MULTILATERAL VERIFICATION OF NUCLEAR DISARMAMENT

2011-2015

International Partnership on Nuclear Disarmament Verification, Oslo, Norway

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VERTIC AND DISARMAMENT VERIFICATION

1986	Founded; headquartered in London.
1993	Pioneered use of USGS NEIC data to detect nuclear testing (as an NGO IDC).
1996	W. Alton Jones supports the 'Getting to Zero' project.
2000	Series of AWE studies on disarmament verification for NPT review conference gets extensive verification yearbook coverage.
2006	Facilitates first meetings between UK and Norway. Participates as an observer in the subsequent UK-Norway Initiative until 2010.
2011	Starts project on multilateral verification of nuclear disarmament.

OTHER VERTIC ACTIVITIES

VERIFICATION

Promoting the implementation of IAEA safeguards.

Development of a bespoke safeguards database, presented in Japan last week.

CBRN research exchange with China.

Smaller projects on cyber security and the environment.

IMPLEMENTATION

Leading assistance provider on the Biological Weapons Convention.

“The most prolific and efficient legislative assistance provider in the world in areas related to [UNSCR1540]” (according to forthcoming monograph).

Established assistance provider on other CBRN issues.

INCREASING TREND TOWARDS MULTILATERAL R&D

1967	Project CLOUD GAP: prepared for a NNWS inspectorate.
1996	The Trilateral initiative: a joint research and development venture between the US, Russia and the IAEA starts work.
1997	US transparency and verification options study (NON-CLEARED inspectors).
2001	US-UK Technical Cooperation for Arms Control commences.
2005	Series of AWE studies on disarmament verification for NPT review conference. The final report, NPT/2005/WP.1, refers to non-security cleared personnel.
2006	UK-Norway Initiative commences.
2010	Report on UK-Norway initiative (NPT/CONF.2010/WP.41), accounts for a pioneering NWS-NNWS collaboration.

THE MVD PROJECT

WHO 53 researchers from governmental and non-governmental institutes on four continents. Mostly drawn from technically proficient non-nuclear weapon states, with representation from one intergovernmental organisation.

WHY Identify the tools, organisational structures and procedures that should enable a multilateral body to carry out disarmament verification effectively and credibly.

Educate and train a growing cadre of stakeholders in the challenges and opportunities presented by multilateral disarmament verification.

HOW Two closed meetings per year, comprising full membership.

Research groups which meet when necessary.

Continuous supporting research conducted by VERTIC.

THE MVD PROJECT (CONT.)

WHEN

'11-'15 Consolidation of group, formulation and organisation of the research, construction of simulation framework, examination of demand.

'19-'21 *Planned*: Peer-review, finalisation and publication of final research products (tools and procedures).

'16-'18 *Proposed*: Running three major simulations; expanding outreach to broader NWS/NNWS community; iterative development of research products (tools and procedures).

FACILITATING CAPACITY BUILDING AND GENERATING DEBATE

Aims	Encourage an inclusive and reinvigorated international debate; and Build technical capacity to contribute to verification.
'11-'15	Three conferences. Five seminars. Five conclaves.
'16-'18	Two conferences. Nine seminars. Two regional hubs. Three conclaves.

INVESTIGATING SUPPORT FOR MULTILATERALISM

Source Member State Views on an IAEA Role in Verifying Nuclear Disarmament, *Verification Matters no. 10*, September 2015.

<39% Proportion of IAEA member states willing to contribute funding to ventures such as the IPNDV.

<77% Proportion of IAEA member states willing to contribute expertise to ventures such as the IPNDV.

>61% Proportion of IAEA member states that may support an IAEA 'long-term plan' specifying roles, capacity-building and resource requirements for nuclear disarmament verification.

DEVELOPING AN EQUIPMENT DEVELOPMENT AND PROCUREMENT STRATEGY

Aims:

[1] Build understanding of strengths and weaknesses of monitoring equipment for disarmament verification.

[2] Inform the research and development of monitoring equipment.

Methodology:

[1] Technology working group.

[2] Equipment technology reviews and 'data sheets'.

Outputs:

'16-'18 Three iterative technology reviews for nuclear disarmament verification.

