

From: [Kuntz, Robert](#)
To: [Thomas Saporito](#)
Cc: [Buckberg, Perry](#)
Subject: Petition Review Board Initial Assessment - Petitions related to Charpy testing.
Date: Monday, December 21, 2020 8:56:00 AM

Mr. Saporito,

The Petition Review Board (PRB) has completed its initial assessment of the petitions you submitted on October 31, 2020, and November 8, 2020. Because your October 31 and November 8 petitions both address Charpy testing and how Charpy test information informs decision-making regarding reactor pressure vessel (RPV) embrittlement, the PRB is consolidating the two petitions into a single evaluation in accordance with Nuclear Regulatory Commission (NRC) Management Directive MD 8.11, "Review Process for 10 CFR 2.206 Petitions," and its associated DH 8.11, Section III.C.2 (Agencywide Documents Access and Management System (ADAMS) Accession number ML18296A043). The PRB's consolidated evaluation will respond to each of the bases included in the two petitions.

Your October 31, 2020, petition requested that the NRC take enforcement action against licensees of all pressurized water reactors (PWRs) in the form of an immediate shut-down order until such time as the following could be provided: an updated safety analysis of the degree of RPV embrittlement, a detailed description of the methodology to provide the updated safety analysis, and a statement of full compliance with NRC regulations. The basis for your petition is that: (1) the current methodology used by licensees to determine the degree of RPV embrittlement is not sufficient, (2) the use of shared data does not provide sufficient and reliable data, (3) licensees that participate in a surveillance program fail to consider modifications to the original licenses, and (4) direct fracture toughness data evaluation methodology will ensure public safety.

Your November 8, 2020, petition requested that the NRC take enforcement action against Energy Harbor Nuclear Corporation (Energy Harbor) for Beaver Valley Power Station, Unit No. 2, in the form of "denial and refusal" of the assertions made in the letter from Energy Harbor to the NRC dated October 28, 2020, issue a confirmatory order requiring the use of the Tinius-Olsen Model IT406 or Model IT542 pendulum impact test machines, issue an order to require the identification of the Instron Impulse system (striker) used by Energy Harbor to test Capsule Y, and issue an order requiring Energy Harbor to identify any outside contractor used to perform Charpy testing on Capsule Y. The basis for your petition is that (1) the model number of the striker used in the testing referenced in the October 28, 2020, letter was not provided and (2) the testing used an outdated Charpy test machine.

The PRB performed its initial assessment to determine whether the petition meets the applicable acceptance criteria in DH 8.11, Section III.C.1. The following is the PRB's initial assessment of the petitions.

Your October 31, 2020 provided the following bases to support the petition:

1. The current methodology used by licensees to determine the degree of embrittlement is not sufficient

The NRC staff is aware of the limitations associated with using Charpy impact testing to correlate to the actual fracture toughness of an RPV material. These limitations are neither mitigated nor improved by the use of instrumented Charpy testing. The NRC's regulatory framework for RPV embrittlement estimates relies on consensus codes and standards (such as American Society for Testing and Materials (ASTM) Standards) and includes conservatism and safety factors (as defined in the American Society of Mechanical Engineers (ASME) Code) that exceed the limited differences that would be found in data from standard (i.e., non-instrumented) and instrumented Charpy testing. ASTM Standards are available for instrumented Charpy testing; however, the ASTM has not determined that it is necessary to prohibit the use of standard Charpy testing and to only require the use of instrumented Charpy testing. Instrumented Charpy testing is not necessary to demonstrate compliance with the regulations, or to assess embrittlement of the RPV consistent with guidance in Regulatory Guide 1.99, "Radiation Embrittlement of Reactor Vessel Materials," Revision 2 (ADAMS Accession No. ML031430205).

2. The use of sharing data does not provide sufficient and reliable data.

Title 10 of the Code of Federal Regulations (10 CFR), Part 50, Appendix H, Section III.C outlines the requirements for an "integrated surveillance program," which prescribes the criteria for approval of such a program. The NRC staff reviews and approves the use of integrated surveillance programs in-lieu of a plant-specific surveillance program, and as part of its review, ensures that the representative materials chosen for surveillance for an RPV are irradiated in one or more other reactors that have similar design and operating features to permit accurate comparisons of the predicted amount of radiation damage.

The use of surveillance data from a different plant to supplement a plant-specific surveillance program is required for PWR plants by the pressurized thermal shock (PTS) rule (10 CFR 50.61), to ensure the most accurate estimates of RPV embrittlement.

