2024 TECHNOLOGY TRANSFER AWARD WINNER

APPLICATION OF EPRI HIGH-ENERGY ARCING FAULT (HEAF) METHODOLOGY FOR FIRE RISK REALISM AND COST SAVINGS

CONSTELLATION ENERGY GENERATION LLC

Robert Cavedo

Suzanne Loyd

TECHNOLOGY TRANSFER AWARD

Constellation Applies EPRI High-Energy Arcing Fault Methodology to Obtain More Realistic Risk Results

2024 TECHNOLOGY TRANSFER AWARD

Constellation Energy piloted the EPRI/U.S. Nuclear Regulatory Commission (NRC) high-energy arcing fault (HEAF) methodology, which helps assess the risk of longer duration electrical faults in switchgear and bus ducts. The trial of the new methodology from EPRI's Risk and Safety Management (RSM) team provided valuable feedback to help make the final publication of the method more practical..

Benefits

Constellation was an early adopter of the HEAF methodology and worked in a short timeframe to begin rollout of the new method across the fleet. Constellation supported the development of the new HEAF methodology by serving as a pilot, they understood the benefits that the method would have in improving realism in fire PRA modeling. Constellation recognized that the method improved their understanding of plant risk, and they provided valuable feedback to the EPRI team. This collaboration helped confirm the acceptability of the methodology for industry use.

After implementing EPRI's High Energy Arcing Fault Frequency and Consequence Modeling research, Constellation quickly incorporated the method into two plant fire models and is continuing to implement it at all sites in the fleet. Shortly after the full incorporation of the HEAF method at the first two plants, the organization was faced with two separate plant issues that required risk insights from the fire risk models. In both cases, the realism introduced into the fire models by the updated HEAF methodology resulted in improved fire risk metrics.

Application

Constellation piloted the HEAF methodology in a plant while it was still in draft form. In just a six-month timeframe, the team performed walkdowns and gathered plant-specific inputs to fully implement the method. Throughout the process, Constellation worked with EPRI to clarify portions of the methodology, helping to ensure its practical application industry-wide.

Using the new HEAF methodology, Constellation was able to credit fault clearing times in the HEAF analysis (rather than assuming a worst-case zone of influence) and also better assign frequency based on where HEAFs are more likely to occur. This resulted in a more realistic view of long-duration electrical faults and their contribution to fire risk. Ultimately, this realism will guide decision makers to focus on the most risk-significant systems and equipment.

The HEAF methodology can be found here:

- High Energy Arcing Fault Frequency and Consequence Modeling, 3002025942 (NUREG-2262).

