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Title:	Arms Control, Disarmament Verification and Authentication
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Intended for:	Technologies for Monitoring & Verification of Post-New START Nuclear Arms Reductions: Identifying the Challenges & Path Ahead workshop

Form 836 (7/06)

Abstract for talk on: **Arms Control, Disarmament Verification and Authentication**

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In this presentation to an audience of U.S. arms control monitoring and verification experts we will discuss LANL experience developing and testing attribute verification systems with information barriers. We will highlight three challenges to providing confidence—in the measurement, protection system, and results. The presentation will focus on current work being done in the area of authentication.

Arms Control, Disarmament Verification and Authentication

Nancy Jo Nicholas
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A New Start for Arms Control

THE WHITE HOUSE

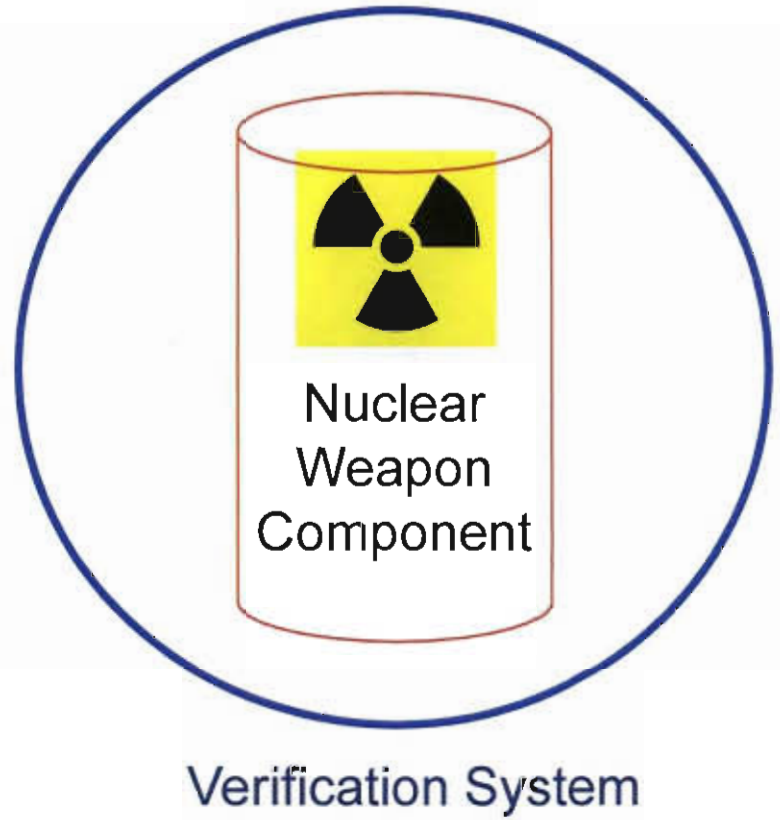
Office of the Press Secretary

FOR IMMEDIATE RELEASE April 1, 2009

Joint Statement by
Dmitriy A. Medvedev, President of the Russian Federation, and
Barack Obama, President of the United States of America,
Regarding Negotiations on Further Reductions in Strategic Offensive Arm

The President of the United States of America, Barack Obama, and the President of the Russian Federation, Dmitriy A. Medvedev, noted that the Treaty on the Reduction and Limitation of Strategic Offensive Arms (START Treaty), which expires in December 2009, has completely fulfilled its intended purpose and that the maximum levels for strategic offensive arms recorded in the Treaty were reached long ago. They have therefore decided to move further along the path of reducing and limiting strategic offensive arms in accordance with U.S. and Russian obligations under Article VI of the Treaty on the Non-Proliferation of Nuclear Weapons.

The Objective: Mutually Assured Confidence



Both the host and monitoring parties (and third parties?):

– must provide confidence to the other party in the veracity of their treaty declaration *while not revealing classified information*

