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10 CFR 50.90

RS-04-035

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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Dresden Nuclear Power Station, Units 2 and 3
Facility Operating License Nos. DPR-19 and DPR-25
NRC Docket Nos. 50-237 and 50-249

Quad Cities Nuclear Power Station, Units 1 and 2
Facility Operating License Nos. DPR-29 and DPR-30
NRC Docket Nos. 50-254 and 50-265

Subject: License Amendment Request
Activation of the Trip Outputs of the Oscillation Power Range Monitor System

Reference: Letter from Keith R. Jury (Exelon Generation Company, LLC) to U. S. NRC, "Schedule for Completing Actions to Implement Long-Term Stability Solution," dated December 19, 2003

In accordance with 10 CFR 50.90, "Application for amendment of license or construction permit," Exelon Generation Company, LLC (EGC), requests changes to the Technical Specifications (TS), Appendix A, of Facility Operating License Nos. DPR-19 and DPR-25 for Dresden Nuclear Power Station (DNPS), Units 2 and 3, and Facility Operating License Nos. DPR-29 and DPR-30, for Quad Cities Nuclear Power Station (QCNPS), Units 1 and 2.

The proposed changes incorporate into the TS the Oscillation Power Range Monitor (OPRM) instrumentation that will be declared operational in accordance with the schedule provided in the referenced letter. The proposed changes revise TS Section 3.3, "Instrumentation," and TS Section 5.6.5, "Core Operating Limits Report (COLR)," to insert a new TS section 3.3.1.3, "Oscillation Power Range Monitor (OPRM) Instrumentation," for the OPRM instrumentation and add the appropriate references for the trip setpoints and methodology. Following NRC approval of the proposed TS changes, DNPS and QCNPS will activate the reactor scram outputs of the OPRM instrumentation.

The attached information supporting the proposed changes is subdivided as follows.

1. Attachment 1 gives a description and safety analysis of the proposed changes.
2. Attachment 2 includes the marked-up TS pages for DNPS with the proposed changes indicated.
3. Attachment 3 includes the marked-up TS Bases pages for DNPS. The TS Bases pages are provided for information only and do not require NRC approval.

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4. Attachment 4 provides re-typed versions of the TS pages for DNPS with the proposed changes included.
5. Attachment 5 includes the marked-up TS pages for QCNPS with the proposed changes indicated.
6. Attachment 6 includes the marked-up TS Bases pages for QCNPS. The TS Bases pages are provided for information only and do not require NRC approval.
7. Attachment 7 provides re-typed versions of the TS pages for QCNPS with the proposed changes included.

EGC has concluded that the proposed changes present no significant hazards consideration under the standards set forth in 10 CFR 50.92, "Issuance of amendment," paragraph (c).

For DNPS, EGC requests approval of the proposed changes by February 25, 2005, but no earlier than the completion of the upcoming refueling outage for DNPS, Unit 3, which is currently scheduled to complete in December 2004. For DNPS, once approved, the changes shall be implemented within 60 days. For QCNPS, EGC requests approval of the proposed changes no earlier than upon completion of the upcoming refueling outage for QCNPS, Unit 1, which is currently scheduled to complete in March 2005. For QCNPS, once approved, the changes shall be implemented within 60 days. The requested approvals are consistent with the schedules submitted in the referenced letter.

The proposed changes have been reviewed by the Plant Operations Review Committees and approved by the Nuclear Safety Review Boards at DNPS and QCNPS.

If you have any questions, please contact Mr. Allan Haeger at (630) 657-2807.

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

Respectfully,

Executed on 2/27/04

Keith R. Jury
Director, Licensing and Regulatory Affairs

Attachments:
1. Evaluation of Proposed Changes
2. Technical Specifications Markup Pages for DNPS
3. Bases Markup Pages for DNPS
4. Technical Specifications Typed Pages for DNPS
5. Technical Specifications Markup Pages for QCNPS
6. Bases Markup Pages for QCNPS
7. Technical Specifications Typed Pages for QCNPS

cc: Regional Administrator – NRC Region III
NRC Senior Resident Inspector – Dresden Nuclear Power Station
NRC Senior Resident Inspector – Dresden Nuclear Power Station
Illinois Emergency Management Agency – Division of Nuclear Safety

Attachment 1

EVALUATION OF PROPOSED CHANGES

1.0 INTRODUCTION

In accordance with 10 CFR 50.90, "Application for amendment of license or construction permit," Exelon Generation Company, LLC (EGC), requests changes to the Technical Specifications (TS), Appendix A, of Facility Operating License Nos. DPR-19 and DPR-25 for Dresden Nuclear Power Station (DNPS), Units 2 and 3, and Facility Operating License Nos. DPR-29 and DPR-30, for Quad Cities Nuclear Power Station (QCNPS), Units 1 and 2.

The proposed changes incorporate into the TS the Oscillation Power Range Monitor (OPRM) instrumentation that will be declared operational in accordance with the schedule provided in Reference 1. The proposed changes revise TS Section 3.3, "Instrumentation," and TS Section 5.6.5, "Core Operating Limits Report (COLR)," to insert a new TS section 3.3.1.3, "Oscillation Power Range Monitor (OPRM) Instrumentation," for the OPRM instrumentation and add the appropriate references for the trip setpoints and methodology. Following NRC approval of the proposed TS changes, DNPS and QCNPS will activate the reactor scram outputs of the OPRM instrumentation.

For DNPS, EGC requests approval of the proposed changes by February 25, 2005, but no earlier than the completion of the upcoming refueling outage for DNPS, Unit 3, which is currently scheduled to complete in December 2004. For DNPS, once approved, the changes shall be implemented within 60 days. For QCNPS, EGC requests approval of the proposed changes no earlier than upon completion of the upcoming refueling outage for QCNPS, Unit 1, which is currently scheduled to complete in March 2005. For QCNPS, once approved, the changes shall be implemented within 60 days. The requested approvals are consistent with the schedules submitted in Reference 1.

2.0 PROPOSED CHANGES

As described in Section 1.0, following NRC approval of the proposed TS changes, DNPS and QCNPS will activate the reactor scram outputs of the OPRM system. The proposed changes incorporate the following TS changes.

A. Section 3.3.1.3, "Oscillation Power Range Monitor (OPRM) Instrumentation"

This change adds a TS section that requires the OPRM system to be operable.

The required minimum number of operable OPRM channels will be four channels. The OPRM instrumentation will be required to be operable when reactor power is ≥ 25% rated thermal power (RTP).

A note is placed in the Actions section which states, "Separate Condition entry is allowed for each channel."

An additional note is placed in the Actions section that states, "When OPRM channels are inoperable due to APRM indication not within limits in accordance with Specification 3.3.1.1, entry into associated Conditions and Required Actions may be delayed for up to 2 hours if the APRM is indicating a lower power value than the calculated power, and for up to 12 hours if the APRM is indicating a higher power value than the calculated power."

Limiting Condition for Operation (LCO) Condition A and associated Required Actions and Completion Times require that, with one or more channels inoperable, the inoperable channels or the associated trip system be placed in trip or that alternate methods to detect and suppress thermal hydraulic instabilities be implemented within 30 days.

LCO Condition B and associated Required Actions and Completion Times require that, with OPRM trip capability not maintained, initiate alternate methods of detecting and suppressing thermal hydraulic instabilities within 12 hours and restore the OPRM trip capability within 120 days.

Condition C applies if the Completion Times for Required Actions are not met. The Required Action allows 4 hours to reduce reactor power to less than 25% RTP.

The proposed SRs are as follows.

SR 3.3.1.3.1 The OPRM instrumentation will have a Channel Functional Test requirement with a frequency of every 184 days (6 months).

SR 3.3.1.3.2 The OPRM instrumentation will have a Channel Calibration every 24 months. A clarifying statement is added to note that the setpoints for the trip function are specified in the COLR. Neutron detectors are excluded from the Channel Calibration via a note.

SR 3.3.1.3.3 The OPRM instrumentation will have a Logic System Functional Test every 24 months.

SR 3.3.1.3.4 This SR verifies that the OPRM system is not bypassed when thermal power is ≥ 25% rated thermal power and recirculation drive flow is less than 60% of rated recirculation drive flow. The required frequency is every 24 months.

SR 3.3.1.3.5 The reactor protection system response time will be verified within limits every 24 months on a staggered test basis. Neutron detectors are excluded from the response time testing via a note.

A note is placed before the SRs that states, "When a channel is placed in an inoperable status solely for the performance of required Surveillances, entry into the associated Conditions and Required Actions may be delayed for up to 6 hours provided the OPRM maintains reactor protection system (RPS) trip capability."

The proposed changes are consistent with the NRC-approved proposed changes for the Asea Brown Boveri (ABB) Combustion Engineering OPRM system installation as described in Reference 2, with the following exceptions. The basis for these exceptions is discussed in Section 4.0 below.

- The Actions note regarding Average Power Range Monitor (APRM) indication is not part of the Reference 2 TS changes.

- The note placed before the SRs regarding delayed entry into the associated Conditions and Required Actions is not part of the Reference 2 TS changes.

- The TS changes in Reference 2 include an SR that requires calibration of the Local Power Range Monitors (LPRMs) every 1000 megawatt days per metric ton uranium (MWD/MTU). The proposed changes in this amendment request do not include this requirement, since it is similar to another SR (i.e., SR 3.3.1.1.9) currently in DNPS and QCNPS TS. The surveillance frequency is updated to include plant-specific information.

- A clarifying statement has been added to SR 3.3.1.3.2 to state that the setpoints for the trip function are specified in the Core Operating Limits Report (COLR).

B. Section 5.6.5, "Core Operating Limits Report (COLR)"

Section 5.6.5.a will have a requirement added to include the setpoints in the COLR for the OPRM trip function as stated in SR 3.3.1.3.2.

Section 5.6.5.b will have a reference added to describe the NRC-approved methodology for determining the setpoints for the OPRM trip function. This reference is NEDO-32465-A, "BWR Owners' Group Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology and Reload Applications," August 1996 (Reference 3).

