

(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.<sup>1</sup>

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, "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 severely 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

<sup>1</sup> See "Extended Burnup Fuel Use in Commercial LWRs; Environmental Assessment and Finding of No Significant Impact," 53 FR 6040, February 29, 1988.