UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

July 26, 2021

Ms. Margaret M. Doane
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: SAFETY EVALUATION OF VOGTLE ELECTRIC GENERATING PLANT UNITS 1 AND 2 LICENSE AMENDMENT REQUESTS FOR RISK-INFORMED RESOLUTION TO GSI-191

Dear Ms. Doane

During the 687th meeting of the Advisory Committee on Reactor Safeguards, July 7-9, 2021, we completed our review of the draft safety evaluation (SE) for Southern Nuclear Operating Company (SNC) license amendment requests (LARs) related to risk-informed resolution of Generic Safety Issue (GSI) -191, "Assessment of Debris Accumulation on Pressurized Water Reactor [PWR] Sump Performance," at Vogtle Electric Generating Plant Units 1 and 2. In support of these LARs, SNC submitted a related exemption request. A joint subcommittee, consisting of members from our Accident Analyses & Thermal-Hydraulic and the Reliability & Probabilistic Risk Assessment (PRA) Subcommittees, also reviewed this topic on May 19, 2021. During these meetings, we met with the U.S. Nuclear Regulatory Commission (NRC) staff and representatives from SNC. We also had the benefit of the referenced documents.

CONCLUSION AND RECOMMENDATIONS

1. The SNC proposed changes to the Vogtle Units 1 and 2 licensing bases and the related exemption request are acceptable.

2. The SE report should be issued, and the related exemption should be approved.

BACKGROUND

GSI-191 History

During a loss-of-coolant accident (LOCA), a two-phase water jet from a pipe break can dislodge and fragment nearby materials such as thermal insulation. This debris can be transported by steam and water to the containment sumps and strainers. Loss of long-term core cooling (LTCC) could occur if debris were to clog the strainers causing recirculation and containment spray pump failures or were to bypass the strainers and block reactor core cooling channels. We have commented on the containment sump plugging issue (GSI-191) for many years and written several letter reports on the staff and industry research and implementation (see *Attachment*). The staff established GSI-191 in 1996 and issued Generic Letter (GL) 2004-02 to

request that licensees address the effects of debris accumulation on pressurized water reactor (PWR) sump performance during design basis accidents. The Commission directed the staff to consider a risk-informed approach as an option for resolution of GSI-191.

SNC GSI-191 Approach

Vogtle Units 1 and 2 contain Westinghouse four-loop PWRs rated at 3626 MWt. To address safety issues discussed in GSI-191 and GL 2004-02, SNC proposed a risk-informed approach using the five key principles in Regulatory Guide (RG) 1.174. SNC subsequently submitted two LARs to implement their proposed risk-informed approach at these two Vogtle units. In addition to amending several technical specifications, SNC requested an exemption to allow the use of risk-informed information as an alternative to certain requirements associated with the deterministic evaluation required by Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.46(a)(1).

DISCUSSION

Our review focused on several topics: modifications and testing, engineering evaluations, and monitoring.

Modifications and Testing

Over the period since issuance of GSI-191, the licensee has already implemented various physical and procedural changes. These modifications included installing new strainers with increased surface areas and reduced opening sizes, increasing Refueling Water Storage Tank (RWST) inventory, removing problematic insulation materials, changing procedures to delay isolation of Residual Heat Removal (RHR) pumps from the RWST, and modifying program controls to ensure debris load limits are not exceeded. SNC has proposed reducing the RHR strainer screen height, allowing these strainers to become fully submerged for an increased number of postulated scenarios.

SNC will also add a new technical specification to enhance containment sump reliability. The proposed technical specification is simpler and more flexible than found at plants with shared strainers and sumps. This new technical specification allows an affected train to be declared inoperable rather than shutting down a unit to implement corrective actions. Several other technical specifications (see *Monitoring*) will be modified to enhance surveillance for detecting debris at the sump suction and structural distress or abnormal corrosion of the sump screen.

Tests were performed to determine the head loss induced by debris accumulation on the sump strainers using NRC guidance. A plant-specific containment computer-aided design model was used to quantify the amount of debris generated for a range of pipe break locations, sizes, and orientations. Using these results, the licensee performed a risk analysis (see *Engineering Evaluations*) that demonstrates a negligible increase in risk by the generated debris. The completeness of this analysis supports issuing the requested exemption.

Engineering Evaluations

In their approach, SNC combined PRA with traditional engineering analysis to evaluate change in core damage frequency and change in large early release frequency. This approach used Vogtle Units 1 and 2 PRA models for internal and seismic events.

