UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

October 16, 2009

Mr. Charles G. Pardee
President and Chief Nuclear Officer
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: CLINTON POWER STATION, UNIT NO. 1 - REQUEST FOR ADDITIONAL INFORMATION RELATED TO LICENSE AMENDMENT REQUEST TO MODIFY CLINTON POWER STATION FACILITY OPERATING LICENSE IN SUPPORT OF THE USE OF ISOTOPE TEST ASSEMBLIES (TAC NO. ME1643)

Dear Mr. Pardee:

By letter to the Nuclear Regulatory Commission (NRC) dated June 26, 2009 (Agencywide Documents Access and Management System Accession No. ML091801061), Exelon Generation Company, LLC (EGC) submitted a request to modify License Condition 2.B.(6) and create new License Conditions 1.J and 2.B(7) as part of a pilot program to irradiate Cobalt (Co)-59 targets to produce Co-60, for the Clinton Power Station, Unit No. 1 (CPS). EGC also requests an amendment to Appendix A, Technical Specifications (TS), of the CPS Facility Operating License, which would modify TS 4.2.1, "Fuel Assemblies," to describe the isotope test assemblies being used.

The NRC staff is reviewing your submittal and has determined that additional information is required to complete the review. The specific information requested is addressed in the enclosure to this letter. During a discussion with your staff on September 29, 2009, it was agreed that you would provide a response within 14 days from the date of this letter for all questions except question 3. Question 3 will be answered within 30 days from the date of this letter.

The NRC staff considers that timely responses to requests for additional information help ensure sufficient time is available for staff review and contribute toward the NRC's goal of efficient and

effective use of staff resources. If circumstances result in the need to revise the requested response date, please contact me at (301) 415-3719.

Sincerely,

Cameron Goodwin

Cameron S. Goodwin, Project Manager
Plant Licensing Branch III-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-461

Enclosure:
Request for Additional Information

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REQUEST FOR ADDITIONAL INFORMATION

CLINTON POWER STATION, UNIT NO. 1

DOCKET NO. 50-461

In reviewing the Exelon Generation Company s submittal dated June 26, 2009 (Agencywide Documents Access and Management System Accession No. ML091801061) (Reference 1), related to modifying License Condition 2.B.(6) and create new License Conditions 1.J and 2.B.(7) as part of a pilot program to irradiate Cobalt (Co)-59 targets to produce Co-60, for the Clinton Power Station, Unit No. 1 (CPS), the Nuclear Regulatory Commission (NRC) staff has determined that the following information is needed in order to complete its review:

RAI 1: Attachment 1, Evaluation of Proposed Changes, Section 3.0, Reference 1

Page 4 of Attachment 1 states that: "The GE14i isotope test assemblies are placed in the nuclear reactor, where they stay for varying amounts of time that depend upon neutron flux and the desired specific activity."

Clarify the terms "varying amounts of time," "desired specific activity," by specifying examples of amounts of time and specific activities. (See related RAI 7)

RAI 2: Attachment 1, Section 4.3, Reference 1

In the section for "No Significant Hazards Consideration" of Attachment 1, it is stated that: "the effects on the spent fuel pool are minimal; post-irradiation handling of the assemblies and the isotope rods will be performed under approved procedures, by experienced personnel."

Enclosure 3 of the application (NEDC-33505P, Section 4.7.1) indicates that the maximum incident (gamma) radiation due to a GE14i bundle placed one foot from the spent fuel pool (SFP) wall is approximately 7.2E+10 MeV/cm^2-sec, so concrete heating due to gamma would be significant. At 4 feet, it has been shown that the energy deposition rate of 1.4E+8 MeV/cm^2-sec is well below that required to cause significant concrete heating. Therefore, in order to minimize the effect of gamma heating on the SFP concrete walls, the irradiated fuel storage procedures are modified to specify that the GE14i fuel bundles be stored at least 4 feet from the pool walls with no limitation on the amount of time a GE14i bundle may remain in the pool.

The applicant should modify the section on "No Significant Hazards Consideration," the significant heating effect of gamma on the SFP and the procedures adopted to mitigate the heating effect.

RAI 3: Evaluation of Hydraulic Characteristics of the GE14i fuel.

Section 5 of DRF Section 0000-0100-9379, "Scope of Verification" lists 4 items to be verified.

1. Verify that the analysis in "GE14i_DP_Evaluation.pdf" (neFile 0000-0100-9380) performed for the GE14 pressure drop data with and without cold rods are accurate and adequate.
2. Verify that flow area calculation for the Hex region in "GE14i_DP_Evaluation.pdf" is performed accurately.
3. Verify that the conclusions in this design study are adequate.
4. Verify that Tables and Figures in this design study summary file are prepared correctly

Please confirm that these verifications are completed.

