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

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**Abstract**

The practical implementation of Safeguards By Design (SBD) in first-of-a-kind Small Modular Reactors (SMRs) presents a challenge to reactor designers because regulations and policies are silent on safeguards measures, or if at all, are specified during deployment rather than during the design phase. Detailed requirements for domestic and International Atomic Energy Agency (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 earlier 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 offers an opportunity to implement the SBD as a more proactive stance during the overall plant design and layout phase. 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, the 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 of 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. Early planning and implementation of safeguards measures can effectively integrate safeguards, security, and safety into the design of a nuclear facility. 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.

## INTRODUCTION to the Westinghouse AP300™ Design

The AP300™ SMR is a new pressurized water reactor (PWR) developed by Westinghouse Electric Company to provide a SMR which focuses on limiting cost drivers without introducing licensing, first-of-a-kind design, and operability risks. The AP300 plant design is based upon proven AP1000® technology including, but not limited to, major equipment, structural components, passive safety features, proven fuel, and Instrumentation and Control (I&C) systems. By using existing AP1000 technology, the AP300 plant design leverages the innovation and operational knowledge of the global AP1000 fleet. The mature supply chain, constructability lessons learned, fast load-follow capabilities, and proven operation and maintenance procedures and best practices equip the AP300 plant for success in deployment.

With the development of the AP300 plant, the design differs as Westinghouse is prioritizing the construction schedule and size of buildings based upon techniques and lessons learned from historical AP1000 projects. Integrated designs and smaller plant footprints will make implementation of safeguards and an integrated Safety-Security-Safeguards (3S) approach after final design a near-impossible task.

## Major Challenges and Potential Solutions to the implementation of 3S and safeguards-by-design in the ap300 PLANT design

Although AP1000 technology is well established in both design and operation, there are no AP1000 reactors with fully implemented IAEA safeguards measures. All AP1000 reactors that have been built in Nuclear Weapons States (NWS) include the United States and China. The United Kingdom has received generic design acceptance. These countries do not require implementation of specific IAEA safeguards measures. Because of this, there are no established IAEA technical measures nor innovation and operational knowledge to leverage for the AP300 plant design. However, Westinghouse is currently undergoing deployment of AP1000 reactors in Non-Nuclear Weapons States (NNWS), such as Poland and Bulgaria, and anticipates deploying AP300 SMRs in other NNWS. Therefore, the implementation of the SBD process into the SMR plant design during the initial design phase is crucial to minimizing overall cost and schedule for the overall project.

Similar challenges are prevalent in the physical security area as regulations and requirements, such as the Design Basis Threat (DBT), are difficult to obtain. Typically, security design becomes country-specific based upon the laws and regulations in place within the country. This challenge results in pushing site-specific design activities until later in the project. Early consideration and inclusion of regulatory requirements in the design for both physical security and safeguards can reduce overall risk to the project.

Many of the challenges to implementing SBD in the SMR plant design are shared concerns with physical security and overall plant safety. Concern for the safe management of nuclear material is one of the primary objectives to all these disciplines. Overlapping concern across these areas provides an opportunity to synchronize efforts across organizations to meet security, safeguards, and safety design objectives.

There are many challenges to implementing SBD in the AP300 plant design including, but not limited to, variations in policies and regulations across States, lack of detailed design in guidance on implementing safeguards systems, the broad knowledge and skills required of staff who overlook the implementation and utilization of safeguards measures, and the economic uncertainty of implementing the first-of-a-kind SBD process.

Sections 2.1, 2.2, and 2.3 outline the various concerns and challenges to the implementation of SBD to the AP300 plant design as well as potential solutions and paths forward to advance SBD implementation.

### Synchronization of Regulations and Policies Across States

A prominent challenge to the implementation of SBD are the varying regulations and policies required by individual States (countries). A major goal of the SBD process for Westinghouse is to develop a standard plant safeguards system for a specific reactor design which can be applied to reactors in various countries to save time and cost by avoiding rework for individual countries.

