

RULEMAKING ISSUE

AFFIRMATION

April 9, 2009

SECY-09-0059

FOR: The Commissioners

FROM: R. W. Borchardt
Executive Director for Operations

SUBJECT: FINAL RULE RELATED TO ALTERNATE FRACTURE TOUGHNESS
REQUIREMENTS FOR PROTECTION AGAINST PRESSURIZED
THERMAL SHOCK EVENTS (10 CFR 50.61a) (RIN 3150-AI01)

PURPOSE:

To obtain Commission approval to publish a final rule to provide alternate fracture toughness requirements for protection against pressurized thermal shock (PTS) events for pressurized-water reactor (PWR) reactor vessels.

BACKGROUND:

PTS events are system transients in a PWR in which there is a rapid operating temperature cooldown that results in cold reactor vessel temperatures with or without repressurization of the reactor vessel. The rapid cooling of the inside surface of the reactor vessel causes thermal stresses. The thermal stresses combine with stresses caused by high pressure. The aggregate effect of these stresses is an increase in the potential for fracture if a preexisting flaw is present in a material susceptible to brittle failure. The ferritic, low-alloy steel of the reactor vessel beltline, which is adjacent to the core where neutron radiation gradually embrittles the material over the lifetime of the plant, can be susceptible to brittle fracture.

The current PTS rule described in Title 10, Section 50.61, "Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events," of the *Code of Federal Regulations* (10 CFR 50.61), and adopted on July 23, 1985, (50 FR 29937) establishes screening criteria

CONTACTS: Veronica M. Rodriguez, NRR/DPR
(301) 415-3703

Matthew A. Mitchell, NRR/DCI
(301) 415-1467

Mark T. Kirk, RES/DE
(301) 251-7631

below which the potential for a reactor vessel to fail due to a PTS event is deemed to be acceptably low. The screening criteria effectively define a limiting level of embrittlement beyond which the licensee cannot continue operation without further plant-specific evaluation.

A licensee may not continue to operate reactor vessels with materials predicted to exceed the screening criteria in 10 CFR 50.61 without implementing compensatory actions or additional plant-specific analyses unless it receives an exemption from the requirements of the rule. Acceptable compensatory actions are neutron flux reduction, plant modifications to reduce the PTS event frequency or severity, and reactor vessel annealing. These actions are addressed in 10 CFR 50.61(b)(3), 10 CFR 50.61(b)(4), 10 CFR 50.61(b)(7), and 10 CFR 50.66, "Requirements for Thermal Annealing of the Reactor Pressure Vessel," respectively.

Currently, no operating PWR reactor vessel is projected to exceed the 10 CFR 50.61 screening criteria before the expiration of its 40-year operating license. However, several PWR reactor vessels are approaching the screening criteria, and others are likely to exceed the screening criteria during the extended period of operation of their first license renewal.

The U.S. Nuclear Regulatory Commission (NRC) Office of Nuclear Regulatory Research (RES) developed a technical basis that supports updating the PTS regulations. This technical basis concludes that the risk of through-wall cracking caused by a PTS event is much lower than previously estimated. This finding indicates that the screening criteria in 10 CFR 50.61 are unnecessarily conservative and may impose an unnecessary burden on some licensees. Therefore, the NRC developed a proposed new rule, 10 CFR 50.61a, "Alternate Fracture Requirements for Protection against Pressurized Thermal Shock Events," providing alternate screening criteria and corresponding embrittlement correlations based on the updated technical basis. This proposed new rule is consistent with the staff requirements memorandum "Staff Requirements - SECY-06-0124 - Rulemaking Plan to Amend Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events (10 CFR 50.61)," dated June 30, 2006, in which the Commission asked the staff to prepare a rulemaking that would allow current PWR licensees to implement the new requirements of 10 CFR 50.61a or to continue to comply with the current requirements of 10 CFR 50.61.

