



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

November 23, 2021

MEMORANDUM TO: Jennifer Whitman, Chief
PRA Licensing Branch B
Division of Risk Assessment
Office of Nuclear Reactor Regulation

FROM: Siva P. Lingam, Project Manager */RA/*
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

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PRA Oversight Branch
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Office of Nuclear Reactor Regulation

SUBJECT: SUMMARY OF OCTOBER 20, 2021, PUBLIC WORKSHOP WITH
NUCLEAR ENERGY INSTITUTE, INDUSTRY, AND ELECTRIC
POWER RESEARCH INSTITUTE TO PROVIDE AN UPDATE ON
STAFF AND EPRI ACTIVITIES ASSOCIATED WITH THE HIGH
ENERGY ARCING FAULTS INVOLVING ALUMINUM
(EPID L-2021-NFO-0007)

On October 20, 2021, the U.S. Nuclear Regulatory Commission (NRC) staff held a Category 3 public meeting with Nuclear Energy Institute (NEI), Industry, and Electric Power Research Institute (EPRI) to provide a status and update on NRC and EPRI activities related to the potential safety-significance of aluminum high energy arcing faults (AI HEAF), and to achieve an understanding of NEI, Industry, and EPRI perspectives related to this topic. Additionally, this meeting was conducted to explain the use of the Office of Nuclear Reactor Regulation (NRR) Office Instruction LIC-504, "Integrated Risk-Informed Decisionmaking Process for Emergent Issues," to apply best available information and NRC risk assessment tools to determine whether any regulatory actions associated with potential safety-significance of AI HEAF should be considered to enhance public safety. The meeting notice and agenda, dated September 28, 2021, are available in the Agencywide Documents Access and Management System (ADAMS) under Accession No. ML21288A082. A list of attendees is provided in Enclosure 1.

The slides presented for this public meeting are available in ADAMS under Accession Nos. ML21291A179 and ML21293A007. A list of the panel members representing NRC, EPRI, NEI, Duke-Energy, and Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) mbH of Germany is included in Enclosure 2. A list of presenters is included in Enclosure 3. The meeting included a facilitated discussion between the panel members regarding relevant operating experience events, thus achieving the goal of the panel discussion. These discussions enabled the representatives to understand the varying views among key

stakeholders on how the presence of AI could lead to an increase in the risk from a HEAF event. During the meeting, the NRC staff informed the industry that the LIC-504 analyses use best available information to perform a realistic analysis of risk, and that industry's ability to share information could enhance the staff's ability to generate recommendations that are commensurate with the risk significance. Some members of industry indicated a willingness to provide NRC with current probabilistic risk assessment information to support more realistic NRC staff assessments associated with NRR Office Instruction LIC-504. The details of the meeting are discussed in Enclosure 4.

No comments were provided by members of the public. No regulatory decisions or commitments were made at the meeting.

Please direct any inquiries to me at (301) 415-1564 or by e-mail at Siva.Lingam@nrc.gov, or Michael Montecalvo at (301) 415-1678 or by e-mail at Michael.Montecalvo@nrc.gov.

Enclosures:

