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Anthony R. Pietrangelo
Nuclear Energy Institute (NEI)

TO:

Vietti-Cook, SECY

FOR SIGNATURE OF :

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DESC:

ROUTING:

Request Amendment of Appendix K to 10 CFR 50, ECCS
Evaluation Models, to Include Optional Adoption of
the Latest Consensus Standard on Decay Heat Rates,
ANS/ANSI-5

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ASSIGNED TO:

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ADM

Springer

SPECIAL INSTRUCTIONS OR REMARKS:

For Appropriate Action.

OFFICE OF THE SECRETARY

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REPRESENTING: NUCLEAR ENERGY INDUSTRY

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NUCLEAR ENERGY INSTITUTE

Anthony R. Pietrangelo
DIRECTOR, RISK & PERFORMANCE-
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September 6, 2001

Annette L. Vietti-Cook
Secretary
U.S. Nuclear Regulatory Commission
Mail Stop O-16 C1
Washington, DC 20555-0001

Attention: Rulemakings and Adjudications Staff

Dear Ms. Vietti-Cook:

On behalf of the nuclear energy industry and pursuant to 10 CFR 2.802, NEI submits the enclosed petition to amend Appendix K to 10 CFR 50, *ECCS Evaluation Models*. The proposed action is twofold: (1) revise Appendix K to allow for voluntary licensee adoption of the most current consensus standard for decay heat power, ANS/ANSI – 5.1, 1994, "Decay Heat Power in Light Water Reactors"; and (2) allow licensees to adopt subsequent NRC-endorsed revisions to this standard without further rulemaking.

If you have any questions concerning this petition, please contact me at 202-739-8081 or arp@nei.org.

Sincerely,

A handwritten signature in black ink that reads "Anthony R. Pietrangelo". The signature is written in a cursive style with a large initial "A".

Anthony R. Pietrangelo

Enclosure





UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of a Proposed Rulemaking
Regarding Amendment of Appendix K
To 10 CFR 50 *ECCS Evaluation Models*

Docket No. _____

PETITION FOR RULEMAKING

The Nuclear Energy Institute (NEI) on behalf of the nuclear energy industry submits this petition for rulemaking pursuant to 10 CFR 2.802. The Petitioner requests that the U.S. Nuclear Regulatory Commission (NRC), following notice and opportunity for comment, amend Appendix K to Part 10 CFR 50, *ECCS Evaluation Models*, to include optional adoption of the latest consensus standard on decay heat rates, ANS/ANSI-5.1-1994. The Petitioner also requests optional adoption by licensees of subsequent revisions to this standard that are endorsed by the NRC.

I. STATEMENT OF PETITIONER'S INTEREST

NEI is the organization of the nuclear energy industry responsible for coordinating the combined efforts of all companies licensed by the NRC to construct or operate nuclear power plants, and of other nuclear industry organizations, in all matters involving generic regulatory policy issues and regulatory aspects of generic operational and technical issues affecting the nuclear power industry. Every company responsible for constructing or operating a commercial nuclear power plant in the United States is a member of NEI. In addition, NEI's members include major architect / engineering firms and all of the major nuclear steam supply system vendors.

II. CURRENT REGULATION AND BACKGROUND

On June 29, 1971, the Atomic Energy Commission published its interim Policy Statement, "Interim Acceptance Criteria for Emergency Core Cooling Systems for Light-Water Power Reactors." The Statement included, as Appendix A [subsequently re-titled Appendix K], Parts 1-3, acceptable evaluation models including conservative assumptions and procedures... and new Part 4 was also added to Appendix A. Section 1.5 of Part 4, *Decay Heat*, reads as follows:

“ The decay heat curve described in the proposed ANS standard, increased by +20 percent allowance for uncertainty, should be used. The fraction of decay heat generated in the hot rod may be considered to be 0.96 times its value.”¹

In October 1971, The American Nuclear Society (ANS) Standards Committee 5 proposed adoption of a standard entitled “Decay Energy Release Rates Following Shutdown for Uranium-Fueled Thermal Reactors.” The Standards Committee approved the proposed standard and submitted it to the American National Standards Institute (ANSI). Following balloting and comments by those voting, minor revisions were made in October 1973. Although the required affirmative votes were received, ANSI tabled action on the standard and it remained in the status of a proposed ANS standard; however, the standard has been cited in the regulation since 1971.

