International Safeguards Technical Cooperation between the U.S. Department of Energy, Brazil, Argentina, and ABACC

By

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DOE International Safeguards Cooperation Partners

★Safeguards Cooperation Agreements

Infrastructure Development

DOE Technical Cooperation Agreements

Partners agree to:

Cooperate on research, development, testing, and evaluation of technology, equipment, and procedures in order to improve nuclear material control, accountancy, verification, and advanced containment and surveillance technologies for international safeguards applications.

Agreement Mechanisms

- Annual Permanent Coordinating Group (PCG) meetings
- Partners implement agreement through action sheets (projects).
- Action sheets developed to address specific safeguards issues and methodologies
  - DOE/ABACC = 18 Action Sheets
  - DOE/CNEN = 13 Action Sheets
  - DOE/ARN = 16 Action Sheets

Action Sheet Summary

- Action Sheets cover topics such as:
  - Nondestructive Analysis Systems (NDA)
  - Destructive Analysis (DA)
  - Environmental Sampling (ES)
  - Safeguards for Fuel Fabrication Facility
  - Unattended and Remote Monitoring Systems (RM)
  - Containment and Surveillance (C&S)
  - Information Management (IM)
  - Physical Protection
  - Training for all above

The following DOE National Laboratories provide support

- **Oak Ridge National Laboratory**

  (Lead laboratory for Latin American Agreements)
  - **NDA**
  - **ES**
  - **Training**
  - **Instrumentation**

- **Los Alamos National Laboratory**
  - **NDA**
  - **Training**
  - **Instrumentation**

- **Lawrence Livermore National Laboratory**
  - **NDA**
  - **Training**

- Sandia National Laboratory
  - Physical Protection
  - C&S
  - RM
  - Training
- New Brunswick Laboratory
  - DA
  - QA/QC
- Pacific Northwest National Laboratory
  - ES
  - IM

Identify and Address Initial Safeguards Needs

- Improved technical cooperation
- Training
- Workshops that provided hands-on approach
- Provide support to foreign partner's safeguards programs
- Alignment with IAEA mission

Training Courses and Workshops

- **General Safeguards Training**
  - **Establish baseline training standards**
  - **Retraining necessary as safeguards methods evolve**
  - **Training is provided on a variety of topics**
  - **Addressed by several Action Sheets**

Physical Inventory Verification (PIV) Workshops

- **Workshops conducted**
  - **1995 at CONUAR at the Ezeiza Atomic Center, Argentina**
  - **1997 at FEC in Brazil**
  - **1999 at CONUAR in Argentina**
  - **2003 FCN/INB in Brazil**
- **State Systems of Accounting for and Control of Nuclear Materials (SSAC) training was conducted in South America and in the United States**

Nondestructive Assay (NDA) Development

- NDA instrumentation and training
- Methods developed for dual use by ABACC and IAEA
- Reciprocal visits conducted at South American facilities and in the United States

Isotopic Measurements (NDA)

- Partners participated in data collection of measurement standards to evaluate performance of selected commercial uranium enrichment software packages used to determine isotopic ratios for uranium and plutonium
- Tested for
  - ease of use
  - flexibility for variation of input parameters/output parameters
  - agreement with known standards
  - ability to provide accurate data across a broad spectrum of matrices
  - generation of accurate correction factors
  - error propagation and reporting

Neutron Calibration Center

DOE is supporting ARN to install a neutron calibration center to be used for training safeguards inspectors from ARN, ABACC and IAEA on NDA measurement activities by passive and active interrogation methods

Environmental Sampling

- Technology used to characterize trace amounts of U and Pu
- Includes:
  - qualification of laboratories
  - round robin exercises to analyze blind/unknown samples
  - analysis of swipe samples collected by the IAEA at key nuclear facilities and around the world
  - building–up capabilities of DOE partners

