September 9, 2003

Mr. John L. Skolds, President
Exelon Nuclear
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: BYRON STATION, UNITS 1 AND 2 - ENVIRONMENTAL ASSESSMENT AND FINDING OF NO SIGNIFICANT IMPACT OF EXEMPTION FROM THE PROVISIONS OF 10 CFR 50.44, 10 CFR 50.46 AND 10 CFR PART 50 APPENDIX K FOR ONE LEAD TEST ASSEMBLY; AND REQUEST FOR AN INCREASE IN THE ROD-AVERAGE BURNUP LIMIT FOR FOUR FUEL ASSEMBLIES (TAC NOS. MB7371 AND MB7372)

Dear Mr. Skolds:

Enclosed is a copy of the Environmental Assessment and Finding of No Significant Impact related to your application dated January 17, 2003, as supplemented by letter dated March 24, 2003, for an exemption from the provisions of 10 CFR 50.44, 10 CFR 50.46 and 10 CFR Part 50 Appendix K for one lead test assembly; and request for an increase in the rod-average burnup for four fuel assemblies.

The proposed exemption request is to use lower tin ZIRLO^{TM} rods in LTA M09E. The request to exceed the current fuel rod-average design basis burnup limit is for four fuel assemblies, consisting of two Lead Test Assemblies (LTAs) (i.e., M09E and M12E) and two “standard” Westinghouse 17x17 VANTAGE+ZIRLO^{TM} assemblies (i.e., M10E and M11E) in which burnup would increase from 60,000 megawatt-days per metric tonne Uranium (MWD/MTU), up to 69,000 MWD/MTU. We understand that you intend to submit an amendment request with respect to an increase in the rod-average burnup.

The assessment is being forwarded to the Office of the Federal Register for publication.

Sincerely,

/RA/

Anthony J. Mendiola, Chief, Section 2
Project Directorate III
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos: STN 50-454, and STN 50-455

Enclosure: Environmental Assessment

cc w/encl: See next page

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cc w/encl: See next page

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Byron Station Units 1 and 2

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7590-01-P

UNITED STATES NUCLEAR REGULATORY COMMISSION

EXELON GENERATION COMPANY, LLC

DOCKET NO. STN 50-454

BYRON STATION, UNIT NO. 1

ENVIRONMENTAL ASSESSMENT AND FINDING OF

NO SIGNIFICANT IMPACT

The U.S. Nuclear Regulatory Commission (NRC) is considering issuance of an exemption to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, for Facility Operating License No. NPF-37 issued to Exelon Generation Company, LLC, (Exelon or the licensee), for operation of the Byron Station, Unit No. 1, located in Ogle County, Illinois. Therefore, pursuant to 10 CFR 51.21, the NRC is issuing this environmental assessment and finding of no significant impact.

ENVIRONMENTAL ASSESSMENT

Identification of Proposed Action

The proposed action would allow the use of a limited number of fuel rods with ZIRLO™ cladding that has a tin content lower than the currently licensed tin content range for ZIRLO™ in one lead test assembly (LTA) (i.e., LTA M09E). The licensee has also requested approval to irradiate two LTAs (i.e., M09E and M12E) that contain low-tin ZIRLO™ clad fuel rods and two "standard" Westinghouse 17x17 VANTAGE+ ZIRLO™ assemblies (i.e., M10E and M11E) up to 69,000 MWD/MTU for Byron, Unit 1 Cycle 13 (B1C13). The burnup limits are not part of the technical specifications (TS), but are design bases limits for the fuel cladding, and limit the current fuel rod-average burnup to less than or equal to 60,000 MWD/MTU. The proposed

action is in accordance with the licensee's application dated January 17, 2003, as supplemented by letter dated March 24, 2003. The licensee has indicated that it intends to submit an amendment request with respect to an increase in the rod-average burnup.

The Need for the Proposed Action

Available industry data indicates that corrosion resistance of nuclear fuel cladding improves for cladding with a low tin content. The optimum tin level provides a reduced corrosion rate while maintaining the benefits of mechanical strength and resistance to accelerated corrosion from abnormal chemistry conditions. In addition, fuel rod corrosion/temperature feedback effects have become more limiting with respect to fuel rod design criteria. By reducing the associated corrosion buildup and, thus, minimizing temperature feedback effects, additional margin to fuel rod internal pressure design criteria can be obtained.

As part of a program to address these issues, Westinghouse Electric Company (Westinghouse), has developed an LTA program in cooperation with Exelon that includes ZIRLO™ fuel cladding with a tin content lower than the currently licensed range for ZIRLO™. Use of fuel rods using such low-tin cladding requires exemptions from 10 CFR 50.44, "Standards for combustible gas control system in light-water-cooled power reactors"; 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors"; and Appendix K to 10 CFR Part 50, "ECCS Evaluation Models."