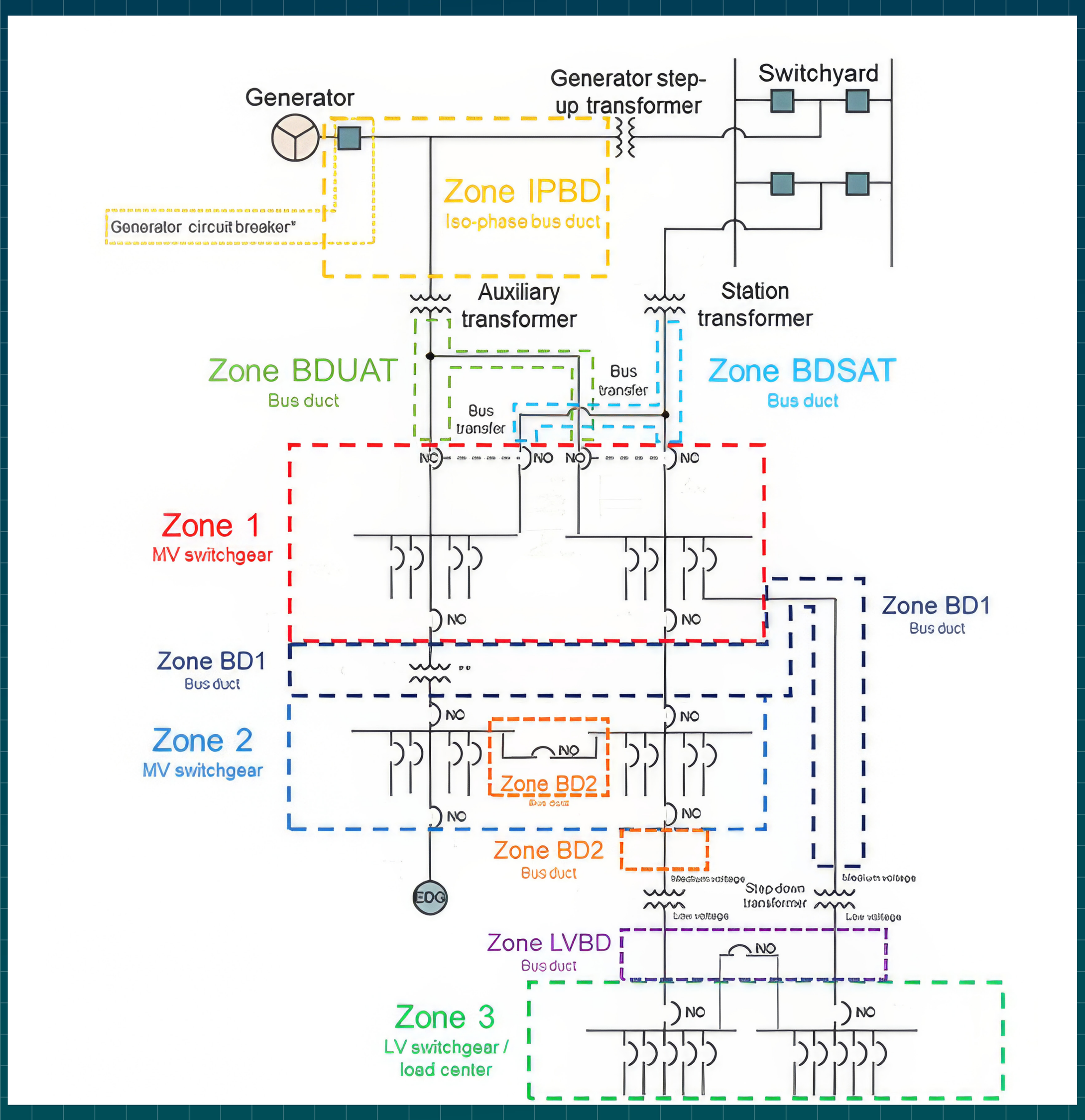

Figure 1
Electrical distribution zones as defined in EPRI 3002025942 (NUREG-2262).