The NRC published the proposed rule for public comment in the *Federal Register* on October 3, 2007 (72 FR 56275). The NRC determined that several changes to the October 3, 2007, proposed rule language were desirable to adequately address issues raised in stakeholders' comments. Because these modifications may not have represented a logical outgrowth from the provisions of the October 3, 2007, proposed rule, the NRC requested stakeholder feedback on the modified provisions through the use of a supplemental proposed rule. The supplemental proposed rule specifically solicited stakeholder comments on the provisions related to the applicability of the rule, to the evaluation of reactor vessel surveillance data, and the adjustment of volumetric examination data to demonstrate compliance with the rule. The NRC published the supplemental proposed rule on August 11, 2008 (73 FR 46557). After consideration of the October 3, 2007, proposed rule, the August 11, 2008, supplemental proposed rule, and the stakeholders' comments received on both, the NRC staff developed this final rule.

DISCUSSION:

The NRC received five comment letters containing a total of 54 comments on the October 3, 2007, proposed rule. The NRC received three comment letters containing a total of five comments on the August 11, 2008, supplemental proposed rule. Industry stakeholders submitted all the comments on the proposed rule and on the supplemental proposed rule. These comments are summarized in Enclosure 1, the *Federal Register* notice, and are discussed in detail in Enclosure 2, "Summary and Analysis of Public Comments on Proposed and Supplemental Proposed Rule Language." Comments that resulted in substantive changes to the final rule are discussed below by subject matter.

Applicability of the Rule

Several commenters stated that the rule should apply only to the existing fleet of PWRs. Plants whose construction permits were issued before the effective date of the final rule and whose reactor vessels were designed and fabricated to the 1998 or earlier Edition of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) will have material properties, operating characteristics, PTS event sequences and thermal-hydraulic responses consistent with those of the reactors that were evaluated as part of the technical basis for 10 CFR 50.61a. Other factors, including materials fabrication and welding methods, would also be consistent with the underlying technical basis of 10 CFR 50.61a. The NRC staff agrees with the commenters and determined that allowing the use of 10 CFR 50.61a only to plants whose reactor vessels were designed and fabricated to the 1998 or earlier Edition of the ASME Code would be prudent. As a result of this comment, the NRC staff modified the rule to reflect this position.

Surveillance Data

Several commenters stated that there is little added value in the requirement to assess reactor vessel surveillance data as a part of this rule because the derivation of the embrittlement correlation has already accounted for the variability in the data. The commenters also stated that there is no viable methodology for adjusting the projected shift in transition temperature (i.e., ΔT_{30}) for the reactor vessel based on the surveillance data. Any effort to make this adjustment is likely to introduce additional error into the prediction. Therefore, the commenters believed that obtaining the ΔT_{30} prediction based on the best estimate of chemical composition for the heat of the material is more reliable than a prediction based on a single set of surveillance measurements.

The NRC staff believes that there is added value in the requirement to assess reactor vessel surveillance data. Although the derivation of the embrittlement correlation has already accounted for the variability in the data, the NRC believes that the surveillance data assessment required in the final rule is needed to determine if the embrittlement for a specific heat of material in a reactor vessel is consistent with the embrittlement predicted by the embrittlement correlation. In addition, the staff believes that, although there is no single methodology for adjusting the projected ΔT_{30} for a reactor vessel based on the surveillance data, a licensee could, on a case-specific basis, justify adjustments to the generic ΔT_{30} prediction. For this reason, the rule does not specify a methodology for adjusting the ΔT_{30} value based on reactor vessel surveillance data, but rather it requires the licensee to propose a case-specific ΔT_{30} adjustment procedure for review and approval by the Director of the Office of Nuclear Reactor

Regulation (NRR). Although the commenters assert that error could possibly be introduced, the staff believes that appropriate plant-specific adjustments based on available reactor vessel surveillance data may be necessary to project reactor vessel embrittlement for this rule.

