



Designation: D5411 – 21

Standard Practice for Calculation of Average Energy Per Disintegration ($\bar{E}$) for a Mixture of Radionuclides in Reactor Coolant¹

This standard is issued under the fixed designation D5411; 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 applies to the calculation of the average energy per disintegration ($\bar{E}$) for a mixture of radionuclides in reactor coolant water.

1.2 The microcurie (μCi) is the standard unit of measurement for this standard. The values given in parentheses are mathematical conversions to SI units, which are provided for information only and are not considered standard.

1.3 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

D1066 Practice for Sampling Steam

D1129 Terminology Relating to Water

D3370 Practices for Sampling Water from Flowing Process Streams

D3648 Practices for the Measurement of Radioactivity

D7282 Practice for Set-up, Calibration, and Quality Control of Instruments Used for Radioactivity Measurements

D7902 Terminology for Radiochemical Analyses

¹ This practice is under the jurisdiction of ASTM Committee D19 on Water and is the direct responsibility of Subcommittee D19.04 on Methods of Radiochemical Analysis.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

2.2 Code of Federal Regulations: 10 CFR 100 Reactor Site Criteria³

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms used in this standard, refer to Terminologies D1129 and D7902. For terms not defined in this test method or in Terminologies D1129 and D7902, refer to other published glossaries.⁴

4. Summary of Practice

4.1 The average energy per disintegration, $\bar{E}$ (pronounced *E bar*), for a mixture of radionuclides is calculated from the known composition of the mixture. $\bar{E}$ is computed by calculating the total beta/gamma energy release rate, in MeV, and dividing it by the total disintegration rate. The resultant $\bar{E}$ has units of MeV per disintegration.

5. Significance and Use

5.1 This practice is useful for the determination of the average energy per disintegration of the isotopic mixture found in the reactor-coolant system of a nuclear reactor (1).⁵ The $\bar{E}$ value is used to calculate a site-specific activity limit for the reactor coolant system, generally identified as:

$$A_{\text{limiting}} = K/\bar{E} \quad (1)$$

where:

K = a power reactor site specific constant (usually in the range of 50 to 200).

The activity of the reactor coolant system is routinely measured, then compared to the value of A_{limiting} . If the reactor coolant activity value is less than A_{limiting} then the 2-h radiation dose, measured at the plant boundary, will not exceed an appropriately small fraction of the Code of Federal

³ Available from DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5094, <http://quicksearch.dla.mil>.

⁴ "American National Standard Glossary of Terms," *Nuclear Science and Technology (ANSI N1.1)*, American National Standards Institute, 1430 Broadway, New York, NY 10018.

⁵ The boldface numbers in parentheses refer to a list of references at the end of this practice.