the OPRM; therefore the following is provided:

  Existing power sources are used for the OPRM in the same manner that their associated APRM/SRM/IRM inputs are powered. The existing DC power supplies (PS23 and PS24) in each of the Neutron Monitoring Cabinets were replaced by the new ABB bulk power supplies (two per cabinet) to accommodate the power requirements of the OPRM/APRM/IRM/SRM systems. The old power supply, PS23, provided a single source of power to the existing APRM equipment. The new bulk power supply that replaced PS23 provides redundant power to the existing APRM equipment, plus provides power to one of the two OPRM modules in each cabinet. The other old power supply, PS24, provided a single source of power to the existing equipment in the SRM/IRM systems. The new bulk power supply that replaced PS24 provides redundant power to the existing SRM/IRM systems, plus provides power to the second of the two OPRM modules in each cabinet.

  Therefore, four of the OPRM modules (one in each channel) use the same divisional power supply as the APRM with which they are associated. The remaining OPRM module in each channel uses the same divisional power supply as the SRM/IRM that is in the same channel. Consequently, electrical faults affecting the OPRM would only affect the same division, causing loss of no more than one APRM or SRM/IRM channel. Thus, the protection function of the APRM or SRM/IRM is not lost since there is sufficient redundancy and independence of the channels. The overall conclusions of the single failure analyses provided in CENPD-400-P-A remain valid.

- The interface between the OPRM and the non-1E annunciator equipment is through qualified optical isolation in accordance with IEEE 1.75, 323-1974, and 344-1975.
- The wiring for the non-1E portions of the equipment is maintained separate from 1E wiring within the panels.

Upon implementation of the OPRM design change, the normal PNPP process for design change package implementation will be followed, including:

- Alarm Response and Off-Normal Instruction updates.
- Operator training.
- A USAR change will be submitted for processing, reflecting implementation of the OPRM trip.
- Operational Requirements Manual changes to be compatible with the new TS requirements.

Revised Technical Specifications

As noted above, the new Specification 3.3.1.3 "OPRM Instrumentation" is consistent with the example provided in CENPD-400-P, Appendix A. Specifically, the LCO, APPLICABILITY, ACTIONS, and SURVEILLANCE REQUIREMENTS are identical to the example, except the description of the enabled region in SR 3.3.1.3.5 is specified as "Thermal Power is > 30% RTP and recirculation drive flow is < the value corresponding to 60% of rated core flow." This region was revised to match the underlying safety analysis, as described in item 2(iii) above.

The other change is to delete the 120 day Completion Time for REQUIRED ACTION B.2. CONDITION B addresses situations when OPRM trip capability is not maintained. The most likely reason for such a situation would be a common cause software error in all four channels of the OPRM. As stated by the NRC staff in the SER for CENPD-400-P, a significant period of time would be necessary in order "to arrange a contract with the OPRM software developer, determine the cause of the potential software defect, repair the defect, test the software modification, and implement the software upgrade in the plant." An actual test case for this scenario is currently ongoing, due to the 10 CFR Part 21 report filed by ABB on June 29, 1999. The current estimate is that this issue will require at least 10 months from identification of the problem until the software upgrade will be ready for implementation. Per Condition B in the CENPD-400, in the interim period until the software is upgraded, the plant is required by Required Action B.1 to be operated under the ICAs, similar to how the plant is operated today. Various versions of the ICAs have been successfully implemented for the past ten years throughout the industry. Operation under the ICAs beyond 120 days does not create a safety concern. The ICAs provide adequate plant safety, and the problem leading to entry into Condition B will be required to be corrected in a timely fashion by the 10 CFR 50 Appendix B Criterion XVI "Corrective Action" requirement. This requires that problems "are promptly identified and corrected". Also, management attention will continue to be focused on restoring OPRM operability, since the plant will be operating in an "Active LCO" (while in Condition B). This proposed change to the Condition B from CENPD-400-P-A will avoid unnecessary plant shutdowns or processing of unnecessary Technical Specification changes, while maintaining plant safety.

Therefore, the proposed Specification 3.3.1.3 conforms to the NRC approved example specification in CENPD-400-P-A, with the only differences being justified above.

As also noted above, the changes to Specification 3.4.1, "Recirculation Loops Operating", are provided to conform this Specification more closely to the Standard Technical Specification 3.4.1 provided in NUREG-1434, and two other precedents from River Bend Station and Susquehanna. The proposed changes primarily eliminate unnecessary requirements associated with the previous manual, administrative techniques for monitoring and responding to instability events.

Also, the proposed Required Action A.1 to declare a loop "not in operation" if a mismatch develops greater than assumed in the Loss of Coolant Accident (LOCA) analysis input assumptions, versus the current requirement to 'Shut down one of the recirculation loops', provides a more appropriate action. The current PNPP Required Action A.1 appears to require that a loop be shut down. However, in the NUREG-1434 Standard Technical Specification Bases for Required Action A.1, it is stated that "This Required Action does not require tripping the recirculation pump in the lowest flow loop when the mismatch between total jet pump flows of the two loops is greater than the required limits." Instead of requiring the pump to be tripped, the proposed action essentially requires that the plant be declared to "be in single loop operation (SLO)". This proposed action is consistent with the existing Susquehanna Required Action. This SLO declaration would activate resources to ensure the SLO limits and setpoints can be implemented in a timely fashion. As discussed in the Summary section above, the Condition B Required Action to reduce thermal power to ≤ 2500 MWt (the single loop analysis value) within the next hour if matched flows cannot be restored, is being retained unchanged, and therefore power would be reduced to ≤ 2500MWt promptly.

