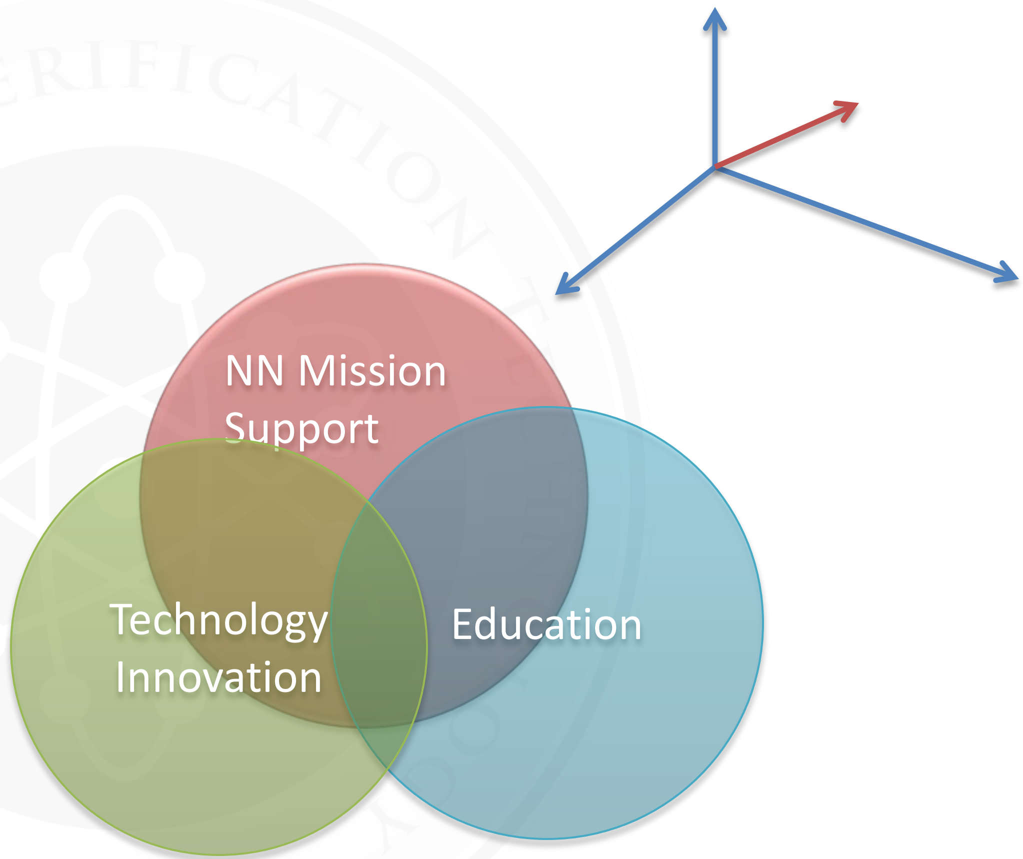
CVT Science & Policy

Contextual Background

CVT Science & Policy

- Focus R&D to *impact* NNSA mission of NN

- FOM ~ $\vec{m} \bullet (\vec{i} \times \vec{e})$



National Academy Study 2012

THE COMPREHENSIVE NUCLEAR TEST BAN TREATY—TECHNICAL ISSUES FOR THE UNITED STATES

Committee on Reviewing and Updating Technical Issues Related to the Comprehensive Nuclear Test Ban Treaty

Policy and Global Affairs

NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

NAS 2012 CTBT

TABLE 4-3: Purposes and Plausible Technical Achievements for Underground Testing at Various Yields in the Absence of Horizontal Proliferation.

