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Sent: Friday, April 9, 2021 3:59 PM
To: Sebrosky, Joseph
Cc: Uribe, Juan; Oesterle, Eric; Afzali, Amir; Steven Nesbit; Henneke, Dennis (GE Power Portfolio); Jason P. Andrus
Subject: [External_Sender] TICAP feedback to NRC observations on VTR TICAP tabletop exercise
Attachments: Response to NRC Observations VTR+XE.pdf

Follow Up Flag: Follow up
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Hi Joe,

Attached to this email, please find the feedback from the TICAP team in response to the NRC/INL staff observations on the VTR TICAP tabletop exercise. I have confirmed with the VTR team that there is no sensitive information in the responses.

As you previously requested, I included the feedback to the NRC/INL staff observations on the Xe-100 TICAP tabletop exercise in the same file as well.

Please let me know if you have any questions.

Thanks and have a great weekend,

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NRC Observations Associated with March 5, Versatile Test Reactor (VTR) Technology Inclusive Content of Application Project (TICAP) Tabletop Exercise

Note: Attachment 1 to this document provides the NRC Observation from the February 3, 2021, X-energy TICAP tabletop exercise. The attachment is provided for ease of reference. Observations from the X-energy tabletop are not repeated for the VTR TICAP Tabletop exercise.

The TICAP team would like to thank the NRC/INL observation team for their participation in the VTR tabletop meeting and for the observations. The red text below indicates informal feedback from the TICAP leads, building upon the feedback given on the Xe-100 tabletop exercise observations. Please note that the previous feedback (i.e., on the Xe-100 observations) has not been reproduced here.

General Observations

I. Overall, the VTR tabletop exercise provided useful feedback to the developers of the TICAP guidance document and provided the VTR design team the opportunity to interpret and apply the TICAP guidance. The tabletop exercise focused on TICAP Section 4.2 (DID) and TICAP Chapters 5, 6 and 7 (SSC categorization, safety functions and criteria). The feedback provided by the VTR team consisted of identification of those areas in TICAP where the guidance was unclear or incomplete and suggested additions to the guidance for clarification or to fill in gaps. In addition, the exercise provided the opportunity for the VTR design team to prepare example input to a safety analysis report (SAR) based on their interpretation of the TICAP guidance and to receive feedback from the TICAP team regarding whether or not the interpretation was correct. There was constructive interaction between the VTR and TICAP teams regarding the TICAP guidance and its implementation.

Thank you. We are glad that the meeting achieved its objectives.

II. The TICAP guidance document has been expanded substantially from what was provided in Southern Company's October 20, 2020 TICAP report. In many cases, the expanded guidance refers to NEI 18-04, which is appropriate. However, there are still areas where the TICAP guidance does not capture some key direction contained in NEI 18-04. Some of these areas are discussed below.

The TICAP guidance document has been undergoing development throughout the conduct of the tabletop exercises. We appreciate the specific comments below and will continue to consider them while developing the guidance.

III. This general observation relates to the X-energy General Observation item II, and Areas of Requested Feedback item III.d. The NRC/INL staff notes the robust discussion that was held regarding the level of detail in the SAR, supporting information placed on the docket, and information that is available for audit. The NRC staff understands that industry intends to revise the TICAP guidance to provide more guidance in this area. This area has been the topic of much discussion during public meetings and it is expected that NRC staff and stakeholder engagement (including with non-industry stakeholders) will continue in this area.

We agree that discussion on this topic is valuable and is a good candidate to be discussed during the TICAP workshops with the NRC/INL staff.

IV. During the discussion of non-safety related with special treatment (NSRST) structures, systems, and components (SSC) SAR content the NRC staff raised a question regarding

where the reliability information for these SSCs would be located (e.g., PRA or SAR) and what this information might entail. The NRC staff believes further discussion on this topic would be beneficial.

This is an important point. We intend to clarify it in the draft guidance and discuss it further as part of the TICAP workshops with the NRC/INL staff.

V. Although it is important to understand the design to ascertain the necessary content for the SAR, the industry should be aware that the NRC staff has been reminded that the purpose of the tabletop exercise is to focus on the appropriateness of the content of the SAR and level of detail. Any observations by the NRC team regarding the design itself should not be interpreted by industry as NRC review.

Thank you for recognizing the purpose of the exercise and explicitly making this statement.

