U.S. Nuclear Regulatory Commission Public Meeting Summary

April 24th, 2018

Title: NRC HEAF Phase II Information Sharing Workshop

Meeting Identifier: 20180110

Date of Meeting: April 18th, 2018
April 19th, 2018

Location: Three White Flint North, Room 02A14

Type of Meeting: Category 3

Purpose of the Meeting(s):

1) Inform interested stakeholders about the status of PRE-GI-018 and related research
2) Review and resolve public comments received on the phase II draft test plan
3) Solicit and review information from industry partners regarding common equipment types and configurations to inform future testing
4) Provide an opportunity for public feedback on future testing

General Details: For details on NRC staff and external participants in attendance, see attachments. The workshop was held as scheduled. The workshop was broadcast by webinar. Large portions of time were dedicated to receiving questions and comments from those in attendance, and each day included a time designated as "public comment period." No facilitator was used for this workshop.

Summary of Presentations: The primary objectives of the public meeting were to share the details and findings from an international research project conducted to investigate the High Energy Arcing Fault (HEAF) phenomena, provide information on the NRC Generic Issues (GI) program related to the aluminum HEAF Pre-GI-018, provide an overview of the test plan and resolution of public comments, and solicit stakeholder feedback on Phase II of the HEAF program that supports assessment of the PRE-GI-018. The second day consisted primarily of discussion focused on test parameter ranges and equipment selection led by NRC staff. The last part of the meeting consisted of NRC staff presenting comments received on the first draft test plan, discussion on how comments were dispositioned, and accompanying changes made to the test plan.

The morning session of the first day consisted of presentations from the NRC staff related to the GI program, need for pilot plants, development of HEAF definitions, an overview of potential hazard modeling techniques and small scale testing. Michael Cheok, Director Division of Risk Analysis opened the workshop and emphasized the need for stakeholder participation to support realistic and representative testing. Mark Henry Salley provided an introduction and objectives of the workshop, including a discussion of the NRC's safety mission, defense-in-depth, and need for openness and collaboration. Mr. Salley's presentation included how the NRC works with international parties to perform research, and a need for stakeholder input to allow for a feasible and effective program to support assessment of the PRE-GI-018 and advancements to fire probabilistic risk assessment (PRA) methods.

Nicholas Melly presented an overview of fire PRA as it relates to HEAFs and previous testing performed as Phase I of the international research program. This presentation acknowledged the differences between electrical fires and HEAF events, a proposal to sub-divide the HEAF events (Bin 16 of Fire PRA methodology), and an overview of HEAF events from operating experience (including international events). Included in this presentation was the potential impacts of the aluminum byproduct that could create equipment failures beyond the boundaries of existing hazard models. Mr. Melly also discussed Information Notice (IN) 2017-04, "High Energy Arcing Faults in Electrical Equipment Containing Aluminum Components," and the results from the recently published NUREG-2218, "An International Phenomena Identification and Ranking Table (PIRT) Expert Elicitation Exercise for High Energy Arcing Faults (HEAFs)."

An overview of the GI program was provided by Thomas Boyce. Stan Gardocki followed with a focused discussion on the proposed Aluminum HEAF GI (PRE-GI-018). The PRE-GI-018 is currently in the assessment stage, where short and long term actions are begin taking to support the assessment of the issue and formulize future actions, if needed. Nicholas Melly, continued the discussion related to the GI assessment by presenting the risk assessment methods currently available to the staff and identifying the need for industry involvement though focus pilot plant assessments to understand risk associated with HEAF events involving aluminum. A comment from the attendees was that inclusion of updated HEAF hazard frequency in the assessment would be beneficial for any potential pilot plant volunteers. Mike Cheok indicated that it would make sense to include frequency updates and any new methods related to HEAF with the assessment. Following this discussion, Kenn Miller, Team Lead in the Division of Engineering, presented the need for several definitions to characterize the HEAF hazard consistent with PRA applications. Kenn proposed three severity classifications to characterize the differences between arc flashes, arc blasts, and HEAFs. The draft definitions were an outcome of several conference calls with the NFPA and its supporting members.

Gabriel Taylor provided an overview of the small scale testing focused on characterizing the HEAF particulate size to advance models used to estimate the contribution of aluminum involvement during a HEAF. Comments included the discussion that arc voltage via variation of gap separation distances, may be a better approach than specifying several medium voltage test voltages. Mr. Taylor identified that the public comment period for the draft test plan noticed in the Federal Register (83 FR 9344) closed on April 4, 2018, but the NRC would accept comments submitted to gabriel.taylor@nrc.gov by May 4, 2018. Those comments submitted to Mr. Taylor will be entered into the NRC document management system and made publically available. The final session of the morning was a presentation from Gabriel Taylor on existing and future HEAF hazard modeling techniques. These potential improvements included minor refinements to existing models, more substantiate refinements by equipment categorization, and a dynamic model similar to those used for arc flash hazard calculations. Mr. Taylor also identified the tradeoffs between the modeling techniques based on realism, levels of difficulty to develop and implement, and cost variation.

