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Sandia National Laboratories (SNL)

National Institute for Standards and Technology (NIST)

University of Maryland (UMd)

<u>**Information Sheet**</u>: **Fire-Induced Electrical Cable Failure Testing**

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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 cause systems to malfunction such as inadvertently repositioning motor operated valves and starting or stopping plant equipment. This risk should be accounted for in plant safety analyses.

The Needs

A consensus regarding the likelihood of hot shorts given fire damaged cables didn’t exist in the late 90’s. To achieve agreement, a fire-induced cable failure test program was conducted by NEI and EPRI in 2001. These results and previous knowledge on cable failure characteristics were used by an expert panel to develop failure likelihoods. Regulatory Issue Summary (RIS) 2004-03, documented the results, and identified configurations requiring additional research (“Bin 2 items”) to determine their inclusion in the fire protection inspection program. In 2006, the NRC sponsored the <u>Ca</u>ble <u>R</u>esponse t<u>o</u> <u>L</u>ive <u>Fire</u> (CAROLFIRE) program, conducted at Sandia National Laboratories to better understand and resolve the remaining RIS 2004-03 Bin 2 items. The CAROLFIRE results are documented in NUREG/CR-6931, Vol. 1-3.

In addition to providing the necessary research to resolve the RIS 2004-03 Bin 2 Items, the program produced a “Gold Mine” of data and information that is being used to better understand the phenomena of fire-induced cable failure. However, both tests programs emphasized on testing risk-significant alternating current (AC) circuits. Future testing of risk-significant direct current (DC) circuits will allow the fire protection community to better understand DC failure characteristics.

The Applications

The insights and data gained from all of the test programs conducted to date will be applicable to a wide range of situations encountered in NPPs, and will enable improved guidance to be written. Cable thermal response data from these programs is also being applied to reduce uncertainty in fire modeling and to more accurately predict the time of cable failure.

The National Institute of Standards and Technology and the University of Maryland have already begun using the data to develop predictive cable failure models. The data can also be used to re-assess the likelihoods of spurious actuation that the expert panel determined using the NEI/EPRI results. This would ultimately reduce uncertainty in fire probabilistic risk assessment and when applied properly would reduce the nuclear power plants fire risk.

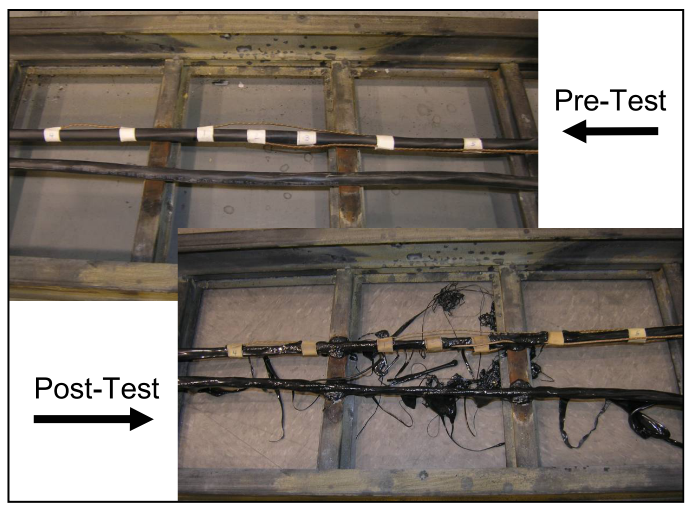

Figure 1. Electrical Cable Fire Damage

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