Unannounced Inspection Workshops

- Were developed to address specific issues for the Brazilian centrifuge plant
- Includes NDA, ES, and C&S
- NDA methods developed to detect hidden cylinders
  - Passive gamma scans
  - Passive neutron measurements at predefined locations
  - Neutron transmission measurements also performed at random locations
- ABACC and IAEA inspectors trained

Destructive Analysis (DA)

- Involves inter-comparison program between laboratories in South America and the U.S.
- Enhances quality control measures
- Supports the bilateral programs of Argentina and Brazil

Containment and Surveillance (C&S)

- Required by ABACC/IAEA agreement
- Systems installed at:
  - Angra I in Brazil
  - Angra II in Brazil
  - Atucha I in Argentina
- Workshops conducted to provide hands-on training on surveillance equipment

Remote Monitoring (RM)

- Reduces the cost of routine inspections
- First applied at the Embalse Nuclear Power Plant in Argentina
- Reciprocal visits and training conducted
- Equipment upgrades provided

Information Management

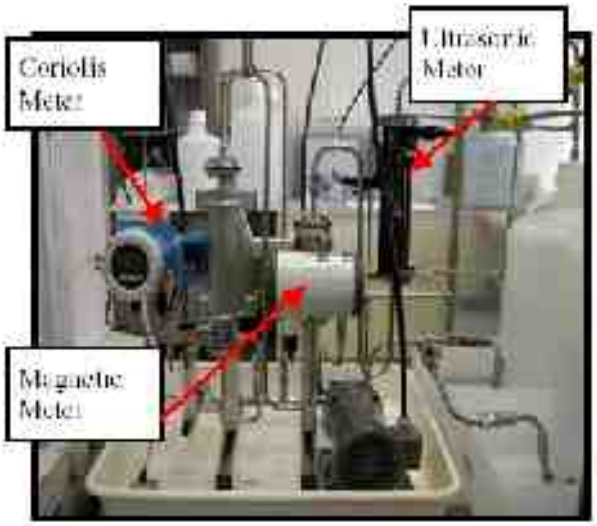
- Investigates technologies used to store, display, and analyze safeguards information
- DOE has made recommendations for network security upgrades
- Current project includes providing additional network structure and security measures
- Supports reporting obligations to the IAEA

Safeguards for Natural Uranium Conversion Plants (NUCP)

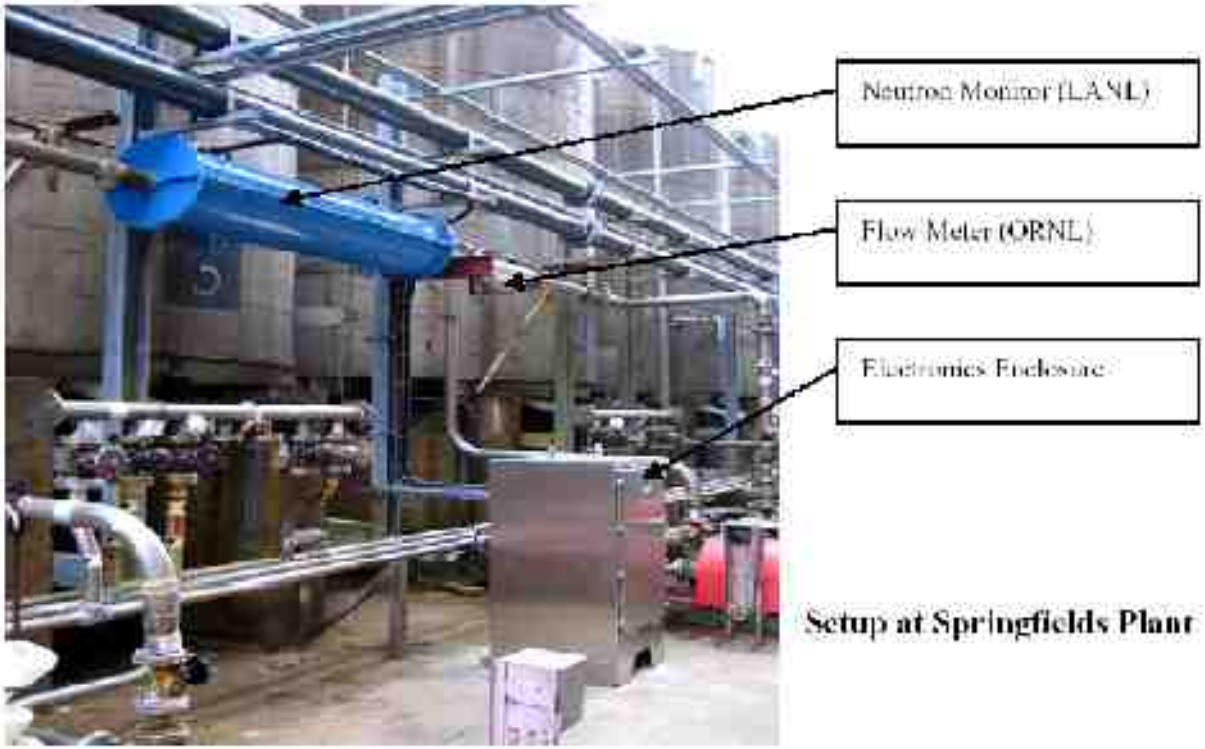
Joint evaluation of new technologies; how these instruments could potentially be implemented at a generic facility

