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International Nuclear Safeguards Cooperation

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International Safeguards and Technical Systems Department

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Sandia National Laboratories specializes in critical aspects of International Safeguards.

- **Equipment and Information Security**
  - International Safeguards relies on making timely and accurate assessments from enormous amounts of collected information, much of which is provided to Safeguards authorities in confidence
  - Safeguards authorities must be able to trust the information they receive as well as ensure that the information is suitably protected
  - Key elements: authentication, encryption, tamper indication and system design
- **Remote and Unattended Monitoring**
  - The IAEA increasingly relies on information collected by unattended Safeguards instruments at facilities worldwide
  - With proper security, much of the information can be communicated to the IAEA remotely by Internet, satellite, or telephone
- **Vulnerability Assessments**
  - Before technologies and systems can be certified for routine Safeguards use, they must survive rigorous independent testing
- **(continued…)**

Sandia National Laboratories contributions to International Safeguards (continued)

- **Containment and Surveillance (C&S) technologies**
  - Safeguards relies heavily on maintaining “Continuity of Knowledge”
  - C&S technologies indicate tampering with nuclear materials or processes
- **Onsite Inspection and Managed Access**
  - Readiness procedures and host/inspector training
- **Geological Repository Safeguards**
  - C&S methods are essential to the safeguards approach for geological repositories
  - Seismic detection, satellite imagery and other technologies can assure the integrity of a repository isolation zone
  - SNL has experience with the Waste Isolation Pilot Plant (WIPP) and Yucca Mountain repositories
- **Other**
  - Extensive science and engineering base: Subject matter expertise for a variety of disciplines relevant to Safeguards, including chemical analysis, materials science, cryptography, and many others

The International Safeguards Cooperation program has two parts.

- **Bilateral Cooperation Agreements between the U.S. Department of Energy (DOE) and various international partners**
  - **Funded by the National Nuclear Security Administration (NNSA) Office of Nuclear Safeguards and Security (NA-241)**
  - **Regional Safeguards authorities: Euratom, ABACC**
  - **States: Japan, Korea, France, Brazil, Argentina, Australia, and many others**
- **Direct support to the International Atomic Energy Agency (IAEA) Department of Safeguards**
  - **The U.S. Program of Technical Assistance to Agency Safeguards (POTAS) provides extra budgetary assistance to the IAEA for research and development projects to resolve technical safeguards questions**
  - **Respond to IAEA requests for support**

The U.S. DOE collaborates with international Safeguards partners through bilateral agreements.

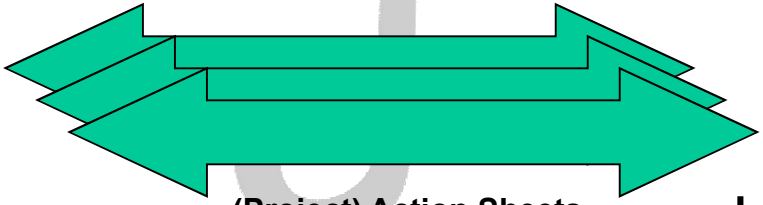
- Collaborations are coordinated by the International Nuclear Safeguards Engagement Program (INSEP) within NNSA (NA-241)
- Cooperation with international partners on nuclear safeguards is tailored to the needs and interests of the partner
  - Sophisticated partners: jointly advance the state of the art for Safeguards technology and implementation
  - Developing partners: provide training and assistance in building a Safeguards infrastructure
- Umbrella agreements are often concluded at high political levels, encompassing a larger scope than just Safeguards
  - Physical protection, nuclear security, and other topics

The bilateral agreements are the formal mechanism to collaborate.

- Implementation of each agreement is overseen by a Permanent Coordinating Group (PCG), which meets annually
- Individual projects within each collaboration are governed by specific "Action Sheets"
- Each side funds its own share of the agreed work plan