The PNPP accidents and transients were examined to determine whether this proposed action of declaring a loop to be "not in operation" is appropriate to apply to PNPP. The loop mismatch requirements are in the Technical Specifications to preserve the initial conditions for the LOCA analysis. As described in the "Applicable Safety Analyses" section of the Bases for Specification 3.4.1, and in USAR Section 6.3.3.7.2, postulated LOCAs are better mitigated by continued core flow from a loop that is operating, versus one that has been purposely shut down. The current action to "Shut down one of the recirculation loops" is undesirable in most mismatch occurrences, because the LOCA is assumed to occur in the loop with higher flow, and if the other (intact) loop has flow, it provides core cooling during the first few seconds of the accident as the pump coasts down relatively slowly.

Additional core flow from an operating loop is also acceptable for transient events. As noted in USAR Appendix 15F "PNPP Single Loop Operation Analysis", Section 15F.3.1 "Abnormal Operating Transients", the consequences of abnormal operational transients from one-loop operation at the reduced power level will be considerably less severe than those analyzed for two-loop operation. Specifically, the pressurization, flow decrease and cold water injection transient results presented in Chapter 15 of the USAR for two-loop operation bound both thermal and overpressure consequences of one-loop operation at the reduced power level. Therefore, if single loop is "declared", but the loop is maintained running, and power is reduced to 2500MWt, the two-loop full power analyses remain bounding. Also, the flow increase transients for two-loop operation remain bounding. USAR Appendix 15F also examines other events such as Rod Withdrawal Error. The analysis for this event covered both rated and off-rated conditions. The USAR discussion notes that if one of the loops is actually inactive, the APRM settings need to be adjusted to their single loop limits because there might be backflow through the inactive jet pumps. This backflow would result in less accurate flow input to the APRM rod block and scram settings. However, if the other loop is not shut down when single loop is "declared", the backflow will not occur, and resetting of the APRM limits to their single loop values is a conservative action.

The PNPP Operational Requirements Manual (ORM) contains a single loop operation flow limit of 48,500 gpm, which is being retained. This was relocated to the ORM as part of Amendment 69, since the flow rate is an operational (versus analysis) issue, to minimize reactor vessel internals vibration when only one loop is running, to within acceptable limits. Since this is a per loop limit, and not a total core flow limit, the vessel internals vibration will not be adversely impacted by maintaining the second loop operating when single loop operation is "declared", and this change can be reflected into the ORM using the normal PNPP procedure change process. Finally, USAR Appendix 15F also addresses an Anticipated Transient Without Scram (ATWS) event, noting it is also bounded by the two-loop full power operation event.

The other proposed changes to TS 3.4.1 are consistent with the controls established in the Standard Technical Specifications and the River Bend specifications, and provide appropriate actions (new Conditions C and D) for implementing SLO limits and setpoints if matched flows cannot be restored. The proposed Bases provide further detail on these new Conditions.

The changes to Administrative Control Specification 5.6.5 simply require that the Core Operating Limits Report (COLR) include the applicable operating limits for the OPRMs, and specify the Topical Report that is used for determining the operating limit values.

Therefore, the proposed Technical Specification changes have been determined to be applicable to PNPP, and do not adversely affect plant safety or the health and safety of the public.

Conclusion of the Safety Analysis

The implementation of the OPRM instrumentation will maintain the margin of safety associated with the MCPR safety limit for instability events, without relying on operator action. The system is designed and installed in a manner that does not degrade the APRM, LPRM or RPS systems. The new automatic features provide equivalent or better protection than the current interim corrective actions. The Specification changes provide appropriate controls over plant operation with the new instrumentation installed.

ENVIRONMENTAL CONSIDERATION

The proposed Technical Specification change request was evaluated against the criteria of 10CFR51.22 for environmental considerations. The proposed change does not significantly increase individual or cumulative occupational radiation exposures, does not significantly change the types or significantly increase the amounts of effluents that may be released off-site and, as discussed in Attachment 2, does not involve a significant hazards consideration. Based on the foregoing, it has been concluded that the proposed Technical Specification change meets the criteria given in 10CFR51.22(c)(9) for categorical exclusion from the requirement for an Environmental Impact Statement.

REGULATORY COMMITMENTS

Upon implementation of the OPRM design change, the normal PNPP process for design change package implementation will be followed, including:

- Alarm Response and Off-Normal Instruction updates.
- Operator training.
- A USAR change will be submitted for processing, reflecting implementation of the OPRM trip.
- Operational Requirements Manual changes to be compatible with the new TS requirements.