Representatives from CNEN, ARN and ABACC participate in joint experiments at ORNL's Flow Loop Monitor Laboratory

Flow meters for NUCPs

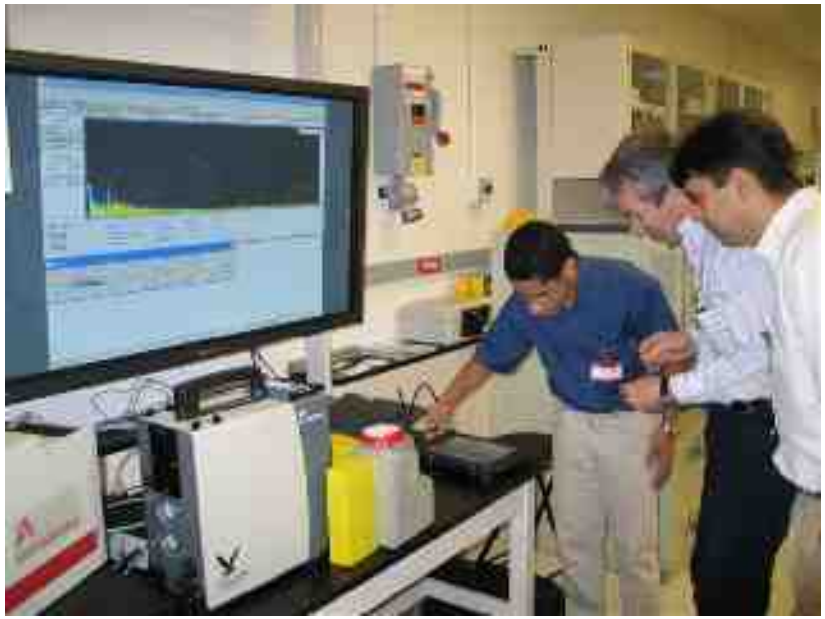


Uranyl nitrate flow loop at ORNL



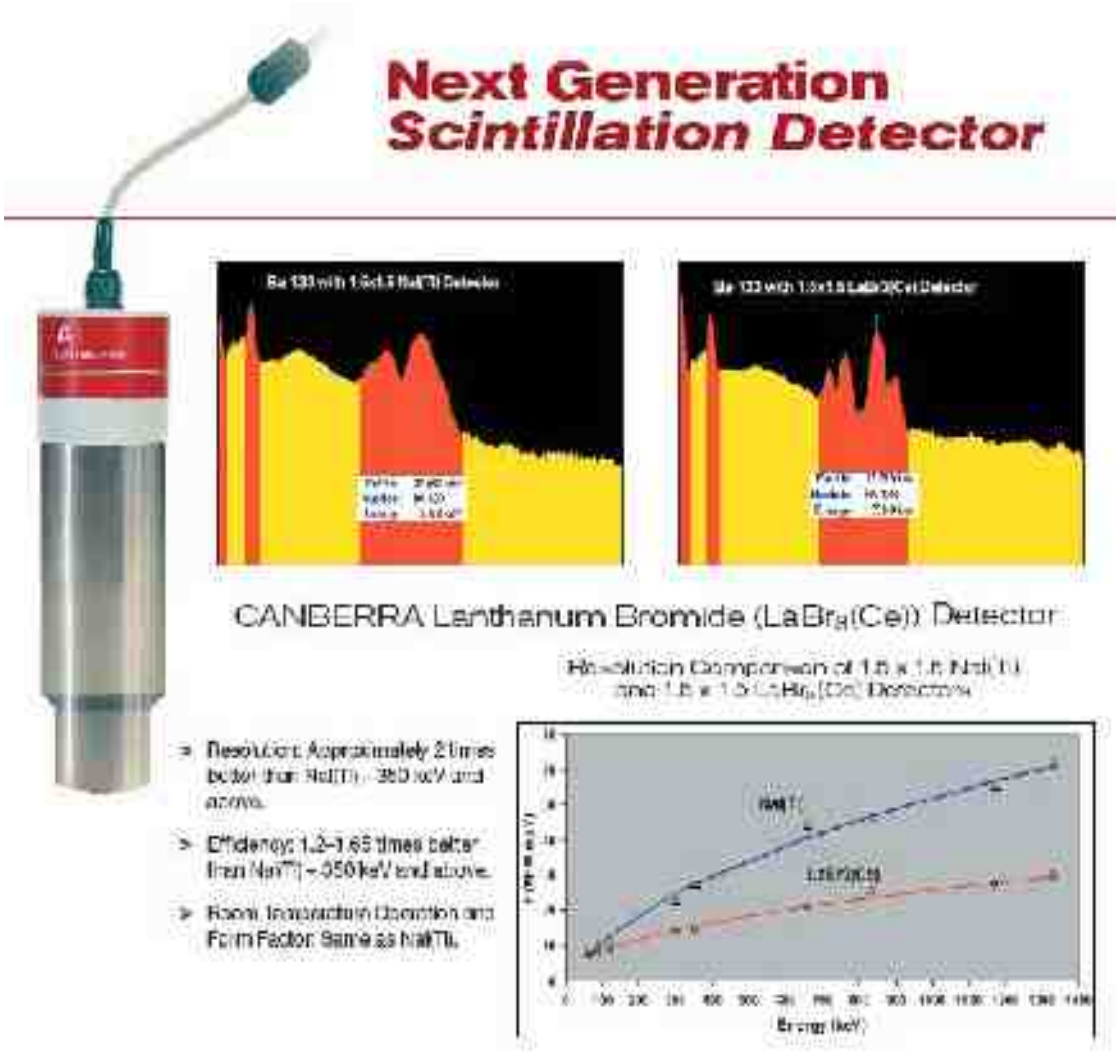
Flow loop at the Springfield Facility

Investigation of New Gamma-ray Detectors for use in NUCPs



Electronically cooled HPGe Detectors:
Canberra's Falcon and Ortec's Detective

Investigation of New Gamma-ray Detectors for use in NUCPs



Future activities

In alignment with:

- IAEA 20/20 Vision for the Future
- Next Generation Safeguards Initiative
  - Goals:
    - Strengthen safeguards policies and institutions
    - Revitalize U.S. safeguards technology and human capital base
    - Better coordinate U.S. safeguards technology development to meet international safeguards needs
    - Promote a “safeguards culture” through nuclear infrastructure development
  - Engagement and outreach:
    - IAEA as key customer
    - Encourage emerging nuclear countries to develop a “safeguards culture”
    - Support international community on initiatives to strengthen international safeguards