Meeting of the DOE-Euratom Permanent Coordination Group, March 2009

Partner Technical Institutions



(Project) Action Sheets

DOE / NNSA National Laboratories

Cooperation with South America

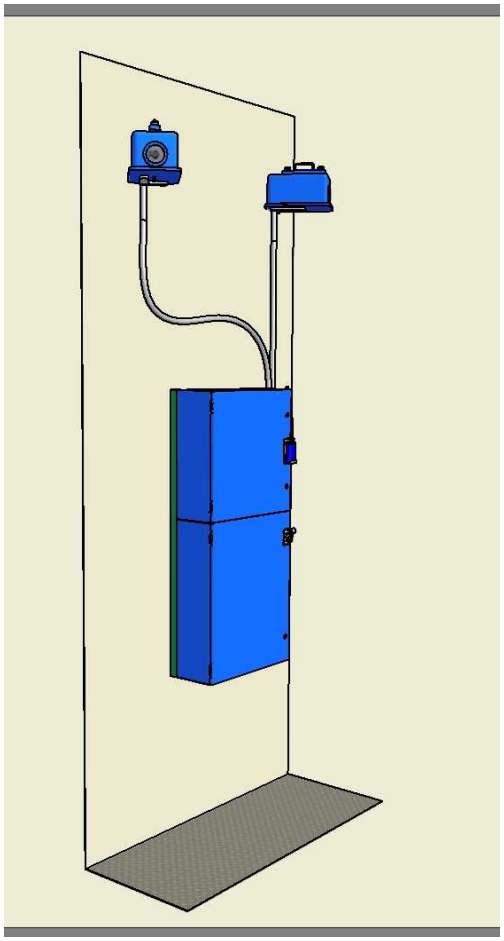
- **Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC)**
  - (AS-18) Develop and deliver a video surveillance system to support unannounced inspections (completed 2010; new work pending)
  - (AS-23) Annual training for ABACC inspectors in containment and surveillance technologies (Sandia instructors join others from ABACC to conduct the training in Argentina and Brazil)

- **Autoridad Regulatoria Nuclear (ARN)**
  - (AS-11) Secure communications for nuclear regulatory network: one link exists; extension to two more facilities planned (completed 2010)

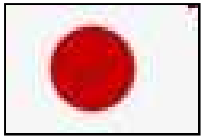
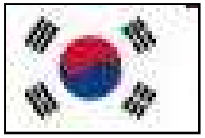
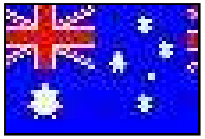
- **Comissão Nacional de Energia Nuclear (CNEN)**
  - (AS-17) Secure data communications: providing assurance to operators that remote monitoring adheres to agreement
  - (AS-22) Assessment of antineutrino monitoring of reactors for safeguards

SNL and ABACC developed the Secure Video Surveillance System (SVSS).

- DOE-ABACC Action Sheet 18
- Support for unannounced inspections
  - Up to two hours may elapse between the notice of inspection and when inspectors reach a facility location of interest
  - Video surveillance with a fast picture-taking interval covers this delay time
  - The surveillance technology presently in use by ABACC and IAEA is obsolete and unreliable
  - SVSS employs commercial, off the shelf components
  - ABACC now seeks IAEA approval of SVSS for routine inspection use

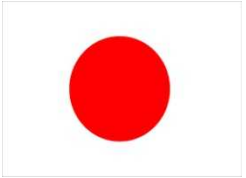


Cooperation with Asia

- **Japan**
  - Japan Atomic Energy Agency (JAEA)
  - (AS-65, completed) Regional cooperation in remote monitoring: a secure link between SNL and Joyo was established, upgraded, and maintained
  - PAS16: Information Sharing Framework for Regional Nonproliferation Cooperation
- **Republic of Korea**
  - Korea Atomic Energy Research Institute (KAERI) and Korea Institute of Nuclear Nonproliferation and Control (KINAC)
  - (AS-12, completed) Regional cooperation in remote monitoring: secure link between SNL, Idaho National Laboratory, and KAERI was established
  - AS-26: Information Sharing Framework for Regional Nonproliferation Cooperation
  - Proposed initiative: Safeguards for Geological Repositories

JAEA and SNL cooperate on technology development and regional cooperation.

