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RS-19-004

10 CFR 50.90

January 16, 2019

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. 50-455

Subject: Supplement #3 to License Amendment Request to Utilize Accident Tolerant Fuel Lead Test Assemblies

References:

1. Letter from D. M. Gullott (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "License Amendment Request to Utilize Accident Tolerant Fuel Lead Test Assemblies," dated March 8, 2018 (ADAMS ML18067A431)

2. Letter from D. M. Gullott (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "Supplement to License Amendment Request to Utilize Accident Tolerant Fuel Lead Test Assemblies," dated July 2, 2018 (ADAMS ML18184A270)

3. Letter from D. M. Gullott (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "Supplement #2 to License Amendment Request to Utilize Accident Tolerant Fuel Lead Test Assemblies," dated December 18, 2018 (ADAMS ML18352B117)

4. January 4, 2019 Regulatory Audit of Byron Station, Unit 2 License Amendment Request to Allow Insertion of Accident Tolerant Fuel Lead Test Assemblies Docket No. 50-455 (ADAMS ML19016A235)

In Reference 1, Exelon Generation Company, LLC, (EGC) requested an amendment to Renewed Facility Operating License No. NPF-66 for Byron Station, Unit 2. The proposed change would add a License Condition to Appendix C, "Additional Conditions," of the Byron Station Unit 2 Operating License that authorizes the use of a limited number of Accident Tolerant Fuel (ATF) Lead Test Rods (LTRs) in two Lead Test Assemblies (LTAs) during Byron Station Unit 2, Cycles 22, 23, and 24. As described in Reference 2, the two LTAs contain standard UO_2 pellets with standard Optimized ZIRLO™ cladding in combination with three test rod configurations – uranium silicide (U_3Si_2) pellets with Optimized ZIRLO™ cladding, standard uranium dioxide (UO_2) pellets with coated Optimized ZIRLO™ cladding, and Advanced Doped

Pellet Technology (ADOPT™) UO_2 pellets with coated Optimized ZIRLO™[1] cladding. The specific number and type of test rods in each LTA is described in Reference 2.

The license condition requested in Reference 1 explicitly states that the two LTAs containing a limited number of Westinghouse Encore® and ADOPT™ accident tolerant fuel rods may be placed in nonlimiting Byron Station Unit 2 core regions during Cycles 22, 23 and 24.

Reference 3 notified the NRC that during a Condition II boron dilution transient, with rods in manual control, at the burnup step of 150 MWD/MTU, the ADOPT™ LTRs are predicted to operate at higher power than the remainder of the core. Although this condition does not exceed Technical Specifications (TS) Safety Limit 2.1.1.3 or any other applicable fuel licensing limit, discussions during the Reference 4 audit on January 4, 2019 confirmed that the originally proposed license condition which reiterated the TS 4.2.1, "Fuel Assemblies," statement that LTAs are placed in nonlimiting core regions requires revision.

This supplement deletes the originally proposed license condition, including the additional typographical correction proposed in Reference 1, and revises TS 4.2.1, "Fuel Assemblies" to allow two LTAs containing up to twenty total LTRs to be placed in the core for evaluation during Byron Station Unit 2, Cycles 22, 23, and 24. The revised TS states that the LTRs containing uranium silicide fuel pellets and standard UO_2 fuel pellets with coated Optimized ZIRLO™ cladding are nonlimiting, and that the rods containing ADOPT™ pellets are required to meet the fuel licensing limits under all conditions but are only required to be nonlimiting in steady-state conditions.

This supplement also clarifies the applicability of the PAD-ATF code to the ADOPT™ pellets. Reference 1 states the ATF designation in the code name denotes the modification of the material properties and fuel performance models for coated cladding and uranium silicide fuel; however, as the project developed it was determined that the effects of the chromium-coated cladding can be accounted for by adjusting input variables of the existing fuel performance models. As a result, the version of PAD-ATF used in the reload analysis of the LTAs does not include a separate explicit model for chromium-coated cladding.

Regarding the applicability of PAD-ATF to the ADOPT™ pellets, Attachment 1, page 14 of Reference 1 states that the ADOPT™ pellet has essentially the same heat capacity, thermal diffusivity, thermal expansion coefficient, and melting temperature as standard uranium dioxide. This conclusion is based on years of operating experience with ADOPT™ fuel in European commercial reactors. Those properties of standard uranium dioxide were not modified in PAD-ATF; therefore, the existing fuel performance models for UO_2 in PAD, which are unmodified in PAD-ATF, are applicable to the ADOPT™ pellet. Physical differences between UO_2 and ADOPT™ fuel density and densification are explicitly accounted for within PAD-ATF using the existing UO_2 models. All other material properties for the ADOPT™ pellets are modeled using the standard UO_2 models.

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[1] *ENCORE, ADOPT, and Optimized ZIRLO are trademark or registered trademark of Westinghouse Electric Company LLC, its affiliates and/or its subsidiaries in the United States of America and may be registered in other countries throughout the world. All rights reserved. Unauthorized use is strictly prohibited. Other names may be trademarks of their respective owners.*

EGC has reviewed the information supporting the No Significant Hazards Consideration (NSHC) and the Environmental Consideration that was previously provided to the NRC in Reference 1. The original NSHC conclusions were based on the LTRs being bounded by the resident fuel in the core. While the overall conclusions remain unchanged, the original NSHC included the explicit statements that the LTAs will be placed in nonlimiting core regions. Since TS 4.2.1 requires revision to explicitly address that the ADOPT™ rods could be limiting under certain transient conditions, the NSHC is also being revised. The change to TS 4.2.1 does not affect the conclusion that neither an environmental impact statement nor an environmental assessment needs to be prepared in support of the proposed amendment.

