U.S. NUCLEAR REGULATORY COMMISSION
TR-108553, REVISION 0, "Framatome Fuel and Structural Response Methodologies Applicability to NuScale"

1.0 INTRODUCTION

By letter dated November 30, 2021, NuScale Power, LLC (NuScale), submitted Topical Report (TR)-108553, Revision 0 (Ref. 1), "Framatome Fuel and Structural Response Methodologies Applicability to NuScale: Supplement 1 to TR-0116-20825-P-A, Revision 1 and Supplement 1 to TR-0716-50351-P-A, Revision 1" to the U.S. Nuclear Regulatory Commission (NRC or the Commission). NuScale asked the NRC to review and approve its proposed bases for an extension to the range of applicability for the fuel analysis and structural response methodologies approved in TR-0116-20825-P-A, Revision 1, "Applicability of AREVA Fuel Methodology for the NuScale Design," (Ref. 2) and TR-0716-50351-P-A, Revision 1, "NuScale Applicability of AREVA Method for the Evaluation of Fuel Assembly Structural Response to Externally Applied Forces," (Ref. 3) to the operating domain of the NuScale Power Module at a higher-rated power level.

This safety evaluation report (SER) is divided into six sections below. Section 2 summarizes applicable regulatory criteria and guidance, Section 3 gives the technical evaluation of TR-108553, Section 4 presents the conclusions of this review, Section 5 states the conditions and limitations on the use of TR-108553, and Section 6 provides the references.

2.0 REGULATORY EVALUATION

The applicant submitted TR-108553 to justify and demonstrate applicability of previously approved AREVA codes and methods for use in NuScale Safety Analyses (SA). These AREVA codes and methodologies are associated with the fuel system design and generally follow the guidance of Standard Review Plan (SRP) Section 4.2.

TR-108553, by itself, does not include a SA and instead, would be referenced as the basis for a SA in a standard design approval (SDA) application, as mentioned in the topical report scope. Therefore, TR-108553 does not independently demonstrate compliance with any rules and regulations; instead, it provides tools that an applicant for the aforementioned application could use to demonstrate compliance. Based on the purpose of TR-108553, the NRC staff does not make any findings about compliance with specific rules or regulations; instead, the NRC staff considered the related rules, regulations, and guidance during to determine whether previously approved TRs on AREVA codes and methods apply to a NuScale design with a higher power level and associated operating conditions.

The following sections present the relevant requirements and guidance that the NRC staff used to inform its review.

2.1. Rules and Regulations Evaluation

Title 10 the *Code of Federal Regulations* (10 CFR) 52.137, "Contents of Applications; Technical Information," states that an SDA application need only contain the information required by this section to the extent the requirements are applicable to the major portion of the standard design for which NRC staff approval is sought. Specifically, 10 CFR 52.137(a) requires the SDA application to contain a final safety analysis report that describes the facility, presents the design bases and the limits on its operation, and presents an SA of the structures, systems, and

components and of the facility as a whole. It must include, among other things, the design of the facility, including: (1) the principal design criteria (PDC) for the facility, (2) the design bases and the relation of the design bases to the PDC, and (3) sufficient information on the materials of construction, general arrangement, and approximate dimensions to provide reasonable assurance that the design will conform to the design bases with an adequate margin for safety.

General Design Criteria (GDC) 2, "Design Bases for Protection against Natural Phenomena," requires structures, systems, and components to be designed to withstand the effects of natural phenomena such as earthquakes without loss of capability to perform their safety functions. The design bases must reflect: (1) appropriate consideration of the most severe natural phenomena that have been historically reported for the site, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated, (2) appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena, and (3) the importance of the safety functions to be performed.

GDC 10, "Reactor design," requires that the reactor core and associated coolant, control, and protection systems be designed with appropriate margin to assure that specified acceptable fuel design limits (SAFDLs) are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences.