VERIFICATION SOLUTIONS

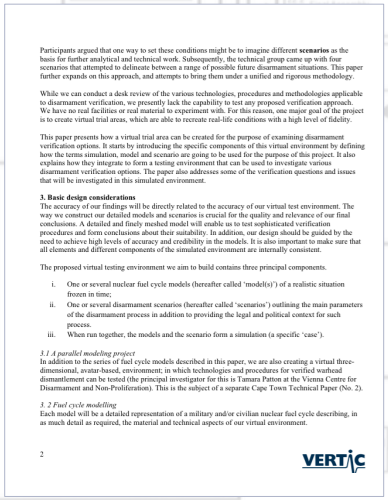
Basis Working paper on a framework for simulations and trials (2013).

Problem Any detailed study on disarmament verification requires creating some 'boundary conditions' within which practical work can be conducted.

Solution Model.

Scenario.

Simulation.



Participants argued that one way to set these conditions might be to imagine different **scenarios** as the basis for further analytical and technical work. Subsequently, the technical group came up with four scenarios that attempted to delineate between a range of possible future disarmament situations. This paper further expands on this approach, and attempts to bring them under a unified and rigorous methodology.

While we can conduct a desk review of the various technologies, procedures and methodologies applicable to disarmament verification, we presently lack the capability to test any proposed verification approach. We have no real facilities or real material to experiment with. For this reason, one major goal of the project is to create virtual trial areas, which are able to recreate real-life conditions with a high level of fidelity.

This paper presents how a virtual trial area can be created for the purpose of examining disarmament verification options. It starts by introducing the specific components of this virtual environment by defining how the terms simulation, model and scenario are going to be used for the purpose of this project. It also explains how they integrate to form a testing environment that can be used to investigate various disarmament verification options. The paper also addresses some of the verification questions and issues that will be investigated in this simulated environment.

3. Basic design considerations

The accuracy of our findings will be directly related to the accuracy of our virtual test environment. The way we construct our detailed models and scenarios is crucial for the quality and relevance of our final conclusions. A detailed and finely meshed model will enable us to test sophisticated verification procedures and form conclusions about their suitability. In addition, our design should be guided by the need to achieve high levels of accuracy and credibility in the models. It is also important to make sure that all elements and different components of the simulated environment are internally consistent.

The proposed virtual testing environment we aim to build contains three principal components.

i. One or several nuclear fuel cycle models (hereafter called 'model(s)') of a realistic situation frozen in time;
ii. One or several disarmament scenarios (hereafter called 'scenarios') outlining the main parameters of the disarmament process in addition to providing the legal and political context for such process.
iii. When run together, the models and the scenario form a simulation (a specific 'case').

3.1 A parallel modeling project

In addition to the series of fuel cycle models described in this paper, we are also creating a virtual three-dimensional, avatar-based, environment; in which technologies and procedures for verified warhead dismantlement can be tested (the principal investigator for this is Tamara Patton at the Vienna Centre for Disarmament and Non-Proliferation). This is the subject of a separate Cape Town Technical Paper (No. 2).

3. 2 Fuel cycle modelling

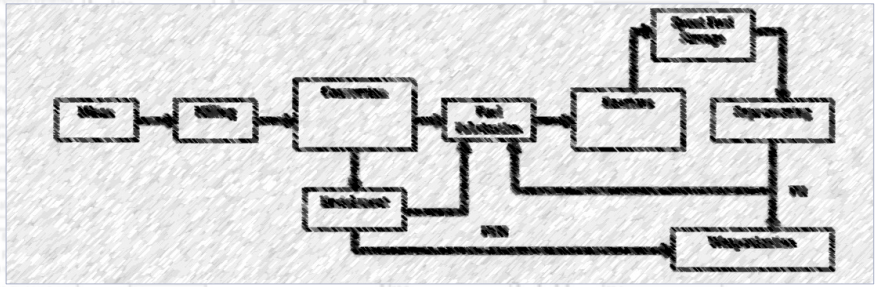
Each model will be a detailed representation of a military and/or civilian nuclear fuel cycle describing, in as much detail as required, the material and technical aspects of our virtual environment.