In addition, the basis for approval of ZIRLO™ cladding used in the Byron core is provided in an NRC safety evaluation addressed to Westinghouse, "Acceptance for Referencing of Topical Report WCAP-12610, 'VANTAGE+ Fuel Assembly Reference Core Report," dated July 1, 1991. The safety evaluation approved the use of the VANTAGE+ fuel design that was described in WCAP-12610-P-A, and found its use acceptable up to a rod-average burnup of 60,000 MWD/MTU. Use of the VANTAGE+ fuel design in the Byron core

beyond that burnup level has not been approved yet because of uncertainty in changes in the gap-release fraction associated with increasing fuel burnup. The present methods for assessing fission gas releases have not been validated with actual data at higher peak-rod burnups. Therefore, part of the Westinghouse LTA program includes acquisition of actual operating data through the limited use of fuel rods in the Byron Unit 1 core to obtain burnup levels higher than 60,000 MWD/MTU that will be examined at the end of the Byron Unit 1, Cycle 13 (B1C13) fuel cycle.

Two LTAs (i.e., LTA M09E and M12E) were in use in Byron Unit 2, Cycle 10 (B2C10). These LTAs are composed of low-tin and standard composition ZIRLO™ cladding. The licensee modified one of the LTAs (M09E) to include fresh fuel rods with ZIRLO™ cladding that has a tin content lower than that of the ZIRLO™ cladding of the currently licensed fuel. No fuel rods were replaced in LTA M12E. Both LTAs will be used in Byron Unit 1 Cycle 13 (B1C13) in non-limiting core locations. In addition, the licensee proposes to irradiate two standard 17x17 VANTAGE+ ZIRLO™ assemblies (i.e., M10E and M11E) in Byron, Unit 1 Cycle 13 (B1C13), also in non-limiting core locations. At the end of B2C10, the approximate assembly average burnup is expected to be 51,094 MWD/MTU for LTA M09E, 51,123 MWD/MTU for LTA M12E, 51,457 MWD/MTU for LTA M10E, and 51,423 MWD/MTU for LTA M11E.

The licensee has requested that it (1) be authorized to use the modified LTA M09E in Byron, Unit 1 Cycle 13 (B1C13) to obtain data on both the use of low-tin ZIRLO™ and high burnup operation (up to 69,000 MWD/MTU), and (2) be authorized to irradiate the other three assemblies (M10E, M11E, and M12E) up to 69,000 MWD/MTU to obtain data on the effects of high burnup operation. The proposed irradiation of these fuel assemblies does not require a change to the TS; however; this burnup will exceed the current design basis limit for the fuel cladding of 60,000 MWD/MTU for peak fuel rod-average burnup.

Irradiation of these four LTAs 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 additional insight regarding gap-release fraction 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.

Environmental Impacts of the Proposed Action

Background

In its previous environmental assessments concerning fuel burnup, the Commission relied on the results of a study conducted for the NRC by Pacific Northwest Laboratories. The results of the study were documented in detail in the report, "Assessment of the Use of Extended Burnup Fuel in Light Water Power Reactors" (NUREG/CR-5009, PNL-6258, February 1988). The overall findings of this study showed there were no significant adverse effects that would result from increasing the batch-average burnup level of 33,000 MWD/MTU to 50,000 MWD/MTU or above as long as the maximum rod average burnup level of any fuel rod was no greater than 60,000 MWD/MTU. Furthermore, based on the above study and the report, "The Environmental Consequences of Higher Fuel Burn-up," (AIF/NESP-032), issued by the Atomic Industrial Forum, the NRC staff concluded that the environmental impacts summarized in Table S-3 of 10 CFR 51.51 and in Table S-4 of 10 CFR 51.52 for a burnup level of 33,000 MWD/MTU are conservative and bound the corresponding impacts for burnup levels up to 60,000 MWD/MTU and uranium-235 enrichments up to 5 percent by weight.[1]

In this environmental assessment regarding the impacts of the use of extended burnup fuel beyond 60,000 MWD/MTU, the Commission is also relying on the results of an updated study conducted for it by the Pacific Northwest National Laboratory (PNNL) entitled,

[1]See “Extended Burnup Fuel Use in Commercial LWRs; Environmental Assessment and Finding of No Significant Impact,” 53 FR 6040, February 29, 1988.

"Environmental Effects of Extending Fuel Burnup Above 60 GWd/MTU," (NUREG/CR-6703, PNNL-13257, January 2001). This report represents an update to NUREG/CR-5009. Although the study evaluated the environmental impacts of high burnup fuel up to 75,000 MWD/MTU, certain aspects of the review were limited to evaluating the impacts of extended burnup up to 62,000 MWD/MTU because of the need for additional data about the effect of extended burn-up on gap-release fractions. During the study, all aspects of the fuel-cycle were considered, from mining, milling, conversion, enrichment and fabrication through normal reactor operation, transportation, waste management, and storage of spent fuel.

