Exelon Generation
4300 Winfield Road
Warrenville, IL 60555

Exelon Nuclear

10 CFR 50.90

RS-03-190

December 5, 2003

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Byron Station, Unit 1
Facility Operating License No. NPF-37
NRC Docket No. STN 50-454

Subject: Request for a License Amendment to Revise Lead Test Assembly Burnup Limits for Byron Station, Unit 1 Cycle 13

References:

(1) Letter from Mr. J. B. Hickman (NRC) to Mr. O. D. Kingsley, (Commonwealth Edison Company (now Exelon Generation Company, LLC)), "Issuance of Exemption from the Requirements of 10 CFR 50.44, 10 CFR 50.46, and 10 CFR Part 50, Appendix K – Byron Station, Units 1 and 2 (TAC Nos. MA3930 and MA3931)," dated February 26, 1999

(2) Letter from George F. Dick (NRC) to Oliver D. Kingsley (Exelon Generation Company, LLC), "Increase in the Maximum Fuel Rod-Average Burnup Limit – Byron Station, Unit 2 (TAC No. MB3014)," dated March 22, 2002

(3) Letter from NRC to John L. Skolds (Exelon Generation Company, LLC), "Byron Station, Units 1 and 2, and Braidwood, Station Units 1 and 2 – Issuance of Amendments (TAC NOS. MB3013, MB3014, MB3011, and MB3012)," dated April 19, 2002

(4) Letter from Mr. Mahesh Chawla (NRC) to John L. Skolds (Exelon Generation Company, LLC), "Byron Station, Units 1 and 2, Exemption from the Requirements of 10 CFR 50.44, 10 CFR 50.46 and 10 CFR Part 50 Appendix K (TAC Nos. MB7371 and MB7372)," dated September 22, 2003

(5) Letter from Keith. R. Jury (Exelon Generation Company, LLC) to NRC, "Request for Exemption from the Provisions of 10 CFR 50.44, 10 CFR 50.46 and 10 CFR 50 Appendix K for One Lead Test Assembly; and Request for an Increase in the Rod-Average Burnup Limit for Four Fuel Assemblies," dated January 17, 2003

In accordance with 10 CFR 50.90, "Application for amendment of license or construction permit," Exelon Generation Company, LLC (EGC) is requesting an amendment to Facility

Operating License No. NPF-37 for Byron Station, Unit 1. The proposed amendment would revise the current fuel rod-average licensing basis burnup limit for four lead test assemblies (LTAs) during Byron Station, Unit 1 Cycle 13 (i.e., B1C13).

Initially, a request to revise the current fuel rod-average licensing basis burnup limit was included as part of an exemption request to utilize LTAs as described in Reference 5. After further review and additional discussion with the NRC, it was decided that a license amendment would be required to change the burnup limit.

There is no specific Technical Specification (TS) or license condition that imposes a limit on fuel rod burnup; however, Byron and Braidwood Stations have a licensing basis commitment that limits the current fuel rod-average burnup to $\leq$ 60,000 megawatt-days per metric tonne Uranium (MWD/MTU). This licensing basis commitment is documented in the NRC safety evaluation supporting license amendments 78 and 70 for Byron and Braidwood Stations respectively, dated December 19, 1995. These amendments approved the use of ZIRLO™ fuel cladding. The approval of ZIRLO™ cladding was based on 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. This safety evaluation approved the use of the VANTAGE+ (i.e., ZIRLO™ clad fuel) fuel design and mechanical analyses, described in WCAP-12610-P-A and found it acceptable up to a rod-average burnup of 60,000 MWD/MTU.

EGC is requesting NRC approval to irradiate two LTAs (i.e., M09E and M12E) and two "standard" Westinghouse 17x17 VANTAGE+ ZIRLO™ assemblies (i.e., M10E and M11E) beyond the current fuel rod-average licensing basis burnup value of 60,000 MWD/MTU up to 65,000 MWD/MTU during B1C13. Irradiation of these four assemblies is intended to confirm the acceptable use of the ZIRLO™ alloys to a discharge burnup level exceeding the current licensing basis. The projected peak fuel rod-average burnup of all four assemblies at the end of B1C13 will be approximately 65,000 MWD/MTU which includes margin for potential end-of-cycle coast down.

LTA M09E is composed of a combination of VANTAGE+ ZIRLO™ clad fuel rods, a limited number of low tin ZIRLO™ (i.e., LT-1) clad fuel rods, and a limited number of lower tin ZIRLO™ (i.e., LT-2) clad fuel rods. Use of the LT-1 fuel rod cladding was previously approved by the NRC in Reference 1. Use of the LT-2 cladding was previously approved by the NRC in Reference 4. The VANTAGE+ ZIRLO™ clad fuel rods and the LT-1 clad fuel rods will be in their third cycle of use during B1C13 and are projected to have an end-of-cycle burnup no greater than 65,000 MWD/MTU. The LT-2 clad fuel rods will be in their first cycle of use and will not exceed the current fuel rod-average licensing basis burnup limit.

LTA M12E is composed of a combination of VANTAGE+ ZIRLO™ clad fuel rods, and a limited number of LT-1 clad fuel rods. All fuel rods in LTA M12E will be in their third cycle of use and are projected to have an end-of-cycle burnup no greater than 65,000 MWD/MTU.

Fuel assemblies M10E and M11E are composed entirely of VANTAGE+ ZIRLO™ clad fuel rods. These fuel assemblies will be in their third cycle of use and are projected to have an end-of-cycle burnup no greater than 65,000 MWD/MTU.

