



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS  
WASHINGTON, DC 20555 - 0001**

July 18, 2016

Mr. Victor M. McCree  
Executive Director for Operations  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555-0001

**SUBJECT:** DRAFT FINAL REGULATORY GUIDE 1.230, "REGULATORY GUIDANCE ON THE ALTERNATE PRESSURIZED THERMAL SHOCK RULE," AND DRAFT FINAL REPORT NUREG-2163, "TECHNICAL BASIS FOR REGULATORY GUIDANCE ON THE ALTERNATE PRESSURIZED THERMAL SHOCK RULE"

Dear Mr. McCree:

During the 635th meeting of the Advisory Committee on Reactor Safeguards, July 6-8, 2016, we completed our review of Draft Final Regulatory Guide 1.230, "Regulatory Guidance on the Alternate Pressurized Thermal Shock Rule," and Draft Final Report NUREG-2163, "Technical Basis for Regulatory Guidance on the Alternate Pressurized Thermal Shock Rule." Our Metallurgy and Reactor Fuels Subcommittee reviewed this material on May 3, 2016. During these meetings we had the benefit of discussions with NRC staff. We also had the benefit of the referenced documents.

### **RECOMMENDATION**

Regulatory Guide 1.230 and NUREG-2163 provide thorough guidance and a strong technical basis for licensees to use the Alternate Pressurized Thermal Shock (PTS) Rule, 10 CFR 50.61a, and should be issued.

### **BACKGROUND**

PTS is the result of a transient that causes severe overcooling (thermal shock) concurrent with or followed by significant pressure in the reactor pressure vessel. A PTS concern arises if one of these transients acts on the beltline region of a reactor pressure vessel where reduced fracture resistance exists because of neutron damage. Such an event may cause the propagation of a flaw at or near the inner vessel surface, potentially affecting the integrity of the vessel. To address this concern, the NRC incorporated the PTS Rule, 10 CFR 50.61, into the *Code of Federal Regulations* in 1985. This rule established screening criteria below which the potential for a reactor pressure vessel to fail due to a PTS event is deemed to be acceptably low. These screening criteria effectively define a limiting level of embrittlement beyond which operation cannot continue without further plant-specific evaluation.

The original PTS Rule was implemented at a time when the embrittlement database for reactor pressure vessel materials was limited and the analysis tools, in particular probabilistic fracture mechanics, were not well developed. For this reason, the original guidance contained significant conservatisms. Subsequent increases in the amount and quality of embrittlement data, along with development of advanced probabilistic fracture mechanics methods, now allow for a more accurate evaluation of PTS.

In early 2010, the NRC issued an Alternate PTS Rule that provided alternate embrittlement requirements for protection against PTS events for pressurized water reactor (PWR) pressure vessels. These requirements are based on more comprehensive, accurate, and realistic analysis methods, while still maintaining adequate safety margins. PWR licensees may choose to comply with the Alternate PTS Rule as a voluntary alternative to complying with the requirements contained in 10 CFR 50.61. We reviewed and recommended approval of the Alternate PTS Rule in our letter of March 13, 2009.

## **DISCUSSION**

It is possible that some plants may exceed the PTS screening criteria of 10 CFR 50.61 during the periods of extended operation beyond their original 40-year licenses. Some plants may meet 10 CFR 50.61 requirements using updated fluence calculations, new surveillance data, and improved material property information to provide better estimates of embrittlement progression. Others may choose to use the Alternate PTS Rule. To use the alternative rule, licensees must provide evidence that key assumptions regarding embrittlement and flaws that underlie the staff's 10 CFR 50.61a probabilistic fracture mechanics analysis are satisfied. The Alternate PTS Rule requires that several criteria must be satisfied to use the alternate embrittlement limits. Regulatory Guide 1.230 and NUREG-2163 provide the following guidance and methods licensees can use to satisfy these criteria.