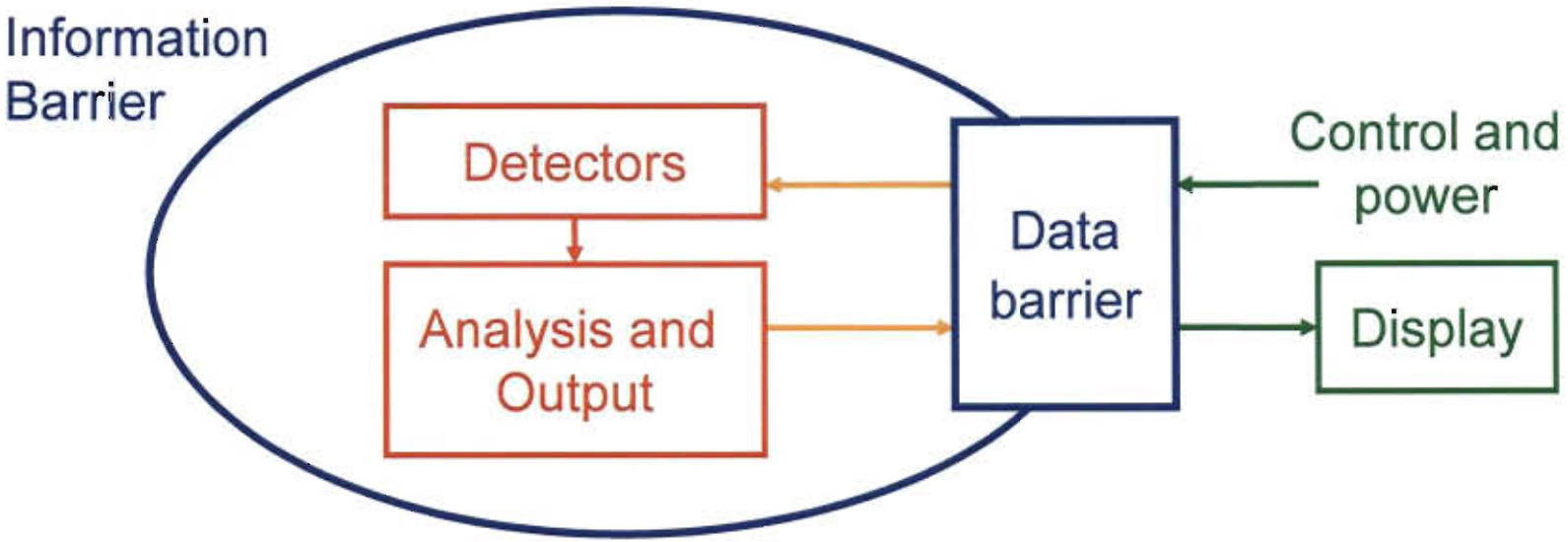
– must be able to *confirm independently,* without access to the material, that an object in a sealed container is in fact a nuclear component

The Challenges

- Evaluate the material/object presented (Measurement)
- Protect the host country's classified information (Certification)
- Allow monitors to draw independent conclusions (Authentication)

Confidence—in the measurement, protection system, and results

Information Barriers



Template Comparison

- Compares each new item with template
- Proof that an item is unchanged
- May accommodate a shorter measurement time

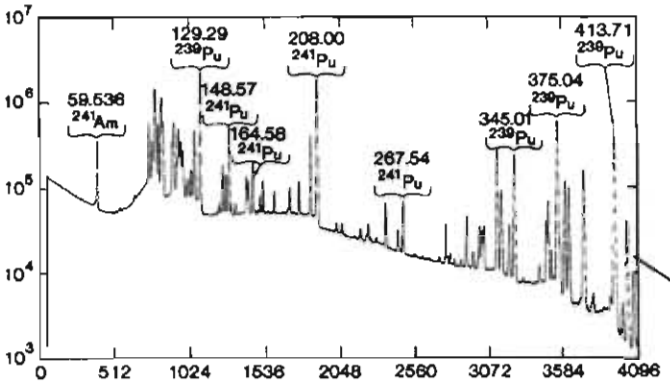
- Do all treaty limited items fit the template?
- Template is probably classified
- How does one initialize the template?
- Only need to fool the system once—during the initialization

Attribute Measurement

- Measures agreed unclassified attributes of each item
- Each measurement is independent of previous results
- System can be used with several types of items with the same attributes

- Attributes are necessarily not very specific
- Choice of attributes is very important
- Not only must attribute be unclassified, but the reason to choose that attribute must also be unclassified

Attributes



Analysis and threshold comparison

- Singles Rate: $S = F\varepsilon Mvs1(1+\alpha)$
- Doubles Rate: $D = F(fD/2)(\varepsilon M)2\{vs2 + [(M-1)/(vi1-1)]\, vs1(1+\alpha)\, vi2\}$
- Triples Rate: $T = F(fT/6)(\varepsilon M)3\{vs3 + [(M-1)/(vi1-1)][3vs2vi2 + vs1(1+\alpha)\, vi3] + 3[(M-1)/(vi1-1)]\, 2\, vs1(1+\alpha)\, vi2\}$