The regular ZIRLO™ and ZIRLO™ (LT-1) high burnup fuel rods will continue to satisfy the specified acceptable fuel design Limits (SAFDLs) specified in NRC-approved Westinghouse

topical reports. The clad integrity of the ZIRLO™ and ZIRLO™ (LT-1) high burnup rods will be maintained as the subject fuel assemblies will be placed in less than limiting core locations and will continue to meet the safety parameter requirements. The acceptability of using the ZIRLO™ and ZIRLO™ (LT-1) high burnup rods has been evaluated and confirmed in the B1C13 Reload Safety Evaluation supported by the Westinghouse LTA Report, "Byron Unit 1 Cycle 13 LTA Report," dated August 2003.

The attached amendment request is subdivided as shown below.

Attachment 1 provides an evaluation of the proposed changes and contains the following sections:

1.0 Description

2.0 Proposed Change

3.0 Background

4.0 Technical Analysis

5.0 Regulatory Analysis

5.1 No Significant Hazards Consideration

This section describes our evaluation performed using the criteria in 10 CFR 50.91(a), "Notice for public comment," paragraph (1), which provides information supporting a finding of no significant hazards consideration using the standards in 10 CFR 50.92, "Issuance of amendment," paragraph (c).

5.2 Applicable Regulatory Requirements/Criteria

6.0 Environmental Consideration

This section provides information supporting an environmental assessment. We have determined that the proposed changes meet the criteria for a categorical exclusion set forth in paragraph (c)(10) of 10 CFR 51.22, "Criterion for categorical exclusion; identification of licensing and regulatory actions eligible for categorical exclusion or otherwise not requiring environmental review."

7.0 References

Attachment 2 provides a summary of regulatory commitments made in this submittal.

This proposed license amendment does not involve a revision to any TS, TS Bases or license condition pages.

We request approval of the proposed amendment by June 4, 2004, prior to exceeding the current fuel rod-average licensing basis burnup limit of 60,000 MWD/MTU. The subject fuel rods, as described above, are projected to exceed 60,000 MWD/MTU in early August 2004.

The NRC has previously approved a similar high burnup request for Byron Station as described in References 2 and 3.

The proposed amendment has been reviewed by the Byron Station Plant Operations Review Committee and approved by the Nuclear Safety Review Board in accordance with the requirements of the EGC Quality Assurance Program.

EGC is notifying the State of Illinois of this application for a license amendment by sending a copy of this letter and its attachments to the designated State Official.

Should you have any questions concerning this letter, please contact J. A. Bauer at (630) 657-2801.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on 12-5-03

Kenneth A. Ainger
Manager, Licensing

Attachments:
Attachment 1: Evaluation of Proposed Changes
Attachment 2: Regulatory Commitments

ATTACHMENT 1
Evaluation of Proposed Changes

INDEX

ATTACHMENT 1
Evaluation of Proposed Changes

1.0 DESCRIPTION

In accordance with 10 CFR 50.90, "Application for amendment of license or construction permit," Exelon Generation Company, LLC (EGC) is requesting an amendment to Facility Operating License No. NPF-37 for Byron Station, Unit 1. The proposed amendment would revise the current fuel rod-average licensing basis burnup limit for four lead test assemblies (LTAs) during Byron Station, Unit 1 Cycle 13 (i.e., B1C13).

2.0 PROPOSED CHANGE

There is no specific Technical Specification (TS) or license condition that imposes a limit on fuel rod burnup; however, Byron and Braidwood Stations have a licensing basis commitment that limits the current fuel rod-average burnup to $\leq$ 60,000 megawatt-days per metric tonne Uranium (MWD/MTU). This licensing basis commitment is documented in the NRC safety evaluation supporting license amendments 78 and 70 for Byron and Braidwood Stations respectively, dated December 19, 1995. These amendments approved the use of ZIRLO™ fuel cladding.

EGC is requesting NRC approval to irradiate two LTAs (i.e., M09E and M12E) and two "standard" Westinghouse 17x17 VANTAGE+ ZIRLO™ assemblies (i.e., M10E and M11E) beyond the current fuel rod-average licensing basis burnup value of 60,000 MWD/MTU up to 65,000 MWD/MTU during B1C13. Irradiation of these four assemblies is intended to confirm the acceptable use of the ZIRLO™ alloys to a discharge burnup level exceeding the current licensing basis. The projected peak fuel rod-average burnup of all four assemblies at the end of B1C13 will be approximately 65,000 MWD/MTU which includes margin for potential end-of-cycle coast down.

LTA M09E is composed of a combination of VANTAGE+ ZIRLO™ clad fuel rods, a limited number of low tin ZIRLO™ (i.e., LT-1) clad fuel rods, and a limited number of lower tin ZIRLO™ (i.e., LT-2) clad fuel rods. Use of the LT-1 fuel rod cladding was previously approved by the NRC in Reference 1. Use of the LT-2 cladding was previously approved by the NRC in Reference 4. The VANTAGE+ ZIRLO™ clad fuel rods and the LT-1 clad fuel rods will be in their third cycle of use during B1C13 and are projected to have an end-of-cycle burnup no greater than 65,000 MWD/MTU. The LT-2 clad fuel rods will be in their first cycle of use and will not exceed the current fuel rod-average licensing basis burnup limit.

LTA M12E is composed of a combination of VANTAGE+ ZIRLO™ clad fuel rods, and a limited number of LT-1 clad fuel rods. All fuel rods in LTA M12E will be in their third cycle of use and are projected to have an end-of-cycle burnup no greater than 65,000 MWD/MTU.

Fuel assemblies M10E and M11E are composed entirely of VANTAGE+ ZIRLO™ clad fuel rods. These fuel assemblies will be in their third cycle of use and are projected to have an end-of-cycle burnup no greater than 65,000 MWD/MTU.

