



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

February 17, 2012

Mr. Michael J. Pacilio  
President and Chief Nuclear Officer  
Exelon Nuclear  
4300 Winfield Road  
Warrenville, IL 60555

SUBJECT: LIMERICK GENERATING STATION, UNIT 1 - ISSUANCE OF AMENDMENT  
RE: SAFETY LIMIT MINIMUM CRITICAL POWER RATIO CHANGES (TAC NO.  
ME7333)

Dear Mr. Pacilio:

The Commission has issued the enclosed Amendment No. 206 to Facility Operating License No. NPF-39, for Limerick Generating Station (LGS), Unit 1. This amendment consists of changes to the Technical Specifications (TSs) in response to your application dated October 12, 2011 (Agencywide Documents Access and Management System Accession No. ML112870080), supplemented by letter dated January 13, 2012 (ADAMS Accession No. ML12017A165).

The amendment consists of revisions to the TSs relating to the Safety Limit Minimum Critical Power Ratios (SLMCPRs). The changes result from a cycle-specific analysis performed to support the operation of Limerick Generating Station, Unit 1, in the upcoming Cycle 15. Specifically, the proposed TS changes will revise the SLMCPRs contained in TS 2.1.2 for two recirculation loop operation and single recirculation loop operation to reflect the changes in the cycle-specific analysis.

A copy of the Safety Evaluation is also enclosed. The Notice of Issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,

A handwritten signature in black ink, reading "Peter Bamford".

Peter Bamford, Project Manager  
Plant Licensing Branch I-2  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket No. 50-352

Enclosures:

1. Amendment No. 206 to License No. NPF-39
2. Safety Evaluation

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UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

EXELON GENERATION COMPANY, LLC

DOCKET NO. 50-352

LIMERICK GENERATING STATION, UNIT 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 206  
License No. NPF-39

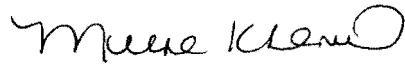
1. The Nuclear Regulatory Commission (the Commission) has found that:
  - A. The application for amendment by Exelon Generation Company, LLC (the licensee), October 12, 2011, as supplemented by letter dated January 13, 2012, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;
  - B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;
  - C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;
  - D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and
  - E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.
2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Facility Operating License No. NPF-39 is hereby amended to read as follows:

(2) Technical Specifications

The Technical Specifications contained in Appendix A and the Environmental Protection Plan contained in Appendix B, as revised through Amendment No.206 , are hereby incorporated into this license. Exelon Generation Company shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. This license amendment is effective as of its date of issuance and shall be implemented within 30 days of the date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION



Meena Khanna, Chief  
Plant Licensing Branch I-2  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Attachment: Changes to the Technical  
Specifications and Facility Operating License

Date of Issuance: February 17, 2012

ATTACHMENT TO LICENSE AMENDMENT NO. 206

FACILITY OPERATING LICENSE NO. NPF-39

DOCKET NO. 50-352

Replace the following page of the Facility Operating License with the revised page. The revised page is identified by amendment number and contains marginal lines indicating the area of change.

Remove  
Page 3

Insert  
Page 3

Replace the following page of the Appendix A Technical Specifications with the attached revised page. The revised page is identified by amendment number and contains marginal lines indicating the areas of change.

Remove

2-1

Insert

2-1

- (3) Pursuant to the Act and 10 CFR Parts 30, 40 and 70, to receive, possess and use at any time any byproduct, source and special nuclear material as sealed neutron sources for reactor startup, sealed sources for reactor instrumentation and radiation monitoring equipment calibration, and as fission detectors in amounts as required;
- (4) Pursuant to the Act and 10 CFR Parts 30, 40, 70, to receive, possess, and use in amounts as required any byproduct, source or special nuclear material without restriction to chemical or physical form, for sample analysis or instrument calibration or associated with radioactive apparatus or components; and
- (5) Pursuant to the Act and 10 CFR Parts 30, 40 and 70, to possess, but not separate, such byproduct and special nuclear materials as may be produced by the operation of the facility, and to receive and possess, but not separate, such source, byproduct, and special nuclear materials as contained in the fuel assemblies and fuel channels from the Shoreham Nuclear Power Station.

C. This license shall be deemed to contain and is subject to the conditions specified in the Commission's regulations set forth in 10 CFR Chapter I (except as exempted from compliance in Section 2.D. below) and is subject to all applicable provisions of the Act and to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) Maximum Power Level

Exelon Generation Company is authorized to operate the facility at reactor core power levels not in excess of 3515 megawatts thermal (100% rated power) in accordance with the conditions specified herein and in Attachment 1 to this license. The items identified in Attachment 1 to this license shall be completed as specified. Attachment 1 is hereby incorporated into this license.

