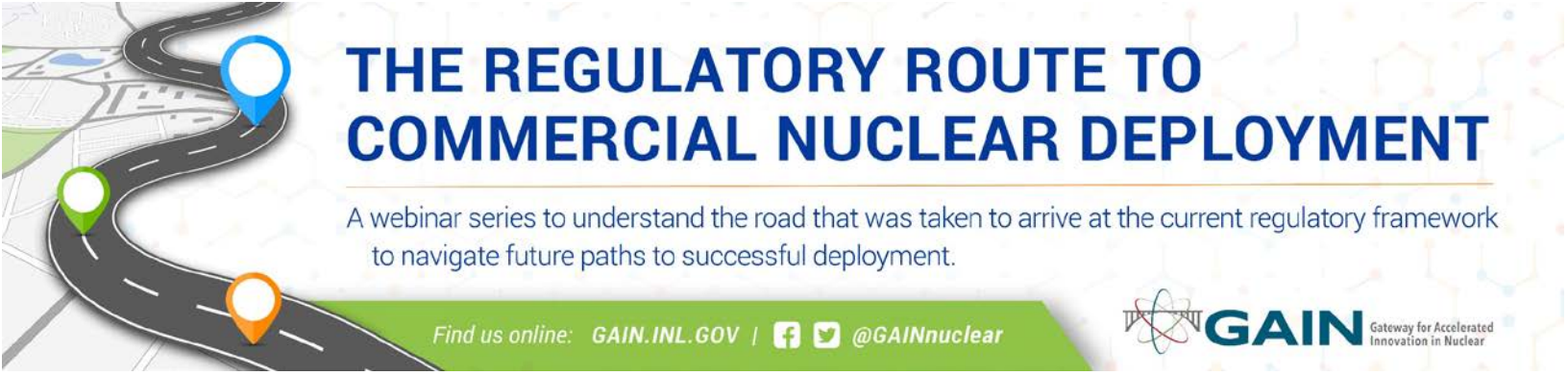

Webinar #1 – Paving the Way: A Historic Journey to Deployment

Wednesday, January 27, 2021, Noon-3 pm MST

Questions and Answers

Question: Provide the definition of a "safe" reactor.

Response: A reactor is considered "safe" if the safety case has been demonstrated showing that there is no undue risk to the environment and the public. Acceptable risk is defined by the NRC's qualitative safety goals, the achievement of which is determined by fulfilling the NRC's Quantitative Health Objectives.

Demonstration of the safety case includes:

- Hazards identified and assessed.
- Appropriate design provisions and limits defined.
- Sound engineering principles applied, including defense-in-depth and quality assurance.
- Robust implementation of safety measures/functions (e.g., control of reactivity (power control); reactor heat removal; containment of radionuclides).
- Analyses of normal, faulted, design basis, beyond design basis and rare-yet-credible conditions (e.g., conditions determined by expert elicitation and/or risk-informed techniques)
- Formalized design and operational safety management.
- Methods available for decommissioning and radioactive waste management.
- Conformance with regulatory requirements and limits with margin.

Regulatory conformance/compliance and review/approval are not sufficient by themselves in ensuring the reactor safety case is complete and adequate. A few experiential examples drawn from Generation II LWR licensed reactor operations include:

- Reactor coolant system material choices for pressure boundary and weldments were inadequate for the operating environmental conditions (e.g., temperature, water chemistry) resulting in widespread material cracking and wastage with consequent degradation of the pressure boundary, potentially placing the reactor outside of the analyzed design basis.
- Plant status information was incomplete/misleading for monitoring and decision making by plant operators (e.g., reactor coolant system inventory and thermodynamic conditions).
- Degradation and failure of piping and components containing wet steam was experienced due to erosion/corrosion mechanisms.

- Unanalyzed effects of non-safety systems and equipment (e.g., instrument air) connected to systems providing safety functions led to unpredictable safety system operation.
- Electrical connectors between equipment in different construction scopes of supply (e.g., Nuclear Steam System Supplier and Architect-Engineer) in safety systems were found to lack environmental qualifications.

Question: Should the NRC's regulatory process and its requirements be modified to prescribe the reactor design process and important considerations more completely, including lessons learned from operating experience?

Response: No. The NRC's regulatory process is intended to provide a minimum set of expectations that the applicant must fulfill to be granted a license for construction and operation of a nuclear reactor facility. As stated in the webinar:

- Adequate design for nuclear safety is the responsibility of the developer/designer with oversight by the owner/operator, not NRC.
- Ultimate responsibility for safe design and operations rests with the license holder, not NRC.
- Liability for protection of public and environment belongs to the license holder.

The NRC establishes overall safety policy and selected requirements to assist in protecting the health and safety of the public and protecting the environment. As discussed in the webinar, NRC should not be viewed as a "design partner" or "design agent." NRC neither comprehensively specifies design requirements, methods, or processes, nor does its reviews ensure that a design fulfills the safety case. NRC reviews are for purposes of achieving reasonable assurance of adequate protection for the public and the environment based on the information provided in the application from the prospective license holder.

