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To: michael.tschiltz@gmail.com; Justin Wheat
Cc: Afzali, Amir
Subject: NRC Feedback for X-energy TIRICE tabletops
Attachments: NRC Observations of X-energy TIRICE Tabletop exercises.docx

Justin and Mike,

Attached is the document detailing the NRC staff's feedback for the June 13-15, 2022, X-energy TIRICE tabletops. This NRC feedback will be made publicly available in the next couple days.

Please let me know if you have any questions.

Mike

Michael D. Orenak, Project Manager
Advanced Reactor Licensing Branch 1 (UAL1)
NRR – Division of Advanced Reactors and Non-Power Production and Utilization Facilities (DANU)
301-415-3229
Michael.Orenak@nrc.gov

Hearing Identifier: NRR_DRMA
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From: Orenak, Michael

Created By: Michael.Orenak@nrc.gov

Recipients:
"Afzali, Amir" <AAFZALI@southernco.com>
Tracking Status: None
"michael.tschiltz@gmail.com" <michael.tschiltz@gmail.com>
Tracking Status: None
"Justin Wheat" <jwheat@enercon.com>
Tracking Status: None

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Nuclear Regulatory Commission Observations Associated with the, "Technology Inclusive Risk Informed Change Evaluation (TIRICE) for Non-Light Water Reactors," X-energy Tabletop Exercises

Contents

Purpose

The purpose of this document is to provide the Nuclear Regulatory Commission (NRC) staff observations of a series of tabletop exercises for the proposed Technology Inclusive Risk Informed Change Evaluation (TIRICE) For Non-Light Water Reactors that were held June 13-16, 2022. TIRICE's purpose is to provide supplemental guidance for determining if NRC staff approval is required before implementing certain facility changes to advanced reactors that were licensed using the methodologies in NEI 18-04, "Risk-Informed Performance-Based Technology Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development," and NEI 21-07, "Technology Inclusive Guidance for Non-Light Water Reactors - Safety Analysis Report Content for Applicants Using the NEI 18-04 Methodology." The purpose of the TIRICE tabletop exercises was to exercise Revision B of the TIRICE process so that the process can be improved.

The NRC staff observed the X-energy tabletop exercise on June 13-15, 2022, and made the observations contained in the following sections. The NRC staff is providing these observations to industry for their consideration and will be the subject of future interactions with industry on the TIRICE process and guidance document. The Natrium tabletop exercise is currently scheduled for July 18-22, 2022, and some NRC staff and contractors also plan to attend this tabletop and will provide additional observations to industry following completion of the tabletop.

NRC Staff Observations Associated with June 13, Example 6a, Human Error Analysis Methodology, TIRICE Tabletop Exercise

General Observations

I. The NRC staff observed that the postulated change in human error analysis methodology, which is an element of the plant's probabilistic risk assessment (PRA), is not subject to the change control under 10 CFR 50.59, "Changes, tests and experiments," thus being 'not applicable,' which, as a next step, leads to application of other regulatory processes. Broadly, the white paper suggests that any PRA changes not be subject to the 10 CFR 50.59 change control process but instead be subject to the process in ASME/ANS RA-S-1.4-2021 (i.e., the PRA Standard, endorsed by Regulatory Guide (RG) 1.247 in 2022), as committed to by the licensee, which can be subject to NRC audit and inspection. The NRC staff provides the following observation:

    - Since the PRA for the reactor designs that follow the risk-informed and performance-based approach in 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," (which endorses NEI 18-04) is used to inform the licensing basis of the plant, there may be a need for some of the more significant changes that impact an element of the PRA to be reviewed and approved by the NRC staff before they are implemented. Since industry's view expressed during the exercise of this example was that all changes that impact an element of the PRA should be handled in accordance with the PRA Standard, additional discussion would be beneficial regarding the scope of such significant changes and the regulatory process to be used for the NRC staff review and approval of such changes. The additional discussion should explore the PRA Standard change process to ensure it sufficiently addresses regulatory

interactions for significant changes of an element of the PRA which may include aspects such as: (1) the use of new or different system analysis model, radiological consequence analysis model, and so forth; (2) the use of new or different PRA modeling methods (e.g., a new modeling technique for multi-module PRA; (3) the use of new or different hazard analysis methods (e.g., a new approach to the probabilistic seismic hazard analysis); and (4) other changes that could produce results that significantly impact the set of licensing basis events, classification and special treatments of the structures, systems, and components (SSCs), or the defense-in-depth (DID) adequacy.