3.0 BACKGROUND

The NRC issued Generic Letter (GL) 94-02, "Long-Term Solutions and Upgrade of Interim Operating Recommendations for Thermal Hydraulic Instabilities in Boiling Water Reactors," which required licensees to develop and submit to the NRC a plan for long-term stability corrective actions. In response to GL 94-02, in Reference 4, EGC committed to implement the long-term solution designated as Option III in NEDO-31960-A (including Supplement 1), "BWR Owner's Group Long-Term Stability Solutions Licensing Methodology," (Reference 5) by installing the ABB Combustion Engineering Option III OPRM system. GL 94-02 also discussed the use of interim corrective actions (ICAs) to provide operator controlled actions to avoid regions of potential instability and insert a manual reactor scram if oscillations are detected.

The ABB system utilizes the OPRM detect-and-suppress function to implement Option III. The system monitors LPRM signals for indications of neutron flux oscillations. The OPRM also monitors indicated power and indicated recirculation flow to automatically enable the OPRM trip when in a predefined region of the power-to-flow map. The OPRM initiates a trip whenever it detects an instability condition when in the predefined region of the power-to-flow map.

The OPRM instrumentation modules, selected annunciators, and sequence of events recorder points were installed at DNPS and QCNPS from 1999 to 2000. The OPRM trip functions were not activated at the time of installation in order to allow evaluation of the performance of the OPRM algorithms without the risk of spurious scrams. During this evaluation period, in 2001, General Electric (GE) Company initiated a report in accordance with 10 CFR 21, "Reporting of defects and noncompliances," concerning stability reload licensing calculations that support the development of setpoints for the OPRM trip function. The OPRM trip functions were not armed pending resolution of this reported condition. The reported condition has now been resolved as described in Reference 6. In the interim, EGC has continued to implement the ICAs to detect and suppress power oscillations and will continue to do so until implementation of the proposed TS changes.

4.0 TECHNICAL ANALYSIS

The OPRM instrumentation installation at DNPS and QCNPS follows the industry approach for implementation/activation of the OPRM trip function in accordance with NRC approved Licensing Topical Reports. In addition, EGC has incorporated relevant industry operating experience into the system settings, as appropriate.

The OPRM Instrumentation System consists of four OPRM instrumentation trip channels. Each trip channel consists of two OPRM instrumentation modules, either of which can initiate the trip signal for that channel. Each OPRM instrumentation module receives input from 20 to 22 LPRMs. Each OPRM instrumentation module also receives input from the other OPRM instrumentation module in the trip channel, as well as from RPS Average Power Range Monitor (APRM) power and flow signals to automatically enable the trip function of the OPRM instrumentation module.

The OPRM system uses three separate algorithms for detecting thermal hydraulic stability related oscillations: the period based detection algorithm (PBDA), the amplitude based algorithm, and the growth rate algorithm. The OPRM system hardware implements these algorithms in microprocessor-based modules. These modules execute the algorithms based on LPRM inputs and generate alarms and trips based on these calculations. These trips result in tripping the RPS when the appropriate trip logic (one out of two, taken twice) is satisfied. As discussed in Reference 3, only the PBDA is used in the safety analysis. The remaining algorithms provide defense in depth and additional protection against unanticipated oscillations.

The PBDA detects a stability related oscillation based on the occurrence of a fixed number of consecutive LPRM signal period confirmations concurrent with the LPRM signal amplitude exceeding a specified peak to average setpoint. Upon detection of a stability related oscillation, a trip is generated in the module associated with that OPRM instrumentation channel.

Each OPRM instrumentation module is continuously tested by a self-test function. On detection of an OPRM instrumentation module self-test failure, either a "Trouble" or "INOP" alarm is activated. The two alarms are displayed on a single control room annunciator and can be distinguished via the alarm printer. The "Trouble" alarm indicates that a condition is present that reduces the robustness of the system but does not cause the OPRM channel to fail to meet its functional requirements. The OPRM instrumentation module provides an "INOP" alarm when the self-test feature indicates that the OPRM instrumentation module may not be capable of meeting its functional requirements. When one OPRM instrumentation module is inoperable, the remaining redundant OPRM instrumentation module in the associated OPRM trip channel maintains the operability of the trip channel; thus, there is no loss of trip function redundancy and no TS actions are required. If both OPRM instrumentation modules in an OPRM channel are inoperable, the associated OPRM instrumentation channel is inoperable, and the proposed TS actions are entered, consistent with the approved TS in Reference 2.

The detailed TS requirements for the OPRM system, including the LCO, Applicability, Conditions, Required Actions, and Completion Times, are consistent with the TS approved by the NRC in Reference 2, with the exceptions described in Section 2.0. The basis for these exceptions follows.

- An additional note has been added to the Actions section. This note allows delayed entry into the Conditions and Required Actions when OPRM channels are inoperable due to APRM indication not within limits in accordance with Specification 3.3.1.1. This entry into associated Conditions and Required Actions may be delayed for up to 2 hours if the APRM is indicating a lower power value than the calculated power, and for up to 12 hours if the APRM is indicating a higher power value than the calculated power. This allowance is necessary for the following reason. In accordance with current SR 3.3.1.1.2, the APRM system is not required to be calibrated until 12 hours after thermal power ≥ 25% RTP. The APRM system provides input to the OPRM system to enable the OPRM modules at the designated enable setpoint. Because calibration is not required until after 25% RTP is reached, it is possible that an APRM channel could be out of calibration above 25% RTP. If so, this could affect the operability of the affected OPRM modules. Although the discussion in the Bases for SR 3.3.1.3.4 states that the setpoints for the enable region are nominal setpoints, without need for consideration of uncertainty, this discussion is based on the assumption that the APRM system is calibrated to within the specified tolerance of 2% compared to the calculated value of RTP. A note in the Actions section of Specification 3.3.1.1 for the APRM system allows delayed entry into the Conditions and required Actions for the APRM system. The proposed note for the OPRM system is consistent with the APRM system note.

- The TS changes in Reference 2 include an SR (SR 3.3.1.3.2) that requires calibration of the LPRMs every 1000 MWD/MTU. This value is bracketed in Reference 2, indicating that plant-specific information should be substituted. DNPS and QCNPS TS, in SR 3.3.1.1.9, currently require this calibration and specify a frequency of 2000 effective full power hours (EFPH). The TS bases state that the 2000 EFPH frequency is based on operating experience with LPRM sensitivity changes. Thus, current SR 3.3.1.1.9 meets the intent of the SR for LPRM calibration in Reference 2, and is not required to be duplicated in proposed Section 3.3.1.3. The TS Bases for TS Sections 3.3.1.3 and 3.3.1.1 have been marked up to reflect that the LPRM calibration is required to demonstrate OPRM operability.

- SR 3.3.1.3.4 verifies that the OPRM system is not bypassed with reactor power ≥ 25% RTP and recirculation drive flow < 60% of rated recirculation drive flow. These values define the region in which the OPRM system is enabled, and are not protective limits. The 60% value is consistent with the value discussed in Reference 3, Section 2.2, "Licensing Compliance." The 25% RTP value is the plant-specific value for the 30% RTP value, which is bracketed in Reference 2. The 25% value results from the previous extended power uprate (EPU) to 117.8% of original licensed thermal power at DNPS and QCNPS, which was approved by the NRC in References 7 and 8. The 25% value results from scaling the 30% RTP value by the percentage of uprate (i.e., 100/117.8) in order to maintain the same pre-and post-uprate RTP boundaries in terms of absolute power for the regions in which instabilities could potentially occur. The value is conservatively rounded from 25.5% RTP to 25% RTP in order to coincide with the Applicability for the LCO, which specifies that the OPRM instrumentation should be operable at or above 25% RTP.

- Proposed SR 3.3.1.3.2 states that the OPRM instrumentation will have a channel calibration every 24 months. A statement is added to note that the setpoints for the trip function are specified in the COLR. This statement clarifies that the setpoints for the trip function are to be stated in the COLR and provides consistency with the statement added to TS Section 5.6.5.a, which requires that the COLR contain the setpoints for SR 3.3.1.3.2.

There are no allowable values in the proposed TS associated with the OPRM trip function. The OPRM PBDA upscale trip setpoints (i.e., the number of confirmation counts and the peak to average signal amplitude required to actuate a trip signal) are determined based on the Option III licensing methodology developed by the BWROG and described in Reference 3, which is approved by the NRC. These are treated as nominal setpoints and do not include additional allowances for uncertainty.

There are also TS related setpoints for the auto-enable (not-bypassed) region, which are established as described in the TS Bases markup, and defined in SR 3.3.1.3.4. These are also treated as nominal setpoints, based on the conservatism in the establishment of the enable region, as discussed in Reference 9.

The PBDA algorithm includes several "tuning" parameters. These were initially established as part of the modification process and have been adjusted based upon both plant and industry operating experience. Since these various parameters are considered to be "tuning" parameters, they are not specifically listed within the TS.

Finally, there are also setpoints for the "defense-in-depth" algorithms discussed in the OPRM upscale function description in the TS Bases markup. These are also treated as nominal setpoints based on qualitative studies performed by the BWROG and documented in Appendix A of Reference 3. These algorithms are not credited in the safety analysis.

In Reference 2, the NRC accepted the use of the ABB OPRM system for licensees to the extent specified and under the limitations delineated in the associated NRC safety evaluation. The NRC requested licensees to address the following plant-specific questions when referencing the Reference 2 report in license applications.

<u>Question 1</u>
"Confirm the applicability of CENPD-400-P, including clarifications and reconciled differences between the specific plant design and the topical report design descriptions."

<u>Response</u>
The OPRM instrumentation design at DNPS and QCNPS includes alarm, trip, inoperable/trouble annunciators and is consistent with the topical report design.

<u>Question 2</u>
"Confirm the applicability of BWROG topical reports that address the OPRM and associated instability functions, setpoints and margin."

Response
Reports NEDO-32465-A (Reference 3) and NEDO-31960-A (Reference 5) were reviewed and determined to be applicable to DNPS and QCNPS. In the safety evaluations for NEDO-31960-A and Supplement 1, the NRC found that Options III and III-A were acceptable long-term solutions for implementation in any type of BWR, subject to the following five conditions:

2.1 "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 ABB design. Automatic protection is actuated if any of the three algorithms meet their trip conditions. Only the PBDA, 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.