3.0 BACKGROUND

As the nuclear industry pursues longer operating cycles with increased fuel discharge burnups, additional data is needed to validate satisfactory fuel performance at burnup levels that exceed the current licensing basis. To gather data on fuel assembly extended burnup, Westinghouse has developed a LTA program in cooperation with EGC. This amendment is requesting NRC approval to irradiate a limited number of LTAs to burnup levels that exceed the current fuel rod-average licensing basis to obtain extended burnup data.

Current Fuel Assembly Design Basis

The reactor core is comprised of an array of 17 x 17 fuel assemblies that are similar in mechanical design and enrichments. The core may currently consist of any combination of VANTAGE 5 and VANTAGE+ fuel assemblies arranged in a checkered low-leakage pattern.

The significant new mechanical design features of the VANTAGE 5 design, relative to the previous optimized (OFA) fuel design include the following:

a. integral fuel burnable absorber (IFBA),
b. intermediate flow mixer (IFM) grids,
c. reconstitutable top nozzle
d. reconstitutable debris filter bottom nozzle,
e. extended burnup capability, and
f. axial blankets.

The VANTAGE+ fuel assembly design includes the following features: ZIRLO clad fuel rods, ZIRLO thimble and instrumentation tubes, and variable pitch plenum spring.

The VANTAGE 5 design has added features, known as PERFORMANCE+ design features, which are: ZIRLO mid-grids and IFM grids, an oxide protective coating at the lower end of the fuel rod cladding, and the protective bottom grid.

Current Fuel Rod Design Basis

The VANTAGE 5 and VANTAGE+ fuel rods consist of uranium dioxide ceramic pellets contained in slightly cold worked Zircaloy-4 or ZIRLO tubing, which is plugged and seal welded at the ends to encapsulate the fuel. The ZIRLO alloy is a zirconium alloy similar to Zircaloy-4, which has been specifically developed to enhance corrosion resistance. The VANTAGE+ fuel rods contain, as in VANTAGE 5, an IFBA coating on some of the enriched fuel pellets. All fuel rods are pressurized with helium during fabrication to reduce stresses and strains, and to increase fatigue life.

An axial blanket, nominally six inches to eight inches in length, of natural or slightly enriched fuel pellets are placed at each end of the enriched pellet column to reduce neutron leakage and improve fuel utilization. The axial blankets utilize chamfered pellets which are physically different in length than the enriched pellets to help prevent accidental mixing during manufacturing. The axial blanket pellets may contain an annulus providing additional plenum space to reduce the rod internal pressure.

The VANTAGE+ fuel rod has the same clad wall thickness as the VANTAGE 5 design. The VANTAGE+ fuel rod length is shorter to provide room for the required fuel rod growth. To offset the reduction in the plenum length, the VANTAGE+ fuel rod has a variable pitch plenum spring. The variable pitch plenum spring provides the same support as the regular plenum spring, but with fewer spring turns, which translates to less spring volume. The bottom end plug has an internal grip feature to facilitate fuel rod loading on both designs (i.e., VANTAGE+ and VANTAGE 5) and provides appropriate lead-in for the removable top nozzle reconstitution feature. The VANTAGE+ fuel rod also has an oxide coating at the bottom end of the fuel rod. The extra layer of oxide coating provides additional debris-induced, rod-fretting wear protection.

The IFBA coated fuel pellets are identical to the enriched uranium dioxide pellets except for the addition of a thin ZrB_2 coating on the pellet cylindrical surface. This coating may be applied with a linear boron-10 loading (in units of milligrams/inch) that is greater than the original IFBA design for added flexibility in the core design. Coated pellets occupy the central portion of the fuel column (up to 132 inches). The number and pattern of IFBA rods within an assembly may vary depending on the specific application. The ends of the IFBA enriched coated pellets, like the enriched uncoated pellets, are also dished to allow for greater axial expansion at the pellet centerline and void volume for fission gas release.

Current Fuel Rod Performance Design Basis

The detailed fuel rod design establishes such parameters as pellet size and density, cladding-pellet diametral gap, gas plenum size, and helium pre-pressurization level. The design also considers effects such as fuel density changes, fission gas release, cladding creep, and other physical properties which vary with burnup. The integrity of the fuel rods is ensured by designing to prevent excessive fuel temperatures, excessive internal rod gas pressures due to fission gas releases, and excessive cladding stresses and strains. This is achieved by designing the fuel rods to satisfy the conservative design bases during Condition I events (i.e., normal operational occurrences) and Condition II events (i.e., incidents of moderate frequency) over the fuel lifetime. For each design basis, the performance of the limiting fuel rod must not exceed the limits specified.

A complete description of the currently licensed fuel assembly design basis and performance parameters is given in Byron/Braidwood Updated Final Safety Analysis Report (UFSAR) Section 4.2, "Fuel System Design."

Lead Test Assembly Design Basis and Approval

A complete description of the features of LTAs M09E and M12E and the associated LT-1 fuel rod cladding was previously provided to the NRC in Reference 5. Use of these LTAs and LT-1 fuel rod cladding was subsequently approved by the NRC in Reference 1.

A complete description of the features of LT-2 fuel rod cladding was previously provided to the NRC in Reference 6. Use of LT-2 fuel rod cladding was subsequently approved by the NRC in Reference 4.

Need for Amendment

Byron Station, Unit 1 is currently operating at full power in Cycle 13 near the beginning of core life. The four subject LTAs are projected to exceed the current fuel rod-average licensing basis burnup limit of 60,000 MWD/MTU in early August 2004. Therefore, we request NRC approval of this license amendment by June 4, 2004. The projected peak fuel rod-average burnup of the applicable rods in all four assemblies at the end of B1C13 will be approximately 65,000 MWD/MTU which includes margin for potential end-of-cycle coast down.

