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RS-18-027

10 CFR 50.90

March 8, 2018

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

Byron Station, Unit 2
Renewed Facility Operating License No. NPF-66
NRC Docket No. STN 50-455

Subject: License Amendment Request to Utilize Accident Tolerant Fuel Lead Test Assemblies

In accordance with 10 CFR 50.90, "Application for amendment of license, construction permit or early site permit," Exelon Generation Company, LLC, (EGC) requests an amendment to Renewed Facility Operating License No. NPF-66 for Byron Station, Unit 2. This amendment request proposes to add a License Condition to Appendix C, "Additional Conditions," of the Byron Station Unit 2 Operating License that authorizes use of two Lead Test Assemblies (LTAs) containing a limited number of Accident Tolerant Fuel (ATF) Lead Test Rods (LTRs) during Byron Station Unit 2, Cycles 22, 23 and 24. These LTAs will be placed in nonlimiting core locations.

After the accident at Fukushima Daiichi, the U.S. Congress mandated the development of nuclear fuels with enhanced accident tolerance to improve performance under Beyond Design Basis Accident (BDBA) conditions. The major expectations for ATF designs included: 1) improved cladding reaction to high temperature steam; 2) reduced hydrogen generation; and 3) reduced BDBA source term. EGC and Westinghouse Electric Company (Westinghouse) have embarked on a joint initiative to gather fuel performance data on Westinghouse EnCore® and Westinghouse ADOPT™ accident tolerant fuel to advance the Congressional mandate. Byron Station plans to load the two LTAs containing Westinghouse EnCore® and ADOPT™ LTRs in Unit 2 during the Spring 2019 refueling outage. The subject LTAs would remain in the Unit 2 core for three cycles; i.e., Cycle 22, 23 and 24; and will then be discharged during the Fall 2023 refueling outage. This initiative will provide test data in support of developing a fuel solution that provides improvements in accident tolerance and fuel economics.

EGC and the Nuclear Industry have had extensive discussions with the NRC regarding the intended safety basis and scope of Technical Specification (TS) 4.2.1, "Fuel Assemblies." Based on the regulatory history of TS 4.2.1, EGC maintains that LTA demonstration programs can be conducted by licensees under 10 CFR 50.59, "Changes, tests, and experiments," without additional NRC approval. However, at this time, the NRC has not communicated alignment with this position, creating regulatory uncertainty regarding the licensing approach for accident tolerant fuel LTAs. Submittal of this License Amendment Request should not be viewed as EGC's endorsement of the position that installation of ATF LTAs requires prior NRC approval; rather, submittal of this License Amendment Request serves only to provide EGC with a stable regulatory path to achieving the goals of this specific ATF LTA project.

Attachment 1 to this letter provides information describing the proposed changes and a summary of the supporting analysis. Attachment 2 presents the proposed License Condition that authorizes use of the two LTAs.

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

In accordance with 10 CFR 50.91, "Notice for public comment; State consultation," paragraph (b), EGC is notifying the State of Illinois of this application for license amendment by transmitting a copy of this letter and its attachments to the designated State of Illinois official.

EGC requests approval of the proposed license amendment request within one year of this submittal date; (i.e., by March 8, 2019), which supports loading the subject LTAs in Byron Station, Unit 2 during Refueling Outage B2R21 scheduled for April 2019, in advance of Cycle 22.

There are no regulatory commitments contained in this letter. Should you have any questions concerning this letter, please contact Joseph A. Bauer at (630) 657-2804.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 8th day of March 2018.

Respectfully,

David M. Gullott
Manager – Licensing
Exelon Generation Company, LLC

Attachment 1: Evaluation of Proposed Changes
Attachment 2: Proposed Additional Condition

cc: NRC Regional Administrator, Region III
NRC Senior Resident Inspector, Byron Station
Illinois Emergency Management Agency – Division of Nuclear Safety

ATTACHMENT 1
Evaluation of Proposed Changes

Subject: License Amendment Request to Utilize Accident Tolerant Fuel Lead Test Assemblies

ATTACHMENT 1
Evaluation of Proposed Changes

1.0 SUMMARY DESCRIPTION

In accordance with 10 CFR 50.90, "Application for amendment of license, construction permit or early site permit," Exelon Generation Company, LLC, (EGC) requests an amendment to Renewed Facility Operating License No. NPF-66 for Byron Station, Unit 2. This amendment request proposes to add a License Condition to Appendix C, "Additional Conditions," of the Byron Station Unit 2 Operating License that authorizes use of two Lead Test Assemblies (LTAs) containing a limited number of Accident Tolerant Fuel (ATF) Lead Test Rods (LTRs) during Byron Station Unit 2, Cycles 22, 23 and 24. These LTAs will be placed in nonlimiting core locations.

After the accident at Fukushima Daiichi, the U.S. Congress mandated the development of nuclear fuels with enhanced accident tolerance to improve performance under Beyond Design Basis Accident (BDBA) conditions. The major expectations for ATF designs included: 1) improved cladding reaction to high temperature steam; 2) reduced hydrogen generation; and 3) reduced BDBA source term. EGC and Westinghouse Electric Company (Westinghouse) have embarked on a joint initiative to gather fuel performance data on Westinghouse EnCore® and Westinghouse ADOPT™ accident tolerant fuel to advance the Congressional mandate. Byron Station plans to load the two LTAs containing Westinghouse EnCore® and ADOPT™ LTRs in Unit 2 during the Spring 2019 refueling outage. The subject LTAs would remain in the Unit 2 core for three cycles; i.e., Cycle 22, 23 and 24; and will then be discharged during the Fall 2023 refueling outage. This initiative will provide test data in support of developing a fuel solution that provides improvements in accident tolerance and fuel economics.

The currently licensed fuel design and reload analysis methods do not fully accommodate the LTA/LTR design and materials; therefore, the Westinghouse analytical codes and methods will be supplemented as necessary using conservative assumptions and qualitative assessments based on test results, to confirm that all applicable limits associated with the LTAs (e.g., fuel thermal mechanical limits, core thermal hydraulic limits, Emergency Core Cooling Systems limits, nuclear limits such as Shutdown Margin, transient analysis limits and accident analysis limits) remain bounded by the current analysis of record.

2.0 DETAILED DESCRIPTION

This amendment request proposes to add a License Condition to Appendix C, "Additional Conditions," of the Byron Station Operating License that authorizes use of two LTAs containing a limited number of ATF LTRs during Byron Station Unit 2, Cycles 22, 23 and 24. These LTAs will be placed in nonlimiting core locations. The new License Condition (shown in Attachment 2) will state the following:

> "Two Lead Test Assemblies containing a limited number of Westinghouse EnCore® and ADOPT™ accident tolerant fuel rods may be placed in nonlimiting Unit 2 core regions during operation of Unit 2, Cycles 22, 23 and 24."