2.2 "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

The applicability of the scram setpoints will be demonstrated by cycle-specific analysis using the methodology described in Reference 3. The PBDA is based upon explicit analysis methodology (Reference 3) that is applied to demonstrate a basis for concluding that the algorithm can be credited in the licensing basis for meeting the requirements of 10 CFR 50, Appendix A, General Design Criterion (GDC) 10, "Reactor design," and GDC 12, "Suppression of reactor power oscillations." The setpoints are selected to assure that a trip will occur for a reactor instability event.

Analysis of sensor failure in the OPRM system is addressed in Reference 3. The analysis of Reference 3 demonstrated that it was more conservative to assume all LPRMs were operable because the sensitivity of the OPRM system increases as the number of LPRM failures increase. Due to the large number of LPRMs and OPRM cells, OPRM system operability is expected to be maintained under all conditions which satisfy operability of a sufficient number of APRM channels to maintain APRM system operability.

2.3 "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 proposed SR 3.3.1.3.4. The bases for the values defining this region are provided above in the discussion related to SR 3.3.1.3.4.

2.4 "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 OPRM systems at DNPS and QCNPS will be a full reactor scram. An automatic select rod insert (SRI) is not available at DNPS or QCNPS.

2.5 "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 Reference 5 and Reference 3, the "Four LPRMs per OPRM Cell - 4BL" configuration is used at DNPS and QCNPS. The 4BL arrangement is one of six approved configurations discussed in Reference 3, Appendix D. As described in Reference 5, current TS requirements for the operability of LPRMs (as amplified in the TS Bases) are sufficient to ensure an adequate number of operable LPRMs to provide input to the OPRM system.

Question 3

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

Response

The plant specific TS are provided in Attachments 2 and 5 and are consistent with Reference 2, Appendix A, except as described in this attachment.

Question 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 and components are mounted in main control room cabinets at DNPS and QCNPS, which are located in a mild environmental zone. The OPRM components, including the replacement power supply are qualified to perform their Class 1E safety function. For ease of reference, the plant-specific environmental conditions at the OPRM installation location for temperature, humidity, and radiation are compared to the OPRM qualification values in the following table. As shown in the table, the generic OPRM qualification values envelope the DNPS and QCNPS temperature and radiation environmental conditions. The generic OPRM qualification values for humidity envelop the DNPS and QCNPS environmental conditions for the normal humidity range. However, the DNPS and QCNPS main control rooms may periodically experience humidity values below the normal range. This is discussed in Section 4.2.

Environmental Condition	DNPS and QCNPS Environmental Conditions	OPRM Generic Qualification (continuous operation)
Temperature	95°F maximum, following high energy line break 65°F minimum	40°F to 120°F
Humidity	40% to 70% relative humidity (RH) normal	30% to 95% RH
Radiation	< 10,000 RAD total integrated dose (TID)	< 10,000 RAD TID

The following sections discuss the plant-specific temperature, humidity, radiation, electromagnetic and seismic environmental conditions pertaining to the OPRM at DNPS and QCNPS.

4.1 Temperature/Heat Loading

The temperature qualification of the OPRM module was performed by test. The OPRM module is designed to operate continuously in a normal ambient temperature range of 40°F to 120°F. The system is designed to operate continuously in an abnormal ambient temperature environment of 140°F for 48 hours. The DNPS and QCNPS control room temperature range is 65°F to 95°F, which is bounded by the design temperature range of the OPRM. The normal temperature range for the DNPS and QCNPS control rooms is between 70°F and 80°F.

The control room heat load has not increased significantly as a result of this modification.

4.2 Humidity

The humidity qualification of the OPRM module was performed by test. The OPRM is designed to operate continuously in a humidity environment range of 30% to 95% RH, non-condensing.

The low end of the generic OPRM qualified humidity range is 30% RH. The normal relative humidity range for the DNPS and QCNPS control rooms is between 40% and 70% RH. However, the control room ventilation system is not equipped with humidification equipment, and thus, depending on outside air conditions, the relative humidity may be as low as 20% RH at DNPS on a temporary basis. For QCNPS, the relative humidity may also be lower than 40% on a temporary basis for the same reason, although no specific minimum expected value has been determined.

The primary concern at low humidity conditions is the possibility of damage from electrostatic discharge. The OPRM equipment has been tested for electrostatic discharge, as described in Section 4.4 below. Further, the potential for electrostatic discharge is minimized, since the modules are located inside panels in metal enclosures, and are not subject to incidental contact by personnel. Finally, the OPRM equipment has been installed and operating satisfactorily in the main control room environments at DNPS and QCNPS for several years. Thus, the OPRM equipment should continue to operate properly if relative humidity is temporarily below 30% RH.

4.3 Radiation

The OPRM module is designed to operate and meet its performance requirements after a total integrated Co-60 gamma dose of less than 10,000 RAD. The plant specific total integrated dose condition at the OPRM installation location of less than 10,000 RAD matches the tested configuration. Therefore, the OPRM module is acceptable for use at DNPS and QCNPS.

4.4 Electromagnetic Interference (EMI)

EMI testing of the OPRM equipment was performed by ABB to ensure it would not be adversely affected by the plant EMI environment (susceptibility), and to ensure the OPRM modules would not be detrimental to the existing plant EMI environment (emissions). As noted in Reference 2, the testing was conducted to MIL-STD-461C-1986, "Guide for Instrumentation and Control Equipment Grounding in Generating Stations," and MIL-STD-462-1967, "Measurement of Electromagnetic Interference Characteristics," for the following tests.

- CE01, 03 Conducted Emissions
- CE07 Conducted Switching Spikes
- RE02 Radiated Emissions (14 kHz to 1 GHz)
- CS01, 02 Conducted Susceptibility AC Power Leads
- CS06 Conducted Susceptibility Spike
- RS02, 03 Radiated Susceptibility

Design features for EMI considerations include a metal enclosure around the OPRM equipment, filtered input wires, and the use of ground planes on circuit boards. Post-maintenance testing of the system at DNPS and QCNPS has energized all portions of the OPRM circuits and has not resulted in any adverse effects on other systems.

In addition, ABB designed and tested the OPRM system to meet the electrostatic discharge requirements of IEC 801-2, "Electromagnetic Compatibility for Industrial Process Measurement and Control equipment," Level 4 (8 kilovolt) under laboratory reference conditions in accordance with IEC 801-2 Section 8.0.

Also, ABB demonstrated fast transient withstand (burst) capability for all power input and output and all process input and output circuits, signal common and protective earth connections based on IEC 801-4 Level 4 (4 kV on power and grounds, 2 kV on process signals) as described in IEC 801-4 Sections 7.3.1 and 7.3.2.

4.5 Seismic

As noted in Reference 2, the OPRM system is seismically qualified by type testing in accordance with IEEE-344-1975, "Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations." The OPRM system is subjected to a minimum of five operating basis earthquakes in each axis followed by at least one safe shutdown earthquake in each axis. Verification has been completed to document that the DNPS and QCNPS control room response spectra are bounded by the test seismic response spectra in Reference 2.

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

Response
The OPRM has two modes of operation – operate and test. In the operate mode, the system performs normal trip and alarm functions. The test mode is used for test, calibration, setpoint adjustment, and downloading of event data. In the test mode, the OPRM's reactor trip output is bypassed and the OPRM module is considered inoperable. If both OPRM modules in a channel are in test, then the trip channel is inoperable. Entry into the test mode is controlled by a keylock switch for each module and is annunciated in the control room.

The OPRM module trip circuits may be bypassed by a selector switch located on a main control board in the control room. This switch allows bypass of only one OPRM module in an RPS division at any given time (one of four OPRM modules). The bypass condition of the selected OPRM module is indicated by the sequence of events monitor and by indicating lights.

Administrative procedures will be provided for manually bypassing OPRM instrumentation channels or protective functions, and for controlling access to the OPRM functions.

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

Response
The changes made to the main control room panels at DNPS and QCNPS for the OPRM system were evaluated by a human factors engineer in accordance with human factors engineering procedures for acceptability and conformance to human engineering design principles. The OPRM system instrumentation and associated components, controls, and annunciators were found acceptable from a human factors engineering perspective.

In the NRC safety evaluation contained in Reference 5, the NRC stated that, "...the recirculation drive flow channel should comply with the requirements of Electrical and Electronics Engineers, Standard 279 ...." As part of the OPRM installation, the existing recirculation drive flow units (i.e., a flow converter unit and a flow arithmetic unit per channel) were replaced with new Class 1E qualified flow units capable of providing total flow signals to the OPRM modules.

Further, in the NRC safety evaluation contained in Reference 5, the NRC requested that the plant-specific submittal discuss the isolation devices between the OPRM system and the associated protection system. The OPRM system inputs and outputs at DNPS and QCNPS are isolated with a combination of Class 1E qualified analog and digital signal isolators.

5.0 REGULATORY ANALYSIS

5.1 No Significant Hazards Consideration

Exelon Generation Company, LLC (EGC), proposes changes to the Technical Specifications (TS) for Dresden Nuclear Power Station (DNPS), Units 2 and 3, and Quad Cities Nuclear Power Station (QCNPS), Units 1 and 2. The proposed changes incorporate into the TS the Oscillation Power Range Monitor (OPRM) instrumentation. The OPRM system monitors neutron flux signals for signs of neutron flux oscillations and initiates a reactor scram whenever it detects an instability condition when in a predefined region of the power-to-flow map. Activation of the OPRM instrumentation will replace manual methods for avoiding instabilities and for detecting and suppressing potential instabilities. Following NRC approval of the proposed TS changes, DNPS and QCNPS will activate the reactor scram outputs of the OPRM instrumentation.

EGC has evaluated whether or not a significant hazards consideration is involved with the proposed changes by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below.

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

   Response: No. This proposed change has no impact on any of the existing neutron monitoring functions. It activates the OPRM scram function and updates the TS to add the OPRM-related functions.

