

## 21 MULTI-MODULE DESIGN CONSIDERATIONS

### 21.0 Introduction

This chapter of the safety evaluation report (SER) identifies sections of other chapters of the U.S. Nuclear Regulatory Commission (NRC) staff's (hereinafter referred to as the staff) review of the NuScale Power, LLC (the applicant) Design Certification Application (DCA) Part 2, where interactions of systems shared between multiple NuScale Power Modules (NPMs) of the NuScale Power Plant have been evaluated. The term, "NuScale Power Plant," refers to the entire site, including up to 12 NPMs and the associated balance-of-plant support systems and structures. The Phase 2 SER for this chapter (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18220B313) did not identify Open Items. The staff's documentation in this SER regarding the interactions of systems shared between multiple NPMs of the NuScale Power Plant is based on Revision 3 of the DCA.

In DCA Part 2, Tier 2, Chapter 21, "Multi-Module Design Considerations," the applicant stated that the modular design of the NuScale Power Plant is consistent with Title 10 of the *Code of Federal Regulations* (10 CFR), Section 52.1, "Definitions," which defines "modular design" as a nuclear power station that consists of two or more essentially identical nuclear reactors (modules) and each module is a separate nuclear reactor capable of being operated independent of the state of completion or operating condition of any other module co-located on the same site, even though the nuclear power station may have some shared or common systems.

In Chapter 21, the applicant refers to DCA Part 2, Tier 2, Chapter 1, "Introduction and General Description of the Plant," which states that the NPM is a collection of systems, subsystems, and components that together constitute a modularized nuclear steam supply system (NSSS). For the purposes of Chapter 21, an NPM is a self-contained NSSS composed of a reactor core, a pressurizer, two steam generators integrated within the reactor pressure vessel and housed in a compact steel containment vessel, and its dedicated module-specific safety systems.

The applicant states that DCA Part 2, Tier 2, Chapter 21 demonstrates that safety-related systems and functions that prevent or mitigate NPM design basis events (DBEs) are not adversely affected as a result of failures of shared (common) systems or interfaces between NPMs.

### 21.1 Summary of Application

**DCA Part 2, Tier 1:** See information under ITAAC below.

**DCA Part 2, Tier 2:** NuScale DCA Chapter 21 contains the Tier 2 information.

**ITAAC:** DCA Part 2, Tier 1, Chapter 3, "Shared Structures, Systems, and Components and Non-Structures, Systems, and Components Design Descriptions and Inspections, Tests, Analyses, and Acceptance Criteria," provides the structures, systems, and components (SSCs) design descriptions and Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) for those SSCs that are common or shared by multiple NPMs. Shared systems in this chapter are either shared by 1-12 NPMs or by 1- 6 NPMs as shown in DCA Part 2, Tier 1, Table 3.0-1, "Shared Systems Subject to Inspections, Tests, Analyses, and Acceptance Criteria." This

chapter also includes non-SSC based Design Descriptions and ITAAC that are common or shared by multiple NPMs. These ITAAC are evaluated, as applicable, in conjunction with SER Sections 6.4, 7.2.11, 8.3.1, 8.3.2, 9.2.2, 9.2.3, 9.2.4, 9.2.5, 9.2.7, 9.2.9, 9.3.4, 9.3.6, 9.4.1, 9.4.2, 9.4.3, 9.4.4, 10.4.5, 10.4.10, 15.0.0, 15.0.3, and 19.1.4.9, and documented in the applicable sections of SER Chapter 14, “Initial Test Program and ITAAC-Design Certification,” Section 14.3, “Inspections, Tests, Analyses, and Acceptance Criteria.”

**Technical Specifications:** There are no technical specifications for this area of review.

**Technical Reports:** There are no technical reports associated with this area of review.

## 21.2 Technical Evaluation

Table 21-1, “NuScale Standard Design Shared Systems Evaluated by NRC Staff,” below lists the systems shared between multiple NPMs, and the SER sections where the staff evaluated multi-module aspects of these systems.