The proposed ANS standard (1971 and 1973) was based on the curve recommended by K. Shure² for infinite irradiation of uranium and for cooling times from 0 to 10⁹ seconds. The approach was simplistic in that a single curve was chosen to represent the decay heat power of “uranium-fueled thermal reactors.” Many phenomena that make the decay heat power unique to each fuel isotope were ignored and assumed to be included within the appropriately large uncertainties that were adopted. Uncertainty bands were chosen by the ANS-5.1 Working Group on the basis of comparison of available data at that time.

In October 1978, the ANS Nuclear Power Plant Standards Committee (NUPPSCO) approved a standard entitled “American National Standard for Decay Heat Power in Light Water Reactors.” The standard was developed to fulfill a need for evaluations of fission reactor performance based upon improved knowledge of decay-heat power in the fuel elements. The standard replaced the 1971 proposed Standard. No action was taken by the NRC to endorse the revised Standard in Appendix K.

In August 1994, NUPPSCO approved a standard entitled “Decay Heat Power in Light Water Reactors.” Since the approval of the 1978 standard, new measurements of decay heat were published. In addition, improved nuclear databases resulted in more precise summation calculations of decay heat. In 1991, comparisons of elements of the standard with results of the new measurements and the new summation calculations were published. In that report, proposed improvements to the standard were outlined. Subsequent to this report, and in response to it, tabular data in tables entitled “Data for Standard Decay Heat Power” and associated uncertainties were reevaluated for the three fuel isotopes, U²³⁵, U²³⁸, and Pu²³⁹, and evaluated for the fuel isotope Pu²⁴¹. The 1994 revision to ANS-5.1 included the

¹71 Federal Register 18645, December 17, 1971.

² K. Shure, “Fission-Product Decay Energy,” In USAEC Report WAPD-BT-24, pp1-17, December 1961.

uncertainties were reevaluated for the three fuel isotopes, U²³⁵, U²³⁸, and Pu²³⁹, and evaluated for the fuel isotope Pu²⁴¹. The 1994 revision to ANS-5.1 included the results of these new evaluations.³ Again, no action was taken by the NRC to endorse the latest standard in Appendix K.

III. PROPOSED AMENDMENT

Appendix K to Part 10 CFR 50 should be amended to allow licensees optional use of ANS/ANSI-5.1-1994, and to allow licensees the option to use subsequent revisions to this standard that are endorsed by the NRC. The proposed wording of the regulation is below with new language underlined.

4. *Fission Product Decay*. The heat generation rates from radioactive decay of fission products shall be either (a) assumed to be equal to 1.2 times the values for infinite operating time published in the 1971 ANS Standard (Proposed American Nuclear Society Standards- "Decay Energy Release Rates Following Shutdown Of Uranium-Fueled Thermal Reactors." Approved by Subcommittee ANS-5, ANS Standards Committee, October 1971). This standard has been approved for incorporation by reference by the Director of the Federal Register. A copy of the standard is available for inspection at the NRC Library, 11545 Rockville Pike, Rockville, Maryland 20852-2738. The fraction of the locally generated gamma energy that is deposited in the fuel (including the cladding) may be different from 1.0; the value used shall be justified by a suitable calculation; or (b) taken from the 1994 ANS Standard (American Nuclear Society Standards- "Decay Heat Power in Light Water Reactors." Approved by ANS Nuclear Power Plant Standards Committee ANS-5.1 and American National Standards Institute, Inc., August 1994); or (c) taken from any subsequent revisions to the ANS Decay Heat standard that are endorsed by the NRC.

IV. JUSTIFICATION FOR AMENDMENT

A. The 1994 standard incorporates more precise results, is more explicit, and uses a statistical approach to address uncertainty.

Appendix K to 10 CFR 50 currently requires that "the heat generation rates from radioactive decay of fission products shall be assumed equal to 1.2 times the values for infinite operating time in the ANS standard,"⁴ in evaluating Emergency Core Cooling System (ECCS) performance in hypothetical Loss of Coolant Accidents (LOCA). Uncertainty bands for the proposed ANS Standard (1971 & 1973), currently endorsed by NRC, were chosen on the basis of available information at

³ American National Standard ANSI/ANS-5.1-1994.