Novel Technologies for Safeguards

3D Design Information Verification (DIV) System

An ORNL collaboration with EURATOM

Experimental area preparation

Mounting the scanner head

Raw range scan

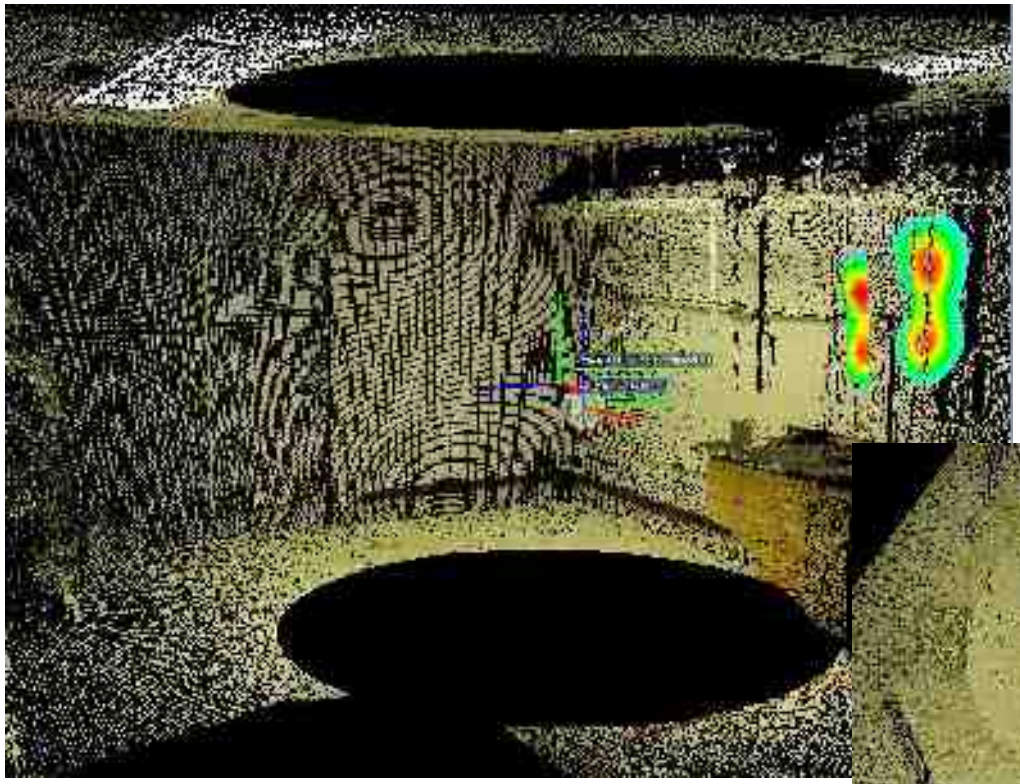
Result: System detected when metal cans and rods were moved 1cm. Movement depicted in red.

The 3D DIV system utilizes a laser scanning head and specialized software to detect changes within a nuclear installations' design. ORNL is conducting tests to determine the system's suitability for IAEA/DOE use.

Novel Technologies for Safeguards

Illustration of Compton imaging system, which is available at LLNL. It is a cart mounted DSSD HPGe detectors which was combined with a visual 4π camera to demonstrate the 4π imaging capability.

Novel Technologies for Safeguards



Combining measurements with 3D laser scanning system and gamma-ray imaging

Novel Technologies for Safeguards

The RMD, Inc. RadCam 2000

RadScan Gamma Camera

VT Nuclear Services (formerly BIL Solutions)

