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Guide for Nuclear Criticality Safety in the Storage of Fissile Materials

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INTRODUCTION

This poster presentation provides an overview of the American National Standards Institute/American Nuclear Society (ANSI/ANS)-8.7-1998 standard entitled "Guide for Nuclear Criticality Safety in the Storage of Fissile Materials" (Revision of N16.5/ANS-8.7-1975; R1987). Basic parameters and guidance for the nuclear criticality safety control outside reactors are described in ANSI/ANS-8.l-1998, "Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors." Because ANS-8.1 provides general guidance and limited single-unit parameter values, ANS-8.7 was developed to provide general storage criteria based on validated calculations, and includes some engineering and administrative practices appropriate to the storage of fissile material. ANS-8.7 presents general storage criteria based upon validated calculations of experiments with arrays of fissile materials, thereby demonstrating the safety of mass limits and storage area spacings that are less restrictive than those previously in use. The standard also provides some engineering and administrative practices appropriate to the storage of fissile material.

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EXPLANATION OF THE STANDARD

The storage standard provides general storage criteria, based on validated calculations, and includes some engineering and administrative practices appropriate to the storage of fissile material. The standard is specific to mass and spacing limits for uranium containing >30 wt % ^{235}U, for ^{233}U, and for plutonium as metals and oxides having specific degrees of hydrogen content. Additionally, various criteria and caveats are noted for the range of limit applications.

DEVELOPMENT AND TECHNICAL BASES OF THE STANDARD

In 1967, members of the Nuclear Criticality Safety Division, within ANS-8, appointed a working group to examine the status of data and to develop the scope of a proposed storage standard. After the production of several drafts, the guide experienced a 1-year trial use and comment period in 1973. Following the trial use period, the consensus committee N-16 approved the guide in 1974. The last approval action on the guide was its 1987 reaffirmation.

Critical experiments that had been performed and reported [1-4] were used to validate numerous computer calculations.[5-7] These calculations were used to develop a storage array model to expand the database for use in the development of the standard. The current revision is reexamining the mass limit tables in the standard with more current computer codes and data.

APPLICATIONS OF THE STANDARD

The applications of the storage standard are self-evident. Wherever multiple units of the specified fissile materials experience neutron interaction, the standard may be considered for use within the bounds of its parameters, limits, and conditions. Such circumstances include storage, transportation, and neutron-interacting process operations.

Limitations for the application of the standard are clearly stated and include, but are not limited to, the following:

1. numerous administrative practices to account for adherence to fissile material specifications, containment, and facility/equipment integrity;
2. moderation control;
3. centering of units to within 10% of the defined cell dimension and minimum unit surface separations;
4. controls and adjustments to be considered for various types and thicknesses of reflectors; and
5. controls and adjustments to be applied where multiple batching is possible.

FUTURE STANDARD DEVELOPMENTS

Future efforts of the ANSI/ANS-8.7 working group include the possible extension of the standard to

1. a broader range of enrichments;
2. the further consideration of containment conditions, such as steel vessels;
3. the inclusion of mass adjustments for interstitial moderation; and
4. the incorporation of fissile solution units.

SUMMARY

It is readily observed that the storage standard can be useful in the design of fissile material storage facilities or neutron-interacting operating processes. The review of the standard and its development efforts (past and present) provide an understanding of the "standard effort" and its dynamic character, along with the opportunity for individuals to enhance the standard with constructive comments or suggestions.

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