International Nuclear Safeguards at Sandia

MISSION FOCUS: Develop and deploy cutting-edge solutions for complex safeguards systems

Safeguards: An Information System

The international community relies on a regimen of monitoring technologies and inspections to ensure that states honor their commitments to the peaceful use of nuclear materials. These safeguards are part of a larger decision-support information system. When the International Atomic Energy Agency (IAEA) announces a safeguards conclusion for each state with a Safeguards Agreement, those conclusions are only as good as the supporting information system. That system includes all of the people, technologies, measurements, procedures, data, infrastructure, and more that must work together.

Sandia Safeguards

Sandia National Laboratories has a long history of contributions to international nuclear safeguards, dating to the U.S. Support Program to the IAEA in the late 1970s. Sandia is an advanced systems engineering laboratory with extensive resources, able to draw upon broad expertise in the surety of nuclear weapons, and synergies with other programs in information assurance, domestic safeguards, nonproliferation, physical protection, arms control, and the nuclear fuel cycle.

Sandia's Contribution

Nuclear proliferation by determined states with enormous resources presents a sophisticated, real, and evolving threat. Sandia is focused on critical aspects of nuclear safeguards: ensuring the cradle-to-grave continuity of knowledge of safeguards information that supports the implementation of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) .

Sandia's capabilities span exploratory research, engineering design and development, systems engineering, simulation and modeling, test and evaluation, implementation, assessments, training and outreach, and program coordination and management.

Sponsor and Partners

Sandia's work is supported principally by the National Nuclear Security Administration (NNSA), spanning all pillars of the NNSA's International Nuclear Safeguards program. The U.S. Program of Technical Assistance to IAEA Safeguards (POTAS) funds selected projects in response to IAEA requests.

Sandia collaborates with international partners, other U.S. Department of Energy laboratories, Department of State, universities, and industry to ensure comprehensive solutions for complex safeguards applications.

Core Capabilities

Information Security and Analysis

Verification of safeguards systems is driven by trusted information that is immune to malicious attack. Safeguards data must be analyzed to be actionable. Sandia provides:

- Vulnerability assessments of critical safeguards equipment
- Authentication solutions to confirm data source / integrity
- Encryption solutions for confidentiality of information
- Joint use technologies for cooperative inspection regimes
- Open source and geospatial info integration and analysis
- Advanced data analytics to help inspectors process and prioritize visual information in onsite inspection environments
- Monitoring modeling to detect nuclear material diversions

Containment and Surveillance (C/S)

Safeguards rely on verified assurance that nothing has changed since nuclear material was last examined ("continuity of knowledge"). Nuclear measurements are expensive; C/S measures offer substantial savings in cost and time. Sandia contributes in these areas:

- Seals and tamper-indicating enclosures assure that safeguarded items cannot be accessed without detection
- Tags uniquely identify high-value items
- Video surveillance provides the safeguards "eyes" while inspectors are not physically present

Cognition-Informed Safeguards

Safeguards practitioners have access to myriad information sources and types that they combine to make assessments about states' nuclear activities. Sandia conducts first-in-kind experimental research to support:

- Presentation of safeguards information to inspectors in the field including inventory lists and facility maps
- Implementation of machine learning models for visual search tasks, given nuanced safeguards performance requirements
- Note-taking practices for complex or unfamiliar equipment
- Establishing trust in voice-controlled user interfaces for potential digital safeguards assistants

Unattended and Remote Data Transmission

International safeguards make increasing use of automated measurements that save inspectors valuable time for non-routine tasks. Sandia supports the surety of data transmission with:

- Measures to ensure the integrity of verification equipment (tamper indication, state of health)
- Material control and accountability hardware / software systems to provide real-time monitoring, tracking, and accountancy of nuclear materials
- Secure transmission
- Wireless communications to facilitate system deployment
- Secure branching of operator instrumentation

Combined Fuel Cycle Analyses

Appreciable quantities of nuclear material will be placed in spent fuel buried in deep underground repositories. Sandia develops solutions to a range of geological repository safeguards challenges:

- Identification and containment integrity verification of disposal canisters
- Repository monitoring during construction, operation, and closure phases
- Long-term information management of data at repositories, given vastly longer timescales than conventional continuity of knowledge for safeguards
- Safeguards implications of deep borehole disposal of spent fuel
- Proliferation risk analyses of advanced reactors and SMRs across the fuel cycle
- R&D of new safeguards approaches for novel advanced reactor and SMR fuel types and facilities

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