

Pre-Application Audit Report of the NuScale Probabilistic Risk Assessment (PRA)

As part of its pre-application activities pertaining to the anticipated design certification application (DCA) from NuScale Power Incorporated (NuScale), members of the NRC staff and their contractors performed an audit of the NuScale probabilistic risk assessment (PRA) being developed in support of an expected DCA. The review was conducted at NuScale headquarters in Corvallis Oregon, on March 1- 3, 2011.

The purpose of this pre-application audit was to gather information from NuScale's risk assessment of their Integral Pressurized Water Reactor (iPWR) design for purposes of:

1. Assessing the extent to which the PRA is aligned with the Nuclear Regulatory Commission (NRC) staff's guidance and expectations for a PRA suitable for supporting design certification, and;
2. Identifying risk-insights regarding the NuScale iPWR design that the NRC staff may use to allocate its review effort for a future application for design certification in a manner consistent with the safety significance of the various design features.

The NRC review team included NRC personnel from the Division of Safety Systems and Risk Assessment and the Advanced Reactors Division in the Office of New Reactors (NRO), and national laboratory personnel from Sandia National Laboratory (SNL) and Oak Ridge National Laboratory (ORNL). Individuals that participated in the audit included:

- Lynn Mrowca NRC (Branch Chief, NRO PRA and Severe Accidents Branch)
- Gregory Cranston NRC (Senior Project Manager)
- Mark Caruso NRC (Senior Reliability and Risk Engineer/Audit Team Leader)
- Todd Hilsmeier NRC (Reliability and Risk Engineer)
- Jeffery Wood NRC (Reliability and Risk Engineer)
- Randy Belles ORNL (Systems Engineer)
- Willard Thomas SNL (Systems & Risk Analyst)

During the morning of the first day of the audit, the NRC staff made presentations which highlighted pertinent NRC guidance documents and described lessons learned and insights gained from NRC reviews of new reactor design certification applications, which will be incorporated into appropriate NRC guidance documents in the future. These presentations were then also used at a public meeting on April 20, 2011.

[\[http://pbadupws.nrc.gov/docs/ML1110/ML111050140.html\]](http://pbadupws.nrc.gov/docs/ML1110/ML111050140.html) For the balance of the first day, NuScale described the changes that had been made to their design since the last update given to the NRC staff. NuScale also provided a description of the PRA that NuScale has developed and the results obtained to date. Additionally, NuScale provided their schedule for completing the PRA prior to submitting the DCA.

On the second and third days of the audit, the audit team reviewed NuScale's PRA documentation, design descriptions and a number of applicable engineering procedures and guidance documents related to PRA and design. Each day the team developed questions for NuScale based on its review of these documents, and then held a question and answer session with NuScale to get clarification of written statements and to fill in information gaps. At the end of the third day, the team provided NuScale with their assessment of the NuScale PRA and NuScale's application of the PRA in the design process.

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Overall, the team found that:

1. NuScale has developed a fairly complete, preliminary, internal events, at-power PRA. This preliminary version of the PRA relies on generic data, conservative modeling assumptions and conservative success criteria. The NRC audit team noted, as reflected in the NuScale schedule, that significant work remains to finalize the design and complete all parts of the PRA and severe accident analyses required for design certification.
2. NuScale employs established techniques and standards for the quantitative evaluation of plant risks associated with external events (e.g., internal flooding, internal fires, high winds, and external flooding). These evaluations are built on conservative bounding assumptions since they are based on the conceptual design. NuScale stated that the external event risk evaluations will be updated during the detailed design phase when more specific information becomes available (e.g., cable and pipe routings, specific component locations, flooding from high energy line breaks and inadvertent system actuations).
3. NuScale is placing heavy emphasis on using the PRA to support design decisions. Quantitative safety goals have been established for the NuScale design which, if achieved, more than satisfies the Commissions objectives for new reactor designs articulated in NRC Policy statements.
4. NuScale is building a robust infrastructure (e.g., internal standards, guidance documents, procedures for development and use of the PRA) for further development of the PRA and use of the PRA in the design process. This infrastructure is consistent with NRC expectations for the development and use of PRA to support certification of a new reactor design.