Verification Challenges at Low Numbers

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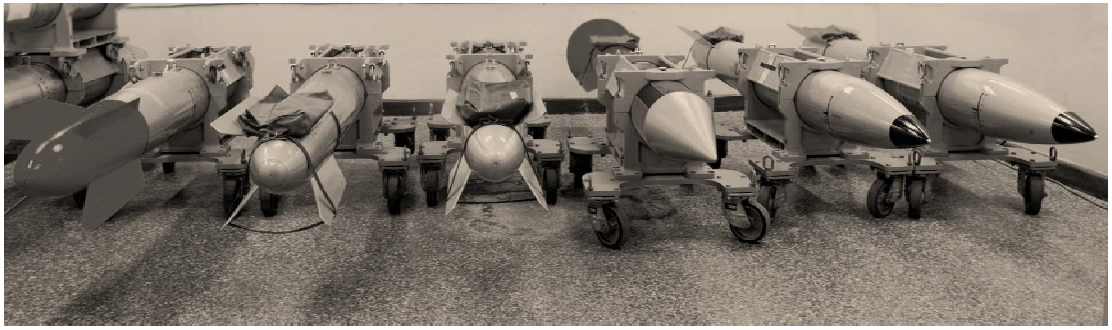
President Obama seeks to reduce and ultimately eliminate nuclear weapons

- This goal sets up a framework for discussion of technical verification challenges at low numbers
- There are verification challenges associated with each order of magnitude reduction
  - 1,000 weapons
  - 100s of weapons
  - 10s of weapons



B61 surrogates used in Ultrasonic Intrinsic Tagging (UIT) study at Pantex
PNNL-14462

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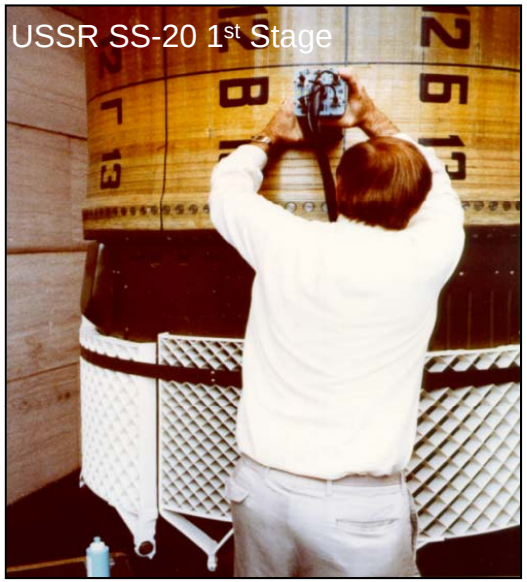
Verification of 1,000 weapons may be straightforward

- Bilateral cooperation between U.S. and Russia only
- New START provides example framework
  - On-site inspections
  - National Technical Means (NTM)
- Challenges
  - Monitoring non-deployed and non-strategic weapons
  - What do you count?



Ultrasonic Intrinsic Tagging

UIT Test on Missile

Significant challenges arise for verifying reductions to 100s

- Emphasis on counting weapons instead of delivery systems
  - Basing strategy

Warhead Counting:
B83 DJTA Sandia Lab News 2009

Mobile Strategies:
W84 Ground Launched Cruise Missile

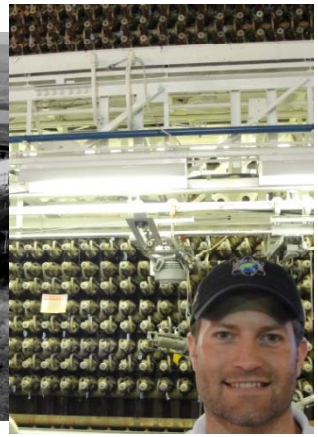
- Challenges:
  - Multilateral
  - Must verify reduction to third party
  - Chain of custody to verify weapon dismantlement

- Issues:
  - Missile defense, conventional, and regional concerns

Multilateral Disarmament Discussions are Challenging

Multilateral verification at 100s of weapons requires a new approach

- Nuclear Archeology:
  - All fissile material production
- Establish baseline stockpile
  - Simple observation
  - Unique identification



B Reactor, Graphite Isotope Ratio Method PNNL-14568
Isotope Ratio for Light Water Reactors PNNL- 18573

- Rethinking of deterrence and targeting?

