



UNITED STATES
NUCLEAR REGULATORY COMMISSION
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March 20, 2023

Mr. Daniel G. Stoddard
Senior Vice President and
Chief Nuclear Officer
Innsbrook Technical Center
5000 Dominion Boulevard
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SUBJECT: SURRY POWER STATION, UNITS 1 AND 2 – AUDIT SUMMARY FOR
LICENSE AMENDMENT REQUEST – APPLICATION OF RISK-INFORMED
APPROACH FOR TORNADO CLASSIFICATION OF THE FUEL HANDLING
TROLLEY SUPPORT STRUCTURE (EPID L-2022-LLA-0068)

Dear Mr. Stoddard:

By letters dated May 11, 2022, (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML22131A351) as supplemented by letter dated July 11, 2022 (ML22192A075), Virginia Electric and Power Company, the licensee (Dominion Energy Virginia) submitted a license amendment request (LAR) for the Surry Power Station, Units 1 and 2 (Surry). The amendment proposed to apply a risk-informed approach to demonstrate that the Fuel Handling Trolley Support Structure, as designed, meets the intent of a tornado resistant structure under the current Surry licensing basis for a 360 miles per hour maximum tornado wind speed.

To enhance the review of the licensee's request, the U.S. Nuclear Regulatory Commission (NRC) staff conducted a virtual audit in the fall of 2022 and participated in a site audit in January of 2023. The NRC staff audited the requested documents to: (1) examine and evaluate supporting analysis of information not included in the submittals, (2) increase the NRC staff's understanding of the LAR, and (3) identify any information that may require docketing to support the NRC staff's regulatory finding. A summary of the regulatory audit is enclosed, as well as the topics discussed during teleconferences held in support of the audit. The audit was conducted in accordance with the plan that was provided to the licensee by letter dated October 3, 2022 (ML22255A186).

D. Stoddard

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If you have any questions, please contact me at (301) 415-5136 or via email at John.Klos@nrc.gov.

Sincerely,

/RA/

John Klos, Project Manager
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-280 and 50-281

Enclosures:

1. Regulatory Audit Summary

cc: Listserv

REGULATORY AUDIT SUMMARY TO SUPPORT REVIEW OF THE
LICENSE AMENDMENT REQUEST TO APPLY A RISK-INFORMED APPROACH
FOR TORNADO CLASSIFICATION OF
THE FUEL HANDLING TROLLEY SUPPORT STRUCTURE
VIRGINIA ELECTRIC AND POWER COMPANY
SURRY POWER STATION, UNIT NOS. 1 AND 2
DOCKET NOS. 50-280 AND 50-281

1.0 BACKGROUND

This audit was conducted with the intent to: (1) examine and evaluate supporting analysis of information not included in the submittal(s), (2) increase the U.S. Nuclear Regulatory Commission (NRC) staff's understanding of the license amendment request (LAR), and (3) identify any information that may require docketing to support the NRC staff's regulatory finding.

By letters dated May 11, 2022, (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML22131A351, as supplemented by letter dated July 11, 2022 (ML22192A075) Virginia Electric and Power Company, the licensee (Dominion Energy Virginia) submitted a license amendment request (LAR) for the Surry Power Station, Units 1 and 2 (Surry). The amendment proposed to apply a risk-informed approach to demonstrate that the Fuel Handling Trolley Support Structure (FHTSS), as designed, meets the intent of a tornado resistant structure under the current Surry licensing basis for a 360 miles per hour maximum tornado wind speed (UFSAR, , Section 15.2.3, "Tornado Criteria ML22283A015)."

The NRC staff performed a preliminary review of the LAR and determined that a regulatory audit would assist in reviewing the licensee's calculations supporting the LAR and timely completion of the review. The regulatory audit was performed consistent with NRC Office of Nuclear Reactor Regulation Office Instruction LIC-111, Revision 1, "Regulatory Audits," dated October 31, 2019 (ML19226A274).

