



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

April 19, 2023

MEMORANDUM TO: Steven T. Lynch, Chief
Advanced Reactor Policy Branch
Division of Advanced Reactors and Non-Power
Production and Utilization Facilities
Office of Nuclear Reactor Regulation

FROM: Jordan P. Hoellman, Project Manager
Advanced Reactor Policy Branch
Division of Advanced Reactors and Non-Power
Production and Utilization Facilities
Office of Nuclear Reactor Regulation

A handwritten signature in black ink, appearing to read "Jordan P. Hoellman".

Signed by Hoellman, Jord
on 04/19/23

SUBJECT: SUMMARY OF FEBRUARY 23, 2023, AND MARCH 16, 2023,
WORKSHOPS ON INSTRUMENTATION AND CONTROLS
LICENSING FRAMEWORK FOR ADVANCED REACTORS

On February 23, 2023, the U.S. Nuclear Regulatory Commission (NRC) staff held an Information Meeting with Question and Answer public meeting with representatives from industry, including the Nuclear Energy Institute (NEI), the national laboratories, and members of the public to discuss the instrumentation and controls (I&C) licensing framework for advanced reactors. The NRC staff posted the meeting notice on the NRC's public website and the NRC staff presentation is available in the NRC's Agencywide Documents Access and Management System (ADAMS) at Accession No. ML23053A291. The industry presentation is available at ADAMS Accession No. ML23061A029. Enclosure 1 lists the meeting attendees who participated remotely.

The NRC staff provided an overview of the Licensing Modernization Project (LMP), as described in NEI 18-04, Revision 1, "Risk-Informed Performance-Based Technology Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development" (ML19241A336), and endorsed in Regulatory Guide (RG) 1.233, "Guidance for a Technology-Inclusive, Risk-Informed and Performance-Based Methodology to Inform the Licensing Basis and Content of Applications for Licenses, Certifications, and Approvals for Non-Light Water Reactors" (ML20091L698), and ongoing activities under the NRC-led Advanced Reactor Content of Applications Project (ARCAP). The NRC staff discussed its implementation of core review team approaches in reviewing applications for advanced reactors to maximize the benefits of risk-informed reviews, noting that I&C staff would be integrated with those core review teams.

Enclosure:
List of Attendees

CONTACT: Jordan Hoellman, NRR/DANU
301-415-5481

In February 2021, the NRC staff issued, “Design Review Guide (DRG): Instrumentation and Controls for Non-Light-Water Reactor (Non-LWR) Reviews” (ML21011A140), which will be referenced in ARCAP and factors in the principles in RG 1.233. The NRC staff’s presentation discussed the relationship between LMP, ARCAP, and the DRG as part of the NRC’s efforts to streamline reviews of future license applications and to ensure common understanding amongst the NRC staff, potential applicants, and the public.

Industry prepared some specific questions related to the relationship between the LMP process and the DRG, which is presented in industry’s presentation. The questions are reproduced below with a summary of the NRC staff’s responses. The NRC staff provided an open forum for discussion on each question and for various industry and public views to be presented and discussed.

Related to the DRG, industry posed two questions.

Question 1: Please clarify any dependencies between NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition,” (or NUREG-1537, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors,”) and the DRG. Our understanding is the DRG is mutually exclusive of any other review guidance.

The NRC staff responded that, yes, the DRG was developed in a manner that is mutually exclusive of any other review guidance such as NUREG-0800 and NUREG-1537. Nonetheless, the DRG was developed based on the I&C reviews of past new light-water reactor (LWR) designs using NUREG-0800 and using the Design-Specific Review Standard (DSRS) initially developed for NuScale.

Question 2: For advanced reactor designs that are considered LWR plant designs, please provide clarification whether there are any restrictions to the use of the DRG.

The NRC staff responded that the DRG is technology-inclusive and can be used for applications for LWR designs and for designs that do not implement the LMP. The NRC staff noted that in such cases, the prospective applicant should engage the NRC staff early during the pre-application stage for common understanding. Because the DRG was developed for applications that follow the LMP to establish the licensing basis of a plant including I&C, there should be interactions with the NRC staff on the applicant’s approach to establish the licensing basis of its design including I&C, how it plans to use the DRG, and how the NRC staff can adjust its review when using the DRG.

Related to licensing basis events (LBEs) defined in the LMP, industry posed two questions regarding the structure, system, and component (SSC) classification for beyond design basis events (as defined in NEI 18-04).

Question 1: LMP (and NEI 18-04, Figure 3-1 (Frequency-Consequence Target)) requires a quantitative PRA [probabilistic risk assessment] approach to determine Licensing Basis Events (LBEs); however, there is no consensus standard for determining software reliability quantitatively. Overly conservative quantitative values may result in software classification of LBEs and/or associated SSC safety classification. Does the NRC plan to provide guidance on how to consider software reliability in the LBE selection process?