The NRC has previously approved a similar change for Byron Station in a safety evaluation transmitted in a letter from George F. Dick (NRC) to Oliver D. Kingsley (Exelon Generation Company, LLC), "Increase in the Maximum Fuel Rod-Average Burnup Limit – Byron Station, Unit 2 (TAC No. MB3014)," dated March 22, 2002 (i.e., Reference 2), and in the associated license amendment No. 127, issued April 19, 2002 (i.e., Reference 3).

4.0 TECHNICAL ANALYSIS

The approval of ZIRLO™ cladding was based on 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. This safety evaluation approved the use of the VANTAGE+ (i.e., ZIRLO™ clad fuel) fuel design and mechanical analyses, described in WCAP-12610-P-A and found it acceptable up to a rod-average burnup of 60,000 MWD/MTU. The safety evaluation notes that WCAP-12610-P-A supports the following conclusions.

1. The mechanical design bases and limits for the ZIRLO™ clad fuel assembly design are the same as those for the previously licensed Zircaloy-4 clad fuel assembly design.

2. The neutronic evaluations have shown that the ZIRLO™ clad fuel nuclear design bases are satisfied and that key safety parameter limits are applicable. The nuclear design models and methods accurately describe the behavior of ZIRLO™ clad fuel.

3. The thermal and hydraulic design basis for the ZIRLO™ clad fuel is unchanged.

4. The methods and computer codes used in the analysis of the non-loss of coolant accident (LOCA) licensing basis events are valid for ZIRLO™ clad fuel and all licensing basis criteria will be met.

5. The large break LOCA evaluation model was modified to reflect the behavior of the ZIRLO™ clad material during a LOCA. It is concluded that the revised evaluation model satisfies the requirements of 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors," and 10 CFR 50, Appendix K, "ECCS Evaluation Models." There is no significant impact on typical large break LOCA analysis results for the ZIRLO™ model revision.

Fuel Assembly History and Composition

Byron Station, Unit 1 Cycle 10

During Byron Station, Unit 1 Cycle 10 (i.e., B1C10) operation, two LTAs (i.e., M09E and M12E) were utilized consistent with TS 4.2.1, "Fuel Assemblies." The LTAs were designed with Westinghouse 17x17 VANTAGE+ features, LTA features (i.e., spring clip, low tin ZIRLO™ cladding, low tin ZIRLO™ guide thimbles and instrument tube, and higher density fuel pellets), and had ZIRLO™ mixing vane mid-grids, and a debris resistant bottom nozzle. A limited number of fuel rods in each assembly were composed of low tin ZIRLO™ (LT-1) cladding; the remaining rods in each LTA had standard ZIRLO™ cladding. LTAs M09E and M12E also have removable top nozzles.

Byron Station, Unit 2 Cycle 10

For Byron Station, Unit 2 Cycle 10 (i.e., B2C10) operation, these two LTAs were again utilized; however, one of the LTAs (i.e., assembly M09E) was modified to also include high burnup fuel rods. Four rods from LTA M09E were removed after B1C10 and replaced with previously burned ZIRLO™ rods from assembly L41E for the purpose of obtaining representative data at extended fuel burnup (i.e., > 60,000 MWD/MTU). The four high burnup donor fuel rods were "twice-burned" (i.e., used for two fuel cycles) in assembly L41E and had rod-average burnups of approximately 45,750 MWD/MTU at the start of B2C10. NRC approval to irradiate the four high burnup rods up to 69,000 MWD/MTU was granted in References 2 and 3.

At the end of B2C10, the four high burnup rods and a limited number of other fuel rods were removed from LTA M09E and replaced with "lower tin" ZIRLO™ (LT-2) fuel rods. No fuel rods were replaced in LTA M12E. The approximate assembly average burnup for each of these two LTAs at the end of B2C10 is 51920 MWD/MTU.

Byron Station, Unit 1 Cycle 13

The composition of LTAs M09E, M12E, M10E and M11E for B1C13 is as follows:

LTA M09E is composed of a combination of VANTAGE+ ZIRLO™ clad fuel rods, a limited number of low tin ZIRLO™ (i.e., LT-1) clad fuel rods, and a limited number of lower tin ZIRLO™ (i.e., LT-2) clad fuel rods. The VANTAGE+ ZIRLO™ clad fuel rods and the LT-1 clad fuel rods will be in their third cycle of use during B1C13 and are projected to have an end-of-cycle burnup no greater than 65,000 MWD/MTU. The LT-2 clad fuel rods will be in their first cycle of use and will not exceed the current fuel rod-average licensing basis burnup limit.

LTA M12E is composed of a combination of VANTAGE+ ZIRLO™ clad fuel rods, and a limited number of LT-1 clad fuel rods. All fuel rods in LTA M12E will be in their third cycle of use during B1C13 and are projected to have an end-of-cycle burnup no greater than 65,000 MWD/MTU.

The two high burnup "regular" assemblies (i.e., M10E and M11E) are standard Westinghouse 17x17 VANTAGE+ ZIRLO™ assemblies. These two assemblies have been irradiated for two cycles. The approximate assembly average burnup for each of these two standard assemblies at the end of B2C10 is also 51920 MWD/MTU.

All fuel rods in assemblies M10E and M11E will be in their third cycle of use during B1C13 and are projected to have an end-of-cycle burnup no greater than 65,000 MWD/MTU.

Technical Justification for Extending Fuel Rod Burnup Limit

The peak rod-average burnup for the subject regular ZIRLO™ and ZIRLO™ (LT-1) clad fuel rods to be used in B1C13 is projected to be approximately 65,000 MWD/MTU which includes margin for potential end-of-cycle coastdown. This burnup will exceed the current licensing basis limit of 60,000 MWD/MTU for peak fuel rod-average burnup; therefore, it is requested that the NRC provide approval to increase the peak rod-average burnup limit for the above four fuel assemblies from 60,000 MWD/MTU to 65,000 MWD/MTU for B1C13. Approval for up to 65,000 MWD/MTU burnup is being requested to ensure sufficient margin exists in the event the fuel cycle is extended due to coast down.

