CONSORTIUM FOR VERIFICATION TECHNOLOGY

OVERVIEW OF THE POLICY RESEARCH THRUST

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CVT Kickoff Meeting
University of Michigan, Ann Arbor, October 16, 2014
CVT POLICY RESEARCH THRUST

BACKGROUND

TWO WAYS OF APPROACHING THE VERIFICATION PROBLEM

Technology-focused and mission-focused approach;
CVT seeks to combine both; unique opportunities for synergisms
given diversity of 13 + 9 CVT partner institutions and groups

POLICY THRUST: A TREATY-ENABLING APPROACH

Emphasizes mission-focused dimension (as defined by existing and
expected future treaties); support and guide CVT technology developments
toward specific treaty applications; track emerging technologies

Source: www.engin.umich.edu (top) and news.kremlin.ru (bottom)
RELEVANT NUCLEAR ARMS CONTROL TREATIES

NUCLEAR NON-PROLIFERATION TREATY
Bans the acquisition of nuclear weapons by non-weapon states and commits the five weapon states to nuclear disarmament; verified by IAEA safeguards

COMPREHENSIVE TEST BAN TREATY
Bans all nuclear explosions in all environments and would be verified by extensive verification mechanisms (International Monitoring System, CTBTO)

FISSILE MATERIAL (CUTOFF) TREATY
At a minimum, treaty would ban fissile material production for weapons purposes; Issue about treaty scope: Would it also cover existing stocks?

NEXT-GENERATION NUCLEAR DISARMAMENT TREATIES
Agreements that place limits on total number of nuclear warheads in arsenals would pose qualitatively new verification challenges
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NEXT-GENERATION NUCLEAR DISARMAMENT

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About 13,000 nuclear warheads are not currently captured by arms control agreements.
THOUSANDS OF NUCLEAR WEAPONS

ARE CURRENTLY NON-DEPLOYED (i.e., IN RESERVE OR AWAITING DISMANTLEMENT)

W87/Mk-21 Reentry Vehicles in storage, Warren Air Force Base, Cheyenne, Wyoming

Photo courtesy of Paul Shambroom, www.paulshambroom.com
KEY VERIFICATION CHALLENGES
OF NUCLEAR DISARMAMENT AT LOW NUMBERS

WARHEAD COUNTING AND WARHEAD AUTHENTICATION
Need to gain confidence in the correctness of baseline declarations using warhead counting techniques (combined with CoK/CoC) and, prior to dismantlement, high confidence in the authenticity of the warhead.

ART OF DEVISING FLEXIBLE VERIFICATION APPROACHES
Best concepts can be initially non-intrusive, but are designed to accommodate “upgrades” to technologies and procedures; concepts ought to be acceptable/adequate for other weapon states.

TAGGING

TRANSFORMING A “NUMERICAL LIMIT” INTO A “BAN ON UNTAGGED ITEMS”

Source: www.automoblog.net

Several CVT participants are working on technologies that will help ensure Continuity of Knowledge (CoK) (including Chain-of-Custody (CoC) detectors for treaty accountable items or materials)
WARHEAD AUTHENTICATION
WILL YOU KNOW A NUCLEAR WEAPON WHEN YOU SEE ONE?

Nuclear weapons have unique signatures but most of them are sensitive and cannot be revealed to inspectors
Black Sea Experiment, July 1989

Liquid scintillator passive well counter to determine the plutonium mass in samples of unknown size
Source: U-Michigan, DNNG

Information barriers (e.g. using electronic components) can sanitize measured data; Certification and authentication is challenging
Source: UK-Norway Initiative

Several CVT participants are working on technologies that will help enable inspection systems for treaty verification (e.g. advanced detector technologies; software and hardware for new types of information barriers)
VERIFIED WARHEAD DISMANTLEMENT

IMPORTANT PRECEDENTS EXIST AND FUTURE WORK CAN BUILD ON THEM

Inspection System developed as part of the 1996–2002 Trilateral Initiative during a demonstration at Sarov
Source: Tom Shea

Visual contact with a mockup nuclear weapon during a dismantlement exercise carried out as part of the UK-Norway Initiative
Source: UK Norway Initiative, David Keir

Rendering of the Princeton setup using a zero-knowledge protocol with 14 MeV neutrons and non-electronic detectors
Source: Sébastien Philippe
EMERGING TECHNOLOGIES
REAL-TIME SATELLITE IMAGERY, BIG DATA, AND CROWDSOURCING
QUASI REAL-TIME IMAGERY
COULD SUPPORT VERIFICATION OF SEVERAL NUCLEAR ARMS CONTROL TREATIES

Posted in February 2014, www.youtube.com/watch?v=BsW6I6c4tt0 see also www.skyboximaging.com

Several CVT participants are focusing on data analytics
(including data fusion, event correlation, and anomaly detection)
VIRTUAL ENVIRONMENTS

WARHEAD DISMANTLEMENT FACILITY AND MANAGED-ACCESS SIMULATOR

WHY USE VIRTUAL ENVIRONMENTS?

- Explore different architectures and inspection protocols
- Encourage “trial and error” and “learning by doing”
- No classified information at risk

PROPOSED NEW FEATURES

- Integration of virtual (real-time) radiation fields
- Enable host-vs-inspector game play
- Facilitate collaborations between CVT partners

Source: Tamara Patton Schell, VCDNP
### “VERIFICATION CHALLENGES”

**LEVERAGING THE WISDOM OF THE (CVT) CROWD**

<table>
<thead>
<tr>
<th><strong>2009 DARPA RED BALLOON CHALLENGE</strong></th>
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<td>Ten numbered eight-foot weather balloons deployed at public locations across the continental United States; find and submit the coordinates of all ten balloons as quickly as possible</td>
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<th><strong>POSSIBLE VERIFICATION CHALLENGES (RELEVANT) FOR THE CVT</strong></th>
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<tr>
<td>“Stack-Monitoring” Challenge (proposed by Ted Bowyer, PNNL)</td>
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<td>“Lifting-the-Tag” Challenge</td>
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<td>“Defeating-the-Inspection-System” Challenge</td>
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