With the implementation of SBD, the cost to implement safeguards systems in the design phase will be driven by the additional support systems needed for a safeguards system. Minor engineering and administrative work will be required to accommodate the safeguards systems in the design phase rather than in the construction phase, where major engineering rework for design changes may be needed to accommodate this equipment. The implementation of a conservative safeguards design into the AP300 standard plant design will allow for compliance with country-specific regulations and requirements set forth by the IAEA. Inventory management, processes, and reporting are all areas for which standardization can greatly minimize future rework after the initial design phase. Figure 1 was created based upon the information provided in Figure AVII-1 of IAEA Safety Series Guide 33, “Safeguards Implementation Practices Guide on Provision of Information to the IAEA [2]”. This figure demonstrates the importance for all requirements to be included in the design phase of the project, such that the safeguards system can be fully integrated before construction of the SMR.



Figure 1: Safeguards Design Methodology

A major difference across States are the requirements and obligations under the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). In addition to the distinct difference in requirements between NWS and NNWS to implement safeguards measures, those States which do require safeguards measures may have additional agreements and requirements in place with the IAEA. Additionally, for emerging markets that currently do not employ commercial nuclear power plants, the lack of a well-established regulatory framework adds difficulty to the SBD process and design implementation. As the State Regulatory Authority (SRA) is responsible for being the liaison between the Owner and the IAEA, states with new SRAs may struggle to engage the IAEA early in the process and slow the overall process, increasing the cost of the project.

Current protocols generally do not allow for reactor vendors to work directly with the IAEA to develop SBD programs. Nuclear new build projects currently require interaction through layers of regulatory interfaces to make critical design decisions early in the design process. SBD can mitigate the challenge of extensive interface across organizations by having an already established safeguards system reducing the required engagement between the SRA and the IAEA. By reducing the overall engagement between organizations, additional effort can go into the establishment of processes and procedures for safeguards systems reducing overall cost and schedule on this effort.

Despite the challenges presented by multiple regulations and policies which vary across States, there are many opportunities to cooperate across organizations and harmonize the efforts performed by the various groups involved in IAEA safeguards design and implementation. Collaboration between regulators provides an opportunity to establish a consistent baseline of regulations and policies as well as harmonize evaluation processes. Currently, requirements for safety, security, domestic safeguards, and IAEA safeguards are State-dependent and are subject to the discretion of the country’s regulator. Additionally, the evaluation processes of on-site inspections and reporting are based upon the regulator’s requirements and therefore can, and often do, vary among States. Inter-State coordination as well as coordination with the IAEA can harmonize these regulations, policies, and processes among States, which presents a clear design basis for nuclear facilities to reactor designers.

In addition to harmonizing the regulations and procedures among States, early and frequent engagement with State and/or regional regulators, owners, designers, and the IAEA enables communication in the early stages of the project which will eventually lead to long-term communication and collaboration for the overall safeguards system implementation and future inspections. This communication will require some extensive coordination and cooperation between the designers and regulators to facilitate design changes to successfully integrate the safeguards system into the overall plant design. This approach of designer-regulator collaboration is a non-traditional approach for most regulators, as typically all interaction occurs between the facility Owner rather than the facility designer. However, this non-traditional approach would allow for more streamlined communication and design changes to accommodate new systems and requirements into the overall plant design.

Early engagement between designers, owners, and regulators will require more streamlined, informal methods of communication. Current processes enable the State and/or Regional Regulators to moderate meetings and the sharing of information across organizations which often creates a barrier to the timely implementation of design changes and the progression of the implementation of a safeguards system within a facility. Enabling open communication across all organizations, the designer, owner, State, SRA, and the IAEA can push forward the design of safeguards system and the early implementation of SBD in new nuclear facilities.

Regular meetings and written communication between the IAEA and reactor designers are not common within the industry but can engage direct interaction across organizations progressing the design of safeguards system more efficiently than the rigid processes currently used. Evaluations of concepts and drafts rather than formal, technically complete submittals can lead to turnaround time of weeks rather than months or years throughout the design process. Although this informal communication process will engage parties throughout the design process, there must be precautions to protect sensitive proprietary information of designers. Measures like non-disclosure agreements across organizations may present a solution to this concern when sharing design-related information. Open and early communication across organizations involved in the SBD process can efficiently coordinate ideas saving both time and money in the development of safeguards measures in a nuclear facility.

