



## Standard Practice for Determining Neutron Exposures for Nuclear Reactor Vessel Support Structures<sup>1</sup>

This standard is issued under the fixed designation E 1035; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This practice covers procedures for monitoring the neutron radiation exposures experienced by ferritic materials in nuclear reactor vessel support structures located in the vicinity of the active core. This practice includes guidelines for:

1.1.1 Selecting appropriate dosimetric sensor sets and their proper installation in reactor cavities.

1.1.2 Making appropriate neutronics calculations to predict neutron radiation exposures.

1.2 This practice is applicable to all pressurized water reactors whose vessel supports will experience a lifetime neutron fluence ( $E > 1$  MeV) that exceeds  $1 \times 10^{17}$  neutrons/cm<sup>2</sup> or  $3.0 \times 10^{-4}$  dpa.<sup>2</sup> (See Terminology E 170.)

1.3 Exposure of vessel support structures by gamma radiation is not included in the scope of this practice, but see the brief discussion of this issue in 3.2.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:

E 170 Terminology Relating to Radiation Measurements and Dosimetry<sup>3</sup>

E 482 Guide for Application of Neutron Transport Methods for Reactor Vessel Surveillance, E 706 (IID)<sup>3,4</sup>

E 693 Practice for Characterizing Neutron Exposures in Iron and Low Alloy Steels in Terms of Displacements Per Atom (DPA), E 706 (ID)<sup>3,4</sup>

E 844 Guide for Sensor Set Design and Irradiation for Reactor Surveillance, E 706 (IIC)<sup>3,4</sup>

E 854 Test Method for Application and Analysis of Solid State Track Recorder (SSTR) Monitors for Reactor Sur-

veillance, E 706 (IIIB)<sup>3,4</sup>

E 910 Test Method for Application and Analysis of Helium Accumulation Fluence Monitors for Reactor Vessel Surveillance, E 706 (IIIC)<sup>3,4</sup>

E 944 Guide for Application of Neutron Spectrum Adjustment Methods in Reactor Surveillance, E 706 (IIA)<sup>3,4</sup>

E 1005 Test Method for Application and Analysis of Radiometric Monitors for Reactor Vessel Surveillance, E 706 (IIIA)<sup>3,4</sup>

E 1018 Guide for Application of ASTM Evaluated Cross Section Data File, E 706 (IIB)<sup>3,4</sup>

#### 2.2 ASME Standard:

Boiler and Pressure Vessel Code, Section III<sup>5</sup>

#### 2.3 Nuclear Regulatory Documents:

Code of Federal Regulations, "Fracture Toughness Requirements," Chapter 10, Part 50, Appendix G<sup>6</sup>

Code of Federal Regulations, "Reactor Vessel Materials Surveillance Program Requirements," Chapter 10, Part 50, Appendix H<sup>6</sup>

Regulatory Guide 1.99, Rev. 1, "Effects of Residual Elements on Predicted Radiation Damage on Reactor Vessel Materials," U. S. Nuclear Regulatory Commission, April 1977<sup>6</sup>

### 3. Significance and Use

3.1 Prediction of neutron radiation effects to pressure vessel steels has long been a part of the design and operation of light water reactor power plants. Both the federal regulatory agencies (see 2.2) and national standards groups (see 2.1) have promulgated regulations and standards to ensure safe operation of these vessels. Recently, it has become apparent that the support structures for pressurized water reactor vessels may also be subject to similar neutron radiation effects (1, 2, 3, 4, 5).<sup>7</sup> The objective of this practice is to provide guidelines for determining the neutron radiation exposures experienced by individual vessel supports.

3.2 It is known that high energy photons can also produce

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<sup>2</sup> Based on data from Table 5 of Master Matrix E 706 and Reference 5.

<sup>3</sup> Annual Book of ASTM Standards, Vol 12.02.

<sup>4</sup> The reference in parentheses refers to Section 5 of Matrix E 706.

<sup>5</sup> Available from American Society of Mechanical Engineers, 345 E. 47th St., New York, NY 10017.

<sup>6</sup> Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

<sup>7</sup> The boldface numbers in parentheses refer to a list of references at the end of this practice.