April 5, 2002

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

SUBJECT: BYRON STATION, UNITS 1 AND 2, AND BRAIDWOOD STATION, UNITS 1 AND 2 - ENVIRONMENTAL ASSESSMENT AND FINDING OF NO SIGNIFICANT IMPACT OF REVISING THE FUEL CENTERLINE TEMPERATURE SAFETY LIMIT (TAC NOS. MB3013, MB3014, MB3011, AND MB3012)

Dear Mr. Skolds:

Enclosed is a copy of the Environmental Assessment and Finding of No Significant Impact related to your application for amendment dated September 21, 2001, as supplemented by letter dated January 31, 2002, for revising the fuel centerline temperature safety limit.

The proposed amendment would revise the Reactor Core Safety Limit (SL) for peak fuel centerline temperature from less than or equal to 4700 °F (i.e., the current TS limit) to the design basis fuel centerline melt temperature of less than 5080 °F, for unirradiated fuel, decreasing by 58 °F per 10,000 Megawatt-Days per Metric Tonne Uranium (MWD/MTU) burnup.

Included in the September 21, 2001, submittal was a request to revise the licensing basis commitment to limit the lead fuel rod-average burnup to 60,000 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.

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: 50-454, 50-455, 50-456, and 50-457

Enclosure: Environmental Assessment

cc w/encl: See next page

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UNITED STATES NUCLEAR REGULATORY COMMISSION

EXELON GENERATION COMPANY, LLC

DOCKET NOS. STN 50-454, STN 50-455, STN 50-456 AND STN 50-457

BYRON STATION, UNIT NOS. 1 AND 2

BRAIDWOOD STATION, UNIT NOS. 1 AND 2

ENVIRONMENTAL ASSESSMENT AND FINDING OF

NO SIGNIFICANT IMPACT

RELATED TO A PROPOSED LICENSE AMENDMENT TO REVISE

FUEL CENTERLINE TEMPERATURE SAFETY LIMIT

The U.S. Nuclear Regulatory Commission (NRC) is considering issuance of an amendment for Facility Operating License Nos. NPF-37, NPF-66, NPF-72, and NPF-77, issued to Exelon Generation Company, LLC, (Exelon or the licensee), for operation of the Byron Station, Unit Nos. 1 and 2, located in Ogle County, Illinois and Braidwood Station, Unit Nos. 1 and 2, located in Will County, Illinois. Therefore, as required by 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 revise the reactor core safety limit for peak fuel centerline temperature from less than or equal to 4700 °F to the design-basis fuel centerline melt temperature of less than 5080 °F, for unirradiated fuel, decreasing by 58 °F per 10,000 Megawatt-Days per Metric Tonne Uranium (MWD/MTU) burnup. The increase in the fuel centerline temperature limit is to accommodate higher burnup of these fuel rods to exceed

the licensing basis commitment rod-average burnup limit. The licensee requested that the licensing basis commitment limiting the fuel rod-average burnup to 60,000 MWD/MTU be revised to increase the rod-average burnup limit for only high burnup lead test assemblies (LTAs) to 69,000 MWD/MTU for Byron, Unit 2 Cycle 10, and 75,000 MWD/MTU for both stations for future campaigns. The burnup limits are not part of the technical specifications, but are limited by the fuel centerline temperature.

The proposed action is in accordance with the licensee's application dated September 21, 2001, as supplemented by letter dated January 31, 2002, requesting NRC to provide an amendment to the technical specification (TS) for Byron Station, Units 1 and 2, and Braidwood Station, Units 1 and 2.

The Need for the Proposed Action

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 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 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.

The proposed irradiation of this fuel assembly does not require a change to the TS. However, the planned additional cycle of operation for the high burnup fuel rods will result in burnup levels exceeding the rod-average burnup limit of 60,000 MWD/MTU for that LTA (which is the design limit for the use of Zircaloy or ZIRLO clad fuel in Byron and Braidwood approved in amendments 78 and 70 respectively).

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 by the NRC by Pacific Northwest National Laboratories (PNNL). The results of the study were documented in detail in the report, "Assessment of the Use of Extended Burnup Fuels 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 generated by 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 relying on the results of another study conducted for it by PNNL entitled, "Environmental Effects of Extending Fuel Burnup Above 60 GWd/MTU," (NUREG/CR-6703, PNL-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 data available to support

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

these findings. 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 irradiation of the four fuel rods in assembly M09E to a burnup of 69,000 MWD/MTU. The following is a summary of the staff's evaluation:

The extended burnup rods in the LTA will have a different radionuclide mix 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 D to the September 21, 2001, amendment 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 rods in the LTA will only contribute a very small variation in the isotopic population of the core. Thus, with extended burnup of the LTA, 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 LTA occurs during operation, then the radioactive material is expected to be removed by the plant cooling water cleanup system.

As discussed in Attachment D to the September 21, 2001, amendment request, the proposed changes 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 rods in the LTA.

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.

For LOCAs, an appreciable amount or all of the fuel melts and a portion of the fission products and aerosols are released from the containment system into the biosphere. The increase in the consequences of a postulated LOCA are not appreciable because of the small number of rods exceeding 60,000 MWD/MTU.

The pressurized-water reactor (PWR) steam generator tube rupture accident involves direct release of radioactive material from the 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. This accident scenario has been addressed acceptably by the licensee, and the consequences have been determined to comply with the Commission's regulations.

The scenario used in evaluating potential fuel-handling accidents involves a direct release of gap activity to the environment. The gap activity of concern is 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,” and 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. Even though the iodine inventory decreases with increasing burnup, the potential doses from fuel-handling accidents increase with fuel burnup because of increased gap-release fraction. However, because of the small number of rods exceeding 60,000 MWD/MTU, the staff concludes that the dose resulting from a fuel-handling accident involving the LTA 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 the 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 penetrates the shipping container and exposes nearby persons to low levels of radiation. Based on the realistic analysis 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 rods in the LTA are not significant. Because of the small number of rods exceeding 60,000 MWD/MTU in the LTA, the 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 are no significant adverse environmental impacts associated with the increase to the fuel centerline temperature limit and the irradiation of the four fuel rods 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 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), and Braidwood Station, Unit Nos. 1 and 2 (dated June 30, 1984).

Agencies and Persons Consulted

On March 20, 2002, the staff consulted with the Illinois State official, Mr. Joe Brittin, 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 permitting a change to the fuel centerline temperature, which would, in turn, permit irradiation of the four fuel rods 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 action.

For further details with respect to the proposed action, see the licensee’s letter dated September 21, 2001, as supplemented by letter dated January 31, 2002. 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 5th day of April, 2002.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

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