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U.S. Nuclear Regulatory Commission
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Limerick Generating Station, Units 1 and 2
Facility Operating License Nos. NPF-39 and NPF-85
NRC Docket Nos. 50-352 and 50-353

Subject: Response to Request for Additional Information
License Amendment Request
Activation of the Trip Outputs of the Oscillation Power Range Monitor Portion of the Power Range Neutron Monitoring System

References: (1) Letter from K. R. Jury, Exelon Generation Company, LLC, to U. S. Nuclear Regulatory Commission, dated May 20, 2004

(2) Letter from T. L. Tate, U. S. Nuclear Regulatory Commission, to C. M. Crane, Exelon Generation Company, LLC, dated January 19, 2005.

In Reference 1, Exelon Generation Company, LLC (Exelon), requested a change to the Technical Specifications (TS), Appendix A, of Facility Operating License Nos. NPF-39 and NPF-85 for Limerick Generating Station (LGS), Units 1 and 2, respectively. The proposed change supports the activation of the trip outputs of the previously-installed Oscillation Power Range Monitor (OPRM) portion of the General Electric (GE) Nuclear Measurement Analysis and Control (NUMAC) Power Range Neutron Monitoring (PRNM) system.

In Reference 2, the NRC requested additional information concerning the Reference 1 submittal. The attachment to this letter restates the NRC questions and provides Exelon's response to each question.

Exelon has concluded that the information provided in this response does not impact the conclusions of the: (1) Technical Analysis, (2) No Significant Hazards Consideration under the standards set forth in 10 CFR 50.92(c), or (3) Environmental Consideration as provided in the original submittal (Reference 1).

There are no regulatory commitments contained within this letter.

If you have any questions or require additional information, please contact Glenn Stewart at 610-765-5529.

A001

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 18th day of February, 2005.

Respectfully,

Ron J. DeGregorio
Site Vice President
Limerick Generating Station
Exelon Generation Company, LLC

Attachment: Response to Request for Additional Information

cc:	Regional Administrator - NRC Region I	w/attachments
	NRC Senior Resident Inspector - LGS	"
	NRC Project Manager, NRR - LGS	"
	Director, Bureau of Radiation Protection - Pennsylvania Department of Environmental Protection	"

bcc:	Vice President - Mid-Atlantic Operations	w/o attachment
	Vice President - Licensing and Regulatory Affairs	"
	Vice President - Operations Support	"
	Vice President - Nuclear Oversight	"
	Plant Manager - LGS	"
	Director, Operations - LGS	"
	Director, Site Engineering - LGS	"
	Director, Site Training - LGS	"
	Manager, Regulatory Assurance - LGS	"
	Manager, Nuclear Oversight - LGS	w/ attachment
	D. Helker, KSA3-E	"
	G. Stewart, KSA3-E	"
	R. Rowcotsky - LGS, SSB	"
	M. Gift - LGS, SSB	"
	S. Cohen - LGS, SSB	"
	C. Peaks - LGS, GML	"
	A. Olson - KSA2-N	"
	Commitment Coordinator - KSA 3-E	"
	Correspondence Control Desk - KSA 1-N-1	"
	DAC - KSA 1-N-1	"

ATTACHMENT

Limerick Generating Station, Units 1 and 2
Docket Nos. 50-352 and 50-353

Activation of the Trip Outputs of the Oscillation Power Range Monitor Portion of the Power Range Neutron Monitoring System

Response to Request for Additional Information

In Reference 1, Exelon Generation Company, LLC (Exelon), requested a change to the Technical Specifications (TS), Appendix A, of Facility Operating License Nos. NPF-39 and NPF-85 for Limerick Generating Station (LGS), Units 1 and 2, respectively. The proposed change supports the activation of the trip outputs of the previously-installed Oscillation Power Range Monitor (OPRM) portion of the General Electric (GE) Nuclear Measurement Analysis and Control (NUMAC) Power Range Neutron Monitoring (PRNM) system.