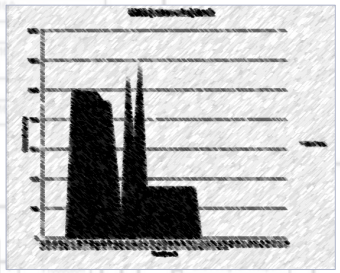
VERIFICATION SOLUTIONS (MODEL)

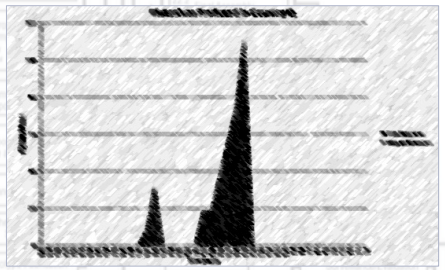
A model is created by establishing a fictitious state, and tracing the development of its nuclear fuel cycle, both civilian and military, across its entire history.

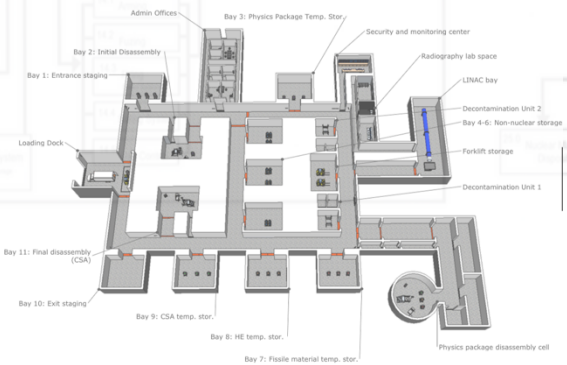
Produces a representation of the imagined state's nuclear infrastructure, materials and quantities of nuclear weapons at any given point in that history. Includes realistic and comprehensive data on mass flows and materials quantities.

Possible to supplement with 3D facilities, in more advanced simulations. Project developed a pre-alpha using Oculus rift.









VERIFICATION SOLUTIONS (SCENARIO)

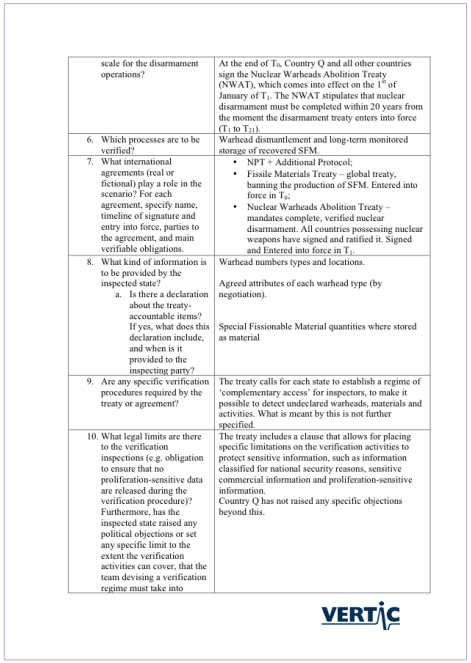
Scenarios serve as the assumptions under which specific questions can be tackled and can be used to generate more data and information that can ground research in any specific sub-topic. Contains information on, for example:

[1] Who is disarming?

[2] Why are they disarming?

[3] Who are involved in verification?

[4] What are they verifying?



scale for the disarmament operations?	At the end of T_{10} Country Q and all other countries sign the Nuclear Warheads Abolition Treaty (NWAT), which comes into effect on the 1st of January of T_1. The NWAT stipulates that nuclear disarmament must be completed within 20 years from the moment the disarmament treaty enters into force (T_1 to T_{21}).
6. Which processes are to be verified?	Warhead dismantlement and long-term monitored storage of recovered SFM.
7. What international agreements (real or fictional) play a role in the scenario? For each agreement, specify name, timeline of signature and entry into force, parties to the agreement, and main verifiable obligations.	• NPT + Additional Protocol; • Fissile Materials Treaty – global treaty, banning the production of SFM. Entered into force in T_{45}. • Nuclear Warheads Abolition Treaty – mandates complete, verified nuclear disarmament. All countries possessing nuclear weapons have signed and ratified it. Signed and Entered into force in T_{21}.
8. What kind of information is to be provided by the inspected state? a. Is there a declaration about the treaty-accountable items? If yes, what does this declaration include, and when is it provided to the inspecting party?	Warhead numbers types and locations. Agreed attributes of each warhead type (by negotiation). Special Fissionable Material quantities where stored as material
9. Are any specific verification procedures required by the treaty or agreement?	The treaty calls for each state to establish a regime of 'complementary access' for inspectors, to make it possible to detect undeclared warheads, materials and activities. What is meant by this is not further specified.
10. What legal limits are there to the verification inspections (e.g. obligation to ensure that no proliferation-sensitive data are released during the verification procedure)? Furthermore, has the inspected state raised any political objections or set any specific limit to the extent the verification activities can cover, that the team devising a verification regime must take into	The treaty includes a clause that allows for placing specific limitations on the verification activities to protect sensitive information, such as information classified for national security reasons, sensitive commercial information and proliferation-sensitive information. Country Q has not raised any specific objections beyond this.

