



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

March 21, 2019

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

**SUBJECT: INTERIM LETTER: CHAPTERS 13 AND 18 OF THE NRC STAFF'S SAFETY EVALUATION REPORT WITH OPEN ITEMS RELATED TO THE DESIGN CERTIFICATION APPLICATION REVIEW OF THE NUSCALE SMALL MODULAR REACTOR**

Dear Ms. Doane:

During the 661<sup>st</sup> meeting of the Advisory Committee on Reactor Safeguards, March 7-8, 2019, we met with representatives of NuScale Power, LLC (NuScale) and the NRC staff to review Chapter 13, "Conduct of Operations," and Chapter 18, "Human Factors Engineering," of the safety evaluation report (SER) with open items associated with the NuScale design certification application (DCA). Our NuScale Subcommittee also reviewed these chapters on January 23, 2019. During this meeting, we had the benefit of discussions with NuScale and the staff. We also had the benefit of the referenced documents.

**CONCLUSIONS AND RECOMMENDATIONS**

1. Operator training drills should include scenarios where computer displays provide misleading or incomplete information to ensure operators maintain alternate diagnostic approaches.
2. The human factors engineering program review needs to be coordinated with the review of reactor building crane design features and operations in subsequent design certification chapters in order to minimize any hazards from heavy load lifts, including module movement.
3. We have not identified any additional major issues at this time for Chapters 13 and 18.

**BACKGROUND**

NuScale submitted a DCA for its small modular reactor on December 31, 2016. The staff's Phase 2 SER chapters related to the DCA include open items. In addition to a description of the staff review and their bases for acceptance of the DCA, the SER chapters also identify the information a combined license (COL) applicant must provide.

Our review is being conducted on a chapter-by-chapter basis to identify issues that may merit further consideration by the staff. This process aids in the resolution of concerns and facilitates

timely completion of the design certification application review. Our review addresses the staff's SER and DCA Chapter 13, Revision 1 and Chapter 18, Revision 1 along with supplemental material, including NuScale responses to staff requests for additional information.

## **DISCUSSION**

For this interim letter, we note the following observations on selected elements of the design addressed in these chapters.

### **DCA Chapter 13 – Conduct of Operations**

The SER on Chapter 13 summarizes the requirements for the COL applicant in the areas of:

- The management and technical support organization,
- Description and schedule of initial personnel training and qualification,
- Design features, facilities and equipment used to support emergency response functions,
- Site-specific information for operational programs,
- Administrative and operating procedures used by the operation organization to ensure activities are conducted in a safe manner

The DCA Chapter 13 topics on the physical security plan, cyber security plan and fitness for duty were not reviewed in this SE because they contain security related information.

There is significant overlap between Sections 13.4, "Operational Programs," 13.5, "Plant Procedures," and all of Chapter 18. The one significant open item in Chapter 13 applies equally well to Chapter 18. It is related to the staff review of NuScale Generic Technical Guidelines (GTGs) focused on (1) the three critical safety functions (CSFs) defined by NuScale, (2) the methodology used to identify key operator actions, and (3) the CSF flowchart logic and operator actions necessary to assess and maintain these functions. The applicant has submitted responses to the staff's requests for additional information. At present, the staff is unable to conclude the NuScale GTGs are acceptable for use as a basis for the development of COL applicant plant specific technical guidelines. NuScale has performed Integrated System Validation (ISV) testing, which will provide needed input for the staff evaluation, as well as any necessary changes to the GTGs and the associated post-accident monitoring variables. The ISV activity and report will be completed as part of the DCA and are being followed as an Open Item.

The staff tentatively concluded that passive reactivity management during an anticipated transient without scram can be credited. However, this is still under review as parts of Chapters 15 and 19. Thus, until these reviews are completed it is premature to draw this conclusion here.

NuScale plant operations rely on computer assistance, including summary displays of plant status. That assistance will be helpful to the operators and protects against some of the most common human errors. However, it may also result in an over reliance on computer aids. NuScale noted that, as part of operator training, black-screen scenarios are conducted with primary computer failures and operators must rely on direct diagnosis of plant instrumentation data. We note that partial computer failures may be more limiting than complete failures. Operator training drills should include scenarios where computer displays provide misleading or incomplete information to ensure operators maintain alternate diagnostic

approaches. Operators should not rely exclusively on high-level computerized information but check and verify available redundant plant information for appropriate response.