VI. The SAR content should focus on presenting the results of implementing the LMP process. For discussion purposes, it may be beneficial to discuss what type of documentation may exist from implementing the LMP process by the applicant, including narrative on the iterations in the process, and the deliberations and decisions of the integrated decision-making process (IDP) and whether this documentation may be something that is audited by the NRC staff.

This topic is a good candidate to be discussed during the TICAP workshops with the NRC/INL staff.

<u>Areas of Requested Feedback</u>

I. What inconsistencies, if any, were noted between the sample SAR content discussed during the 3/5 tabletop and NRC expectations.

   a. NEI 18-04 (Section 3.2.2 – Task 6) states that, where possible, external events are to be analyzed in the PRA but, in some cases, may be selected and treated deterministically. There is no discussion in the TICAP guidance document about how to select and treat external events selected using a deterministic approach. Accordingly, the VTR report did not address this topic. For deterministically selected external events, it is not clear how they can be plotted on the frequency-consequence (F-C) curve since there is no frequency associated with the events. The discussion around this topic did not lead to a clear understanding of which external events are selected and treated deterministically and how they are compared to the F-C curve.

   We think that this question is an interesting one and requires further clarification and discussion. We suggest that this topic be discussed at the upcoming TICAP workshops between the TICAP team and NRC/INL staff.

   There are several levels in which external hazards are selected and treated deterministically in NEI 18-04. The selection of DBEHLs may be performed deterministically or based on a probabilistic hazard evaluation and leads to specific Safety-Related Design Criteria (SRDC) to ensure that each SR SSC is capable of performing its RSF in the case of occurrence of an event at the DBEHL.

   External events are also identified in definition of LBEs derived from the PRA when those events are incorporated into the PRA. The development of a PRA in the LMP methodology including the selection of the initiating events benefits from the deterministic analyses that are needed to support the design as illustrated in Figure 3-3 of NEI 18-04. For the PRA evaluation of external events, whether selected deterministically or via probabilistic hazard

analysis, all are dispositioned probabilistically via PRA modeling or application of the PRA standard screening criteria.

b. The largest inconsistency was in the area of defense-in-depth (DID). NEI 18-04 (Chapter 5) contains an extensive description on how to determine the adequacy of DID. DID attributes and evaluation criteria are described in Chapter 5 of NEI 18-04. The final determination of DID adequacy is to be made using an IDP and evaluation criteria as described in Section 5.9.3 of NEI 18-04. The TICAP guidance document does not mention the IDP, but does call for the SAR to include an "Integrated DID Summary." However, the TICAP guidance document does not explain what the "Integrated DID Summary" is to contain nor does it refer to NEI 18-04, Section 5.9.3. The VTR report (Appendix A, Section 4.2) does mention the IDP in various places, but does not include a summary of the IDP review and conclusions. In fact, the VTR design team, in Appendix A, Section A.4.2.4, of their report, questioned the need for the "Integrated DID Summary," since DID information can be found elsewhere in their report. The lack of a summary section in the VTR report is a concern because it puts the burden on the reviewer to piece together the DID information in the report and confirm that the evaluation criteria contained in NEI 18-04 (Section 5.9.3) for deciding on the adequacy of DID were used and met. It would seem reasonable to make the "Integrated DID Summary" the focus of the TICAP guidance in order to tie all of the DID pieces together and serve as a roadmap to the other SAR sections for details, thus making the reviewer's job easier.

The discussion of DID in Section 4.2 of a SAR developed using the TICAP guidance is a good candidate for discussion as part of the upcoming workshops with the NRC/INL staff. We would like to note that the guidance for Section 4.2.3 of the SAR (i.e., "Integrated DID Summary") was expanded to include explicit reference to NEI 18-04 Sections 5.9.2 and 5.9.4 as a result of the VTR tabletop exercise.

II. Does the NRC/INL have any suggestions for additional contexts that may be helpful to see in the tabletop report

a. It was helpful to review the pages of the document prior to page 55 to be able to put the VTR design information into context with the LMP/TICAP process and to note the differences into approaches used for developing the CSDR for DOE and the SAR content for the NRC.

We are glad that the context was useful and plan to include this background information in the final VTR tabletop report.

b. The format following page 55 of the document showing by color code the guidance, the SAR content developed using the guidance, and comments from the vendor on the guidance and SAR content was very helpful from a user-friendly standpoint.

We appreciate the feedback and intend to include similar formatting in future tabletop exercise content, to the maximum extent possible.

c. It seems that there may be have some duplication in the tables of information presented and some effort to streamline the information presented in the tables and the number of tables would likely be beneficial.