Significant Hazards Consideration

The standards used to arrive at a determination that a request for amendment does not involve a significant hazard are included in Commission regulation 10CFR50.92, which states that operation of the facility in accordance with the proposed changes would not:
1) involve a significant increase in the probability or consequences of an accident previously evaluated; or
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 has been reviewed with respect to these three factors and it has been determined that the proposed change does not involve a significant hazard because:

1. The proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

   The proposed change specifies limiting conditions for operation, required actions and surveillance requirements for the Oscillation Power Range Monitor (OPRM) system, and allows operation in regions of the power to flow map currently restricted by the requirements of Interim Corrective Actions (ICAs) and certain limiting conditions of operation of Technical Specification (TS) 3.4.1. 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 thermal-hydraulic (T-H) oscillations that may develop into a T-H instability event. A T-H instability event has the potential to challenge the Minimum Critical Power (MCPR) safety limit. The OPRM system can automatically detect and suppress conditions necessary for T-H instability. With the activation of the OPRM System, the restrictions of the ICAs and TS 3.4.1 will no longer be required.

   The probability of a T-H instability event is impacted by power to flow conditions during operation inside specific regions of the power to flow map, in combination with power shape and inlet enthalpy conditions, such that only under such conditions can the occurrence of an instability event be postulated to occur. Operation in these regions may increase the probability that operation with conditions necessary for a T-H instability can occur. However, when the OPRM is OPERABLE with operating limits as specified in the Core Operating Limits Report (COLR), the OPRM can automatically detect the onset of significant local power oscillations and generate a trip signal. Actuation of a Reactor Protection System (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 one or more of the OPRM channels is not maintained, the proposed change includes Required Actions which limit the period of time before the affected OPRM channel (or RPS system) must be placed in the tripped condition. If these actions would result in a trip function such as a scram, or if the OPRM trip capability is not maintained, an alternate method to detect and suppress thermal hydraulic oscillations is required, i.e., the same ICAs as are in place today. In either case the duration of the period of time allowed by the Required Actions is limited, and the probability of a T-H instability event during this limited time is not significantly increased.

   Several changes to TS 3.4.1 are made which are more consistent with, or conservative with, respect to the reviewed and approved Standard Technical Specifications for Boiling Water Reactors. These generic changes are considered applicable to the Perry Nuclear Power

Significant Hazards Consideration

Plant. They simply provide guidance on the operator actions to be taken and the associated time limits when the Specification is entered, and do not impact the probability of occurrence of an accident. For the above reasons, 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 will become available as a result of the proposed change and have the potential to reduce the consequences of anticipated and postulated T-H instability events. The OPRM installation has been evaluated to not adversely impact other installed equipment such as the Average Power Range Monitors (APRMs) or the RPS in a manner that could prevent response to various postulated events, so those events will not have increased consequences due to the OPRMs. Therefore, the proposed change does not significantly increase the consequences of an accident previously evaluated.

Therefore, the proposed change, which specifies limiting conditions for operation, required actions and surveillance requirements for the OPRM system, and allows operation in certain regions of the power to flow map, does not significantly increase either the probability or consequences of an accident previously evaluated.

2. The proposed change would not create the possibility of a new or different kind of accident from any accident previously evaluated.

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 to 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 new equipment malfunctions due to software errors are not 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, and within the range for which postulated 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 changes to TS 3.4.1 to be more consistent, or conservative, with respect to the reviewed and approved Standard Technical Specifications, simply provide guidance on the operator actions to be taken and the associated time limits when the

Significant Hazards Consideration

Specification is entered, and also do not create the possibility of a new or different kind of accident from any accident previously evaluated.

Therefore, the proposed change, which specifies limiting conditions for operation, required actions and surveillance requirements of the OPRM system, and allows operation in certain regions of the power to flow map, does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. The proposed change will not involve a significant reduction in the margin of safety.

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 to 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 reducing the burden on the control room operators. Therefore, operation with the OPRM system does not involve a significant reduction in a margin of safety. In the event an OPRM channel becomes inoperable, 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. If these actions would result in a trip function such as a scram (or if the OPRM trip capability is not maintained), the alternate method to detect and suppress thermal hydraulic oscillations (the current ICAs) is required to be put in place. The duration of the period of time allowed by the Required Actions is limited, and the probability of a significant T-H instability event during this limited time is not significantly increased.

Operation in regions currently restricted by the requirements of ICAs and Technical Specification 3.4.1 is within the nominal operating domain and ranges of plant systems and components, and within the range assumed for 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 the margin of safety. The changes to TS 3.4.1 to be more consistent, or conservative, with respect to the reviewed and approved Standard Technical Specifications, simply provide guidance on the operator actions to be taken and the associated time limits when the Specification is entered, and also do not significantly reduce the margin of safety.

Therefore, the proposed change, which specifies limiting conditions for operation, required actions and surveillance requirements of the OPRM system, and allows operation in certain regions of the power to flow map, does not involve a significant reduction in a margin of safety.

Based on the above considerations, it is concluded that a significant hazard would not be introduced as a result of this proposed change. Also, since NRC approval of this change must be obtained prior to implementation, no unreviewed safety question can exist.

3.3 INSTRUMENTATION

3.3.1.3 Oscillation Power Range Monitor (OPRM) Instrumentation

LCO 3.3.1.3 Four channels of the OPRM Period Based Algorithm instrumentation shall be OPERABLE.