⁴ Title 10, Code of Federal Regulations, Part 50, Appendix K, "Licensing of Production and Utilization Facilities," (39 FR 1003, January 1974). Government Printing Office, Washington, DC.

the time – data published between 1950 and 1963. The ANS Standards Subcommittee 5 has concluded that the 1.2 factor appears to have been based upon the ANS uncertainty for cooling time (i.e. time after shutdown) less than or equal to 10^3 seconds.⁵

In contrast, the 1994 ANS standard expresses uncertainty in a statistical approach as one standard deviation in a normal distribution. The Standard explicitly addresses and incorporates a conservative multiplying factor of 1.02 for the increase over U^{235} decay heat power from U^{238} fission products at typical U^{238} fission rates. This multiplication factor was determined in 1974 by the ANS-5.1 Working Group, which was comprised of researchers, industry representatives, and knowledgeable NRC personnel. The basis for the advanced, statistical approach was derived from numerous contemporary data measurements, providing essentially equivalent results. The revised standard for LOCA applications includes cooling time up to 10^4 seconds and incorporates more precise results, including detailed evaluation of the influence of neutron capture in fission products for the shutdown range, and cooling times up to 10^9 seconds.⁶

B. Federal law requires NRC to utilize technical standards developed by voluntary consensus standard bodies.

Pursuant to NRC Directive 6.5, “NRC Participation in the Development and Use of Consensus Standards”, Appendix K to Part 50 should be modified to endorse the most current consensus standard for decay heat power. The National Technology Transfer and Advancement Act of 1995⁷ endorses the utilization of consensus technical standards by Federal agencies:

“...all Federal agencies and departments shall use such technical standards that are developed or adopted by voluntary consensus standard bodies, using such technical standards as a means to carry out policy objectives or activities determined by the agencies and departments.”

The NRC has recently exercised the directive. On August 3, 2001, NRC noticed in the Federal Register a proposed rule to amend its regulations to incorporate, by reference, a later edition and addenda of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code.

⁵ American National Standard ANSI/ANS-5.1-1994.

⁶ *ibid*

⁷ Public Law 104-113, “The National Technology Transfer and Advancement Act of 1995”. March 7, 1996. Government Printing Office, Washington, DC.

- C. The amendment would allow licensees greater operational flexibility without impacting safety.

The amendment will allow licensees to gain operating margin for emergency core cooling system (ECCS) equipment based on the more realistic decay heat assumptions in the 1994 standard. This will result in more effective utilization of resources in operating and maintaining this equipment. This may also result in the potential for higher extended power uprates. Safety would not be impacted because the acceptance criteria for ECCS equipment remain unchanged.

- D. The amendment would obviate the need for future rulemakings to codify methods and practices found acceptable to the NRC.

The last clause in the proposed amendment would allow licensees to adopt future revisions to the standard that have been accepted by the NRC. This would save the NRC resources devoted to promulgating rules that simply codify the latest revisions of standards

V. REGULATORY ANALYSIS

Adoption of the 1994 ANS standard or any subsequent revision accepted by the NRC would be optional for licensees under the proposed amendment. No new or additional requirements would be imposed by this action. Thus, a cost-benefit analysis of this proposal is not necessary.

VI. CONCLUSION

For the reasons provided in Section IV of this petition, 10 CFR 50 Appendix K should be amended to allow licensees to voluntarily utilize ANSI/ANS-5.1-1994, "Decay Heat Power in Light Water Reactors." The proposed amendment would modernize the regulation to a contemporary consensus standard, incorporating results from recent data measurements and summation calculations.

This proposed amendment is also consistent with NRC's Strategic Performance Goals. Nuclear safety will be enhanced because decay heat curves and uncertainties are based on up-to-date data measurements for specific fuel isotopes, allowing more accurate decisions involving relative risk. Public confidence will be increased because bases and data are technically accurate and reproducible. NRC will make accurate decisions about this topic because the technical bases are sound and more realistic. This will allow NRC staff to allocate resources more effectively to other safety significant issues. Finally, this amendment will reduce unnecessary

technical burden on licensees, and like NRC, allow them to expend resources to other issues.

Because this amendment would merely codify the latest consensus standard on decay heat, we believe a direct final rule would be the most appropriate and cost-effective means of implementation.