In evaluating LTCC, the licensee compared parameters, including fuel types, fiber limits, sump switchover time, rated thermal power, and minimum time for chemical effects to result in precipitation, with industry findings (WCAP-17788) and staff guidance. The amount of fiber that may reach the core inlet exceeded the WCAP limit in some cases. By crediting the reduced head loss due to non-uniform material buildup associated with coolant flow, SNC showed that additional fiber could accumulate before core inlet channels become blocked. The staff concurred that in-vessel debris will not block the core inlet prior to the availability of cooling through alternate flowpaths and found there is reasonable assurance that in-vessel debris will not limit LTCC.

For these assessments, the licensee modified the PRA model to consider additional structures, systems, and components (e.g., sump strainers) and events (e.g., core blockage scenarios). A screening approach was used to focus analysis on a discreet set of breaks that were significant risk contributors.

In accordance with RG 1.174 and NUREG-1855, the applicant performed an uncertainty evaluation, which focused on ΔCDF and included parametric, model, and completeness considerations. Parametric and model uncertainties were evaluated through sensitivity runs. Completeness uncertainty was qualitatively evaluated. All parametric and model uncertainty/sensitivity results were acceptable based on RG 1.174 guidance.

Independent staff calculations, using conservative inputs, confirmed that there were adequate margins in the SNC results. The staff concluded that the SNC analysis scope and level of detail were sufficient and that the PRA model used for the evaluation complies with RG 1.200, Revision 2, and can be applied in regulatory decision-making.

Monitoring

The licensee implemented procedures and programs for monitoring, controlling, and assessing changes having the potential to impact inputs and assumptions used in the PRA and associated engineering analysis supporting these LARs. These procedures and programs ensure that potential debris accumulation in containment is limited, the impact of observed changes is assessed, and the capability of the sump strainers is maintained. SNC provided a list of relevant programmatic requirements including its Maintenance Rule program, its online configuration risk management procedure, and its quality assurance program. The licensee stated that no changes would be made to ASME Section XI inspection programs or mitigation strategies.

Consistent with recommendations in the staff evaluation of Technical Specification Task Force Traveler, TSTF-567, SNC proposed a new technical specification (see *Modifications and Testing*) that provides operability requirements and expands existing surveillance requirements for the containment sump. The new technical specification requires verification, by visual inspection, that the containment sump does not show structural damage, abnormal corrosion, or debris blockage. It also requires inspection of the containment drainage flow paths, the containment sump strainers (or screens), the pump suction trash racks, and the inlet to relevant piping.

The licensee committed to performing periodic updates of its risk-informed assessment every 48 months. If such updates reveal non-conforming situations with respect to GSI-191 (i.e., acceptance criteria of RG 1.174 are exceeded), SNC will address these items in their corrective action program.

SUMMARY

The SNC Vogtle GSI-191 submittals provide confidence that safety margins and defense-in-depth will be maintained and that the risk associated with LOCA-generated debris is very low.

The SNC proposed changes to the Vogtle Units 1 and 2 licensing bases and the related request for an exemption are acceptable. The SE report should be issued, and the related exemption should be approved.

We are not requesting a formal response from the staff to this letter report.

Sincerely,


Signed by Sunseri, Matthew
on 07/26/21

Matthew W. Sunseri
Chairman

Enclosure:
Prior ACRS Letter Reports Addressing GSI-191

REFERENCES

1. U.S. Nuclear Regulatory Commission, “Safety Evaluation by the Office of Nuclear Reactor Regulation Related to a License Amendment Request for a Risk-Informed Resolution to GSI-191 Amendment No. [Xxx] to Facility Operating License No. NPF-68 and Amendment No. [Xxx] to Facility Operating License No. NPF-81 Southern Nuclear Operating Company, Inc. Vogtle Electric Generating Plant, Units 1 and 2 Docket Nos. 50-424 and 50-425,” Draft, May 2021 (ML20268A070).

2. Southern Nuclear Operating Company, Inc., “Exemption Request and License Amendment Request for a Risk-Informed Resolution to GSI-191,” August 17, 2018 (ML20230A346).

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4. Southern Nuclear Operating Company, Inc., “Vogtle Electric Generating Plant - Units 1 & 2 - Supplement to Request for Exemption to Support Risk-Informed Resolution to Generic Letter 2004-02,” February 15, 2021 (ML21046A094).

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11. Southern Nuclear Operating Company, Inc., "Vogtle Electric Generating Plant - Units 1 &2, Response to Supplemental Information Needed for Acceptance of Systematic Risk Informed Assessment of Debris Technical Report," dated July 11, 2017 (ML17192A245).

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ENCLOSURE

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