   Activation of the OPRM scram function will replace the current methods that require operators to insert an immediate manual reactor scram in the reactor operating region where thermal hydraulic instabilities could potentially occur. While this region will continue to be avoided during normal operation, certain transients, such as a reduction in reactor recirculation flow, could place the reactor in this region. Operation in this region, with the OPRM instrumentation scram function activated would no longer require an immediate manual scram and thus may potentially cause a marginal increase in the probability of occurrence of an instability event. This potential increase in probability is acceptable because the OPRM function will automatically detect the instability condition and initiate a reactor scram before the Minimum Critical Power Ratio (MCPR) Safety Limit is reached. Consequences of the potential instability event are reduced because of the more reliable automatic detection and suppression of an instability event, and the elimination of dependence on the manual operator actions. Operators will continue to monitor for indications of thermal hydraulic instability when the reactor is operating in regions of potential instability as a backup to the OPRM instrumentation.

The potential for spurious reactor scrams has been evaluated. Operating experience with the OPRM has not resulted in the generation of any spurious reactor scram signals.

Therefore, the proposed changes do not involve a significant increase in the probability or consequences of an accident previously evaluated.

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

   Response: No. The proposed changes replace procedural actions that were established to avoid operating conditions where reactor instabilities might occur with an NRC approved automatic detect and suppress function (i.e., OPRM).

   Potential failures in the OPRM trip function could result in either failure to take the required mitigating action or an unintended reactor scram. These are the same potential effects of failure of the operator to take the appropriate action under the current procedural actions. The effects of failure of the OPRM equipment are limited to reduced or failed mitigation, but such failure cannot cause an instability event or other type of accident.

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

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

   Response: No. The OPRM trip function is being implemented to automate the detection and subsequent suppression of an instability event prior to exceeding the MCPR Safety Limit. The OPRM trip provides a trip output of the same type as currently used for the APRM. Its failure modes and types are identical to those for the present APRM output. Since the MCPR Safety Limit will not be exceeded as a result of an instability event following implementation of the OPRM trip function, it is concluded that the proposed change does not reduce the margin of safety.

   Therefore, the proposed changes do not involve a significant reduction in a margin of safety.

Based on the above, EGC concludes that the proposed amendment presents no significant hazards consideration under the standards set forth in 10 CFR 50.92, paragraph (c), and accordingly, a finding of no significant hazards consideration is justified.

5.2 Applicable Regulatory Requirements/Criteria

10 CFR 50, Appendix A, General Design Criterion (GDC) 10, "Reactor design," 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, "Suppression of reactor power oscillations," requires the reactor core

and associated coolant, control, and protection systems to be designed to assure that power oscillations which can result in conditions exceeding acceptable fuel design limits are either not possible or can be reliably and readily detected and suppressed. The OPRM instrumentation provides compliance with GDC 10 and GDC 12, thereby providing protection from exceeding the fuel MCPR Safety Limit.

The NRC issued GL 94-02, which requested licensees to develop and submit to the NRC a plan for long-term stability corrective actions to ensure compliance with GDC 10 and 12. The OPRM provides the long-term stability corrective actions requested in GL 94-02.

10 CFR 50.36, "Technical specifications," requires that a TS LCO be established for any structure, system or component that is part of the primary success path and wich functions to mitigate a design basis accident or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier. The OPRM instrumentation is part of the primary success path in providing protection from exceeding the MCPR Safety Limit for thermal hydraulic stability-related oscillations.

The proposed changes are similar to those approved by the NRC for the Columbia Generating Station and the Perry Nuclear Power Plant, Unit 1, in References 10 and 11, respectively.

5.3 Conclusion

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

6.0 ENVIRONMENTAL CONSIDERATION

A review has determined that the proposed amendment would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, "Standards for Protection Against Radiation," or would change an inspection or surveillance requirement. However, the proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, and (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22, "Criterion for categorical exclusion; identification of licensing and regulatory actions eligible for categorical exclusion or otherwise not requiring environmental review," paragraph (c)(9). Therefore, in accordance with 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

7.0 REFERENCES

1. Letter from Keith R. Jury (Exelon Generation Company, LLC) to U. S. NRC, "Schedule for Completing Actions to Implement Long-Term Stability Solution," dated December 19, 2003

2. Letter from U. S. NRC to R. A. Pinelli (BWR Owners' Group), "Acceptance of Licensing Topical Report CENPID-400-P, 'Generic Topical Report for the ABB Option III Oscillation Power Range Monitor,'" dated August 16, 1995

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

4. Letter from J. C. Brons (Commonwealth Edison Company) to U. S. NRC, "Response to Generic Letter 94-02 (BWR Stability)," dated September 9, 1994

5. Letter from U. S. NRC to L. A. England (BWR Owners' Group), "Acceptance for Referencing NEDO-31960 and NEDO-31960 Supplement 1, 'BWR Owner's Group Long-Term Stability Solutions Licensing Methodology,'" dated July 12, 1993

6. Letter from K. S. Putnam (Boiling Water Reactor Owners' Group) to U. S. NRC, "Resolution of Reportable Condition for Stability Reload Licensing Calculations Using Generic Regional Mode DIVOM Curve," dated September 30, 2003

7. Letter from U. S. NRC to O. D. Kingsley (Exelon Generation Company, LLC), "Dresden Nuclear Power Station, Units 2 and 3 – Issuance of Amendments for Extended Power Uprate," dated December 21, 2001

8. Letter from U. S. NRC to O. D. Kingsley (Exelon Generation Company, LLC), "Quad Cities Nuclear Power Station, Units 1 and 2 – Issuance of Amendments for Extended Power Uprate," dated December 21, 2001

9. Letter from K. P. Donovan (BWR Owners' Group) to U. S. NRC, "Guidelines for Stability Option III 'Enabled Region,'" dated September 17, 1996

10. Letter from U. S. NRC to J. V. Parrish (Energy Northwest), "Columbia Generating Station – Issuance of Amendment RE: Oscillation Power Range Monitoring Technical Specifications," dated April 5, 2001

11. Letter from U. S. NRC to J. K. Wood (FirstEnergy Nuclear Operating Company), "Perry Nuclear Power Plant, Unit 1 – Issuance of Amendment RE: Activation of Thermal-Hydraulic Stability Monitoring Instrumentation," dated April 5, 2001

Attachment 2

Technical Specifications Markup Pages for Dresden Nuclear Power Station

<u>Pages</u>
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3.3.1.3-1 (new page)
3.3.1.3-2 (new page)
3.3.1.3-3 (new page)
5.6-3
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3.3 INSTRUMENTATION

3.3.1.3 Oscillation Power Range Monitor (OPRM) Instrumentation

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

APPLICABILITY: THERMAL POWER ≥ 25% RTP.

ACTIONS

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

1. Separate Condition entry is allowed for each channel.

2. When OPRM channels are inoperable due to APRM indication not within limits in accordance with Specification 3.3.1.1, entry into associated Conditions and Required Actions may be delayed for up to 2 hours if the APRM is indicating a lower power value than the calculated power, and for up to 12 hours if the APRM is indicating a higher power value than the calculated power.

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

(continued)

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
B. OPRM trip capability not maintained.	B.1	Initiate alternate method to detect and suppress thermal hydraulic instability oscillations.	12 hours
	AND		
	B.2	Restore OPRM trip capability.	120 days
C. Required Action and associated Completion Time not met.	C.1	Reduce THERMAL POWER < 25% RTP.	4 hours

SURVEILLANCE REQUIREMENTS

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

SURVEILLANCE		FREQUENCY
SR 3.3.1.3.1	Perform CHANNEL FUNCTIONAL TEST.	184 days
SR 3.3.1.3.2	------------------NOTE------------------- Neutron detectors are excluded. --- Perform CHANNEL CALIBRATION. The setpoints for the trip function shall be as specified in the COLR.	24 months
SR 3.3.1.3.3	Perform LOGIC SYSTEM FUNCTIONAL TEST.	24 months
SR 3.3.1.3.4	Verify OPRM is not bypassed when THERMAL POWER is ≥ 25% RTP and recirculation drive flow is < 60% of rated recirculation drive flow.	24 months
SR 3.3.1.3.5	------------------NOTE------------------- Neutron detectors are excluded. --- Verify the RPS RESPONSE TIME is within limits.	24 months on a STAGGERED TEST BASIS

5.6 Reporting Requirements

5.6.5 CORE OPERATING LIMITS REPORT (COLR) (continued)

3. The LHGR for Specification 3.2.3.

4. Control Rod Block Instrumentation Setpoint for the Rod Block Monitor—Upscale Function Allowable Value for Specification ~~3.3.2.1.~~

5. The OPRM setpoints for the trip function for SR 3.3.1.3.2.

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

1. ANF-1125(P)(A), "Critical Power Correlation - ANFB."

2. ANF-524(P)(A), "ANF Critical Power Methodology for Boiling Water Reactors."

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

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

5. XN-NF-85-67(P)(A), "Generic Mechanical Design for Exxon Nuclear Jet Pump Boiling Water Reactors Reload Fuel."

6. ANF-913(P)(A), "CONTRANSA2: A Computer Program for Boiling Water Reactor Transient Analysis."

7. XN-NF-82-06(P)(A), Qualification of Exxon Nuclear Fuel for Extended Burnup Supplement 1 Extended Burnup Qualification of ENC 9x9 BWR Fuel.

8. ANF-89-14(P)(A), Advanced Nuclear Fuels Corporation Generic Mechanical Design for Advance Nuclear Fuels Corporation 9x9-IX and 9x9-9X BWR Reload Fuel.