Thank you for the observation. The draft used for the tabletop meeting was not the final draft, and the tables will be reviewed prior to final publication.

d. It would be useful to have the tabletop report provide a comprehensive summary discussion on DID adequacy using the IDP review and the evaluation criteria in Section 5.9.3 of NEI 18-04, since these criteria seem to represent the bottom line on DID adequacy, as described in NEI 18-04.
We will consider this feedback with the understanding that the limited scope of the tabletop exercises and design maturity of the associated plants limit the extent that a comprehensive DID evaluation may be performed . We would like to mention, as noted in response to item I.b. above, additional changes to the guidance are under development on the integrated DID Summary. In general, we think that topic is an important one for the upcoming workshops; however, it may be possible to use the body of the tabletop report to communicate further context and details about the IDP review beyond that which the TICAP guidance indicates should be included in the SAR.

e. It would be useful to describe how external events are selected and, for those selected deterministically, how they are incorporated into the risk-informed and performance-based LMP process.
We will consider this feedback. Similar to the response to II.d. above, we would like to mention that the question of how to select external events is covered in NEI 18-04 and was not intended to be in the scope of TICAP. The Design Basis External Hazard Levels (DBEHLs) may be selected deterministically or probabilistically, but the process is intended to cover events at the limiting hazard levels down to 10^{-4}/plant year with the requirement that the SR SSCs can support their RSFs with a high degree of confidence. If there are external events selected deterministically, they will at some point be included in the PRA. At that time, they will be subject to the PRA Standard screening criteria and, if not screened out, reflected in the AOOs, DBEs, and BDBEs. Only those events that survive the screening criteria and produce LBEs above $5x10^{-7}$/plant-year will appear on the F-C chart.

With respect to the design of safety related SSCs, external events are addressed in Chapter 6 of the TICAP guidance through the DBEHLs and Safety Related Design Criteria. However, it may be possible to use the body of the tabletop report to communicate further context and details about the selection of external events beyond that which the TICAP guidance indicates should be included in the SAR.

f. The VTR report states that a PRA self-assessment identified some gaps in Capability Category II requirements of the non-LWR PRA standard. It may be useful to specifically discuss the gaps and their resolutions in the PRA summary of the SAR or a peer review report for audit.
The NLWR PRA Standard requirements for peer review and configuration control and the NEI PRA Peer Review Guidance specify that peer review findings and dispositions be documented in the plant records and associated corrective actions programs. The dispositions of these findings is a rather dynamic process and is subject to frequent changes and this creates a major problem for inclusion in the SAR. Hence this matter is best handled via the on-site audit process.

III. What other clarifying questions, if any, does the NRC have based on NRC/INL team observations.

a. Page 27 of NEI 18-04 states that in comparing LBE frequencies and consequences to the F-C curve, 95th percentile values of both frequency and consequence are to be used. In addition, Section 3.2.1 of the TICAP guidance document states that in plotting LBEs

on the F-C curve, the 5% and 95% uncertainty bands should be shown. In Appendix B, Section B.5.4.1 of the VTR report, mean values were used in plotting the LBEs on the F-C curve. The use of mean values was questioned during the tabletop exercise and the TICAP team stated that mean values should be used. Emails between Brandon Chisholm (Southern Co.) and Tom King (INL/NRC) were exchanged on 3/6/21 on this topic, but the issue remains open. It is not clear why the TICAP team endorsed the use of mean values when their own guidance states otherwise. Therefore, since NEI 18-04 and the TICAP guidance call for the use of 95th percentile values of frequency and consequence or showing the uncertainty bands, these are what should be used when comparing LBEs to the F-C curve. This will then be consistent with the direction in NEI 18-04 and the guidance in TICAP and will help support the consideration of uncertainty in DID evaluations. In addition, Appendix A, Section A.4.2 (DID), of the VTR report does provide 95th percentile values of LBE frequency and consequence in tabular form, including a comparison to corresponding F-C curve consequence targets. Therefore, for consistency and to avoid confusion, it would seem reasonable to use 95th percentile values or show uncertainty bands in all cases when plotting LBEs on the F-C curve.

This may have been a miscommunication. At the time of the VTR tabletop exercise, only mean values were provided since the VTR team had not yet addressed uncertainties. As such, the information in the tabletop report is a process maturity snapshot of the VTR SAR content and is only as complete as the current design maturity allows.

