NRR\DRA PRA Licensing Branch Comments on Industry White Papers for Crediting FLEX in Risk-Informed Decision Making

BACKGROUND

Regulatory Guide (RG) 1.174, Revision 2, “An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis,” states that

> *The scope, level of detail, and technical adequacy of the PRA are to be commensurate with the application for which it is intended and the role the PRA results play in the integrated decision process.*

The technical adequacy of the PRA must be compatible with the safety implications of the proposed change and the role that the PRA plays in justifying that change. That is, the more the potential change in risk or the greater the uncertainty in that risk from the requested change, or both, the more rigor that must go into ensuring the technical adequacy of the PRA. For the risk-informed approach used to assess proposed TS changes consistent with RG 1.177, Revision 1, “An Approach for Plant-Specific, Risk-Informed Decisionmaking: Technical Specifications,” the above-mentioned discussion regarding the technical adequacy applies to all Tiers of evaluation to the extent that a PRA model is used.

RG 1.200, Revision 2, “An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities,” describes one acceptable approach for determining whether the technical adequacy of the PRA, in total or the parts that are used to support an application, is sufficient to provide confidence in the results such that the PRA can be used in regulatory decision making. RG 1.200, Revision 2, clarifies the American Society of Mechanical Engineers/American Nuclear Society (ASME/ANS) PRA standard to be ASME/ANS RA-Sa-2009, “Addenda to ASME RA-S- 2008, Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications.” The ASME/ANS PRA standard provides technical supporting requirements in terms of three Capability Categories (CCs). The intent of the delineation of the Capability Categories within the Supporting Requirements (SRs) is generally that the degree of scope and level of detail, the degree of plant specificity, and the degree of realism increase from CC I to CC III. In general, the staff anticipates that current good practice, i.e., CC II of the ASME/ANS standard, is the level of detail that is adequate for the majority of applications.

The APLA staff reviewed industry white papers on qualitative and quantitative credit for FLEX capabilities. An APLA review of license amendment requests is typically focused on the quantitative aspects of the risk assessments; the defense-in-depth and safety-margin review is completed by other technical Branches with consultation from APLA. The APLA staff reviewed the White paper to determine whether quantitative approach provided in the White paper is adequate for risk-informed changes to plants. This review is performed by examining the proposed approach in accordance with the acceptable guidance discussed above (meeting the guidelines of ASME PRA Standard and RG 1.200) and, if the acceptable guidance is not followed, by assessing whether the White paper explains why the acceptable method is not selected and provides alternative technical information to provide confidence in the results such that the model can be used in regulatory decision making.

Generally, a new proposed methodology such as the incorporation of FLEX equipment (that must be brought in from staging areas) into the PRA, is best accomplished through the submittal of Topical Reports. Each Topical should provide details of the specific plants, plant configurations and specific methods, including the population of plants for which (each) Topical is applicable. The methodology would include the interaction between the typically external initiating event and the transportation, alignment, and subsequent operation of the FLEX equipment.

COMMENTS

White Paper on Streamlined Approach for Crediting FLEX in Risk-Informed Decision Making	**Comments by APLA Staff**
Page 1: The semi-quantitative treatment described here is intended to provide an initial framework for near-term decision making and is intended to provide a foundation for the longer term solution of developing consensus guidance for direct implementation in PRA models.	While the semi-quantitative treatment, with appropriate considerations, could potentially be used for limited scope applications, such as SDPs and NOEDs, the staff finds that additional development and explanation is needed before determining whether the semi-quantitative treatment can be developed to provide a foundation for direct implementation of FLEX capabilities in PRA models that are used to support risk-informed applications for changes to a licensing basis. As discussed in the Background section, the existing NRC guidance provides an acceptable approach to determine the technical adequacy of PRA models compatible with safety implications of the application. Consistent with this guidance, following a change to a PRA model such as integration of FLEX capabilities, the model should be evaluated against all relevant supporting requirements (e.g. human reliability analysis, data analysis, system analysis, accident sequence analysis, etc.) and peer-reviewed if the change in the model qualifies as an upgrade (as is expected to be the case here) Subsequently, the impact of those supporting requirements that do not meet the appropriate CC should be evaluated for the specific application and generally be included in the risk-informed application. The proposed framework in the White paper does not seem to provide a level of detail, plant specify or realism to be suitable for evaluation against ASME PRA Standard as clarified by RG 1.200 and, therefore, the technical adequacy of the model cannot be determined using the existing guidance Furthermore, the white paper does not provide sufficient information to show that the proposed framework will be technically adequate for a wide range of risk-informed applications for changing a licensing basis It should be noted that some of those applications require a high-level of rigor for reviewing technical adequacy of both internal and external PRA models. Some elements of the proposed approach (e.g. HRA and data analysis) discussed in later comments do not seem to have been adequately justified for even more limited scope applications.