(2) Technical Specifications

The Technical Specifications contained in Appendix A and the Environmental Protection Plan contained in Appendix B, as revised through Amendment No. 206, are hereby incorporated into this license. Exelon Generation Company shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

## 2.0 SAFETY LIMITS AND LIMITING SAFETY SYSTEM SETTINGS

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### 2.1 SAFETY LIMITS

#### THERMAL POWER, Low Pressure or Low Flow

2.1.1 THERMAL POWER shall not exceed 25% of RATED THERMAL POWER with the reactor vessel steam dome pressure less than 785 psig or core flow less than 10% of rated flow.

APPLICABILITY: OPERATIONAL CONDITIONS 1 and 2.

#### ACTION:

With THERMAL POWER exceeding 25% of RATED THERMAL POWER and the reactor vessel steam dome pressure less than 785 psig or core flow less than 10% of rated flow, be in at least HOT SHUTDOWN within 2 hours and comply with the requirements of Specification 6.7.1.

#### THERMAL POWER, High Pressure and High Flow

2.1.2 The MINIMUM CRITICAL POWER RATIO (MCPR) shall not be less than 1.09 for two recirculation loop operation and shall not be less than 1.12 for single recirculation loop operation with the reactor vessel steam dome pressure greater than 785 psig and core flow greater than 10% of rated flow.

APPLICABILITY: OPERATIONAL CONDITIONS 1 and 2.

#### ACTION:

With MCPR less than 1.09 for two recirculation loop operation or less than 1.12 for single recirculation loop operation and the reactor vessel steam dome pressure greater than 785 psig and core flow greater than 10% of rated flow, be in at least HOT SHUTDOWN within 2 hours and comply with the requirements of Specification 6.7.1.

#### REACTOR COOLANT SYSTEM PRESSURE

2.1.3 The reactor coolant system pressure, as measured in the reactor vessel steam dome, shall not exceed 1325 psig.

APPLICABILITY: OPERATIONAL CONDITIONS 1, 2, 3, and 4.

#### ACTION:

With the reactor coolant system pressure, as measured in the reactor vessel steam dome, above 1325 psig, be in at least HOT SHUTDOWN with the reactor coolant system pressure less than or equal to 1325 psig within 2 hours and comply with the requirements of Specification 6.7.1.



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

AMENDMENT NO. 206 TO FACILITY OPERATING LICENSE NO. NPF-39

EXELON GENERATION COMPANY, LLC

LIMERICK GENERATING STATION, UNIT 1

DOCKET NO. 50-352

1.0 INTRODUCTION

By letter dated October 12, 2011 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML112870080), supplemented by letter dated January 13, 2012 (ADAMS Accession No. ML12017A165), Exelon Generation Company, LLC (Exelon, the licensee) requested changes to the Technical Specifications (TSs) for Limerick Generating Station (LGS), Unit 1. The supplement clarified the application, did not expand the scope of the application as originally noticed, and did not change the U.S. Nuclear Regulatory Commission (NRC or Commission) staff's original proposed no significant hazards consideration determination as published in the *Federal Register* on December 6, 2011 (76 FR 76196).

The submittal seeks to revise TS 2.1, "Safety Limits," to reflect revised Safety Limit Minimum Critical Power Ratio (SLMCPR) values (limits) listed in TS 2.1.2 and calculated for operating Cycle 15. The SLMCPR analysis establishes SLMCPR values that will ensure that during normal operation and during abnormal operational transients, at least 99.9 percent of all fuel rods in the core do not experience transition boiling if the limit is not violated. The SLMCPRs are calculated to include cycle-specific parameters.

The NRC staff has completed its review and finds that the requested TS modifications are acceptable.

2.0 REGULATORY EVALUATION

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Section 36, "Technical specifications," paragraph (c)(1), requires that power reactor facility TS include safety limits for process variables that protect the integrity of certain physical barriers that guard against the uncontrolled release of radioactivity. The fuel cladding integrity SLMCPR is established to assure that at least 99.9 percent of the fuel rods in the core do not experience boiling transition during normal operation and abnormal operating transients. Thus, the TSs must contain the SLMCPR.