In Reference 2, the NRC requested additional information concerning the Reference 1 submittal. Each NRC question is restated below followed by our response.

Question

1. The delta critical power ratio over initial minimum critical power ratio versus oscillation magnitude (DIVOM) curve is used to calculate a final minimum critical power ratio (MCPR). If this calculated MCPR value is greater than the safety limit MCPR, then the licensing criterion is considered to have been met. Please describe the DIVOM correlation that will be used to determine the oscillation power range monitor (OPRM) scram set points. The response should include the following information:

    a. Will a generic DIVOM correlation be used or will a plant cycle-specific correlation be developed? Please demonstrate that the DIVOM curve used is the limiting one.

    b. If a plant cycle-specific DIVOM curve was developed for the next cycle, please describe how it was derived including whether any approved methodologies used, and whether the slope of the curve is conservative.

    c. Provide specific values for the OPRM scram setpoints and the DIVOM correlation for the next cycle and discuss its applicability to the range of power operation.

<u>Response</u>

The Boiling Water Reactor Owners Group (BWROG) Stability Long-Term Solution Option III methodology for establishing the OPRM period based detection algorithm (PBDA) trip setpoints is described in the NRC approved topical report NEDO-32465-A (Reference 3). The Option III methodology was originally licensed utilizing a generic DIVOM curve. However, for application to LGS, a plant/cycle-specific DIVOM curve will be utilized. The acceptability of utilizing a plant/cycle-specific DIVOM curve is documented in BWROG letter BWROG-03048 (Reference 4). For plant/cycle-specific application, the methodology described in NEDO-32465-A remains unchanged, with the exception of utilizing a plant/cycle-specific DIVOM curve in place of the generic DIVOM curve.

The methodology for developing the DIVOM curve is described in Section 4.4 of NEDO-32465-A. For plant/cycle-specific application, the methodology for developing the DIVOM curve is described in Section 4.4 of NEDO-32465-A except that plant and cycle-specific parameters (e.g., core power and flow, core loading, cycle energy, fuel types, etc.) are utilized in place of the generic fleet parameters. The values of other OPRM system parameters, such as the PBDA period confirmation setpoints in Table 3-1 of NEDO-32465-A, remain within their original acceptable range. The current values of these setpoints have been established based on recent industry operational experience of the Option III OPRM system. The PBDA trip setpoints in Table 3-2 of NEDO-32465-A remain unchanged.

As described in Section 4.4.4 of NEDO-32465-A, TRACG analyses will be performed to determine the relationship between the hot bundle oscillation magnitude and the change in critical power ratio (CPR), i.e., the DIVOM correlation. These analyses will utilize plant and cycle-specific inputs/parameters as described above. Conservative assumptions are utilized in the calculation of the DIVOM correlation, including (but not limited to) use of the limiting exposure point for the cycle, use of the limiting power/flow point and use of conservative hot channel parameters (i.e., high radial peaking factors). The overall Option III methodology includes additional conservatisms, resulting in conservative OPRM PBDA trip setpoints.

The OPRM PBDA trip setpoints will be determined by applying the plant/cycle-specific DIVOM to the process for initial applications described in Section 5 of NEDO-32465-A. In this process, the final minimum critical power ratio (FMCPR) is calculated from the initial minimum critical power ratio (IMCPR) based on the following equation:

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

The FMCPR is then compared to the Safety Limit MCPR (SLMCPR). If the FMCPR is greater than the SLMCPR, the OPRM PBDA trip setpoints are acceptable.

The evaluation of the initial plant/cycle-specific DIVOM correlation and OPRM PBDA trip setpoints for LGS has not been completed at this time. Therefore, these values are not yet available. However, the OPRM PBDA trip setpoints will be documented in the Core Operating Limits Report (COLR) for each unit. The OPRM PBDA trip setpoints are applicable when the plant is operating in the OPRM enabled region (i.e., ≥30% Simulated Thermal Power and <60% recirculation drive flow).