The LMP does provide examples of tables and other possible activities to capture the final results in the SAR including where uncertainties play an important role in the final determination of DID adequacy; however, it was a high priority to developers that the LMP did not dictate format or other changes that would impact their internal design processes or documentation systems. As a result, how the tables look in the end is flexible, although the required results documentation needs to meet the expectations of LMP. In doing so, some of the information is included in the SAR and some in design records.

NRC Observations Associated with February 3, 2021, X-Energy
TICAP Tabletop Exercise

Joe, thanks very much for the observations and input. The TICAP team has added some informal feedback, indicated by red font. Although our responses are initial reactions from the tabletop and guidance leads and not a fully vetted response, we thought it would be useful for you to see this information now, rather than after the completion of all of the tabletop exercises.

Please understand that all of the NRC/INL team's input will be considered as we proceed to refine our draft guidance.

General Observations

I. The staff notes that the first TICAP tabletop exercise was run differently than the LMP tabletop exercises. Namely the LMP tabletops were done after the NEI LMP guidance document was already written and therefore provided more insights on implementation of the LMP guidance. For TICAP, it appears that the vendors are implementing the tabletops earlier in the process and using the tabletops to help develop the TICAP guidance. The staff would just like to confirm this understanding is correct going forward. The staff understands that the focus of future tabletops will be to test-run TICAP against selected portions of the application. This is particularly relevant for Chapters 5, 6, and 7 which would help the staff see the difference between the information provided in the SAR for a safety-related SSC and a non-safety-related with special treatment SSC.
   Your understanding is correct. All of the TICAP tabletop exercises were conducted alongside the development of the draft guidance.

II. The staff would like to confirm industry's understanding of the TICAP guidance related to incorporating by reference technical report/topical reports into the safety analysis report. The staff considers such documents that are incorporated by reference (IBR) into the SAR to be part of the SAR (i.e., part of the licensing basis) and therefore subject to the SAR change process. That is also our understanding. We have a distinction between IBR and other reference material (REF) for that reason. Although the TICAP guidance on content of application includes reference to NEI 98-03 for distinctions between IBR and documents referenced in the SAR, the discussions of the Chapter 2 content seemed to convey an inconsistently applied approach regarding whether IBR documents are considered part of the SAR. Additional discussions in this area may be needed, and clarifications to the TICAP guidance document may be appropriate.

III. It may be beneficial for the NRC staff to have a content of application version continuously accessible throughout the entire period of the tabletop exercises such that more meaningful questions/feedback could be developed for the focus area for the tabletop exercise.
   Access was given to the core TICAP/ARCAP team via SharePoint site on 3/3/2021.

Areas of Requested Feedback

I. What inconsistencies, if any, were noted between the sample SAR content discussed during the 2/3 tabletop and NRC expectations

   a. The TICAP guidance document that was provided to support the tabletop has more content in it than the staff has previously seen. It provided the staff with a better

understanding of how Southern is developing the document. The staff thought this was a step in the right direction.
Thank you for the feedback.

b. The staff was expecting the tabletop to cover more topics. Only two chapters were discussed (chapter 2, Generic Analyses (20-page document – provided) and chapter 8 (plant programs – only 2 pages provided). Chapters 5, 6, and 7 were referenced during discussions but the staff did not have any proposed input to "observe"
SAR Chapters 5, 6, and 7 were initially considered within the scope of the Xe-100 tabletop exercise but the focus was shifted to Chapters 2 and 8 after work began on the exercise. This shift was at the request of the developer in response to resource prioritization during the tabletop performance period.

   i. Having information on chapters 5, "SSC Categorization," Chapter 6, "Safety-related SSC capabilities,", and Chapter 7, "Non-safety related with special treatment capabilities," would have been helpful to assess level of detail provided for these chapters. Other tabletop exercises have included portions of Chapters 5, 6, and/or 7 within their scope.
   ii. In areas where another document is referenced or referred to, some sample content (e.g. a table of contents) would be useful in confirming that the total level of detail available for review is adequate for the staff to make findings on the proposed information. Treatment of references is a work in progress.

c. It was not clear to the staff the extent to which the TICAP guidance document was used to support the tabletop. Most of the exercise discussion was on Chapter 2 and it was not clear to the staff how the TICAP guidance document was used to develop the content for this chapter.
It is our intention for the X-energy TICAP Tabletop Report to provide additional context regarding how the guidance document was used to support the exercise.