1. *Criteria relating to the date of construction and design requirements.* The Alternate PTS Rule is applicable to licensees whose construction permits were issued before February 3, 2010, and whose reactor pressure vessels were designed and fabricated to the 1998 edition (or an earlier edition) of The American Society of Mechanical Engineers Boiler and Pressure Vessel Code. The reason for this applicability restriction is because the structural and thermal hydraulic analyses that establish the basis for the Alternate PTS Rule embrittlement limits only represent plants constructed before this date. It is the responsibility of a licensee to demonstrate that the risk-significant factors controlling PTS, for any plant constructed after February 3, 2010, are adequately addressed by the technical-basis calculations developed in support of the Alternate PTS Rule.

2. *Criteria relating to evaluation of plant-specific surveillance data.* The Alternate PTS Rule includes statistical tests that must be performed on reactor pressure vessel surveillance data to determine whether the surveillance data are sufficiently close to the predictions of an embrittlement trend curve.

3. *Criteria relating to inservice inspection data and nondestructive examination requirements.* The Alternate PTS Rule describes a number of tests and conditions on the collection and analysis of inservice inspection data that are intended to provide reasonable assurance that the distribution of flaws is consistent with that assumed in the staff's probabilistic fracture mechanics calculations.

Guidance is also provided, which licensees can use to estimate a plant-specific through-wall cracking frequency for cases in which the embrittlement limits of the Alternate PTS Rule are not satisfied.

Regulatory Guide 1.230 is comprehensive and provides specific criteria, calculation methodologies, and examinations that licensees can use to demonstrate that the requirements of the Alternate PTS Rule are satisfied. The technical justification of these criteria is provided in NUREG-2163.

The staff has received and adequately responded to the public comments on these documents. Regulatory Guide 1.230 and NUREG-2163 provide thorough guidance and a strong technical basis for licensee use of the Alternate PTS Rule and should be issued.

Sincerely,

*/RA/*

Dennis Bley  
Chairman

#### REFERENCES

1. U.S. Nuclear Regulatory Commission, Draft Final Regulatory Guide 1.230, "Regulatory Guidance on the Alternate Pressurized Thermal Shock Rule," December 15, 2015 (ML15344A402).
2. U.S. Nuclear Regulatory Commission, Draft NUREG-2163, "Technical Basis for Regulatory Guidance on the Alternate Pressurized Thermal Shock Rule," December 8, 2015 (ML15344A400).
3. Advisory Committee on Reactor Safeguards, "Draft Final Rule 10 CFR 50.61a. 'Alternate Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events'," March 13, 2009 (ML090710128).
4. U.S. Nuclear Regulatory Commission, "NRC Staff Responses to Public Comments on DG-1299 and NUREG-2163," December 10, 2015 (ML15344A398).
5. Advisory Committee on Reactor Safeguards, "Pressurized Thermal Shock Technical Basis Reevaluation Project," October 12, 2000 (ML003759757).
6. Advisory Committee on Reactor Safeguards, "Reevaluation of the Technical Basis for the Pressurized Thermal Shock Rule," February 14, 2002 (ML020510265).
7. Advisory Committee on Reactor Safeguards, "Risk Metrics and Criteria for Reevaluating the Technical Basis of the Pressurized Thermal Shock Rule," July 18, 2002 (ML022030522).

8. Advisory Committee on Reactor Safeguards, "Pressurized Thermal Shock (PTS) Reevaluation Project: Technical Bases for Potential Revision to PTS Screening Criteria," February 21, 2003 (ML030580848).
9. Advisory Committee on Reactor Safeguards, "Pressurized Thermal Shock (PTS) Reevaluation Project: Technical Basis for Revision of the PTS Screening Criterion in the PTS Rule," March 11, 2005 (ML050730177).

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Letter to Mr. Victor M. McCree Executive Director for Operations, NRC, from Dennis Bley, Chairman, ACRS, dated July 18, 2016

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