

FINAL SUPPORTING STATEMENT  
FOR  
FRACTURE TOUGHNESS REQUIREMENTS FOR PROTECTION AGAINST  
PRESSURIZED THERMAL SHOCK EVENTS

10 CFR 50.61

DESCRIPTION OF THE INFORMATION COLLECTION

Pressurized thermal shock (PTS) events are system transients in pressurized water reactors (PWRs) that can cause severe overcooling (thermal shock) concurrent with or followed by immediate repressurization to a high pressure. The thermal stresses caused by rapid cooling of the reactor vessel inside surface combine with the pressure stresses to increase the potential for fracture if an initiating flaw is present in low toughness material. Such material may exist in the reactor vessel beltline, adjacent to the core, where neutron radiation gradually embrittles the material during the plant lifetime. The toughness of reactor vessel materials is characterized by a "reference temperature for nil ductility transition" ( $RT_{NDT}$ ). The value of  $RT_{NDT}$  at a given time in a vessel's life is used in fracture mechanics calculations to determine whether assumed pre-existing flaws would propagate as cracks when the vessel is stressed.

10 CFR 50.61 establishes a screening criterion, a limiting level of embrittlement beyond which operation cannot continue without further plant-specific evaluation. The screening criterion is given in terms of  $RT_{NDT}$ , calculated as a function of the copper and nickel contents of the material and the neutron fluence according to the procedure given in 50.61, and called  $RT_{PTS}$  to distinguish it from other procedures for calculating  $RT_{NDT}$ .

Effective January 1996, 50.61 was amended to change the procedure for calculating the amount of radiation embrittlement when surveillance data meet the credibility criteria of Regulatory Guide 1.99, Revision 2, "Radiation Embrittlement of Reactor Vessel Materials." The amended rule requires resubmittal of the  $RT_{PTS}$  analysis if there is a significant change in projected values of  $RT_{PTS}$ , or upon a request for a change in the expiration date for operation of the facility.

Section 50.61(b)(1) requires each PWR licensee, other than a licensee for a PWR for which 50.82(a)(1) certifications have been submitted, to have projected values of  $RT_{PTS}$ , accepted by the NRC, for each reactor vessel beltline material for the expiration date of the operating license (EOL) fluence of the material. The assessment must use the calculation procedures given in 50.61 and must specify the bases for the projected value, including the assumptions regarding core loading patterns, and must specify the copper and nickel contents and the fluence value used in the calculation for each beltline material. This assessment must be updated whenever there is a significant change in projected values of  $RT_{PTS}$ , or upon a request for a change in the expiration date for operation of the facility.

Section 50.61(b)(3) provides for submittal and anticipated approval by NRC of detailed plant-specific analyses, submitted to demonstrate acceptable risk with  $RT_{PTS}$  above the screening limit due to plant modifications, new information or new analysis techniques.

Section 50.61(b)(4) requires licensees for PWRs for which the analysis required by 50.61(b)(3) indicates that no reasonably practical flux reduction program will prevent  $RT_{PTS}$  from exceeding the PTS screening criterion to submit a safety analysis to determine what, if any, modifications to equipment, systems, and operation are necessary to prevent potential failure of the reactor vessel as a result of postulated PTS events if continued operation beyond the screening criterion is allowed. This analysis must be submitted at least three years before  $RT_{PTS}$  is projected to exceed the PTS screening criterion.

Section 50.61(b)(6) states that if NRC concludes that operation of the facility with  $PT_{PTS}$  in excess of the PTS screening criterion cannot be approved on the basis of the licensee's analyses submitted in accordance with 50.61(b)(3) and (4), the licensee shall request and receive approval by NRC prior to any operation beyond the criterion.

Section 50.61(c)(3) requires licensees to report to NRC any information believed to significantly improve the accuracy of the  $RT_{PTS}$  values. The burden is included in the estimates for  $RT_{PTS}$  assessment under Item 12 of this Supporting Statement.

