This digital exhibit for the 2021 Regulatory Information Conference is brought to you by the Fire and External Hazards Analysis branch of the NRC's Office of Nuclear Regulatory Research. This exhibit will provide a brief overview of the background and origins of the NRC's high-energy arcing fault, or HEAF, research program. It will summarize the progress of the joint NRC Electric Power Research Institute, or EPRI, working group and discuss the technical and regulatory paths to the issue's ultimate resolution. This digital exhibit will be accompanied by a live question and answer session. HEAF is a term used to describe a sustained discharge of electric current across a gap between two conductors with different voltages. The arc generates significant heat, light and pressure which have the potential to damage surrounding equipment. This type of electrical failure is typically observed in switching equipment with voltages of 440 volts and higher and bus ducts. The NRC first considered the impact of HEAFs in the early 2000s, during the development of fire probabilistic risk assessment, or PRA, methodology to support risk analysis for plants transitioning to National Fire Protection Association or NFPA 805, the performance based standard for fire protection. The original hazard model for HEAFs, documented in Appendix M to NUREG/CR-6850, was based largely on the 2001 event at the San Onofre Nuclear Generating Station. This model is simplistic and predicts damage based solely on the distance from the faulted equipment. The HEAF phenomenon was brought back to the attention of regulatory agencies in 2013 through the International Fire Records Exchange Program conducted under the auspices of the Nuclear Energy Agency. The participating countries determined that HEAFs were often associated with complicated shutdowns and that the hazard model in use had few supporting data. To explore the HEAF phenomenon further and provide a better technical basis for the hazard model, the NRC led an international experimental research program from 2014 through 2016. This experimental program, led by the NRC, was performed at the KEMA High Power Laboratories. The program consisted of 26, first-of-their-kind experiments, in which arcing faults were induced in retired nuclear electrical enclosures donated by the international partners. The NRC worked with the National Institute of Standards and Technology and Sandia National Laboratories to collect data using an array of sensors, instruments, and video equipment. While most of the experiments produced results in line with the existing model,Ê two experiments produced far more energy and damage than anticipated. It was later determined that the cause of the excess energy and resulting damage was the oxidation of aluminum components present in the electrical enclosures. To further characterize the impact of aluminum on the severity of a HEAF, a second series of experiments was carried out between 2018 and 2019. Experiments were run at three scales: small-scale experiments investigated aluminum oxidation and morphology; medium-scale experiments investigated the temperature and spectral emissions of the arc column; and large-scale experiments collected data on enclosure breach and energy distribution. Under the memorandum of understanding for conducting fire research, the NRC formed a joint working group with EPRI to use experimental data and state-of-the-art modeling techniques to develop revised tools and methods for the treatment of HEAFs in fire PRA to account for the aluminum HEAF impacts. The working group effort consists of four major components: a survey of the nuclear fleet, hazard modeling, updating PRA guidance and target fragility testing. EPRI conducted a comprehensive survey of the operating US nuclear fleet with the goals of ensuring that full-scale experiments are representative Of in-plant configurations and garnering a better understanding of the location and configuration of equipment containing aluminum. The survey found that all operating US nuclear power plants contain aluminum and equipment with the potential for HEAF events. Experimental evidence has shown that the impact of a HEAF event is highly variable and depends on a number of factors, including: fault duration, system voltage, available current, equipment geometry, and electrode composition. To predict the hazard, a multi-physics model is being developed that will allow for the calculation of the HEAF hazard across a wide variety of electrical configurations. This task includes validation of the selected model. The task to update PRA methods is aimed at improving the realism and fidelity of the hazard model. This task includes evaluating US operating experience, updating fire ignition frequencies and updating non-suppression probabilities. This task also incorporates the configuration of plant electrical distribution systems. While the modeling effort will allow for the calculation of the HEAF hazard, the specific impact on a particular target is unknown. Current HEAF guidance conservatively postulates that systems, structures and components within the zone of influence will be damaged. Existing fire PRA target damage models were designed with a conventional fire in mind; however, HEAFs present a much shorter, higher energy source term, the effects of which have not been quantified. To address this knowledge gap, the response of common targets to short duration, high energy exposures are being evaluated in physical testing to develop a damaged model. This damage model can be coupled with the hazard and PRA models to comprehensively and realistically assess the risk of HEAFs. In addition to the analytical tasks of the Joint Working Group, the NRC is pursuing an enterprise risk management approach to achieve timely resolution of the aluminum HEAF issue. This approach will employ an NRC screening method using EPRI insights to bin plants of interest for further evaluation. The screening method Will consider factors such as the fidelity of the fire PRA model, the conditional core damage probability of aluminum HEAF, and the change in core damage frequency, while taking into account EPRI best practices and potential mitigation using diverse and flexible coping strategies, or flex, equipment as appropriate. The NRC is committed to achieving timely resolution of this issue in a transparent and defensible manner. In addition to the technical input from EPRI partners in the Joint Working Group, the NRC continues to routinely solicit feedback from the public and stakeholders during the development and execution of this program. The NRC will publish information developed as part of the agency's efforts on this issue, resolution for public comment and seek interaction with stakeholders as necessary to guide the direction of the program. The latest information on the HEAF research program can be found at the link shown.