Note that a minor typographical error has also been corrected in the header of Appendix C.

The two LTAs will contain up to a combined total of 20 LTRs. The specific composition of the two LTAs are as follows:

LTA #1 is a Westinghouse VANTAGE+ Optimized Fuel Assembly design and contains:

- Up to two rods with uranium silicide (U_3Si_2) pellets and coated Optimized ZIRLO™ cladding.
  Note: The uranium silicide pellets in each rod will be enclosed in a capsule within a sealed segmented rod of approximately one foot in length. The segmented rod is inserted into a standard rod to make up part of the normal full-length rod.
- Up to two rods with uranium silicide pellets and standard Optimized ZIRLO™ cladding
  Note: The uranium silicide pellets will be enclosed in the fuel rod as noted above.
- Up to four rods with standard uranium dioxide (UO_2) pellets and coated Optimized ZIRLO™ cladding
- All other rods in LTA #1 will have standard uranium dioxide pellets and standard Optimized ZIRLO™ cladding

LTA #2 is a Westinghouse VANTAGE+ Optimized Fuel Assembly design and contains:

- Up to eight rods with standard uranium dioxide pellets and coated Optimized ZIRLO™ cladding
- Up to two rods with Westinghouse ADOPT™ uranium dioxide pellets and coated Optimized ZIRLO™ cladding
- Up to two rods with Westinghouse ADOPT™ uranium dioxide pellets and standard Optimized ZIRLO™ cladding
- All other rods in LTA #2 will have standard uranium dioxide pellets and standard Optimized ZIRLO™ cladding

The cladding coating will consist of pure chromium (Cr) or chromium with a thin secondary material inter-layer applied to the outer surface of the Optimized ZIRLO™ cladding. There are no other changes to the existing fuel assembly design.

3.0 TECHNICAL EVALUATION

The evaluation and description of the proposed Byron Station Lead Test Assembly License Condition is presented below in the following sections. It should be noted that the technical information presented here has been summarized from Westinghouse Corporation Design Reviews; however, has not yet been formally documented in an approved/verified Engineering Report.

Section 3.1, Overview
Section 3.2, Current Byron Station Unit 2 Core Configuration
Section 3.3, Nuclear Safety and Design Considerations
Section 3.4, Technical Analysis
Section 3.5, ADOPT™ Fuel Description

3.1 Overview

The proposed License Amendment requests approval for Byron Station, Unit 2 to load two LTAs with a combined total of up to 20 LTRs containing either Westinghouse EnCore® fuel (uranium silicide fuel pellets) or Advanced Doped Pellet Technology (ADOPT™) fuel (uranium dioxide fuel pellets containing additions of chromium and aluminum oxides) and/or chromium coated fuel rod cladding.

This License Amendment is necessary to support the Westinghouse initiative to develop its EnCore® and ADOPT™ accident tolerant fuel. The Westinghouse ATF initiative is being performed pursuant to the US Department of Energy program to develop light water reactor fuel types for the current fleet that have enhanced severe accident tolerance. Of particular importance are the areas of cladding strength and high temperature steam reaction kinetics, and fuel pellet thermal properties and fission product retention. The Westinghouse uranium silicide fuel with coated Optimized ZIRLO™ cladding improves severe accident tolerance when compared to the existing uranium dioxide/Optimized ZIRLO™ cladding fuel system. The ADOPT™ fuel, described in Section 3.5, has also shown accident tolerance benefits.

The below evaluation presents the current technical justification and the regulatory basis supporting the conclusion that inserting the subject LTAs in the Byron Unit 2 core during Cycles 22, 23 and 24 can be conducted in a safe manner, is bounded by the limits specified in the current analysis of record, and is appropriate to support advancement of the Accident Tolerant Fuel initiative.

3.2 Current Byron Station Unit 2 Core Configuration

A complete description of the Byron Station fuel system design basis can be found in the Updated Final Safety Analysis Report (UFSAR), Section 4.2, "Fuel System Design." Some key details are presented below.

The Byron Station Unit 2 core consists of 193 fuel assemblies. The core currently (i.e., Cycle 21) consists of two regions of Westinghouse VANTAGE+ Optimized Fuel Assemblies (OFAs) with ZIRLO™ cladding; and one region of Westinghouse VANTAGE+ OFAs with Optimized ZIRLO™ cladding. Each fuel assembly consists of 264 fuel rods arranged in a 17x17 array. These fuel assemblies are commonly referred to as "17 OFA." There is a total of 50,952 fuel rods in the core.

The VANTAGE+ fuel rods consist of uranium dioxide ceramic pellets contained in slightly cold worked ZIRLO™ or Optimized ZIRLO™ cladding tubing, which is plugged and seal welded at the ends to encapsulate the fuel. The ZIRLO™ and Optimized ZIRLO™ alloys are zirconium alloys similar to Zircaloy-4, which have been specifically developed to enhance corrosion resistance. The VANTAGE+ fuel rods contain enriched uranium dioxide fuel pellets, and an integral fuel burnable absorber (IFBA) coating on some of the enriched fuel pellets.

3.3 Nuclear Safety and Design Considerations

The specific composition of the two LTAs is detailed above in Section 2.0. Use of the subject LTAs has been evaluated using existing methods (to the extent practical) and sound engineering practices to determine that this initiative is safe from a public health and safety perspective. It is recognized that the currently licensed fuel design and reload analysis methods do not fully accommodate the LTA/LTR design and materials; therefore, the Westinghouse analytical codes and methods will be supplemented as necessary using conservative assumptions and qualitative assessments based on test results, to confirm that all applicable limits associated with the LTAs (e.g., fuel thermal mechanical limits, core thermal hydraulic limits, Emergency Core Cooling Systems limits, nuclear limits such as Shutdown Margin, transient analysis limits and accident analysis limits) remain bounded by the current analysis of record.

Only two LTAs containing a combined total of up to 20 LTRs will be loaded into Byron Station, Unit 2. There is a combined total of 50,952 fuel rods in the Unit 2 core. The combined total of 20 LTRs represent 0.039% of the core inventory. Of these 20 LTRs, the four fuel rods containing uranium silicide pellets represent 0.008% of the core inventory (note again that approximately only one foot of each rod will contain uranium silicide pellets); the 12 fuel rods with standard uranium dioxide fuel pellets and coated Optimized ZIRLO™ cladding represent 0.024% of the core inventory; and the four fuel rods containing ADOPT™ fuel pellets represent 0.008% of the core inventory.

