American Nuclear Society

REAFFIRMED
March 23, 2009
ANSI/ANS-15.2-1999
(R2009)

quality control for plate-type uranium-aluminum fuel elements

an American National Standard

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This standard does not necessarily reflect recent industry initiatives for risk informed decision-making or a graded approach to quality assurance. Users should consider the use of these industry initiatives in the application of this standard.

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American National Standard Quality Control for Plate-Type Uranium-Aluminum Fuel Elements

Secretariat
American Nuclear Society

Prepared by the
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American National Standard

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Foreword

(This Foreword is not part of American National Standard Quality Control for Plate-Type Uranium-Aluminum Fuel Elements, ANSI/ANS-15.2-1999.)

The American Nuclear Society Standards Committee established Subcommittee ANS-15 in the fall of 1970 with the task of preparing a standard for the operation of research reactors. In January 1972, this charter was expanded to include the task of preparing standards for all aspects of research reactor needs. To implement this enlarged responsibility, a number of working groups were established by the subcommittee to develop standards for consideration and complementary action by ANS-15. This standard addresses itself to quality control for plate-type uranium-aluminum fuel elements.

In this process of creating standards against the background of established and varied practices in many operating facilities, it is important to consider that:

a. It is not intended that the standard be used as a demand model for backfitting purposes.
b. The standard should be a vital aid for the new owner-agency.
c. The standard should be helpful for the facility undergoing change or modification.
d. Thoughtful use of the standard by industry should ease the burden of licensing and chartering agencies.

It is affirmed further that the use of any standard of performance, conduct, or excellence is volitional. The decision to use a standard is a management matter, presumably based on technical advisement.

Further guidance may be found in the following American National Standards which, like ANSI/ANS-15.2-1999, have been developed for research reactors:

ANSI/ANS-15.1-1990, *Development of Technical Specifications for Research Reactors*
ANSI/ANS-15.4-1988, *Selection and Training of Personnel for Research Reactors*
ANSI/ANS-15.7-1977 (R1986), *Research Reactor Site Evaluation*
ANSI/ANS-15.8-1976 (R1995), *Quality Assurance Program Requirements for Research Reactors*
ANSI/ANS-15.10-1994, *Decommissioning of Research Reactors*
ANSI/ANS-15.11-1993, *Radiation Protection at Research Reactor Facilities*
ANSI/ANS-15.15-1978 (R1986), *Criteria for the Reactor Safety Systems of Research Reactors*
ANSI/ANS-15.16-1982 (R1988), *Emergency Planning for Research Reactors*
ANSI/ANS-15.17-1982 (R1987), *Fire Protection Program Criteria for Research Reactors*
ANSI/ANS-15.19-1991, *Shipment and Receipt of Special Nuclear Material by Research Reactors*

At the time of the development of this revision of the Standard, Working Group ANS-15.2 had the following membership:

M. L. Gildner, Chairman, *Oak Ridge National Laboratory*
R. W. Knight, *Oak Ridge National Laboratory*
K. R. Catlett, *Babcock & Wilcox*
R. R. Hobbins, *Idaho National Engineering Laboratory*
J. C. Ottone, *CERCA*

Subcommittee ANS-15, Operation of Research Reactors, had the following membership at the time of this standard:

W. J. Richards, Chairman, *U.S. Department of Defense*
A. Adams, Jr., *U.S. Nuclear Regulatory Commission*
T. L. Bauer, *University of Texas*
S. K. Bhatnagar, *U.S. Department of Energy*
L. M. Bobek, *Worcester Polytechnic Institute*
W. J. Brynda, *Brookhaven National Laboratory*
A. F. DiMeglio, *Individual*
P. C. Ernst, *Individual*
J. P. Farrar, *University of Virginia*
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M. L. Gildner, *Oak Ridge National Laboratory*
D. R. Harris, *Rensselaer Polytechnic Institute*
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E. Lee, *Oak Ridge National Laboratory*
R. E. Malenfant, *Los Alamos National Laboratory*
R. C. Nelson, *Jason Associates Corporation*
P. B. Perez, *North Carolina State University*
T. M. Raby, *National Institute of Standards and Technology*
J. Razvi, *GA Technologies, Inc.*
T. R. Schmidt, *Sandia National Laboratory*
M. H. Voth, *Pennsylvania State University*
R. R. Walston, *U.S. Department of Energy*

