

## **INTERNATIONAL SAFEGUARDS: CHALLENGES AND OPPORTUNITIES FOR THE 21<sup>ST</sup> CENTURY**

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The United States has a major stake in the success of the international safeguards system administered by the International Atomic Energy Agency (IAEA). IAEA safeguards serve as the only international mechanism available to monitor nuclear activities in conformance with the Non-Proliferation Treaty (NPT) and safeguards commitments undertaken by states worldwide. They also promote international confidence in peaceful uses of nuclear energy, deter and provide possible early warning of incipient weapons programs, and serve as a benchmark for compliance with resolutions of the IAEA Board of Governors and UN Security Council.

Today, the international safeguards system is under more strain than at any point in its history, due both to expanding responsibilities and high-profile investigations in Iran, North Korea, Iraq, and of proliferation networks. Over the last 25 years, the number of safeguarded facilities has more than tripled and the amount of highly enriched uranium (HEU) and separated plutonium under safeguards has increased by a factor of six. The number of states with Additional Protocols in force has increased from five to 84 over ten years. Sources of information are expanding, and methods of inspection are evolving. Against this backdrop, the IAEA regular safeguards budget has remained essentially flat in real terms (the exception being a one-time increase adopted in 2002), large numbers of senior IAEA inspectors and staff are approaching retirement, and U.S. investment in safeguards technology has lost momentum and direction.

If current trends continue, strains on the system will inevitably worsen. The anticipated renaissance for nuclear power is expected to be significant given growing concerns surrounding fossil fuel dependency and global climate change. This expansion could entail the deployment of new types of reactors and large-scale, complex facilities for fuel enrichment and fabrication, interim spent fuel storage, spent fuel processing, and long-term waste storage. Much of this growth could come in developing parts of the world, including regions where risks of terrorism and proliferation are greatest.

As nuclear energy expands, proliferation challenges will continue to evolve. In particular, countries may exploit renewed interest in peaceful nuclear energy to justify pursuit of uranium enrichment or reprocessing capabilities for undeclared military programs or as an option to “break-out” if the security environment erodes. As ownership of the nuclear fuel cycle shifts from governments to commercial entities, new opportunities will arise for clandestine proliferation networks to acquire and transfer sensitive nuclear equipment and technology.

This paper summarizes a year-long investigation initiated by National Nuclear Security Administration’s (NNSA) Office of Nonproliferation and International Security involving safeguards experts from the Department of Energy (DOE) and the national laboratories. The study examined the broad range of current and future challenges that the international safeguards system must confront today and over the next 25 years. It identified new authorities, capabilities, and resources that the IAEA, as well as other key

institutions and organizations, will need to respond to these challenges. Its main recommendation is to launch a multi-year **Next Generation Safeguards Initiative** to strengthen international safeguards, coordinate U.S. safeguards technology programs, and revitalize the U.S. safeguards technology and human capital base. There is a pressing need and a new opportunity for the United States and the international community to work together to make strengthened nuclear safeguards a reality.

## **KEY FINDINGS AND RECOMMENDATIONS**

### Topical Area: Mission of International Safeguards

***Finding #1:*** The mission of IAEA safeguards has evolved far beyond the traditional focus on material accountancy at declared nuclear facilities. The lessons of Iraq, Iran, North Korea, and Libya suggest that safeguards, to be effective, must also succeed in detecting or investigating undeclared nuclear activities, including certain weaponization and illicit procurement activities that may indicate noncompliance.

#### ***Recommendation 1a:***

- **The United States should continue to work with the international community to ensure that the IAEA has a credible, independent capability to (i) *detect* undeclared activities at or adjacent to declared locations, and (ii) *investigate* specific indications, possibly derived from third parties, of possible undeclared activities at locations away from declared sites.**

#### ***Recommendation 1b:***

- **The United States should explore options for sharing additional proliferation-relevant information with the IAEA to strengthen its ability to determine the absence of undeclared nuclear activities.**

***Finding #2:*** The IAEA supports broader nonproliferation objectives by participating in efforts to secure nuclear materials and prevent nuclear terrorism. In particular, the IAEA plays a central role in promoting safeguards-conscious nuclear infrastructure development. Developing countries in particular will not only need to establish state systems of accounting and control as required under safeguards agreements, but they also must internalize a safeguards culture and adopt best practices in nuclear safety, physical protection, and nuclear material security.

#### ***Recommendation 2:***

- **The United States should work with the IAEA and the international community to facilitate global nuclear expansion in a manner that prioritizes international safeguards needs and requirements, including through promotion of safeguards-conscious infrastructure development and adoption of an effective mechanism for comprehensive nuclear fuel services.**

## Topical Area: International Safeguards Authorities and Approaches

***Finding #3:*** The IAEA can accomplish much of its expanded mission under its existing authorities. These authorities, if interpreted broadly, confer substantial investigative powers upon the IAEA, but they have been applied more narrowly in practice. More frequent use of special inspections under INFCIRC/153 in a non-discriminatory and non-confrontational manner could strengthen the ability of the IAEA to resolve outstanding safeguards issues, especially in states without an Additional Protocol (AP) in force. Universal adoption of the Additional Protocol and the modified Small Quantities Protocol (SQP) remains an important priority and would substantially strengthen the ability of the IAEA to investigate potential undeclared nuclear activities.