The properties of the uranium silicide fuel (EnCore®) and coated Optimized ZIRLO™ cladding are sufficiently understood to give a high level of confidence in the safety of the proposed activity. ADOPT™ fuel has been widely used in European Boiling Water Reactors (BWRs) and is discussed in detail in Section 3.5. In addition, fuel assemblies containing segmented fuel rods with ADOPT™ fuel pellets have been irradiated in European commercial Pressurized Water Reactors (PWRs), starting in 2007 and reaching 58 MWd/kg fuel assembly burnup without any issues. The ADOPT™ uranium dioxide fuel pellets are very similar to standard uranium dioxide fuel. ADOPT™ pellets incorporate very small amounts of aluminum oxide and chromium oxide based dopants (typically several hundred ppm) to modify the pellet viscoplastic characteristics, which results in improvements in density, plasticity, density, and grain size; which in turn results in improved accident tolerance. Other than the aluminum oxide and chromium oxide dopants, ADOPT™ is identical to standard uranium dioxide and has similar enrichments.

Impact on any aspect of reactor operation or safety will be negligible since the core design and reactor performance (during both normal and abnormal/accident operations) will be dominated by currently approved fuel types.

The core design will ensure that the LTRs within the LTAs, and the LTAs in the core, will be loaded in nonlimiting core locations based the following considerations:

(a) the LTAs will be designed to be at a lower power than the lead assembly power; (i.e., 5% for EnCore®; 2% for ADOPT™);

(b) the LTRs containing the uranium silicide within the LTA will be designed with a lower uranium silicide enrichment in order to be neutronically similar to the symmetric uranium dioxide rods;

(c) safety parameters related to peaking factors/thermal limits will be analyzed with the uranium silicide explicitly modeled; and

(d) regarding Rod Ejection Accidents, the LTAs will be placed away from the rodded locations.

There are several design bases of the fuel system which are potentially impacted by the proposed LTA demonstration. The below design basis limits/criteria have been, or will be, evaluated to confirm safe operation. Since this LTA initiative involves a very limited number of LTAs and LTRs, it is expected (and will be confirmed prior to use) that the LTAs present a negligible impact on reactor operation or nuclear safety.

- The fuel rod cladding must exhibit satisfactory mechanical, material and chemical properties, and must satisfy stress/strain and vibration/fatigue limits.

- The fuel pellet must exhibit satisfactory thermal physical and chemical properties, and dimensional, densification and swelling performance.

- The fuel rod must exhibit satisfactory pellet-clad mechanical interaction characteristics, pellet-clad gap and gas plenum dimensional stability, conformance to fuel temperature and internal gas pressure limits, heat transfer, fuel reliability, and overall dimensional stability.

- The fuel rod must be compatible with the overall fuel assembly design. The fuel rod must not compromise the performance or structural integrity of the fuel assembly, must not impair its ability to accommodate inserts such as Rod Cluster Control Assemblies (RCCAs), Wet Annular Burnable Absorbers (WABAs), Secondary Sources and Thimble Plug Assemblies; and must not impair the performance of the reactivity control systems or the incore nuclear instrumentation.

- The subject LTRs must not impair any aspect of neutronic behavior, including thermal margin, hot and cold reactivity, reactivity coefficients, reactor kinetics, and stability.

- The fuel rod and fuel assembly must be thermal-hydraulically compatible with the core and reactor coolant system (RCS), and must be compatible with all core and RCS materials and other plant equipment.

Since this LTA initiative involves a very limited number of LTRs and LTAs, impact on any aspect of reactor operation or safety will be negligible. As stated above, the Byron Station Unit 2 core will contain only four rods fueled with uranium silicide (two rods with coated Optimized ZIRLO™ cladding and two rods with standard Optimized ZIRLO™ cladding), 12 uranium dioxide fueled rods with coated Optimized ZIRLO™ cladding; and four ADOPT™ rods (two rods with coated Optimized ZIRLO™ cladding and two rods with standard Optimized ZIRLO™ cladding). The uranium silicide fueled rods will have decreased enrichment in order to be neutronically similar to the symmetric uranium dioxide fueled rods. The modified Westinghouse analytical methods are capable of accurately modeling all aspects of neutronic behavior, including thermal margin, hot and cold reactivity, reactivity coefficients. reactor kinetics, and stability. All parameters associated with the fuel pellets and rods can be modeled conservatively with sufficient margin to ensure that the margin of safety is not reduced. Additionally, given the very small number of LTRs in the core, all parameters associated with core-wide neutronic design basis limits will be negligibly affected. The LTAs will be loaded in non-limiting locations within the core.

The thermal, physical and chemical properties of the uranium silicide and ADOPT™ fuel pellets are sufficiently understood to give a high level of confidence in the safety of the proposed activity. Sufficient design margin will be employed to ensure that pellet dimensional changes during operation will not pose a safety or operational concern.

Specific to uranium silicide fuel pellets, the Idaho National Laboratory (INL) Advanced Test Reactor (ATR) data, to date, indicates that the cladding strain from the pellet and pellet fission product retention will likely be comparable to, or better than, uranium dioxide fuel. Any increase in the RCS activity, caused by fuel oxidation arising from the introduction of reactor coolant into the fuel rod during normal operation, is expected to be detected and monitored by existing plant equipment in accordance with approved procedures (i.e., no changes to the RCS radiochemistry procedures will be needed). The mechanical, material, and chemical properties of the coated clad are also well understood. This clad will be stronger, harder and more oxidation resistant than the standard clad, and existing stress/strain and vibration/fatigue criteria will be satisfied. The plant safety and accident analyses methodologies and consequences are not significantly impacted by the new pellet or clad design.

Based on industry and testing experience to date, the performance of the LTRs with respect to the shape, volume and function of the pellet-clad gap is well understood. The ability of the gap to accommodate fission product gases will not be affected, and there are no new pellet-clad interaction concerns introduced. Fuel temperature and pellet-clad heat transfer will be conservatively modeled and will not pose a safety or operational concern. There are no significant new fuel reliability concerns anticipated; it is projected that the integral fuel rod will perform well in all modes of operation; and no adverse interactions with the current RCS chemistry regime are anticipated.

The LTRs will not affect the performance of the host LTAs and will be mechanically identical and compatible with the co-resident fuel rods. The structural integrity of the assembly will be maintained and there will be no adverse effect on any piece of assembly hardware or method of fabrication; therefore, the ability of the assembly to accommodate RCCAs and other inserts will not be affected. In particular, control rod motion will be unaffected during normal operation and transients, and the ability to control reactivity will be unaffected. The mechanical and nuclear function of the incore instrumentation will not be affected by the fuel rods, and there will also be no impact on the function or accuracy of the reactor protection system or the core monitoring system. The LTAs will be thermal-hydraulically identical to the co-resident fuel; subsequently, there will be no impact to any aspect of core thermal-hydraulics or performance of the reactor coolant system.

