Regulatory Guide 1.XXX
(SD TASK RS 809-5)

"Cable Penetration Fire Stop Qualification Test For 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, "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, "Licensing of Production and Utilization Facilities," requires, among other things, that design control measures provide for verifying or checking the adequacy of design such as by the performance of a suitable testing program. Where a test program is used to verify the adequacy of a specific design feature, it shall include suitable qualification testing of a prototype unit under the most adverse design conditions.

B. DISCUSSION

Immediately following the Browns Ferry fire of March 22, 1975, NRC appointed a Special Review Group to identify the lessons learned from this event and make recommendations for the future in light of these lessons. The Review Group published its report in February 1976 (NUREG-0050, "Recommendations Related to Browns Ferry Fire," Special Review Group, USNRC,

February 1976). Among other recommendations, the Review Group recommended that greater attention be given to fire prevention measures in nuclear power plants. The Review Group specifically recommended that a standard qualification test be developed to resolve the problem of the uncertainties of flammability of fire stop materials and designs to assure acceptable performance of fire stops. It should be noted that the immediate cause of the Browns Ferry fire was the ignition of polyurethane foam that was being used to seal air leaks in cable penetrations between the Unit 1 reactor building and a cable spreading room located beneath the control room of Units 1 and 2.

IEEE Std. 634-1978, "IEEE Standard Cable Penetration Fire Stop Qualification Test," dated April 19, 1978 was prepared by Task Force 12-40 of the Insulated Conductors Committee of the Power Engineering Society of the Institute of Electrical and Electronics Engineers, Inc. (IEEE) and was subsequently approved by the IEEE Standards Board on December 15, 1977.

The standard provides qualification test procedures for type testing cable penetration fire stops when mounted in rated fire barriers. A fire rated barrier is qualified in accordance with the ASTM Standard E119-76 test ("Standard Methods of Fire Tests of Building Construction and Materials"). The technical approach taken by the IEEE standard involves qualifying, by testing, a fire rated barrier that has been changed due to a physical penetration (i.e., cable and/or cable tray) of the rated barrier. The technical approach provides testing guidance that will, as a minimum, equal the testing of the rated fire barrier, since the qualified barrier-with-penetration rating should equal the qualified barrier fire rating.

C. REGULATORY POSITION

Conformance with the requirements of IEE Std. 634-1978, "IEEE Standard Cable Penetrations Fire Stop Qualification Test," is acceptable for qualifying cable penetration fire stops and provides an adequate basis for complying with design verification requirements of Criterion III of Appendix B to 10 CFR Part 50 with respect to the design verification of the performance of cable penetration fire stops in nuclear power plants when mounted in rated fire barriers, subject to the following:

1. Section 7, "References," of IEEE Std. 634-1978 lists additional standards. The specific applicability or acceptability of these reference standards has been or will be covered separately in other regulatory guides, where appropriate.

2. Sections 5.1.2, 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 shall 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 standard fire due to the ventilation parameters of the compartment on the exposed side;

(c) cable termination less than two 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 destruction 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 which undergoes the above procedure should no longer be considered qualified. Requalification should be in accordance with the provisions of this regulatory guide.

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

5. 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 per interface type should be used for each interface type within the penetration. An interface type is considered to be any physical

contact between 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 with two feet of the cable penetration fire stop. Additionally, the temperature should be measured by thermocouple one inch away from each of the interface types mentioned above.

6. Section 6.1.1 contains some ambiguity on the passage of flame. Specifially, the phrase "hot enough to ignite..." could be interpreted to qualify flame as well as gases. Any passage of flame should be considered to terminate the endurance of the fire stop.

7. 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 termperature 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 degrees fahrenheit. For those thermocouples placed one inch away from each interface type, the maximum temperature should not exceed 400 degrees fahrenheit.

8. Section 5.3.3 states that the cable of the exposed side shall protrude a minimum of one 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 this initial burning phase, a cable protrusion of one 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 three 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.

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

(1) all construction permit applications,

(2) standard reference system preliminary design applications (PDA) or Type-2 final design applications (FDA-2), and

(3) licenses to manufacture 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, or applications for such approval.

This implementation date (to be specified in the active guide) will in no case be earlier than (to be filled in at the time of issuance for comment).