Early interaction between designers, owners, the State, SRAs, and the IAEA will allow for the clarification of requirements and expectations of the design to implement in the facility. Establishing detailed specifications will allow acceptable implementation of safety, security, and safeguards measures through the finalization of design elements and design implementation.

### Detailed Guidance and Processes for the Implementation of Safeguards

A major obstacle in the development of a SBD program for the SMR is the lack of detailed guidance and processes to design and implement a safeguards system. There are a variety of resources online provided by the IAEA including articles and reports providing guidance on the implementation of safeguards in a nuclear reactor. However, the guidance is provided at a very high level and lacks clarity of requirements for reactor designers to implement.

From the perspective of a reactor designer, understanding the requirements for safeguards systems, especially for an unattended monitoring system, is crucial throughout the design phase as additional physical systems and barriers can be intrusive by nature. Understanding the required locations and supporting parameters are necessary for the early integration of these measures and overall implementation of an SBD program.

IAEA Nuclear Energy Series No. NP-T-2.9, “International Safeguards in the Design of Nuclear Reactors”, provides an example of the general guidance and states there will be requirements for the operation of equipment without providing detailed requirements to implement in the design. This report states, “The basic requirements of IAEA safeguards equipment include physical space, uninterruptible power and a data transmission backbone… Even without detailed IAEA design criteria for safeguards equipment or systems, which might be specified only late in the design life cycle, provision of cabling and penetrations can be included in design” [1]. Without the equipment locations identified and requirements for power rating, backup power, space for the equipment itself as well as for inspection and maintenance, and transmission, it is impossible to accurately design for these spaces, especially when equipment locations (cameras, seals, etc.) are not yet finalized. The location is especially crucial to early planning.

Although these guidance documents provide an overview as to the types of equipment the IAEA uses, there is no clear documentation of the specific requirements of the equipment and their location within the nuclear facility. Defining the requirements for structural supports for cameras and equipment, the required space to allow ready access for maintenance and replacement of equipment, the footprint necessary for backup power and data processing equipment, penetrations and required routings of cables, and explaining the key elements requiring direct line of site availability are all critical details necessary to refine and finalize the reactor design.

The IAEA safeguards equipment has specific requirements for power, lighting, and supports to ensure the equipment is properly monitoring required areas and the data is adequately stored and/or transmitted for IAEA supervision. The support of auxiliary systems within the reactor design are not explicitly discussed in the guidance documents but Westinghouse has understanding from industry experience that auxiliary systems such as lighting must support the operation of safeguards equipment. For example, cameras for monitoring will require a minimum brightness (lumens) to ensure the cameras can clearly monitor and survey the selected area. These requirements of auxiliary systems which support the operation of safeguards equipment must be provided upfront for designers to implement during the design phase and avoid future rework of existing systems to accommodate safeguards equipment. Without these safeguards specific specifications, reactor designers default to standard industrial safety codes for minimal lighting requirements and width of egress pathways. These safety related standards are not likely to be adequate for the needs of the IAEA for safeguards purposes. Thus, finalization of the reactor design using the concept of SBD cannot be completed without these parameters being adequately defined and shared with industry.

Power and backup power requirements for electronic equipment is not provided within these guidance documents providing no design basis for reactor designers. Parameters such as power rating and minimum time duration for emergency power are crucial parameters to consider in the design, and therefore the plant design cannot be built to accommodate this equipment without such information. Additionally, surveillance equipment often has data transmission requirements which are not detailed in the IAEA provided guidance. The AP300 plant design has a 72-hour emergency power supply for various system such as emergency lighting. Although the IAEA may deploy battery backup for their safeguards equipment, the detailed requirements of the design of auxiliary systems and electrical supplies must be provided to ensure that the plant design can adequately allow for space to accommodate the addition of this equipment and to ensure lines of sight and adequate illumination are provided. Understanding the backup power requirements (kilowatts per hour and duration), the means of providing backup (battery or generator), the footprint needed for installation, maintenance and testing, any potential hazards associated with the backup power equipment (fire, exhaust, corrosive materials), and connections/routings necessary to use the backup power are all aspects which needs to be considered and addressed throughout the phases of reactor design.