Environmental Impacts

The NRC has completed its evaluation of the proposed action and concludes that there are no significant environmental impacts associated with (1) using LTA M09E with fuel rods composed of ZIRLO™ cladding that has a tin content lower than the currently licensed tin content range for ZIRLO™, and (2) irradiating four fuel assemblies (M09E, M10E, M11E, and M12E) to a burnup of 69,000 MWD/MTU. The following is a summary of the staff's evaluation:

The extended burnup assemblies will have a different mix of fission and activation product radionuclides than the rest of the core. The activities of short-lived fission products will tend to remain constant or decrease slightly, while activities associated with activation products and actinides tend to increase with increasing burnup. As discussed in Attachment 2 to the licensee's January 17, 2003, request, although there are variations in core inventories of isotopes due to extended burnup, there are no significant increases of isotopes that are major contributors to accident doses. In addition, the four fuel assemblies will only contribute a small variation in the isotopic population of the entire core (193 assemblies). Thus, with extended burnup of the four assemblies and their placement in non-limiting core locations, no significant increase in the release of radionuclides to the environment is expected during normal operation.

In addition, no change is being requested by Exelon in the licensed technical specifications pertaining to allowed cooling-water activity concentrations. If leakage of radionuclides from the extended burnup fuel assemblies occurs during operation, then the radioactive material is expected to be removed by the plant cooling water cleanup system.

Using the modified LTA M09E in B1C13 with low-tin ZIRLO™ cladding and irradiating the four fuel assemblies to a burnup of 69,000 MWD/MTU will not result in changes in the operation or configuration of the facility. There will be no change in the level of controls or methodology used for processing radioactive effluents or handling solid radioactive waste, nor will the proposal result in any change in the normal radiation levels within the plant. Accordingly, the impacts on workers and the general population would not be significant because of the small radiological effect of the four extended-burnup assemblies.

Environmental Impacts of Potential Accidents

Accidents that involve the damage or melting of the fuel in the reactor core and spent-fuel handling accidents were also evaluated in NUREG/CR-6703. The accidents considered were a loss-of-coolant accident (LOCA), a steam generator tube rupture, and a fuel-handling accident. In addition, Exelon addressed both LOCA and non-LOCA events in Attachment 2 to the January 17, 2003 request.

For LOCAs, the amount of radionuclides that would be released from the core (1) is proportional to the amount of radionuclides in the core and (2) is not significantly affected by the gap-release fraction. The gap-release fraction is a small contribution to the amount of radionuclides available for release when the fuel is severally damaged. Any increase in the amount of some longer-lived radionuclides available for release from the four LTAs (1) will be small and (2) will not result in a significant increase in the overall core inventory of

radionuclides. Therefore, there would be no significant increase in the previously calculated dose from a LOCA and the dose would remain below regulatory limits.

The pressurized-water reactor (PWR) steam generator tube rupture accident involves direct release of radioactive material from contaminated reactor coolant to the environment. As discussed previously, no change is being requested by Exelon in the licensed technical specifications pertaining to allowed cooling-water activity concentrations. The maximum coolant activity is regulated through technical specifications that are independent of fuel burnup. Therefore, the gap-release fraction does not significantly affect the amount of radionuclides available for release during a steam generator tube rupture. Therefore, there would be no significant increase in the previously calculated dose from a steam generator tube rupture and the calculated dose would remain below regulatory limits.

The scenario postulated to evaluate potential fuel-handling accidents involves a direct release of gap activity to the environment. The assumptions regarding gap activity are based on guidance in Regulatory Guide 1.183, “Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors” and NUREG-1465, “Accident Source Terms for Light-Water Nuclear Power Plants"; the gap activity consists primarily of the noble gases, iodines, and cesiums. The only isotopes that contribute significant fractions of the committed effective dose equivalent and thyroid doses are ^{131}I and ^{134}Cs. Similarly, the only isotopes that contribute significant fractions of the deep dose are ^{132}I and ^{133}Xe. The inventory of iodine, the primary dose contributor, decreases with increasing burnup. However, gap-release fraction increases as burnup increases; this in turn, would increase the calculated dose from a fuel handling accident involving one of the four assembles addressed in this exemption. As discussed earlier and outlined in NUREG/CR-6703, additional information is needed to assess the relationship between gap-release fraction and burnup beyond 60,000

MWD/MTU to 75,000 MWD/MTU. However, based on the trend of the gap-release fraction from 33,000 MWD/MTU to 60,000 MWD/MTU, the increase in gap-release fraction as burnup increases from 60,000 MWD/MTU to 69,000 MWD/MTU is expected to be small. Therefore, the staff concludes (1) that the increase in the previously calculated dose resulting from a fuel-handling accident involving one of the assemblies would not be significant and (2) that the dose would remain below regulatory limits.