The parameters that influence embrittlement (i.e., neutron fluence, neutron spectrum, irradiation temperature, and material chemistry) are well understood and are part of the staff's review of RPV embrittlement estimates. Other factors, such as transient behavior during reactor trips raised in the petition, have no discernable impact on the ability of surveillance specimens from one plant to provide relevant data to assess radiation embrittlement of another plant, since the elastic deformation of the RPV steel due to such evolutions does not affect the degree of the embrittlement.

(3) Licensees that participate in a surveillance program fail to consider modifications to original licenses

Consistent with NRC staff guidance, the review for license amendment requests for power uprates ensures continued compliance with 10 CFR 50.60, 10 CFR 50.61, and Appendices G and H to 10 CFR Part 50 under the proposed uprated conditions.

10 CFR Part 54 provides the requirements for the renewal of operating licenses for nuclear power plants. NRC staff guidance for the review of license renewal applications specifically addresses methods to adequately manage embrittlement of the RPV during the period of extended operation and ensure accurate RPV embrittlement estimates.

The parameters that influence embrittlement (i.e., neutron fluence, neutron spectrum, irradiation temperature, and material chemistry) are well understood and are incorporated in the NRC staff's guidance and reviews of power uprate license amendments and license renewal applications, to ensure accurate estimates of RPV embrittlement. Since RPV fluence calculations explicitly consider the actual plant operating history, the additional neutron fluence from a power uprate or license renewal is incorporated in the plant-specific calculations.

- (4) Direct fracture toughness is a more accurate methodology for determining degree of RPV embrittlement.

The petition suggests that direct fracture toughness measurements, as referenced in PWROG-18068, "Use of Direct Fracture Toughness for Evaluation of RPV Integrity," provide additional insight into the material toughness of RPV materials and is a more accurate measure of material toughness compared to data from Charpy testing.

Requiring inclusion and testing of fracture toughness specimens from RPV materials to monitor the change in material properties is not necessary to provide reasonable assurance of adequate protection. The addition of these requirements would not have a corresponding benefit to public health and safety (see ADAMS Accession No. ML19038A477).

The use of direct fracture toughness measurements is not prohibited by the NRC and would allow licensees to potentially reduce or remove the conservatism and safety factors that are incorporated when using data obtained from traditional Charpy testing.

Your November 8, 2020 provided the following bases to support the petition:

1. The testing used an outdated Charpy test machine and the striker used was not provided in the licensee's October 28, 2020, letter to the NRC.

The test equipment identification information provided by the licensee meets Section 11.4.2.1 in ASTM E185-82, which is required by Appendix H to 10 CFR Part 50.

Test equipment used for Charpy testing is required per ASTM E185-82 to be calibrated and properly adjusted periodically to maintain accuracy and that calibration be conducted with standards traceable to the National Bureau of Standards (NIST). The use of manual reading of data provides sufficiently accurate readings of the absorbed energy to fracture the surveillance specimens, consistent with the pertinent consensus codes and standards, to adequately assess the condition of the RPV.

The NRC's regulatory framework relies on the use of consensus codes and standards. ASTM standards are available for instrumented Charpy testing; however, the ASTM has not determined it is necessary to prohibit the use of standard Charpy testing and to require only the use of the most up-to-date apparatus to perform instrumented Charpy testing. The use of instrumented Charpy testing apparatuses are capable of providing the data necessary to adequately assess RPV embrittlement; however, the mandatory use of these apparatuses is beyond the current regulations.

Given that the NRC's regulatory framework relies on consensus codes and standards (such

as ASTM Standards) and includes conservatism and safety factors (as defined in the ASME Code) that accommodate the use of data from a calibrated standard Charpy impact testing apparatus, it is not necessary for the staff to require the use of the most up-to-date apparatus to perform instrumented Charpy testing.

In summary, the PRB's initial assessment is to not accept your petition for further review on the following basis:

- The bases for item (1) from the October 31, 2020 petition and item (1) from the November 8, 2020 petition do not meet the acceptance criteria in DH 8.11 Section III.C.1(a) "The petition specifies facts that constitute the basis for taking the requested action, and those facts are sufficient to provide support for the requested action. . . ."
- The bases for the remaining items from the petitions meet the DH 8.11 acceptance criteria in Section III.C.1(b)(ii) "The issues raised have previously been the subject of a facility-specific or generic NRC staff review...." but none of the additional Section III.C.1(b)(ii) circumstances apply.

I offer you the opportunity to clarify or supplement your petitions in a public meeting with the PRB. If you decide to take advantage of this opportunity, the meeting with the PRB would be conducted consistent with the format described in MD 8.11 Section III.F. The PRB will consider your statements and information presented at the meeting, along with the original petition, in making its final determination on whether to accept your petition for review. Please indicate by December 31, 2020, whether you wish to have this public meeting.

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