The NRC staff responded that no plan exists at this time. The NRC staff noted that if there is such a need for additional guidance, the NRC staff would like to understand the details including the urgency and significance. The NRC staff noted that industry may develop such guidance for NRC endorsement or that the NRC staff can investigate such an effort.

The NRC staff issued SECY-22-0076, "Expansion of current policy on potential common-cause failures in digital instrumentation and control systems," in August 2022 (ML22193A290) to request that the Commission expand the current policy for digital I&C common cause failures (CCFs) to allow the use of risk-informed approaches to demonstrate the appropriate level of defense-in-depth (DID), including not providing any diverse automatic actuation of safety functions. The proposed expanded policy encompasses the current points of Staff Requirements Memorandum (SRM) to SECY-93-087 (with clarifications) and expands the use of risk-informed approaches in points 2 and 3. The current policy will continue to remain a valid option for licensees and applicants. Further, the NRC staff noted that its goal is to provide more flexibility in addressing the digital I&C CCF challenge while continuing to ensure safety.

Additionally, the NRC staff discussed that the LMP process is an iterative, integrated, risk-informed and performance-based approach through which identification of LBEs or event sequence families (i.e., initiating events followed by successes and failures of SSCs), SSC classification and special treatment, and DID adequacy are systematically evaluated. NEI 18-04 and NEI 21-07, Revision 1, "Technology Inclusive Guidance for Non-Light Water Reactor Safety Analysis Report: For Applicants Utilizing NEI 18-04 Methodology" (ML19241A336), discusses the combination of the targets and the resulting special treatments providing a means to address assumptions, limitations, and uncertainties in PRA results. If software reliability is an issue of significance and large uncertainty, the LMP process leads to steps that consider affected LBEs and their uncertainties, SSC classification and associated special treatment along with capability and reliability targets, and DID adequacy evaluation. Issues such as software reliability, if difficult to quantify or having large uncertainty, the LMP process may provide a more integrated approach that may provide a logical solution or decisions on design and special treatment. The LMP process also has an integrated decision-making process (IDP) where the IDP panel reviews and makes decisions on the LBEs, SSC classification and special treatment, and DID adequacy. Further, all modeled SSCs and human actions in the PRA in support of the LMP process should be according to Trial-use RG 1.247, "Acceptability of Probabilistic Risk Assessment Results for Advanced Non-Light Water Reactor Risk-Informed Activities" (ML21235A008), which endorses ASME/ANS RA-S-1.4-2021, "Probabilistic Risk Assessment Standard for Advanced Non-Light Water Reactor Nuclear Power Plants," with exceptions and clarification and NEI 20-09, "Performance of PRA Peer reviews Using the ASME/ANS Advanced NLWR PRA Standard" (ML21125A284).

Question 2: The LMP process presents a use case where safety-related SSCs may be required to mitigate CCF; however, Commission policy, and current practice among operating LWR plants, categorically allows the use of non-safety-related SSCs (SRM-SECY-93-087 Positions 3 and 4). Can non-safety functions be used to mitigate the effects of CCF as is currently implemented among operating LWR plants? Provide clarification regarding the acceptance criteria for strategies used to address CCF, such as diversity, and associated safety classification.

The NRC staff noted that this question is likely broader than I&C systems and that the NRC staff can work with prospective applicants on the issue. The LMP process in RG 1.233, which has

been endorsed by Commission in SRM-SECY-19-0117, is regulatory guidance, not a regulatory requirement. If the LMP result on CCF is consistent with SRM-SECY-93-087, the NRC staff noted that there should generally be no issue. If there is a difference, the NRC staff encourages prospective applicants to engage the NRC staff in pre-application discussions when these issues are discovered.

Related to special treatment criteria for non-safety-related with special treatment (NSRST) SSCs (as defined in NEI 18-04), industry posed one question. Industry noted that they had additional questions related to NSRST SSCs that could be deferred to a future workshop because additional time may be needed for those discussions.

Question 1: Are NSRST criteria limited to the sections that are specified, or should the entirety of the DRG be considered?