2.0 AUDIT ACTIVITIES

The NRC staff conducted a regulatory audit that consisted of a document review via the licensee's electronic room portal (eroom) and a virtual teleconference and a site audit. An audit plan was provided to the licensee by letter dated October 3, 2022 (ML22255A186), which contained the subject areas, an outlined schedule, and logistics for the audit.

The list of documents that were examined by the audit team is provided in Section 4.0 below and the discussion topics that were part of the teleconference are included in the Enclosure.

Audit activities for each subject area are summarized below.

Risk-informed audit review areas

The NRC staff reviewed the audit documents to assess the details associated with:

1. A potential radiological release resulting from tornado wind damage to the FHTSS and why it is expected to be bounded by the fuel accidents analyzed under the design basis, including the cask-drop and fuel handling accidents. For this item, the scope of the audit included:
 - a. The accident scenarios and radiological conditions considered when evaluating a potential radioactive release resulting from tornado wind damage to the FHTSS.
 - b. The methodology and results of the analysis demonstrating that a potential radioactive release resulting from tornado wind damage to the FHTSS is bounded by the failure of all 324 fuel assemblies stored in the first three rows of storage racks adjacent to the cask loading area.
 - c. The current design-basis accident analysis of record for the cask-drop and fuel handling accidents.
2. The estimated radiological releases associated with the fuel accidents analyzed under the design basis and why they are expected to be less than the acceptance guidelines for Large Early Release Frequency (LERF) in Regulatory Guide (RG) 1.174, Revision 3, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis,"(ML17317A256). For this item, the scope of the audit included:
 - a. The justification and technical basis for comparing consequence-based criteria from design-basis fuel accidents in terms of Total Effective Dose Equivalent (TEDE) (i.e., 6.3 rem TEDE for offsite dose) against the acceptance guidelines for LERF in RG 1.174.
 - b. The estimated releases associated with these accidents.
 - c. The analysis demonstrating the release from the design-basis fuel accidents bounds the acceptance guidelines for LERF.
3. The likelihood of falling members of the FHTSS targeting the spent fuel pool with an angle of attack that can result in localized damage to the spent fuel pool. For this item, the scope of the audit included:
 - a. basis for only considering single impacts from the heaviest falling members of the FHTSS when evaluating spent fuel pool integrity.
 - b. The methodology and results of the analysis demonstrating the worst case impact of a single falling member of the FHTSS.

4. Procedures governing the operation of the FHTSS during severe weather conditions, such as tornado watches and warnings, and actions taken specific to the FHTSS under such conditions.
5. The risk to the public from a potential radiological release resulting from tornado wind damage to the FHTSS. For this item, the scope of the audit included:
 - a. The calculation of the spent fuel damage frequency provided in the LAR, including assumptions and justification for the input parameters used, such as the site-specific tornado initiating event frequencies and the tornado wind fragility of the FHTSS such that as stated in the LAR, Section 3.4, that the spent fuel damage is expected to be bounded by the fuel accidents analyzed under the design basis.
 - b. The methodology and results of the analysis demonstrating that the risk to the public from a potential radiological release resulting from tornado wind damage to the FHTSS meets the Commission's safety goals and their quantitative health objectives. An example of an approach that relates spent fuel damage to the Commission's quantitative health objectives is documented in NUREG 1738, "Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants," dated January 2001 (ML010430066).

Structural audit review areas

The NRC staff reviewed the audit documents to assess detailed information concerning:

1. The engineering assumptions, methodology, industry standards, input variables and related calculations and outputs/results that support the amendment's accountability for the FHTSS change. These information presented and discussed additional elements of:
 - a. The cask-drop analyses.
 - b. The fuel handling accident analysis.
 - c. SU-CALC-STR-CE-2085, Revision 0, "Tornado Wind Fragility Analysis of Surry Fuel Handling Trolley Support Structure."
 - d. NOTEBK-PRA-SPS-RA.LI.016, Revision 0, "Fuel Building Trolley Support Structure Risk Analysis."
 - d. SU-CALC-STR-CE-2085, Revision 0, Addendum A, "Comparison of the Applied Tornado Wind Loads on the FHTSS with and without Siding."
 - e. Structural analysis to estimate the median structural capacity of the FHTSS.
 - f. The sensitivity study performed by doubling the composite variability in the fragility curve from 0.175 to 0.35.

