March 22, 2002

Mr. Oliver D. Kingsley, President
Exelon Nuclear
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: INCREASE IN THE MAXIMUM LEAD FUEL ROD-AVERAGE BURNUP LIMIT - BYRON STATION, UNIT 2 (TAC NO. MB3014)

Dear Mr. Kingsley:

By letter dated September 21, 2001, Exelon Generation Company, LLC (Exelon), requested amendments to the licenses for Byron Station, Units 1 and 2, and Braidwood Station, Units 1 and 2. The submittals requested approval to revise the reactor core safety limit (SL) for peak fuel centerline temperature.

Also included in the submittal was a request to revise the licensing basis commitment to limit the lead fuel rod-average burnup of 60,000 Megawatt-Days per Metric Tonne of Uranium (MWD/MTU). The revised limit would be 69,000 MWD/MTU for two lead test assemblies (LTAs) currently in the Byron Unit 2 reactor, and an increase in burnup to 75,000 MWD/MTU for future LTAs. Exelon's commitment on fuel burnup limit is not incorporated in the plants' licenses or technical specifications. Additional information was provided by Exelon in its letter of January 31, 2002.

The staff has evaluated Exelon's request and agrees to the commitment change for the present Byron Unit 2 cycle (Cycle 10) which will permit the lead fuel rod-average burnup limit to increase to 69,000 MWD/MTU for the requested two LTAs. Within the two LTAs, only four high burnup fuel rods in LTA M09E will exceed 60,000 MWD/MTU by the end of the cycle. While the NRC staff is in agreement with the proposed change, it is expected that the maximum burnup for the four high burnup rods in LTA M09E will be limited to approximately 65,500 MWD/MTU by the present peak fuel centerline temperature of 4,700 °F included in technical specification 2.1.1.3. The staff believes that the data obtained will provide useful information to the Nuclear Regulatory Commission and to industry.

The details of the NRC staff's review are included in the attached Safety Evaluation.

Exelon's license amendment request to increase the maximum peak fuel centerline temperature and its request to increase the maximum lead fuel rod-average burnup to 75,000 MWD/MTU for future LTAs are under staff review.

Sincerely,

/RA/

George F. Dick, Jr., Project Manager, Section 2
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. STN 50-455

Enclosure: Safety Evaluation

cc w/encl: See next page

Exelon's license amendment request to increase the maximum peak fuel centerline temperature and its request to increase the maximum lead fuel rod-average burnup to 75,000 MWD/MTU for future LTAs are under staff review.

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George F. Dick, Jr., Project Manager, Section 2
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cc w/encl: See next page

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

EXELON GENERATION COMPANY, LLC

BYRON STATION, UNIT 2

DOCKET NO. STN 50-455

1.0 INTRODUCTION

By letter dated September 21, 2001, Exelon Generation Company, LLC (Exelon, the licensee) requested amendments to the licenses for Byron Station, Units 1 and 2, and Braidwood Station, Units 1 and 2. The submittal requested approval to revise the reactor core safety limit (SL) for peak fuel centerline temperature (technical specification (TS) 2.1.1.3). Also included in the submittal was a request to permit the licensee to exceed a lead fuel rod-average burnup of 60,000 Megawatt-Days per Metric Tonne of Uranium (MWD/MTU) in lead test assemblies (LTAs) currently in the Byron Unit 2 reactor, and an increase in burnup to 75,000 MWD/MTU for future LTAs. Additional information was provided by the licensee in its letter of January 31, 2002.

This safety evaluation (SE) is limited to the request to exceed 60,000 MWD/MTU for four fuel rods that are presently in the Byron Unit 2 reactor in assembly LTA M09E. The requests to revise the SL for peak centerline temperature, increase the fuel burnup limit to 69,000 MWD/MTU for the two LTAs being irradiated in Byron Unit 2 and increase the burnup limit to 75,000 MWD/MTU for future LTAs are currently under staff review. They will be addressed in future correspondence.

2.0 BACKGROUND

Two LTAs are currently in use in Byron Unit 2 (Cycle 10). These LTAs are composed of low-tin ZIRLO cladding and fuel pin spring clips, and higher density fuel pellets. Additionally, one of the LTAs (LTA M09E) was modified to include four fuel rods which have been previously burned during two cycles to 45,750 MWD/MTU. Following irradiation during a third cycle, the four rods will have a projected burnup of approximately 69,000 MWD/MTU. Irradiation of these four fuel rods to a higher burnup will provide data on fuel and materials performance that will support industry goals of extending the current fuel burnup limits and will provide data to address the Nuclear Regulatory Commission's (NRC) questions related to fuel performance behavior at high burnups. The data will also help confirm the applicability of nuclear design and fuel performance models at high burnups.

There are no TSs which impose a limit on fuel rod burnup; however, both Byron and Braidwood Stations have a licensing basis commitment to limit the current lead fuel rod-average burnup to 60,000 MWD/MTU. The licensing basis commitment is documented in the staff's SE

supporting license amendments 78 and 70, dated December 19, 1995, for Byron and Braidwood Stations, respectively. These amendments also approved the use of ZIRLO cladding.

Approval of ZIRLO cladding was based on an NRC SE, "Acceptance for Referencing of Topical Report WCAP-12610, Vantage+ Fuel Assembly Reference Core Report," dated July 1, 1991. This SE approved the use of Vantage+ fuel design, i.e., ZIRLO clad fuel, described in WCAP-12610-P-A and found it acceptable up to a lead fuel rod-average burnup of 60,000 MWD/MTU.