APPLICABILITY: THERMAL POWER ≥ 25% RTP

New LCO

ACTIONS

---------------------------------NOTES---------------------------------
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. OR A.2 Place associated RPS trip system in trip. OR A.3 Initiate alternate method to detect and suppress thermal hydraulic instability oscillations.	30 days 30 days 30 days
B. OPRM trip capability not maintained.	B.1 Initiate alternate method to detect and suppress thermal hydraulic instability oscillations.	12 hours
C. Required Action and associated Completion Time not met.	C.1 Reduce THERMAL POWER 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 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/T average core exposure
SR 3.3.1.3.3	-----------------NOTE----------------- Neutron detectors are excluded. -------------------------------------- Perform CHANNEL CALIBRATION.	24 months
SR 3.3.1.3.4	Perform LOGIC SYSTEM FUNCTIONAL TEST.	24 months
SR 3.3.1.3.5	Verify OPRM is not bypassed when THERMAL POWER is > 30% RTP and recirculation drive flow is < the value corresponding to 60% of rated core flow.	24 months
SR 3.3.1.3.6	-----------------NOTE----------------- Neutron detectors are excluded. -------------------------------------- Verify the RPS RESPONSE TIME is within limits.	24 months on a STAGGERED TEST BASIS

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.1 Recirculation Loops Operating

LCO 3.4.1 Either:

a. Two recirculation loops shall be in operation ~~with:~~ with matched flows;

1. ~~Matched flows; and~~
2. ~~Total core flow and THERMAL POWER within limits.~~

OR

b. One recirculation loop shall be in operation with:

1. Thermal power ≤ 2500 MWt;
2. ~~Total core flow and THERMAL POWER within limits;~~ LCO 3.2.1 "AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR)" limits modified for single recirculation loop operation as specified in the COLR; and
3. ~~Required limits modified for single recirculation loop operation as specified in the COLR; and~~ LCO 3.2.2 "Minimum Critical Power Ratio (MCPR)" limits modified for single recirculation loop operation as specified in the COLR; and
4. 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 reset for single loop operation.

~~-----NOTE-----~~
~~Required limit and setpoint modifications 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. Recirculation loop jet pump flow mismatch not within limits.	A.1 ~~Shut down one of the recirculation loops.~~ Declare the recirculation loop with lower flow to be "not in operation".	2 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. Thermal power > 2500 MWt during single recirculation loop operation.	B.1 Reduce thermal power to ≤ 2500 MWt.	1 hour
C. ~~Total core flow as a function of THERMAL POWER within Region I of Figure 3.4.1-1.~~ Requirements b.2, b.3 or b.4 of the LCO not met.	C.1 ~~Determine APRM and LPRM neutron flux noise levels.~~ Satisfy the requirements of the LCO.	~~Once per 8 hours~~ ~~AND~~ ~~30 minutes after an increase of ≥ 5% RTP~~ 24 hours
~~D. Total core flow as a function of THERMAL POWER within Region I of Figure 3.4.1-1.~~ ~~AND~~ ~~APRM or LPRM neutron flux noise levels > 3 times established baseline noise levels.~~	~~D.1 Restore APRM and LPRM neutron flux noise level to ≤ 3 times established baseline level.~~	~~2 hours~~
~~E.~~ D. Required Action and associated Completion Time of Condition A, B, or C not met. OR No recirculation loops in operation.	~~E.1~~ D.1 ~~Reduce THERMAL POWER to be within Region II of Figure 3.4.1-1.~~ Be in MODE 3. ~~AND~~ ~~E.2 Be in MODE 2.~~ ~~AND~~ ~~E.3~~	12 hours ~~6 hours~~ ~~12 hours~~