Question

2. a. In Table 3.3.1-1, "Reactor Protection System Instrumentation Action Statements," proposed action 10a states that if the condition exists due to a common-mode OPRM deficiency, then an alternate method to detect and suppress oscillations is initiated. Please describe the alternate method.

   b. Backup stability protection (BSP) may be used when the Option III OPRM system is temporarily inoperable. The BSP regions are confirmed on a plant cycle-specific basis to provide consistency with the long-term solution (LTS) general requirement of long-term applicability. Please identify the differences between the proposed BSP and interim corrective actions (ICA) being used currently. Also describe the Limerick BSP system in detail, including its applicability to the range of power operation.

Response

Alternate methods for detecting and suppressing core thermal hydraulic instabilities (THI) required by TS Table 3.3.1-1, Action 10.a, will be implemented by performance of a newly created backup stability solution operations strategy. The backup stability solution operations strategy will be implemented when it has been determined that a common mode deficiency exists in the OPRM System that has rendered all four OPRM channels inoperable at once. The new strategy, which will remain in effect until the OPRM System has been returned to OPERABLE status, will contain actions similar to those currently in effect at LGS relative to THI monitoring and avoidance. Current actions are based on the Interim Corrective Actions (ICAs) for instability prevention recommended by the BWROG and committed to by PECO Energy Company (now Exelon Generation Company, LLC) in its response to NRC Generic Letter 94-02 (References 5 through 8). The new strategy maintains similar guidance on how and when to monitor for THI, and contains detailed power-to-flow operating maps that depict "Immediate Exit" and "Immediate Scram" regions of high power and low flow to enable manual operator actions for preventing plant operation in areas where the potential for THI is increased.

Specific direction to be provided in the new backup stability solution operations strategy will also include the TS actions proposed for deletion by this License Amendment Request. The previous TS actions to be used as part of the new strategy will need to be slightly modified from their current form to maintain consistency with the BWROG backup stability solution guidance and OPRM System design characteristics. The LGS strategy will also maintain the direction to scram the reactor following the trip of both Reactor Recirculation Pumps.

Once OPRM upscale trip functions are made active at LGS, and as long as the OPRM upscale trip functions remain OPERABLE, there is no longer any technical need to retain TS Figure 3.4.1-1. This figure identifies the conditions of core power and flow where the potential for THI is increased, and was necessary as part of the ICA methodology to prevent THI by avoiding operating regions where THI occurrence was likely. Since the OPRM System is an NRC approved instability detect and suppress solution, it will constantly monitor for conditions of THI and provide an automatic trip signal to protect against exceeding the Minimum Critical Power Ratio (MCPR) Safety Limit, thus eliminating the need for manual actions for THI protection. The power-to-flow operating maps contained within the new backup stability solution operations strategy described above will re-instate the manual THI preventative actions for which TS Figure 3.4.1-1 was intended.

Question

3. Was the OPRM portion of the power range neutron monitoring (PRNM) system in test mode before the trip outputs were activated? If so, please describe any lessons learned during the testing period of the system. Please include any changes that were necessary in order to avoid spurious scrams at Limerick 1 and 2 and whether deviations from the Nuclear Regulatory Commission-approved methodology, if any, were conservative?

Response

Power Range Neutron Monitoring (PRNM) System hardware, which includes the OPRM System, was installed at LGS in 2000 (Unit 1) and 2001 (Unit 2). Following installation of the PRNM System, the OPRM upscale function has been fully operational except for the trip and associated trip alarm functions. The OPRM upscale function has been de-activated, i.e., not connected to the Reactor Protection System (RPS) logic, in order to allow evaluation of the OPRM algorithms without the risk of spurious scrams. During the evaluation period, in 2001,

General Electric (GE) submitted a 10 CFR Part 21, "Reporting of defects and noncompliances" report to the NRC associated with stability reload licensing calculations supporting the development of the OPRM upscale trip function setpoints. The OPRM upscale function was not armed pending resolution of this reportable condition. As a result, LGS has no historical OPRM upscale trip or alarm data.