The focus of TR-108553 is to demonstrate the applicability of the referenced codes and methods to NuScale's licensing actions (e.g., an SDA) to analyze the fuel assembly structural response, as required by GDC 2. It is also the focus of this TR to demonstrate applicability of the codes and methods to analyze the margin to the SAFDLs, as required by GDC 10. The NRC staff notes that TR-108553 is an applicability TR, which does not develop nor implement a methodology for an SA; instead, TR-108553 justifies extending the range of applicability of a previously approved methodology to a plant and fuel design not included in the development of the original methodologies. Therefore, the NRC staff's review would not result in a finding regarding a specific rule or regulation; instead, any approval would allow an applicant to use the referenced methodology to perform a NuScale specific analysis to determine compliance with the applicable regulations.

2.2. Guidance Evaluation

The SRP provides detailed review guidance regarding methods that the NRC staff finds acceptable in meeting the applicable regulatory requirements. Specifically, SRP Section 4.2, including Appendix A, contains guidance relevant to this review. TR-108553 does not contain an actual analysis of the NuScale fuel system design; instead, it provides an applicability analysis of AREVA codes and methods to the NuScale fuel system design. For this reason, the NRC staff used the guidance in SRP Section 4.2, including Appendix A, to identify the sensitive parameters for each respective analysis topic identified in TR-108553, Revision 0.

3.0 TECHNICAL EVALUATION

The TR provides the justification for using the previously approved AREVA methods to analyze the NuScale Power Module fuel at higher-rated power levels. For the NRC staff to approve the extension of the range of applicability in TR-0116-20825-P-A, Revision 1 and TR-0716-50351-P-A, Revision 1 to the power level and operating conditions (pressure, temperature, etc.) described by TR-108553 in Table 2-2, the NRC staff performed a review to confirm that the prior NRC staff conclusions remained applicable for the NuScale fuel at the higher-rated power level

and the associated operating conditions. This review included three major aspects: (1) the NRC staff reviewed the referenced approved TRs and independently confirmed that the updated NuScale parameters fall within their validation databases; (2) the NRC staff evaluated the justifications provided in the TR and confirmed that the previously approved modifications remain acceptable; and (3) the NRC staff reviewed responses to the requests for additional information issued during the reviews of TR-0116-20825-P-A, Revision 1 and TR-0716-50351-P-A, Revision 1 to ensure the conditions described by TR-108553 did not introduce any new technical challenges and that applicability of the referenced TR was maintained at the higher-rated power levels and associated operating conditions. The NRC staff did not identify any technical issues during the review that would preclude the continued applicability of the reference TRs to the new operating parameters.

The NRC staff's safety evaluation for TR-0116-20825-P-A, Revision 1, “Applicability of AREVA Fuel Methodology for the NuScale Design,” contains the basis for the NRC staff's findings of acceptability for use by NuScale of the reference AREVA TR related to cladding creep collapse, M5 cladding, COPERNIC computer code, fuel rod bowing, and fuel mechanical design. As stated in the safety evaluation for TR-0116-20825-P-A, the NRC staff confirmed the applicability of the AREVA TR to the conditions described by TR-0116-20825-P-A. Similarly, for the operating domain at the higher-rated power level described by TR-108553, the NRC staff compared the operating conditions described by TR-108553 to the operating conditions for the referenced AREVA TR and finds these new operating conditions are more akin to the parameters of an operating PWR for which the reference AREVA TR were developed and approved for use. Therefore, the NRC staff finds that the extension of the range of applicability described in TR-108553 is acceptable.