Requirements for running conduit, locations of wall penetrations, space for data cabinets, and internet, Wi-Fi, and Ethernet Local Area Network (LAN) requirements must be provided to successfully design for the layout of this equipment. Accommodating additional penetrations and equipment can potentially impact the overall layout of the plant and may require additional rooms for space. Due to the overall compact layout of the AP300 plant design, this presents a major potential challenge to the implementation of SBD for this facility.

Additional space such as office space for inspectors and equipment, clearance for equipment maintenance, and clearance for inspections are also required and should be identified during the initial design phase to reduce cost and time later in the project. Specific spacing requirements must be implemented to protect the health and safety of inspectors who will be in the plant inspecting the safeguards measures such as tamper-resistant devices (i.e. seals). Limited access in the standard plant design for certain areas of the plant creates challenges for inspection in regularly unoccupied areas and presents an overall concern for compliance with inspection requirements. By providing detailed requirements in this early stage of design, reactor designers can modify the arrangement of the plant to have adequate space to account for these requirements. Given than many SMRs are working to minimize the overall footprint of the plant, reactor designers cannot ensure adequate space will be available for IAEA’s equipment without having detailed requirements for IAEA equipment early in the design phase. Without this information, it essentially negates the reactor designers’ SBD efforts. Therefore, it is critical for the reactor designer to understand the form, fit, and function of the system even if the IAEA engineering team continues to develop the specific component design. The reactor designers are in the best position to integrate safeguards systems into the overall plant design. It’s critical for the reactor designer to understand form, fit, and function for the system even if the IAEA Engineering team continues to develop the specific component design. Reactor designers are in the best position to integrate the design within thin their specific plant design.

Another area of concern in the process of implementing safeguards measures at the final stages of design or early construction is potential overlap and obstacles when interfacing with security measures throughout the plant. Security-related surveillance equipment, such as cameras, are implemented to detect potential threats. Because there is a high likelihood that the security and IAEA safeguards systems have similar aspects, there needs to be assurance that equipment does not overlap and obscure the other from functioning properly. Once again, this illustrates the need for detailed information associated with the IAEA’s safeguards equipment (size, weight, location, field of view, interfaces). This is an essential element that needs to be addressed throughout the reactor design phase to prevent potential interference from other reactor plant components. Alternatively, there may be room for coordination between security and IAEA safeguards such as utilizing the same wall penetrations, sharing electrical routing, and other interfaces the systems may be able to share while maintaining independent systems.

Historically, overall design of a safeguards system is developed by the IAEA utilizing the information provided by the owner in the IAEA Design Information Questionnaire (DIQ). The DIQ contains a variety of design information pertaining to all areas of the facility which contains a significant quantity of radioactive material or is relevant to the fuel handling process, and therefore is an area of interest for tracking and surveillance within the facility. The DIQ is submitted from the owner to the SRA, and then from the SRA to the IAEA. There is typically no involvement of the designer themselves in this process. However, the SBD process requires collaboration between the designer, owner, regulator and/or State Authority, and the IAEA. This SBD process then enables collaboration and contributions from the designers itself. Therefore, with designer involvement, specific guidelines are crucial to receiving accurate input from the designers regarding potential locations for surveillance and detection measures along with identifying potential solutions for various support.

Specific design requirements for reactor designers are crucial to reduce cost and time spent later in the project since early planning can allow for the design modifications to be made in the planning phase rather than the construction phase. Overall advanced planning can enable reactor designers to engage in the SBD process and implement design changes to accommodate IAEA safeguards measures.

### Reactor Designer Training for Cross Functional Disciplines

A key component of implementing SBD for nuclear facilities is having personnel working on the design of a reactor trained on IAEA safeguards and the implementation of safeguards system. During the initial design phase of a nuclear facility, a wide variety of engineering disciplines are involved and collaborate. Most disciplines on a specific project provide input to the project design with specialized roles: electrical engineering, mechanical engineering, piping, safety system design, security, safeguards, etc. However, coordination across these subdisciplines is required to successfully implement safeguards in harmony with safety and security. Most reactor designer engineering departments focus on one of the 3S’s, most of which are concerned with safety. In order to integrate a safeguards system which requires the support of many functional areas, reactor designer staff must have a comprehensive understanding of the requirements of other disciplines, how these requirements are typically met, how these disciplines interface with other disciples, and a general understanding of the priorities of each discipline.