Fuel rod design criteria that become more limiting for high burnup fuel rods include fuel rod growth, clad fatigue, rod internal pressure and cladding corrosion. The NRC-approved PAD 4.0 code, with NRC-approved models for the Zircaloy-4/ ZIRLO™ cladding in-reactor behavior, were used to calculate the key fuel rod performance criteria over its irradiation history. This code has been used to perform similar evaluations for other high burnup LTAs. In addition, a developmental corrosion model for ZIRLO™ based primarily on data from high burnup fuel irradiated at the V. C. Summer and North Anna plants was used as an evaluation tool. This developmental corrosion model conservatively predicted the observed corrosion on ZIRLO™ (LT-1) clad fuel rods that were examined in previous post-irradiation examination (PIE) campaigns at Byron Station. Both the NRC-approved PAD 4.0 code and ZIRLO™ developmental corrosion model have been used in the B1C13 specific reload safety evaluation to confirm that the fuel rod design limits will be met.

The regular ZIRLO™ and ZIRLO™ (LT-1) high burnup fuel rods will continue to satisfy the specified acceptable fuel design limits (SAFDLs) specified in NRC-approved Westinghouse topical reports, (see References 7, 8, 9, 10 and 11). The clad integrity of the ZIRLO™ and ZIRLO™ (LT-1) high burnup rods will be maintained as the subject fuel assemblies will be placed in less than limiting core locations and will continue to meet the safety parameter requirements. The acceptability of using the ZIRLO™ and ZIRLO™ (LT-1) high burnup rods has been evaluated and confirmed in the B1C13 Reload Safety Evaluation supported by the Westinghouse LTA Report, "Byron Unit 1 Cycle 13 LTA Report," dated August 2003. Specifically regarding the ZIRLO™ (LT-1) high burnup rods, since the two original LTAs only contain a limited number of ZIRLO™ (LT-1) clad rods, this limited number of fuel rods taken to higher burnup would not result in a safety concern. The rationale for this statement is based on: 1) the assemblies will retain a coolable geometry, and 2) the plant dose criterion will not be exceeded or approached in the event that the ZIRLO™ (LT-1) clad fuel rods fail. These conclusions are based on prior Westinghouse bounding calculations.

It has been shown in WCAP-12610-P-A, (i.e., Reference 9), that even though there are variations in core inventories of isotopes due to extended burnup up to 75,000 MWD/MTU, there are no significant increases of isotopes that are major contributors to accident doses. It is worthy to note that, at higher burnups, there is actually a reduction in certain isotopes that are major dose contributors under accident situations (e.g., Kr-88). With only a limited number of ZIRLO™ and ZIRLO™ (LT-1) high burnup rods in the entire core, any variation of isotopes will be extremely small. Thus, the radiation dose limitations of 10 CFR 100, "Reactor Site Criteria," will not be exceeded.

It should be noted that upon startup of B1C13, the reactor coolant system (RCS) activity is higher than normal, which is indicative of a potentially leaking fuel rod. The current RCS dose equivalent Iodine-131 concentration is approximately 7E-03 microcuries/gram (μCi/gm). This RCS activity level is still significantly below the Technical Specification limit of 1.0 μCi/gm. At the current time, we are unable to distinguish what fuel rod(s) in what fuel assembly may be leaking; however, as discussed above, should a fuel rod in one of the LTAs be leaking, there is no safety concern as Westinghouse bounding calculations have shown that, even at the extended burnup levels, 1) the assemblies will retain a coolable geometry, and 2) the plant dose criterion will not be exceeded or approached.

There have been a number of other previous successful experiences with high burnup (i.e., greater than 60,000 MWD/MTU) ZIRLO clad fuel rods/assemblies at V.C. Summer, North Anna, Byron and Prairie Island nuclear stations. It should be noted that this is the first industry request to expose low tin ZIRLO (i.e., LT-1) cladding to a burnup in excess of 60,000 MWD/MTU.

Based on the above discussion, the conclusions supported in WCAP 12610-P-A, noted above, remain valid for the subject fuel rods projected to experience burnup up to 65,000 MWD/MTU.

Pre-characterization Measurements and Post-irradiation Examinations of LTAs

Westinghouse Electric Company, LLC Topical Report, WCAP 15604-NP, Revision 2-A, "Limited Scope High Burnup Lead Test Assemblies," provides the basis for the operation of a limited number of fuel assemblies to fuel rod burnups up to 75,000 MWD/MTU which is greater than the currently licensed rod-average burnup limit. The NRC has approved this WCAP in a safety evaluation transmitted in a letter from William H. Ruland (NRC) to Robert H. Bryan (Westinghouse Electric Company, LLC), "Acceptance for Referencing of Topical Report WCAP-15604-NP, Rev. 1, 'Limited Scope High Burnup Lead Test Assemblies,'" dated January 8, 2003, and a subsequent letter from Herbert N. Berkow (NRC) to Robert H. Bryan (Westinghouse Owners Group), "Response to Comments from the Westinghouse Owners Group (WOG) on the Safety Evaluation for WCAP-15604-NP, Rev. 1, 'Limited Scope High Burn-up Lead Test Assemblies,'" dated August 28, 2003.

WCAP 15604 and the associated NRC safety evaluation specify a number of pre-characterization measurements and post irradiation examinations that should be conducted on high burnup LTAs. The minimum pre-characterization measurements specified by the WCAP and NRC safety evaluation are as follows:

- fuel rod cladding oxidation measurements;
- fuel rod/assembly growth measurements; and
- visual examinations.