The NRC staff responded that as shown in Figure X-2 (Overall I&C Review Approach) and discussed in Section X.0.2 (Overall Review Approach) of the DRG, the NRC staff review focuses on those safety-significant functions and the SSCs selected to meet those functions. Safety-significant functions include those classified as risk-significant or credited for DID adequacy. The NRC staff noted that per NEI 18-04, non-safety-related SSCs performing risk-significant functions or functions required for DID adequacy are considered NSRST SSCs. DRG Sections X.2.2.1.1 (Independence), X.2.2.2.1 (Quality), and Appendix A (System Characteristics) include statements regarding “safety-related I&C systems and I&C systems that are not safety-related but warrant special treatment” in lieu of referring to “safety-significant functions,” which includes both types of systems. However, it does not mean that the NSRST criteria are limited only to these sections and appendix. Instead, the entirety of the DRG should be considered to confirm that the safety-significant functions, and the corresponding SSCs, adequately support the overall plant-level or I&C system-level performance objectives. The NRC staff noted that depending on the application, the design, risk insights, and other factors, the NRC staff can customize the review accordingly. In general, the NRC staff’s review focus will be areas of most risk significance (i.e., those LBEs that are closer to the frequency-consequence target in NEI 18-04).

The meeting ended with an open discussion. Both the NRC staff and industry acknowledged that they appreciated the dialogue and discussion during the workshop and that they were looking forward to future workshops to further discuss industry questions. The NRC staff requested feedback on how these meetings can be more engaging and how to increase participation by prospective applicants.

On March 16, 2023, the NRC staff continued its public workshops on the I&C licensing framework for advanced reactors in a hybrid meeting with representatives from industry, the national laboratories, and others. The NRC staff posted the meeting notice on the NRC’s public website and it is available in ADAMS under Accession No. ML23062A720. This workshop continued discussions related to specific industry questions regarding the LMP implementation for the design of I&C systems. The discussion centered around implementation of the design basis accident (DBA) analysis described in NEI 18-04 and design considerations for safety-related and NSRST equipment. The NRC staff noted that the LMP methodology provides applicants with the flexibility to provide an appropriate balance of prevention and mitigation techniques to ensure plant safety, which results in less prescriptive requirements for particular SSCs, including I&C systems. Furthermore, the NRC staff noted that the industry questions regarding the LMP implementation are broader than I&C systems. Therefore, this is a topic that warrants further discussions and the involvement of NRC and industry representatives from

other disciplines. The NRC staff and industry agreed that further discussion would be useful to specifically examine the LMP implementation of the DBA analysis to ensure common understanding and to understand the challenges more fully in a future workshop.

The NRC staff provided additional clarity on an NRC area of interest related to remote operations and control rooms, noting that the NRC staff is interested in the concepts being considered by potential applicants. Understanding the concepts being considered will help the NRC staff proactively address gaps in existing guidance and enhance the NRC's effectiveness and efficiency in future licensing reviews. The NRC staff noted that they are initiating an effort to explore these concepts of operation from human factors engineering perspectives and encouraged stakeholders to continue participation in this work. The NRC staff and industry agreed that representation from additional technical disciplines, including probabilistic risk analysts and human factor engineers, would benefit future workshop discussions.

The NRC staff discussed plans for future workshops to engage on specific areas, including the use of alternative international I&C safety standards. The NRC staff is planning for its next public workshop in April to continue discussions on specific areas, including the use of alternative international I&C safety standards.

SUBJECT: SUMMARY OF FEBRUARY 23, 2023, AND MARCH 16, 2023, WORKSHOPS ON INSTRUMENTATION AND CONTROLS LICENSING FRAMEWORK FOR ADVANCED REACTORS DATED: APRIL 19,2023

DISTRIBUTION:

PUBLIC

RidsNrrDanu Resource

RidsNrrDanuUarl Resource

RidsNrrDanuUarp Resource

RidsNrrDex Resource

SLynch, NRR

JHoellman, NRR

JPaige, NRR

IGarcia, NSIR

IJung, NRR

DTaneja, NRR

JAshcraft, NRR

MWaters, NRR

RAlvarado, NRR

CCheung, NRR

GOberson, NRR

MHayes, NRR

ADAMS Accession No.: ML23082A319

NRC-001

OFFICE	NRR/DANU/UARP/PM	NRR/DANU/UARP/BC	NRR/DANU/UARP/PM
NAME	JHoellman	SLynch	JHoellman
DATE	3/24/2023	4/19/2023	4/19/2023

OFFICIAL RECORD COPY

PUBLIC MEETING
U.S. NUCLEAR REGULATORY COMMISSION
Thursday, February 23, 2023
1:00 p.m. – 3:00 p.m. EST

List of Attendees* (remote)
Hoellman, Jordan
Stacia (Guest)
Zhao Chang Zeng
Kenneth Deutsch
William Catullo
Alan Smith (Guest)
Joseph Ashcraft
Mark Burzynski (GE Power Portfolio, consultant)
Mohammad Alavi (GA) (Guest)
Christopher P. Chwasz
Dinesh Taneja
Matthew A Shakun
Christopher Phillips
Rossnyev Alvarado (She/Her)
Joseph Sebrosky
Alan Campbell (NEI)
Tom Case (Guest)
Jana Bergman
Michael Waters
Steve Kincaid Kairos Power (Guest)
Nanette Valliere (She/Her/Hers)
Ryan Marcum
Amanda Spalding
Amy Cabbage
Larry Valmonte
Samir Darbali
L Bieldt (XE) (Guest)
Christopher Sommer
John Bolin (GA) (Guest)
Justin Vazquez (He/Him)