Yield (tons of TNT equivalent)*	**Countries of lesser prior nuclear-explosion test experience and/or design sophistication** (advances achievable in the specified yield ranges also include all of those achievable at lower yields)**	**Countries of greater prior nuclear-explosion test experience and/or design sophistication (items in column to left, plus)**
Subcritical experiments (permissible under the CTBT)	• Equation-of-state studies • High-explosive lens tests for implosion weapons • Development and certification of simple, bulky, relatively inefficient unboosted fission weapons (e.g., gun-type weapon)	• Limited insights relevant to designs for boosted fission weapons
< 1 t (likely to remain undetected)	• Building experience and confidence with weapons physics experiments	• One-point safety tests • Validation of some unboosted fission weapon designs • Address some stockpile and design code issues
1 t–100 t (may not be detectable, but strongly location dependent without evasion)	• One-point safety tests • Pursue unboosted designs***	• Develop low-yield weapons (validation of some unboosted fission weapon designs with yield well below a kiloton) • Possible overrun range for one-point safety tests
100 t–1 kt likely to be detected without evasion, reduced probability of detection with evasion (but strong location dependence)	• Pursue improved implosion weapon designs • Gain confidence in certain small nuclear designs	• Proof tests of compact weapons with yield up to 1kt • Validate some untested implosion weapon designs • Assess stockpile issues and validate some design codes
1 kt–10 kt unlikely to be concealable	• Begin development of low-yield boosted fission weapons • Eventual development and full testing of some implosion weapons and low-yield thermonuclear weapons • Eventual proof tests of fission weapons with yield up to 10 kt	• Development of low-yield boosted fission weapons • Development and full testing of some implosion weapons and low-yield thermonuclear weapons • Proof tests of fission weapons with yield up to 10 kt
> 10 kt not concealable	• Eventual development and full testing of boosted fission weapons and thermonuclear weapons or higher- yield unboosted fission weapons	• Development and full testing of new configurations of boosted fission weapons and thermonuclear weapons • Pursue advanced strategic weapons concepts (e.g., EMP)

Bureau of Arms Control, Verification and Compliance (AVC) in DoS

VERIFICATION TECHNOLOGY
RESEARCH AND DEVELOPMENT NEEDS

The following represents the priority needs of the Bureau of Arms Control, Verification and Compliance (AVC) for research and development programs to address critical arms control and nonproliferation technology requirements in the realm of verification and transparency. Responding to these priorities may involve the use of current technologies in unconventional ways, while others will require years of basic research, a properly resourced transition and acquisition process to build deployable systems, and diplomatic legwork on our part to create a feasible environment for deployment.

The Nuclear Non-Proliferation Treaty

In April 2009, the President outlined his nuclear security strategy in Prague. He indicated that the Administration would work to strengthen the Nuclear Non-Proliferation Treaty (NPT). These initiatives will require improved capabilities to detect and characterize activities associated with the nuclear fuel cycle and with nuclear weapon development.

- Remote detection capabilities for undeclared or clandestine nuclear facilities and nuclear weapon development activities.
- Detection of diversion and unauthorized activities in declared facilities.
- Big Data Analytics tools to support compliance verification.

The Global Verification Regime and the International Monitoring System

3 Monitoring Technologies

- Seismology
- Hydroacoustics
- Infrasound
- Radionuclide

TABLE 2-1: Phenomena Associated with Nuclear Explosions, and Technologies Used for Monitoring Them.