Accordingly, there will be no adverse impact affecting the interface with any plant equipment, including the reactor pressure vessel, fuel storage, fuel handling, and fuel inspection.

Detailed post-irradiation fuel exams will be conducted at the end of each cycle of operation to ensure that the performance of the LTRs and LTAs conforms to expectation.

In summary, the placement of a limited number of LTRs and LTAs in nonlimiting core locations will not impact the public health and safety; and there will not be a significant impact on any aspect of normal plant operations or accident analyses.

3.4 Technical Analysis

Mechanical Design Methodology

Westinghouse will evaluate the mechanical design impact of the LTRs on the LTA fuel assembly and its subcomponents. No component changes or changes to basic fuel assembly design requirements are expected, and no adverse mechanical design impacts are anticipated from the proposed activity.

The most significant impacts of the LTRs on the LTA will be evaluated. These items will include the LTR's interface/interaction with the top nozzle, bottom nozzle, holddown springs, guide thimble and instrument tube, grid assembly, and joints and connections. The chromium-coated clad results in a slight change in cladding outer diameter, diameter growth and variation, and surface roughness. No changes are expected to the 17 OFA LTA assembly subcomponents, except for the LTRs themselves. The uranium silicide pellets and rod segments will have an insignificant impact on rod weight and assembly. The interface between the LTRs and the 17 OFA assembly will be assessed to ensure no changes in spacer grid or fuel rod support system are required. No grid-to-rod fretting or grid damage is anticipated. There is no change to the LTA interface with any other plant equipment, and there is no change to any fuel handling tools, equipment, or procedures. No impact is anticipated on the lost parts analysis. There will not be any change or impact to the storage of the LTAs as the LTA weight is minimally changed and the LTA reactivity will fall within the current analyzed envelope. The LTA shipping and handling loads will be evaluated and documented; no adverse impact is expected.

The LTR mechanical design is based on the 17 OFA fuel rod. All standard fuel rod design criteria will be evaluated for the LTRs to ensure that sufficient margin exists to any rod failure or damage criterion. The licensed PAD fuel performance code (with slight modifications to account for the new LTA materials – referred to as "PAD-ATF") will be used for much of this analysis. This evaluation includes all fuel rod performance requirements, heat transfer requirements, fuel boundary integrity requirements, fuel rod internal pressure requirements, requirements for axial location of the rod segment containing the uranium silicide pellets, requirements for fuel rod support and positioning, and plenum spring design criteria. The debris fretting resistance of the coated LTRs is expected to be better than the standard rods.

To ensure a conservative deployment of the new uranium silicide fuel type, an encapsulation/segmentation strategy will be employed for these four LTRs. The uranium silicide pellets will be encapsulated within a separate distinct thin zirconium alloy capsule; and this capsule will subsequently be placed within a separate unique fuel rod segment. This separate uranium silicide-containing segment will then be inserted at a chosen axial location within the standard fuel rod, which will otherwise contain standard uranium dioxide fuel pellets. The encapsulation/segmentation design of the four uranium silicide LTRs, including the axial location of the uranium silicide segment, will be identical. The individual segments will screw together in standard segmented rod fashion. Westinghouse has utilized segmented rods in the past without issue in commercial reactors. Capsules are also a standard well-proven and understood technology in test reactors. The density of the standard uranium silicide pellets will be approximately 12% greater than uranium dioxide, and the design of the uranium silicide pellets will be slightly modified to support the placement of the LTRs in non-limiting locations.

The pellets will be fabricated using a standard arc melting process. Significant "out of pile" testing will take place prior to use of the LTRs in Byron Station Unit 2, including testing of steam oxidation, leaker rod, strength, stability, pellet-clad interaction, thermal conductivity, and hydriding. Thermal conductivity is one example of a significantly improved pellet property; the thermal conductivity of uranium silicide is approximately twice that of uranium dioxide at 300°C, and is approximately seven times greater at 1200°C. Several "in pile" tests will also be conducted in the Idaho National Laboratory (INL) Advanced Test Reactor (ATR) prior to the Byron Station Unit 2 deployment. This testing will focus on fuel swelling, fission gas release, and thermal-mechanical properties. In the experience acquired in these test reactors, up to approximately 20 MWd/kgU, uranium silicide has generally exhibited superior performance under irradiation compared to uranium dioxide. Additional subsequent testing including the INL Transient Reactor Test Facility (TREAT) reactor transient tests will continue to inform the LTR program.

The coated cladding will consist of a standard Optimized ZIRLO™ substrate with a thin (approximately 25 micron) layer of chromium, applied via a cold spray process. A thin secondary material interface between the coating and substrate may also be employed. The coating will be of high quality in terms of density, adherence and uniformity. Significant focus has been placed on the optimization of the clad and of the cold spray process variables (including temperature, velocity, pressure, and particle size). Fabrication plans include variants with coating application both before and after the final phase of pilgering (i.e., tubing reduction). An extensive out of pile testing program is underway for the coated clad, including comprehensive mechanical testing (strain, spallation, and cracking), autoclave corrosion testing, high temperature steam oxidation, strength testing, post-quench ductility, ultra-high temperature testing, and boiling performance. The coated clad has been found to compare well with Optimized ZIRLO™ in the out of pile testing to date in the areas of mechanical properties, corrosion, and post-quench ductility. In pile testing of coated clad at the Massachusetts Institute of Technology Test Reactor (MITR) has been completed with satisfactory results. Further in pile testing is underway/planned at the Halden Reactor Project, MITR and ATR.

Fabrication of the LTRs will be performed using standard techniques. Pellet inspection, rod loading and characterization, and welding of the coated clad rods will be performed at the commercial Columbia Fuel Fabrication Facility. All required rod inspections will be performed using standard or augmented inspection techniques, including X-ray, UT, calibrated gauge, and leak check.

A comprehensive fuel examination plan has been established to confirm expected performance of the LTAs and LTRs. This post-irradiation examination plan includes high magnification visual exams, rod cleaning, profilometry, oxide thickness measurement, and eventual shipment of LTRs to the hotcell for destructive evaluation.

Seismic

The impact of the LTAs on the seismic evaluation will be negligible. The maximum expected change in fuel assembly weight (containing the uranium silicide rod segments or ADOPT™ pellets) is well within the normal variation in the fuel assembly weight, and therefore, will not have a detrimental impact on fuel assembly physical characteristics (such as weight and natural frequency). Westinghouse will evaluate the grid deformation analysis for the LTAs to ensure that adequate margin is maintained and that the ability to maintain a coolable geometry is not impacted.

Core Physics

Westinghouse will employ a conservative nuclear design for the LTRs and LTAs. No adverse core physics impacts are anticipated from the proposed activity.