The NRC staff used 10 CFR Part 50, Appendix A, Criterion 10 (GDC-10), "Reactor Design," and NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," as evaluation criteria for the proposed license amendment request (LAR). GDC-10 states, in part, that the reactor core and associated coolant, control, and protection systems

shall be designed with appropriate margin to assure that specified acceptable fuel design limits (SAFDLs) are not exceeded. As described in the LGS Updated Final Safety Analysis Report, Section 3.1, LGS meets the requirements of GDC-10. NUREG-0800, provides guidance on the acceptability of the reactivity control systems, the reactor core and fuel system design. Specifically, Section 4.2, "Fuel System Design," Revision 2, specifies all fuel damage criteria for evaluation of whether fuel designs meet the SAFDLs. Section 4.4, "Thermal Hydraulic Design," Revision 1, provides guidance on the review of thermal-hydraulic design in conforming to GDC-10 and the fuel design criteria established in Section 4.2.

The purpose of the SLMCPR is to ensure that SAFDLs, as specified in GDC-10, are not exceeded during steady state operation and analyzed transients. The fuel cladding is one of the physical barriers that separate the radioactive materials from the environment. The integrity of this cladding barrier is related to its relative freedom from perforations or cracking. Thermal stresses, which can occur from reactor operation significantly above design conditions, can cause fuel cladding perforations. Since the parameters that result in fuel damage are not directly observable during reactor operation, the thermal and hydraulic conditions that result in the onset of transition boiling are used to mark the beginning of the region in which fuel cladding damage could occur. Margin to these thermal and hydraulic conditions is protected by the SLMCPR values in the TS.

### 3.0 TECHNICAL EVALUATION

#### 3.1 Proposed TS Changes

The submittal seeks to revise TS 2.1.2 to reflect revised SLMCPR values for operating Cycle 15. In accordance with the NRC-approved methodologies described below, the licensee must evaluate the appropriateness of the SLMCPR values for operation beyond Cycle 15, and seek NRC approval when warranted. The licensee proposes to change the SLMCPR values in TS 2.1.2 from 1.07 to 1.09 for two recirculation loop operation, and from 1.09 to 1.12 for single-loop operation. These SLMCPR values apply when the reactor steam dome pressure is greater than 785 psig [pounds per square inch gauge] and core flow is greater than 10 percent of rated core flow.

#### 3.2 NRC Staff Evaluation

The licensee described the methodology to calculate the new SLMCPR values for the TS in its submittal and supplement. The Cycle 15 SLMCPR analysis was performed by Global Nuclear Fuel (GNF) using plant- and cycle-specific fuel and core parameters, and NRC approved methodologies, including the following:

- NEDE-24011-P-A, "General Electric Standard Application for Reactor Fuel (GESTAR II)," Revision 18, April, 2011
- NEDC-32505P-A, "R-Factor Calculation Method for GE11, GE12 and GE13 Fuel," Revision 1, July 1999
- NEDC-32601P-A, "Methodology and Uncertainties for Safety Limit MCPR Evaluations," August 1999



- NEDC-32694P-A, "Power Distribution Uncertainties for Safety Limit MCPR Evaluation," August 1999
- NEDO-10958P-A, "General Electric BWR [Boiling-Water Reactor] Thermal Analysis Basis (GETAB): Data, Correlation, and Design Application," January 1977

The LGS, Unit 1, Cycle 15 core, has 764 GE fuel assemblies, of which there are 280 fresh GNF2 bundles, 280 once burned GE14 bundles, and 204 twice burned GE14 bundles. The licensee addressed the applicability of the above approved methodologies to the associated SLMCPR calculation since the data bases for the GNF2 fuel were not included in those approved methodologies. The NRC staff reviewed the licensee's justification for the applicability of the above approved methodologies to LGS Unit 1, Cycle 15 including a review of the NRC staff's report dated September 25, 2008, "Audit Report for Global Nuclear Fuels GNF2 Advanced Fuel Assembly Design GESTAR II Compliance Audit," (ADAMS Accession No. ML081630579). This report was based on the GESTAR II compliance report for GNF2 fuel<sup>1</sup> and concluded that the justification is acceptable because GNF2 fuel meets the requirements as specified in the limitations and conditions of the approved methodologies.

By letter dated October 12, 2011, and clarified by letter dated January 13, 2012, the licensee addressed the final core loading pattern selection for LGS Unit 1, Cycle 15 operation with respect to the combination of the input parameters such as cycle energy requirements, thermal limit margins, reactivity margins, discharge exposure limitations and other limits, as well as desired control rod patterns and channel distortion minimization. The licensee addressed the SLMCPR calculation process with respect to the uncertainties associated with R-Factor, core flow rate and the Local Power Range Monitor update/calibration interval. The licensee also addressed the bundle groupings for both two-loop operation and single-loop operation SLMCPR calculations, along with the number of bundles in the group, their contribution to percent number of rods subject to boiling transition (NRSBT) and group average fuel assembly exposure for Cycle 15. Finally, by letter dated January 13, 2012, the licensee provided an updated two-loop power/flow map for Cycle 15 operation including stability Option III features of the scram region and controlled entry region for backup stability protection, using decay ratio criterion specified in GESTAR II.