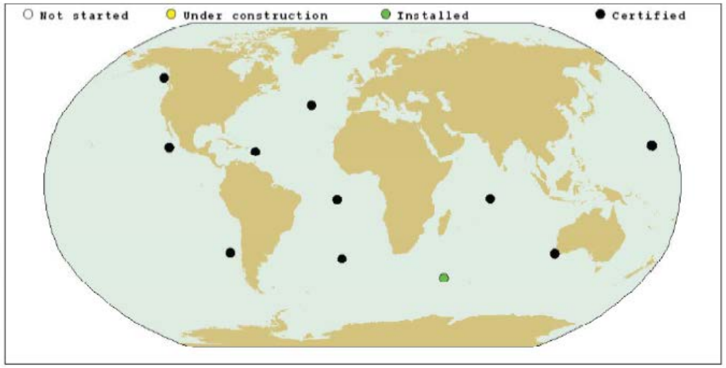
Phenomena	Primary Monitoring Environments	Propagation	Technology Used
Seismic Waves	Underground, underwater	Through the Earth and water	Seismometers
Radionuclides—Particulate and Gases	Atmospheric, underground, underwater and space	Through air; through water; through rock fractures; through space (trapped in the Earth's magnetic field)	Ground-based and airborne collectors; satellite-based detectors
Hydroacoustic Waves	Underwater	Through water	Hydrophones—T-phase seismic stations
Infrasound Waves	Atmospheric	Through air	Infrasound detectors
Electromagnetic Pulse (EMP)[2]	Atmospheric	Through air and space	Satellites—EMP burst detectors*
Optical Flash	Atmospheric, space	Through air and space	Satellites—Optical flash detectors*
Nuclear Radiation	Space	Through space	Satellites—Radiation detectors*

