ANS

# Decay Heat Power in Light Water Reactors

An American National Standard

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# American National Standard
# Decay Heat Power
# in Light Water Reactors

Secretariat
**American Nuclear Society**

Prepared by the
**American Nuclear Society**
**Standards Committee**
**Working Group ANS-5.1**

Published by the
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**American National Standard**

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## Foreword

(This Foreword is not a part of American National Standard "Decay Heat Power in Light Water Reactors," ANSI/ANS-5.1-2014.)

This American National Standard provides values for the decay heat power from fission products and actinides following the shutdown of light water reactors operated with nuclear fuel consisting of uranium. The energy released in the fission process is divided into (1) prompt energy from the kinetic energy of fission fragments, neutrons, and gamma rays from prompt de-excitation of fission products and (2) delayed energy from beta particles and gamma rays emitted from the decay of fission products.

The development of this standard was initiated due to the importance of energy release after reactor shutdown and the need for accurate data to evaluate fuel rod heating during a loss-of-coolant accident. The ANS Standards Subcommittee first proposed the adoption of a new standard on decay heat power in October, 1971. Following minor revisions in 1973, it was submitted to the American National Standards Institute but remained as a draft standard. After significant technical developments based on data from new experimental programs, the draft standard was revised and approved and released as the 1979 standard. Since then, it was reaffirmed in 1985, revised in 1994, and revised again in 2005. The revisions since 1979 have been guided largely by recommendations made by Dickens, England, and Schenter on future improvements to the standard.[1)] A detailed technical summary of the development of the standard and revisions is provided as an Appendix to this standard.

The standard prescribes methods that enable the calculation of fission product decay heat power and uncertainty with accuracies comparable to those of summation codes but without the need for complex calculations. Fission product decay heat values are provided for thermal neutron-induced fission of $^{235}$U, $^{239}$Pu, and $^{241}$Pu and fast fission of $^{238}$U.

As revised, this standard provides better guidance on methods and implementation, an improved representation of uncertainties in the fission product decay heat values, and an improved method for the neutron capture correction. Also included, for the first time, is a complete estimate of all actinide contributions to decay heat power. The changes in this revision do not alter the tabular data for standard fission product decay heat power and uncertainty values from the 1994 and 2005 standards, but they do include several recommendations for near-term improvements to the standard identified by Dickens, England, and Schenter.

### Relationship to Other Standards

ANSI/ANS-19.3.4-2002 (R2008), "Determination of Thermal Energy Deposition Rates in Nuclear Reactors"

Proposed American National Standard ANS-19.8, "Fission-Product Yields for $^{235}$U, $^{238}$U, and $^{239}$Pu" (in draft form)

ANSI/ANS 19.1-2002 (R2011), "Nuclear Data Sets for Reactor Design Calculations"

This standard might reference documents and other standards that may have been superseded or withdrawn at the time this standard is applied.

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[1)] J. K. Dickens, T. R. England, and R. E. Schenter, "Current Status and Proposed Improvements to the ANSI/ANS-5.1 American National Standard for Decay Heat Power in Light Water Reactors," *Nucl. Safety*, **32**, 209 (1991).

This standard does not incorporate the concepts of generating risk-informed insights, performance-based requirements, or a graded approach to quality assurance. The user is advised that one or more of these techniques could enhance the application of this standard.

The working group acknowledges the substantial efforts of earlier working groups in establishing and maintaining this standard. The working group specifically acknowledges the significant contributions made to the standard by the late J. Kirk Dickens and Robert Schenter, who passed away before this standard was issued. Both of these working group members played key roles in the development and advancement of the standard and provided a roadmap for future improvements of the standard that was used to guide this revision.

Working Group ANS-5.1 of the Standards Committee of the American Nuclear Society had the following membership at the time of its approval of this revision of the standard:

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The membership of Subcommittee ANS-19 at the time of the review and approval of this standard was as follows:

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The membership of the Safety and Radiological Analyses Consensus Committee at the time of the review and approval of this standard was as follows:

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