2.0 SYSTEM DESCRIPTION

Using the existing local power range monitors (LPRMs) and the recirculation coolant loop flows, the NUMAC-PRNMS provides APRM and OPRM trip signals to the RPS. The APRM system averages LPRM signals, processes flow signals from the reactor core recirculation flow instrumentation, and then compares the results to RPS trip setpoints. The OPRM detects and suppresses reactor core power instabilities using the Option III approach described in LTR NEDO-31960, "BWR Owners' Group Long-Term Stability Solutions Licensing Methodology," dated June 1991, which was approved by the staff.

The GE NUMAC-PRNMS consists of four APRM channels and four voter channels. Trip signals from each of the four APRM channels are sent to all four voter channels. One voter module is dedicated to each RPS trip relay. A trip from any one unbypassed APRM will result in a "half-trip" in all four of the voter channels, but no trip inputs to either RPS trip system. A reactor trip occurs when two or more of the four APRM functions or two or more of the four OPRM functions calculate a trip condition. The voters perform a vote of the OPRM channel trip outputs separate from the APRM trip outputs (i.e., an OPRM trip in one channel and an APRM trip in another channel will not result in a reactor trip from two of four voters in a trip state).

The NUMAC-PRNM system provides LPRM, APRM, recirculation flow values, APRM upscale, downscale, bypass, and inoperative; rod block monitor (RBM) upscale, downscale, bypass, and inoperative; flow reference; and flow compare signals in digital form. This information is input to the plant computer through a multiplexed fiber-optic data link, except for the sequence of events monitoring, for which existing interfaces are being retained. To allow connection to existing interfaces in the plant computer system, an intermediate Multi-Vendor Data Acquisition System (MVDAS) will be added to transform the digital information on the multiplexed fiber-optic data link to a form that can be accepted by the plant computer system.

The MVDAS is a microprocessor controlled VersaModule Eurocard (VME) bus-based assembly that uses commercial components. Software to control the unit and databases to identify points, assign analog outputs, and assign position in data streams are downloaded into the MVDAS as part of the setup process. The MVDAS unit logic includes health checks to ensure correct operation. All multiplexed messages include error checking codes to detect message errors during transmission. Critical messages from the NUMAC-PRNM system to the MVDAS include diagnostic assessments that can detect loss of incoming signals. Internal checks in the MVDAS include hardware checks to ensure that the MVDAS is functioning and assessing hardware performance. These checks include clock monitors, memory monitors, and remote device response monitors.

The MVDAS receives the digital information and produces analog outputs via digital-to-analog output cards and bistable digital outputs via digital output cards to connect to the existing computer system. The MVDAS also provides bidirectional communications between the NUMAC-PRNM system and the 3D Monicore computer through an Ethernet connection. Data available to the 3D Monicore computer includes reactor power stability data, LPRM/APRM gains, and LPRM current to voltage test data. Additionally, the 3D Monicore computer can send percent core thermal power for APRM gain calculations and LPRM gain adjustment factors to the NUMAC-PRNM system. The gain adjustment factors are applied only after manual acceptance of the factors at the NUMAC-PRNM system equipment.

3.0 EVALUATION

As stated in the staff's safety evaluation of NEDC-32410P, to receive NRC approval of a NUMAC-PRNMS installation, a licensee must confirm:

1. The applicability of NEDC-32410P, including clarifications and reconciled differences between the specific plant design and the topical report design descriptions,

2. The applicability of the BWR Owners' Group topical reports that address the NUMAC-PRNMS and associated instability functions, setpoints and margins,

3. Plant-specific revised TSs for the NUMAC-PRNM system functions are consistent with NEDC-32410P, Appendix H, and Supplement 1,

4. Plant-specific environmental conditions are enveloped by the NUMAC-PRNM system equipment environmental qualification values,

5. Administrative controls are provided for manually bypassing APRM/OPRM channels or protective functions, and for controlling access to the APRM/OPRM panel and channel bypass switch, and

6. Any changes to the plant operator's panel have received human factors reviews per plant-specific procedures.

The licensee's actions for NMP2 with regard to the above conditions are discussed in the following sections.

3.1 Applicability of the NUMAC-PRNM System Design to the NMP2 Plant Design

The NRC staff compared the applicable NMP2 design features with the corresponding design features in NEDC-32410P-A. The NMP2 unit is a GE BWR/5; a BWR design addressed in the LTR. Consistent with the LTR system description, the six APRM channels currently used in NMP2 will be combined into four 2-out-of-4 logic channels that will provide inputs through dedicated RPS channel voters to the four RPS channels. These proposed design modifications conform to the NUMAC-PRNM system design description in NEDC-32410P-A, and are compatible with the existing plant neutron monitoring system and RPS. Therefore, the staff finds that the NUMAC-PRNMS design is applicable to the NMP2 unit.

MVDAS health checks, error checking, man-machine interfaces, and software/hardware diagnostics are design features that monitor system integrity and minimize the effects of the new failure modes introduced by the MVDAS. These modes and effects were evaluated in a failure modes and effects analysis of the MVDAS. Integration of the microprocessor-based MVDAS into the operating practices of the NUMAC-PRNM system will include configuration of the MVDAS system integrity functions to minimize the failure effects. Fiber optic connections isolate the MVDAS from the safety functions of the NUMAC-PRNMS. Additionally, operator actions to operate and maintain the MVDAS will be implemented into applicable plant procedures. These actions provide an acceptable basis for staff approval.

The existing Note (f) states:

(f) Verify measured core flow (total core flow) to be in the range of established core flow at the existing loop flow (APRM%).

