

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 review of the NuScale Power, LLC (the applicant) Design Certification Application (DCA), Part 2, "Final Safety Analysis Report (FSAR)," 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 staff's evaluation of NuScale small modular reactor (SMR) multi-module design considerations is based on Revision 1 of the NuScale 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) 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.

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	FSAR Tier 2	NPMs Supported	SER Section
1	RWB 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	Table 21-2	12 (6 each for two independent subsystems)	9.3.6
6	Normal control room HVAC system	Table 21-2	12	9.4.1
7	RXB HVAC system	Table 21-2	12	9.4.2
8	Control room habitability system	Table 21-2	12	6.4
9	Boron addition system	Table 21-2	12	9.3.4
10	Reactor component cooling water system	Table 21-2	12 (6 each for two independent subsystems)	9.2.2
11	Circulating water system	Table 21-2	12 (6 each for two independent subsystems)	10.4.5
12	Site cooling water system	Table 21-2	12	9.2.7
13	Demineralized water system	Table 21-2	12	9.2.3
14	Auxiliary boiler system	Table 21-2	12	10.4.10

15	Potable water systems	Table 21-1	12	9.2.4
16	Ultimate Heat Sink	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

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 does not result in an accident in another NPM and that no design basis accidents (DBAs) result from operation or failure of shared 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. Consistent with the SRP and, DSRs if applicable, the staff reviewed information presented in the DCA on the design and operation of the above mentioned shared systems.