Consensus Committee N17, Research Reactors, Reactor Physics, and Radiation Shielding, had the following membership at the time it reviewed and approved this standard:

T. M. Raby, Chairman
A. Weitzberg, Secretary

H. Alter ..... U. S. Department of Energy
A. D. Callihan ..... Individual
R. E. Carter ..... Individual
D. Cokinos ..... Brookhaven National Laboratory
A. De La Paz ..... Vista Technologies
B. Dodd ..... Health Physics Society
D. Duffey ..... American Institute of Chemical Engineers
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W. C. Hopkins ..... Bechtel Corporation
L. I. Kopp ..... Individual
J. Miller ..... Institute of Electrical and Electronics Engineers, Inc.
J. E. Olhoeft ..... Individual
T. M. Raby ..... American Nuclear Society
W. J. Richards ..... U. S. Department of Defense
M. M. Ter Pogossian ..... American College of Radiology
J. F. Torrence ..... National Institute of Standards and Technology
D. K. Trubey ..... Individual
S. H. Weiss ..... U. S. Nuclear Regulatory Commission
A. Adams, Jr. (Alt.)
A. Weitzberg ..... Halliburton NUS Corporation
W. L. Whittemore ..... GA Technologies, Inc.

Contents

Quality Control for Plate-Type Uranium-Aluminum Fuel Elements

1. Scope and Purpose

1.1 Scope. This standard sets forth general requirements for the establishment and execution of a program designed to verify that the quality of plate-type uranium-aluminum fuel elements being purchased for research reactors conforms to the requirements of the contract and applicable technical documents, including specifications, standards, and drawings.

1.2 Purpose. The purpose of this standard is to promote standardization of methods, procedures, and techniques that are used to verify the quality of the product.

The quality verification program herein comprises the elements of an inspection system, including planning, documentation, surveillance, inspection, testing, and certification. Experience has shown that there is significant benefit for the purchaser's technical representatives to be present at times during fuel fabrication to witness critical fabrication steps, review fuel fabrication inprocess documentation, and resolve any technical noncompliances with the detailed fuel specifications.

The documents listed in Section 16 should be included in the quality control program to the extent applicable to meet contract requirements between the purchaser and fuel-element supplier.

1.3 Application. It is intended that this standard be used in the nuclear industry to promote uniformity in the quality-verification program for acceptance of fuel elements consisting of flat or curved plates clad with aluminum and containing fuel comprised of uranium-aluminum alloy, U_3O_8-aluminum dispersion, UAl_x-aluminum dispersion, or U_xSi_y-aluminum dispersion. The standard is applicable only to fuel elements in which the fuel plates, for structural rigidity, are fastened to side plates by mechanical means. Actual quality verification requirements, to ensure compliance to specific product requirements, must be included in the purchaser's product requirement specification.

It is recognized that in the attempt to provide a uniform standard applicable to the full range of research reactors, certain sections of the document may have been made excessively detailed for some reactor situations and too general for other situations; it is therefore intended that the purchaser will alter these portions or substitute specific requirements for these items in the purchase document.

1.4 Definitions

boron-10 equivalence. The ratio of the thermal neutron macroscopic absorption cross section per gram of the impurity to the macroscopic cross section per gram of Boron-10.

fuel core. The uranium-bearing region of each fuel plate. This may be aluminum-uranium alloy, or a dispersion of U_3O_8, or UAl_x, or U_xSi_y in aluminum.

fuel element. The finished product described by the purchaser's product specification, including fuel plates, support plates, end fittings, etc.

fuel grading. The design of the distribution of fissionable material throughout the fuel core component.

fuel homogeneity. The measure of consistency of the fissionable material/filler mixture in the fuel core.

fuel plate. The fuel core, complete with aluminum frame and cladding, rolled or otherwise formed into an integral unit.

lot. The amount of material purchased or handled as a unit or traceable to a common step in fabrication. Material blended together to form a lot shall have the same chemical and physical characteristics.

mechanical assembly. The method used for fastening the fuel plates into side plates to form the fuel element (e.g., roll swaging). Welding, brazing, or other methods involving metallurgical bonding are excluded.

metallurgical bond. The method of joining involving high temperature or pressure, or both, and which produces grain growth across the bond interface.