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Page 3: The process assumes a base human error probability (HEP) of 0.1 and a base availability/reliability rate of 0.1 per available train. Page 4: An initial failure probability screening value of 0.1 is used for nominal deployment of the applicable FLEX mitigation strategy.	The base HEP of 0.1 is not supported by any analyses or data. For risk-informed applications to make changes to the licensing basis, the acceptable guidance requires a human reliability analysis (HRA) to be performed and reviewed consistent with ASME PRA Standard and RG 1.200, if FLEX capabilities are included in the PRA and credited in the analysis. For applications with a limited scope, such as SDPs or NOEDs, using a single base HEP value, use of an arguably conservative value may be sufficient if acceptable to APHB. Although the paper presents one value for base HEP, some scenarios may involve multiple operator actions for successful deployment of FLEX systems. For risk-informed applications to make changes to a licensing basis, the HRA should appropriately consider those actions and their dependencies.
Page 4: Has been demonstrated to be feasible under nominal conditions … However, the base deployment value is assumed to account for these factors in that it represents an average over these conditions for internal events. These are underlying random conditions that are not modeled in the PRA. These variations, such as changes in temperature from day to day could have an influence on performance, e.g., performance could degrade if the actions were being taken at very high or very low temperatures. However, since they are random with respect to when the demand could occur, their probability of occurrence coincident with the implementation of FLEX is low, and are not modeled explicitly. The nominal value is characterized as being the average value over the spectrum of these conditions.	Under the discussion of base HEP value, the assumption that other adverse environmental conditions (that were not present in the validation exercise) are random with respect to when the demand could occur may be valid only for internal events. There could be a dependency between occurrence of such environmental conditions and the demand for FLEX capabilities for external events and, therefore, the relationship needs additional evaluation. Most of the risk-informed applications for making changes to a licensing basis require an evaluation of external events and, if FLEX capabilities are credited for those evaluations, the stated assumption is not valid and explicit modeling is warranted for those scenarios. An HRA that meets the appropriate CC of ASME PRA Standard supporting requirements would ensure that the human failure events are adequately modeled and quantified in a PRA.

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Page 5: Description of T_{Trans}, $T_{Install}$ and T_{Exe}	Similar to the previous comment, the description of those time windows seems to apply only for internal events. T_{Trans}, $T_{Install}$ and T_{Exe} from validation studies does not take into account the adverse impact of the conditions on those time windows following an external event. Although under Environmental Factors the nominal value is increased by a factor of two for adverse conditions, that factor may not sufficiently capture the impact of adverse conditions as increase in those time windows because of those adverse conditions may make the actions unfeasible.
Page 6: This node [command and control] is simply a go / no-go evaluation (i.e., either functional or impaired) and either leads to a pass-through to assess environmental factors and equipment availability issues in the last two nodes of the decision tree, or it leads to guaranteed failure of the action.	PRAs typically assign a range of values to some of the elements identified under this node, such as availability of sufficient cues and indications for the direction of the actions and adequacy of associated procedures to support confidence in successful completion of the manual action, instead of using go/no go criteria. The licensee should either use an acceptable approach or justify that the criteria used to implement the proposed approach is conservative.
Page 8: If conditions do not exist that preclude deployment or present adverse conditions as described above, then nominal conditions are assumed to apply and no adjustment is made in the decision tree to the calculated value.	In some regulatory activities such as SDPs or NOEDs, it may be practical to look back or predict the environmental conditions for the next few days. In risk-informed applications for making changes to a licensing basis, where external hazards typically need to be analyzed, the environmental condition cannot be anticipated. As noted earlier, for external events, it is likely that adverse environmental conditions exist for those scenarios that take credit for FLEX capabilities and the PRA model should assume a high dependency between adverse conditions and the demand for FLEX capabilities for those conditions.
Page 8: Given this requirement and assuming that the site has fully met the intent of this requirement, equipment reliability should not be a serious concern. Multiple trains of equipment typically lead to unreliability values in the E-3 range or lower in most PRA models, and in the E-2 range for single trains	1- White paper does not provide enough justification to support the statements that the “equipment reliability should not be a serious concern” and that those presented values are “conservative”. The current practices in PRA provide generic and plant-specific data for systems and trains in plants. Reliability for FLEX equipment should be based on data obtained from surveillance test of that equipment, and the capability of the surveillance to develop reliability estimates evaluated. This analysis

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of equipment. Given the uncertainty of deploying the FLEX equipment for potentially longer time periods, it is deemed appropriate, however, to utilize a conservative value of 1E-2 in this node assuming that the N+1 requirement is maintained. If the reliability of one of the trains of equipment is questionable or it is known that one train of the FLEX equipment would not be available for the subject analysis (NOED, SDP, etc.), then a conservative value of 1E- would be applied for the single train of equipment that is available to support the FLEX mitigation strategy deployment.	should also appropriately consider and estimate the reliability of those FLEX systems for which the reliability data may not be as readily available as other typical plant systems. It is also unclear whether damage from movable FLEX equipment is included in the equipment unavailability or the HEP. The ASME PRA Standard describes supporting requirements for data analysis elements to provide estimates of the parameters used to determine the probabilities of the basic events representing equipment failures and unavailabilities modeled in the PRA. Where FLEX capabilities are credited in risk-informed applications for changes to a licensing basis, in accordance with the acceptable approach the licensees consider the reliability data consistent with the ASME PRA Standard and RG 1.200. If relevant SRs are not met, the licensee should clearly justify that the data used to support the analysis is conservative for that specific application or has no impact on the application. 2- The unreliability discussion in the streamlined quantitative approach does not seem to consider the common cause failure (CCF). The ASME PRA Standard describes supporting requirements for systems analysis and data analysis elements as they relate to treatment of CCF. For almost all risk-informed applications for changes to a licensing basis, the NRC staff verifies whether those supporting requirements are met at the appropriate CC.