Current standard 17x17 OFA design dimensions will be employed for the LTRs and LTAs, and all LTRs will be placed on the LTA periphery. As previously noted, the design of the uranium silicide pellets will be slightly modified to support the lower operating temperature and the placement of the LTRs in non-limiting locations. Integral Burnable Absorbers (IFBA) will not be used in the uranium silicide, ADOPT™ or chromium-coated LTRs. There will be no change to the standard overall nuclear design process in terms of incore fuel management, safety analyses, or operational data evaluation.

The 25 micron chromium coating and ADOPT™ fuel rods are not explicitly modeled; however, due to the limited number of these items, the ADOPT™ LTRs will have a negligible core-wide neutronic impact. Individual LTR rod power will be slightly suppressed due to the parasitic neutron absorption of the chromium. For conservatism, the non-uranium silicide LTRs (i.e., chromium coated uranium dioxide rods and/or ADOPT™ rods) average rod power will be designed to be at least 2% below the core lead rod power.

The standard uranium dioxide fuel will dominate the global neutronic behavior, and the four uranium silicide rods will form a negligible fraction of the core inventory. There will accordingly be no neutronic impact on reactor operation, core performance or reactivity management. Since the uranium silicide mechanical properties differ from uranium dioxide, additional conservatism and analyses will be employed. For additional conservatism, the uranium silicide LTR average power will be designed to be at least 5% below the core lead rod power, and the associated LTA will be one of the lower enrichment reload batch assemblies. Safety parameters related to peaking factors and fuel melting will be analyzed with the uranium silicide explicitly modeled. The LTAs will be placed in non-rodded locations to ensure negligible impact on the Rod Ejection Accident consequences.

Westinghouse is performing a scoping study with design codes updated to incorporate uranium silicide. The purpose of the study is to quantify all potentially impacted parameters on the reload design or safety analyses and to define a process to address any resulting issues. Using standard assembly design and core design techniques, no significant issues have been identified to date.

Loss-of-Coolant Accidents (LOCA)

The presence of a small number of LTRs will have an insignificant impact on the consequences of a postulated LOCA and limiting Peak Cladding Temperature (PCT). The stored energy in the uranium silicide pellets is expected to be less than uranium dioxide, and the reduced pre-transient corrosion and LOCA oxidation performance of the coated cladding will be improved compared to un-coated cladding. Therefore, it is expected that the introduction of a limited number of LTRs will not adversely affect the consequences of a design basis LOCA.

Non-LOCA Events

Two broad categories of non-LOCA events will be considered for the LTRs/LTAs: those that are dependent on core-average effects; and those which are impacted by local effects in the fuel rods. Events dependent on core-average effects are expected to be negligibly impacted due to the small number of LTRs in the core since the core-average parameters used in the analyses, such as initial stored energy and decay heat, are not expected to be significantly changed. Events which are impacted by local effects in the fuel rods (e.g., hot rod, hot channel or hot spot) could be affected more significantly and require more detailed consideration. Westinghouse will complete an evaluation of the non-LOCA events. It is anticipated that, based on the placement of the LTAs in non-limiting core locations, the conclusions documented in the applicable UFSAR sections will remain valid.

Thermal-Hydraulic

Westinghouse will perform the thermal-hydraulic design evaluations using the existing methods applicable to Byron Station Unit 2 operating conditions and reload designs. No adverse impacts are anticipated from the proposed activity.

The evaluations are intended to verify that the LTRs are less limiting than the standard fuel rods with respect to thermal performance margin, and the LTRs/LTAs are hydraulically compatible with the resident fuel assemblies. The adequacy and conservative treatment of fuel thermal performance is reflected by the projected ample margin to the Departure from Nucleate Boiling Ratio (DNBR). Existing thermal-hydraulic design methods remain applicable and valid for the LTRs. Applicability of these codes will continue to be validated throughout the ATF development process by comparing the updated LTR test data to the fuel design input. No adverse impact on thermal performance is anticipated, and all the LTRs will be hydraulically compatible with the standard fuel rods.

The evaluation of the LTR thermal performance will be substantiated with comparative Critical Heat Flux (CHF) testing between coated and uncoated heater rods in the testing apparatus. The focus of this testing will be to verify that no CHF margin loss occurs due to the coating, and to verify that no deterioration of surface heat transfer occurs. LTR hydraulic compatibility will be evaluated to verify that the coating surface roughness is similar to a standard fuel rod, and to verify that no local hydraulic mismatch occurs due to a change in LTR surface friction.

An assessment will be performed to validate that the LTR thermal-hydraulic reload design evaluations remain bounded by the current analyses. A bounding current analysis will be confirmed by placing the LTRs in non-limiting core locations to assure non-peak LTR power, verifying there is no change to the current DNB correlations and DNBR limits, and verifying that impacts to all other reload safety analysis and design inputs are negligible.

An evaluation will be performed to confirm there are no adverse effects on the thermal-hydraulic design of the reload core due to the presence of the LTRs/LTAs. These evaluations include a comparison of surface roughness and friction between the LTRs and standard rods, and a mechanical consistency and cooling check of key core components. Any impact on the cycle specific crud-induced power shift (CIPS) and crud-induced localized corrosion (CILC) analysis due to the LTRs/LTAs will also be assessed.

Fuel Rod Design

In general, the impact of fuel rod lead use materials (i.e., coated cladding, ADOPT™ pellets, and uranium silicide pellets) on fuel performance will be beneficial. Relative to standard fuel rods, the chromium-coated cladding will exhibit less corrosion and hydrogen pickup. The ADOPT™ pellets will exhibit improved performance during transients with less fission gas release and more fuel plasticity; and the uranium silicide will operate at a lower fuel temperature due to its higher thermal conductivity. The anticipated improved fuel swelling rate and fission gas release for uranium silicide fuel remain to be experimentally verified at higher burnup; however, no adverse effects are anticipated from the proposed activity, particularly with the additional protection from the uranium silicide fuel capsule and segmented rod.

While the current PAD code (i.e., fuel performance code) is capable of modeling the ADOPT™ fuel pellet, material properties and fuel performance models are being updated for coated cladding and uranium silicide fuel with known correlations from literature, test reactor data and results of atomistic modeling. This information, along with ATF material properties and updated fuel temperature models, are being incorporated into the developmental PAD-ATF fuel performance code. Key aspects of the chromium-coated clad modeling include the corrosion and hydrogen pickup models. Key aspects of the uranium silicide modeling include thermal conductivity, thermal expansion, Young's modulus, densification, swelling, and relocation. Preliminary results to date indicate that, compared to uranium dioxide, uranium silicide will operate at a lower temperature with less fission gas release and less gaseous swelling for the same dimensional design and linear heat rate. It is noted that, considering the design of the subject uranium silicide segmented LTR, the additional layer of cladding and gap from the LTR capsule will increase the uranium silicide fuel temperature above the expected temperature of uranium silicide pellets loaded in a standard fuel rod. The chromium-coated cladding will exhibit reduced oxidation and hydrogen pickup in the base material during normal operation.