(continued)

5.6 Reporting Requirements

5.6.5 CORE OPERATING LIMITS REPORT (COLR) (continued)

9. ANF-89-98(P)(A), Generic Mechanical Design Criteria for BWR Fuel Designs.

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

11. Commonwealth Edison Company Topical Report NFSR-0091, "Benchmark of CASMO/MICROBURN BWR Nuclear Design Methods."

12. EMF-85-74(P), RODEX2A (BWR) Fuel Rod Thermal Mechanical Evaluation Model.

13. NEDE-224011-P-A, "General Electric Standard Application for Reactor Fuel (GESTAR)."

14. NEDC-32981P, "GEXL96 Correlation for ATRIUM 9B Fuel," September 2000.

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

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 Post Accident Monitoring (PAM) Instrumentation Report

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

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

Attachment 3

Bases Markup Pages for Dresden Nuclear Power Station

<u>Pages</u>

i
B 3.3.1.1-31
B 3.3.1.3-1 (new page)
B 3.3.1.3-2 (new page)
B 3.3.1.3-3 (new page)
B 3.3.1.3-4 (new page)
B 3.3.1.3-5 (new page)
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SURVEILLANCE REQUIREMENTS

SR 3.3.1.1.6 and SR 3.3.1.1.7 (continued)

As noted, SR 3.3.1.1.7 is only required to be met during entry into MODE 2 from MODE 1. That is, after the overlap requirement has been met and indication has transitioned to the IRMs, maintaining overlap is not required (APRMs may be reading downscale once in MODE 2).

If overlap for a group of channels is not demonstrated (e.g., IRM/APRM overlap), the reason for the failure of the Surveillance should be determined and the appropriate channel(s) declared inoperable. Only those appropriate channels that are required in the current MODE or condition should be declared inoperable.

A Frequency of 7 days is reasonable based on engineering judgment and the reliability of the IRMs and APRMs.

SR 3.3.1.1.9

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 APRM System. The 2000 effective full power hours (EFPH) Frequency is based on operating experience with LPRM sensitivity changes.

SR 3.3.1.1.9 also ensures the operability of the OPRM system (Specification 3.3.1.3).

SR 3.3.1.1.10, SR 3.3.1.1.13, SR 3.3.1.1.15, and SR 3.3.1.1.17

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

Note 1 to SR 3.3.1.1.15 and SR 3.3.1.1.17 states that neutron detectors are excluded from CHANNEL CALIBRATION because they are passive devices, with minimal drift, and because of the difficulty of simulating a meaningful signal. For the APRMs, changes in neutron detector sensitivity are

(continued)

B 3.3 INSTRUMENTATION

B 3.3.1.3 OSCILLATION POWER RANGE MONITOR (OPRM) INSTRUMENTATION

BASES

BACKGROUND

General Design Criteria 10 (GDC 10) requires the reactor core and associated coolant, control, and protection systems to be designed with appropriate margin to assure that acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences. Additionally, GDC 12 requires the reactor core and associated coolant, control and protection systems to be designed to assure that power oscillations which can result in conditions exceeding acceptable fuel design limits are either not possible or can be reliably and readily detected and suppressed. The OPRM System provides compliance with GDC 10 and GDC 12, thereby providing protection from exceeding the fuel 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, "Reactor Protection System (RPS) Instrumentation." Only the period based detection algorithm is used for safety analysis. The remaining algorithms provide defense in depth and additional protection against unanticipated oscillations.

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

(continued)

BASES

BACKGROUND (continued)	The OPRM System consists of 4 OPRM trip channels, each channel consisting of two OPRM modules. Each OPRM module receives input from LPRMs. Each OPRM module also receives input from the RPS average power range monitor (APRM) power and flow signals to automatically enable the trip function of the OPRM module. The outputs of the OPRM trip channels input to the associated RPS trip channels which are configured into a one-out-of-two taken twice trip logic as described in the Bases for Section 3.3.1.1. Each OPRM module is continuously tested by a self-test function. On detection of any OPRM module failure, either a Trouble alarm or INOP alarm is activated. The OPRM module provides an INOP alarm when the self-test feature indicates that the OPRM module may not be capable of meeting its functional requirements.
APPLICABLE SAFETY ANALYSES	It has been shown that BWR cores may exhibit thermal-hydraulic reactor instabilities in high power and low flow portions of the core power to flow operating domain (Reference 4). 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. The OPRM Instrumentation satisfies Criterion 3 of 10 CFR 50.36(c)(2)(ii). The OPERABILITY of the OPRM System is dependent on the OPERABILITY of the four individual instrumentation channels with their setpoints within the specified nominal setpoint. Each channel must also respond within its assumed response time.

(continued)

BASES

APPLICABLE SAFETY ANALYSES (continued)	The nominal setpoints for the OPRM Period Based Trip Function are specified in the Core Operating Limits Report. The trip setpoints are treated as nominal setpoints and do not include additional allowances for uncertainty. Trip setpoints are those predetermined values of output at which an action should take place. The setpoints are compared to the actual process parameter value and when the measured output value of the process parameter exceeds the setpoint, the associated device (e.g., trip unit) changes state. The OPRM period based setpoint is determined by cycle specific analysis based on positive margin between the Safety Limit MCPR and the Operating Limit MCPR minus the change in CPR (ΔCPR). This methodology was approved for use by the NRC in Reference 5.
LCO	Four channels of the OPRM System are required to be OPERABLE to ensure that stability related oscillations are detected and suppressed prior to exceeding the MCPR safety limit. Only one of the two OPRM modules (with an active period based detection algorithm) is required for OPRM channel OPERABILITY. The minimum number of LPRMs required to maintain the APRM system OPERABLE per LCO 3.3.1.1 provides an adequate number of LPRMs to maintain an OPRM channel OPERABLE.
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, 3, and 9, the region of anticipated oscillation is defined by THERMAL POWER $\geq$ 25% RTP and

(continued)

BASES

APPLICABILITY (continued)

recirculation drive flow < 60% of rated recirculation drive flow. The OPRM trip is required to be enabled in this region, and the OPRM must be capable of enabling the trip function as a result of anticipated transients that place the core in that power/flow condition. Therefore the OPRM instrumentation is required to be OPERABLE with THERMAL POWER ≥ 25% RTP. It is not necessary for the OPRM instrumentation to be OPERABLE with THERMAL POWER < 25% RTP because the MCPR safety limit is not applicable below 25% RTP.

ACTIONS

A Note has been provided to modify the ACTIONS related to the OPRM instrumentation channels. Section 1.3 Completion Times, specifies that once a Condition has been entered, subsequent divisions, subsystems, components, or variables expressed in the Condition discovered to be inoperable or not within limit 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.

A Note allows delayed entry into the Conditions and Required Actions when OPRM channels are inoperable due to APRM indication not within limits in accordance with Specification 3.3.1.1. In accordance with SR 3.3.1.1.2, the APRM system is not required to be calibrated until 12 hours after thermal power ≥ 25% RTP. The APRM system provides input to the OPRM system to enable the OPRM modules at the designated enable setpoint. Because APRM calibration is not required until after 25% RTP is reached, it is possible that an APRM channel could be out of calibration above 25% RTP. If so, this could affect the operability of the affected OPRM modules. This Note is consistent with a Note in the Actions section of Specification 3.3.1.1 for the APRM system.

(continued)

BASES

ACTIONS

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

Because of the reliability and on-line self-testing of the OPRM instrumentation and the redundancy of the RPS design, an allowable out of service time of 30 days has been shown to be acceptable (Ref. 6) to permit restoration of any inoperable channel to OPERABLE status. However, this out of service time is only acceptable provided the OPRM instrumentation still maintains OPRM trip capability (refer to Required Actions B.1 and B.2 Bases). The remaining OPERABLE OPRM channels continue to provide trip capability (see Condition B) and provide operator information relative to stability activity. The remaining OPRM modules have high reliability. With this high reliability, there is a low probability of a subsequent channel failure within the allowable out of service time. In addition, the OPRM modules continue to perform on-line self-testing and alert the operator if any further system degradation occurs.

If the inoperable channel cannot be restored to OPERABLE status within the allowable out of service time, the OPRM channel or associated RPS trip system must be placed in the tripped condition per Required Actions A.1 and A.2. Placing the inoperable OPRM channel in trip (or the associated RPS trip system in trip) would conservatively compensate for the inoperability, 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, the alternate method of detecting and suppressing thermal hydraulic instability oscillation is required (Required Action A.3). This alternate method is described in Reference 7. It consists of avoidance of the region where oscillations are possible, exiting this region if it is entered due to unforeseen circumstances, and increased operator awareness and monitoring for neutron flux oscillations while taking action to exit the region. If indications of oscillation, as described in Reference 7, are observed by the operator, the operator will take the actions described by procedures, which include initiating a manual scram of the reactor. Continued operation with one OPRM channel inoperable, but not tripped, is permissible if the OPRM system maintains trip capability, since the combination

(continued)

BASES

ACTIONS

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

of the alternate method and the OPRM trip capability provides adequate protection against oscillations.

B.1 and B.2

Required Action B.1 is intended to ensure that appropriate actions are taken if multiple, inoperable, untripped OPRM channels within the same RPS trip system result in not maintaining OPRM trip capability. The OPRM trip function 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 both trip systems will generate a trip signal from the OPRM Period Based Trip Function on a valid signal.

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

C.1

With any Required Action and associated Completion Time not met, the plant must be placed in a mode or other specified

(continued)

BASES

ACTIONS

C.1 (continued)

condition in which the LCO does not apply. To achieve this status, THERMAL POWER must be reduced to < 25% RTP within 4 hours. Reducing THERMAL POWER to < 25% RTP places the plant in a region where instabilities cannot occur. The 4 hours is reasonable, based on operating experience, to reduce THERMAL POWER < 25% RTP from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

The Surveillances are modified by a Note to indicate that, when a channel is placed in an inoperable status solely for the performance of required Surveillances, entry into associated Conditions and Required Actions may be delayed for up to 6 hours, provided the associated Function maintains trip capability. Upon completion of the Surveillance, or expiration of the 6 hour allowance, the channel must be returned to OPERABLE status or the applicable Condition entered and Required Actions taken. This Note is based on the RPS reliability analysis (Ref. 8) assumption of the average time required to perform channel surveillance. That analysis demonstrated that the 6 hours testing allowance does not significantly reduce the probability that the RPS will trip when necessary.

SR 3.3.1.3.1

A CHANNEL FUNCTIONAL TEST is performed on each required channel to ensure that the channel will perform the intended function.

A Frequency of 184 days provides an acceptable level of system average unavailability over the Frequency interval and is based on the reliability analysis (Ref. 6).