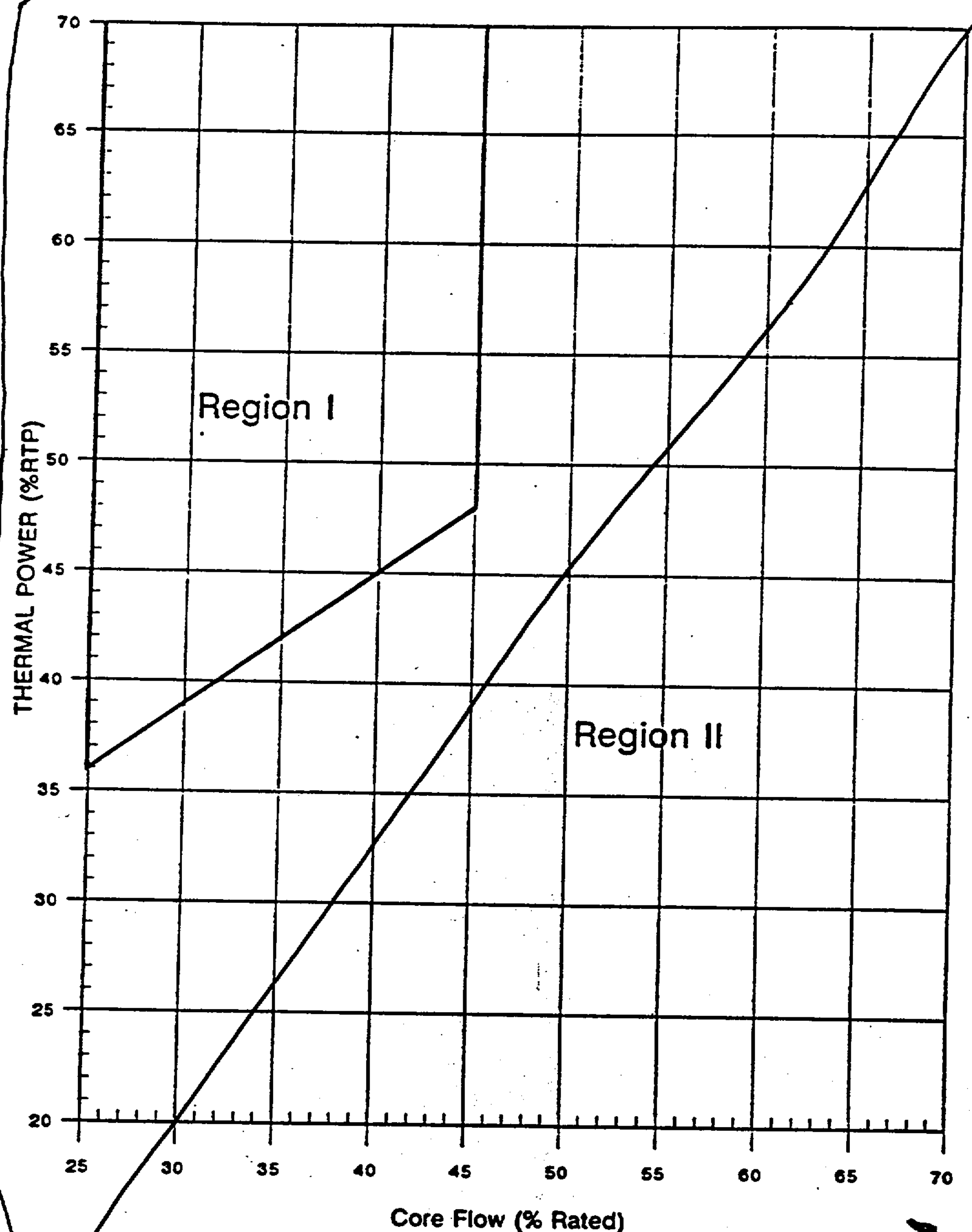
(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION		COMPLETION TIME
F. One or more required limit or setpoint modifications not performed.	F.1	Declare associated limit(s) not met.	Immediately
	OR		
	F.2	Declare associated equipment inoperable.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.4.1.1	-------------------NOTE------------------- Not required to be performed until 24 hours after both recirculation loops are in operation. -- Verify recirculation loop jet pump flow mismatch with both recirculation loops in operation is: a. ≤ 10% of rated core flow when operating at < 70% of rated core flow; and b. ≤ 5% of rated core flow when operating at ≥ 70% of rated core flow.	24 hours
SR 3.4.1.2	Verify: a. Total core flow ≥ 45% rated core flow; or b. THERMAL POWER and total core flow within Region II of Figure 3.4.1-1.	24 hours



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THERMAL POWER versus Core Flow
Figure 3.4.1-1

5.6.2 Annual Radiological Environmental Operating Report (continued)

results of these analyses and measurements in the format of the table in the Radiological Assessment Branch Technical Position, Revision 1, November 1979. In the event that some individual results are not available for inclusion with the report, the report shall be submitted noting and explaining the reasons for the missing results. The missing data shall be submitted in a supplementary report as soon as possible.

5.6.3 Radioactive Effluent Release Report

The Radioactive Effluent Release Report covering the operation of the unit during the previous calendar year shall be submitted by May 1 of each year. The report shall include a summary of the quantities of radioactive liquid and gaseous effluents and solid waste released from the unit. The material provided shall be consistent with the objectives outlined in the ODCM and process control program and in conformance with 10 CFR 50.36a and 10 CFR 50, Appendix I, Section IV.B.1.

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. LCO 3.2.1, Average Planar Linear Heat Generation Rate (APLHGR),

2. LCO 3.2.2, Minimum Critical Power Ratio (MCPR),

3. LCO 3.2.3, Linear Heat Generation Rate (LHGR), ~~and~~ 2

(continued)

5.6 Reporting Requirements

5.6.5 Core Operating Limits Report (COLR) (continued)

4. LCO 3.3.1.1, RPS Instrumentation (SR 3.3.1.1.14); and

5. LCO 3.3.1.3, Oscillation Power Range Monitor (OPRM) Instrumentation;

b. The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC in 1) NEDE-24011-P-A, General Electric Standard Application for Reactor Fuel or 2). NEDO-32465 "Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications". (The approved revision at the time reload analyses are performed shall be identified in the COLR.)

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 Special Reports

Special Reports shall be submitted in accordance with 10 CFR 50.4 within the time period specified for each report.

The following Special Reports shall be submitted:

a. Violations of the requirements of the fire protection program described in the USAR which would have adversely affected the ability to achieve and maintain safe shutdown in the event of a fire shall be reported via the Licensee Event Report system.

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(continued)

B 3.3 INSTRUMENTATION

B 3.3.1.3 Oscillation Power Range Monitor (OPRM) Instrumentation

BASES

New 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 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 Oscillation Power Range Monitor (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 execute the algorithms based on local power range monitor (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, and 7). Therefore, only the period based detection algorithm is required for channel OPERABILITY. 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 Neutron Monitoring System (NMS) average power range monitor (APRM) power and flow signals to automatically enable the trip function of the OPRM module in specific areas of the power to flow map.