As the result of these comments, the staff continued to work on statistical procedures to identify deviations from generic embrittlement trends. Based on this work, the staff enhanced the procedure described in the rule to, among other things, detect trends from the plant- and heat-specific surveillance data that may emerge at high fluences that the equations described in the proposed rule do not predict. To address this potential deficiency, which could be particularly important during a plant's period of extended operation, the staff added two more statistical tests in the rule. These tests will determine if the embrittlement trend from a particular heat of material show a more rapid increase after significant radiation exposure than the progression predicted by the generic embrittlement trend curve.

Inservice Inspection Volumetric Examination and Flaw Assessments

In the supplemental proposed rule, the NRC staff requested comments on the adjustments of volumetric examination data to demonstrate compliance with the rule and received numerous comments in support of the staff's initiative. The staff decided to permit the adjustment of flaw sizes to account for the effects of uncertainties related to the nondestructive ultrasonic examination (e.g., probability of detection, flaw density, and flaw location) before the estimated size and density distribution are compared to the allowable size and density distribution in the final rule. Licensees are required to base their methodology to account for the nondestructive examination uncertainties on statistical data collected from ASME Code inspector qualification tests and any other tests that measure the difference between the actual flaw size and the size determined from the ultrasonic examination. Collecting, evaluating, and using data from these tests will require extensive engineering judgment. Therefore, the Director of NRR must review and approve the methodology to ensure that the risk associated with PTS is acceptable.

RESOURCES:

The following full-time equivalent (FTE) required to complete this final rulemaking have been allocated in the fiscal year (FY) 2009 budget.

	<u>FY 2009</u>
NRR	0.4 FTE
RES	0.1 FTE
Office of New Reactors (NRO)	0.1 FTE
Office of the General Counsel (OGC)	0.1 FTE
Office of Administration (ADM)	0.1 FTE

No additional resources are necessary to complete this rulemaking.

RECOMMENDATIONS:

The staff recommends that the Commission take the following three actions:

- (1) Approve the enclosed final rule (Enclosure 1) for publication in the *Federal Register*.

- (2) Certify that this rule, if promulgated, will not have a significant impact on a substantial number of small entities. This certification is included in the enclosed *Federal Register* notice and satisfies the requirement of the Regulatory Flexibility Act (5 U.S.C. 605(b)).
- (3) Note the following:
 - a. The staff has prepared a final regulatory analysis for this rulemaking (Enclosure 3).
 - b. The final rule contains amended information collection requirements subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501, et seq.) that must be submitted to the Office of Management and Budget (OMB) for its review and approval before the final rule can be published in the *Federal Register* (Enclosure 4).
 - c. The staff has determined that this action is not a "major rule," as defined in the Congressional Review Act of 1996 (5 U.S.C. 804(2)) and has confirmed this determination with OMB. The staff will inform the appropriate Congressional and U.S. Government Accountability Office contacts.
 - d. The staff will inform the appropriate Congressional committees.
 - e. The Office of Public Affairs will issue a press release when the NRC publishes the final rule in the *Federal Register*.

COORDINATION:

The staff briefed the Materials, Metallurgy, and Reactor Fuels Subcommittee of the Advisory Committee on Reactor Safety (ACRS) on the supplemental proposed rule and on the final rule on October 1, 2008 and March 4, 2009, respectively. The staff also briefed the ACRS Full Committee on the final rule on March 5, 2009. The staff received the Committee's recommendation for approval by letter dated March 13, 2009 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML090710128). The staff coordinated this paper with NRR, RES, NRO, ADM, the Office of Information Services, and the Office of Enforcement. In accordance with the requirements from the Office of the Chief Financial Officer, the staff did not submit this paper for review by the Chief Financial Officer because the resource needs are less than \$100,000 or 1.0 FTE and because the paper has no impact on other planned work. OGC has no legal objection to this paper.