Environmental Impacts of Transportation

The environmental effects of incident-free spent fuel transportation were also evaluated in NUREG/CR-6703. Incident-free transportation refers to transportation activities in which shipments of radioactive material reach their destination without releasing any radioactive cargo to the environment. The vast majority of radioactive shipments are expected to reach their destination without experiencing an accident or incident, or releasing any cargo. The incident-free impacts from these normal, routine shipments arise from the low levels of radiation that are emitted externally from the shipping container. Although Federal regulations in 10 CFR Part 71 and 49 CFR Part 173 impose constraints on radioactive material shipments, some radiation is not entirely shielded by the shipping container and exposes nearby persons to low levels of radiation. Based on the analyses presented in NUREG/CR-6703, the staff concludes that doses associated with incident-free transportation of spent fuel with burnup to 75,000 MWD/MTU are bounded by the doses given in 10 CFR 51.52, Table S-4, for all regions of the country if dose rates from the shipping casks are maintained within regulatory limits.

Additionally, the environmental effects of spent fuel transportation accidents were also evaluated in NUREG/CR-6703. Accident risks are the product of the likelihood of an accident involving a spent-fuel shipment and the consequences of a release of radioactive material resulting from the accident. The consequences of such a transportation accident are

represented by the population dose from a release of radioactive material, given that an accident occurs that leads to a breach in the shipping cask's containment systems. The consequences are a function of the total amount of radioactive material in the shipment, the fraction that escapes from the shipping cask, the transport of radioactive material to humans, and the characteristics of the exposed population. Considering the uncertainties in the data and computational methods, the overall changes in transportation accident risks due to increasing fuel burnup of the four fuel assemblies are not significant. The calculated doses resulting from a spent fuel transportation accident will remain below regulatory limits, and no significant increase in the environmental effects of spent-fuel transportation accidents are expected.

Non-Radiological Impacts

With regard to potential non-radiological impacts, the proposed action does not have a potential to affect any historic sites. It does not affect non-radiological plant effluents and has no other environmental impact. Therefore, there are no significant non-radiological environmental impacts associated with the proposed action.

Summary

Based on the staff's independent assessment discussed above, the NRC concludes that there will be no significant environmental impacts associated with (1) using LTA M09E with fuel rods composed of ZIRLO™ cladding that has a tin content lower than the currently licensed tin content range for ZIRLO™, and (2) irradiating the four fuel assemblies (M09E, M10E, M11E, and M12E) to a burnup of 69,000 MWD/MTU.

Environmental Impacts of the Alternatives to the Proposed Action

As an alternative to the proposed action, the staff considered denial of the proposed action (i.e., the "no action" alternative). Denial of the application would result in no change in

current environmental impacts. The environmental impacts of the proposed action and the alternative action are similar. However, it would deny to the licensee and the NRC operational data on low-tin content ZIRLO™ and the performance of fuel at extended burnup conditions.

Alternative Use of Resources

The action does not involve the use of any different resources than those previously considered in the Final Environmental Statement for the Byron Station, Unit Nos. 1 and 2, dated April 30, 1982.

Agencies and Persons Consulted

On July 9, 2003, the staff consulted with the Illinois State official, Frank Niziolek, of the Illinois Department of Nuclear Safety, regarding the environmental impact of the proposed action. The State official had no comments.

Finding of No Significant Impact

On the basis of the foregoing environmental assessment, the NRC staff concludes that (1) allowing use of an LTA (i.e., LTA M09E) with a limited number of replacement fuel rods with ZIRLO™ cladding that has a tin content lower than the currently licensed tin content range for ZIRLO™, and (2) permitting irradiation of four fuel assemblies (M09E, M10E, M11E, and M12E) to a burnup of 69,000 MWD/MTU, will not have a significant effect on the quality of the human environment. Accordingly, the NRC has determined not to prepare an environmental impact statement for the proposed actions.

For further details with respect to the proposed action, see the licensee's letters dated January 17 and March 24, 2003. Documents may be examined, and/or copied for a fee, at the NRC Public Document Room, located at One White Flint North, 11555 Rockville Pike (first floor), Rockville, Maryland. Publicly available records will be accessible electronically from the ADAMS Public Library component of NRC's Web site, http://www.nrc.gov (the Public Electronic

Reading Room). If you do not have access to ADAMS or if there are problems in accessing the documents located in ADAMS, contact the NRC Public Document Room (PDR) Reference staff at 1 (800) 397-4209, or (301) 415-4737, or by e-mail to pdr@nrc.gov.

Dated at Rockville, Maryland, this 9th day of September, 2003.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Anthony J. Mendiola, Chief, Section 2
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