OPRM channel and cell data from the Process Computer System has been collected and evaluated. The data collected prior to 2004 has limited applicability because OPRM System setpoint and tuning parameter values were either set at default values or previously recommended GE values. In the time since the original OPRM installation, industry wide observations of OPRM response have resulted in vendor bulletins containing recommendations for specific values, consistent with NEDO-32465-A, of OPRM parameter settings. During the March 2004 Unit 1 refueling outage, LGS implemented these recommended OPRM parameter settings, as well as interim OPRM trip setpoints, for two OPRM channels. During the subsequent startup, OPRM data was monitored and collected with the plant operating in the OPRM enabled region (i.e., ≥30% Simulated Thermal Power and <60% recirculation drive flow). Evaluation of this data indicated that some pre-trip alarms would have been generated, but at no time would either of the two channels have generated a trip signal. Similar actions are planned for Unit 2 during and following the 2R08 refueling outage scheduled for March 2005; trip setpoints for all four OPRM channels will be set consistent with the results of the LGS Unit 2 cycle-specific OPRM calculations (provided calculation results have been made available by GE) and the OPRM parameter settings recommended by GE.

In addition to the LGS data that has (and will) be evaluated prior to activation, lessons learned from the activation efforts at other sites will be reviewed and incorporated, as applicable, during activation at LGS.

Question

4. Attachment 1, Page 2 of 15, item A, states that there are no allowable values associated with the OPRM upscale trip function. Please explain how the operability of the OPRM upscale function is determined in the absence of the allowable values. If some other number has been used by the procedure, then explain how this meets the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.36(c)(1)(ii)(A).

Response

BWROG Stability Long-Term Solution Option III is implemented utilizing the OPRM system. The OPRM system is a subsystem of the GE NUMAC PRNM system, which is a digitally based system. As such, the OPRM system and its components are not subject to calibration error, setpoint drift or measurement uncertainty attributable to typical analog systems. Furthermore, the input signals to the OPRM system, i.e., Local Power Range Monitor (LPRM) signals, are continuously self-normalized such that the OPRM PBDA amplitude setpoint is based on a relative comparison to a value of unity (one). Therefore, the OPRM system is not subject to uncertainty due to LPRM drift or inoperability. The PBDA confirmation counts are discretely determined and counted by the digital system. Because of these factors, the OPRM system utilizes analytically determined trip setpoints and allowable values are not required. This is consistent with the NRC approved Licensing Topical Report NEDC-32410P-A (Reference 9).

The OPRM PBDA trip setpoints are determined conservatively and ensure that the Safety Limit MCPR will not be exceeded in the event a reactor instability occurs, thus meeting the

requirements of 10 CFR 50.36(c)(1)(ii)(A). All OPRM system setpoints will be validated against the approved setpoints identified in the associated design and licensing documents.

The accuracy of GE NUMAC PRNM system signal processing will be verified by the performance of the following refueling interval Average Power Range Monitor (APRM)/OPRM system channel calibration surveillance test procedures:

- ST-2-074-426(427,428,429)-1 (Unit 1)
- ST-2-074-426(427,428,429)-2 (Unit 2)

These surveillance tests, which satisfy Surveillance Requirement 4.3.1.1, verify all internal voltage, resistance and time references to National Institute of Standards and Technology (NIST) traceable standards. The calibration of the PRNM system's internal references assures proper and accurate digital processing of the OPRM upscale trip algorithms, which digitally monitor the changes in normalized LPRM cell averages.

These surveillance tests will also be revised to ensure the OPRM channels meet their minimum number of OPERABLE cells requirement, as required by TS Table 3.3.1-1, Footnote (o), and TS Table 4.3.1.1-1, Footnote (c).

