Technical Advisory Committee of the Nuclear Risk Research Center
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SUBJECT: DETAILS OF ENVISIONED RISK-INFORMED DECISION-MAKING FRAMEWORK

Dear Dr. Apostolakis:

In our February 16, 2021 letter on the Nuclear Risk Research Center (NRRC) research plan for fiscal year 2021, we concluded that 1) most of the NRRC research activities have achieved adequate maturity and sophistication to warrant their practical use and 2) the needs and priorities for development of increasingly detailed models for specific hazards and damage mechanisms are highly dependent on their intended applications.

This letter aims at clarifying information about the elements of a risk-informed, performance-based (RIPB) decision-making framework that are necessary to enable us to provide more refined and focused recommendations on specific research programs.

CONCLUSION

The intended applications of probabilistic risk assessments (PRAs) within a RIPB decision-making framework should provide the primary motivation and structure for the NRRC research. As a result, prioritization of the different research areas, planning of the corresponding research details, and publication of the resulting application guides should be consistent with those needs of the industry that are planned to be addressed using risk-informed, performance-based initiatives.

We are requesting a more formal, comprehensive, and detailed briefing on how the scope and details of each research project are carefully tailored to meet the timing, scope, and structure of the utilities' needs for integrated risk management. A thorough discussion and a better understanding of these issues will help us to more effectively focus our reviews of specific research projects and our recommendations for how that research supports an integrated risk-informed decision-making (RIDM) framework.

The present request is an extension of our November 19, 2019 letter report that requested a briefing on the industry readiness for implementation of the risk-informed Reactor Oversight Process (ROP). Unfortunately, due to the pandemic, it was not possible to have that briefing. The items discussed in that letter report could be integrated into this requested briefing.

BACKGROUND

As noted in our February 16, 2021 letter report:

> "Since 2014, the NRRC research has made important advances in the scientific and engineering state of knowledge about events, phenomena, and accident scenarios that contribute to the risk from a nuclear power plant. The PRA is a vital tool to support effective risk-informed decision-making (RIDM) programs and practices that focus on the most important sources of risk at each nuclear power plant site. Therefore, it is essential that the scope and details of each research project are carefully tailored to meet the utilities' needs for integrated risk management. We will comment on the current status of the integration of NRRC research activities with the utilities' RIDM programs in a separate letter report."

DISCUSSION

For the last several years, appropriately, as part of each research program summary, the overall scope of research and the technical objectives of the individual projects are related to the NRRC short-, intermediate-, and long-term goals. These goals, in turn, are established according to the following mission and vision of the NRRC:

> **"Mission Statement**
> To assist nuclear operators and the nuclear industry in their continuous effort to improve the safety of nuclear facilities, that is, to manage the relevant risks, by developing and employing modern methods of Probabilistic Risk Assessment (PRA), risk-informed decision making and risk communication."
>
> **"Vision Statement**
> To become an international center of excellence in PRA methodology and risk management method, thereby gaining the trust of all the stakeholders."

Also, the Technical Advisory Committee mission is to provide:

> "…independent oversight, reviews, and recommendations to ensure that all NRRC research programs and work products maintain the highest standards of technical excellence."

Based on the above missions and vision, as well as NRRC's significant progress in developing PRA methods and models since 2014, it is now the right time for us to be more actively engaged in a robust and detailed conversation on the timing, scope, and methods of the envisioned RIPB decision-making framework in Japan, as well

as the relationship between those programs and the sophistication of the PRA models (scope and level of detail). This will help us and the NRRC research teams to better focus our collective efforts in delivering "the highest standards of technical excellence" in areas that best serve the Japanese operators.

Our conclusion is based on the following perspective, which is consistent with the U.S. Nuclear Regulatory Commission definition of RIDM:

> "An approach to regulatory decisionmaking, in which insights from probabilistic risk assessment are considered with other engineering insights."

A robust RIPB decision-making framework involves the following distinct components:

- Risk Analysis Component – Uses tools (e.g., PRA models) and rules (e.g., standards) to analyze what could go wrong, how often, and its consequences.

- Risk Integration Component – Uses the insights from the Risk Analysis Component in combination with other considerations to develop a relationship between the risk and a set of acceptable risk levels. In other words, it establishes the relationship between the risk analysis results and a set of performance objectives to be used by the decision makers. In this component, performance objectives for the major plant elements (e.g., functions, structures, systems, and components) that are evaluated in the Risk Analysis Component are established for monitoring.

- Risk Management Component – Uses the results from the Risk Integration Component to make decisions on many topics, including the following:
  - Risk Reduction – Take temporary or permanent measures to reduce the risk.
  - Risk Prioritization – Prioritize activities to proactively or reactively, but holistically, manage the risk.
  - Risk Monitoring – Monitor plant performance and provide reasonable assurance that the risk remains below the risk acceptance targets.

These three components are highly inter-related and do not effectively function without the other. That is, to achieve the NRRC vision of becoming "…an international center of excellence in PRA methodology and **risk management method** [emphasis added]", the following needs to be achieved:

- Risk Analysis Component (e.g., PRA models) with sufficient scope and level of detail needed by the Risk Integration Component to provide an adequate and appropriate picture of a plant's risk profile.

- Risk Integration Component to evaluate the risk profile that is used to establish the overall plant performance objective(s) that the Risk Management Component is trying to achieve.

Thus, although the Risk Analysis Component is the foundation of the overall RIDM process (ground zero), it has to be focused on the objective(s) of the Risk

Management Component, with full awareness of how the Risk Integration Component is formulated.

Finally, the Risk Analysis Component, by itself, has many beneficial attributes. For example, it 1) identifies and provides understanding of potential failure modes, 2) identifies and justifies sources and levels of uncertainties, 3) provides a tool to improve the effectiveness of corrective and compensatory measures, 4) provides a tool for evaluating the cost-effectiveness of different options, 5) provides a tool for quantifying engineering judgment and transparently communicating technical issues with the stakeholders, 6) provides a basis for development and communication of the safety case for regulators and the public, etc. However, to fully benefit from all of these features, the other two components (Risk Integration and Risk Management) have to be adequately developed to provide the necessary context for the Risk Analysis Component.

Most of our discussions with the NRRC research teams to date have focused primarily on detailed technical elements of the Risk Analysis Component of the RIDM framework. To better help the NRRC and the Japanese nuclear industry achieve their goal of comprehensive RIPB decision-making, we need to more fully understand how the Risk Integration Component and the Risk Management Component of that framework are being envisioned, the timing of their development and implementation, and key elements of their supporting infrastructure. A thorough discussion with representatives of the organization responsible for coordinating industry RIDM programs and initiatives, members of the RIDM Promotion Team, and NRRC management responsible for integration of the center's research programs and priorities will help us to more effectively focus our reviews of specific research projects and our recommendations for how that research best supports an integrated RIDM framework.

Sincerely,

John W. Stetkar
Chairman

REFERENCES

1. Technical Advisory Committee of the Nuclear Risk Research Center, "Proposed NRRC Research Plan for Fiscal Year 2021," February 16, 2021.

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