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Alternative Method for Calculating Embrittlement for Steel Reactor Vessels

Comment On: NRC-2019-0180-0003
Alternative Method for Calculating Embrittlement for Steel Reactor Vessels; Request for Comment on Petition for Rulemaking

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General Comment

Comment Letter Attached.

Attachments

UW_NRC-2019-0180_Comments_121919

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December 19, 2019

Secretary
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
ATTN: Rulemakings and Adjudications Staff

RE: Docket ID NRC-2019-0180. Petition for rulemaking; notice of docketing, and request for comment; Alternative Method for Calculating Embrittlement for Steel Reactor Vessels. 84 Fed. Reg. 63819, 63819-63820, November 19, 2019.

Dear Sir or Madam:

Below please find comments on NuScale Power, LLC (NuScale), Petition for Rulemaking (Petition), dated August 19, 2019. These comments are submitted by Uranium Watch (UW), a non-profit organization that has been following the NuScale Design Certification Application (DCA) process.

According to the *Federal Register* Notice, NuScale "is requesting that the NRC revise its regulations to alleviate a requirement for calculating the embrittlement for advanced reactor designs and to add the embrittlement trend curve formula for calculating the mean value of the transition temperature shift described in American Society for Testing and Materials E900-152 to the NRC's regulations and guidance documents." According to NuScale, "The purpose of this petition is to amend Section 50.61 to alleviate an unnecessarily burdensome requirement on advanced reactor designs by adding an alternative formula for calculating the mean value of the transition temperature shift."

In December 2016 NuScale has submitted a Design Certification Application[1] to the Nuclear Regulatory Commission (NRC) for a Small Modular Nuclear Reactor (SMR) light water reactor design. The NRC is in the process of reviewing that design.[2]

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[1] https://www.nrc.gov/reactors/new-reactors/design-cert/nuscale/documents.html

[2] https://www.nrc.gov/reactors/new-reactors/design-cert/nuscale/review-schedule.html

COMMENTS

I. UW is opposed to any changes in NRC regulations and guidance regarding the methods used to determine embrittlement for so-called advanced reactor designs. UW requests that the NRC deny the Petition, based on the following:

1. The NRC has provided little information regarding the consequences of granting NuScale's request to amend its regulations at 10 C.F.R. 50.61 and Regulatory Guide 1.99.

2. The Petition is submitted on behalf of NuScale and other potential advanced reactor design and construction and operation license applicants. It was not submitted on behalf of the public. The purpose is to further the financial interests of the Petitioner.

3. NuScale requests that the NRC commence a rulemaking to amend Section 50.61 "to alleviate an unnecessarily burdensome requirement for calculating the mean value of the transition temperature shift." The Petition states, "Nuclear power plants that reference NuScale's design without the benefit of this rulemaking will be unduly restricted during startup and shutdown operations."

   However, NuScale fails to discuss how, exactly, NuScale reactor licensees would be "unduly restricted during startup and shutdown operations," the consequences of those restrictions, how such restrictions would affect startup and shutdown operations, and impacts to public health and safety.

4. According to the Petition, "NuScale requests that the formula for calculating the mean value of the transition temperature shift described in American Society for Testing and Materials (ASTM) E900-152 be added for use as an alternative to Equation 3 in 10 CFR 50.61(c)(1)(iv)." Further, "ASTM E900-15 is derived from a much larger database than was available for RG 1.99. It represents the latest industry consensus ETC and credits advanced manufacturing technologies."

   However, there is no discussion of the "advanced manufacturing technologies" being referenced. There is no information to support the assumption that the technologies to be used to manufacture the NuScale SMR reactor pressure vessels and other vessels subject to the Part 50.61 requirements will be adequate to support the proposed rule changes. There is no data or information about the chemical composition control of modern RPV fabrication techniques used to mitigate embrittlement and how those techniques will be used to manufacture NuScale and other "advanced' reactor vessels.

5. The Petition does not explain how the fact that ASTM E900-15 is derived from a much larger database than was available for RG 1.99 is related to new reactor designs that have never operated. There is no information regarding the particulars of the ASTM database and how that data base provides the necessary analysis.

6. The petitioner states that ASTM E900-15 represents the latest industry consensus embrittlement trend correlation and is derived from a much larger database than was available when Regulatory Guide 1.99 was issued and last revised. However, there is no indication that the data base includes SMRs or other "advanced" reactor designs.

   Given that the NuScale SMR is a reactor design with no manufacturing and operational history and the same is true for other "advanced" reactor designs that may be developed in the future, it is incumbent on the NRC and the nuclear industry to maintain conservatisms in reactor design and operation. Further, the perspective licensees for the NuScale SMR and other new reactor designs have no construction and operational experience with these new designs. Some, such as the entity[3] that intends to site the first NuScale Design light water SMR has no experience in the design, licensing, siting, construction, operation, and decommissioning of nuclear reactors.