The NRC staff reviewed the information presented in the submittal and supplemental information and concluded that the licensee provided satisfactory data and methodology descriptions. The NRC staff determined that the proposed revisions to the TS SLMCPR values for LGS Unit 1, Cycle 15 operation, from 1.07 to 1.09 for two recirculation loop operation and from 1.09 to 1.12 for single-loop operation, are acceptable for the following reasons:

- (1) Approved methodologies are used with acceptable justification for the method deviation and adjusted uncertainties relating to R-Factor and Traversing Incore probe reading.
- (2) The GNF2 data contained in Figure 5, of Attachment 4, of the submittal, Enclosure 1, as supplemented by letter dated January 13, 2012, provides sufficient evidence of an acceptable relationship between MCPR Importance Factor and Critical Power Ratio margin.

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1. "GNF2 Advantage Generic Compliance with NEDE-24011-P-A (GESTAR II), NEDC-33270P, March 2007, and GEXL17 Correlation for GNF2 Fuel, NEDC-33292P, March 2007," FLN-2007-011, dated March 14, 2007 (ADAMS Accession No. ML070780335).

- (3) Qualitative descriptions of the final core loading pattern and critical power analysis are provided and considered acceptable.
- (4) A core map for Cycle 15 was provided and dominant fuel bundle locations were identified based on the LGS Unit 1 Cycle 15 SLMCPR calculation in terms of percent contribution to NRSBT.
- (5) Mechanisms to explain the magnitude of the SLMCPR increase are identified, along with the result that the GNF2 fuel would dominate the SLMCPR calculation.

The NRC staff also reviewed the justification for the SLMCPR value of 1.09 for two recirculation loop operation and 1.12 for single-loop operation using the approach stated in Revision 18 of the GESTAR-II methodology. Based on the review of the submittal, and the supplemental information, the NRC staff has concluded that the SLMCPR analysis for LGS Unit 1, Cycle 15 operation using the plant- and cycle-specific calculation in conjunction with the approved method is acceptable. The Cycle 15 SLMCPR will ensure that 99.9 percent of the fuel rods in the core will not experience boiling transition, which conforms with GDC-10 regarding acceptable fuel design limits. The NRC staff has concluded that the justification for analyzing and determining the SLMCPR value of 1.09 for two recirculation loop operation and 1.12 for single-recirculation loop operation for LGS Unit 1, Cycle 15 is acceptable, since approved methodologies were used in conjunction with the assumption of a higher R-Factor uncertainty, performance of a bounding calculation at rated core power and minimum core flow, and an analysis on power shape for Cycle 15 operation which results in no fuel axial power shape penalty.

Based on the review above, and because the changes were analyzed based on NRC-approved methods using LGS Unit 1, cycle-specific inputs for the Cycle 15 fuel bundles, the NRC staff finds that the TS changes proposed in the LAR involving the SLMCPR values for both two-loop and single-loop operation, are acceptable for LGS Unit 1, Cycle 15 operation.

#### 4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Pennsylvania State official was notified of the proposed issuance of the amendment. The State official had no comments.

#### 5.0 ENVIRONMENTAL CONSIDERATION

The NRC staff has determined that the amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, and there has been no public comment on such finding (76 FR 76196). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

## 6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that (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.

Principal Contributor: T. Huang

Date: February 17, 2012

February 17, 2012

Mr. Michael J. Pacilio  
President and Chief Nuclear Officer  
Exelon Nuclear  
4300 Winfield Road  
Warrenville, IL 60555

SUBJECT: LIMERICK GENERATING STATION, UNIT 1 - ISSUANCE OF AMENDMENT RE:  
SAFETY LIMIT MINIMUM CRITICAL POWER RATIO CHANGES (TAC NO.  
ME7333)

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A copy of the Safety Evaluation is also enclosed. The Notice of Issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,

/RA/

Peter Bamford, Project Manager  
Plant Licensing Branch I-2  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket No. 50-352

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**Amendment Accession No.: ML120330196**

	LPLI-2/PM	LPLI-2/LA	SRXB/BC	SNPB/BC	OGC	LPLI-2/BC
Name	PBamford	ABaxter	AUlses	AMendiola	LWoodall, NLO	MKhanna
Date	02/07/2012	02/07/2012	02/08/2012	02/08/2012	02/15/2012	2/17/12

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