Contribution ID: **412** Type: **Oral**

Reactor Designer Lessons Learned on the Approach to Safeguards by Design for Small Modular Reactors; Opportunities and Challenges

The practical implementation of safeguards by design (SBD) in first-of-a-kind small modular reactors presents a challenge to reactor designers because regulations and policies are silent on safeguards measures, or if at all, specified during deployment rather than during the design phase. Detailed requirements for domestic and IAEA safeguards systems depend upon site, design, and country specific factors, however, there is a need to standardize the applicable safeguards systems for all cases within the standard design to reduce schedule, clearly define scope, and minimize budget risk.

SBD implementation for SMRs is especially challenging because existing tools and methodologies applied to previous reactor designs do not meet the needs of new reactor designs due to various design enhancements including smaller overall site footprints and new nuclear fuel types. The application of safeguards technology and processes provides an opportunity to implement the SBD as a more proactive stance during the overall plant design and layout. The detailed requirements for safeguards system depend upon site, the reactor design, and country-specific factors; however, there is a desire in the industry to make a standard physical safeguards system applicable for standard reactor designs.

Despite support for industry incorporating SBD, policies, procedures, State-specific laws, and regulations do not provide a clear or consistent pathway for vendor and designer interactions for early safeguards implementation. There are many hurdles regarding direct communication and partnership with the IAEA and their delegates in the deployment of safeguards, including requirements to work through owners, countries, and regulators.

By proactively incorporating the reactor designer and vendors into this process early, SBD can streamline the implementation of nuclear safeguards systems throughout design, construction, and operation, reducing the overall cost of safeguards programs. The challenges of timing and managing budget and schedule risk can only be addressed by inclusion of new partners in the implementation of safeguards and to achieve the objective of SBD of the new fleet of nuclear reactors.

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Track Classification: Topical Group C: Safety, Security and Safeguards: Track 10: Safety, Security and Safeguards Interfaces related to SMRs