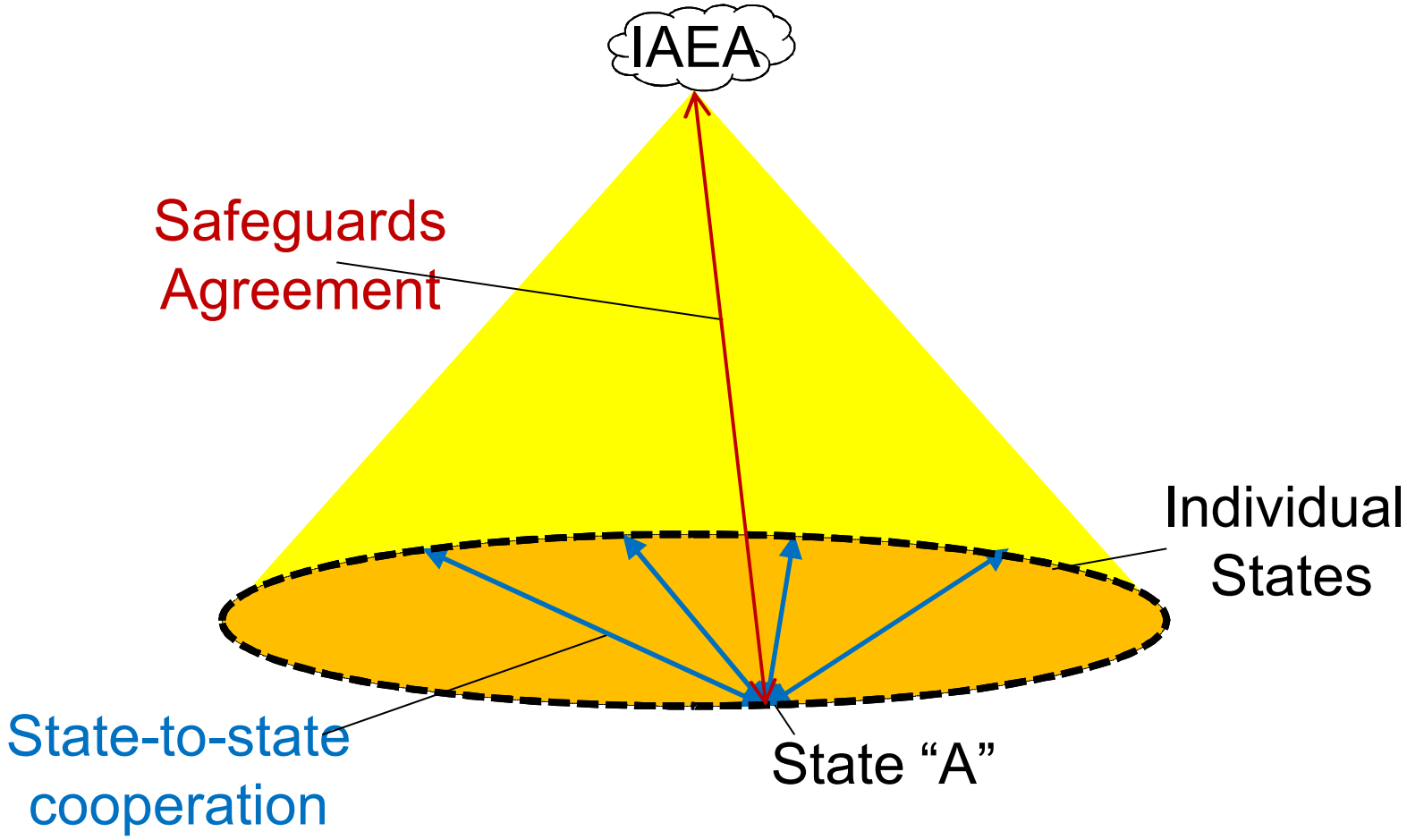


- **Project Action Sheet 16: An Information Sharing Framework for Regional Nonproliferation Cooperation**
  - Establish the requirements for a system that enables direct, transparent sharing of nonproliferation-, safeguards-, and security-relevant information multilaterally.
  - Clarify the need for the framework.

- **Action Sheet 65 developed a remote monitoring network at the Joyo fresh fuel storage vault**
  - Video data exchanged through SNL with Idaho National Laboratory

- **SNL Technical Team:**
  - Risa Mongiello, George Baldwin

Direct state-to-state and regional cooperation can complement the international safeguards system