SR 3.3.1.3.2

The CHANNEL CALIBRATION is a complete check of the instrument loop. This test verifies the channel responds to the measured parameter within the necessary range and accuracy. CHANNEL CALIBRATION leaves the channel adjusted to

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.3.1.3.2 (continued)

account for instrument drifts between successive calibrations, consistent with the plant specific setpoint methodology.

Calibration of the channel provides a check of the internal reference voltage and the internal processor clock frequency. It also compares the desired trip setpoint with those in the processor memory. Since the OPRM is a digital system, the internal reference voltage and processor clock frequency are, in turn, used to automatically calibrate the internal analog to digital converters. The nominal setpoints for the period based detection algorithm are specified in the COLR. As noted, neutron detectors are excluded from CHANNEL CALIBRATION because of difficulty of simulating a meaningful signal. Changes in neutron detector sensitivity are compensated for by performing the 2000 effective full power hour (EFPH) calibration against the TIPs (SR 3.3.1.1.9). SR 3.3.1.1.9 thus also ensures the operability of the OPRM instrumentation.

The nominal setpoints for the OPRM trip function for the period based detection algorithm (PBDA) are specified in the Core Operating Limits Report. The PBDA trip setpoints are the number of confirmation counts required to permit a trip signal and the peak to average amplitude required to generate a trip signal.

The Frequency of 24 months is based upon the assumption of the magnitude of equipment drift provided by the equipment supplier (Ref. 6).

SR 3.3.1.3.3

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 designated to monitor.

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.3.1.3.3 (continued)

The 24 month Frequency is based on engineering judgement and reliability of the components. Operating experience has shown these components usually pass the surveillance when performed at the 24 month Frequency.

SR 3.3.1.3.4

This SR ensures that trips initiated from the OPRM System will not be bypassed (i.e., fail to enable) when THERMAL POWER is ≥ 25% RTP and recirculation drive flow is < 60% of rated recirculation drive flow. This normally involves calibration of the bypass channels. The 25% RTP value is the plant specific value for the enable region, as described in Reference 9. The value has been conservatively rounded to coincide with the LCO Applicability.

These values have been conservatively selected so that specific, additional uncertainty allowances need not be applied. Specifically, for THERMAL POWER, the Average Power Range Monitor (APRM) establishes the reference signal to enable the OPRM system at 25% RTP. Thus, the nominal setpoints corresponding to the values listed above (25% of RTP and 60% of rated recirculation drive flow) will be used to establish the enabled region of the OPRM System trips. (References 1, 2, 5, 9, and 11)

If any bypass channel setpoint is nonconservative (i.e., the OPRM module is bypassed at ≥ 25% RTP and < 60% of rated recirculation drive flow), then the affected OPRM module is considered inoperable. Alternately, the bypass channel can be placed in the conservative condition (nonbypass). If placed in the nonbypass condition, this SR is met and the module is considered OPERABLE.

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

SR 3.3.1.3.5

This SR ensures that the individual channel response times are less than or equal to the maximum values assumed in the accident analysis. The OPRM self-test function may be

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.3.1.3.5 (continued)

utilized to perform this testing for those components it is designed to monitor. The RPS RESPONSE TIME acceptance criteria are included in Reference 10.

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 BASES. 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-39160, "BWR Owners Group Long-Term Stability Solutions Licensing Methodology," June 1991.

2. NEDO-31960, "BWR Owners Group Long-Term Stability Solutions Licensing Methodology," Supplement 1, March 1992.

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

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

5. NEDO-32465-A, "BWR Owners Group Reactor Stability Detect and Suppress Solution Licensing Basis Methodology and Reload Application," August 1996.

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

7. BWROG Letter BWROG-9479, "Guidelines for Stability Interim Correction Action," June 6, 1994.

(continued)

BASES

REFERENCES (continued)

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

9. GE-NE-A22-00103-04-01, Rev. 0, Class III, "Dresden and Quad Cities Extended Power Uprate Task Report, Task 0202: Thermal Hydraulic Stability," October 2000.

10. Technical Requirements Manual.

11. Letter from K. P. Donovan (BWR Owners' Group) to U. S. NRC, "Guidelines for Stability Option III 'Enabled Region,'" dated September 17, 1996

Attachment 4

Technical Specifications Typed Pages for Dresden Nuclear Power Station

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3.3.1.3-2 (new page)
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3.3 INSTRUMENTATION

3.3.1.3 Oscillation Power Range Monitor (OPRM) Instrumentation

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

APPLICABILITY: THERMAL POWER ≥ 25% RTP.

ACTIONS

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

1. Separate Condition entry is allowed for each channel.

2. When OPRM channels are inoperable due to APRM indication not within limits in accordance with Specification 3.3.1.1, entry into associated Conditions and Required Actions may be delayed for up to 2 hours if the APRM is indicating a lower power value than the calculated power, and for up to 12 hours if the APRM is indicating a higher power value than the calculated power.

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

(continued)

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
B. OPRM trip capability not maintained.	B.1	Initiate alternate method to detect and suppress thermal hydraulic instability oscillations.	12 hours
	AND		
	B.2	Restore OPRM trip capability.	120 days
C. Required Action and associated Completion Time not met.	C.1	Reduce THERMAL POWER < 25% RTP.	4 hours

SURVEILLANCE REQUIREMENTS

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

SURVEILLANCE		FREQUENCY
SR 3.3.1.3.1	Perform CHANNEL FUNCTIONAL TEST.	184 days
SR 3.3.1.3.2	-----NOTE----- Neutron detectors are excluded. ----- Perform CHANNEL CALIBRATION. The setpoints for the trip function shall be as specified in the COLR.	24 months
SR 3.3.1.3.3	Perform LOGIC SYSTEM FUNCTIONAL TEST.	24 months
SR 3.3.1.3.4	Verify OPRM is not bypassed when THERMAL POWER is ≥ 25% RTP and recirculation drive flow is < 60% of rated recirculation drive flow.	24 months
SR 3.3.1.3.5	-----NOTE----- Neutron detectors are excluded. ----- Verify the RPS RESPONSE TIME is within limits.	24 months on a STAGGERED TEST BASIS

5.6 Reporting Requirements

5.6.5 CORE OPERATING LIMITS REPORT (COLR) (continued)

3. The LHGR for Specification 3.2.3.

4. Control Rod Block Instrumentation Setpoint for the Rod Block Monitor—Upscale Function Allowable Value for Specification 3.3.2.1.

5. The OPRM setpoints for the trip function for SR 3.3.1.3.2

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

1. ANF-1125(P)(A), "Critical Power Correlation - ANFB."

2. ANF-524(P)(A), "ANF Critical Power Methodology for Boiling Water Reactors."

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

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

5. XN-NF-85-67(P)(A), "Generic Mechanical Design for Exxon Nuclear Jet Pump Boiling Water Reactors Reload Fuel."

6. ANF-913(P)(A), "CONTRANSA2: A Computer Program for Boiling Water Reactor Transient Analysis."

7. XN-NF-82-06(P)(A), Qualification of Exxon Nuclear Fuel for Extended Burnup Supplement 1 Extended Burnup Qualification of ENC 9x9 BWR Fuel.

8. ANF-89-14(P)(A), Advanced Nuclear Fuels Corporation Generic Mechanical Design for Advance Nuclear Fuels Corporation 9x9-IX and 9x9-9X BWR Reload Fuel.

(continued)

5.6 Reporting Requirements

5.6.5 CORE OPERATING LIMITS REPORT (COLR) (continued)

9. ANF-89-98(P)(A), Generic Mechanical Design Criteria for BWR Fuel Designs.

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

11. Commonwealth Edison Company Topical Report NFSR-0091, "Benchmark of CASMO/MICROBURN BWR Nuclear Design Methods."

12. EMF-85-74(P), RODEX2A (BWR) Fuel Rod Thermal Mechanical Evaluation Model.

13. NEDE-224011-P-A, "General Electric Standard Application for Reactor Fuel (GESTAR)."

14. NEDC-32981P, "GEXL96 Correlation for ATRIUM 9B Fuel," September 2000.

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

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

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 Post Accident Monitoring (PAM) Instrumentation Report

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

Attachment 5

Technical Specifications Markup Pages for Quad Cities Nuclear Power Station

Pages

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3.3.1.3-1 (new page)

3.3.1.3-2 (new page)

3.3.1.3-3 (new page)

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3.3 INSTRUMENTATION

3.3.1.3 Oscillation Power Range Monitor (OPRM) Instrumentation

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

APPLICABILITY: THERMAL POWER $\geq$ 25% RTP.

ACTIONS

-----NOTES-----

1. Separate Condition entry is allowed for each channel.

2. When OPRM channels are inoperable due to APRM indication not within limits in accordance with Specification 3.3.1.1, entry into associated Conditions and Required Actions may be delayed for up to 2 hours if the APRM is indicating a lower power value than the calculated power, and for up to 12 hours if the APRM is indicating a higher power value than the calculated power.

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

(continued)

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
B. OPRM trip capability not maintained.	B.1	Initiate alternate method to detect and suppress thermal hydraulic instability oscillations.	12 hours
	<u>AND</u>		
	B.2	Restore OPRM trip capability.	120 days
C. Required Action and associated Completion Time not met.	C.1	Reduce THERMAL POWER < 25% RTP.	4 hours

SURVEILLANCE REQUIREMENTS

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

SURVEILLANCE		FREQUENCY
SR 3.3.1.3.1	Perform CHANNEL FUNCTIONAL TEST.	184 days
SR 3.3.1.3.2	-----NOTE----- Neutron detectors are excluded. ---------- Perform CHANNEL CALIBRATION. The setpoints for the trip function shall be as specified in the COLR.	24 months
SR 3.3.1.3.3	Perform LOGIC SYSTEM FUNCTIONAL TEST.	24 months
SR 3.3.1.3.4	Verify OPRM is not bypassed when THERMAL POWER is ≥ 25% RTP and recirculation drive flow is < 60% of rated recirculation drive flow.	24 months
SR 3.3.1.3.5	-----NOTE----- Neutron detectors are excluded. ---------- Verify the RPS RESPONSE TIME is within limits.	24 months on a STAGGERED TEST BASIS

5.6 Reporting Requirements

5.6.5 CORE OPERATING LIMITS REPORT (COLR) (continued)

3. The LHGR for Specification 3.2.3.

4. Control Rod Block Instrumentation Setpoint for the Rod Block Monitor—Upscale Function Allowable Value for Specification 3.3.2.1.