1. List of Attendees
2. List of Panel Members
3. List of Presenters
4. Meeting Details

LIST OF ATTENDEES

OCTOBER 20, 2021, PUBLIC MEETING WITH

NUCLEAR ENERGY INSTITUTE, INDUSTRY, AND

ELECTRIC POWER RESEARCH INSTITUTE

TO PROVIDE AN UPDATE ON STAFF AND EPRI ACTIVITIES ASSOCIATED WITH

HIGH ENERGY ARCING FAULTS INVOLVING ALUMINUM

Christian Araguas	U.S. Nuclear Regulatory Commission (NRC)
Scott Burnell	NRC
Stephanie Coffin	NRC
Glenn Dentel	NRC
Mike Franovich	NRC
Stanley Gardocki	NRC
Kenneth Hamburger	NRC
John Hughey	NRC
Matthew Humberstone	NRC
J.S. Hyslop	NRC
Meena Khanna	NRC
Andrea Kock	NRC
Robert Krsek	NRC
Siva Lingam	NRC
Sarah Lopas	NRC
David Loveless	NRC
Michael Mahoney	NRC
Nick Melly	NRC
Michael Montecalvo	NRC
Angel Moreno	NRC
Charles Moulton	NRC
Tony Nakanishi	NRC
Ching Ng	NRC
Lundy Pressley	NRC
Reinaldo Rodriguez	NRC
Andy Rosebrook	NRC
MarkHenry Salley	NRC
Neil Sheehan	NRC
Muzzamil Siddiqui	NRC
David Stroup	NRC
Mark Thaggard	NRC
Edgardo Torres	NRC
Shilp Vasavada	NRC
Sunil Weerakkody	NRC
Jennifer Whitman	NRC
Antonios Zoulis	NRC

Dr. Marina Röwekamp	Gesellschaft für Anlagen- and Reaktorsicherheit (GRS) gGmbH, Germany
Ashley Lindman	Electric Power Research Institute (EPRI)
Ferrante Fernando	EPRI
Marko Randjelovic	EPRI
Thomas Short	EPRI
Tina Taylor	EPRI
Kelli Voelsing	EPRI
Mark Woodby	EPRI
Victoria Anderson	Nuclear Energy Institute (NEI)
Andrew Mauer	NEI
Brett Titus	NEI
Jennifer Uhle	NEI
Jeffrey Ertman	Duke-Energy
Jack Lemmer	Duke-Energy
Robert Rishel	Duke-Energy
Greg Norris	Entergy
Jeffrey Stone	Exelon
Anthony Putorti	National Institute of Standards and Technology
Wayne Harper	Energy Northwest
Trevor McLaen	Energy Northwest
Chris LaFleur	Sandia National Laboratories
Austin Michael Glover	Sandia National Laboratories
Young Jo	Southern Nuclear Company
Brian Krystek	Engineering Planning and Management, Inc. (EPM)
Travis Weber	EPM
Matti Lehto	STUK International, Finland
Rodney Pletz	Unknown
Jason Floyd	Jensen Hughes
Victor Ontiveros	Jensen Hughes
Chico Pellizari	EPM
Robert Rhodes	Unknown
Steve Turner	Consultant
Andy Zach	U.S. Senate Environment and Public Works Committee

Note: Several personnel from the Industry also attended (not able to capture the names by phone numbers in the Microsoft Teams).

LIST OF PANEL MEMBERS
OCTOBER 20, 2021, PUBLIC MEETING WITH
NUCLEAR ENERGY INSTITUTE, INDUSTRY, AND
ELECTRIC POWER RESEARCH INSTITUTE
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HIGH ENERGY ARCING FAULTS INVOLVING ALUMINUM

Victoria Anderson	Nuclear Energy Institute
Mike Franovich	U.S. Nuclear Regulatory Commission (NRC)
Nick Melly	NRC
Robert Rishel	Duke Energy
Dr. Marina Röwekamp	Gesellschaft für Anlagen- and Reaktorsicherheit (GRS) gGmbH, Germany
Kelli Voelsing	Electric Power Research Institute

LIST OF PRESENTERS
OCTOBER 20, 2021, PUBLIC MEETING WITH
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Victoria Anderson	Nuclear Energy Institute
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Nick Melly	NRC
Michael Montecalvo	NRC
Robert Rishel	Duke Energy
Dr. Marina Röwekamp	Gesellschaft für Anlagen- and Reaktorsicherheit (GRS) gGmbH, Germany
Kelli Voelsing	Electric Power Research Institute
Sunil Weerakkody	NRC

MEETING DETAILS
OCTOBER 20, 2021, PUBLIC MEETING WITH
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TO PROVIDE AN UPDATE ON STAFF AND EPRI ACTIVITIES ASSOCIATED WITH
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Purpose