Credit: Wan Ki Yoon, KINAC, Transparency Workshop, February 2008, Tokyo Japan

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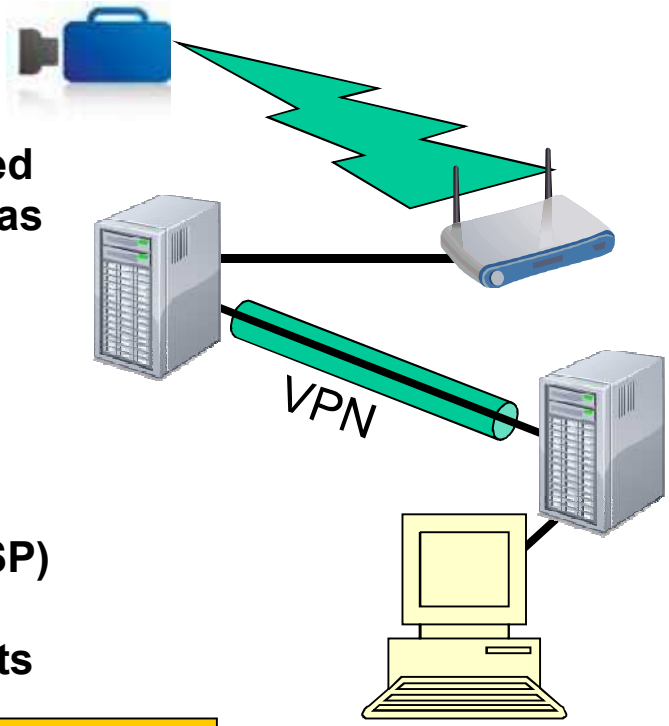
Cooperation with Europe

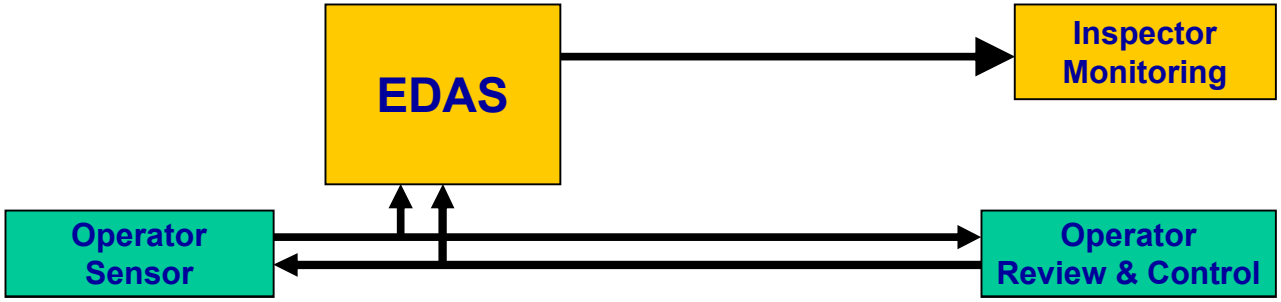
- **Euratom**
  - **(AS-20, completed) Wireless Data Collection – tested the security of various communication links in collaboration with the European Joint Research Centre (JRC)**
  - **(AS-30) SNL and JRC comparing and testing 3D sensing technologies for application to Safeguards**
  - **(AS-32, AS-41) Enhanced Data Authentication System – Demonstrate authenticated branching of operator's process sensors for safeguards, essential for future nuclear fuel cycle facilities**
    - **AS-32 emphasis: inspector requirements; AS-41: operator requirements**

- **Synergy: SNL participates actively in the European Safeguards Research and Development Association (ESARDA)**
  - **Observers to ESARDA working groups: Containment & Surveillance, Safeguards Implementation, Verification Technologies & Methodologies**
  - **Attendance and contributed papers at annual meetings of ESARDA**

Action sheets with Euratom have developed secure approaches for remote monitoring.

- **Action Sheet 20: Secure Wireless Communication (Closed)**
  - Demonstration of short-distance, authenticated and encrypted wireless links within a facility, as well as remote transmission using a Virtual Private Network (VPN)-secured Internet connection
- **Action Sheets 32 (closed) and 41: Enhanced Data Authentication System (EDAS)**
  - Development of a Secure Sensor Platform (SSP) for authentication of operator-owned sensor data to complement Safeguards measurements





International Safeguards Cooperation also contributes to infrastructure development.

INSEP assists states developing civilian nuclear energy programs to prepare adequately for implementing Safeguards

- **Gulf Nuclear Energy Infrastructure Institute, "GNEII"**
  - **Regional training provides a broad survey of the infrastructure required to support a nuclear energy program**
  - **Coordinated with primary sponsor, U.S. Department of State**
  - **Pilot course planned for spring 2011 in the United Arab Emirates**

Direct support to the IAEA Department of Safeguards supplements the regular budget.