II. The NRC staff's understanding is that the PRA Standard change process does not address when a change that impacts an element of the PRA would require NRC staff review and approval. The draft TIRICE guidance seems to assume additional guidance will be developed as a separate future activity to address questions specific to changes to the PRA and possible thresholds for seeking NRC approvals. The staff would like to have additional discussion on how to proceed with its review of TIRICE and how potential endorsement would be contingent upon a separate process to be developed for assessing plant changes for PRA implications and requirements for when such changes may warrant NRC review and approval. In lieu of a separate effort, could a process be built from the experience with large light water reactor licensing actions, such as the change control provisions within the license conditions for adoption of NFPA 805, and incorporated into TIRICE?

III. Looking forward to the upcoming Natrium tabletop and discussions, it would be useful to consider exercising additional examples of plant changes that would result in an increase in consequences or an increase in both frequency and consequences. While the staff agrees that many assessments will be able to use bounding type assumptions, it might also be helpful to include examples where either initial margins are smaller or changes decrease margins to a point of challenging or exceeding the proposed criteria. Such examples could introduce assessments beyond those using bounding-type assumptions and provide useful insights on the criteria to be included in the guidance.

IV. Additional discussion would be beneficial on design changes that might increase the consequences of licensing basis events when a design objective—such as using 1 rem for DBEs and BDBEs to justify alternative emergency planning zones—has been used in the analyses. One possible solution is through TIRICE proposing an additional criterion for "risk significant" to supplement the definition in NEI 18-04.

NRC Observations Associated with June 13, Example 1, Steam Generator Tube TIRICE Tabletop Exercise

General Observations

I. The DID change process is captured in the Safety Analysis Report (SAR) according to the guidance in Technology-Inclusive Content of Application Project (TICAP) and NEI 18-04. The NRC staff would be comfortable with including the DID change process in the TIRICE document and not in the SAR in the future if this is something industry would want to pursue. Would the SAR reference the TIRICE document instead of providing the DID process within?

NRC Observations Associated with June 14, Example 2, Helium Circulators TIRICE Tabletop Exercise

General Observations

I. The NRC staff does not have any specific comments for this example.

NRC Observations Associated with June 14, Example 3a, PSRV valve testing TIRICE Tabletop Exercise

General Observations

I. The NRC staff does not have any specific comments for this example.

NRC Observations Associated with June 14, Example 7, computer code TIRICE Tabletop Exercise

General Observations

I. Because of the increasing prevalence of PRA methods used in various evaluations performed for nuclear plants, additional discussion might be valuable to further define the scope of the analyses that are considered to be part of the PRA. For example, the PRA will include the frequency determinations for event sequences and plant response models that determine source terms (e.g., mechanistic source term), atmospheric dispersion models, and perhaps other considerations such as probabilistic fracture mechanics (PFM). The current proposed TIRICE screening criteria have the potential to provide a broad umbrella for screening out PRA methods. The additional discussions should identify relevant examples to help define of the scope of PRA methods that would fall under this umbrella and therefore be subject to being screened out. It may be useful for the guidance to point to where the change control is provided for those supporting analyses not included in the PRA methods (e.g., deterministic analyses on the performance of a specific SSC).

II. The proposed change to (g) introduces a potential issue for codes or methods used in both PRA and design basis accident analyses. As currently worded, if a code or method is used as part of the PRA analysis, it would be evaluated solely under the PRA Standard change process. The TIRICE wording should make it clear that changes to codes or methods used in design basis accident analyses are evaluated by the 50.59 equivalent criteria in TIRICE, regardless of any evaluation within the PRA analysis and its associated change process.

NRC Observations Associated with June 15, Example 3b, Dump Valve TIRICE Tabletop Exercise

General Observations

I. The NRC staff does not have any specific comments for this example.

NRC Observations Associated with June 15, Example 5, Startup/Shutdown Pump Manual Action TIRICE Tabletop Exercise

General Observations

I. In this example, as in other examples, the NRC staff suggests differentiating between design basis accidents (DBAs) and other licensing basis events (LBEs) because there is much less flexibility in changes to the DBAs.

NRC Observations Associated with June 15, Example 4b, Addition of a H_2 Facility TIRICE Tabletop Exercise

General Observations

I. There may be a need for more discussions to define the distinctions between the 50.59 equivalent criteria in TIRICE process, the separate PRA Standard change process, and the changes captured in the 50.71(e) process.