RAI 4: Qualitative Assessment of Impact on Update Safety Analysis Report Chapter 15 Transient & Anticipated Transient without Scram (ATWS) Events (0000-0100-9699-Supplement-R0)

Section 3.3.4, Flexibility Options, indicate that: "The thermal-hydraulic characteristics and critical power performance of the GE14i ITAs [Isotope Test Assemblies] are not expected to be different than the GE14 fuel (Reference 2) as explained in previous sections. In addition, 8 GE14i assemblies represent a very small fraction of the bundles in the Clinton Cycle 13 core to affect average core performance. Therefore, the flexibility options available to CPS will remain unaffected by the implementation of the GE14i assemblies. The fast pressurization events in combination with the licensed flexibility options for CPS will be analyzed as part of the reload transient analysis in Cycle 13. The thermal limits of the GE14i ITAs will be computed explicitly."

Provide a summary of this analysis.

RAI 5: Thermo-Mechanical Evaluation (Section 4.4 of NEDC-33505P), and GE14i Thermal-Mechanical Evaluation (Design Study summary, 4/29/2009)

1. Provide detailed proof to support the conclusion made in the Thermo-Mechanical evaluation regarding cladding failure expected due to mechanical interaction between the inner and outer cladding, applied over the lifetime of ITAs in the core.
2. Regarding the thermo-mechanical evaluation, there is considerable pressure difference between the system and the internal cavity even though there is no fission product gas generation in the ITA fuel rods.

   Explain in detail how cladding collapse due to this pressure difference and cladding creep is prevented from occurring during the lifetime of the ITA in the core.
3. Section 6 of the Design Study summary indicates that some of the inputs were outside of the range of acceptable inputs in to the GE Thermal-Mechanical Methodology, GSTRM, and these inputs were modified as necessary and were confirmed to have no impact on the final results. List the input parameters that were outside of the range of acceptable inputs to GSTRM and discuss if the extensions of these specific parameters are acceptable and explain whether additional margin is applied to the affected downstream safety analyses (as specified in the safety evaluation for NEDC-33173P).

RAI 6: Stability (Section 4.5.1 of NEDC-33505P)

Section 4.5.1 states that "the section provides a qualitative assessment of the impact of GE14i ITAs on thermal hydraulic instability and demonstrated that an ITA is very unlikely to result in single-channel instability."

DRF 0000-0100 6431 states that: "When implementing the long-term solution, a procedure to review the thermal hydraulic stability of the lead use assemblies (LUA) in a core reload should be established. The review should ensure that inclusion of the LUA as proposed in the core reload is very unlikely to result in single-channel instability."

(a) Provide reasonable assurance with supporting analyses that, the thermal hydraulic stability as prescribed by the Option III with respect to the two stability aspects, namely, (i) the OPRM system setpoint, and (ii) the size of the backup stability protection (BSP) regions is maintained during the lifetime of the ITAs in the CPS core.

(b) Provide typical calculations supporting (a) using core and channel decay ratios for CPS facility.

RAI 7: Reference 9 of Safety Analysis Report, GE14 Fuel Design Cycle-Independent Analyses for CPS.

This document summarizes the cycle-independent analyses that are performed for the GE14 reloads and reported in the plant and cycle unique Supplemental Reload Licensing Reports. This report primarily provides the result of cycle-independent GE14 analyses and evaluations. These analyses include (1) Loss-of-Coolant Accident, (2) Reactor Internal Pressure Differences, (3) Reactor Pressure Vessel Internals Structural Evaluation/Assessment, and (4) Recirculation Pump Seizure: Single-Loop Operation. This report contains other technical areas, such as, Decay Heat, Fuel Handling Accident, Neutron Fluence Impact, ATWS, and Special Transient – Pressure Regulator System Single Failure (Cycle 8 specific analysis including GE14 and current operating fuel types).

Because of the importance of the analyses described in this report to the evaluation of the license amendment application, the staff requests that this document be submitted to the NRC document desk.

RAI 8: Evaluation of Hydraulic Characteristics of the GE14i fuel (DRF Section 0000-0100-9379, April 22, 2009), and the application of GEXL + correlation.

(a) If full scale pressure drop data from GE14i fuel is not available, explain the procedure how pressure drop data were collected from the full-scale GE14 critical power testing with zero-power rods.

(b) With the number and location of the cold rods in the GE14i fuel are different from the stern test configuration with zero-power rods, and the use of as few as four different rod-to-rod power distributions with zero power rods, how reasonably accurate is the statement "the cold rod impact on the pressure drop characteristics of the GE14i fuel is negligible or within the uncertainty established for the GE14 fuel."