During Byron Unit 1 Cycle 10 operation, two LTAs consisting of low ZIRLO fuel cladding, fuel pin spring clips, and higher density fuel pellets were utilized consistent with plant's TSs. For Byron Unit 2 Cycle 10 operation, these LTAs were again utilized; however, one of the LTAs was modified to also include four fuel rods with a beginning of cycle burnup of approximately 45,750 MWD/MTU to confirm the use of the ZIRLO alloy at extended discharge burnup levels exceeding 60,000 MWD/MTU, which is the current licensing basis maximum burnup for the Vantage+ fuel design. The anticipated rod-average burnup at the end of Cycle 10 for the four high burnup rods is approximately 69,000 MWD/MTU. Therefore, in its September 21, 2001, submittal, the licensee requested to increase the rod-average burnup limit for high burnup LTAs to approximately 69,000 MWD/MTU for Byron Station Unit 2 Cycle 10.

3.0 EVALUATION

The NRC has been working recently with the industry to develop guidelines for lead test assemblies including fuel assemblies such as the ones under review. The objective is to develop a set of guidelines which provides a structured process for the evaluation of LTAs while maintaining safety. These guidelines will be consistent with the NRC performance goals which are: maintain safety, maintain public confidence, improve efficiency and effectiveness of regulation, and reduce unnecessary burden. Many different aspects will be addressed in LTA guidelines, including: characterization of the fuel assembly both pre- and post-irradiation, the poolside examinations to be performed, the number of LTAs allowed in any given core, the location or placement of LTAs within the core, what the safety analysis should cover, and reporting requirements. The evaluation of the request to irradiate the four rods to a higher burnup has been completed with these guidelines in mind.

3.1 Pre- and Post-Irradiation Characterization of the Four Lead Test Rods

The LTA containing the four twice-burned rods was characterized through post-irradiation examinations (PIEs) to assure that the fuel assembly parameters were within acceptable limits before it was used for an additional cycle and so that the impact of the increased rod burnup could be quantified after the rods are removed from the core. The examinations performed include oxide measurements, assembly length measurements, assembly bow, profilometry, gamma scans, and crud scraping. The peak crud free measured oxide thicknesses for the four rods in the 45,043 MWD/MTU to 46,310 MWD/MTU burnup range was measured to be 38.6 to 49.6 microns. The ZIRLO rods had a peak oxide value of 14.3 to 16.3 microns over a burnup range of 26,635 to 28,037 MWD/MTU. In comparison, the low-tin ZIRLO rods had a peak oxide

value of 5.8 to 10.3 microns over a burnup range of 22,256 to 27,254 MWD/MTU. These oxide values are typical for the given burnup and irradiation for an additional cycle should not result in unusual behavior which would yield an oxide thickness greater than 100 microns.

Post-irradiation testing of LTAs is essential to the value of any LTA program. Exelon described the anticipated post-irradiation testing program which will include measurements of rod peak crud free oxidation, assembly length, assembly bow, profilometry, gamma scan, grid growth, grid oxide, guide thimble oxide, and grid cell size. Exelon committed to share the results of these tests with the NRC staff for informational purposes. These anticipated tests are considered to be appropriate by the NRC staff.

3.2 Fuel Assembly Description

Following the utilization of the two LTAs in Byron Unit 1 Cycle 10, one of the LTAs, M09E, was modified to include four high burnup rods before being placed in the core for Byron Unit 2 Cycle 10. Cycle 10 is in progress with a refueling outage scheduled for fall 2002. The top nozzle for M09E was replaced with a new removable top nozzle. The LTA is identical in shape and appearance to the current fuel assembly design. LTA M09E is a once-burned fuel assembly incorporating Westinghouse 17X17 Vantage+ features in addition to the original LTA features (i.e. spring clip, low tin ZIRLO cladding, and higher density fuel pellets). LTA M09E has ZIRLO guide thimbles and mixing vane mid-grids, a removable top nozzle, and a debris resistant bottom nozzle.

LTA M09E is not in a “near limiting” location; however, the LTA is not on the core periphery and is experiencing approximately an overage core power and enthalpy rise hot channel factor.

3.3 LOCA and Non-LOCA Analysis

In accordance with TS 4.2.1, LTA M09E was placed in a nonlimiting core region. Cycle-specific reload safety evaluations were performed for Byron Unit 2 Cycle 10, which considered the effects of the high burnup rods. The fuel rod design calculations predicted that the LTAs would be within core design limits for Byron Unit 2 Cycle 10. The LOCA analysis showed that the LTAs were acceptable for Cycle 10 without any peak clad temperature penalty. For evaluation of the LTAs for the Cycle 10 core, fuel temperatures and pressures for the entire core were put into the LOCA and non-LOCA analyses. The high burnup LTA was bounded by these fuel temperatures and pressures.

4.0 CONCLUSION

The staff has evaluated Exelon’s request and agrees to the commitment change for the present Byron Unit 2 cycle (Cycle 10) which will permit the lead fuel rod-average burnup limit to increase to 69,000 MWD/MTU for the requested two LTAs. Within the two LTAs, only four high burnup fuel rods in LTA M09E will exceed 60,000 MWD/MTU by the end of the cycle. While the staff is in agreement with the proposed change, it is expected that the maximum burnup for the four high burnup rods in LTA M09E will be limited to approximately 65,500 MWD/MTU by the present peak fuel centerline temperature of 4,700 °F included in technical specification 2.1.1.3.

Exelon's license amendment request to increase the maximum peak fuel centerline temperature and its request to increase the maximum lead fuel rod-average burnup to 75,000 MWD/MTU for future LTAs are under staff review.

Principal Contributors: U. Shoop
G. Dick

Date: March 22, 2002