VERIFICATION SOLUTIONS (SIMULATION)

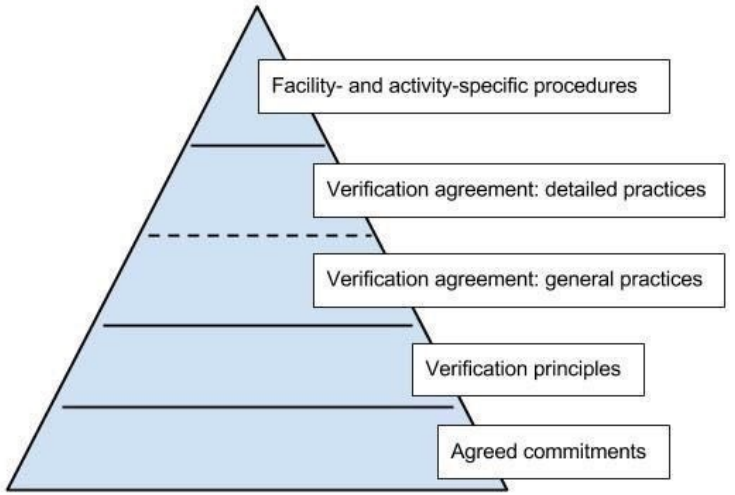
LEVEL 1 [EASY] Exercise designed to tease out agreed commitments.

LEVEL 2 Exercise designed to define applicable verification principles.

LEVEL 3 Exercise designed to define general verification practices contained in a verification agreement.

LEVEL 4 Exercise designed to define detailed verification practices contained in a verification agreement.

LEVEL 5 [HARD] Exercise designed to define facility and activity specific procedures.



VERIFICATION SOLUTIONS (EXAMPLE OUTPUTS)

[1] Develop an outline verification agreement that could become a foundation for a range of future nuclear disarmament verification activities.

[2] Develop a detailed verification agreement, including precise monitoring procedures and compliance processes, that could be applied to a specific disarmament activity.

[3] Explore the application of selected monitoring equipment for the verification of certain disarmament activities.

[4] Test the verifiability of existing disarmament agreements, or hypothetical agreements developed through other verification simulations.

[5] Train and build capability among the participants, and to pass on knowledge and expertise to emerging actors in the field.

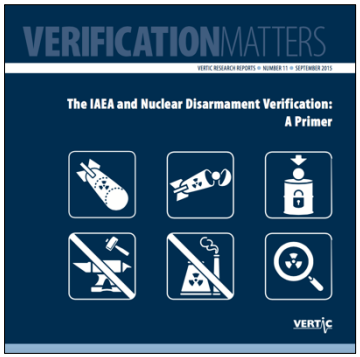
FURTHER READING ON DISARMAMENT VERIFICATION

VERIFICATION MATTERS (IN-DEPTH REPORTS)

2009 VM9: exploring verified warhead dismantlement.

2015 VM10 and 11: exploring multilateral verification.

Today VM12: methodology and exercise frameworks.



VERIFICATION BRIEFS (SUMMARY REPORTS)

2011 VB15: Wilton park conference report on uncertain futures for multilateralism.

2012 VB17: exploring new ideas regarding multilateral verification efforts.

2013 VB19: making the case for a multilateral R&D effort.