Fuel Handling, Storage, and Shipping

The LTAs are not expected to have an impact on any aspect of the criticality analyses. This includes criticality analyses for the Spent Fuel Pool, New Fuel Vault, Traveller™ PWR Fuel Shipping Package Arrays, and fuel handling equipment. Impacts to criticality for dry cask storage will be analyzed in the future. Specific to the Spent Fuel Pool and New Fuel Vault, several evaluations were performed to assess the impact of an Optimized Fuel Assembly with four uranium silicide LTRs. These evaluations showed a negligible impact on reactivity.

Similarly, with respect to fuel burnup, calculations show that the reactivity trajectory of the LTAs with exposure will be very similar to that of the standard fuel assemblies when placed in the Spent Fuel Pool Racks or dry casks. Additionally, evaluation of the Traveller™ container rod pipe arrays and transportation package arrays indicates that margin exists below the upper subcritical limit for all normal and accident conditions. It is concluded that the LTAs will have a negligible impact on reactivity associated fuel handling, storage or shipping.

Best Estimate Analyzer for Core Operations Nuclear (BEACON™) Core Monitoring System

Online core monitoring with the BEACON™ Core Monitoring System (i.e., the Power Distribution Monitoring System) will not be affected by the LTAs or LTRs, and the ability to accurately calculate the reactor 3-dimensional power shape will not be affected. The placement of the LTRs in the LTAs, and the placement of the LTAs in the core, will be designed to have a negligible effect on the measurements of the incore flux detectors and the excore nuclear instrumentation system detectors. Nuclear data libraries for the uranium silicide and ADOPT™ LTRs will be developed so these rods can be explicitly modeled.

Alternate Source Term

The radiological source term will not be significantly affected by the LTRs and LTAs. The fissile material (i.e., low enriched uranium) has not changed, the fuel form and chemical properties are not significantly different, and the fission product retention properties of the fuel have not been reduced. The timing, magnitude, and chemical form of fission products released during an accident will not be significantly different. In the unlikely event of a total failure of all LTRs, the very small number of LTRs contained in the LTAs provides assurance that the radiological release limits for design basis accidents will not be challenged.

3.5 ADOPT™ Fuel Description

Advanced Doped Pellet Technology (ADOPT™) fuel is uranium dioxide fuel containing additions of chromium and aluminum oxides. The additives facilitate greater densification and diffusion during sintering, which result in a higher density and an enlarged grain size compared to undoped uranium dioxide. While achieving the desired pellet properties, the amount of additives has been kept at a minimum in the ADOPT™ design. This has the benefit of reducing the amount of parasitic neutron absorption introduced by the additives such as chromium. Aluminum oxide can, to some extent, be used as a substitute for chromium oxide. The available data suggests beneficial rod performance properties such as improved resistance to post failure degradation and increased pellet clad interaction (PCI) margins for ADOPT™ in comparison to undoped uranium dioxide pellets. It has also been shown through power ramp tests and bump tests, that there is significantly less gas release from the ADOPT™ fuel during transients.

The ADOPT™ uranium dioxide fuel pellets are very similar to standard uranium dioxide fuel. As noted, ADOPT™ pellets incorporate very small amounts of aluminum- and chromium-oxide based dopants (typically several hundred ppm) to modify the pellet viscoplastic characteristics, which results in improvements in density, plasticity, and grain size, and which in turn results in improved accident tolerance; otherwise, ADOPT™ is identical to standard uranium dioxide.

The use of ADOPT™ pellets poses negligible risk. ADOPT™ is the standard Westinghouse BWR fuel product in Europe, and for many years has been licensed for use in multiple international BWRs. The first ADOPT™ -fueled test rods were inserted in 1999, and since that time over 1800 fuel assemblies containing ADOPT™ fuel have been irradiated. ADOPT™ fuel has reached exposures of 60.8 MWd/kg average fuel assembly burnup and 72 MWd/kg fuel rod average burnup. Hot cell examinations and poolside examinations have verified acceptable fuel pellet performance. As such, substantial commercial reactor operating experience exists for ADOPT fuel.

Fuel assemblies containing segmented fuel rods with ADOPT™ fuel pellets have also been irradiated in European commercial PWRs, starting in 2007 and reaching 58 MWd/kg fuel assembly burnup without any issues. The performance of ADOPT™ fuel in a PWR environment is anticipated to be similar to that observed in BWRs. Four LTRs containing ADOPT™ uranium dioxide fuel pellets with be included in one of the two LTAs as previously discussed.

The fuel performance of ADOPT™ pellets is well understood. The ADOPT™ pellets exhibit satisfactory thermal physical and chemical properties, and dimensional, densification and swelling performance. ADOPT™ fuel has essentially the same heat capacity, thermal diffusivity, thermal expansion coefficient, and melting temperature as standard uranium dioxide. The ADOPT™ pellets will be enriched to levels characteristic of standard pellets and will not impair any aspect of neutronic behavior, including thermal margin, hot and cold reactivity, reactivity coefficients and reactor kinetics, and stability. All primary operational parameters such as DNBR, fuel temperature, linear heat rate, fuel enthalpy, clad strain, and fuel burnup will be negligibly impacted by the use of ADOPT™ pellets; however, sufficient design margin will be employed.

The use of ADOPT™ pellets will have a negligible impact on the mechanical design of the assembly. There is no direct effect on the fuel rod clad. The fuel rod interface with all fuel assembly subcomponents will be unaffected, and the ADOPT™ pellet dimensions will be very similar to the dimensions of standard uranium dioxide pellets, and the weight of an ADOPT™ rod will be similar to the weight of a standard rod. The thermal-hydraulic performance and seismic performance of the LTR and LTA will not be affected by the slightly different ADOPT™ pellet. Westinghouse has significant experience with the fabrication of ADOPT™ pellets and subsequent full fuel assembly fabrication, and therefore no issues are expected. Westinghouse has a large amount of operating experience with ADOPT™ fuel, and the fuel performance of ADOPT™ pellets and ADOPT™ -fueled rods is well understood and can be accurately modeled. Any modifications to NRC-approved fuel or reactor analysis methods to accommodate the use of ADOPT™ in a PWR will be minor and will pose negligible risk.

