

Technical Advisory Committee of the Nuclear Risk Research Center
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Dr. George Apostolakis
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SUBJECT: DEVELOPMENT OF JAPANESE INDUSTRY FULL-SCOPE, ALL-HAZARDS, ALL-OPERATING-MODES LEVEL 2 PROBABILISTIC RISK ASSESSMENT

Dear Dr. Apostolakis:

During the 23rd meeting of the Technical Advisory Committee of the Nuclear Risk Research Center (NRRC), November 17-21, 2025, we were informed that there is an initiative underway to develop a full-scope, all-hazards, all-operating-modes, Level 2 probabilistic risk assessment (PRA)¹ for a nuclear power plant in Japan. This letter report provides our input on this important initiative.

CONCLUSION

By establishing a unified, all-hazards, all-modes Level 2 PRA capability, this initiative will provide Japan with a foundational risk assessment infrastructure; one that, in its national context, may prove even more influential than WASH-1400 was in shaping the use of risk information in the United States and worldwide. We are highly supportive of this initiative.

RECOMMENDATIONS

1. Develop a Japan-Specific Full-Scope Level 2 PRA

Development of a full-scope Level 2 PRA covering all operating modes and all relevant hazards will enable the Japanese industry to develop a unified and technically robust framework that supports consistent evaluation of nuclear power

¹ In this letter report, we use the term "Level 2 PRA" in its integrated risk assessment context: the combination of a Level 1 evaluation of event scenarios that result in core damage with a Level 2 evaluation of accident progression and containment functions that mitigate offsite radioactive releases.

plant risk. This effort will enhance the industry's ability to apply risk-informed approaches, advance Japan's national nuclear safety objectives, support regulatory decision-making, and improve operational efficiency. The NRRC should actively support this initiative.

2. Integrate Industry's Methods into a Coherent PRA Framework

The NRRC should support industry implementation of state-of-the-practice hazard-specific methods, data collection approaches, and analytical tools into the unified Level 2 PRA framework to maintain consistency, traceability, and configuration control. These state-of-the-practice methods will promote methodological harmonization and improve the transparency and defensibility of risk insights for both regulators and stakeholders.

BACKGROUND

In alignment with Japan's broader objective of achieving the highest levels of safety through a transition toward proven risk-informed and performance-based (RIPB) regulatory and operational decision-making, the nuclear industry is now considering a major initiative to develop a Japan-specific, full-scope Level 2 PRA that covers all operating modes and all relevant hazards. This effort is envisioned as an industry-led initiative supported by the NRRC and other industry organizations. The initiative will benefit significantly from NRRC technical expertise, methodological insights, and extensive experience in PRA development and hazard characterization. The initiative aims to establish a unified, coherent PRA framework that enhances consistency across hazard models, improves traceability and configuration control, and strengthens the technical foundation needed for RIPB applications.

DISCUSSION

We are highly supportive of the proposed full scope Level 2 PRA initiative. The most critical reasons for this support are as follows.

Strategic Importance to Industry's High-Level Objectives

The high-level objectives of the nuclear power plant operators in Japan include safe and reliable operation of nuclear facilities in a manner that strengthens Japan's energy security and carbon-neutrality goals, advances technical and human excellence, fulfills long-term responsibilities such as decommissioning, and earns enduring public trust through transparency and dialogue, while generating affordable energy. The industry-led development of a Japan-specific, full-scope Level 2 PRA capability is strategically very important for enabling nuclear operators to fully achieve these objectives by applying high-quality, risk-informed and performance-based (RIPB) decision-making. By establishing a consistent, technically robust framework for quantifying plant risk across all operating modes and hazards, this initiative will elevate the industry's ability to make transparent, defensible, and safety-enhancing decisions. Supported by the NRRC's and other industry experts' technical expertise, the effort will significantly strengthen Japan's capabilities in the

use of advanced PRA and RIPB practices, resulting in enhanced safety, reliability, and operational excellence across the nuclear fleet.

Technical Reasons for Our Support of the Full-Scope Level 2 PRA Initiative

- **Necessity for Japan-Specific Representation of Plant Behavior**

Japanese plant operations, maintenance practices, and plant configurations cannot be adequately represented by generic or partially adapted foreign PRA models. Therefore, a full-scope Level 2 PRA that is developed to support integrated risk-informed decision-making is highly effective to ensure technical accuracy, transparency, and credibility. The NRRC's and other industry experts' technical expertise and analytical capabilities will be important supporting resources, helping the industry to ensure that the modeling appropriately reflects Japan-specific plant behavior.

- **Japan's Hazard Environment Requires a Tailored Level 2 PRA**

Japan faces a unique hazard environment, particularly with respect to seismic and tsunami challenges. These hazards:

- Create accident progression pathways distinct from internal events behavior;
- Influence structural response, containment performance, and fission product transport; and
- Require detailed modeling of equipment performance, system interactions, and mitigation feasibility under hazard-induced conditions.

A unified, industry-developed Level 2 PRA that integrates internal events, internal fires and flooding, seismic, tsunami, and meteorological hazards is essential for accurately characterizing severe accident risks in Japan.

- **Operating Mode Coverage is Essential for Comprehensive Understanding of Risk**

Accidents can initiate or evolve during any plant operating state. Japan's outage configurations, coolant inventory conditions, and containment alignments vary significantly across modes. Without all-modes coverage, significant severe accident scenarios would remain unquantified, impairing the industry's ability to provide complete and defensible risk insights.

- **Integration of Japanese Data, Methods, and Operating Experience**

Japan possesses extensive seismic, tsunami, fragility, equipment reliability, and operational experience data. An industry-developed Level 2 PRA provides a national platform to:

- Embed Japan-specific hazard and fragility data;
- Incorporate operating practices and human performance characteristics; and
- Reflect realistic equipment performance and accident management strategies.

- **Foundation for Risk-Informed / Performance-Based (RIPB) Regulation**

Japan is transitioning to more extensive use of RIPB programs, including revised Reactor Oversight Program (ROP) concepts, risk-informed maintenance strategies, and other regulatory modernization activities. A Japan-specific, industry-developed full-scope Level 2 PRA will directly support development of PRA-supported guidance for regulators and utilities to be more efficient and effective in their decision making through use of technically rigorous and transparent RIPB programs.

- **Long-Term Technical Value to Japan**

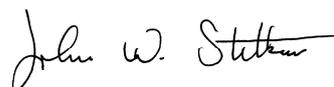
A full-scope Level 2 PRA developed by the industry provides enduring national benefits, including:

- Strengthening Japan's technical independence and analytical self-sufficiency;
- Supporting continuous improvement in PRA, severe accident phenomenology, and hazard integration; and
- Increasing confidence in nuclear safety among operators, regulators, policy makers, and the public.

Summary

Developing a Japan-specific, full-scope Level 2 PRA that incorporates all operating modes and all relevant hazards is an important *industry-led initiative*. It will enable nuclear operators to generate accurate and defensible risk insights tailored to Japan's unique plant designs, hazard environment, safety culture, and operating strategies. This capability will serve as a core national asset, supporting high-quality risk-informed decision-making and strengthening Japan's nuclear safety for decades to come.

Sincerely,



John W. Stetkar
Chairman

REFERENCES

1. United States Nuclear Regulatory Commission, WASH-1400 (NUREG-75/014), "Reactor Safety Study, An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants," October 1975.