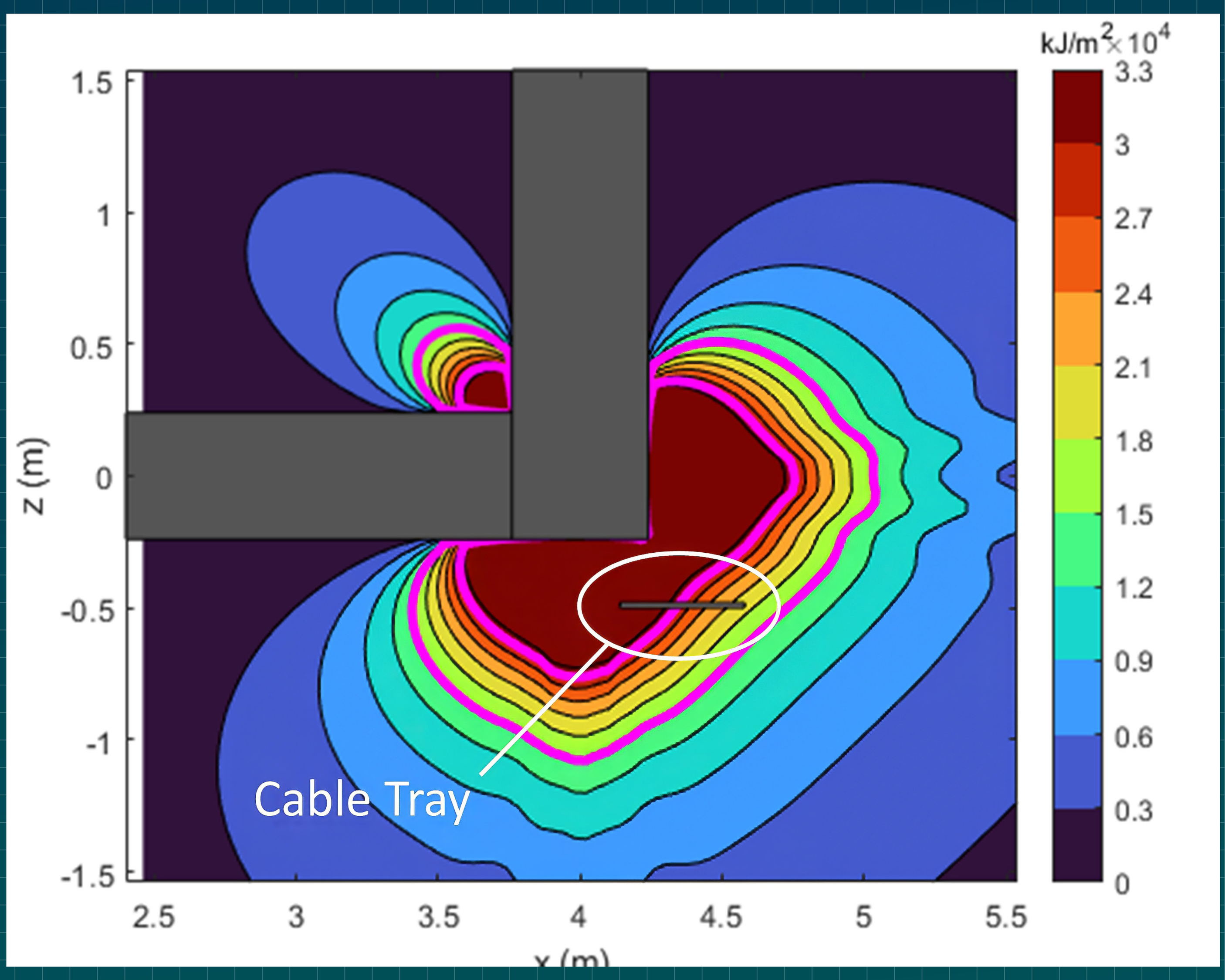

Figure 2
Contour plot of the Fire Dynamics Simulator results for a 0 s stiff, 15 s decay arc at a bus duct elbow. Magenta contours are the 15 MJ/m² and 30 MJ/m² target fragility thresholds applicable to thermoplastic (TP) and thermoset (TS) cables.

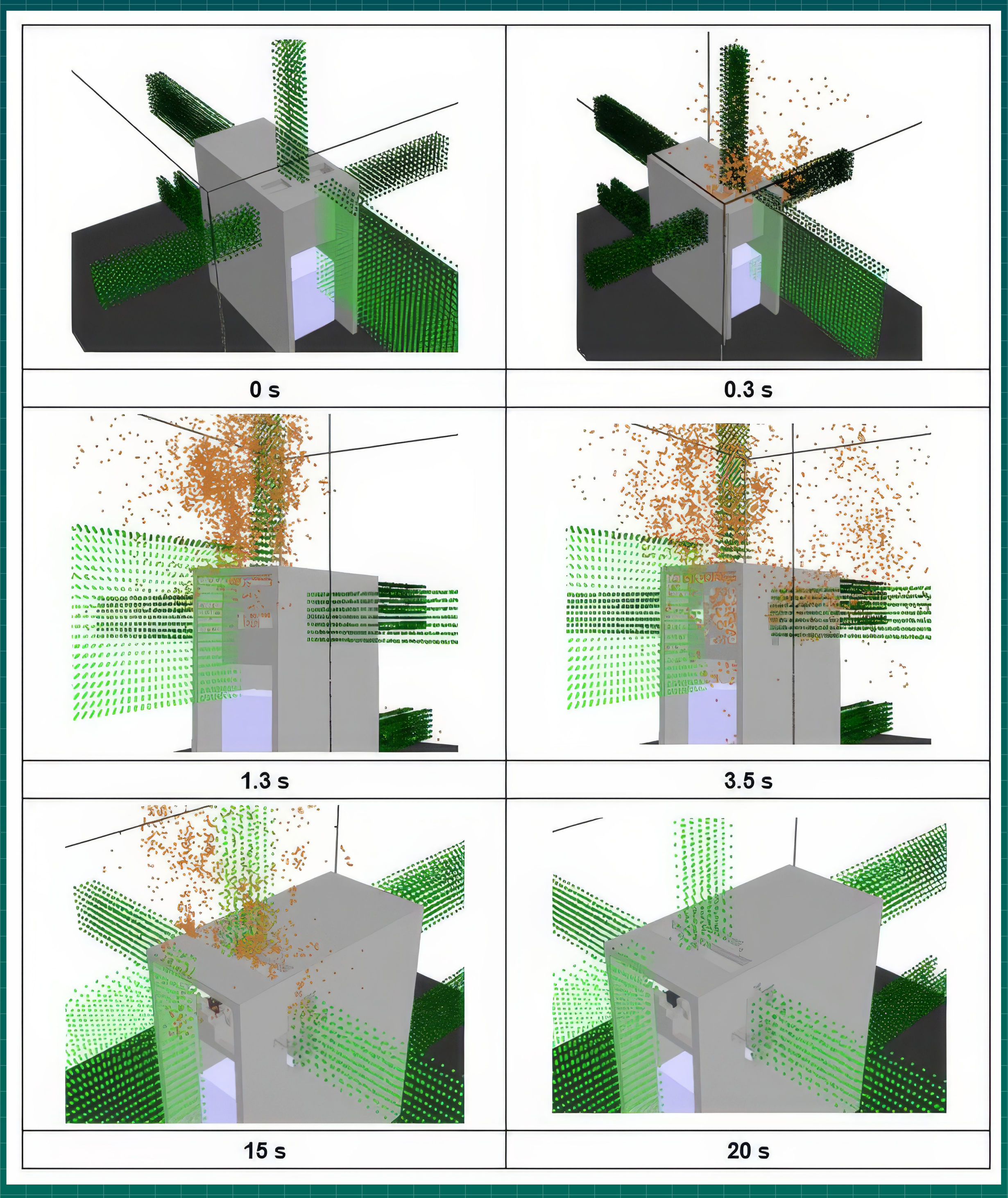

Figure 3
Particle distribution at various times for a 233 MJ HEAF in medium-voltage switchgear.

