June 27, 2016

MEMORANDUM TO: Mark Tonacci, Chief
Licensing Branch 1
Division of New Reactor Licensing
Office of New Reactors

FROM: Gregory Cranston, Senior Project Manager ***/RA/***
Licensing Branch 1
Division of New Reactor Licensing
Office of New Reactors

SUBJECT: SUMMARY OF APRIL 14, 2016, PUBLIC MEETING WITH NUSCALE POWER, LLC TO DISCUSS NUSCALE'S APPROACH TO CONTAINMENT INTEGRATED LEAKAGE RATE TESTING (PROJ0769)

On April 14, 2016, a Category 1 public meeting was held at the NRC Headquarters Office, Two White Flint North, 7-C02, 11545 Rockville Pike, Rockville, Maryland and a closed portion at NuScale Power, LLC's (NuScale) 11333 Woodglen Drive, Rockville, Maryland office, between representatives of the U.S. Nuclear Regulatory Commission (NRC) staff and NuScale.

The purpose of the meeting was to discuss topics related to how NuScale's small modular reactor containment integrity will be verified and leakage rate tested to quantify potential leakage from the containment subsequent to a design basis loss of coolant accident. NuScale is proposing to deviate from Title 10 *Code of Federal Regulations* (CFR), Part 50 , General Design Criteria (GDC) 52, "Capability for containment leakage rate testing," and 10 CFR 50, Appendix J,"Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors," (Appendix J) with respect to Type A testing of the primary reactor containment vessel (CNV or containment). Type A tests are intended to measure the containment overall integrated leakage rate (1) after the containment has been completed and is ready for operation, and (2) at periodic intervals thereafter.

Additionally, GDC 52 states that the containment and other equipment which may be subjected to containment test conditions shall be designed so that periodic integrated leakage rate testing can be conducted at containment design pressure.

The GDC 16, "Containment design," requires that the containment and associated systems shall be provided to establish an essentially leak-tight barrier against the uncontrolled release of radioactivity to the environment and to assure that the containment design conditions important to safety are not exceeded for as long as postulated accident conditions require.

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NuScale stated that since their CNV will be a stainless steel clad vessel, built in accordance with American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code Class 1, there is reasonable assurance CNV integrity will be maintained through design and inspection of the CNV. The NRC staff did not state any concern with application of ASME Boiler and Pressure Vessel code for construction, inspection, and code testing requirements to certify the vessel as a code vessel but noted that the NRC regulations require the containment to be Type A tested per 10 CFR 50, Appendix J. NuScale stated that they believe their CNV design, with appropriate periodic inspections, meets the intent of GDC 52 and Appendix J.

In lieu of conducting Type A tests on the CNV, as defined in Appendix J, NuScale stated that they will:

- provide a CNV designed to ASME Class 1 rules
- ensure that all CNV surfaces are accessible for inspection
- conduct 100% visual examinations
- evaluate selected welds using ultra sonic (UT) examination methods
- perform fatigue analysis
- perform material surveillance

NuScale reiterated that they believe their approach provides superior leak-tight assurance and precludes the need to pressurize the CNV to a high pressure in order to conduct pre-operational and periodic Type A tests.

The NRC staff stated that they understood the approach that NuScale was proposing to ensure CNV integrity without the need to pressurize the CNV to a very high pressure. The NRC staff noted that NuScale's approach would mean relying on an analytical based method rather than on a performance based method without even an initial confirmatory integrated leakage rate test of the CNV and associated isolation valves and boundaries. The NRC staff also pointed out that operating experience has shown the value of initial and periodic integrated leakage rate testing, particularly if there is work done on the CNV during an outage that could adversely affect the CNV integrity. Mechanical connections may pass local leak rate testing but not an integrated test initially if local leakage rate test methods and associated procedures have not been verified to be acceptable based on performance.

The staff discussed an example of a test at one nuclear plant where the flanged connection between the containment head and lower containment vessel was local leakage rate tested for leak tight integrity, after being reassembled, by pressurizing between the double O-ring seals on the flange face to design pressure. It passed this local leakage rate test. Then the containment was pressurized to design pressure to conduct the Type A integrated leakage rate test. During the Type A test the flange connection leaked through the double O-ring seals causing the Type A test to fail. It should be noted that when the containment is pressurized to full design pressure, the force on the containment head to try to open a gap between the flanges is considerably greater than during local leakage testing of the seals when only the volume between the double O-ring seals is pressurized to design pressure. The cause of the leak at the flange during the Type A test, which did not occur during the local leakage rate test, was determined to be the torqueing method used on the flange bolts to install the containment head, which caused the containment head to be tilted up slightly on one side. That condition, combined with the increased force to try to lift the containment head off the flange face during the Type A test, allowed air to leak past the double O-ring seals. The containment head flange bolts were re-torqued properly and the Type A test passed.