7. There is no information regarding the neutron and other types of embrittlement that will affect the NuScale SMR design.

8. The Petition fails to describe how a mathematical model will suffice to determine potential embrittlement.

9. NuScale's proposed use of the mean values to assess embrittlement factor, does not provide the necessary data and conclusions from that data.

10. There is no scientific basis for amending the rules.

11. In sum, the information provided in the Petition does not support the request, assumptions, and any future Rulemaking responsive to the Petition.

II. In responding to this Petition and and in any possible Rulemaking, the NRC must consider a number of factors.

1. The NuScale SMR will is expected to consist of 12 individual RPVs. The NRC must consider how embrittlement issues in one or more vessels could affect the whole system.

2. The NRC must consider whether NuScale reactor pressure vessels are more at risk than regular nuclear reactors for sudden catastrophic pressure vessel failure, and thus catastrophic nuclear disaster. The NRC must evaluate US Department of Energy studies of NuScale and other reactos that have thinner nuclear reactor pressure vessel shells. The NRC must consider the possibility that significant radiation damage occurs through a greater fraction of wall thickness, and thus, they suffer from more embrittlement and therefore would be more subject to sudden through wall cracking

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[3] Utah Associated Municipal Power Systems (UAMPS), Salt Lake City, Utah.

and pressure vessel failure.

3. To protect the public, the NRC and nuclear industry should use the value that is the most safe and conservative, not the most convenient.

4. The NRC must take into consideration a study, entitled, "Assessment of Materials Issues for Light-Water Small Modular Reactors," Sandusky, et al., for the US Department of Energy[4]:

> The primary objective of this report is to evaluate materials degradation issue unique to the operational environments of LWSMR. Concerns for specific primary system components and materials are identified based on the review of design information shared by mPower and NuScale… A less obvious example of a new design configuration relates to vessel fabrication practices. Vessel fabrication will certainly be more complicated due to the integration of all of the primary system components from a traditional PWR into a single vessel enclosure.
> ***
> Examples of new environmental exposure conditions include reactor vessel fluence and CRD operating environment. The smaller diameter and lower operating pressures used by LWSMR designs allow for significantly thinner vessel shells, but with higher EOL neutron fluence. As a consequence, significant radiation damage occurs through a greater fraction of the wall thickness. With regard to CRDs and CRD penetrations, some LWSMRs will locate the CRDs at the top of the integrated vessel, causing them to be exposed to steam at higher pressurizer temperatures.
> ***
>
> As significant changes in material selection are unlikely for LWSMR designs, research to resolve key materials degradation concerns identified for large advanced PWRs remains of high importance and expanded activities are needed in many areas. Significant benefit for LWSMRs can be gained by R&D to characterize the effects of component fabrication processes and promotes application of advanced fabrication processes that cost-effectively provide increased confidence in long-term primary system performance....

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[4] "*Assessment of Materials Issues for Light-Water Small Modular Reactors* " Primary Authors: Dave Sandusky, XGEN Engineering Wayne Lunceford, Alliance Engineering Contributing Authors: S. M. Bruemmer and M. A. Catalan Pacific Northwest National Laboratory February 2013 Prepared for the U.S. Department of Energy under Contract DE-AC05-76RL01830 Pacific Northwest National Laboratory Richland, Washington 99352
https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-22290.pdf

5. The NRC must consider the fact that there are other causes of embrittlement besides neutrons. Hydrogen attack and corrosion can lead to pressure vessel failure. They all work together to weaken reactor vessels. The embrittlement effects must be evaluated together for the NuScale SMR and other "advanced" reactor designs (as yet unknown at this time).

6. The NRC must evaluate how exposure to neutron irradiation for extended periods changes the microstructure and microchemistry of the steels used (not just intended to be used) in affected SMRs and other reactor designs and degrades their fracture properties.

7. The NRC must consider the repercussions of using a non-conservative methodology for evaluating reactor embrittlement. This includes the fact that the repercussions of a failed, exploding nuclear reactor pressure vessel may be a Chernobyl-style disaster or worse.

8. The NRC must also evaluate this Petition considering postulated accident scenarios, source terms, proposed changes to Emergency Planning Zones, possible changes to the Price Anderson Act, other NRC decisions meant to pave the way for the deployment of thousands of so-called "advanced" reactors throughout the US.

Thank you for providing this opportunity to comment.

Sincerely,

/s/

Sarah Fields
Program Director