The use of ADOPT™ pellets will not affect any aspect of the chromium-coated fuel rod cladding performance. The ADOPT™ pellets are very similar to standard uranium dioxide pellets and any differences will be transparent to the cladding. ADOPT™ has improved pellet-clad interaction performance when compared to standard uranium dioxide, which will be a beneficial effect. There will be no adverse LOCA or non-LOCA impacts, because the ADOPT™ pellet decay heat, stored energy, thermal conductivity, neutronic characteristics, and kinetic characteristics are very similar to standard uranium dioxide pellets.

A conservative nuclear design will be utilized for the ADOPT™ rods, and there will be no negative neutronic impact on reactor operation, core performance, and reactivity management. The ADOPT™ -fueled rods will be designed to be at least 2% below the core lead rod power. Similarly, online core monitoring with the BEACON™ core monitoring system will not be negatively affected.

There will be no impact on any aspect of criticality evaluation or source term because of the similarities between ADOPT™ uranium dioxide pellets and standard uranium dioxide. The initial reactivity and reactivity trajectory of the ADOPT™ LTRs will be very similar to standard uranium dioxide, and the fuel form and associated chemical properties are not significantly different.

In summary, the use of the ADOPT™ pellets in four fuel rods poses negligible risk, and will help facilitate understanding of this important ATF concept.

4.0 REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements/Criteria

The Byron Station Technical Specification (TS) 4.2.1, "Fuel Assemblies," addresses the use of LTAs within the Byron Station reactor cores. TS 4.2.1 states, in part:

> *"A limited number of lead test assemblies that have not completed representative testing may be placed in nonlimiting core regions."*

Upon initial review, one could conclude that LTAs may be utilized in the core, subject to the limitations of TS 4.2.1, without further NRC review and approval. The requirement for "a limited number" of assemblies is met for this initiative since the LTRs will be placed in only two fuel assemblies. Furthermore, the core design will ensure that the LTRs within the LTAs, and the LTAs in the core, will be loaded in nonlimiting core locations based the following considerations:

(a) the LTAs will be designed to be at a lower power than the lead assembly power; (i.e., 5% for EnCore®; 2% for ADOPT™);

(b) the LTRs containing the uranium silicide within the LTA will be designed with a lower uranium silicide enrichment in order to be neutronically similar to the symmetric uranium dioxide rods;

(c) safety parameters related to peaking factors/thermal limits will be analyzed with the uranium silicide explicitly modeled; and

(d) regarding Rod Ejection Accidents, the LTAs will be placed away from the rodded locations.

10 CFR 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors," requires nuclear power reactors fueled with uranium oxide pellets within cylindrical Zircaloy or ZIRLO cladding to be provided with an emergency core cooling system with certain performance requirements. Although the Westinghouse EnCore® and ADOPT™ Lead Test Rods contain fuel and cladding material other than those defined in 10 CFR 50.46,

the acceptance criteria specified in 10 CFR 50.46 will continue to be satisfied for the Byron Station Unit 2 core.

10 CFR Part 50, Appendix K, "ECCS [Emergency Core Cooling System] Evaluation Models," Section I, "Required and Acceptable Features of the Evaluation Models," specifies the required attributes of the ECCS Evaluation Models. Paragraph A.1, "The Initial Stored Energy in the Fuel," states that, "the thermal conductivity of the UO_2 [uranium dioxide] shall be evaluated as a function of burn-up and temperature..." Paragraph I.A.5, "Metal-Water Reaction Rate," specifies that "the rate of energy release, hydrogen generation, and cladding oxidation from the metal/water reaction shall be calculated using the Baker-Just equation," where the Baker-Just equation applies specifically to the "zirconium-water" reaction. Based on the properties of the Westinghouse EnCore® and ADOPT™ Lead Test Rods, the results of the ECCS Evaluation Models for the resident fuel remain bounding when considering the impact of the Lead Test Rods.

4.2 Precedent

EGC, along with many licensees, have previously conducted numerous LTA campaigns; however, the use of LTAs containing Westinghouse EnCore® and ADOPT™ (with and without chromium-coated cladding) accident tolerant fuel rods is a "first of a kind" LTA initiative.

4.3 No Significant Hazards Consideration

Overview

In accordance with 10 CFR 50.90, "Application for amendment of license, construction permit or early site permit," Exelon Generation Company, LLC, (EGC) requests an amendment to Renewed Facility Operating License No. NPF-66 for Byron Station, Unit 2. This amendment request proposes to add a License Condition to Appendix C, "Additional Conditions," of the Byron Station Unit 2 Operating License that authorizes use of two Lead Test Assemblies (LTAs) containing a limited number of Accident Tolerant Fuel (ATF) Lead Test Rods (LTRs) during Byron Station Unit 2, Cycles 22, 23 and 24. These LTAs will be placed in nonlimiting core locations.

After the accident at Fukushima Daiichi, the U.S. Congress mandated the development of nuclear fuels with enhanced accident tolerance to improve performance under Beyond Design Basis Accident (BDBA) conditions. The major expectations for ATF designs included: 1) improved cladding reaction to high temperature steam; 2) reduced hydrogen generation; and 3) reduced BDBA source term. EGC and Westinghouse Electric Company (Westinghouse) have embarked on a joint initiative to gather fuel performance data on Westinghouse EnCore® and Westinghouse ADOPT™ accident tolerant fuel to advance the Congressional mandate. Byron Station plans to load the two LTAs containing Westinghouse EnCore® and ADOPT™ LTRs in Unit 2 during the Spring 2019 refueling outage. The subject LTAs would remain in the Unit 2 core for three cycles; i.e., Cycle 22, 23 and 24; and will then be discharged during the Fall 2023 refueling outage. This initiative will provide test data in support of developing a fuel solution that provides improvements in accident tolerance and fuel economics.

The currently licensed fuel design and reload analysis methods do not fully accommodate the LTA/LTR design and materials; therefore, the Westinghouse analytical codes and methods will be supplemented as necessary using conservative assumptions and qualitative assessments based on test results, to confirm that all applicable limits associated with the LTAs (e.g., fuel thermal mechanical limits, core thermal hydraulic limits, Emergency Core Cooling Systems limits, nuclear limits such as Shutdown Margin, transient analysis limits and accident analysis limits) remain bounded by the current analysis of record.
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.

EGC has evaluated the proposed change for Byron Station, using the criteria in 10 CFR 50.92, and has determined that the proposed change does not involve a significant hazards consideration. The following information is provided to support a finding of no significant hazards consideration.

Criteria

1. **Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?**

Response: No.

The proposed change involves only a very small number of LTRs, which will be conservatively designed from a neutronic standpoint, and are thermal-hydraulically and mechanically compatible with all plant Systems, Structures and Components (SSCs). The fuel pellets and fuel rods themselves will have no impact on accident initiators or precursors. There will not be a significant impact on the operation of any plant SSC or on the progression of any operational transient or design basis accident. There will be no impact on any procedure or administrative control designed to prevent or mitigate any accident.