Byron Station has performed these pre-characterization measurements and examinations on the four subject LTAs.

The minimum post-irradiation examinations specified by the WCAP and NRC safety evaluation are the same as the pre-characterization measurements. Byron Station will conduct these measurements and examinations after the four subject LTAs have been discharged.

5.0 REGULATORY ANALYSIS

5.1 NO SIGNIFICANT HAZARDS CONSIDERATION

Overview

In accordance with 10 CFR 50.90, "Application for amendment of license or construction permit," Exelon Generation Company, LLC (EGC) is requesting an amendment to Facility Operating License No. NPF-37 for Byron Station, Unit 1. The proposed amendment would revise the current fuel rod-average licensing basis burnup limit for four lead test assemblies (LTAs) during Byron Station, Unit 1 Cycle 13 (i.e., B1C13).

There is no specific Technical Specification (TS) or license condition that imposes a limit on fuel rod burnup; however, Byron and Braidwood Stations have a licensing basis commitment that limits the current fuel rod-average burnup to $\leq$ 60,000 megawatt-days per metric tonne Uranium (MWD/MTU). This licensing basis commitment is documented in the NRC safety evaluation supporting license amendments 78 and 70 for Byron and Braidwood Stations respectively, dated December 19, 1995. These amendments approved the use of ZIRLO™ fuel cladding. The approval of ZIRLO™ cladding was based on 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. This safety evaluation approved the use of the VANTAGE+ (i.e., ZIRLO™ clad fuel) fuel design and mechanical analyses, described in WCAP-12610-P-A and found it acceptable up to a rod-average burnup of 60,000 MWD/MTU.

EGC is requesting NRC approval to irradiate two LTAs (i.e., M09E and M12E) and two "standard" Westinghouse 17x17 VANTAGE+ ZIRLO™ assemblies (i.e., M10E and M11E) beyond the current fuel rod-average licensing basis burnup value of 60,000 MWD/MTU up to 65,000 MWD/MTU during B1C13. Irradiation of these four assemblies is intended to confirm the acceptable use of the ZIRLO™ alloys to a discharge burnup level exceeding the current licensing basis. The projected peak fuel rod-average burnup of all four assemblies at the end of B1C13 will be approximately 65,000 MWD/MTU which includes margin for potential end-of-cycle coast down.

The NRC has previously approved a similar change for Byron Station in a safety evaluation transmitted in a letter from George F. Dick (NRC) to Oliver D. Kingsley (Exelon Generation Company, LLC), "Increase in the Maximum Fuel Rod-Average Burnup Limit – Byron Station, Unit 2 (TAC No. MB3014)," dated March 22, 2002, and in the associated license amendment No. 127, issued April 19, 2002.

Criteria

According to 10 CFR 50.92, "Issuance of amendment," paragraph (c), a proposed amendment to an operating license involves no significant hazards consideration if operation of the facility in accordance with the proposed amendment would not:

(1) Involve a significant increase in the probability or consequences of an accident previously evaluated; or

(2) Create the possibility of a new or different kind of accident from any accident previously evaluated; or

(3) Involve a significant reduction in a margin of safety.

In support of this determination, an evaluation of each of the three criteria set forth in 10 CFR 50.92 is provided below regarding the proposed license amendment.

1. The proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

Fuel rod defects or failures are not considered as initiators for any previously analyzed accident; therefore the requested license amendment will have no effect on the probability of any previously evaluated accident. In addition, NRC-approved methodologies and technical reports have been used in the B1C13 specific reload safety evaluation to confirm that the fuel rod design limits will be met; therefore, increasing the burnup limit of the specified fuel assemblies to the requested value will not increase the consequences of any previously analyzed accident.

The regular ZIRLO™ and ZIRLO™ (LT-1) high burnup fuel rods will continue to satisfy the specified acceptable fuel design limits (SAFDLs) specified in NRC-approved Westinghouse topical reports. The clad integrity of the ZIRLO™ and ZIRLO™ (LT-1) high burnup rods will be maintained as the subject fuel assemblies will be placed in less than limiting core locations and will continue to meet the safety parameter requirements. The acceptability of using the ZIRLO™ and ZIRLO™ (LT-1) high burnup rods has been evaluated and confirmed in the B1C13 Reload Safety Evaluation supported by the Westinghouse LTA Report, "Byron Unit 1 Cycle 13 LTA Report," dated August 2003.

It has been shown in WCAP-12610-P-A, that even though there are variations in core inventories of isotopes due to extended burnup up to 75,000 MWD/MTU, there are no significant increases of isotopes that are major contributors to accident doses. It is worthy to note that, at higher burnups, there is actually a reduction in certain isotopes that are major dose contributors under accident situations (e.g., Kr-88). With only a limited number of ZIRLO™ and ZIRLO™ (LT-1) high burnup rods in the entire core, any variation of isotopes will be extremely small. Thus, the radiation dose limitations of 10 CFR 100, "Reactor Site Criteria," will not be exceeded.

Based on the above discussion, it is concluded that the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. The proposed change does not create the possibility of a new or different kind of accident from any accident previously evaluated.

The proposed change to increase the current fuel rod-average burnup limit does not involve the use or installation of new equipment and all currently installed equipment will not be operated in a new or different manner. No new or different system interactions are created and no new processes are introduced. The proposed change will not introduce any new failure mechanisms, malfunctions, or accident initiators not already considered in the design and licensing bases.

Based on this evaluation, the proposed change does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. The proposed change does not involve a significant reduction in a margin of safety.