- g. Reviewed and discussed the conservatisms, methodology of the FHTSS analytical analyses concerning free-falling member impacts, and angles of attack to the SFP which could result in localized damage.
- h. A walkdown of the FHTSS structure and its surroundings.

3.0 AUDIT TEAM

The NRC audit team members:

- Dr. Steven Alferink, Reliability and Risk Analyst, Team Leader (steven.alferink@nrc.gov)
- Ata Istar, Civil Engineer (ata.istar@nrc.gov)
- De (Wesley) Wu, Reliability and Risk Analyst (de.wu@nrc.gov)
- Elijah Dickson, Senior Reliability and Risk Analyst (Elijah.dickson@nrc.gov)
- John Klos, Project Manager (john.klos@nrc.gov)

4.0 DOCUMENTS EXAMINED BY STAFF VIA THE LICENSEE'S EROOM

1. Calculation CE-2085, Revision 0, "Tornado Wind Fragility Analysis of Surry Fuel Handling Trolley Support Structure."
2. Engineering Technical Evaluation ETE-CCE-2021-0003, Revision 0, "Evaluation of the Integrity of the Spent Fuel Pool Liner and Reinforced Concrete Floor and Walls under the Impact from Postulated Falling Structural Review."
3. PRA Notebook SU-NOTE BK-PRA-SPS-RA-LI.016, Revision 0, "Fuel Handling Trolley Support Structure High Winds Risk Analysis."
4. PRA Notebook SU-NOTE BK-PRA-SPS-RA-LI.016, Revision 1, "Fuel Handling Trolley Support Structure High Winds Risk Analysis."
5. Procedure 0-AP-37.01, Revision 77, "Abnormal Environmental Conditions."
6. Procedure 0-NSP-BS-005, Revision 14, "Monitoring of Structures."
7. Procedure 0-OP-ZZ-021, Revision 32, "Severe Weather Preparation."
8. Technical Report CE-0087, Revision 8, "Guideline for Monitoring of Structures, SPS."
9. Nuclear Energy Services Report 81A0849, Revision 0, Surry Power Station, Units 1 and 2 High Density Fuel Storage Racks Cask-Drop Accident Consequences, 9/7/1982.
10. Calculation, RA-0010, Revision 1, Radiological Consequences of a Fuel Handling Accident at Surry Based on the Alternate Source Term, 6/28/2017.
11. Surry Abnormal Procedure 0-AP-37.01, Rev. 77, "Abnormal Environmental Conditions."
12. Surry Operating Procedure 0-OP-ZZ-021, Rev. 32, "Severe Weather Preparation."
13. Calculation, SU-CALC-SAC-13930.12-DC-27-5, Rev. 1, "Estimate of Damage Level to Fuel Pool Wall from Cask TN-2100 Drop."
14. Calculation, SU-CALC-MEC-14247.01-DC-27-3, Rev. 1, "Analysis of Structural Integrity of the Spent Fuel Pool Mat Due to Cask Drop Impact."
15. CE-2085, Rev. 0, "Tornado Wind Fragility Analysis of Surry Fuel Handling Trolley Support Structure."

5.0 TELECONFERENCE DISCUSSION POINTS OF THE AUDIT

November 14, 2022, Audit Teleconference

The civil and structural items below were discussed after the NRC staff completed its e-room audit review and became areas of regulatory and technical review during the site audit and walkdown. .

