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Modeling High Energy Arcing Fault Hazards and Zones of Influence

Comment On: NRC-2022-0096-0001
Modeling High Energy Arcing Fault Hazards and Zones of Influence

Document: NRC-2022-0096-DRAFT-0001
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General Comment

See attached file(s)

Attachments

Determining the Zone of Influence for High Energy Arcing Faults using Fire Dynamics Simulator - EPM Comments

Predicting High Energy Arcing Fault Zones of Influence for Aluminum using a Modified Arc Flash Model - EPM Comments

Section	Page	Comment
2.2.1	41	While the assumption of low speed flows makes sense for thermal impacts, has consideration been given to the impact that the a pressure wave would have, including the force of potential metal shrapnel from the cabinet enclosure.
2.2.3	43	Voltage field/magnetic field impacts can have a significant affect on plasma shape/direction and particle speeds. This can have various impacts on the potential ZOIs. A peer review of the approach by others who typically model plasmas should be conducted and documented. There has been research and modeling of this type for plasma thrusters in the aerospace industry.
2.2.3	43	Discussion is provided regarding the lack of FDS capability for dynamic 3-phase arcs, but no discussion is provided on the potential impact to the model results.
3.2	47	The basis for the single point specific heat for Copper (I) oxide gas is not provided. If it is an assumed value this should be noted directly.
3.2	47	Copper oxide is naturally found in 2 different forms, Copper (II) Oxide: CuO and Copper (I) Oxide: Cu2O, depending upon the oxidation state of the copper cation. Only Cu2O is discussed by this report. The relative contribution (or exclusion) of CuO is not defined/demonstrated.
3.5	48	The heat of reaction for Cu2O as noted is 1340 kJ/kg . However for CuO it would be approximately 2460 kJ/kg. If Cu2O is expected to be the dominant product, this should be noted. Currently the relative contribution (or exclusion) of CuO is not defined/demonstrated.
4	63	The validation results focuses on a few HEAF experiments in controlled environments and a couple industry events. Has consideration been given to any potential additional variables in live Nuclear Power Plants that may increase severity of the HEAF seen in other events. Back in 2017 there was a HEAF event at Turkey Point that was powerful enough to blow open a fire door and is what sparked the potential aluminum increasing the HEAF severity discussion. Some of the most severe events should be discussed somewhere in the report. Perhaps some form of severity factor is needed to capture these anomalies.
4.5	79	Consider adding a summary table of the bias factor and standard deviation for each phenomena to the end of this section as a quick reference for the end user.
4.5	79	A bias factor of only 0.57 for the predicted exposure suggests gaps in the FDS capabilities may be significant. Other FDS-based validation for NPPs in NUREG-1824 are much closer to 1.0 for most phenomena (except where overprediction is conservative such as smoke). Additional discussion may be warranted regarding the acceptability of the model results.
7	203	The summary mentions the future PRA guidance but it should be noted here, like it is in the scope, that this guidance will be in a separate report. If at all possible before this report is finalized it would be helpful to reference the report name/number for those looking to use the guidance.

Section	PDF Page	Comment
FRONT	9	Typo in Figure 15 title, "approxiation" should be "approximation"
3	20	Consider adding a summary table of the bias factor and standard deviation for each model to the end of this section as a quick reference for the end user.
3.4	26	Figure 8. Does Arc Duration = Fault Duration from section 5 tables? Terminology should be consistent/clarified.
3.6	33	Typo in Figure 15 title, "approxiation" should be "approximation"
4	37	It is unclear how the ZOI results can be applied to HEAF modeling. Some brief discussion should be included for picking the correct ZOI. For example, should Fault duration be Fault Clearing Time estimated on a per plant basis.