The purpose of this public workshop between the U.S. Nuclear Regulatory Commission (NRC) staff, the Nuclear Energy Institute (NEI), Industry, and the Electric Power Research Institute (EPRI) was to provide a status and update on NRC and EPRI activities related to the potential safety-significance of aluminum high energy arcing faults (AI HEAF), and to achieve an understanding of NEI, Industry, and EPRI perspectives related to this topic. Additionally, this meeting was conducted to explain the use of the Office of Nuclear Reactor Regulation (NRR) Office Instruction LIC-504, "Integrated Risk-Informed Decisionmaking Process for Emergent Issues" (Agencywide Documents Access and Management System (ADAMS) Accession No. ML19253D401), to apply best available information and NRC risk assessment tools to determine whether any regulatory actions should be considered regarding the potential safety-significance of AI HEAF to enhance public safety.

Background

Insights from review of U.S operating experience (NRC Information Notice 2017-04, "High Energy Arcing Faults in Electrical Equipment Containing Aluminum Components," dated August 21, 2017 (ADAMS Accession No. ML17058A343) and an international collaborative research program identified that AI HEAFs may release more energy than expected and assumed in the current fire probabilistic risk assessment (PRA) methodology. Subsequent NRC testing provided additional information and insights to characterize the hazard. The NRC used a modified Institute of Electrical and Electronic Engineers 1584 methodology to develop a preliminary revised zone of influence (ZOI) for the AI HEAF hazard, which indicated that the revised ZOI may be larger than the ZOI in the current fire PRA methodology in some fire scenarios. The risk impact from the fire scenarios with increased ZOIs will be configuration based and plant specific.

As described in its August 21, 2021, memo (ADAMS Accession No. ML21237A360), the NRC has exited the Generic Issues Program for AI HEAFs and entered into a regulatory process consistent with NRR Office Instruction LIC-504. The revised approach supports a more efficient resolution of the issue using a risk-informed process and aligns with the Be RiskSMART framework. As stated above, the LIC-504 evaluation will use the best available HEAF technical information, along with available plant information.

The NRC staff has reviewed additional information from the ongoing RES testing, operating experience, and collaborative research with EPRI. After considering this additional information, the staff continues to believe that the increased ZOI of the AL HEAF hazard, in some scenarios,

does not constitute an immediate safety concern that warrants prompt regulatory action (ADAMS Accession No. ML21272A262).

The NRC staff will continue to work with EPRI under the memorandum of understanding on Fire Research to advance the state of knowledge for evaluating A HEAFs in PRAs.

The NRC staff will assess if any longer-term regulatory actions are justified based on the detailed LIC-504 evaluation.

NRC Observations of the Workshop

- The agenda included a facilitated panel that included the NRC, an international expert, NEI, EPRI, and a member of industry speaking on operating experience related to HEAF as well as an update from the NRC staff on the risk-informed process we are using to evaluate the issue.
- The workshop had a large number of participants, including numerous members of industry and several public stakeholders. There were no comments or questions from members of the public at the end of the meeting.
- The intended purposes of the workshop, which were to facilitate a better understanding of the perspectives and interpretation of the operating experience and to convey the status of our efforts, were achieved.
- The NRC staff emphasized that the agency has not taken positions on how plant operating experience may affect previous estimates of ZOIs as a result of AI HEAF. The staff has not made any conclusions at this time, and have reaffirmed that there is no need for any prompt regulatory actions.
- Based on the EPRI Industry survey and analysis of U.S. plants, there appears to be a small subset of plants that AI-HEAF may pose a risk concern. The staff does not know the identities of these plants (<https://www.epri.com/research/programs/061177/results/3002020692>).
- It is not possible or appropriate to draw definitive conclusions from single specific events (increased risk or not) based on limited information and different plant configurations. The NRC staff clarified that we are not using specific events alone or information in isolation to conclude the need for any regulatory action. Rather, the staff is using insights from operating experience and testing to refine the approaches and considerations taken, thus far, as part of its evaluation.
- While there was a diversity of views regarding the potential increased risk associated with AI HEAF, participants came away with a better understanding of these perspectives and the reasons behind them.
- The NRC staff provided an overview of the LIC-504 process and how it will allow NRC to move forward in an expeditious and risk-informed manner.