The recirculation drive flow signals that are used in part to determine when to automatically arm the OPRM upscale trip functions will be calibrated as part of the following refueling interval recirculation flow calibration surveillance test procedures:

- ST-2-043-500-1 (Unit 1)
- ST-2-043-500-2 (Unit 2)

These surveillance tests are currently performed to meet APRM system operability requirements, and will be revised to indicate that performance also meets the requirements of TS Table 4.3.1.1-1, Footnotes (c) and (g), to calibrate the flow input function of the OPRM system and to verify the OPRM system enabled (not bypassed) recirculation drive flow setpoints.

Similarly, the Simulated Thermal Power (STP) signals that are used in part to determine when to automatically arm the OPRM upscale trip functions are calibrated as necessary throughout plant operation to a calculated calorimetric heat balance per TS 4.3.1.1, via performance of the following surveillance test procedures:

- ST-6-107-887(888)-1 (Unit 1)
- ST-6-107-887(888)-2 (Unit 2)

These surveillance tests will be revised to indicate that performance also meets the requirements of TS Table 4.3.1.1-1, Footnote (c), to verify the OPRM system enabled (not bypassed) STP setpoints.

An OPRM system daily channel check, required by TS Table 4.3.1.1-1, will be met during the performance of the following surveillance test procedures:

- ST-6-107-590-1 (Unit 1)
- ST-6-107-590-2 (Unit 2)

An OPRM system semi-annual channel functional test (to include the flow input function), required by TS Table 4.3.1.1-1, will be met during the performance of the following surveillance test procedures (which also meet the channel functional test requirements of the APRM system):

- ST-2-074-626(627,628,629)-1 (Unit 1)
- ST-2-074-626(627,628,629)-2 (Unit 2)

These APRM/OPRM system channel functional test procedures will also be revised to ensure the OPRM channels meet their minimum number of OPERABLE cells requirement, as required by TS Table 3.3.1-1, Footnote (o), and TS Table 4.3.1.1-1, Footnote (c).

Logic system functional testing of the OPRM system upscale trip input signals to the 2-Out-Of-4 Voters will be tested, as required by Surveillance Requirement 4.3.1.2, during performance of the following refueling interval surveillance test procedures:

- ST-2-074-100-1 (Unit 1)
- ST-2-074-100-2 (Unit 2)

Response time testing of the OPRM system upscale trip 2-Out-Of-4 Voter outputs will be conducted, as required by Surveillance Requirement 4.3.1.3, during performance of refueling interval surveillance test procedures. Currently, response time testing for APRM system upscale/inoperable trip 2-Out-Of-4 Voter outputs is addressed in:

- ST-2-074-826(827,828,829)-1 (Unit 1)
- ST-2-074-826(827,828,829)-2 (Unit 2)

OPRM system upscale trip 2-Out-Of-4 Voter output testing requirements will either be added to these procedures, or included in new surveillance test procedures that address the testing of the OPRM system upscale trip 2-Out-Of-4 Voter outputs only.

TS Table 3.3.1-1, Footnote (e), currently requires LPRM detector calibration every 1000 effective full power hours to ensure APRM system operability. Footnote (e) is also applicable to the OPRM system, and will be met during performance of the following surveillance test procedures:

- ST-2-074-505(506)-1 (Unit 1)
- ST-2-074-505(506)-2 (Unit 2)

Prior to declaring the OPRM system OPERABLE, each of the above requirements will be verified, except the refueling interval RPS logic system functional test, whose performance LGS has requested be considered met for the OPRM system based on previous RPS logic system functional and factory acceptance testing. Following activation, the above requirements will be verified during the performance of station surveillance test procedures at specified intervals. Requirements to be included in station procedures will be based on recommendations provided by GE (Reference 10) for verifying OPRM system operability.