Each OPRM module is continuously tested by a self-test function. On detection of any OPRM module failure, either a Trouble light or an INOP alarm are activated. Trouble indicates the OPRM module is still functioning but needs attention, while INOP indicates that the OPRM module may not be capable of meeting its functional requirements.

APPLICABLE SAFETY ANALYSIS

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 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.

(continued)

BASES

APPLICABLE SAFETY ANALYSES (continued)	The OPRM Instrumentation satisfies Criterion 3 of 10 CFR 50.36(c)(2)(ii).
LCO	Four channels of the OPRM period based detection algorithm 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 power/core flow region protected against anticipated oscillations is defined by THERMAL POWER > 30% RTP and recirculation drive flow < the value corresponding to 60% of rated core flow. The OPRM trip is required to be enabled in this region, and the OPRM must be capable of enabling the trip function as a result of transients that place the core into that power/flow region. 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 instabilities would not be expected to grow large enough to threaten the MCPR Safety Limit. This expectation is due, in part, to the large MCPR margin that exists at low power (Ref. 6).

(continued)

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.

<u>A.1, A.2, and A.3</u>

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 (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.

(continued)

ACTIONS

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

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

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. The RPS logic is one-out-of-two taken twice. 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 in trip (or the associated RPS trip system in trip).

(continued)

ACTIONS

B.1 (continued)

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 as described in the Bases for 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 without OPRM trip capability is considered acceptable with implementation of the alternate method of detecting and suppressing thermal-hydraulic instability oscillations, during the period when corrective actions are underway to resolve the inoperability that led to entry into Condition B. One reason this Condition may be utilized is to provide time to implement a software upgrade in the plant if a common cause software problem is identified (Ref. 8).

C.1

With any Required Action and associated Completion Time not met, THERMAL POWER must be reduced to < 25% RTP within 4 hours. Reducing THERMAL POWER to < 25% RTP places the plant in a region where instabilities 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.

(continued)

BASES (continued)

SURVEILLANCE REQUIREMENTS

For the following OPRM instrumentation surveillances, both OPRM modules are tested, although only one is required to satisfy the surveillance requirement.

SR 3.3.1.3.1

A CHANNEL FUNCTIONAL TEST is performed to ensure that the 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/T Frequency is based on operating experience with LPRM sensitivity changes.

SR 3.3.1.3.3

The CHANNEL CALIBRATION 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. Calibration of the channel provides a check of the internal reference voltage and the internal processor clock frequency, and compares the desired trip setpoints with those in processor memory. The Allowable Values for these items are specified in the Core Operating Limits Report (COLR). 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

(continued)

SURVEILLANCE REQUIREMENTS

SR 3.3.1.3.3 (continued)

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 MWD/T LPRM calibration using the TIPs (SR 3.3.1.3.2).

The Frequency of 24 months is based upon the assumption of the magnitude of equipment drift provided by the equipment supplier (Ref. 9).

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, high 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 recirculation drive flow is < the value corresponding to 60% of rated core flow.

(continued)

SURVEILLANCE REQUIREMENTS

SR 3.3.1.3.5 (continued)

This normally involves verification of the OPRM bypass function, by ensuring the OPRM modules are enabled when the APRM input is > 30% RTP and the recirculation drive flow input is < the value corresponding to 60% of rated core flow. The APRM and recirculation drive flow inputs are calibrated by surveillances in their respective Technical Specifications. Adequate margins for the instrument setpoint methodology are incorporated into the actual setpoints.

If any bypass channel setpoint is nonconservative (i.e., the OPRM module is bypassed at > 30% RTP and recirculation drive flow < the value corresponding to 60% of rated core flow), then the affected OPRM module is considered inoperable. Alternatively, the bypass channel can be placed in the conservative condition (enabled). If placed in the enabled condition, this SR is met and the module is considered OPERABLE.

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

SR 3.3.1.3.6

This SR ensures that the individual channel response times are less than or equal to the maximum values assumed in the accident analysis (Ref. 10). 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 11.

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.3.1.3.6 (continued)

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

REFERENCES

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

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. BWR Owners' Group 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.

(continued)

BASES

REFERENCES (continued)

8. NRC Letter, B. Boger to R. Pinelli, "Acceptance of Licensing Topical Report CENPD-400-P, 'Generic Topical Report for the ABB Option III Oscillation Power Range Monitor'," August 16, 1995.

9. 00000-ICE-3230, "ABB Combustion Engineering Nuclear Operations, LTSSS Requirements Specification."

10. GENE-A13-00381-14, "Licensing Basis Hot Bundle Oscillation Magnitude for Perry" (latest approved revision).

11. USAR Table 7.2-3 "Reactor Protection System Response Time Table".

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.1 Recirculation Loops Operating

No changes, provided for information

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 a two speed motor driven recirculation pump, a flow control valve and associated piping, jet pumps, valves, and instrumentation. The recirculation loops 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.

(continued)

No changes, provided for information

BACKGROUND (continued)

The subcooled water enters the bottom of the fuel channels and contacts the fuel 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 (i.e., 55 to 100% RTP) without having to move control rods and disturb desirable flux patterns.

Each recirculation loop is manually started from the control room. The recirculation flow control valves provide regulation of individual recirculation loop drive flows. The flow in each loop can be manually or automatically controlled. During single recirculation loop operation, the recirculation flow control system is maintained in the Loop Manual mode. If the recirculation flow control system is not in the Loop Manual mode while in single recirculation loop operation, immediately initiate action to place the recirculation flow control system in the Loop Manual mode within one hour.