/RA Bruce S. Mallett for/

R. W. Borchardt
Executive Director
for Operations

Enclosures:

1. *Federal Register* Notice
2. Summary and Analysis of Comments
3. Regulatory Analysis
4. OMB Supporting Statement

- (2) Certify that this rule, if promulgated, will not have a significant impact on a substantial number of small entities. This certification is included in the enclosed Federal Register notice and satisfies the requirement of the Regulatory Flexibility Act (5 U.S.C. 605(b)).
- (3) Note the following:
- a. The staff has prepared a final regulatory analysis for this rulemaking (Enclosure 3).
 - b. The final rule contains amended information collection requirements subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501, et seq.) that must be submitted to the Office of Management and Budget (OMB) for its review and approval before the final rule can be published in the *Federal Register* (Enclosure 4).
 - c. The staff has determined that this action is not a "major rule," as defined in the Congressional Review Act of 1996 (5 U.S.C. 804(2)) and has confirmed this determination with OMB. The staff will inform the appropriate Congressional and U.S. Government Accountability Office contacts.
 - d. The staff will inform the appropriate Congressional committees.
 - e. The Office of Public Affairs will issue a press release when the NRC publishes the final rule in the *Federal Register*.

COORDINATION:

The staff briefed the Materials, Metallurgy, and Reactor Fuels Subcommittee of the Advisory Committee on Reactor Safety (ACRS) on the supplemental proposed rule and on the final rule on October 1, 2008 and March 4, 2009, respectively. The staff also briefed the ACRS Full Committee on the final rule on March 5, 2009. The staff received the Committee's recommendation for approval by letter dated March 13, 2009 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML090710128). The staff coordinated this paper with NRR, RES, NRO, ADM, the Office of Information Services, and the Office of Enforcement. In accordance with the requirements from the Office of the Chief Financial Officer, the staff did not submit this paper for review by the Chief Financial Officer because the resource needs are less than \$100,000 or 1.0 FTE and because the paper has no impact on other planned work. OGC has no legal objection to this paper.

**/RA Bruce S. Mallett for/
R. W. Borchardt
Executive Director
for Operations**

- Enclosures: 1. *Federal Register* Notice
2. Summary and Analysis of Comments
3. Regulatory Analysis
4. OMB Supporting Statement

WITS 200800297/EDATS: SECY-2008-0414 Package: ML083470915; SECY : ML083470928 * Via E-Mail ** Via Memo

OFFICE	NRR:DPR:PM	Tech Editor *	NRR:DCI	NRR:DRA	NRR:DSS	RES:DE *	NRO:DE
NAME	VRodriguez	KAzariah	BElliot	SDinsmore	LLOis	MKirk	NRay
DATE	12/15/08	12/12/08	12/16/08	12/23/08	12/16/08	12/23/08	12/18/08
OFFICE	ADM:RDEB	NRR:DCI:BC	NRR:DRA:BC	NRR:DSS:BC	RES:DE:BC	NRO:DE:BC	NRR:DPR:BC
NAME	MHarrison (MLesar for)	MMitchell	MRubin	GCranston	RHardies	AHowe	JZimmerman (BRichter for)
DATE	12/22/08	12/17/08	12/23/08	12/16/08	12/17/08	12/19/08	12/22/08
OFFICE	NRR:DCI:D	NRR:DRA:D	NRR:DSS:D	RES:DE:D *	NRO:DE:D	NRR:DPR:D	RES:D
NAME	MEvans (JLubinski for)	MCunningham	WRuland	MCase	MMayfield	TMcGinty	BSheron
DATE	01/09/09	01/05/09	01/09/09	01/06/09	12/31/08	12/29/08	01/16/09
OFFICE	NRO:D	OE:D	OIS *	ADM **	OGC NLO	NRR:D	EDO
NAME	MJohnson (GHolahan)	CCarpenter (GGulla for)	TBoyce (TDonnell for)	MLesar	BJones	ELeeds (BBoger for)	RBorchardt by Bruce Mallett
DATE	01/16/09	01-09-09	01/22/09	12/22/08	01/21/09	01/30/09	04/09/09