Meeting Details

The panel members provided the following presentations:

Kelli Voelsing of EPRI concluded her presentation with the following highlights:

- Aluminum exists in all U.S. plants and in many components.
- Detailed survey results on the location and types of structures, systems, and components (SSCs) containing AI provide valuable information for the purpose of informing NRC RES proposed testing on HEAFs.
- The presence of AI is not directly related to increased risk.
- Actual changes in plant risk from AI involved in HEAFs cannot be determined until realistic ZOIs are determined and applied with the newly developed fire PRA modeling guidance for HEAFs.
- The EPRI bounding assessment using the current fire PRA data and draft methodology provide high confidence that for a large portion of the U.S. plants, the presence of AI would likely have limited impact.

Dr. Marina Rowekamp of Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) gGmbH, Germany, and Senior member of the Organization for Economic Co-operation and Development/Nuclear Energy Agency Fire Incidents Records Exchange (OECD/NEA FIRE) database and HEAF projects, addressed HEAF events that occurred in the early 2000s at Maanshan (Taiwan) and in 2011 at Onagawa (Japan). She also provided international insights from HEAF operating experience with the following highlights:

- The OECD/NEA FIRE database is a collection of fire events in nuclear power plants of 14 countries from Asia, Europe, and North America.
- Operating experience indicates significance of HEAF as an important phenomenon for causing ensuing fires at the component where the HEAF occurred, but also as an event combination with other events.
- HEAF needs to be considered in design and operation of nuclear installations.

Victoria Anderson of NEI provided NEI's perspectives on HEAF stating that AI HEAF is not a safety concern based on robust cables, 100,000s of component operating years with aluminum widespread, and no increased ZOI noted with operating experience.

Robert Rishel of Duke Energy presented Shearon Harris and Robinson operating experience expressing that ZOI damage was less than predicted by current guidance, damage to SSCs was limited to the associated cabinet/enclosure, and a nearby cable tray was degraded but remained functional.

Nick Melly of NRC/RES shared the operating experience describing the events at Fort Calhoun, Unit 1; Columbia; Diablo Canyon, Unit 1; Kewaunee, Unit 1; and Shearon Harris, Unit 1. Panel members and others discussed these events and provided their views.

After panel members' presentations, Kenneth Hamburger of NRC/RES updated the NRC/EPRI Working Group (WG) activities as noted below:

- Characterize the primary factors that influence the occurrence and severity of arcing fault events (arc flash, arc blast, or HEAF)

- Develop tools and methods to assess the risk posed by arcing fault events based on experimental data, operating experience, and engineering judgment

Mr. Hamburger also summarized the WG deliverables and schedule to be completed by summer 2022.

Sunil Weerakkody and Michael Montecalvo of NRC/NRR explained the NRR LIC-504 process and the state of progress of its assessment, citing examples of recommendations from recent LIC-504 assessments.

Stephanie Coffin, Deputy Director for RES and Andrea Kock Deputy Director for NRR provided opening and closing remarks respectively, emphasizing that this public workshop was held to hear the opinions from various related organizations and present the NRC perspectives on the ongoing risk evaluation of AI HEAF and reiterated a few of the key messages conveyed in the NRC Observations, above.

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JHughey, NRR	HMarchlewski, OCHCO
MHumberstone, RES	CNolan, OEDO
	RWilliams, OEDO

ADAMS Accession Nos.:

Packages: ML21291A179 and ML21293A007

Meeting Notice: ML21039A199

Meeting Slides: ML21291A180, ML21291A181, ML21291A182, ML21291A183
ML21291A184 (non-public), ML21291A185, ML21293A009, and
ML21293A008

Meeting Summary: ML21316A225

***by e-mail**

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OFFICE	RES/DRA/FXHAB/BC*	NRR/DRA/APLB/BC	NRR/DORL/LPL4/PM*
NAME	MSalley	JWhitman	SLingam
DATE	11/18/21	11/23/21	11/23/21

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