REVIEW / COMMENT DOCUMENTATION

Reviewer: NRC-2022-0096 (87 FR 29396) **Date:** 2022 **Title:** Draft Modified IEEE Hazard Report

Comment No.	Document Number Section / Paragraph	Review Comments (Print)/Basis for Comment	Proposed Resolution	Comment Disposition / Resolution
(1) ML22165A208	Page xi	COVID is misspelled	Correct spelling	Corrected Spelling
(2) ML22165A208	Section 2.2.1	IEEE 1584-2018 Appendix G.7.6 describes the minimum working distance of 12 inches is due to being within the range of the arc plasma cloud and metal droplets. No tests were performed at such short working distances. A minimum working distance of 12 inches was used because the plasma cloud is not considered to have exceeded a radius of 12 in. The plasma cloud size and effect of direct contact with it should be considered in future arc-flash model revisions. The arc flash boundary is not simply based on the limits for sustaining injury to humans, it is a limitation of the testing. Target response within the plasma cloud could be substantially different than target response outside the plasma cloud. Further justification should be provided to apply a model outside the validation range (less than the minimum 12 inch distance).	Reevaluate applicability of methodology and include clear bounds of use, including non applicability to use in PRAs due to conservatism.	Any model predictions that are less than 12 inches (0.3m) is not included in the report. This is noted as “N/A” in the ZOI tables starting on page 4-2. The footnotes for the ZOI tables communicate that the results are not applicable due to the ZOI being less than 0.3 m (12 in). Your comments identify that treatment in this manner is a non-conservatism and as such, the report has been corrected to replace “N/A” with the models limiting distance 0.3 m [12 in]. Your comment also identifies that the level of conservatism / non-conservatism is unknown since there isn’t sufficient research to evaluate model prediction capabilities within the plasma region. While this is a conservative assumption, it does not take into consideration the ensuing enclosure fire, which likely encompasses this limiting ZOI. As such, additional text has been added in section 2.2.1 to clarify that the ZOI is limited to 0.3 m (12 in.) when the model predicted damage is less than 1-ft.

(3) ML22165A208	Section 2.2.2	There is no clear basis for excluding insulated conditions, and this is therefore not realistic for cases with insulated bus bars.	Reevaluate applicability of methodology and include clear bounds of use, including non applicability to use in PRAs due to conservatism.	The sub-section title (electrode configuration) likely caused confusion in the draft report. These are terms used in the initial model to identify how the electrodes are oriented to the targets and enclosure configuration. There is no relation to insulated conductors. The insulation referred to the enclosure. As such, wording has been added to clarify the configuration. Based on these clarifications, the comment is not valid since both insulated and non-insulated conductors are applicable.
(4) ML22165A208	Page 3-15	HCB and VCB are not adequately explained, and the chosen approach was not sufficiently justified.	Include explanation and justification.	Discussion on configuration is added, along with justification for using it in the sensitivity study.
(5) ML22165A208	Section 3.4.2	The medium voltage equation on page 3-10 is written such that it is assumed that all three phases contribute to the fault. This is therefore not applicable for cases with two phases, or phase-to ground. A single phase-to-ground fault, for example, would have less energy.	Clarify applicability of equation and reevaluate applicability of methodology and include clear bounds of use, including non applicability to use in PRAs due to conservatism.	Comment is accurate, however, the typical HEAF involves all three phase. Typical event progression involves a single-phase to ground or phase-to-phase arc that rapidly propagate to all three phases. This has been observed in OE, even for events involving insulated buses. There have been a limited number of events that do not involve all three phases but are considered a less common scenario. The current PRA framework does not provide a means for establishing when a HEAF will not involve all three phases. Because of these reasons, it is common practices to assume all three phases are involved in a HEAF.
(6) ML22165A208	Section 3.6	In the arcing power equation on page 3-13, it is unclear if the arc voltage is the terminal voltage or system voltage.	Specify terminal voltage or system voltage.	Arc voltage is the voltage across the arc. It is discussed in appendix A. A reference to appendix A has been added.

(7) ML22165A208	Figure 17	The Total Energy Release is linear with fault duration, but ZOI due to radiation is to the 4th power which would not be linear. There is no basis given for a linear increase in ZOI.	Revise the figure with an appropriate relationship or provide justification for the linear relationship.	The comment identifies a heat flux (power) relationship for a black body emission source. That relationship predicts power (heat flux) based on the temperature of the emitting object. Power (heat flux) can be integrated to derive energy. The Figure presents the zone of influence which has a dependency on energy, distance, target fragility. Figure 17 presents the results of the model which is empirically derived and includes other forms of heat transfer than just radiation. Since the model encompasses all forms of heat transfer registered by the measurement device, it is unclear how this comment as written is relative to the figure.
(8) ML22165A208	Page 4-2	In the ZOI tables, the difference between Aluminum and Steel is not substantial. It would be useful to have the ZOI in different directions specified.	Specify the ZOI in different directions.	The model can be used to provide directionally dependent ZOIs by choosing the applicable configuration (HCB or VCB). However, this requires detailed knowledge of the equipment lineup. Since this is unique to the equipment and plant configuration, the decision was made to not include this level of complexity and keep the application of the model as a first order approximation.

(9) ML22165A208	**Page A-1**	Arc voltage is smaller (20% of open circuit voltage) because high fault current generates large voltage drop (80%) through impedance in transformer and cables. Based on Figure 19, there does not appear to be a phase shift (the phase voltage sinusoids have the same period with no significant offset due the fault) from the open circuit condition to the fault condition. The transformer source is highly inductive (large X/R ratio) and the cable has a moderate X/R ratio. If the arc was purely resistive with no reactance, there would be a phase shift. The arc fault likely has a similar X/R ratio (reactance to resistance ratio) to the open circuit impedance and is likely **not purely resistive.**	**Correct the X/R ratio.**	Changed “purely resistive” to “highly resistive” The model doesn’t require an X/R ratio, and as such is not discussed.
(10) ML22165A134	Front / PDF page 9	Type in Figure 15 title	“approxiation” should be “approximation”	Corrected in List of Figures
(11) ML22165A134	Section 3 / PDF page 20	Missing summary table	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.	Added summary table to Section 3.7 and made changes to section title.
(12) ML22165A134	Section 3.4 / PDF page 26	**Figure 8. Does Arc Duration = Fault Duration from section 5 tables?**	Terminology should be consistent/clarified.	These are the same. Discussion added to clarify what arc duration is.
(13) ML22165A134	Section 3.6 / PDF page 33	Typo in Figure 15	“approxiation” should be “approximation”	Corrected in Figure Caption

(14) ML22165A134	Section 4 / PDF page 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.	Add clarification.	Clarification added
(15) IEEE SA	General	IEEE SA notes that the research information letters are based on NRC research that is dissimilar to that performed as a part of the IEEE/NFPA Collaboration Research. The procedures, configurations, measurements, equipment, and tests differ. Of course, with these differences, it is understood that results, conclusions, and any derived models will also differ.	These new models would not be the IEEE 1584 model, and could not be referred to as such.	All references to the “base model” and IEEE 1584 have been either removed or replaced. The new model is referred to as the final model. Report title has also been changed.