- Complete chain of custody
  - Deployment to disposition
    - Dusty Rhoades, “Operational Impacts of Warhead Monitoring” (INMM 2011)

B53 Dismantlement
Chain of Custody

Move towards high confidence verification at 100s of weapons

- Greater intrusiveness required for verification
  - Share some classified information
  - Prove item is a genuine weapon
  - Watch component destruction

Fissile Material Transparency Tech Demonstration LA-UR-01-3570

- Monitoring entire weapon lifecycle
  - Rigorous on-site inspections and National Technical Means (modified Open Skies)
  - Deployment, storage, and assembly/dismantlement sites

Monitoring by Boeing OC-135B and NTM difficult when Multilateral

- Must detect undeclared materials and activities

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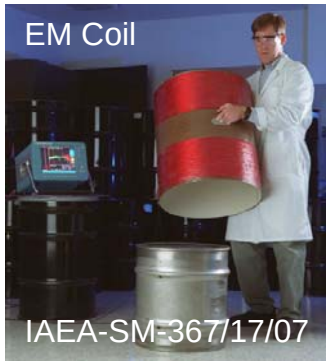
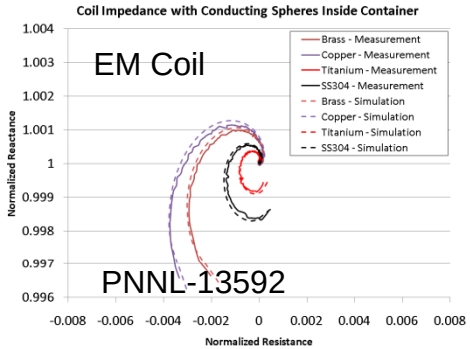
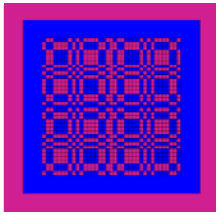
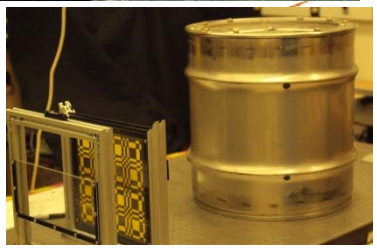
Verification technology required in all stages

- Non-Destructive Assay
  - Passive and active radiation techniques
    - Limitations with complex designs
    - Imaging, templating
  - Gamma and neutron detectors
    - Very robust spectral data
    - Without information barrier, will reveal classified
  - Complex, high tech equipment very difficult to certify (host) and authenticate (inspector)
- Non-Destructive Evaluation
  - EM coil, ultrasonics, others
- TID/TIE; Unique ID
  - Secure material, items, containers







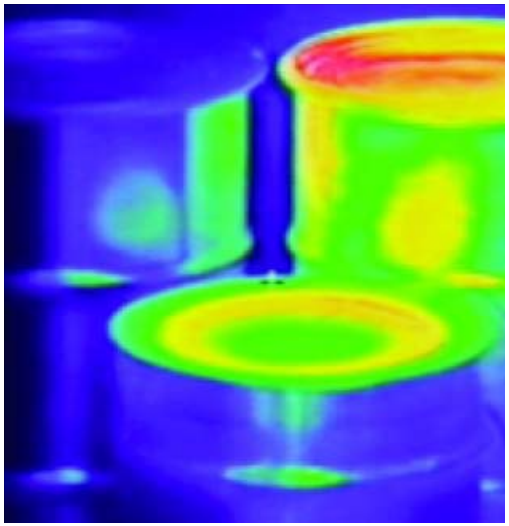


Chain of custody challenges must be overcome

- Must be maintained to verify weapon dismantlement
  - Confidence that measured item at end of dismantlement came from presented weapon at the front-end of the dismantlement process
  - Trusted Radiation Attributes Demonstration System

TRADS SAND2000-1481C

- Authentication and certification
- Protection against diversion and spoofing
  - Room sweeping, cameras, portal monitors, NDA, imagers
- Maintain custody of more than just weapon
- Cannot be present during dismantlement!
  - May change at 10s of weapons



Thermal Images of Fissile Material in Drums

International verification at 10s of weapons is a novel approach

- Dedicated, international dismantlement facility?
- International inspectorate?

- Will require a robust global material control regime
- Inter-play between adversarial countries

- Survivability of remaining stockpile
  - Maintain stability, address imbalances
  - Strong international enforcement regime

- Irreversibility of dismantlement

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Conclusions

- At each order of magnitude reduction of weapons, there are significant challenges that must be overcome
  - Deficiencies in verification technology
  - Multilateral verification issues
- Destabilizing issues increase as weapons decrease
  - Deterrence questions
  - Survivability of limited warheads
  - Non-nuclear 1st strike capabilities
  - Technical disparity between parties

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