- **The IAEA relies on extra-budgetary contributions from each Member State Support Program (MSSP)**
  - The MSSPs do not conduct routine Agency business
  - Typically for specialized tasks and technology development
  - Cost-free experts are supplemental staff

- **Within the U.S., the responsible entity is the Program of Technical Assistance to IAEA Safeguards (POTAS)**
  - Oversight is provided by an U.S. government interagency committee:
    - Subgroup on Safeguards Technical Support (SSTS)
    - Members include DOE and other U.S. agencies (NRC, DOS, DOD)
  - Administration is done by the International Safeguards Project Office (ISPO) at Brookhaven National Laboratory
  - Funding is provided by the U.S. Department of State under a Work-for-Others arrangement
  - Technical support is provided by many government, contractor, and commercial providers

POTAS-funded support to the IAEA is entirely in response to IAEA requests.

- **Each POTAS task is the result of a formal process:**
  - The IAEA issues an "SP-1" request for proposal
  - ISPO relays the request to potential technical organizations
    - U.S. National Laboratories
    - Commercial providers
  - If appropriate, Sandia will assemble a team to develop and submit a proposal
  - ISPO, IAEA and the SSTS review and decide on a proposal to accept

  If Sandia's proposal is accepted:
  - Work for Others Interagency Agreement established
  - Project is funded and started
  - A capsule summary of each active task is reported to ISPO quarterly; a financial status update is provided monthly

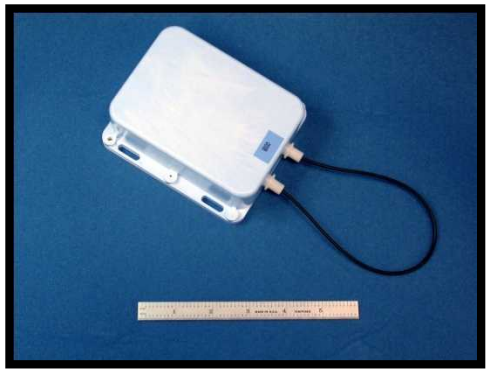
Sandia has made a wide variety of contributions to the IAEA through POTAS.

- **Current work**
  - Remotely Monitored Sealing Array (RMSA): joint task with Canberra
  - Participation in meetings of the IAEA Application of Safeguards to Geological Repositories (ASTOR) group
- **Recently-completed tasks**
  - Vulnerability Assessment of the Ultrasonic Sealing Bolt (USSB)
  - Consulting on Equipment Security
  - Vulnerability Assessment of the "Sign and Forward System"
  - Consulting on Information Collection and Analysis Systems
  - Mobile Monitoring System for Container Transport (MMCT) at Chernobyl
  - Universal Nondestructive Assay Platform (UNAP) Workshop
  - Antineutrino Workshop
- **Pending Proposals**
  - Applications of Reflective Particle Tag technology
  - Development of an Authenticated Switch (CRADA with Canberra)

Development of a Remotely Monitored Sealing Array (RMSA)

- **The RMSA is an active loop seal for IAEA Safeguards application**
  - Seal integrity and status is reported via authenticated and encrypted wireless transmission to a central “translator”
  - Seals units are optimized for low power consumption and last 4-5 years on a battery without replacement
  - Plastic fiber optic seal cable is easy to install and terminate
  - Incorporates advanced tamper indication and communications capabilities
  - Low life-cycle cost
- **Task is coordinated jointly with Canberra Aquila (manufacturer)**

RMSA
pre-production
prototype



Sandia National Laboratories staff members have broad experience in Safeguards.

- George Baldwin
  - Cost free expert to the IAEA Safeguards Training Section, 1993-1995
- Steve Balsley
  - Unit Head at the IAEA Seibersdorf Analytical Laboratory, 2004-present
- J. David Betsill
  - JAEA International Fellow, 2006-2009
- Joe Damico
  - IAEA Cost Free Expert, 2002-2007
  - JAEA International Fellow, 2000-2002
- Richard Lucero
  - JAEA International Fellow, 1997-2000
- Nick Mascarenas
  - Cost free expert to IAEA Technical Support Division, began Jan 2011
- Catherine Pasterczyk
  - Cost free expert to the IAEA, 2011 – present
- Keith Tolk
  - Cost free expert to the IAEA Seals Unit, 2000-2005

Summary

- **Bilateral cooperation strengthens international safeguards**
  - Leverages the development of safeguards technologies and systems
  - Demonstrates technologies of potential interest to the IAEA
  - Transfers safeguards skills to bilateral partners
  - Maintains direct technical contact with the international safeguards community

- **Direct support of the IAEA through POTAS promotes improved implementation of safeguards**
  - Responds to IAEA needs on specific technologies
  - Stimulates growth of the IAEA technical base