U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF STANDARDS DEVELOPMENT

DRAFT REGULATORY GUIDE AND VALUE/IMPACT STATEMENT

July 1979
Division 1
Task RS 809-5

# QUALIFICATION TEST FOR CABLE PENETRATION FIRE STOPS FOR USE IN NUCLEAR POWER PLANTS

## A. INTRODUCTION

General Design Criterion 3, "Fire Protection," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," requires that structures, systems, and components important to safety be designed and located to minimize, consistent with other safety requirements, the probability and effect of fires and explosions. In addition, Criterion III, "Design Control," of Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50 requires, among other things, that design control measures provide for verifying the adequacy of design by such measures as the performance of a suitable testing program. Where a test program is used to verify the adequacy of a specific design feature, it must include suitable qualification testing of a prototype unit under the most adverse design conditions.

This guide describes a method acceptable to the NRC staff for meeting the Commission's regulations with respect to the qualification testing of cable penetration fire stops used in nuclear power plants.

## B. DISCUSSION

In a nuclear power plant, cables and cable raceways penetrate such barriers as walls, floors, or floor-ceiling assemblies throughout the plant. When these barriers are rated as fire-resistive barriers, the cable penetrations should have the same resistance to fire as the barriers. The fire rating for a barrier with no penetrations is arrived at by testing it according to the procedure outlined in ANSI/ASTM E119-71, "Methods of Fire Tests of Building Construction



This regulatory guide and the associated value/impact statement are being issued in draft form to involve the public in the early stages of the development of a regulatory position in this area. They have not received complete staff review, have not been reviewed by the NRC Regulatory Requirements Review Committee, and do not represent an official NRC staff position.

Public comments are being solicited on both drafts, the guide (including any implementation schedule) and the value/impact statement. Comments on the value/impact statement should be accompanied by supporting data. Comments on both drafts should be sent to the Secretary of the Commission, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555, Attention: Docketing and Service Branch, by SEP 25 1979

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and Materials."* This rating is expressed in hours and represents the ability of the barrier to withstand exposure to a standard fire for that length of time without failure as determined by the acceptance criteria given in ANSI/ASTM E119-71.

Task Force 12-40 of the Insulated Conductors Committee of the Power Engineering Society of the Institute of Electrical and Electronics Engineers, Inc. (IEEE) has developed a standard for the qualification testing of cable penetration fire stops. This standard, designated IEEE Std 634-1978, "IEEE Standard Cable Penetration Fire Stop Qualification Test,"** was approved by the IEEE Standards Board on December 15, 1977.

The standard provides qualification test procedures for type testing cable penetration fire stops when they are mounted in rated fire barriers. The technical approach taken by the IEEE standard involves qualifying, by testing, a rated fire barrier that has been changed by the addition of a physical penetration (i.e., a cable or cable tray). The standard provides guidance that will, as a minimum, result in testing equivalent to the testing of the rated fire barrier, since the rating of the qualified fire barrier with the penetration should equal the rating of the qualified fire barrier. This test is for the purpose of design verification only; it is not used to verify the adequacy of specific penetration fire stop installations at nuclear power plants.

## C. REGULATORY POSITION

Conformance with the requirements of IEEE Std 634-1978, "IEEE Standard Cable Penetration Fire Stop Qualification Test," is acceptable to the NRC staff for qualifying cable penetration fire stops and provides an adequate basis for complying with the Commission's regulations with respect to the design verification of the performance of cable penetration fire stops when mounted in rated fire barriers in nuclear power plants, subject to the following:

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* Copies may be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

** Copies may be obtained from the Institute of Electrical and Electronics Engineers, United Engineering Center, 345 East 47th Street, New York, New York 10017.

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1. Section 4, "References," of IEEE Std 634-1978 lists additional standards. The specific applicability or acceptability of these referenced standards has been or will be covered separately in other regulatory guides, where appropriate.