**Table 21-1: NuScale Standard Design Shared Systems Evaluated by NRC Staff**

No.	System	DCA Part 2 Tier 2	NPMs Supported	SER Section
1	Radioactive Waste Building heating, ventilation, and air conditioning (HVAC) system	Table 21-1	12	9.4.3
2	Diesel Generator Building HVAC system	Table 21-1	12	9.4.4
3	Turbine Building HVAC system	Table 21-1	6	9.4.4
4	Annex Building HVAC system	Table 21-1	12	9.4.2
5	Containment flooding and drain system (CFDS)	Table 21-2	Two independent subsystems each supporting 6 NPMs	9.3.6
6	Normal control room HVAC system	Table 21-2	12	9.4.1
7	Reactor Building HVAC system	Table 21-2	12	9.4.2
8	Control room habitability system (CRHS)	Table 21-2	12	6.4
9	Boron addition system (BAS)	Table 21-2	12	9.3.4
10	Reactor component cooling water system (RCCWS)	Table 21-2	Two independent subsystems each supporting 6 NPMs	9.2.2

No.	System	DCA Part 2 Tier 2	NPMs Supported	SER Section
11	Circulating water system	Table 21-2	Two subsystems each supporting 6 NPMs	10.4.5
12	Site cooling water system (SCWS)	Table 21-2	12	9.2.7
13	Demineralized water system (DWS)	Table 21-2	12	9.2.3
14	Auxiliary boiler system (ABS)	Table 21-2	12	10.4.10
15	Potable water system	Table 21-1	12	9.2.4
16	Ultimate heat sink (UHS)	Table 21-2	12	9.2.5
17	13.8 KV and switchyard system, medium voltage AC electrical distribution system (EMVS), low voltage AC electrical distribution system (ELVS)	Table 21-3	12	8.3.1
18	Highly reliable DC power system (EDSS) common (EDSS-C)	Table 21-3	12	8.3.2
19	Normal DC power system (EDNS)	Table 21-3	12	8.3.2
20	Safety display and indication system (SDIS)	Table 21-3	12	7.2.11
21	Plant Protection System (PPS)	Table 21-3	12	7.2.11
22	Plant Control System (PCS)	Table 21-3	12	7.2.11
23	Utility water system	Table 21-1	12	9.2.9
24	Process sampling system (PSS)	Table 21-2	12	9.3.2
25	Gaseous radioactive waste system (GRWS)	Table 21-2	12	11.3.4
26	Liquid radioactive waste system (LRWS)	Table 21-2	12	11.2.4
27	Fire protection system and fire detection System	Table 21-2	12	9.5.1
28	Nitrogen distribution system (NDS)	Table 21-2	12	9.3.1
29	Instrument air system (IAS)	Table 21-2	12	9.3.1
30	Fuel handling equipment	Table 21-2	12 (only one at a time)	9.1.4
31	Module assembly equipment (MAE)	Table 21-2	12 (only one at a time)	9.1.5

The failure of shared systems that are not safety-related is considered within the NuScale transient and accident analyses and is evaluated in SER Chapter 15, "Transient and Accident

Analysis.” The applicant described its categorization and classification of DBEs, including postulated accidents, in DCA Part 2, Tier 2, Section 15.0.0, “Classification and Key Assumptions.” SER Section 15.0.0, “Classification and Key Assumptions,” contains the staff’s review of the categorization and classification of these events.

DCA Part 2, Tier 2, Chapter 21, discusses the suitability of shared components and the design measures taken to ensure these components do not introduce multi-module risks. Specifically, DCA Part 2, Tier 2, Section 21.1.2, “Safety-Related System Protection from Internal Events,” describes the applicant’s determination that an accident in one NPM that results in an accident in another NPM is bounded by analysis and shown to be acceptable. SER Chapter 15 documents the staff’s evaluation of the design basis accidents (DBAs). Internal hazards are discussed in SER Chapter 3, “Design of Structures, Components, Equipment, and Systems.”

The applicant’s radiological consequence analyses evaluate the radiological consequences offsite, in the control room, and in the technical support center for the DBAs described in DCA Part 2, Tier 2, Chapter 15. These DBAs are analyzed for a single NPM. SER Section 15.0.3, “Radiological Consequences of Design Basis Accidents,” contains the staff’s review of the radiological consequences of these events.

The staff discussed multi-module risk including internal and external events in SER Section 19.1.4.9, “Evaluation of Multimodule Risk.”

### **21.3 Conclusion**

As applicable to NuScale multi-module design considerations and assertions, the staff has documented findings and conclusions in the SER sections as discussed above. The staff reviewed information presented in the DCA on the design of the shared systems listed in Table 21-1 above.