The proposed Note (f) states:

(f) Calibration includes the flow input function.

This change is consistent with NEDC-32410P-A, which states that plants with four channels of flow instrumentation should delete requirements for daily flow signal comparisons and replace this requirement with a Channel Functional Test (CFT) and automatic comparison of all four recirculation flow values.

The licensee proposes to change the shiftly channel checks to daily channel checks and delete the requirement for flow signal channel checks prior to startup because NMP2 TS SR 4.0.4 requires a surveillance prior to entry into the applicable operational conditions. Consequently, this change is essentially an administrative change. The NRC staff, therefore, finds this change acceptable.

The existing TS requires a weekly CFT for the Neutron Flux-Upscale, Setdown function and a CFT 24 hours prior to startup (if not performed within the previous 7 days - Note (c)). A quarterly CFT is also required for the Flow-Biased Simulated Thermal Power-Upscale and Fixed Neutron Flux-Upscale functions, and 24 hours prior to startup as described in Note (c).

The licensee proposes APRM function CFTs on a semiannual frequency. This frequency is consistent with NEDC-32410P-A and, therefore, is acceptable.

The licensee proposes adding Note (h) to TS Table 4.3.1.1-1. Note (h) requires the inclusion of the flow input function when performing a CFT of the APRM Flow-Biased Simulated Thermal-Upscale Function. The flow transmitters are excluded from this requirement. This change is consistent with NEDC-32410P-A and, therefore, is acceptable.

The licensee proposes adding Note (i) to TS Table 4.3.1.1-1. Note (i) allows operation for 12 hours without performing functional testing when entering OC 2 (Mode 2 in NEDC-32410P-A) from OC 1 (Mode 1 in NEDC-32410P-A). This change is consistent with NEDC-32410P-A and, therefore, is acceptable.

The existing TS requires a semiannual channel calibration for the Neutron Flux-Upscale, Setdown function. A channel calibration of the Flow-Biased Simulated Thermal Power-Upscale function is required weekly to adjust the APRM flow-biased channel to conform to a calibrated flow signal, and semiannually and during refuel outages to verify the simulated thermal power time constant is 6±0.6 seconds. The Fixed Neutron Flux-Upscale calibration is required weekly and semi-annually. The Inoperative function does not require calibration.

The proposed changes revise the calibration intervals of the Neutron Flux-Upscale, Setdown, Flow-Biased Simulated Thermal Power-Upscale, and Fixed Neutron Flux-Upscale from semi-annual to refuel cycle frequency, and delete the existing Note (h) and Note (i). The Flow-Biased Simulated Thermal Power-Upscale refuel cycle calibration interval is clarified by revising Note (f) to require that the calibrations include the flow input function. A channel calibration of the 2-out-of-4 voter function is not required and is indicated as such. The licensee proposes that

surveillances be required for OCs 1, 2, and 5 (while shutdown margin demonstrations are being performed in accordance with TS 3.10.3). These changes are consistent with NEDC-32410P-A and, therefore, are acceptable.

3.3.5 Changes to TS 4.3.1.3, Response Time Testing

In May 1997, following issuance of Licensing Amendment 73 by the NRC, the licensee relocated response time testing requirements from TS 4.3.1.3 (Surveillance Requirements) to Table 7.2-3 (Reactor Protection System Response Times) of the NMP2 Updated Safety Analysis Report (USAR). The licensee committed to add the 2-out-of-4 voter function and response time in the next USAR amendment. Section 8.3.4.4.2 of NEDC-32410P-A recommended deletion of the response time testing requirements for APRM electronics and the 2-out-of-4 logic module portion of the APRM functions (0.04s of the 0.09s response requirement). The topical report further recommended that licensees retain the requirement for response time testing from the 2-out-of-4 logic module output relays through the RPS contactors (0.05s of the 0.09s response requirement). Accordingly, the licensee deleted the digital portion of the APRM function response time testing from the NMP2 TS surveillance requirements. APRM response time testing will be staggered such that all of the 2-out-of-4 voter output relays and associated K12 relays will be tested once per two refueling outages. The APRM function staggered testing frequency is consistent with NEDC-32410P-A and, therefore, is acceptable.

3.3.6 Changes to TS Table 4.3.6-1, Control Rod Block Instrumentation Surveillance Requirements

The existing TS Table 4.3.6-1 requires CFTs of the Rod Block Monitor and Reactor Coolant System Recirculation Flow functions quarterly and 24 hours prior to reactor startup. The licensee proposes semiannual CFTs and deletion of a CFT 24 hours prior to reactor startup. These changes are consistent with NEDC-32410P-A and, therefore, are acceptable.

The existing TS Table 4.3.6-1 requires quarterly channel calibrations of the Rod Block Monitor and Reactor Coolant System Recirculation Flow functions. The licensee proposes calibrations of these function each refueling cycle. These changes are consistent with NEDC-32410P-A and, therefore, are acceptable.

The licensee proposes the addition of a brief description of the NUMAC-PRNM system in Bases Section 3/4.3.1, Reactor Protection System Instrumentation. The licensee also clarified Note(l) of Table 3.3.1-1, regarding the actions to be taken when an APRM channel is inoperable. These Bases discussions are consistent with NEDC-32410P-A and the NUMAC-PRNM system configuration and, therefore, are acceptable.

The NRC staff finds that the proposed NMP2 TS and associated Bases conform to the staff-approved model TS and approved LTR custom TS in NEDO-32410P-A, Appendix H, and Supplement 1. The staff further finds that the proposed amendments to the NMP2 TS are consistent with the design of the NUMAC-PRNM system, and the existing design of the NMP2 units, and, therefore, are acceptable.