In response to 50.61, the licensees of operating PWRs have submitted the fluence predictions and chemical composition data and these have now been accepted. A number of licensees have undertaken flux reduction programs for those plants having high values of  $RT_{PTS}$ . Some of these are still under review. Submittal of requests to operate beyond the screening criterion [per 50.61(b)(4)], is expected to be made during the years 2004-2007. The number of licensees affected by 50.61(b)(4) is estimated at 3 during this clearance period because some plants have instituted sufficient flux reduction to prevent them from reaching the screening criteria before end of life.

## A. JUSTIFICATION

### 1. Need for the Collection of Information

Maintaining the structural integrity of the reactor pressure vessel of light-water-cooled reactors is a critical concern related to the safe operation of nuclear power plants. To assure the structural integrity of reactor vessels, NRC has developed regulations, including 10 CFR 50.61, and regulatory guides, including Regulatory Guide 1.99, Revision 2, to provide analysis and measurements methods and procedures to establish that the reactor vessel has adequate safety margin for continued operation. The fracture toughness of the vessel materials varies with time. As the plant operates, neutrons escaping from the reactor core impact the vessel beltline materials causing embrittlement of those materials. The information collections in 10 CFR 50.61, as well as those in 10 CFR 50.60 and Appendices G and H of Part 50, provide estimates of the extent of the embrittlement, and evaluations of the consequences of the embrittlement in terms of the structural integrity of the vessel.

2. Agency Use of the Information

The information and analyses required by 50.61 will be reported on the plant's docket pursuant to the provisions of 10 CFR 50.4 and reviewed by NRC to ensure the requirements of the regulation are met. There is a safety issue involved in the information collection requirement described above. By reviewing the submittals from the PWR licensees, the NRC can make certain that (a) all of them are aware of the potential threat to the integrity of their reactor vessel from pressurized thermal shock events, and (b) those that need to consider additional flux reduction in order to stay below the screening criterion will become aware of the need as early as possible, when flux reduction is most effective.

3. Reduction of Burden Through Information Technology

There is no legal obstacle to the use of information technology. Moreover, NRC encourages its use; however, at the current time, no responses are submitted electronically.

4. Effort to Identify Duplication and Use Similar Information

There are no other NRC or Federal government requirements regarding analyses for flux reduction or plant PTS safety analyses. The Information Requirements Control Automated System (IRCAS) was searched, and no duplication was found. However, materials information leading to calculation of an  $RT_{NDT}$  value for the reactor vessel is submitted in response to the requirements of Appendices G and H, 10 CFR Part 50 (See Supporting Statement included in this submittal as Section 18.) For new plants, it appears in the final safety analysis report. During the operating life, the information is updated by the individual plant submittals that support requests for changes in the pressure-temperature limits.

5. Effort to Reduce Small Business Burden

This information does not affect small business.

6. Consequences to Federal Program or Policy Activities if the Collection is Not Conducted or is Conducted Less Frequently

This regulation requires one-time information collections only. If this information were not collected, the NRC would be unable to establish that each reactor pressure vessel has an adequate safety margin for continued safe operation.

7. Circumstances Which Justify Variations from OMB Guidelines

There are no variations from OMB guidelines in this collection of information.

8. Consultations Outside the NRC

The opportunity for public comment was published in the Federal Register on August 29, 2003 (68 FR 52063). No comments were received.

9. Payment or Gift to Respondents

Not applicable.

10. Confidentiality of Information

Proprietary or confidential information is protected in accordance with 10 CFR 2.790 of the NRC regulations.

11. Justification for Sensitive Questions

No sensitive information is requested under these regulations.

12. Estimated Industry Burden and Burden Hour Cost

The licensees of all 72 operating PWR plants are subject to the regulation. It is estimated that 30 plants would be affected by the  $RT_{PTS}$  assessment; approximately 6 plants would also be affected by the flux reduction analyses, and approximately 3 plants would be affected by the provisions of 50.61(b)(3) and (4).