Historically, the NRC has on occasion imposed detailed design requirements for purposes of achieving more rapid and predictable response from license holders based on recognized design deficiencies and significant operating experience. This has led to the "patchwork" characteristic of today's regulatory requirements which are a mix of both high level and prescriptive requirements. Such detailed design impositions should not be viewed as a required characteristic of the NRC's statutory role.

Question: There were several questions regarding the disposition of, regulatory requirements for, ongoing development activities, and the economics associated with Spent Nuclear Fuel (SNF).

Response: Rather than answer the questions as offered, it is suggested that the interested parties refer to the following references which provide global perspectives on topics applicable to SNF. These references will in-turn identify further relevant sources which may address additional topics of interest.

- INTERNATIONAL ATOMIC ENERGY AGENCY, *Status and Trends in Spent Fuel and Radioactive Waste Management*, IAEA Nuclear Energy Series No. NW-T-1.14, January 2018.

- OECD NUCLEAR ENERGY AGENCY, *The Economics of the Back End of the Nuclear Fuel Cycle*, NEA No.7061, 2013.

Question: What are sources of information that support access to the considerable global nuclear power facility operating experience?

Response: There are multiple sources of operating experience information ranging from data bases on specific equipment and systems to broad lessons learned, many of which are searchable. For example:

- OECD Nuclear Energy Agency, *International Reporting System for Operating Experience*
- Electric Power Research Institute – multiple topical reports on operating experience (e.g., common cause failure; digital I&C; maintenance; relay failures)
- Institute of Nuclear Power Operations operating experience data bases
- Nuclear Regulatory Commission (NRC) reactor safety information topics
- NRC "Operating Experience Smart Sample (OpESS) Program" at https://www.nrc.gov/reactors/operating/ops-experience/operating-experience-smart-sample.html
- Idaho National Laboratory – *Retrospective Analysis of US LWR Technology Commercialization: Lessons for Today's Nuclear Industry*, INL/EXT-20-58211, Rev.1, May 2020.

Question: Why can China build modern nuclear reactors faster and less costly than the West?

Response: China has well-developed infrastructure and supply chains to support building multiple reactors at a time. This allows considerable efficiencies in cost and time (mature learning curve). This is discussed at some length in the following reference (e.g., at section 2.3)

- *The Future of Nuclear Energy in a Carbon-Constrained World* – An Interdisciplinary MIT Study, September 2018. http://energy.mit.edu/research/future-nuclear-energy-carbon-constrained-world/

Question: Can you discuss the importance of testing to demonstrate new technology and design approaches?

Response: Approaches to providing for the three Fundamental Safety Functions when establishing the Safety Case (discussed in the webinar) vary among technology types and vary further within the individual strategies established by technology developers and their owner/operator partners. These approaches typically rely on a varied testing program as one part of an integrated approach for assessing and confirming key design and safety basis assumptions. Other parts of this integrated approach generally include the use of analytical tools, and the consideration of operating experience (sometimes from other industries). The testing portion of the approach may also include the operation of a prototype facility to gain additional information over a range of conditions within the area(s) of interest.

Additional information regarding the regulatory requirements associated with this integrated approach to Safety Case development when establishing the plant's licensing basis can be found in Subpart [e] of 10 CFR 50.43; *Additional standards and provisions affecting class 103 licenses and certifications for commercial power*.

Question: With regard to the responses given to the emergency preparedness question near the end of this webinar, can more information be included in the written response follow-up to the webinar about the NRC's plans or potential schedule for revising EPZs?

Response: In 2018, the NRC staff provided SECY-18-0103 (https://www.nrc.gov/docs/ML1813/ML18134A076.pdf) to the Commission with its observations and recommendations for changes to existing regulations associated with establishing Emergency Planning Zones (EPZs). These recommendations for the proposed rule change were based, in part, on an extensive series of interactions with industry stakeholders and members of the public.

The SECY recommended that the proposed rule would be technology inclusive and would provide all existing and future small modular reactor (SMR) and non-LWR applicants and licensees, and future NPUF licensees that would be licensed after the effective date of the final rule, the alternative to develop a performance-based emergency planning (EP) program, rather than using the existing, deterministic, EP requirements in Title 10 of the Code of Federal Regulations (10 CFR) Part 50. The NRC staff's proposed rule did not include within its scope emergency planning, preparation, and response for large LWRs, which for the purposes of this rule are those LWRs that are licensed to produce greater than 1,000 megawatts thermal power, fuel cycle facilities, or currently operating non-power reactors.

The Commission agreed with the NRC staff's recommendations and directed them to commence the rulemaking process to incorporate the option for performance-based EP into regulation. That proposed rule was published in the Federal Register (https://www.federalregister.gov/documents/2020/05/12/2020-09666/emergency-preparedness-for-small-modular-reactors-and-other-new-technologies) for public comment in May 2020. The public

comment period has now ended, and the Commission is considering those comments and inputs as it works toward finalizing and publishing an updated rule.

In the interim, license applicants can use the exemption process to pursue and propose performance-based and "right-sized" EP for their proposed facilities. This exemption approach was successfully implemented by the Tennessee Valley Authority in its Early Site Permit application for the Clinch River site, with the NRC approving a performance-based emergency plan (December 2019).