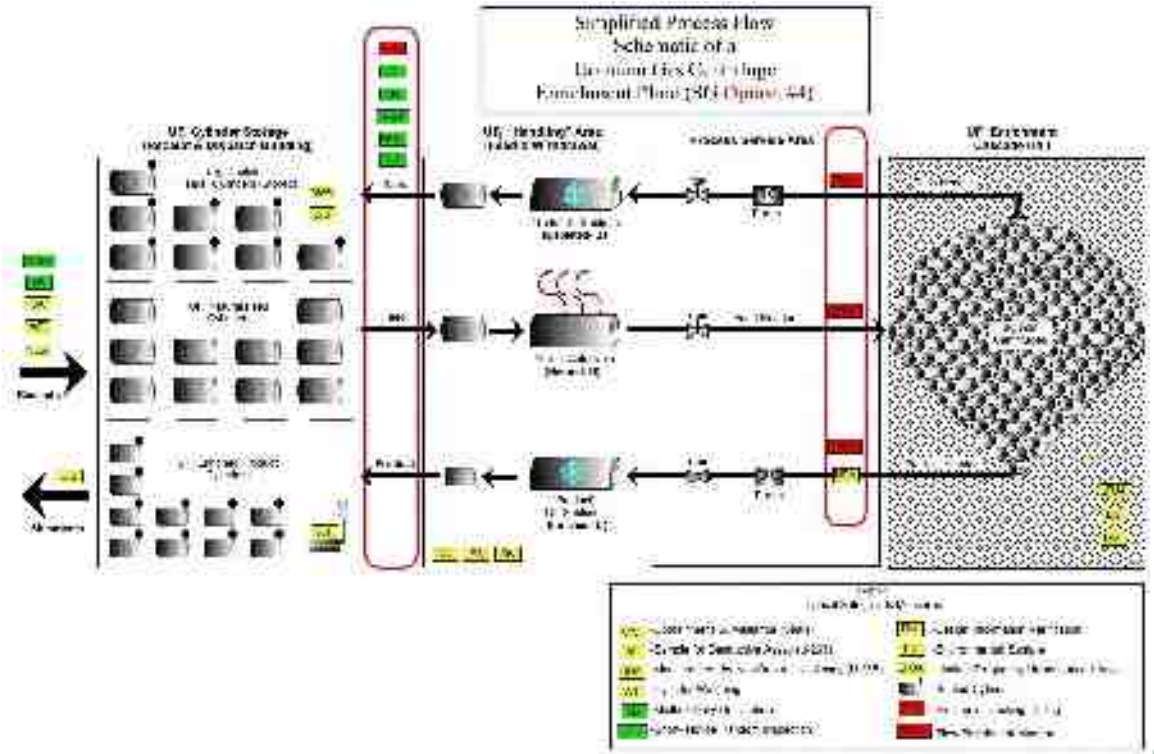
DOE Roadmap for Enrichment Plants

- Investigate feasibility of applying existing technologies for safeguards applications
- Identify benefits to IAEA and potential concerns of plant operators
- Assemble and test prototype systems
- Conduct demonstrations and field trials in real-life operating environments

Safeguards in Enrichment Plants

Multi-lab study on advanced safeguards approaches for large-capacity GCEPs (> 2,000 t-SWU/year)

- Identified potential new measures for verifying nuclear material flows
  - Cylinder tracking
  - Continuous load cell monitoring
  - On-line UF_6 flow and enrichment monitoring



UF_6 Cylinder Tracking

Objective

- Monitor the movement and processing of all declared cylinders

Benefits

- Increase efficiency of verifying on-site inventories
- Enhance capability to continuously monitor movement of cylinders through key measurement points
- Provide a new capability to detect the processing of undeclared cylinders if integrated with other safeguards measures (short-notice random inspections, mail-box declarations, surveillance of feed and withdrawal areas)

Conclusions

- Separate agreements between the DOE, ABACC, CNEN and ARN work together to forge a productive interaction between the United States, Brazil, and Argentina for enhancing nuclear material safeguards
- Collaboration agreements serve as useful vehicles through which new technologies can be evaluated and field tested in various facilities
- Agreements provide mechanisms for technical exchange through training and workshops, and for integrating modern technology into domestic and regional safeguards application
- Cooperation has enhanced ability to align safeguards methods with those of the IAEA
- Cooperation has evolved with technology and should continue as new safeguards methods are developed
- Cooperation is effective for addressing emerging issues and serves as a means by which countries can work together to achieve common goals of strengthening the nonproliferation regime

Questions?