U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
*Protecting People and the Environment*

**Sandia National Laboratories (SNL)**

**National Institute for Standards and Technology (NIST)**

**University of Maryland (UMd)**

**Information Sheet**: **Electric Cable Fire Damage Testing ("CAROLFIRE"),** Hugh Woods *(NRC/RES/DRASP)*

***The Risk***

The results of the Individual Plant Examinations of External Events (IPEEE) program and actual fire events indicate that fire can be a significant contributor to nuclear power plant risk, depending on design and operational conditions. The question of how to determine risk resulting from fire damage to electrical power, control, and instrumentation cables in nuclear power plants has been of concern since the Browns Ferry fire in 1975. In earlier years, it was generally believed that any system that depended on electric cables passing through a compartment damaged by fire would be unavailable for its intended safety function. The Browns Ferry Fire and recent testing have prompted wider realization that short circuits involving an energized conductor can pose considerably greater risk by creating "hot shorts" which can reposition motor operated valves and start or stop plant equipment such as pumps. This risk should be accounted for in plant safety analyses.

***The Needs***

Different opinions between the nuclear industry and NRC staff concerning the relative likelihood of hot shorts in cases of fire damage to electric cables resulted in the conduct of a series of cable fire tests by NEI/EPRI, in 2001. Based on results of those tests, data from other tests available in the literature, and results of an industry/NRC expert panel, the NRC issued Regulatory Issue Summary (RIS) 2004-03, Revision 1, that presents guidance for NRC inspectors concerning which fire-induced causes of hot shorts are most likely to occur and should be considered during inspections. The RIS also describes other potential hot shorts whose likelihood could not be decided when the RIS was issued, referred to as "Bin 2" items.

The primary need addressed by the Cable Response to Live Fire (CAROLFIRE) testing program was for data to determine the safety importance of Bin 2 items. The secondary need was to decrease the uncertainty inherent in present fire modeling tools by providing electrical data (e.g., likelihood of hot shorts), and thermal data to support fire models, both simultaneously from the same experimental setup.

***The Applications***

CAROLFIRE included small- and intermediate-scale fire tests which together comprised 96 individual experiments of varying complexity. Testing by SNL involved a range of common thermoplastic and thermoset cable construction and variations in several other test conditions, such as thermal exposure intensity and type, raceway type, and grouping of like versus dissimilar cable types.

The data obtained from CAROLFIRE is applicable to a wide range of situations encountered in NPPs, and will enable improved guidance to be written. Also, the data has been used to develop more accurate sub-models by NIST and UMd, This will enable a more accurate determination of the risk due to fires in NPPs, which will support risk informed regulation of NPPs.

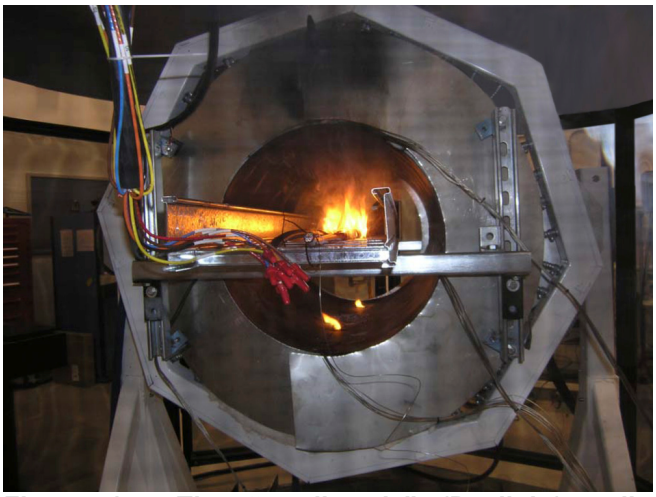

**Figure 1. The "small-scale" (Penlight) radiant heating test facility at SNL, shown testing two multi-conductor cables for the US NRC's CAROLFIRE program. Photo by Steven Nowlen, SNL.**

**Program Management**

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**For More Information**

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