The Westinghouse EnCore® and ADOPT™ (with and without chromium-coated cladding) LTAs are of the same design as the co-resident fuel in the core, with the exception of containing a limited number of LTRs in place of the standard fuel rods. The LTAs will be placed in nonlimiting core locations. The Byron Station Unit 2, Cycle, 22, 23 and 24 reload designs will meet all applicable design criteria. Evaluations of the LTAs will be performed as part of the cycle specific reload safety analysis to confirm that the acceptance criteria of the existing safety analyses will continue to be met. Operation of the Westinghouse EnCore® and ADOPT™ fuel will not significantly increase the predicted radiological consequences of accidents currently postulated in the Updated Final Safety Analysis Report.

Based on the above discussion, the proposed changes do not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. **Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?**

Response: No.

The proposed change involves the use of a very small number of LTRs in two LTAs which are very similar in all aspects to the co-resident fuel, as noted in Question 1. The proposed change does not change the design function or operation of any SSC, and does not introduce any new failure mechanism, malfunction, or accident initiator not considered in the current design and licensing bases.

The Byron Station Unit 2 reactor cores will be designed to meet all applicable design and licensing basis criteria. Demonstrated adherence to these standards and criteria precludes new challenges to components and systems that could introduce a new type of accident. The reload core designs for the cycles in which the Westinghouse LTAs will operate (i.e., Cycles 22, 23 and 24) will demonstrate that the use of the LTAs in nonlimiting core locations is acceptable. The relevant design and performance criteria will continue to be met and no new single failure mechanisms will be created. The use of Westinghouse LTAs does not involve any alteration to plant equipment or procedures that would introduce any new or unique operational modes or accident precursors.

Therefore, the proposed change will not create the possibility of a new or different kind of accident than those previously evaluated.

3. **Does the proposed change involve a significant reduction in a margin of safety?**

Response: No.

Operation of Byron Station Unit 2 with two Westinghouse LTAs containing a limited number of LTRs, placed in nonlimiting core locations, does not change the performance requirements on any system or component such that any design criteria will be exceeded. The current limits on core operation defined in the Byron Station Technical Specifications will remain applicable to the subject LTAs during Cycles 22, 23 and 24. Westinghouse analytical codes and methods will be used, and supplemented as necessary using conservative assumptions, to confirm that all applicable limits associated with the LTAs (e.g., fuel thermal mechanical limits, core thermal hydraulic limits, Emergency Core Cooling Systems limits, nuclear limits such as Shutdown Margin, transient analysis limits and accident analysis limits) remain bounded by the current analysis of record.

To further assure no reduction in the margin of safety, the LTRs will be designed with reduced uranium enrichment and will be placed in non-limiting core locations as noted above. With respect to non-fuel SSCs, there is no reduction in the margin of safety for any safety limit, limiting safety system setting, limiting condition of operation, instrument setpoint, or any other design parameter.

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

Based on the above, EGC concludes that the proposed amendment does not involve a significant hazards consideration under the standards set forth in 10 CFR 50.92, and accordingly, a finding of "no significant hazards consideration" is justified.

4.4 Conclusions

Based on the evaluation presented above, there is high confidence that utilization of two LTAs containing a limited number of Westinghouse EnCore® and ADOPT™ (with and without chromium-coated cladding) accident tolerant fuel rods during Byron Station Unit 2, Cycles 22, 23 and 24, will have a negligible impact on any aspect of reactor operations or reactor safety. Westinghouse analytical codes and methods will be supplemented as necessary using conservative assumptions and qualitative assessments based on test results, to confirm that all applicable limits associated with the LTAs (e.g., fuel thermal mechanical limits, core thermal hydraulic limits, Emergency Core Cooling Systems limits, nuclear limits such as Shutdown Margin, transient analysis limits and accident analysis limits) remain bounded by the current analysis of record.

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the site licensing basis and Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

5.0 ENVIRONMENTAL CONSIDERATION

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 to utilize two Lead Test Assemblies (LTAs) containing a limited number of Westinghouse EnCore® and Westinghouse ADOPT™ accident tolerant fuel rods during Byron Station Unit 2, Cycles 22, 23 and 24, 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 these changes are being proposed as an amendment to the 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 4.3, "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 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. It is expected that all plant equipment would operate as designed in the event of an accident to minimize the potential for any leakage of radioactive effluents. The proposed changes will have a negligible impact on the amounts of radiological effluents released offsite during normal at-power operations or during the accident scenarios.

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.

There is no change in individual or cumulative occupational radiation exposure due to the proposed change. Specifically, the proposed change to utilize two LTAs containing a limited number of Westinghouse EnCore® and ADOPT™ accident tolerant fuel rods during Byron Station Unit 2, Cycles 22, 23 and 24, has no impact on any radiation monitoring system setpoints. The proposed action will not change the level of controls or methodology used for processing of radioactive effluents or handling of solid radioactive waste, nor will the proposed action result in any change in the normal radiation levels within the plant.

Therefore, in accordance with 10 CFR 51.22, paragraph (b), no environmental impact statement or environmental assessment need be prepared in support of the proposed amendment.

6.0 REFERENCES

1. Byron/Braidwood Stations, Updated Final Safety Analysis Report, Section 4.2, "Fuel System Design"

2. Byron Station Technical Specification 4.2.1, "Fuel Assemblies"

ATTACHMENT 2

BYRON STATION
UNIT 2

Docket No. 50-455

Renewed Facility Operating License No. NPF-66

Proposed Additional Condition

APPENDIX C

ADDITIONAL CONDITIONS

RENEWED FACILITY OPERATING LICENSE NO. NPF-66

The licensee shall comply with the following conditions on the schedules noted below:

Amendment Number	Additional Condition	Implementation Date
127	The safety limit equation specified in TS 2.1.1.3 regarding fuel centerline melt temperature (i.e., less than 5080 °F, decreasing by 58 °F per 10,000 MWD/MTU burnup as described in WCAP-12610-P-A, "VANTAGE+ Fuel Assembly Reference Core Report," April 1995) is valid for uranium oxide fuel without the presence of poisons mixed homogeneously into the fuel pellets. If fuel pellets incorporating homogeneous poisons are used, the topical report documenting the fuel centerline melt temperature basis must be reviewed and approved by the NRC and referenced in this license condition. TS 2.1.1.3 must be modified to also include the fuel centerline melt temperature limit for the fuel with homogeneous poison.	With Implementation of the Amendment
XXX	Two Lead Test Assemblies containing a limited number of Westinghouse Encore® and ADOPT™ accident tolerant fuel rods may be placed in nonlimiting Unit 2 core regions during operation of Unit 2, Cycles 22, 23 and 24.	With Implementation of the Amendment