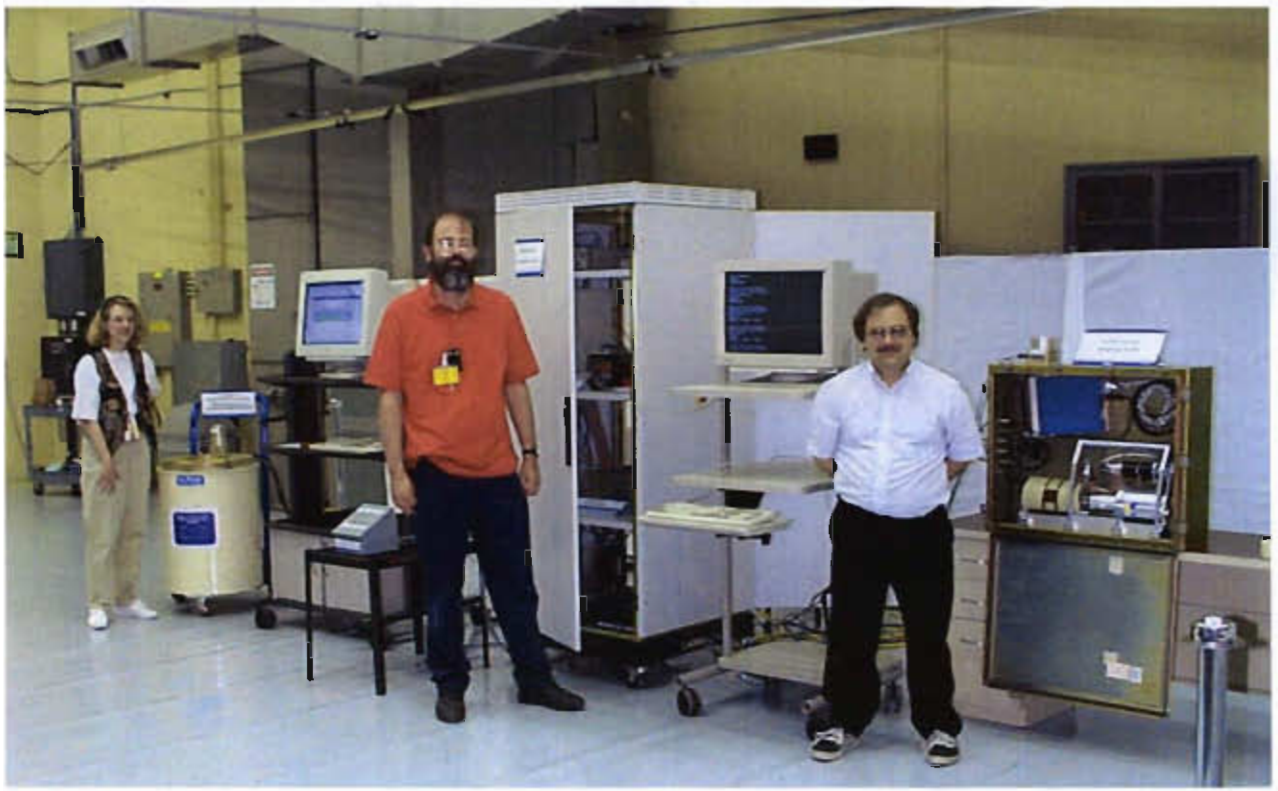
The Challenges

- **Evaluate the material/object presented (Measurement)**
- Protect the host country's classified information (Certification)
- Allow monitors to draw independent conclusions (Authentication)

Confidence—in the measurement, protection system, and results

Measurement – Technical Feasibility

- The Trilateral Initiative demonstration
  - LANL/LLNL collaboration
  - IAEA/Russian audience
  - Small plutonium sources



The Challenges

- Evaluate the material/object presented (Measurement)
- **Protect the host country's classified information (Certification)**
- Allow monitors to draw independent conclusions (Authentication)

Confidence—in the measurement, protection system, and results

Certification – Technical Feasibility

- The Fissile Material Transparency Technology Demonstration (FMTTD)

- LANL/LLNL collaboration
- Russian audience
- Measurements on US weapon component

Only measurement of its kind ever performed.