In accordance with 10 CFR 50.91, "Notice for public comment; State consultation," paragraph (b), EGC is notifying the State of Illinois of this supplement to the Reference 1 application for license amendment by transmitting a copy of this letter and its attachment to the designated State of Illinois official.

There are no regulatory commitments contained in this letter. Should you have any questions concerning this letter, please contact Ms. Rebecca L. Steinman at (630) 657-2831.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 16th day of January 2019.

Respectfully,

David M. Gullott
Director – Licensing and Regulatory Affairs
Exelon Generation Company, LLC

Attachments:
1. Revised No Significant Hazards Consideration
2. Markup of Technical Specifications Pages
3. Revised Technical Specifications Pages

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

ATTACHMENT 1
Revised No Significant Hazard 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 revise Byron Station Technical Specifications (TS) 4.2.1, "Fuel Assemblies," to allow two Lead Test Assemblies (LTAs) containing a limited number of Accident Tolerant Fuel (ATF) Lead Test Rods (LTRs) to be placed in the reactor during Byron Station Unit 2, Cycles 22, 23 and 24. The revised TS states that the LTRs containing uranium silicide fuel pellets and standard UO_2 fuel pellets with coated Optimized ZIRLO™ cladding are nonlimiting, and that the rods containing ADOPT™ pellets are required to meet the fuel licensing limits under all conditions but are only required to be nonlimiting in steady-state conditions.

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 ADOPT™ and EnCore® (with and without chromium-coated cladding, respectively) 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 core locations that assure that the LTRs containing uranium silicide fuel pellets and standard UO_2 fuel pellets with coated Optimized ZIRLO™ cladding are nonlimiting. The rods containing ADOPT™ pellets meet the fuel licensing limits under all conditions but are only nonlimiting in steady-state conditions. 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 the core 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 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.

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.

4.3 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.

ATTACHMENT 2

Markup of Technical Specifications Pages

Byron Station, Unit 2

Renewed Facility Operating License No. NPF-66

NRC Docket No. 50-455

Markup of Technical Specifications Page

4.0-1

4.0 DESIGN FEATURES

4.1 Site

4.1.1 Site Location

The site is located in Rockvale Township, approximately 3.73 mi (6 km) south-southwest of the city of Byron in northern Illinois.

4.1.2 Exclusion Area Boundary (EAB)

The EAB shall not be less than 1460 ft (445 meters) from the outer containment wall.

4.1.3 Low Population Zone (LPZ)

The LPZ shall be a 3.0 mi (4828 meter) radius measured from the midpoint between the two reactors.

4.2 Reactor Core

4.2.1 Fuel Assemblies

The reactor shall contain 193 fuel assemblies. Each assembly shall consist of a matrix of Zircaloy, ZIRLO®, or Optimized 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~~ (LTAs) have not completed representative testing may be placed in nonlimiting core regions.

4.2.2 Control Rod Assemblies

The reactor core shall contain 53 control rod assemblies. The control material shall be silver indium cadmium, hafnium, or a mixture of both types.

During Unit 2 Cycles 22, 23, and 24, two LTAs containing up to twenty total lead test rods may be placed in the reactor for evaluation. The LTA rods containing uranium silicide fuel pellets and rods containing standard UO_2 fuel pellets with coated cladding shall be nonlimiting. The LTA rods containing ADOPT™ fuel pellets may be loaded in core regions which are nonlimiting under steady state reactor conditions and shall comply with fuel limits specified in the COLR and Technical Specifications under all operational conditions.

ATTACHMENT 3

Revised Technical Specifications Pages

Byron Station, Unit 2

Renewed Facility Operating License No. NPF-66

NRC Docket No. 50-455

Revised Technical Specifications Page

4.0-1

4.0-2

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4.0 DESIGN FEATURES

4.2 Reactor Core (continued)

4.2.2 Control Rod Assemblies

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4.3 Fuel Storage

4.3.1 Criticality

The spent fuel storage racks are designed and shall be maintained, as applicable, with:

a. Fuel assemblies having a maximum U-235 enrichment of 5.0 weight percent;

b. A $k_{eff} \leq 0.95$ if fully flooded with unborated water, which includes an allowance for uncertainties as described in Holtec International Report HI-982094, "Criticality Analysis for Byron/Braidwood Rack Installation Project," Project No. 80944, 1998;

c. A nominal 10.888 inch north-south and 10.574 inch east-west center to center distance between fuel assemblies placed in Region 1 racks; and

d. A nominal 8.97 inch center to center distance between fuel assemblies placed in Region 2 racks.

4.3.2 Drainage

The spent fuel pool is designed and shall be maintained to prevent inadvertent draining of the pool below elevation 410 ft, 0 inches.

4.3.3 Capacity

The spent fuel pool is designed and shall be maintained with a storage capacity limited to no more than 2984 fuel assemblies.