5. The OPRM setpoints for the trip function for SR 3.3.1.3.2.

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

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

2. Commonwealth Edison Topical Report NFSR-0085, "Benchmark of BWR Nuclear Design Methods."

3. Advanced Nuclear Fuels Methodology for Boiling Water Reactors, XN-NF-80-19(P)(A).

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

5. Qualification of Exxon Nuclear Fuel for Extended Burnup, XN-NF-82-06(P)(A).

6. Advanced Nuclear Fuels Corporation Generic Mechanical Design for Advanced Nuclear Fuels 9x9-IX and 9x9-9X BWR Reload Fuel, ANF-89-014(P)(A).

7. Generic Mechanical Design Criteria for BWR Fuel Designs, ANF-89-98(P)(A).

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

9. ANFB Critical Power Correlation, ANF-1125(P)(A).

(continued)

5.6 Reporting Requirements

5.6.5 CORE OPERATING LIMITS REPORT (COLR) (continued)

10. Advanced Nuclear Fuels Corporation Critical Power Methodology for Boiling Water Reactors/Advanced Nuclear Fuels Corporation Critical Power Methodology for Boiling Water Reactors: Methodology for Analysis of Assembly Channel Bowing Effects/NRC Correspondence, ANF-524(P)(A).

11. COTRANSA 2: A Computer Program for Boiling Water Reactor Transient Analyses, ANF-913(P)(A).

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

13. Commonwealth Edison Topical Report NFSR-0091, "Benchmark of CASMO/MICROBURN BWR Nuclear Design Methods."

14. ANFB Critical Power Correlation Application for Coresident Fuel, EMF-1125(P)(A).

15. EMF-85-74(P), RODEX2A(BWR) Fuel Rod Thermal Mechanical Evaluation Model, Supplement 1(P)(A) and Supplement 2 (P)(A), Siemens Power Corporation, February 1998.

16. NEDC-32981P, "GEXL96 Correction for ATRIUM 9B Fuel."

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

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

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.

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Attachment 6

Bases Markup Pages for Quad Cities Nuclear Power Station

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BASES

SURVEILLANCE REQUIREMENTS

SR 3.3.1.1.6 and SR 3.3.1.1.7 (continued)

A Frequency of 7 days is reasonable based on engineering judgment and the reliability of the IRMs and APRMs.

SR 3.3.1.1.9

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 APRM System. The 2000 effective full power hours (EFPH) Frequency is based on operating experience with LPRM sensitivity changes.

SR 3.3.1.1.9 also ensures the operability of the OPRM system (Specification 3.3.1.3).

SR 3.3.1.1.10 and SR 3.3.1.1.15

A CHANNEL FUNCTIONAL TEST is performed on each required channel to ensure that the channel will perform the intended function. A successful test of the required contact(s) of a channel relay may be performed by the verification of the change of state of a single contact of the relay. This clarifies what is an acceptable CHANNEL FUNCTIONAL TEST of a relay. This is acceptable because all of the other required contacts of the relay are verified by other Technical Specifications and non-Technical Specifications tests at least once per refueling interval with applicable extensions. Any setpoint adjustment shall be consistent with the assumptions of the current plant specific setpoint methodology.

The 92 day Frequency of SR 3.3.1.1.10 is based on the reliability analysis of Reference 13. The 24 month Frequency of SR 3.3.1.1.15 is based on the need to perform this Surveillance under the conditions that apply during a plant outage and the potential for an unplanned transient if the Surveillance were performed with the reactor at power. Operating experience has shown that these components usually pass the Surveillance when performed at the 24 month Frequency.

(continued)

B 3.3 INSTRUMENTATION

B 3.3.1.3 OSCILLATION POWER RANGE MONITOR (OPRM) INSTRUMENTATION

BASES

BACKGROUND

General Design Criteria 10 (GDC 10) requires the reactor core and associated coolant, control, and protection systems to be designed with appropriate margin to assure that acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences. Additionally, GDC 12 requires the reactor core and associated coolant, control and protection systems to be designed to assure that power oscillations which can result in conditions exceeding acceptable fuel design limits are either not possible or can be reliably and readily detected and suppressed. The OPRM System provides compliance with GDC 10 and GDC 12, thereby providing protection from exceeding the fuel 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, "Reactor Protection System (RPS) Instrumentation." Only the period based detection algorithm is used for safety analysis. The remaining algorithms provide defense in depth and additional protection against unanticipated oscillations.

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

(continued)

BASES

BACKGROUND (continued)

The OPRM System consists of 4 OPRM trip channels, each channel consisting of two OPRM modules. Each OPRM module receives input from LPRMs. Each OPRM module also receives input from the RPS average power range monitor (APRM) power and flow signals to automatically enable the trip function of the OPRM module. The outputs of the OPRM trip channels input to the associated RPS trip channels which are configured into a one-out-of-two taken twice trip logic as described in the Bases for Section 3.3.1.1.

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

APPLICABLE SAFETY ANALYSES

It has been shown that BWR cores may exhibit thermal-hydraulic reactor instabilities in high power and low flow portions of the core power to flow operating domain (Reference 4). 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.

The OPRM Instrumentation satisfies Criterion 3 of 10 CFR 50.36(c)(2)(ii).

The OPERABILITY of the OPRM System is dependent on the OPERABILITY of the four individual instrumentation channels with their setpoints within the specified nominal setpoint. Each channel must also respond within its assumed response time.

(continued)

BASES

APPLICABLE SAFETY ANALYSES (continued)	The nominal setpoints for the OPRM Period Based Trip Function are specified in the Core Operating Limits Report. The trip setpoints are treated as nominal setpoints and do not include additional allowances for uncertainty. Trip setpoints are those predetermined values of output at which an action should take place. The setpoints are compared to the actual process parameter value and when the measured output value of the process parameter exceeds the setpoint, the associated device (e.g., trip unit) changes state. The OPRM period based setpoint is determined by cycle specific analysis based on positive margin between the Safety Limit MCPR and the Operating Limit MCPR minus the change in CPR (ΔCPR). This methodology was approved for use by the NRC in Reference 5.
LCO	Four channels of the OPRM System are required to be OPERABLE to ensure that stability related oscillations are detected and suppressed prior to exceeding the MCPR safety limit. Only one of the two OPRM modules (with an active period based detection algorithm) is required for OPRM channel OPERABILITY. The minimum number of LPRMs required to maintain the APRM system OPERABLE per LCO 3.3.1.1 provides an adequate number of LPRMs to maintain an OPRM channel OPERABLE.
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, 3, and 9, the region of anticipated oscillation is defined by THERMAL POWER ≥ 25% RTP and

(continued)

BASES

APPLICABILITY (continued)	recirculation drive flow < 60% of rated recirculation drive flow. The OPRM trip is required to be enabled in this region, and the OPRM must be capable of enabling the trip function as a result of anticipated transients that place the core in that power/flow condition. Therefore the OPRM instrumentation is required to be OPERABLE with THERMAL POWER ≥ 25% RTP. It is not necessary for the OPRM instrumentation to be OPERABLE with THERMAL POWER < 25% RTP because the MCPR safety limit is not applicable below 25% RTP.
ACTIONS	A Note has been provided to modify the ACTIONS related to the OPRM instrumentation channels. Section 1.3 Completion Times, specifies that once a Condition has been entered, subsequent divisions, subsystems, components, or variables expressed in the Condition discovered to be inoperable or not within limit 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. A Note allows delayed entry into the Conditions and Required Actions when OPRM channels are inoperable due to APRM indication not within limits in accordance with Specification 3.3.1.1. In accordance with SR 3.3.1.1.2, the APRM system is not required to be calibrated until 12 hours after thermal power ≥ 25% RTP. The APRM system provides input to the OPRM system to enable the OPRM modules at the designated enable setpoint. Because APRM calibration is not required until after 25% RTP is reached, it is possible that an APRM channel could be out of calibration above 25% RTP. If so, this could affect the operability of the affected OPRM modules. This Note is consistent with a Note in the Actions section of Specification 3.3.1.1 for the APRM system.

(continued)

BASES

ACTIONS

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

Because of the reliability and on-line self-testing of the OPRM instrumentation and the redundancy of the RPS design, an allowable out of service time of 30 days has been shown to be acceptable (Ref. 6) to permit restoration of any inoperable channel to OPERABLE status. However, this out of service time is only acceptable provided the OPRM instrumentation still maintains OPRM trip capability (refer to Required Actions B.1 and B.2 Bases). The remaining OPERABLE OPRM channels continue to provide trip capability (see Condition B) and provide operator information relative to stability activity. The remaining OPRM modules have high reliability. With this high reliability, there is a low probability of a subsequent channel failure within the allowable out of service time. In addition, the OPRM modules continue to perform on-line self-testing and alert the operator if any further system degradation occurs.

If the inoperable channel cannot be restored to OPERABLE status within the allowable out of service time, the OPRM channel or associated RPS trip system must be placed in the tripped condition per Required Actions A.1 and A.2. Placing the inoperable OPRM channel in trip (or the associated RPS trip system in trip) would conservatively compensate for the inoperability, 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, the alternate method of detecting and suppressing thermal hydraulic instability oscillation is required (Required Action A.3). This alternate method is described in Reference 7. It consists of avoidance of the region where oscillations are possible, exiting this region if it is entered due to unforeseen circumstances, and increased operator awareness and monitoring for neutron flux oscillations while taking action to exit the region. If indications of oscillation, as described in Reference 7, are observed by the operator, the operator will take the actions described by procedures, which include initiating a manual scram of the reactor. Continued operation with one OPRM channel inoperable, but not tripped, is permissible if the OPRM system maintains trip capability, since the combination

(continued)

BASES

ACTIONS

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

of the alternate method and the OPRM trip capability provides adequate protection against oscillations.