* Not included in the IMS but available through NTM.
SOURCE: Committee

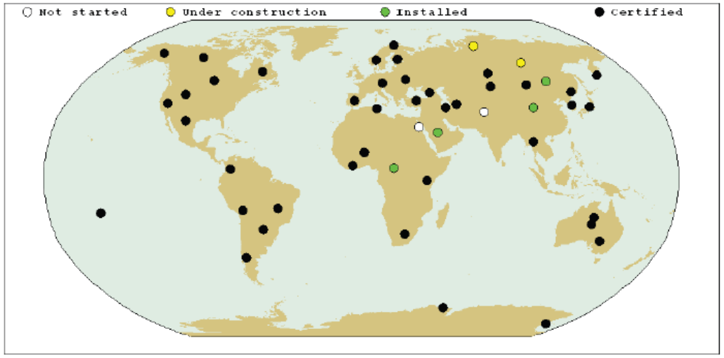
IMS

Hydroacoustic Network

30 June 2010

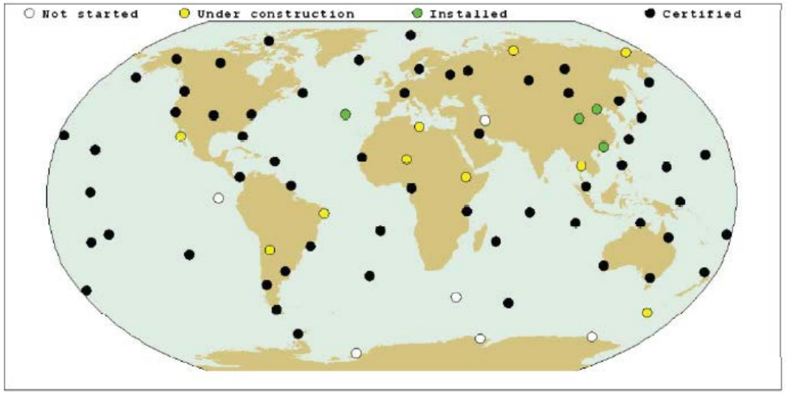


Primary Seismic Network



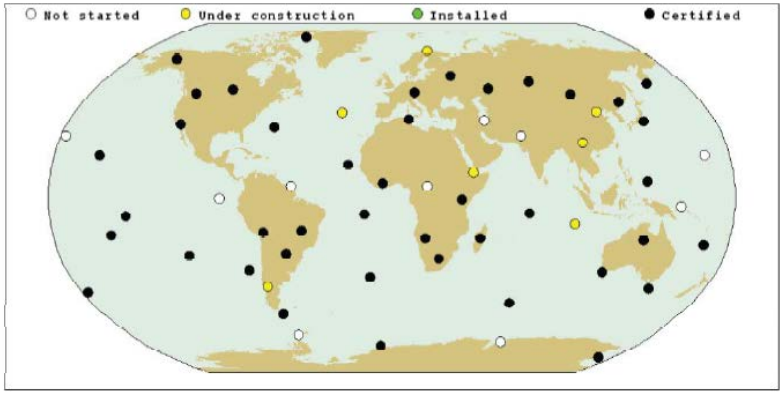
Radionuclide Network

30 June 2010

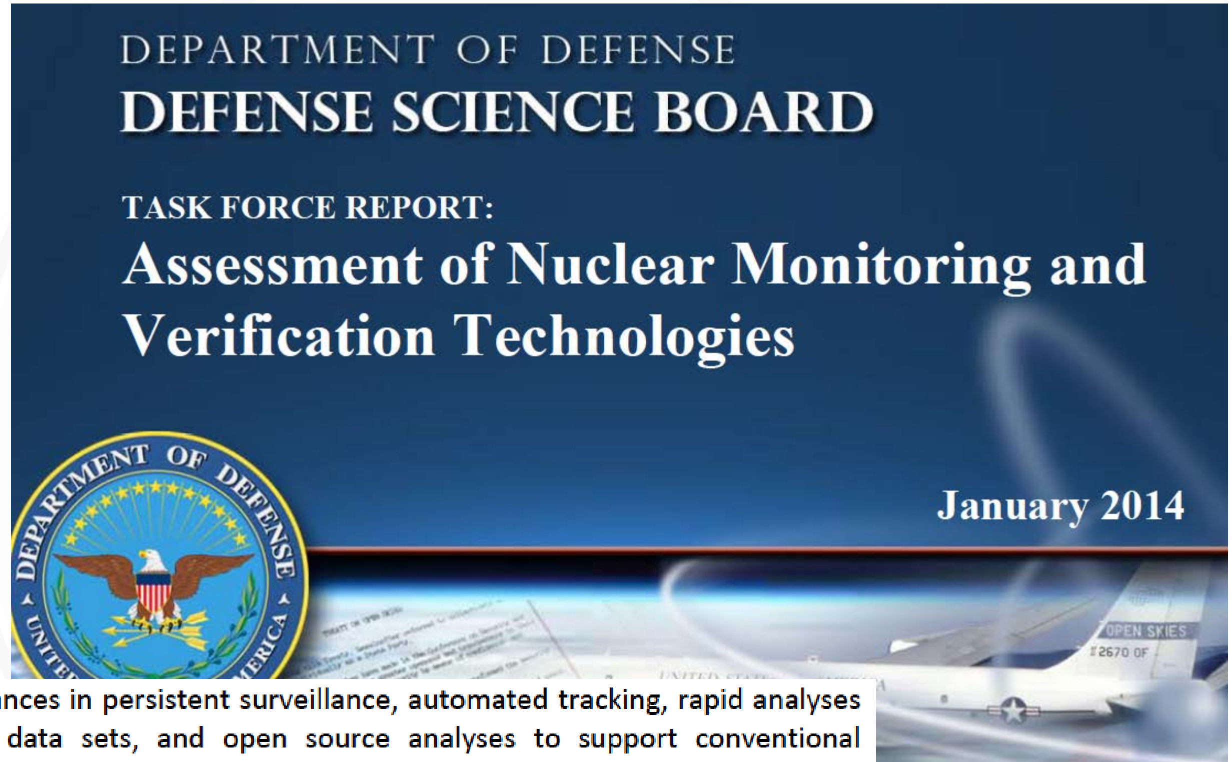


Infrasound Network

30 June 2010



DSB Report January 2014


DEPARTMENT OF DEFENSE
DEFENSE SCIENCE BOARD
TASK FORCE REPORT:
Assessment of Nuclear Monitoring and Verification Technologies
January 2014