Appendix J initial and periodic Type A tests not only verify that analytical methods are correct but verify that procedures associated with maintaining containment integrity at flanged fittings (containment flange and access flange face seals, for example), or elsewhere, are correct and administered correctly.

The NRC staff stated that relying on design and analysis without any testing or operational experience on the new, unique NuScale CNV design does not currently provide a convincing basis to justify an exemption from the 10 CFR Part 50, Appendix J, containment Type A testing requirement.

The NRC staff asked NuScale if there are any reasons that NuScale cannot pressurize the CNV with air and conduct a leakage rate test at design pressure. NuScale stated that they have the capability to do a Type A CNV test at design pressure, if needed. However, NuScale also stated that they believe that a Type A test would not provide additional assurance beyond that provided by design and inspection.

The NRC staff asked NuScale if there were other situations where they could pressurize the CNV with air that could be used to measure leakage. NuScale stated that they intend to pressurize CNV during the transition mode (moving the module within the reactor building from the refueling area to the module bay). The CNV would be pressurized to about 100 to 150 psia. The purpose of this pressurization is to support CNV draining subsequent to refueling operations to remove as much of the water from the CNV as possible before starting the vacuum pumps in the CNV evacuation system to pull and maintain a vacuum in the CNV during plant operation. NuScale stated that the purpose of pressurizing with air is not to assess CNV leakage or leakage paths. However, the frequency that the CNV evacuation systems operate during normal operation could be an indication of CNV leakage, but there is currently no intent to attempt to quantify evacuation system flow and correlate that flow to CNV leakage. The NRC staff commented that detection of leakage after refueling and prior to reactor startup would alert the plant operators so that the leak path could be located and repaired prior to startup, but that detection of leakage would not necessarily provide any quantification to compare that leakage to the allowable leak rate. The NRC staff also noted that 100 to 150 psia is well below CNV peak accident pressure which peaks out at several hundred psia and then reduces to about 100-200 psia within about 3 hours, according to NuScale. For both of these cases the appropriate instrumentation (temperature, water vapor pressure, pressure, flow, for example) would have to be added to accurately quantify the leakage.

The NRC staff asked NuScale what value of the overall leakage from the CNV they would assume if they did not conduct Type A tests. NuScale stated that they would assume zero leakage through the CNV for the Type A tests and add the cumulative leakage from all the Appendix J Type B and Type C local leakage rate tests to report total CNV leakage. The CNV isolation valves would be tested individually for each penetration and the higher leakage rate of the two valves would be used for that penetration to add to the total.

NuScale stated that they will fully comply with Appendix J, Type B and Type C testing requirements.

- Type B tests applicable to the NuScale CNV include tests intended to detect local leaks and to measure leakage across each pressure-containing or leakage-limiting boundary for primary reactor CNV penetrations and include penetrations whose design incorporates resilient seals or gaskets (such as CNV flange and CNV access cover double O-ring seals) and electrical penetrations.

- Type C tests applicable to NuScale include tests intended to measure CNV isolation valve leakage rates. The CNV isolation valves included are either those that provide a direct connection between the inside and outside atmospheres of the primary reactor CNV or those that connect to the reactor coolant pressure boundary and that are required to close automatically upon receipt of a CNV isolation signal in response to controls intended to affect CNV isolation. A closed system may be credited in lieu of an isolation valve and must also be leak rate tested to confirm it does not leak.

The NRC staff asked NuScale if they intend to submit an exemption from GDC 16. NuScale's response was that they are providing an "essentially leak-tight barrier" thus fulfilling the intent of GDC 16. NuScale is only using a different means to verify leak-tightness. Therefore, NuScale does not plan on requesting an exemption from GDC 16.

The NRC staff asked if NuScale plans on conducting a Type A test of the assembled CNV with air at the factory before transporting the module to the plant site. NuScale stated that they propose to only do the code required hydrostatic test at 125 percent of design test at the factory and currently did not intend to perform a leakage rate test with air.