The Challenges

- Evaluate the material/object presented (Measurement)
- Protect the host country's classified information (Certification)
- **Allow monitors to draw independent conclusions (Authentication)**

Confidence—in the measurement, protection system, and results

Authentication Challenge

- Everything interesting (the object, the measurement system, and the data) has been hidden.
- If the host has a reason to cheat, ...
- **Why should the monitors believe the red/green lights?**

Authentication – Proposed Solutions

- Combination of methods
- Functional testing
- Validation techniques (reverse engineering)
- Construction techniques
  - Commercial off the shelf (COTS)
  - Custom
- Cooperative design
- Random selection

Authentication: Construction Techniques

- The Next-Generation Attribute Measurement System (NG-AMS)
  - LANL design
  - U.S. labs audience
  - Small plutonium sources

COTS-based system

Authentication: Cooperative Design

- Both parties develop design together.
- Both parties build systems from agreed design.
- Both parties are intimately familiar with both design and capabilities of measurement system.
- If the host certifies the measurement system and the monitor validates the validation system, then demonstrating the continued equality of the two systems (continuity of knowledge) is equivalent to authenticating the host system.

Mutually assured confidence

Authentication: Cooperative Design

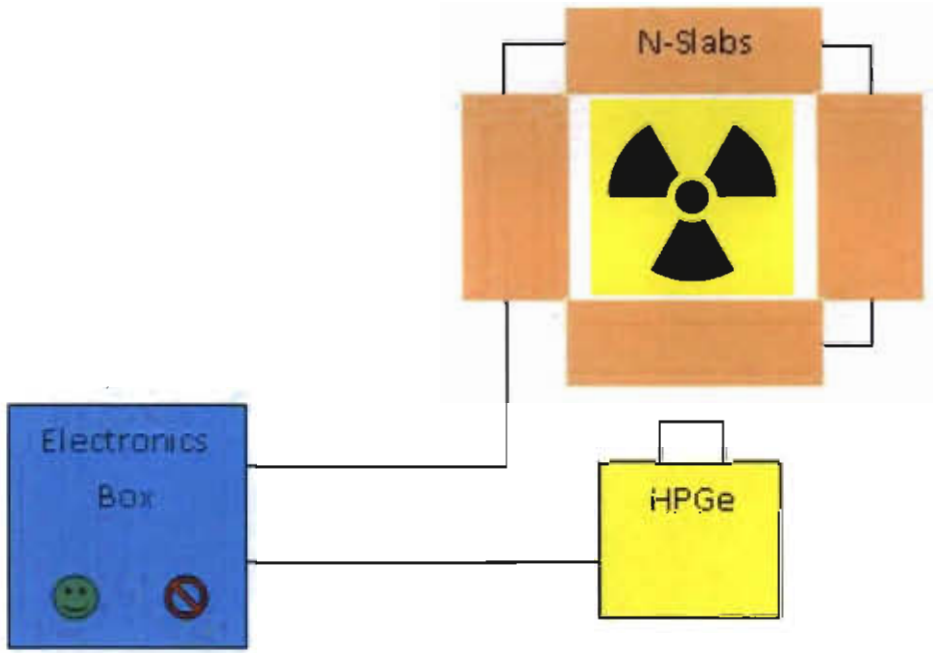
- The Attribute Measurement System for Neutrons and Gammas (AVNG)
  - VNIIEF/LANL/ LLNL collaboration
  - Russian construction
  - U.S. audience
  - Multi-kg plutonium sources

Authentication: Random Selection

- Motivation – confidence that the measurement system (host) and validation system (monitoring party) are identical.
- Simple in concept
  - Several "identical" copies of a component or system are presented
  - One (or more) is randomly chosen for use in the measurement system
  - One (or more) is randomly chosen for validation
  - If the two are identical, validation of the "validation copy" is equivalent to validation of the measurement system
  - But the devil is in the details
- What about continuity of knowledge?

Authentication – Technical Feasibility?

- The Third-Generation Attribute Measurement System (3G-AMS)
  - Multi-lab (U.S.) design and construction
  - Designed for random selection
  - Multi-lab (U.S.) red teams
  - Testing with realistic plutonium items



The Challenges – Current Status

- Evaluate the material/object presented (Measurement) – Done
- Protect host country's classified information (Certification) – Toolkit exists
- Allow monitors to draw independent conclusions (Authentication) – Current primary effort

Confidence—in the measurement, protection system, and results