The NRC staff's safety evaluation for TR-0716-50351-P-A, Revision 1, “NuScale Applicability of AREVA Method for the Evaluation of Fuel Assembly Structural Response to Externally Applied Forces,” contains the basis for the NRC staff's findings of acceptability for use by NuScale of the reference TR ANP-10337-P-A, “PWR Fuel Assembly Structural Response to Externally Applied Dynamic Excitations,” (Ref 4). As stated in the safety evaluation for TR-0716-50351, the NRC staff thoroughly reviewed the differences between the proposed NuScale reactor and fuel designs as compared with the reactor and fuel designs covered by the referenced AREVA methodology and found NuScale demonstrated that the AREVA methodology, with the stated modifications in TR-0716--50351, could be used to perform fuel system structural response analyses. Furthermore, the NRC staff's previous review evaluated each of the applicability limitations from ANP-10337P-A and determined they remained applicable to TR-0716-50351, as described in the SER to TR-0716-50351 (TR-0716-50351-P-A). In its review of TR-108553, the NRC staff reviewed these prior determinations and noted the prior NRC staff findings remain appropriate for these changes given that the fuel design parameters are generally consistent between TR-108553 and TR-0716-50351. Therefore, the extension of the range of applicability described by TR-108553 does not change the NRC staff’s previous findings. The NRC staff finds that the AREVA methodology is acceptable for use in performance of fuel system structural response analyses for the fuel design and operating conditions described by TR-108553.

4.0 STAFF CONCLUSIONS

The NRC staff has completed its review of TR-108553 (Ref. 1) and concludes that NuScale demonstrated that the AREVA fuel assembly structural response methodology and fuel system design codes and methods described in the TR is acceptable and can be used, with the stated modifications described by the TR, to perform NuScale fuel design and structural response

analyses. The NRC staff reached its conclusions by: (1) reviewing the differences between the power level and operating conditions of the fuel against those used in the previously approved methodology, (2) reviewing the conditions and limitations of the referenced approved methodology TRs, (3) reviewing responses to the requests for additional information issued during the reviews of TR-0116-20825-P-A, Revision1 and TR-0716-50351-P-A, Revision 1 to ensure the conditions described by TR-108553 did not introduce any new technical challenges and that applicability of the referenced TRs was maintained at the higher-rated power levels and associated operating conditions, and (4) evaluating the justification in TR-108553 for all modifications used to address fuel design and methodology differences.

The NRC staff finds that is appropriate and acceptable to approve the extensions of the range of applicability of TR-0116-20825-P-A, Revision 1, "Applicability of AREVA Fuel Methodology for the NuScale Design," and TR-0716-50351-P-A, Revision 1, "NuScale Applicability of AREVA Method for the Evaluation of Fuel Assembly Structural Response to Externally Applied Forces," to the fuel design and operating conditions proposed in TR-108553. Further, the NRC staff finds that the use of the AREVA fuel codes and methodologies, as described in TR-108553, to analyze the NuScale fuel system design is acceptable.

5.0 CONDITIONS AND LIMITATIONS

An applicant or licensee referencing TR-108553, with its described modifications and operating conditions, must apply the methodology and meet the limitations and conditions provided in TR-0116-20825-P-A, Revision 1 (Ref. 2) and TR-0716-50351-P-A (Ref. 3). Any applicant or licensee referencing TR-108553 with any modifications or operating conditions different than those described in TR-108553 and considered in this evaluation would need to address this in their application or license amendment request.

6.0 REFERENCES

1. TR-108553, "Framatome Fuel and Structural Response Methodologies Applicability to NuScale: Supplement 1 to TR-0116-20825-P-A, Revision 1 and Supplement 1 to TR-0716-50351-P-A, Revision 1" Revision 0, NRC Project No. 0769, November 2021 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21334A334).

2. TR-0116-20825-P-A, "Applicability of AREVA Fuel Methodology for the NuScale Design," Revision 1, November 24, 2017 (ML18040B306).

3. TR-0716-50351-P-A, "NuScale Applicability of AREVA Method for the Evaluation of Fuel Assembly Structural Response to Externally Applied Forces," Revision 1, NRC Project No. 0769, December 19, 2019 (ML19353A883).

4. ANP-10337-P-A, "PWR Fuel Assembly Structural Response to Externally Applied Dynamic Excitations," Revision 0, April 30, 2018 (ADAMS Accession No. ML18144A816).