2. Sections 5.1.3, 5 2.2, 5.2.3, and 5.3.2 state that the cable penetration fire stop or module, the cable selection and raceway fill, the opening dimensions of the cable penetration fire stop, the raceway mounting and anchoring to the fire stop assembly, and the cable arrangement shal' be representative of the actual installed conditions. These requirements should be interpreted to include, as applicable:

a. The passage of bare metal such as grounding straps or fluid conduits through the fire stop;

b. Any differential pressure across the fire stop with low pressure on the unexposed side, whether the differential pressure is part of normal operation or would be generated by the fire;

c. Cable termination less than 2 feet from the fire stop with the cable jacket stripped and the conductor connected to a typical termination device;

d. The use of structural supports for the cables, trays, conduit, or piping.

3. The intentional modification of an installed fire stop to add additional elements through the penetration and the subsequent resealing of that fire stop is not addressed in IEEE Std 634-1978. An installed fire stop that undergoes the above procedure should no longer be considered qualified unless its prototype was successfully tested under similar conditions. Requalification should be performed in accordance with this regulatory guide.

4. Section 5.3.3 states that the cable of the exposed side shall protrude a minimum of 1 foot. During the initial burning of the exposed-side cable jacket, the temperature at the exposed side of the fire stop may exceed the limits of the time temperature curve in ANSI A2.1-1972 (ASTM E119-1971) as measured on thermocouples located 6 or 12 inches from the penetration (Section 5.3.7). During



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this initial burning phase, a cable protrusion of 1 foot on the exposed side is not considered representative of the combustible loading under actual installed conditions. For penetration fire stops rated at one hour or less, a more representative cable length of 3 feet should be used on the exposed side, and the thermocouples should be a minimum of 6 inches (wall assemblies) or 12 inches (floor and floor/ceiling assemblies) from the excess cable.

5. Section 5.3.5 states that cable penetration fire stop designs that are unsymmetrical may require testing on both sides for qualification. Designs that are unsymmetrical with respect to the use and application of fire stop materials should be tested on both sides.

6. Section 5.3.10 states that a minimum of three thermocouples shall be used on the unexposed side and designates the minimum distribution pattern for these thermocouples. Single-point measurements should not be considered adequate for these tests. A minimum of three thermocouples should be used for each interface type within the penetration. An interface type is considered to be any physical contact between a specific pair of dissimilar materials. The temperature should also be measured by three thermocouples at the conductor-insulation/bare-conductor interface for applications where the conductor will be terminated and stripped within 2 feet of the cable penetration fire stop. Additionally, the temperature should be measured by a thermocouple on the surface of the fire stop 1 inch away from each of the interface types.

7. Section 6.1.1 contains some ambiguity on the passage of flame. Specifically, the phrase "hot enough to ignite..." could be interpreted to modify the noun "flame" as well as the noun "gases." Any passage of flame during the test period should be considered a failure of the test specimen.

8. Section 6.1.2 states that the transmission of heat through the cable penetration fire stop shall not raise the temperature on its unexposed surface above the self-ignition temperature of various listed materials. This measured temperature should be taken to be the temperature as measured by the highest-reading thermocouple on the unexposed surface and should not exceed 600°F. For those thermocouples placed 1 inch away from each interface type, the maximum temperature should not exceed 400°F.

## D. IMPLEMENTATION

This proposed guide has been released to encourage public participation in its development. Except in those cases in which an applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the method to be described in the active guide reflecting public comments will be used in the evaluation of all (1) construction permit applications, (2) standard reference system preliminary design applications (PDA) or Type-2 final design applications (FDA-2), and (3) licenses to manufacture that are docketed after the implementation date to be specified in the active guide, except those portions of a construction permit application that:

a. Reference an approved standard reference system preliminary or final design (PDA or FDA) or application for such approval,

b. Reference an approved standard duplicate plant preliminary or final design (PDDA or FDDA),

c. Reference parts of a base plant design qualified and approved for replication,

d. Reference a plant design approved or under review for approval for manufacture under a Manufacturing License.

This implementation date will in no case be earlier than January 31, 1980.