II. Does the NRC/INL have any suggestions for additional contexts that may be helpful to see in the tabletop report

a. Tech specs and other plant programs were referenced in the discussions on Chapter 8. It is unclear what guidance is going to be provided in TICAP regarding these topics. Southern has previously indicated that Tech Specs are outside the scope of the guidance it is developing. Having a clear understanding of what is and is not within the scope of TICAP is needed. Having information in the SAR (perhaps in chapters 5, 6, and 7) regarding associated technical specifications could obviate the need for a technical specification basis document. This has been the subject of ARCAP/TICAP scope discussions and is a good candidate for a topic to be discussed during the TICAP workshops with the NRC/INL team.

b. For those guidance documents and plant programs that are not part of TICAP, and for which no development plans are scheduled, it would be beneficial to gather insights on what the industry plans to reference/rely upon for completion of that portion of the SAR (i.e., How to meet 10CFR 50.36(a)) It would probably be inappropriate for TICAP to respond on that point, given that it is beyond the TICAP scope.

III. What other clarifying questions, if any, does the NRC have based on NRC/INL team observations

a. It would be helpful to provide a definition of what an “Affirmative Safety Case” is and the extent to which it will be described in the guidance document.
The TICAP slides presented at the June 11, 2020 Stakeholder Meeting address the definition. The wording was refined somewhat in the slides presented at the December 10, 2021 Stakeholder Meeting. The definition will be covered in the guidance document.

b. If we agree that Chapter 1 does not contain any licensing basis info that needs to be maintained or is part of change control process scope, no information that would be utilized by the staff in developing its findings should be included in Chapter 1 that is not provided elsewhere in the SAR (e.g., deviations/exceptions to the NEI 18-04 methodology were mentioned in Chapter 1 and those would likely be part of the licensing basis).
We understand the point and are addressing it in the guidance.

c. References to Southern Co. documents and DOE documents for additional guidance make the document less user friendly – relevant portions from these documents and/or examples from the LMP tabletops should be included in the TICAP guidance document. See related comment above (i.e., I.b.ii)
We agree.

d. The NRC staff notes that it is important to reach a common understanding about where PRA-related information will be located in the application. To this end, it would helpful to map each of the SRP Section 19.0 acceptance criteria to the various TICAP chapters. The NRC staff recognizes that some of these acceptance criteria do not apply to non-light water reactors, and that additional information will be provided that is specific to the use of PRA-related information in supporting implementation of the LMP process. The following table provides, as an example, an initial attempt at how this mapping could be performed using the existing guidance from the SRP. The table is provided for illustrative purposes to assist in further refining the TICAP guidance document.
The intent of our guidance is to meet the requirements stated in 10 CFR 52.47(a)(27) related to the PRA. Our approach places substantial reliance on conformance with the non-LWR PRA Standard as opposed to providing extensive PRA documentation in the SAR. Consistent with application of the LMP-based Affirmative Safety Case, we want to focus on what is necessary and sufficient today for an advanced reactor application, not on past SRP guidance for large light water reactor applications.

TICAP Chapter	PRA-Related Information
2 – Generic Analysis	SRP 19.0 Acceptance Criteria: 9 – PRA quality control 10- PRA technical adequacy 11 – Meet Capability Category I 12 – Prior NRC staff reviews, etc. 13 – Use of assumptions 18 – PRA maintenance process 19 – PRA maintenance and upgrade

	20 – PRA maintenance and upgrade program 21 – Treatment of tornados 22 – Treatment of hurricane missiles
3 – Licensing Basis Events	Use of PRA-related information for LBE selection (specific to LMP)
4 – Integrated Evaluations	SRP 19.0 Acceptance Criteria: 1 – Use of PRA to identify vulnerabilities 2 – Demonstrate that the QHOs are met 3 – Demonstrate the the CPG is met 4 – Identify risk-informed safety insights 5 – TMI requirement to perform PRA (n/a) 6 – Use PRA results in an integrated fashion 7 – Importance analysis 8 – Uncertainty analysis 14 – PRA quantitative and qualitative results 15 – PRA includes internal floods and fires 16 – Reporting of significant risk contributors 17 – Definition of “significant” 23 – Containment structure integrity 24 - Containment structural integrity
5 – Safety Functions, Design Criteria, and SSC Classification	Use of PRA-related information for SSC classification (specific to LMP)