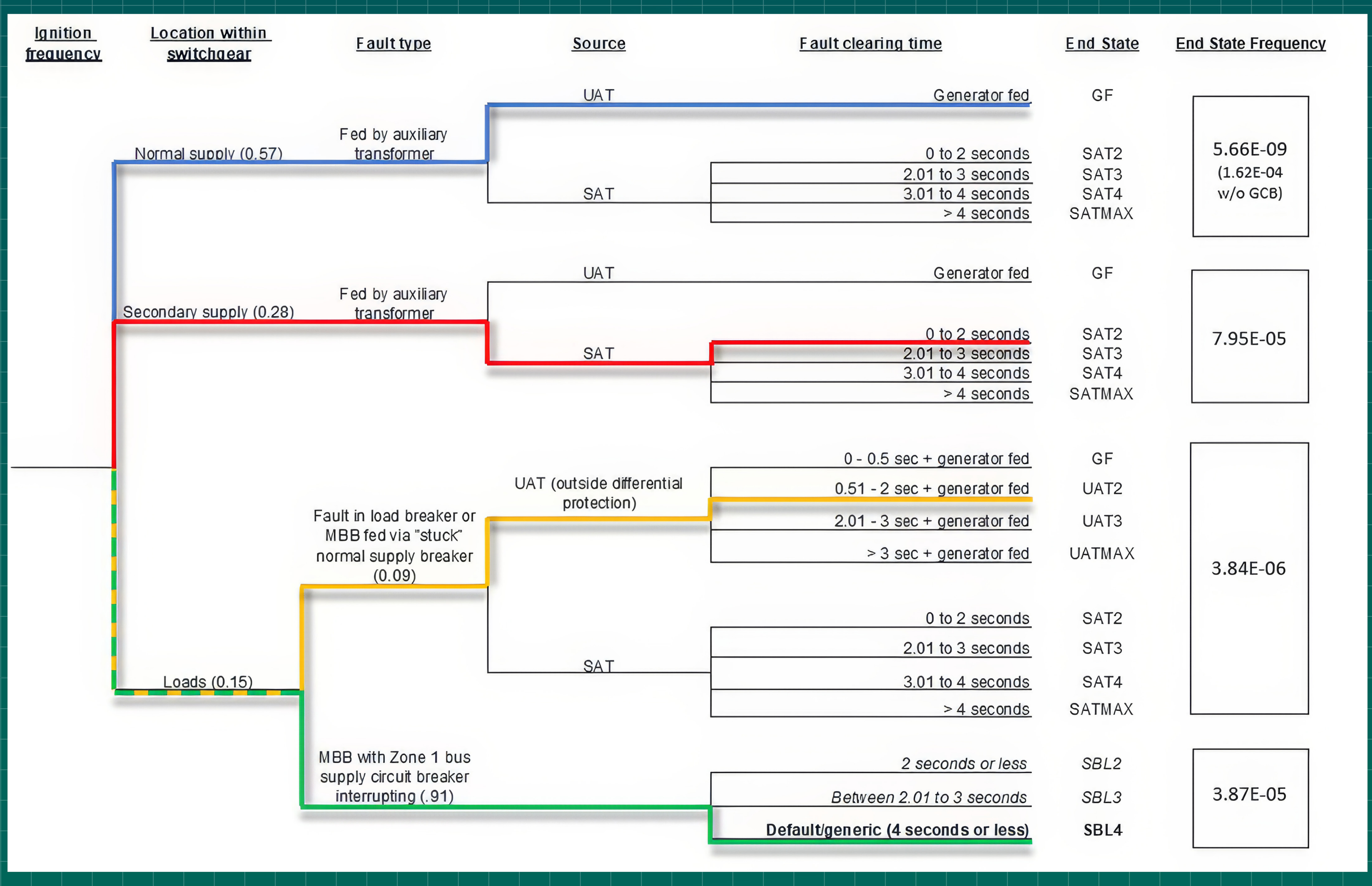

Figure 4
Example of detailed methodology for Zone 1 (medium-voltage switchgear) HEAFs.

EPRI