- 1)  $RT_{PTS}$  assessment - 120 staff hours per plant ( $30 \times 120 = 3,600$  staff hours over the 3-year period, or annualized for the 3-year period results in 10 plants  $\times$  120 staff hours for a total annual burden of 1,200 staff hours).
- 2) Flux reduction analyses - 600 staff hours per plant ( $600 \times 6 = 3,600$  staff hours over 3 years, or annualized for the 3-year clearance period results in 2 plants  $\times$  600 staff hours for a total burden of 1,200 staff hours).
- 3) Provisions of 50.61(b)(3) and (4) - 120 staff hours per plant ( $3 \times 120 = 360$  staff hours over the 3-year period, or annualized for the 3-year period results in 1 plant  $\times$  120 staff hours for a total annual burden of 120 staff hours).

The total estimated annual industry burden = 2,520 hours ( $1,200 + 1,200 + 120$ ) at a cost of \$393,120 ( $2,520 \text{ hours} \times \$156 \text{ per hour}$ ). Although each information collection contained in section 50.61 requires that a report or notification be submitted to NRC, the primary burden for each requirement is the preparation of the analysis or assessment that forms the basis for the report. Therefore, staff estimates that 90 percent of the burden for the requirements in section 50.61 are attributable to recordkeeping (2,268 hours), and 10 percent of the burden (252 hours) is associated with submitting the required reports or notifications.

The provisions of this regulation affect 30 recordkeepers. An annualized total of 13 responses are expected each year during this clearance period.

13. Estimate of Other Additional Costs

Based on the number of pages maintained for a typical clearance, the records storage cost has been determined to be equal to .0004 times the recordkeeping burden cost. Therefore, the records storage cost for this clearance is estimated to be \$142 (.0004 x 2,268 hours x \$156).

14. Estimated Annualized Cost to the Federal Government

Licensee submittals will be evaluated by the staff at the estimated cost given below.

1) RT<sub>PTS</sub> assessment

The staff estimates that reevaluations of RT<sub>PTS</sub> values will be submitted by 15 PWR licensees within the 3-year clearance period. (Of the 30 licensees affected by the RT<sub>PTS</sub> assessment, as stated above, only 15 licensees will find significant changes that require NRC review.) On the average, 40 hours are estimated for the review of each submittal. Total review time is estimated at 600 staff hours at an estimated cost of \$93,600 (15 x 40 hours x \$156) over the 3-year clearance period. Thus, the estimated annualized burden is 200 hours at a cost of \$31,200.

2) It is estimated that an analysis and schedule for implementation of a flux reduction program will be submitted by 6 licensees over 3 years. Further, it is estimated that 25 hours will be required to review each submittal. Total review time is estimated to be 150 staff hours at a cost of \$23,400 (6 x 25 hours x \$156) over 3 years, or annualized for the 3-year clearance period, a burden of 50 hours per year at a cost of \$7800.

3) It is estimated that evaluations of the requests under 50.61(b)(6) will be submitted by 3 licensees over 3 years. Further, it is estimated that 40 hours will be required to review each submittal. Total review time is estimated to be 120 staff hours at a cost of \$18,720 (3 x 40 x \$156) over 3 years, or annualized for the 3-year clearance period, a burden of 40 hours per year at a cost of \$6240.

Total annual Federal cost = \$45,240 (\$31,200 + \$7800 + \$6240).

15. Reasons for Changes in Burden or Cost

There has been a change in burden and cost, in that the staff anticipates that an estimated number of 3 licensees will need to meet the provisions of 50.61(b)(3) and (4) which will increase the industry burden costs from \$374,400 to \$393,120 per year and increase the Federal government costs from \$39,000 to \$45,240 per year. Also, there has been a change to the base burden cost from \$141 to \$156.

16. Publication for Statistical Use

The collected information is not published for statistical purposes.

17. Reason for Not Displaying the Expiration Date

The requirement is contained in a regulation. Amending the Code of Federal Regulations to display information that, in an annual publication, could become obsolete would be unduly burdensome and too difficult to keep current.

18. Exceptions to the Certification Statement

None.

B. COLLECTIONS OF INFORMATION EMPLOYING STATISTICAL METHODS

Not applicable.