Response to SDAA Audit Question

Question Number: A-3.9.4-2

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Question:

During the Advisory Committee on Reactor Safeguards subcommittee meeting for the NuScale Design Certification Application on April 17, 2019 (ADAMS Accession No. ML19114A107), several members inquired about unique environmental conditions for the control rod drive mechanisms (CRDMs), which are very similar in configuration to those in existing PWRs, but operate in different environmental conditions. While there is operating experience with existing PWR CRDMs, the CRDMs typically operate in a water solid environment, so NuScale's unique design, where the mechanisms operate in a borated steam environment and are cooled by cooling coils, introduces additional uncertainties. Specifically, a member of the Advisory Committee inquired about the potential for chemical buildup to form from substances evaporating off the top of the PZR water level and whether this buildup would prevent the rod from inserting into the core. Significant accumulation of particulates such as boric acid crystals around the movable elements of the CRDM latch mechanism could inhibit the ability of the latches to release the CRD shafts and scram the reactor. This accumulation could affect multiple CRDMs and could lead to a common-cause failure of some or all CRDMs. The NRC staff had requested assurance from the DCA applicant that accumulation of boric acid crystals would not adversely impact the ability of the CRDMs to perform their safety-related function of inserting the control rods. The DCA applicant had provided a response that it had considered the phenomenon in the design process but did not consider it to adversely impact the ability of the CRDMs to drop the control rods. For the US460 design, the general operating environment (e.g., a borated steam environment and external cooling system for the CRDMs) remains similar to the design reviewed under the Design Certification, but the new design may have introduced additional susceptibilities to this previously identified phenomenon. Therefore, the staff requests additional information to confirm that this phenomenon would not adversely impact the ability of the CRDMs to drop the control rods for the US460 design. This information is necessary to confirm the design meets the requirements of GDC 26, 27, and 29.

Response:

NuScale's response provided during DCA review in NRC Request for Additional Information RAI No. 9691, Question 03.09.04-13 (ADAMS Accession No. ML19200A208) and the NRC's subsequent evaluation of it in FSER Section 3.9.4.4.6 (see ADAMS Accession No. ML20205L405) remain applicable in principle.

The primary components of the CRDM, as relates to the possibility of adverse functional impacts caused by boric acid crystallization buildup, remain essentially unchanged, as can be determined upon comparison of DCA and SDAA Figures 4.6-1 through 4.6-3. The notable difference in CRDM designs is the method that the electromagnetic drive coils are cooled. In the US720 design a forced-water heat exchanger was implemented, whereas the US460 configuration uses a cooling jacket that acts as a cooling tank driven by natural circulation. This difference in coil cooling method is inconsequential to the DCA review discussions and the resulting conclusion that this phenomenon is not expected to occur.

No changes to the SDAA are necessary.