The proposed change to increase the current fuel rod-average burnup limit of 60,000 MWD/MTU up to 65,000 MWD/MTU during B1C13 will cause the following fuel rod design criteria to become more limiting: fuel rod growth, clad fatigue, rod internal pressure and cladding corrosion. However, the regular ZIRLO™ and ZIRLO™ (LT-1) high burnup fuel rods will continue to satisfy the SAFDLs specified in NRC-approved Westinghouse topical reports as noted above. The clad integrity of the ZIRLO™ and ZIRLO™ (LT-1) high burnup rods and the appropriate margin to safety will be maintained as the subject fuel assemblies will be placed in less than limiting core locations and will continue to meet the safety parameter requirements. The acceptability of using the ZIRLO™ and ZIRLO™ (LT-1) high burnup rods has been evaluated and confirmed in the B1C13 Reload Safety Evaluation supported by the Westinghouse LTA Report, "Byron Unit 1 Cycle 13 LTA Report," dated August 2003

Based on the above evaluation, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above discussions, it has been determined that the subject license amendment request does not involve a significant increase in the probability or consequences of an accident previously evaluated; or create the possibility of a new or different kind of accident from any accident previously evaluated; or involve a significant reduction in a margin of safety. Therefore, the requested license amendment does not involve a significant hazards consideration under the standards set forth in 10 CFR 50.92(c).

5.2 APPLICABLE REGULATORY REQUIREMENTS/CRITERIA

The following discussion identifies the existing regulatory requirements regarding fuel assemblies and the design basis criteria for the existing fuel burnup requirements.

Technical Specification (TS) 4.2.1, "Fuel Assemblies," provide the following description of fuel assemblies:

> "The reactor shall contain 193 fuel assemblies. Each assembly shall consist of a matrix of Zircaloy or ZIRLO clad fuel rods with an initial composition of natural or slightly enriched uranium dioxide (UO_2) as fuel material. Limited substitutions of zirconium alloy or stainless steel filler rods or vacancies for fuel rods, in accordance with approved applications of fuel rod configurations, may be used. Fuel assemblies shall be limited to those fuel designs that have been analyzed with applicable NRC staff approved codes and methods and shown by tests or analyses to comply with all fuel safety design bases. A limited number of lead test assemblies that have not completed representative testing may be placed in nonlimiting core regions."

There is no specific TS or license condition that imposes a limit on fuel rod burnup; however, Byron and Braidwood Stations have a licensing basis commitment that limits the current fuel rod-average burnup to $\leq$ 60,000 megawatt-days per metric tonne Uranium (MWD/MTU). This licensing basis commitment is documented in the NRC safety evaluation supporting license

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

The current approval of ZIRLO™ cladding was based on 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. This safety evaluation approved the use of the VANTAGE+ (i.e., ZIRLO™ clad fuel) fuel design and mechanical analyses, described in WCAP-12610-P-A and found it acceptable up to a rod-average burnup of 60,000 MWD/MTU. The safety evaluation notes that WCAP-12610-P-A supports the following conclusions.

1. The mechanical design bases and limits for the ZIRLO™ clad fuel assembly design are the same as those for the previously licensed Zircaloy-4 clad fuel assembly design.

2. The neutronic evaluations have shown that the ZIRLO™ clad fuel nuclear design bases are satisfied and that key safety parameter limits are applicable. The nuclear design models and methods accurately describe the behavior of ZIRLO™ clad fuel.

3. The thermal and hydraulic design basis for the ZIRLO™ clad fuel is unchanged.

4. The methods and computer codes used in the analysis of the non-loss of coolant accident (LOCA) licensing basis events are valid for ZIRLO™ clad fuel and all licensing basis criteria will be met.

5. The large break LOCA evaluation model was modified to reflect the behavior of the ZIRLO™ clad material during a LOCA. It is concluded that the revised evaluation model satisfies the requirements of 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors," and 10 CFR 50, Appendix K, "ECCS Evaluation Models." There is no significant impact on typical large break LOCA analysis results for the ZIRLO™ model revision.

High Burnup Design Basis Criteria

Westinghouse Electric Company, LLC Topical Report, WCAP 15604-NP, Revision 2-A, "Limited Scope High Burnup Lead Test Assemblies," provides the basis for the operation of a limited number of fuel assemblies to fuel rod burnups up to 75,000 MWD/MTU which is greater than the currently licensed rod-average burnup limit. The NRC has approved this WCAP in a safety evaluation transmitted in a letter from William H. Ruland (NRC) to Robert H. Bryan (Westinghouse Electric Company, LLC), "Acceptance for Referencing of Topical Report WCAP-15604-NP, Rev. 1, 'Limited Scope High Burnup Lead Test Assemblies,'" dated January 8, 2003, and a subsequent letter from Herbert N. Berkow (NRC) to Robert H. Bryan (Westinghouse Owners Group), "Response to Comments from the Westinghouse Owners Group (WOG) on the Safety Evaluation for WCAP-15604-NP, Rev. 1, 'Limited Scope High Burn-up Lead Test Assemblies,'" dated August 28, 2003.

Impact on Previous Submittals/Precedent

No other license amendment requests currently under review by the NRC are impacted by the information presented in this license amendment request.

The NRC has previously approved a similar change for Byron Station in a safety evaluation transmitted in a letter from George F. Dick (NRC) to Oliver D. Kingsley (Exelon Generation Company, LLC), "Increase in the Maximum Fuel Rod-Average Burnup Limit – Byron Station, Unit 2 (TAC No. MB3014)," dated March 22, 2002, and in the associated license amendment No. 127, issued April 19, 2002.

6.0 ENVIRONMENTAL CONSIDERATION

Overview

In accordance with 10 CFR 50.90, "Application for amendment of license or construction permit," Exelon Generation Company, LLC (EGC) is requesting an amendment to Facility Operating License No. NPF-37 for Byron Station, Unit 1. The proposed amendment would revise the current fuel rod-average licensing basis burnup limit for four lead test assemblies (LTAs) during Byron Station, Unit 1 Cycle 13 (i.e., B1C13).