1. The cask-drop analyses calculation presented aspects concerning the FHTSS impact on the spent fuel pool (SFP) liner which were performed to ensure that the concrete scabbing threshold is maintained under the kinetic energy of 125 and 120 ton cask-drops.
The pending site audit will further review how these analyses consider damage from all FHTSS members that may impact the SFP wall/liner under the full range of postulated failure conditions.

The risk insights review items below were discussed after the NRC staff completed its e-room audit review and became areas of regulatory and technical review during the site audit and walkdown. .

1. Risk-informed LARs are normally compared to the acceptance guidelines for the risk metrics of core damage frequency (CDF) and LERF in RG 1.174, Revision 3. These risk metrics, which are based on subsidiary objectives derived from the quantitative health objectives (QHOs) in the Commission's Safety Goal Policy Statement. The NRC notes that these measures are not directly applicable to spent fuel pools and FHAs. As such, it the NRC staff questioned how the licensee's analysis and the acceptance guidelines in Regulatory Guide 1.174 are sufficient as a basis for consideration in this LAR.

The NRC site audit is expected to further discuss the justification that the individual risk of an early fatality within one mile and the individual risk of a cancer fatality within ten miles of the plant from events considered in this license amendment request meet the QHOs in the Commission's Safety Goal Policy Statement (e.g., Appendix 4C of NUREG-1738 (ML23XXXX)).

2. Regulatory Guide 1.76, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants," Revision 1, ML070360253 is based on NUREG/CR-4461, Revision 2, "Tornado Climatology of the Contiguous United States," (ML070810400) which relies on the Enhanced Fujita scale to relate the degree of damage from a tornado to the maximum tornado wind speed. The NRC staff notes that the current LAR is based on the Fujita scale, which corresponds to higher wind speeds for the same frequency of exceedance than the Enhanced Fujita scale.

Further discussion during the site audit will include the impact of using the Fujita scale, versus the Enhanced Fujita scale related to safety margins and risk associated with this license amendment request.

3. The stated purpose of Calculation CE-2085, Revision 0, "Tornado Wind Fragility Analysis of Surry Fuel Handling Trolley Support Structure," is to estimate the median wind speed capacity and the wind fragility generic variability for the development of a tornado wind fragility curve for the FHTSS. This calculation determined the interaction

ratios (i.e., demand to capacity ratios) of all members of the FHTSS under the effect of 210 mph tornado winds to be less than 1.

The site audit will further expand on the following points of;

- a. A discussion if Calculation CE-2085 supports the FHTSS satisfies the acceptance criteria for a maximum tornado wind speed of 200 mph in RG 1.76, Revision 1.
- b. If Calculation CE-2085 supports the FHTSS satisfying the acceptance criteria for a maximum tornado wind speed of 200 mph in RG 1.76, Revision 1, and demonstrates the margin between the maximum tornado wind speed of 200 mph and the maximum tornado wind speed that the FHTSS can withstand.

January 24-26, 2022, Site Audit and System Walkdown

During the site audit the NRC staff participated in a detailed discussion of the above topics and completed a walkdown of related systems discussed in this licensing amendment. During the audit exit meeting, the NRC staff indicated that there will likely be three requests for additional information (RAIs) to docket information in support in order for a regulatory decision on the licensee's submittal.

The three areas for possible RAIs include:

- a. the FHTSS civil structural analysis calculation for the SFP and the identification of the calculation's engineering assumptions that were considered,
- b. further justification of how the principles of RG 1.174 are met for this LAR, and
- c. additional documentation identifying the conservatisms for how the acceptance criteria of RG 1.174 are met utilizing the approach in NUREG-1738 (which translates RG 1.174 criteria for applicability to SFP issues).

6.0 AUDIT CONCLUSION

The audit started on October 14, 2022 and by this audit summary was closed on February 15, 2023. Based on the NRC staff's review of the proposed license amendment RAIs will be issued as necessary.

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