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October 5, 2021

MEMORANDUM TO: Michael X. Franovich, Director
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Office of Nuclear Regulatory Research

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SUBJECT: PROMPT SAFETY CONCERN DETERMINATION REGARDING
ALUMINUM ENHANCED HIGH ENERGY ARCING FAULTS

As described in its August 21, 2021 memo (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21237A360), the U.S. Nuclear Regulatory Commission (NRC) has exited the Generic Issues Process for aluminum enhanced high energy arcing faults (AL HEAFs), and entered into a regulatory process consistent with the LIC-504, "Integrated Risk-Informed Decision-making Process for Emergent Issues," Revision 5 (ADAMS Accession No. ML19253D401). The revised approach supports a more efficient resolution of the issue using a risk-informed process and aligns with the Be RiskSMART framework. The LIC-504 evaluation will use the best available HEAF technical information, along with available plant information. Consistent with the LIC-504 process, Phase 1 of the LIC-504 evaluation will reaffirm that no immediate safety issue exists. Phase 2 will assess if any longer-term regulatory actions are justified.

The purpose of this memorandum is to communicate the NRC staff's determination of whether AI HEAFs, constitute an immediate safety concern requiring prompt regulatory action, under Phase 1 of the LIC-504 process.

The enclosure to this memorandum is a summary of the staff's evaluation. This memorandum is an update to an earlier memorandum regarding this issue published on March 4, 2016 (ADAMS Accession No. ML16064A250).

Enclosure:
Discussion of Immediate Safety Concern –
Aluminum Enhanced High Energy Arcing Faults

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In summary, the staff has reviewed additional information from the ongoing Office of Nuclear Regulatory Research testing, operating experience, and collaborative research with the Electric Research Power Institute. After considering this additional information, the staff continues to believe that the increased zones of influence (in which targets are assumed to be damaged) of the AL HEAF hazard, in some scenarios, does not constitute an immediate safety concern that warrants prompt regulatory action.

Please contact me or Charles Moulton if you require any additional information.

SUBJECT: PROMPT SAFETY CONCERN DETERMINATION REGARDING ALUMINUM
ENHANCED HIGH ENERGY ARCING FAULTS DATED: 10/05/2021

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DISCUSSION OF IMMEDIATE SAFETY CONCERN –
ALUMINUM ENHANCED HIGH ENERGY ARCING FAULTS

Insights from an international collaborative research program identified that aluminum enhanced high energy arcing faults (AL HEAFs) may release more energy than expected and assumed in the current fire Probabilistic Risk Assessment methodology. Subsequent U. S. Nuclear Regulatory Commission (NRC) testing and collaborative research between the NRC's Office of Nuclear Regulatory Research (RES) and the Electric Research Power Institute (EPRI) provide additional information and insights to characterize the hazard. Based on this work, the NRC developed a revised zone of influence (ZOI) for the AL HEAF hazard. The revised AL HEAF ZOIs are larger for most bus duct scenarios, some medium voltage switchgear scenarios, and a limited number of low voltage switchgear scenarios. The risk impact from the scenarios with increased ZOIs will be configurational-based and plant-specific.

The following information provides the NRC staff's basis to conclude that there is no immediate safety concern regarding this issue and no prompt regulatory actions are warranted.

- Fire protection programs at nuclear power plants utilize the concept of defense-in-depth to assure that there are multiple barriers ensuring the ability to safely shut down a nuclear plant during and following a fire.
- Plant components, specifically properly designed, maintained, and functional fuses and circuit breakers, prevent high energy events or act to limit the extent of the HEAF ZOI by limiting the fault duration because the extent of HEAF ZOIs are dependent on the duration of the electrical fault.
- The new methodology includes the determination that 1-hour (and 3-hour) rated Electrical Raceway Fire Barrier Systems provide protection from HEAF events both in preventing ignition of, and damage to, protected cables. The underlined text is a change from the current methodology.
- Over half the nuclear fleet (those plants that did not adopt National Fire Protection Association (NFPA) Standard 805) is licensed using deterministic assumptions, which assume that any fire in the plant damages all unprotected equipment within a fire area. Sufficient equipment and capability have been provided to meet all required functions using protected equipment and equipment outside the fire area. The increased ZOI due to aluminum would not impact their analyses.
- Of the remaining plants (those that have transitioned to a risk-informed/performance-based fire protection program in accordance with Title 10 of the *Code Of Federal Regulations* (CFR) 50.48(c) and NFPA 805), a significant number of fire areas continue to demonstrate compliance using the same deterministic strategies they originally used prior to transition.
- In the current methodology, many targets are assumed to be damaged within the ZOI. The expansion of the ZOI will not result in a significant increase in risk for targets that were assumed to have already been damaged by the original ZOI.

Enclosure

- Preliminary results show decreases in the ZOI for some scenarios, and the new methodology being developed by the RES/EPRI working group is expected to confirm decreases in the ZOI for some scenarios. Some of these scenarios may partially offset the risk increases from those scenarios with an expanded ZOI.
- Plants have contingency plans for loss of large areas due to fire and explosions per the requirements of 10 CFR 10.155(b)(2).
- The NRC staff reviewed additional information from operating experience, ongoing RES testing, and collaborative research with EPRI, which did not change their earlier conclusion regarding whether AL HEAFs constitute an immediate safety concern.

After comprehensively considering previous and new information, the staff continues to believe that the potential increased zones of influence of the AL HEAF hazard, in some scenarios, does not constitute an immediate safety concern that warrants prompt regulatory action on the part of nuclear power plant licensees.