Criteria

EGC has evaluated this proposed operating license amendment consistent with the criteria for identification of licensing and regulatory actions requiring environmental assessment in accordance with 10 CFR 51.21, "Criteria for and identification of licensing and regulatory actions requiring environmental assessments." EGC has determined that these proposed changes meet the criteria for a categorical exclusion set forth in paragraph (c)(9) of 10 CFR 51.22, "Criterion for categorical exclusion; identification of licensing and regulatory actions eligible for categorical exclusion or otherwise not requiring environmental review," and as such, has determined that no irreversible consequences exist in accordance with paragraph (b) of 10 CFR 50.92, "Issuance of amendment." This determination is based on the fact that this change is being proposed as an amendment to a license issued pursuant to 10 CFR 50, "Domestic Licensing of Production and Utilization Facilities," which changes a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, "Standards for Protection Against Radiation," or which changes an inspection or a surveillance requirement, and the amendment meets the following specific criteria:

(i) The amendment involves no significant hazards consideration.

As demonstrated in Section 5.1, "No Significant Hazards Consideration," the proposed change does not involve any significant hazards consideration.

(ii) There is no significant change in the types or significant increase in the amounts of any effluent that may be released offsite.

The proposed change, which would increase the current fuel rod-average licensing basis burnup limit from 60,000 megawatt-days per metric tonne Uranium (MWD/MTU) to 65,000 MWD/MTU, does not result in an increase in power level, does not increase the production nor alter the flow path or method of disposal of radioactive waste or byproducts; thus, there will be no change in the amounts of radiological effluents released offsite.

Based on the above evaluation, the proposed change will not result in a significant change in the types or significant increase in the amounts of any effluent released offsite.

(iii) There is no significant increase in individual or cumulative occupational radiation exposure.

The proposed change will not result in any changes to the configuration of the facility. The proposed change to increase the current fuel rod-average licensing basis burnup limit from 60,000 MWD/MTU to 65,000 MWD/MTU will not cause a change in the level of controls or methodology used for the processing of radioactive effluents or handling of solid radioactive waste, nor will the proposed amendment result in any change in the normal radiation levels in the plant. Therefore, there will be no increase in individual or cumulative occupational radiation exposure resulting from this change.

Please note that the NRC has previously concluded that the proposed change will not have a significant effect on the quality of the human environment as documented in a letter from Anthony J. Mendiola (NRC) to John L. Skolds (Exelon Generation Company, LLC), "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."

7.0 REFERENCES

1. Letter from Mr. J. B. Hickman (NRC) to Mr. O. D. Kingsley, (Commonwealth Edison Company), "Issuance of Exemption from the Requirements of 10 CFR 50.44, 10 CFR 50.46, and 10 CFR Part 50, Appendix K – Byron Station, Units 1 and 2 (TAC Nos. MA3930 and MA3931)," dated February 26, 1999

2. Letter from George F. Dick (NRC) to Oliver D. Kingsley (Exelon Generation Company, LLC), "Increase in the Maximum Fuel Rod-Average Burnup Limit – Byron Station, Unit 2 (TAC No. MB3014)," dated March 22, 2002

3. Letter from NRC to John L. Skolds (Exelon Generation Company, LLC), "Byron Station, Units 1 and 2, and Braidwood, Station Units 1 and 2 – Issuance of Amendments (TAC NOS. MB3013, MB3014, MB3011, and MB3012)," dated April 19, 2002

4. Letter from Mr. Mahesh Chawla (NRC) to John L. Skolds (Exelon Generation Company, LLC), "Byron Station, Units 1 and 2, Exemption from the Requirements of 10 CFR 50.44, 10 CFR 50.46 and 10 CFR Part 50 Appendix K (TAC Nos. MB7371 and MB7372)," dated September 22, 2003

5. Letter from K. L. Graesser (Commonwealth Edison Company, (now Exelon Generation Company, LLC)) to NRC, "Exemption Request for Two Lead Test Assemblies (LTAs)," dated October 22, 1998

6. Letter from Keith. R. Jury (Exelon Generation Company, LLC) to NRC, "Request for Exemption from the Provisions of 10 CFR 50.44, 10 CFR 50.46 and 10 CFR 50 Appendix K for One Lead Test Assembly; and Request for an Increase in the Rod-Average Burnup Limit for Four Fuel Assemblies," dated January 17, 2003

7. WCAP-12488-A, "Westinghouse Fuel Criteria Evaluation Process," October 1994

8. WCAP-12488-A, Addendum 1-A, Revision 1, "Addendum 1 to WCAP-12488-A, Revision to Design Criteria," January 2002

9. WCAP-12610-P-A, "VANTAGE+ Fuel Assembly Reference Core Report," April 1995

10. WCAP-10125-P-A, "Extended Burnup Evaluation of Westinghouse Fuel," December 1985

11. WCAP-10125-P-A, Addendum 1-A, "Addendum 1 to WCAP-10125-P-A, Revisions to Design Criteria," May 2003

ATTACHMENT 2
Regulatory Commitments

The following table identifies those actions committed to by Exelon Generation Company, LLC in this license amendment request. Any other statements in this submittal are provided for informational purposes and are not considered to be regulatory commitments.

REGULATORY COMMITMENT	DUE DATE
Byron Station will perform the following measurements/examinations on lead test assemblies M09E, M10E, M11E and M12E: 1. fuel rod cladding oxidation measurements 2. fuel rod/assembly growth measurements 3. visual examinations	After fuel assembly discharge from Byron Station, Unit 1 Cycle 13