

Regulatory Guide Periodic Review

Office: **RES/DE/CIB**

Regulatory Guide Number: **1.99**

Title: **Radiation Embrittlement of Reactor Vessel Materials**

Recommended Staff Action: **RG 1.99, Revision 2, is acceptable for continued use**

1. What are the known technical or regulatory issues with the current version of the RG?

Regulatory Guide (RG) 1.99, Revision 2 (Rev. 2), "Radiation Embrittlement of Reactor Vessel Materials," issued in May 1986, establishes the NRC's position for an acceptable approach to calculate the effects of neutron radiation embrittlement of the low-alloy steels currently used for light-water-cooled reactor vessels. The neutron embrittlement of reactor vessel beltline materials is determined using RG 1.99, Rev. 2, with methods for estimating the Charpy transition temperature shift at 30 ft-lb (ΔT_{30}) and the decrease in upper-shelf energy (USE). Since the publication of RG 1.99, Rev. 2, the NRC has maintained research programs and participated in international meetings with the purpose of expanding the understanding of radiation damage mechanisms. Two examples of such programs may be found in NUREG/CR-6551 [1] and ORNL/TM 2006/530 [2]. While the staff has identified potential technical issues with RG 1.99, Rev. 2 procedures as a part of their continued research efforts, those technical issues have not indicated any safety concerns or a need to revise the RG at this time.

2. What is the impact on internal and external stakeholders of not updating the RG for the known issues, in terms of numbers of licensing and inspection activities?

Approximately 10-20 licensing activities per year (e.g., pressure-temperature (P-T) limit evaluations, license renewal submittals, extended power uprates, etc.) involve the use of RG 1.99, Rev. 2. There will be no impact on these analyses unless RG 1.99, Rev. 2 is revised.

3. What is an estimate of the level of effort needed to address identified issues in terms of full-time equivalent (FTE) and contract dollars?

NRC staff requires approximately 2-3 FTE to complete documentation of the technical evaluation of the underlying physical processes responsible for irradiation damage, the data quantifying the magnitude of irradiation damage in reactor steels, and to assess the impact of this information on the methodologies described in RG 1.99, Rev. 2. Based on the results of these activities, the staff will require further effort if it is decided that a revision of this RG is needed.

4. Based on the answers to the questions above, what is the recommended staff action for this guide (Reviewed with no issues identified, Reviewed with issues identified for future consideration, Revise, or Withdraw)?

The staff has reviewed RG 1.99, Rev. 2 and identified no technical issues for resolution at this time. Revision 2 is therefore deemed to be acceptable for continued use. The NRC plans to complete a detailed evaluation of embrittlement prediction methodologies, data, and understandings to assess their impact on RG 1.99. The NRC will publish a report on this evaluation, including a determination of the future need to revise RG 1.99, in approximately two years' time.

5. If a RG should be revised, provide a conceptual plan and timeframe to accomplish this.

Staff anticipates completion of the documents described in Item 4 within approximately two years of the date of this document, at which point the determination of whether RG 1.99, Rev. 2 should be revised will be made.

References

1. NUREG/CR-6551, MCS 970501, "Improved Embrittlement Correlations for Reactor Pressure Vessel Steels," U.S. Nuclear Regulatory Commission, November 1998, ADAMS Legacy Library Accession No. ML14010A095.
2. ORNL/TM-2006/530, "A Physically Based Correlation of Irradiation-Induced Transition Temperature Shifts for RPV Steels," Oak Ridge National Laboratory, November 2007, ADAMS Accession No. ML081000630.

NOTE: This review was conducted in January 2014 and reflects the staff's plans as of that date. These plans are tentative and subject to change.