B.1 and B.2

Required Action B.1 is intended to ensure that appropriate actions are taken if multiple, inoperable, untripped OPRM channels within the same RPS trip system result in not maintaining OPRM trip capability. The OPRM trip function 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 both trip systems will generate a trip signal from the OPRM Period Based Trip Function on a valid signal.

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

C.1

With any Required Action and associated Completion Time not met, the plant must be placed in a mode or other specified

(continued)

BASES

ACTIONS

C.1 (continued)

condition in which the LCO does not apply. To achieve this status, THERMAL POWER must be reduced to < 25% RTP within 4 hours. Reducing THERMAL POWER to < 25% RTP places the plant in a region where instabilities cannot occur. The 4 hours is reasonable, based on operating experience, to reduce THERMAL POWER < 25% RTP from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

The Surveillances are modified by a Note to indicate that, when a channel is placed in an inoperable status solely for the performance of required Surveillances, entry into associated Conditions and Required Actions may be delayed for up to 6 hours, provided the associated Function maintains trip capability. Upon completion of the Surveillance, or expiration of the 6 hour allowance, the channel must be returned to OPERABLE status or the applicable Condition entered and Required Actions taken. This Note is based on the RPS reliability analysis (Ref. 8) assumption of the average time required to perform channel surveillance. That analysis demonstrated that the 6 hours testing allowance does not significantly reduce the probability that the RPS will trip when necessary.

SR 3.3.1.3.1

A CHANNEL FUNCTIONAL TEST is performed on each required channel to ensure that the channel will perform the intended function.

A Frequency of 184 days provides an acceptable level of system average unavailability over the Frequency interval and is based on the reliability analysis (Ref. 6).

SR 3.3.1.3.2

The CHANNEL CALIBRATION is a complete check of the instrument loop. This test verifies the channel responds to the measured parameter within the necessary range and accuracy. CHANNEL CALIBRATION leaves the channel adjusted to

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.3.1.3.2 (continued)

account for instrument drifts between successive calibrations, consistent with the plant specific setpoint methodology.

Calibration of the channel provides a check of the internal reference voltage and the internal processor clock frequency. It also compares the desired trip setpoint with those in the processor memory. Since the OPRM is a digital system, the internal reference voltage and processor clock frequency are, in turn, used to automatically calibrate the internal analog to digital converters. The nominal setpoints for the period based detection algorithm are specified in the COLR. As noted, neutron detectors are excluded from CHANNEL CALIBRATION because of difficulty of simulating a meaningful signal. Changes in neutron detector sensitivity are compensated for by performing the 2000 effective full power hour (EFPH) calibration against the TIPs (SR 3.3.1.1.9). SR 3.3.1.1.9 thus also ensures the operability of the OPRM instrumentation.

The nominal setpoints for the OPRM trip function for the period based detection algorithm (PBDA) are specified in the Core Operating Limits Report. The PBDA trip setpoints are the number of confirmation counts required to permit a trip signal and the peak to average amplitude required to generate a trip signal.

The Frequency of 24 months is based upon the assumption of the magnitude of equipment drift provided by the equipment supplier (Ref. 6).

SR 3.3.1.3.3

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 designated to monitor.

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.3.1.3.3 (continued)

The 24 month Frequency is based on engineering judgement and reliability of the components. Operating experience has shown these components usually pass the surveillance when performed at the 24 month Frequency.

SR 3.3.1.3.4

This SR ensures that trips initiated from the OPRM System will not be bypassed (i.e., fail to enable) when THERMAL POWER is ≥ 25% RTP and recirculation drive flow is < 60% of rated recirculation drive flow. This normally involves calibration of the bypass channels. The 25% RTP value is the plant specific value for the enable region, as described in Reference 9. The value has been conservatively rounded to coincide with the LCO Applicability.

These values have been conservatively selected so that specific, additional uncertainty allowances need not be applied. Specifically, for THERMAL POWER, the Average Power Range Monitor (APRM) establishes the reference signal to enable the OPRM system at 25% RTP. Thus, the nominal setpoints corresponding to the values listed above (25% of RTP and 60% of rated recirculation drive flow) will be used to establish the enabled region of the OPRM System trips. (References 1, 2, 5, 9, and 11)

If any bypass channel setpoint is nonconservative (i.e., the OPRM module is bypassed at ≥ 25% RTP and < 60% of rated recirculation drive flow), then the affected OPRM module is considered inoperable. Alternately, the bypass channel can be placed in the conservative condition (nonbypass). If placed in the nonbypass condition, this SR is met and the module is considered OPERABLE.

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

SR 3.3.1.3.5

This SR ensures that the individual channel response times are less than or equal to the maximum values assumed in the accident analysis. The OPRM self-test function may be

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.3.1.3.5 (continued)

utilized to perform this testing for those components it is designed to monitor. The RPS RESPONSE TIME acceptance criteria are included in Reference 10.

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 BASES. 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-39160, "BWR Owners Group Long-Term Stability Solutions Licensing Methodology," June 1991.

2. NEDO-31960, "BWR Owners Group Long-Term Stability Solutions Licensing Methodology," Supplement 1, March 1992.

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

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

5. NEDO-32465-A, "BWR Owners Group Reactor Stability Detect and Suppress Solution Licensing Basis Methodology and Reload Application," August 1996.

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

7. BWROG Letter BWROG-9479, "Guidelines for Stability Interim Correction Action," June 6, 1994.

(continued)

BASES

REFERENCES (continued)

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

9. GE-NE-A22-00103-04-01, Rev. 0, Class III, "Dresden and Quad Cities Extended Power Uprate Task Report, Task 0202: Thermal Hydraulic Stability," October 2000.

10. Technical Requirements Manual.

11. Letter from K. P. Donovan (BWR Owners' Group) to U. S. NRC, "Guidelines for Stability Option III 'Enabled Region,'" dated September 17, 1996.

Attachment 7

Technical Specifications Typed Pages for Quad Cities Nuclear Power Station

<u>Pages</u>
i
3.3.1.3-1 (new page)
3.3.1.3-2 (new page)
3.3.1.3-3 (new page)
5.6-3
5.6-4

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(continued)

3.3 INSTRUMENTATION

3.3.1.3 Oscillation Power Range Monitor (OPRM) Instrumentation

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

APPLICABILITY: THERMAL POWER ≥ 25% RTP.

ACTIONS

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

1. Separate Condition entry is allowed for each channel.
2. When OPRM channels are inoperable due to APRM indication not within limits in accordance with Specification 3.3.1.1, entry into associated Conditions and Required Actions may be delayed for up to 2 hours if the APRM is indicating a lower power value than the calculated power, and for up to 12 hours if the APRM is indicating a higher power value than the calculated power.

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

(continued)

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
B. OPRM trip capability not maintained.	B.1	Initiate alternate method to detect and suppress thermal hydraulic instability oscillations.	12 hours
	<u>AND</u>		
	B.2	Restore OPRM trip capability.	120 days
C. Required Action and associated Completion Time not met.	C.1	Reduce THERMAL POWER < 25% RTP.	4 hours

SURVEILLANCE REQUIREMENTS

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

SURVEILLANCE		FREQUENCY
SR 3.3.1.3.1	Perform CHANNEL FUNCTIONAL TEST.	184 days
SR 3.3.1.3.2	-------------------NOTE------------------- Neutron detectors are excluded. -- Perform CHANNEL CALIBRATION. The setpoints for the trip function shall be as specified in the COLR.	24 months
SR 3.3.1.3.3	Perform LOGIC SYSTEM FUNCTIONAL TEST.	24 months
SR 3.3.1.3.4	Verify OPRM is not bypassed when THERMAL POWER is ≥ 25% RTP and recirculation drive flow is < 60% of rated recirculation drive flow.	24 months
SR 3.3.1.3.5	-------------------NOTE------------------- Neutron detectors are excluded. -- Verify the RPS RESPONSE TIME is within limits.	24 months on a STAGGERED TEST BASIS

5.6 Reporting Requirements

5.6.5 CORE OPERATING LIMITS REPORT (COLR) (continued)

3. The LHGR for Specification 3.2.3.

4. Control Rod Block Instrumentation Setpoint for the Rod Block Monitor—Upscale Function Allowable Value for Specification 3.3.2.1.

5. The OPRM setpoints for the trip function for SR 3.3.1.3.2.

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

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

2. Commonwealth Edison Topical Report NFSR-0085, "Benchmark of BWR Nuclear Design Methods."

3. Advanced Nuclear Fuels Methodology for Boiling Water Reactors, XN-NF-80-19(P)(A).

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

5. Qualification of Exxon Nuclear Fuel for Extended Burnup, XN-NF-82-06(P)(A).

6. Advanced Nuclear Fuels Corporation Generic Mechanical Design for Advanced Nuclear Fuels 9x9-IX and 9x9-9X BWR Reload Fuel, ANF-89-014(P)(A).

7. Generic Mechanical Design Criteria for BWR Fuel Designs, ANF-89-98(P)(A).

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

9. ANFB Critical Power Correlation, ANF-1125(P)(A).

(continued)

5.6 Reporting Requirements

5.6.5 CORE OPERATING LIMITS REPORT (COLR) (continued)

10. Advanced Nuclear Fuels Corporation Critical Power Methodology for Boiling Water Reactors/Advanced Nuclear Fuels Corporation Critical Power Methodology for Boiling Water Reactors: Methodology for Analysis of Assembly Channel Bowing Effects/NRC Correspondence, ANF-524(P)(A).

11. COTRANSA 2: A Computer Program for Boiling Water Reactor Transient Analyses, ANF-913(P)(A).

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

13. Commonwealth Edison Topical Report NFSR-0091, "Benchmark of CASMO/MICROBURN BWR Nuclear Design Methods."

14. ANFB Critical Power Correlation Application for Coresident Fuel, EMF-1125(P)(A).

15. EMF-85-74(P), RODEX2A(BWR) Fuel Rod Thermal Mechanical Evaluation Model, Supplement 1(P)(A) and Supplement 2 (P)(A), Siemens Power Corporation, February 1998.

16. NEDC-32981P, "GEXL96 Correction for ATRIUM 9B Fuel."

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

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

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.

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