List of Attendees* (remote)
Tony Nakanishi
Robert Arteaga
Steven Lynch
Baofu Lu (Guest)
Greg Oberson (He/Him)
Susan Gallier
Beth Reed
Sean Kelley (GE Power Portfolio, consultant)
Chris Crefeld (Guest)
Calvin Cheung
Ted Quinn (Guest)
Boyce Travis
Shelby Small (GE Power Portfolio)
Larry Parme (Guest)
Frank Hope
Wendy Reed
Gilberto Blas Rodriguez
Juan Jimenez (Guest)
Adrian Muniz
Lee Maccarone
Bobby Kunkle (Guest)
Brandon Norris (X-energy) (Guest)
Mark Krzyzaniak (AES) - KINECTRICS AES
Jason Paige
Farshid Shahrokhi (FRA-CORP)
Mike Dunevant (TerraPower) (Guest)
Norbert Carte
Wesley Steh (Guest)
Robert J Atkinson (Services - 6)
Mike Innes (Guest)
Ossy Font
Aaron Holloway
Scott Tonsfeldt
Stephen Philpott

List of Attendees* (remote)
Shayan Shahbazi
Daniel Watson
Juan Jimenez (X-energy) (Guest)
Yong Chang Liu
Maggie Staiger (Guest)
Anders Gilbertson (He/Him/His)
Steven Reynolds
Jack Zhao
Meek, Oscar (GE Power Portfolio)
Elliott Korb (Guest)
Jessica Maddocks (X-energy) (Guest)
Kurt Harris
Hangbok Choi (Guest)
Steven Arndt
Michael Ellett (Guest)
Brett Banks (Guest)
Matt Gibson
Ismael Garcia
Matt Hertel (X-energy) (Guest)
Erin Wisler (Contractor) (Guest)
Matthew Dennis
Ming Li
Steve Vaughn (Guest) - X-energy, LLC
Mary H Miller (Services - 6)
William Kennedy
Lisa Peterson
Luis Betancourt
Steven Pope
Willie M. Crawford, CMOVAMC
Thomas Braudt (Guest)
Clayton Crouch (Services - 6)
W. Bennett (Guest)
John Segala
mike (Guest)

List of Attendees* (remote)
phil (Guest)
b b c (Guest)
Christina Antonescu

* Attendance list based on Microsoft Teams Participant list. List does not include 3 individuals that connected via phone.

**PUBLIC MEETING
U.S. NUCLEAR REGULATORY COMMISSION
Thursday, March 16, 2023
8:30 a.m. – 10:00 a.m. EST**

List of Attendees (in-person)
Jordan Hoellman (NRC)
Michael Waters (NRC)
Samir Darbali (NRC)
Dinesh Tenaja (NRC)
Steve Lynch (NRC)
Ian Jung (NRC)
Steve Kincaid (Kairos Power)
Shelby Small (General Electric-Hitachi)
Paul Hunton (Idaho National Laboratory)
Lon Dawson (Sandia National Laboratories)
Ted Quinn (Paragon Energy Solutions)
Alan Campbell (Nuclear Energy Institute)
List of Attendees* (remote)
James O'Driscoll
David Desaulniers
Richard M Paese
Jana Bergman
Mary H Miller (Services - 6)
Wesley Steh (Guest)
Joseph Ashcraft
Joseph Sebrosky
Niav Hughes Green (She/Her)
Amy Cabbage
Rob Burg
Mark Burzynski (Guest)
Matthew A Shakun
William Catullo
Jesse Seymour
Calvin Cheung
Warren R Odess-Gillett

List of Attendees (in-person)
Stephen Fleger
Alan Smith (Guest)
Sarah Fields (Guest)
Kelly Dickerson (She/Her)
Skip Butler (GE Power Portfolio)
Erin Wisler (Guest)
Amanda J Spalding
Christopher Phillips
Francis J Mascitelli (Constellation Nuclear)
Brian Green (He/Him)
Gilberto Blas Rodriguez
Ismael Garcia
Sean Kelley (GE Power Portfolio, consultant)
Allen R Fisher (GE Power Portfolio)
Christopher Sommer
Mike Dunevant (TerraPower) (Guest)
Stacia Van Linden (Guest)

* Attendance list based on Microsoft Teams Participant list. List does not include 1 individual that connected via phone.