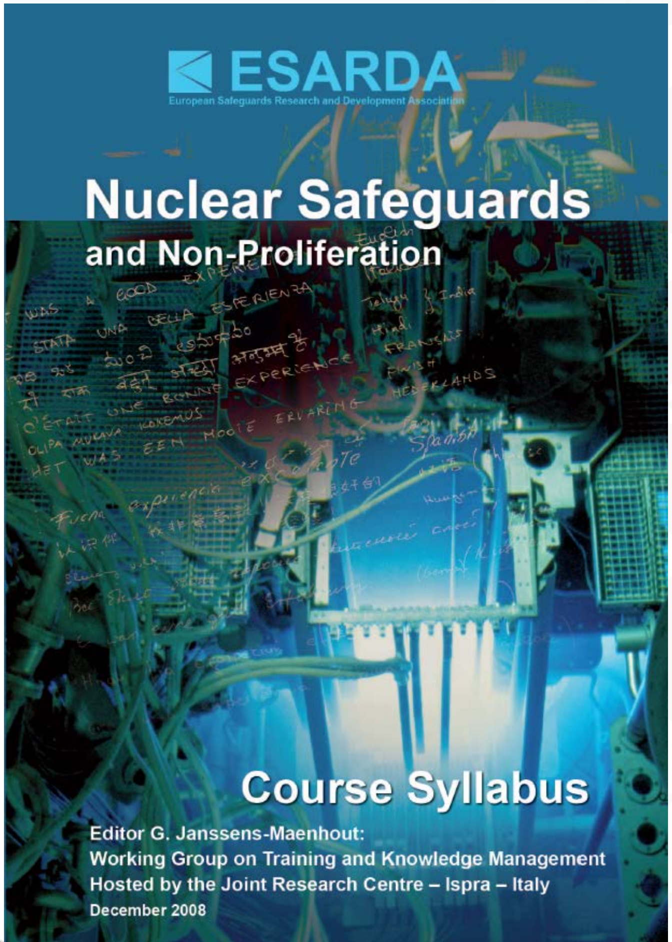
Principal Findings: The advances in persistent surveillance, automated tracking, rapid analyses of large and multi-source data sets, and open source analyses to support conventional warfighting and counterterrorism have not yet been exploited by the nuclear monitoring community. Conversely, developers of these capabilities are largely unaware of the challenges and requirements for nuclear activity monitoring.

Radiation detection remains important for monitoring and verifying sources of special nuclear material (SNM) when access allows inherent range and background limitations to be overcome.

CVT Reading Room

https://www.dropbox.com/sh/jx9wxqbktl2fd60/AACfYghNy6jMlpOyEhdzUcLaa?dl=0

ESARDA 2008



Nuclear Safeguards
and Non-Proliferation

Course Syllabus

This compact course is open to masters degree students (nuclear engineering, physics, chemistry, law, business, international relations etc.) Its primary aim is to complement engineering studies by including nuclear safeguards and non-proliferation in the academic curriculum. For this reason, the course has been attributed 3ECTS (European Credit Transfer System) points in the past. The course also serves the exposure of other students and professionals to this theme of continuing international attention.

The course addresses aspects of the efforts to create a global nuclear non-proliferation system and how this sytem works in practice, including the Treaty on Nonproliferation of Nuclear Weapons (NPT), safeguards systems and technology, and export control. Also regional settings, such as Euratom Treaty, are presented and discussed. The course deals in particular with technical aspects and application of safeguards; i.e. how to implement the safeguards principles and methodology within the different nuclear facilities. The course is complemented with exercises, lab visits and topical lectures on actual issues, the latter not included in this syllabus and not part of the formal examination.

Table of contents

CVT Science Pathway

- Guide impactful research towards CVT-specific applications
- Seek coherence among disparate research activities
- Cross-pollinate technical thrusts and ideas among participants, nurture technical collaborations
- Define unifying Grand Challenge goals within Thrust Areas
- Identify and promote emerging disruptive technologies
- CVT tabletop exercises (TTXs) for university participants that highlight practical technical challenges

Site visits