Safeguards training must occur on an organizational level and for individuals. As an organization, reactor designer companies must prioritize awareness of safeguards implementations and their requirements. This can occur through the development of individuals skills, training of personnel, and internal seminars. Westinghouse has prioritized all three of these developmental tools to inform and train the organization as a whole while progressing individual’s knowledge and understanding of safeguards requirements. An opportunity to progress the knowledge of reactor designers is to provide training specifically geared toward safeguards systems design. Current training opportunities lack guidance regarding the implementation of safeguards measures which are crucial to the technical development of reactor designers responsible for the accommodation of safeguards systems within the design.

Oftentimes in large projects, there are competing priorities due to the number of subdisciplines working on the design and deployment of a nuclear facility. When applicable, overlap of priorities should be identified and focused on to reach the goals of individual groups. Safety and security, for example, may both be concerned with the number of people present. Security may require the presence of two or more individuals to reduce the potential risk of theft, diversion, and sabotage, while Safety wants to limit the number to minimize the number of individuals receiving radiation exposure. In this example, minimization of radiation exposures and overall prevention of theft, diversion, and sabotage are conflicting concern between the two disciplines. This is an opportunity for groups to coordinate and prioritize their efforts to identify options which achieve the best overall outcome. By understanding the responsibilities and priorities of each functional area, addressing major design concerns as a collective whole can save time and cost on the project

With a need for overall comprehension of the priorities of various subdisciplines, this creates an opportunity for designers to implement training on IAEA safeguards and the overall integration of safety, security, and safeguards. Designer-led training can provide information on what safeguards is, provide specific examples of existing IAEA technical measures, establish expectations for designers, and present potential options for implementation.

Several organizations within the industry provide comprehensive training which is available to designers to learn about IAEA safeguards including non-governmental organizations as well as government organizations. Non-governmental organizations include, but are not limited to, the Institute of Nuclear Materials Management (INMM), the European Safeguards Research and Development Association (ESARDA), and the World Institute for Nuclear Security (WINS). States or State Associated agencies involved in the training of safeguards include the United States Nuclear Regulatory Commission (U.S. NRC), the United States Department of Energy (U.S. DOE), as well as United States National Labs. Additionally, the IAEA themselves and other private companies and consultants provide a wide range of training options. These training opportunities already exist on a multitude of platforms both locally and remotely. By providing these training opportunities in multiple platforms, these organizations minimize travel expenses for designers and allows a larger number of participants to learn about the subject. Additionally, the types of training available to designers allows the training of multiple disciplines at the same time and provides a means to begin communication and engagement between the various disciplines. Many of the training sessions also leave time for roundtable discussions to engage interactive discussion across disciplines and organizations to better learn how safeguards measures can be successfully implemented while minimizing time and cost.

Continuing these trainings while also engaging designers and allowing for open feedback and the ability to raise concerns regarding the physical implementation of these systems is critical to the successful deployment of SBD in SMRs and other nuclear facilities, especially with harmonization to safety and security. This open line of communication and training allows all 3S disciplines to become aware of and understand the priorities and responsibilities of each discipline and to identify ways to harmonize goals and successfully implement IAEA safeguards into reactor facility design.

## Major Conclusions

There are many opportunities to develop and implement SBD in SMRs while coordinating the goals and responsibilities with safety and security. Although there are many potential solutions to the concerns identified in previous sections, there are still risks associated with the implementation of SBD.

A concern which may present the greatest risk to this effort is the economic uncertainty associated with this first-of-a-kind design and deployment of an IAEA SBD system, especially in SMRs as many of these are novel designs. A major concern is the inability to clearly identify all SBD associated costs. Although the training across designer subdisciplines as discussed may limit this risk, as with all first-of-a-kind designs, there is no way to ensure total certainty within the design and there may be unknown challenges identified in later stages of the project during physical implementation. The uncertainty in design completion may lead to a variety of further challenges, such as delays which result in additional costs and lost opportunities. Uncertainty delays carry forward through to design certification and licensing, creating further challenges to the overall market due to this uncertainty with the SMR design completion. Overall changes in anticipated costs associated with safety, security, or safeguards can significantly impact the economic viability of the SMR program which is an overall risk to SMR deployment.