## **DCA Chapter 18 – Human Factors Engineering**

This chapter describes the human factors engineering (HFE) program for the NuScale plant. The HFE program takes advantage of state-of-the art technology and incorporates accepted HFE standards and guidelines, including the applicable staff guidance (NUREG-0711). The staff reviewed the HFE program under four general activities described in NUREG-0711:

- Planning & analysis - HFE program management, operating experience review, functional requirements and function allocation, task analysis, staffing and qualifications, and treatment of 'important human actions'
- Design - human-system interface design, procedure development, and training program development
- Human factors verification and validation
- Operational implementation - implementation and operation, and design implementation

In addition to developing a well-defined HFE program, NuScale has gone further at the DCA stage, completing many of the tasks included in their program. The results of this comprehensive work are reported in technical reports cited in Chapter 18 and in citations in those reports. Some have been included by reference in Chapter 1.

The NuScale simulator control panel layout and proposed operational practices evolved from testing with operators. The staffing and qualifications program is based on actual tests for a variety of scenarios. It is anchored to operating experience reviews, functional requirements analysis and function allocation, task analysis, and development of human-machine interface, for which there are technical reports.

The SE has 23 open items, most of which should be resolved when the staff reviews the results of NuScale's verification and validation program, including the ISV. All of the open items are confirmatory in nature. Closure of some items will require completion of the SERs for Chapters 7, 15 and 19.

A unique feature of the NuScale design involves heavy load lift and movement adjacent to operating reactors. The 12 module NuScale plant will have module movement for refueling every two months. Each refueling requires a NuScale module to be removed and relocated to the refueling station. When refueled, the module is returned to its original location. Such heavy load lift operations will be frequent, involving constant activity adjacent to operating reactors.

The HFE issues related to heavy load lifting and module movement deserve attention. The staff appropriately identified the notion of risk relative to the reactor-building crane and its operation. NuScale noted that these HFE issues pertaining to module movement will be addressed by the crane vendor. We emphasize that the applicant is responsible for this HFE analysis and the staff is expected to review it at the DCA or COL stage. In addition, NuScale design features not currently included and detailed for module movement could be incorporated to reduce the probability that a load drop would damage an operating module or the pool wall. The HFE program review needs to be coordinated with a review of these potential design features in

subsequent DCA chapters to minimize any hazards from heavy load lifts that include module movement. This also includes HFE review considering incremental installation of additional modules while some are already operating.

**SUMMARY**

We have identified some items that need to be resolved. However, we have not identified any additional major issues at this time for Chapters 13 and 18.

Sincerely,

*/RA/*

Peter C. Riccardella  
Chairman

## REFERENCES

1. U. S. Nuclear Regulatory Commission, "NuScale Power, LLC, Design Certification Application - Safety Evaluation With Open Items for Chapter 13, 'Conduct of Operations'," January 3, 2019 (ML18233A533).
2. NuScale Power, Design Certification Application, Chapter 13, "Conduct of Operations," Revision 1, March 15, 2018, (ML18086A060).
3. U. S. Nuclear Regulatory Commission, "NuScale Power, LLC, Design Certification Application - Safety Evaluation With Open Items for Chapter 18, 'Human Factors Engineering'," Proprietary, January 2, 2019 (ML18199A279).
4. U. S. Nuclear Regulatory Commission, "NuScale Power, LLC, Design Certification Application - Safety Evaluation With Open Items for Chapter 18, 'Human Factors Engineering'," January 2, 2019 (ML19017A253).
5. NuScale Power, Design Certification Application, Chapter 18, "Human Factors Engineering," Revision 1, March 15, 2018, (ML18086A065).
6. NuScale Power, Design Certification Application, Chapter 1, "Introduction and General Description of the Plant," Revision 1, March 15, 2018 (ML18086A149).
7. U.S. Nuclear Regulatory Commission, NUREG-0711, "Human Factors Engineering Program Review Model," Revision 3, November 30, 2012 (ML12324A013).

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Accession No: ML19079A218

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