### ***Recommendation 3:***

- **The United States should work to put into effect the policies and authorities necessary for the IAEA to accomplish its evolving mission, in particular by considering more frequent use of special inspections, provision of assistance that supports universal adoption of the AP and modified SQPs, and mechanisms to improve use of export control and trade information in support of international safeguards.**

***Finding #4:*** IAEA safeguards are transitioning from strict material accountancy and a non-discriminatory, checklist-based approach to a State Level Approach (SLA) that provides for deeper analysis in particular states, especially non-cooperative ones. The SLA process can also guide safeguards implementation for the nuclear fuel cycle of the future and strengthen nuclear materials management in support of measures to detect undeclared activities, combat terrorism, and investigate clandestine networks. This transition represents the most significant adjustment to IAEA safeguards since adoption of the Model Additional Protocol.

### ***Recommendation 4a:***

- **The United States should launch technical and/or policy consultations with like-minded Member States and the Secretariat to ensure the SLA process is credible and capable of detecting noncompliance.**

### ***Recommendation 4b:***

- **The United States should encourage the transition to a State Level Approach to safeguards evaluations, including through the provision and involvement of U.S. safeguards experts as the process develops.**

## Topical Area: Safeguards Technologies and Capabilities

***Finding #5:*** A generational improvement in safeguards technologies is needed to achieve greater effectiveness and efficiency. Information technology is the field that carries the most near-term potential to strengthen international safeguards. Detection of diversion will depend on the ability to synthesize and analyze the thousands of data files per day produced by integrated networks of hundreds of sensors. Moreover, the State Level Approach is drawing upon a rapidly expanding universe of available information, including information from state declarations, on-site inspections, environmental sample results, commercial imagery, and open source publications.

Other technology development priorities include advanced safeguards approaches and proliferation risk reduction assessments; enhanced modeling and simulation tools to facilitate the integration of safeguards into the design of new nuclear facilities, especially sensitive bulk handling facilities; improved automation and process monitoring systems that operate in unattended mode and collect and transmit certain types of data in real-time; measurement technologies that can characterize more complex material forms and yield faster, more precise results; and portable and multifunctional detectors for IAEA use during special inspections, Complementary Access, or other inspections or visits. It should be noted that among these certain technologies may be difficult to share while protecting proprietary information.

***Recommendation 5a:***

- **DOE/NNSA should seek to complete an international safeguards technology survey and work plan. The plan should prioritize and integrate support for R&D and engineering application of new technologies and methods that improve the speed and precision of nuclear measurements.**
  - **New measurement technologies should be incorporated into systems that can perform real-time process monitoring and surveillance in unattended mode at declared facilities with extremely high reliability.**
  - **Existing and new technologies should be modified and integrated into a new generation of hand-held tools capable of detecting potential undeclared activities at or in the immediate vicinity of declared nuclear sites and performing elemental and isotopic identification.**

***Recommendation 5b:***

- **The United States should develop new applications to collect, integrate, analyze, and archive safeguards-relevant information with the goal of improving the overall effectiveness and efficiency of the inspection process. The United States should also work with other IAEA Member States to ensure that they have the infrastructure in place to report relevant information to the Agency. Finally, new tools to improve the information analysis capabilities of the IAEA are necessary.**

***Recommendation 5c:***

- **DOE/NNSA should establish formal mechanisms for communicating IAEA safeguards technology needs to the technical community and mechanisms for transferring fully developed applications to the IAEA should be strengthened.**

Topical Area: Human and Financial Resources

***Finding #6:*** The IAEA’s mandate and workload will continue to exceed available resources if current funding trends continue. The size of this gap will depend on the nature of the evolution of the international fuel cycle, in particular with respect to the types and locations of new nuclear facilities;<sup>1</sup> the availability of needed expertise in safeguards-relevant fields; the costs of planning for and introducing new safeguards technologies and approaches as they become available; the extent to which new technologies and approaches can produce efficiencies in safeguards implementation; and the ability and willingness of IAEA Member States to provide human, financial, and technical support.

U.S. spending on safeguards-specific research and development is highly fragmented, with multiple agencies (and multiple offices within individual agencies) sponsoring basic research in broad fields that could be applicable to international safeguards. Coordination is difficult, and the potential for missed opportunities is high. Moreover, mechanisms for identifying IAEA safeguards technology needs to the R&D community and facilitating the development and transfer of specific applications to the IAEA are intermittent and hampered by inadequate funding.

Poor succession planning and rigid retirement and rotation policies significantly undermine the ability of the IAEA to attract and retain expertise in mission-critical areas including nuclear fuel cycle technologies, information analysis and environmental sample analysis. At the same time, the safeguards human capital base in the United States – the pool of expertise available to develop, design, implement, and support the approaches, methods, and technologies necessary to respond to future safeguards challenges – must be revitalized and expanded to ensure a seamless succession from the current generation of experts, many of whom will soon retire, to a new generation of talent with capabilities that cover the full spectrum of safeguards-relevant disciplines.

***Recommendation 6a:***

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<sup>1</sup> New bulk handling fuel cycle facilities such as enrichment, reprocessing, and fuel fabrication plants will have a much larger incremental impact on the cost of IAEA accountancy than item accounting facilities such as reactors. However, to the extent that these new bulk handling facilities are constructed in Nuclear Weapon States (NWS), the impact on budgets may be mitigated depending on whether the IAEA selects such facilities for safeguards.

- **U.S. support for international safeguards could be optimized using a multi-pronged approach that strengthens existing interagency mechanisms for coordinating technical interactions with, and support for, the IAEA, complemented by a dedicated DOE safeguards technology program that coordinates and builds upon activities already underway at DOE and other agencies and that focuses on reinvigorating the U.S. safeguards technology and human resource base.**

*Recommendation 6b:*

- **DOE/NNSA and the national laboratory complex should expand university partnerships in order to cultivate new safeguards experts and develop a program of incentives to encourage current experts to pursue IAEA service.**