Although there is risk in the uncertainty of the overall cost of the implementation of SBD in SMRs, communication can also allow designers to develop detailed cost estimates to validate and justify the economics of the SMR program allowing the SMR to be marketed with a known “total cost”, rather than leaving the cost of the implementation of a safeguards program as an unknown.

Efforts which would most greatly impact the success of an SBD program for SMRs include synchronization across States, detailed guidance and processes for the implementation of safeguards equipment and systems, and increased training of personnel. Synchronization of policies and regulations which SMR designs must follow are opportunities for the IAEA and regulatory bodies to assist designers in the implementation of SBD.

Westinghouse has taken the initiative to prioritize its understanding of safeguards implementation which has then led to the development of a core effort within the engineering organization. Westinghouse has trained personnel, specifically those involved in the overall integration of plant systems to further identify potential design changes which must be considered in the implementation of SBD. Potential changes to the overall layout to accommodate cabinets and additional equipment, additional cable routing and penetrations, and clearance for inspection have all been considered in preliminary discussions and ideas surrounding SBD implementation. Additionally, coordination with security personnel and groups responsible for plant safety have also been a priority in the initial planning phase. However, without further input from the IAEA regarding equipment types and locations, the amount of effort Westinghouse can put into making these design changes is extremely limited.

Westinghouse’s current experience has been associated with the development of Westinghouse’s AP300 SMR reactor design as well as previous experience with safeguards implementation with other reactor designs. Westinghouse does not currently have any advanced reactor nuclear facilities with a fully implemented IAEA safeguards system but is undergoing the design process for a first-of-a-kind system implementation for the Lubiatowo-Kopalino site in Poland as well as efforts to pursue the SBD process for both the AP300 SMR as well as the eVinci™ microreactor.

Westinghouse anticipates implementing SBD for the standard plant design for the AP300 plant and other advanced reactor designs such as the eVinci™ Microreactor. By implementing SBD during the design phase of the AP300 plant development, there is an opportunity to minimize the overall time and cost spent on a safeguards system. Westinghouse however will require a collaborative relationship with States and the IAEA to design this standard system during the design phase. The relevant information regarding the plant is solely held by Westinghouse as these designs are not finalized and therefore have no contracts with potential owners at this time, so there are no owners of plants to participate in such discussions..

Another initiative taken by Westinghouse in the SBD process involves the preparation of a standard plant DIQ. The DIQ for research and power reactors is typically to be submitted by the owner to the regulator, and then from the SRA to the IAEA. During this process the designer has no direct involvement with the IAEA in the provision of design information or the actual design of the safeguards system. Westinghouse, however, is attempting to implement the SBD process for the AP1000 reactor design for future projects in NNWS. Since the AP1000 design is complete, a standard plant DIQ has been completed and submitted to the U.S. NRC for informal review. The DIQ contains no site-specific information as the form was submitted for a standard plant to be updated by Owners for future use. However, even with the AP1000, the SBD process still requires rework in the final design phase as the preliminary design is complete. A true SBD process would take place while the nuclear facility remains in the design phase. Utilizing lessons learned from the AP1000 safeguards implementation for future projects can be advantageously used in the deployment of SBD in the AP300 plant design and other SMRs.

Westinghouse is looking for further information and collaboration with the IAEA and State regulatory bodies to continue these discussions and further develop SBD in the Westinghouse AP300 plant design, as well as other reactors that Westinghouse is developing and deploying. Without detailed design requirements and further collaboration with the States and IAEA, there is concern for the delay in the development of a safeguards system in the AP300 standard plant design, which would then require safeguards implementation during final stages of planning rather than implementing the SBD process. Westinghouse looks forward to the continued discussion and collaboration with various stakeholders to successfully deploy the AP300 plant design.

**References**

1. International Safeguards in the Design of Nuclear Reactors, IAEA Nuclear Energy Series No. NP-T-2.9, IAEA, Vienna (2014).
2. Safeguards Implementation Practices Guide on Provision of Information to the IAEA, IAEA Services Series 33, IAEA, Vienna (2016)

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