During single recirculation loop operation, with the volumetric recirculation loop drive flow greater than 48,500 gpm, immediately initiate action to reduce flow to less than or equal to 48,500 gpm within one hour.

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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

(continued)

No changes, provided for information

BASES

APPLICABLE SAFETY ANALYSES (continued)

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 USAR.

A plant specific LOCA analysis has been performed assuming only one operating recirculation loop. This analysis has demonstrated that, in the event of a LOCA caused by a pipe break in the operating recirculation loop, the Emergency Core Cooling System response will provide adequate core cooling, provided the APLHGR requirements are modified accordingly (Ref. 3).

The transient analyses of Chapter 15 of the USAR have also been performed for single recirculation loop operation (Ref. 3) and demonstrate sufficient flow coastdown characteristics to maintain fuel thermal margins during the abnormal operational transients analyzed provided the MCPR requirements are modified. During single recirculation loop operation, modification to the Reactor Protection System 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 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."

Recirculation loops operating satisfies Criterion 2 of the NRC Policy Statement.

(continued)

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BASES

LCO

Two recirculation loops are normally required to be in operation with their flows matched within the limits specified in SR 3.4.1.1 to ensure that during a LOCA caused by a break of the piping of one recirculation loop the assumptions of the LOCA analysis are satisfied. In addition, the total core flow must be ≥ 45% of rated core flow, or total core flow expressed as a function of THERMAL POWER must be in Region II as identified in Figure 3.4.1-1, "THERMAL POWER versus Core Flow." Alternatively, with only one recirculation loop in operation, THERMAL POWER must be ≤ 2500 MWt, total core flow must be ≥ 45% of rated core flow, or total core flow expressed as a function of THERMAL POWER must be in Region II of Figure 3.4.1-1, and modifications to the required APLHGR limits (LCO 3.2.1, "AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR)"), MCPR limits (LCO 3.2.2, "MINIMUM CRITICAL POWER RATIO (MCPR)"), and APRM Flow Biased Simulated Thermal Power – High setpoint (LCO 3.3.1.1) must be applied to allow continued operation consistent with the assumptions of Reference 3.

the limits specified in SR 3.4.1.1 not met, the recirculation loop with the lower flow must be considered to be not in operation. With…

The LCO is modified by a Note which allows up to 12 hours before having to put in effect the required modifications to required limits and setpoints after a change in the reactor operating conditions from two recirculation loops operating to single recirculation loop operation. If the required limits and setpoints are not in compliance with the applicable requirements at the end of this period, the associated equipment must be declared inoperable or the limits "not satisfied," and the ACTIONS required by nonconformance with the applicable Specifications implemented. This time is provided due to the need to stabilize operation with one recirculation loop, including the procedural steps necessary to limit flow and flow control mode (to only Loop Manual mode) in the operating loop, monitor for excessive APRM and local power range monitor (LPRM) neutron flux noise levels; and the complexity and detail required to fully implement and confirm the required limit and setpoint modifications. 96-109

The concepts expressed by this paragraph are moved to the Action C.1 Bases discussion

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.

(continued)

BASES

(Both inserts come from the STS Bases)

APPLICABILITY (continued)

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 recirculation loop is considered to be not in operation when the pump in that loop is idle or when the mismatch between total jet pump flows of the two loops is greater than required limits. The loop with the lower flow must be considered not in operation. Should a LOCA occur with one recirculation loop not in operation, the core flow coastdown and resultant core response may not be bounded by the LOCA analyses. Therefore, only a limited time is allowed to restore the inoperable loop to operating status.

A.1

With both recirculation loops operating but the recirculation loop flows not matched, Required Action A.1 requires that the recirculation loops must be restored to operation with matched flows within 2 hours. If the flow mismatch can not be restored to within limits within 2 hours, one recirculation loop must be ~~shut down~~ declared to be "not in operation".

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

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

This Required Action does not require tripping the recirculation pump in the lowest flow loop when the mismatch between total jet pump flows of the two loops is greater than the required limits. However, in cases where large flow mismatches occur, low flow or reverse flow can occur in the low flow loop jet pumps, causing vibration of the jet pumps. If large mismatches are detected, the condition should be alleviated by changing flow control valve position to re-establish forward flow or by tripping the pump, per plant procedures.

B.1 See Insert (A)

~~B.1, C.1, and D.1~~

~~Due to thermal hydraulic stability concerns, operation of the plant is divided into Regions I and II based on THERMAL POWER and core flows. Because the plant is susceptible to instability in Region I, APRM and LPRM neutron flux noise levels are required to be determined to assure that thermal hydraulic instability is not occurring. For the LPRM neutron flux noise determination, 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 are monitored. If evidence of approaching instability occurs (i.e., APRM or LPRM neutron flux noise levels exceed three times the established baseline levels) action must be initiated to restore the power and flow to within Region II by increasing core flow to ≥ 45% of rated core flow or by reducing THERMAL POWER to less than or equal to the limits for the existing core flow. The allowed Completion Times are reasonable, based on operating experience, to restore plant parameters in an orderly manner and without challenging plant systems.~~

(continued)

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Insert A for Bases Page B 3.4-5

B.1

Should a LOCA or transient occur with THERMAL POWER > 2500 MWt during single loop operation, the core response may not be bounded by the safety analyses. Therefore, only a limited time is allowed to reduce THERMAL POWER to ≤ 2500 MWt.

