



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

September 24, 2019

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

**SUBJECT:** SAFETY EVALUATION OF THE NUSCALE TOPICAL REPORT  
TR-0716-50351, REVISION 0, "NUSCALE APPLICABILITY OF AREVA  
METHOD FOR THE EVALUATION OF FUEL ASSEMBLY STRUCTURAL  
RESPONSE TO EXTERNALLY APPLIED FORCES"

Dear Ms. Doane:

During the 666<sup>th</sup> meeting of the Advisory Committee on Reactor Safeguards, September 4-6, 2019, we reviewed the staff's safety evaluation report of NuScale topical report, TR-0716-50351, Revision 0, "NuScale Applicability of AREVA Method for the Evaluation of Fuel Assembly Structural Response to Externally Applied Forces." Our NuScale Subcommittee also reviewed this topical report on August 20, 2019. During these meetings, we had the benefit of discussions with NuScale, Framatome, and the staff. We also had the benefit of the referenced documents.

### **CONCLUSIONS AND RECOMMENDATION**

1. The fuel assembly structural response methodology described in TR-0716-50351 is acceptable for use in performing NuScale fuel system structural response analyses. The associated safety evaluation report should be issued.
2. The modifications to the approved ANP-10337P-A methodology will ensure that the seismic analysis of the NuScale fuel will be in conformance with General Design Criterion 2; 10 CFR Part 50, Appendix S; and related staff guidance.

### **BACKGROUND**

NuScale submitted a design certification application for its small modular reactor on December 31, 2016. Appendix 3A, Revision 2 of the application provides the seismic analysis of the NuScale Power Module (NPM). The NPM includes the reactor vessel, containment vessel, fuel and the associated structures, systems, and components.

NuScale submitted TR-0716-50351 on September 30, 2016, to be referenced as part of its design certification application. This topical report examines the applicability of the AREVA fuel assembly structural response analysis methodology. The NRC approved the Framatome (formerly AREVA)

topical report ANP-10337P-A, "PWR Fuel Assembly Structural Response to Externally Applied Dynamic Excitations" for referencing in license applications for operating reactors on May 21, 2018. The methodology presented in ANP-10337P-A covers structural acceptance criteria, model architecture, model parameter and allowable limits definition, seismic and loss-of-coolant accident analysis, and non-grid component strength evaluation methodology.

The NuScale topical report evaluated the applicability of each section of the ANP-10337P-A report to the NuScale fuel assembly and plant design. Additionally, the report identified NuScale fuel design differences and potential analysis impacts.

## **DISCUSSION**

The NuScale fuel assembly, NuFuel-HTP2™, is similar to the standard 17x17 Framatome HTP™ fuel design, with M5 fuel pin cladding, Zircaloy-4 guide tubes, HTP™ grids, and HMP™ bottom grids. However, NuFuel-HTP2™ is about one-half the length, and it contains 5 versus 7 spacer grids. To accommodate these differences, the NuScale topical report clarifies the ANP-10337P-A methodology in the following areas:

- methodology for evaluating fuel in the irradiated condition, including its effect on both spacer grids and overall fuel assembly structural response;
- spacer grid allowable impact load in both the irradiated and non-irradiated condition;
- protocol for benchmarking fuel assembly dynamic characteristics from tests;
- methodology for calculating non-grid component loads and stresses;
- acceptance criteria for guide tube stresses under loss-of-coolant accident and safe shutdown earthquake loads;
- description of the numerical model for vertical load analysis;
- methodology for combining loads from the horizontal and vertical analyses; and
- structural damping of the fuel assemblies due to NPM design differences.

## **SUMMARY**

The fuel assembly structural response methodology described in TR-0716-50351 is acceptable for use in performing NuScale fuel system structural response analyses. The associated safety evaluation report should be issued. The modifications to the approved ANP-10337P-A methodology will ensure that the seismic analysis of the NuScale fuel will be in conformance with General Design Criterion 2; 10 CFR Part 50 Appendix S; and related staff guidance.

Sincerely,

**/RA/**

Peter Riccardella  
Chairman

## REFERENCES

1. U. S. Nuclear Regulatory Commission, "Advance Safety Evaluation on NuScale's TR-0716-50351, Revision 0, 'NuScale Applicability of AREVA Method for the Evaluation of Fuel Assembly Structural Response to Externally Applied Forces'," August 21, 2019 (ML19233A071).
2. NuScale Power, LLC, TR-0716-50351, "NuScale Applicability of AREVA Method for the Evaluation of Fuel Assembly Structural Response to Externally Applied Forces," Revision 0, September 30, 2016 (ML16274A469).
3. Framatome, ANP-10337P-A, "PWR Fuel Assembly Structural Response to Externally Applied Dynamic Excitations," Revision 0, April 30, 2018 (ML18144A816).

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Accession No: **ML19268A109**

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