Question

5. In order to ensure that the proposed OPRM trip will perform its intended design functions, the equipment should be qualified for all environmental conditions where it is installed as required by General Design Criterion 4 of Appendix A to Part 50 of 10 CFR (10 CFR Part 50). Therefore, please confirm that the OPRM equipment at Limerick 1

and 2 has been qualified for electromagnetic interference (EMI) and radio frequency interference (RFI) based on either the worst case EMI/RFI levels at its installed location or using the generic levels identified in the Electric Power Research Institute's Report, TR-102323, "Guidelines for Electromagnetic Interference Testing in Power Plants," and Regulatory Guide 1.180, "Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems," dated October 2003.

Response

The OPRM equipment at LGS was installed in 2000 (Unit 1) and 2001 (Unit 2) as part of the installation of the GE NUMAC PRNM system. LGS has confirmed that this equipment is qualified for EMI and RFI, based on Reference 11, which documents that the LGS PRNM instruments are qualified for the LGS application, since they met the LGS Electromagnetic Compatibility (EMC) requirements at the time of installation. EMI qualification for the PRNM system was summarized in Attachment 2 of Reference 12 in response to Section 4.4.2.4.4 of References 13 and 9, and was approved by the NRC in Amendment letters dated April 12, 2000, and January 16, 2001 (References 14 and 15), for LGS, Units 1 and 2, respectively. This summary states that the conditions and limitations defined in EPRI TR-102323 are met at LGS. Since original PRNM installation, no modifications have been made to the PRNM system, which impact the system's ability to meet these requirements.

References:

1. Letter from K. R. Jury, Exelon Generation Company, LLC, to U. S. Nuclear Regulatory Commission, dated May 20, 2004

2. Letter from T. L. Tate, U. S. Nuclear Regulatory Commission, to C. M. Crane, Exelon Generation Company, LLC, dated January 19, 2005

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

4. BWROG-03048, "Utility Commitment to NRC for OPRM Operability at Option III Plants," dated September 30, 2003

5. NRC Bulletin 88-07 Supplement 1, dated December 30, 1988

6. BWROG-92030, Implementation Guidance For Stability Related Interim Corrective Actions, dated March 18, 1992

7. Letter dated September 9, 1994, from G.A. Hunger (PECO Energy Company) to USNRC, "Response to NRC Generic Letter 94-02, Long Term Solutions and Upgrade of Interim Operating Recommendations for Thermal Hydraulic Instabilities in Boiling Water Reactors"

8. BWROG-94079, Guidelines for Stability Interim Corrective Action, dated June 6, 1994

9. NEDC-32410P-A, "Nuclear Measurement Analysis and Control Power Range Neutron Monitor (NUMAC PRNM) Retrofit Plus Option III Stability Trip Function," Supplement 1, dated November 1997

10. GEK-105913, Volume I, NUMAC Power Range Neutron Monitoring System Operations and Maintenance Instructions

11. General Electric Nuclear Energy DRF C51-00215-00 (5.4) Rev. 0, "NUMAC Power Range Neutron Monitoring (PRNM) Components 299X739G012 Qualification Summary," March 2000 (Exelon Limerick Drawing No. G-080-VC-00048)

12. Letter dated February 11, 2000, from J. A. Hutton, PECO Energy Company, to USNRC, "Response to Request for Additional Information Related to Technical Specifications Change Request No. 99-05-0"

13. NEDC-32410P-A, "Nuclear Measurement Analysis and Control Power Range Neutron Monitor (NUMAC PRNM) Retrofit Plus Option III Stability Trip Function," dated October 1995

14. Letter dated April 12, 2000, from B. C. Buckley, USNRC, to J. A. Hutton, PECO Energy Company, "Limerick Generating Station, Unit 1 - Issuance of Amendment RE: Power Range Neutron Monitoring (TAC No. MA6965)"

15. Letter dated January 16, 2001, from J. W. Clifford, USNRC, to J. A. Hutton, PECO Energy Company, "Limerick Generating Station (LGS), Unit 2 - Issuance of Amendment RE: Power Range Neutron Monitoring (TAC No. MA6966)"