The 1 hour Completion Time is based on the low probability of an accident occurring during this time period, on a reasonable time to complete the Required Action, and on frequent core monitoring by operators allowing changes in THERMAL POWER to be quickly detected.

BASES (Concepts in this Insert are combination of "Note" words from pg. B 3.4-4, and STS Bases words.)

ACTIONS

~~B.1~~, C.1 ~~and B.1 (continued)~~

Baseline values are determined uniquely for each cycle during operation in Region I. Within 2 hours of entering Region I for the first time during a cycle the baseline is established. This initial baseline is then used for comparison to all subsequent neutron flux noise levels during operation in this region.

A determination of APRM and LPRM neutron flux noise levels every 8 hours provides frequent periodic information relative to established baseline noise levels (see Condition C) that indicate stable steady state operation. A determination of these noise levels within 30 minutes after an increase of ≥ 5% RTP provides a more frequent indication of the stability of operation following any significant potential for change of the thermal hydraulic properties of the system. These Frequencies provide early detection of neutron flux oscillations due to core thermal hydraulic instabilities. Action must be initiated to restore the plant to a more stable power/flow ratio if such indications of limit cycle neutron flux oscillations are detected.

or requirements b.2, b.3 or b.4 of the LCO are not met for some other reason, the unit must be brought to a MODE in which the LCO does not apply (see Condition D). The 24 hour Completion Time of the Condition provides time before the required modifications to required limits and setpoints have to be in effect after a change in the reactor operating conditions from two recirculation loops operating to single recirculation loop operation. This time is provided due to the need to stabilize operation with one recirculation loop, including the procedural steps necessary to limit flow and adjust the flow control mode (to only Loop Manual mode) in the operating loop, and the complexity and detail required to fully implement and confirm the required limit and setpoint modifications. The 24 hour Completion Time is also based on the low probability of an accident occurring during this period, on a reasonable time to complete the Required Action, and on frequent monitoring by operators allowing abrupt changes in core flow conditions to be quickly detected.

D.1
~~E.1, E.2, and E.3~~

With no recirculation loops in operation, or the Required Action and associated Completion Time of Conditions A, B, or C not met, the unit is required to be brought to a MODE in which the LCO does not apply. ~~Action must be initiated within 2 hours to reduce THERMAL POWER to be within Region II to assure thermal hydraulic stability concerns are addressed.~~ The plant is ~~then~~ required to be placed in ~~MODE 2 in 6 hours and~~ MODE 3 within ~~in~~ 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 ~~s, are~~ reasonable, based on operating experience, to reach MODE 3 from full power conditions in an orderly manner and without challenging plant systems.

E.1

If the required limit and setpoint modifications for single recirculation loop operation are not performed within 24 ~~12~~ hours after transition from two recirculation loop operation to single recirculation loop operation, ~~the required limits which have~~

(continued)

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BASES

ACTIONS

~~F.1 (continued)~~

~~not been modified must immediately be declared not met. The Required Actions for the associated limits must then be taken.~~

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SURVEILLANCE REQUIREMENTS

SR 3.4.1.1

This SR ensures the recirculation loop flows are within the allowable limits for mismatch. At low core flow (i.e., < 70% of rated core flow), the MCPR requirements provide larger margins to the fuel cladding integrity Safety Limit such that the potential adverse effect of early boiling transition during a LOCA is reduced. A larger flow mismatch can therefore be allowed when core flow is < 70% of rated core flow. The 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 percent of rated core flow. This SR is not required when both loops are not in operation since the mismatch limits are meaningless during single loop or natural circulation operation. The Surveillance must be performed within 24 hours after both loops are in operation. The 24 hour Frequency is consistent with the Frequency for jet pump OPERABILITY verification and has been shown by operating experience to be adequate to detect off normal jet pump loop flows in a timely manner.

SR 3.4.1.2

This SR ensures the reactor THERMAL POWER and core flows are within appropriate parameter limits to prevent uncontrolled power oscillations. At low recirculation flows and high reactor power, the reactor exhibits increased susceptibility to thermal hydraulic instability.

Interim actions have been developed based on the guidance provided in References 4 and 5 to respond to operation in these conditions. This SR identifies when the conditions requiring these interim actions are necessary. The Frequency is based on operating experience and the operators' inherent knowledge of reactor status, including

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.4.1.2 (continued)

significant changes in THERMAL POWER and core flow.

Since refueling activities (fuel assembly replacement or shuffle, SRM/IRM/LPRM replacement, as well as any modifications to fuel support orifice size or core plate bypass flow) can affect the relationship between core flow and THERMAL POWER, this relationship must be re-established each cycle. Within two hours of entering Region I during a new cycle, a baseline neutron flux noise level should be established.

REFERENCES

1. USAR, Section 6.3.3.7.2.
2. USAR, Section 5.4.1.1.
3. USAR, Chapter 15, Appendix 15F.
4. NRC Bulletin 88-07, Supplement 1, "Power Oscillations in Boiling Water Reactors," December 1988.
5. GE Letter, "Interim Recommendations for Stability Actions," November 1988.