The NRC staff asked how NuScale intends to address the aspect of GDC 52 which requires that the containment be designed so that periodic integrated leakage rate testing can be conducted at containment design pressure. The NRC staff also asked what special circumstances for an exemption (under 10 CFR 50.12(a)(2), "Specific exemptions") NuScale proposes.

NuScale responded that through design and inspection, they believe they meet the underlying purpose which is to ensure leak tightness. NuScale believes that the integrated leak rate pressure testing is not necessary to meet the underlying intent of the rule. The NRC staff noted that they are not aware of an alternative to integrated leakage rate test to provide assurance that the CNV structure would meet allowable leakage rates during design basis accidents.

Though discussed, but not specifically cited at the meeting, it should be noted that regulation 10 CFR 50.34(a)(1)(ii)(D), "Contents of applications; technical information," states that a demonstrable containment leak rate is required to evaluate the offsite radiological consequences. There are also similar references regarding containment leak rate in 52.17(a)(1)(ix), "Contents of applications; technical information"; 52.47(a)(2)(iv), "Contents of applications; technical information"; and, 52.79(a)(1)(vi), "Contents of applications; technical information in final safety analysis report."

The meeting ended with an overall summary of the discussion. There were no comments from the public. The agenda and list of meeting attendees are included in Enclosures 1 and 2.

Subsequent to this meeting, NuScale orally informed the staff that they are reconsidering doing an initial containment Type A test with air but have not indicated the test pressure or frequency of subsequent Type A testing. The staff is awaiting this additional information from NuScale prior to any further engagement on this topic.

The meeting notice is available in the Agencywide Document Access and Management System (ADAMS) with Accession No. ML16089A428. There was no presentation material used during the meeting. Please direct any inquiries to Gregory Cranston at (301) 415-0546, or email at gregory.cranston@nrc.gov.

ADAMS is the system that provides text and image files of NRC public documents and can be accessed at the NRC Electronic Reading Room at http://www.nrc.gov/reading-rm/adams.html. If you do not have access to ADAMS or have problems accessing the documents located in ADAMS, contact the NRC Public Document Room staff at (800) 397-4209, (301) 415-4737, or pdr@nrc.gov.

Project No.: PROJ0769

Enclosures:
1. Meeting Agenda
2. Meeting Attendees

cc: DC NuScale Power LLC Listserv

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1. Meeting Agenda
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cc: NuScale Listserv

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MEETING AGENDA

APRIL 14, 2016

NUSCALE CONTAINMENT INTEGRATED LEAKAGE RATE TESTING

TIME	TOPIC	LEAD
9:00 a.m. – 9:10 a.m.	Introductions	All
9:10 a.m. – 10:00 a.m.	Containment as an ASME III Class 1 pressure vessel and NuScale's approach to ensuring containment integrity	NuScale
10:00 a.m. – 10:05 a.m.	Questions	All
10:05 a.m. – 10:30 a.m.	Break and move to different meeting room	All
10:30 a.m. – 11:20 a.m.	10CFR50, Appendix J Type A, B and C testing	NuScale
11:20 a.m. – 11:30 a.m.	Questions and Meeting Summary	NRC/NuScale

MEETING ATTENDEES

NAME	AFFILIATION
Mark Tonacci	NRC
Greg Cranston	NRC
Thomas Scarbrough	NRC
Jason Huang	NRC
Tim Lupold	NRC
Michelle Hart	NRC
Mark Caruso	NRC
Donnie Harrison	NRC
Anne-Marie Grady	NRC
Clint Ashley	NRC
Hanry Wagage	NRC
Anthony Markley	NRC
Demetrius Murray	NRC
Prosanta Chowdhury	NRC
Omid Tabatabai	NRC
Lawrence Burkhart	NRC
Katherine Brandtjen	Member of the Public
Steven Mirsky	NuScale
Steven Unikewicz	NuScale
Steven Pope	NuScale
Randy Newton	NuScale (Corvallis)
Zach Houghton	NuScale (Corvallis)
Tamas Liszkai	NuScale (Corvallis)
J.J. Arthur	NuScale (Corvallis)
Jennie Wike	NuScale (Corvallis)
Marty Bryan	NuScale (Corvallis)
Mark Peres	NuScale (Corvallis)
Zack Rad	NuScale (Corvallis)
Gary Becker	NuScale (Corvallis)
Guy Martin, Jr.	NuScale (Corvallis)