In the afternoon, presentations from the National Fire Protection Association (NFPA) research, the Electric Power Research Institute (EPRI) research and DNVGL testing facilities and equipment failure rates were given. The session began with a presentation from Mark Earley of the NPFA on Arc Flash Collaborative Research Project between the NFPA and the Institute of Electrical and Electronic Engineers (IEEE). Mr. Earley provided a historical perspective to the program, along with an overview of the numerous arc flash testing that has been done to support development and refinement of IEEE and NFPA standards. In addition, Mr. Earley provided several slides on key technical journal articles that have been developed from this research.

Ashley Lindeman presented an EPRI perspective of the High Energy Arcing Faults, including an overview of two recently published EPRI white papers, EPRI 3002011922, “Characterization of Testing and Event Experience for High-Energy Arcing Fault Events,” and EPRI 3002011923, “Nuclear Station Electrical Distribution Systems and High-Energy Arcing Faults.” Mrs. Lindemans’ presentation identified HEAFs as being both a safety and economic consideration, highlighted the importance of optimizing electrical protection, and proper maintenance.

The afternoon session concluded with a presentation from Bas Verhoeven of DNVGL. Mr. Verhoevens’ presentation focused on the types of testing that could be performed, certification, and power system reliability and failures. The reliability/failure portion of the presentation focused on the types of equipment outages and failure rates during type testing.

The agenda for the second day was reversed to support a more detailed and focused discussion on the test parameters and equipment selection. A portion of the afternoon covered the phase II test plan overview and comment resolution. The day started with a presentation that identified the various parameters that influence the HEAF phenomena and an overview of the draft test matrix. After each parameter was introduced and background for the selection of the test parameter range given, the stakeholders were solicited for feedback and discussion. Parameters covered included: arcing duration, voltage, arcing current, power system configuration, arcing location, conductor gap (spacing), bus insulation, enclosure thickness, and bus duct configuration. Outcomes from these discussions included the proposed change in the low voltage arcing duration to 2 and 4 seconds, and to include a split of insulated and non-insulated bus for the bus duct experiments. As an outcome of the discussion, and as a suggestion from the participants, the various parameters and test characteristics identified were ranked for their importance to the HEAF phenomena. For each parameter, a discussion was held to clarify the meaning of the parameter, then following that discussion, the parameter was ranked either high, medium, or low, with respect to its importance to the HEAF phenomena. Those rankings are reproduced at the end of this memorandum in a tabular form. Not everyone in attendance voted, and not everyone voted for each issue. Votes received from the webinar were also included in the summary below.

Table 1. Summary of Parameter Ranking

Parameter	Importance Ranking High/Medium/Low	Comment
Duration	High (consensus)	
Voltage	High (consensus)	Arc voltage not system
Current	High (consensus)	
Arc Location (orientation)	5(high) 2(medium) 3(low)	More examination of the IEEE testing configuration
Grounding Config.	Low (consensus)	Important to frequency
Delta vs. Wye	Low (consensus)	experience that arc voltage has not shown a difference
Current Decay	5 High 6 Medium 3 Low	Plant information necessary for decay behavior
Enclosure Thickness	3 Medium 9 Low	
Bus Insulation (enclosure)	Low (consensus)	
Bus Insulation (non-segmented bus)	9 High 1 Medium	
Circuit Characteristics	2 High 7 Medium	Potentially included in earlier parameters, however needed for modeling
Bus Gap	11 High 1 Low	Linked to arc voltage; Low because of phase to phase interaction and other arc strike locations within the enclosure
DC offset	6 Medium 3 Low	
Ventilation (enclosure)	9 High 1 Medium	
Ventilation (bus duct)	3 Medium 7 Low	
Aluminum Alloy	1 High 8 Low	State of knowledge- High rank outlier
Measurement Separation Interval	High (consensus)	Target Locations and Positions
Atm. Conditions	1 Medium 10 Low	Important to frequency and initiation of event; unknown to consequence
Ventilation (oxygen availability; aluminum)	8 High 3 Medium	
Ventilation (oxygen availability; copper)	2 Medium 10 Low	

The session concluded with a presentation from Nicholas Melly on the updated draft test plan and an overview of the changes made from the public comments received. Nicholas provided detailed discussion on the experimental configuration and solicited feedback on the proposed location of various measurement devices.

Action Items/Next Steps:

- Follow up meetings and workshops will be held as needed. None are currently scheduled.
- EPRI has committed to provide the NRC with a generator decrement curve.
- The NRC is accepting comments on the small-scale draft test plan until May 4th, 2018 (Contact Gabriel.Taylor@nrc.gov)
- Volunteer pilot plants are needed for the Generic Issues process.
- Additional feedback on equipment selection for large-scale testing is still needed.

Attachments:

- Meeting Notice and Agenda (ML18103A058)
- List of Participants (ML18114A815)
- Presentation Slides (ML18108A210)
- Phase II Draft Test Plan (ML18102A604)
- Needs & Objectives (ML18081B300)
- Transcripts Day 1 (ML18114A817)
- Transcripts Day 2 (ML18114A818)