(c) Explain the validity of the derived GEXL correlation and the R-factor with the statistically limited number of trials and data points.

(d) Explain why only outlet-peaked axial power shape was used in the GEXL correlation development for the GE14i fuel assembly, and not bottom/cosine peaked shapes.

RAI 9: Letter of May 19, 2009, from NRC (Peter Bamford) to Exelon Nuclear (Charles Pardee), Clinton Power Station, Unit No. 1 – Withdrawal of License Amendment Request Regarding Bulk Isotope Generation Project (TAC No. ME0657)

"Information Needed" section of this letter required that "this specific request is beyond the scope of both the GESTAR-II and the LTA programs," as well as the NRC staff's approval of these processes. The letter further stated that: "In order to review this application, it must be structured so that it can be evaluated without reliance on the LTA program and GESTAR-II." The NRC staff requests the licensee provides the following information that was listed in the letter.

(a) Provide, in detail, all probable isotope production rod failures. List and explain all probable means by which the target rods can fail during loading, operation and offloading from the core. Explain also, the administrative and other controls which will be in place to mitigate consequences of such failures.

(b) Provide isotope production rod design limits, including, but not limited to, the expected and design maximum Co-60 activities per rod model. Also, describe the prototype testing associated with the conditions of use (high neutron and gamma fields for years, exposure to corrosive materials, temperature, pressure, puncture, dropped source, torque, and build up of expected radioactivity including activation of contaminants).

(c) Using the estimated neutron flux at the location of target rod, provide a mathematical analysis to show the time to reach equilibrium activity between production and decay of Co-60 isotope.

(d) Provide, for agency records, detailed engineering drawings and specifications of the assembly and target rods. Specifically provide the items listed below:

Drawing Number	Title
• 147C1233	Canister
• 147C1236	Inner tube
• 147C1237	Inner tube cap
• 147C1238	Outer tube
• 147C1239	Female threaded canister
• 147C1240	Male threaded connector
• 147C1241	Lower end plug extension
• 147C1242	Upper end plug extension
• 147C3356	Inner capsule (co-59 bearing)
• 147C3357	Rod segment
• 147C3358	Rod (segmented)
• 147C3359	Isotope target

(e) Provide details of the impact of Co-60 rods on predicted core power.

(f) Provide details of the impact of Co-60 rods on instrumentation and measured core power.

RAI 10: Letter referenced in RAI 9

(a) Provide the necessary and sufficient technical information to show that the target pellets are of high purity to minimize the production of unwanted/unanalyzed isotopes.

(b) Provide assurance that there will be no cobalt contamination (i.e., no unencapsulated Co-59) is loaded in to the reactor.

RAI 11: Letter referenced in RAI 9

The application does not indicate reintroduction or any restrictions on the reintroduction of cobalt rod segments. The application should describe if there are any plans to shuffle rod segments (i.e., disassemble rods and swap rod segments within a rod, or with a rod in a different location in the same or different Co-60 isotope production assembly), between power cycles (during refueling outages).

RAI 12: Section 4.6, Manufacturing Quality Assurance, of NEDC-33505P Rev 0

(a) Provide detailed procedure of how the rod integrity is verified by helium leak check of both the inner and outer tubes following welding of the tubes during the manufacturing process.

(b) Describe details of methods and procedures that are in place to ensure the rod integrity during the lifetime of the target rods while in the CPS core.

RAI 13: Non-limiting Core Locations.

(a) The applicant intends to place a limited number of ITAs in the CPS non-limiting core locations with respect to thermal limit margins and shutdown margin. Provide the details of analyses and methodologies used to identify the locations that are non-limiting locations. Provide the criteria and the key parameters used to determine the non-limiting locations.

(b) Since ITAs are to be used in the subsequent cycles, provide justification and assurance for the assumption/prediction that the ITAs will remain in nonlimiting core regions during the subsequent CPS cycles.

RAI 14: NEDC-33505P Rev 0 Section 3.2.1.3 ITA Margin Consideration

Regarding the reference section, explain which of the power suppression options is used to accommodate the power peak and provide the technical bases for the selection.

Reference 1: Letter (RS-09-074) from Exelon Generation Company (J. L. Hansen) to US NRC with attachments, "License Amendment Request to Modify Clinton Power Station Facility Operating License in Support of the Use of Isotope Test Assemblies," Exelon Nuclear, June 26, 2009.

effective use of staff resources. If circumstances result in the need to revise the requested response date, please contact me at (301) 415-3719.

Sincerely,

/RA/

Cameron S. Goodwin, Project Manager
Plant Licensing Branch III-2
Division of Operating Reactor Licensing
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