Using 3D Modeling for Verification Design

While the United States and Russia contemplate deeper nuclear arms reductions, the question of how other states might become part of a more unified global reduction process moves increasingly into the spotlight. Advancing beyond bilateral arms reductions toward a multilateral process raises new challenges, and it further complicates the question of how to simultaneously satisfy an inspector's need to verify and a host's need to protect sensitive information during the dismantlement of a nuclear arsenal.

Since the Nuclear Nonproliferation Treaty mandated the pursuit of 'a Treaty on general and complete disarmament under strict and effective international control' back in 1970, states and organizations have been developing a range of possible methods or systems for verifying nuclear disarmament on a multilateral scale, each employing different approaches and technologies. In continuing to move toward the goal of a verification system that is acceptable to all concerned, it is important to understand the strengths and vulnerabilities of the systems proposed so far. In this way, we can continue to build on the best ideas toward the most feasible process for achieving verified multilateral nuclear disarmament.

Three dimensional (3D) modeling is a new and potentially powerful tool for learning from current efforts to design techniques for verifying nuclear disarmament, and to inform future activities. Interactive digital 3D models allow the user flexible navigation and views of facilities and verification systems. Users can zoom out for a view of the entire facility or can pinpoint areas or items for a look at a detailed component level. Furthermore, by using real dimensions, 3D models can allow us to analyze and adapt systems much more cost effectively than full scale exercises. While 3D models cannot constitute a replacement for

In this issue

Trust & Verify
April-June 2012 • Issue Number 137 • ISSN 0966–9221

Verification Research, Training and Information Centre (VERTIC)
Development House
56–64 Leonard Street
London EC2A 4LT
United Kingdom
tel +44 (0)20 7065 0880
fax +44 (0)20 7065 0890
website www.vertic.org

such exercises, they can serve as another useful tool for system refinement and perhaps make live exercises more efficient and effective. The project described in this article explores the use of a 3D modeling programme called Google SketchUp for these aims. And the work lays further groundwork for potentially increasing the use of 3D visualization as a tool for designing verification systems.

In this project, Google SketchUp was used to develop 3D models of three proposed systems for verifying multilateral nuclear disarmament. These proposals are the 'UK-Norway Initiative', the 'Integrated Facility Monitoring System', and the 'Trilateral Initiative'. The 3D models visualize key components of each of these systems such as loading bays, cameras, security doors, tagging and sealing stations, and monitoring stations for inspectors. The models will be featured on a website, and users will be able to navigate each of these systems and click on key components for more information.

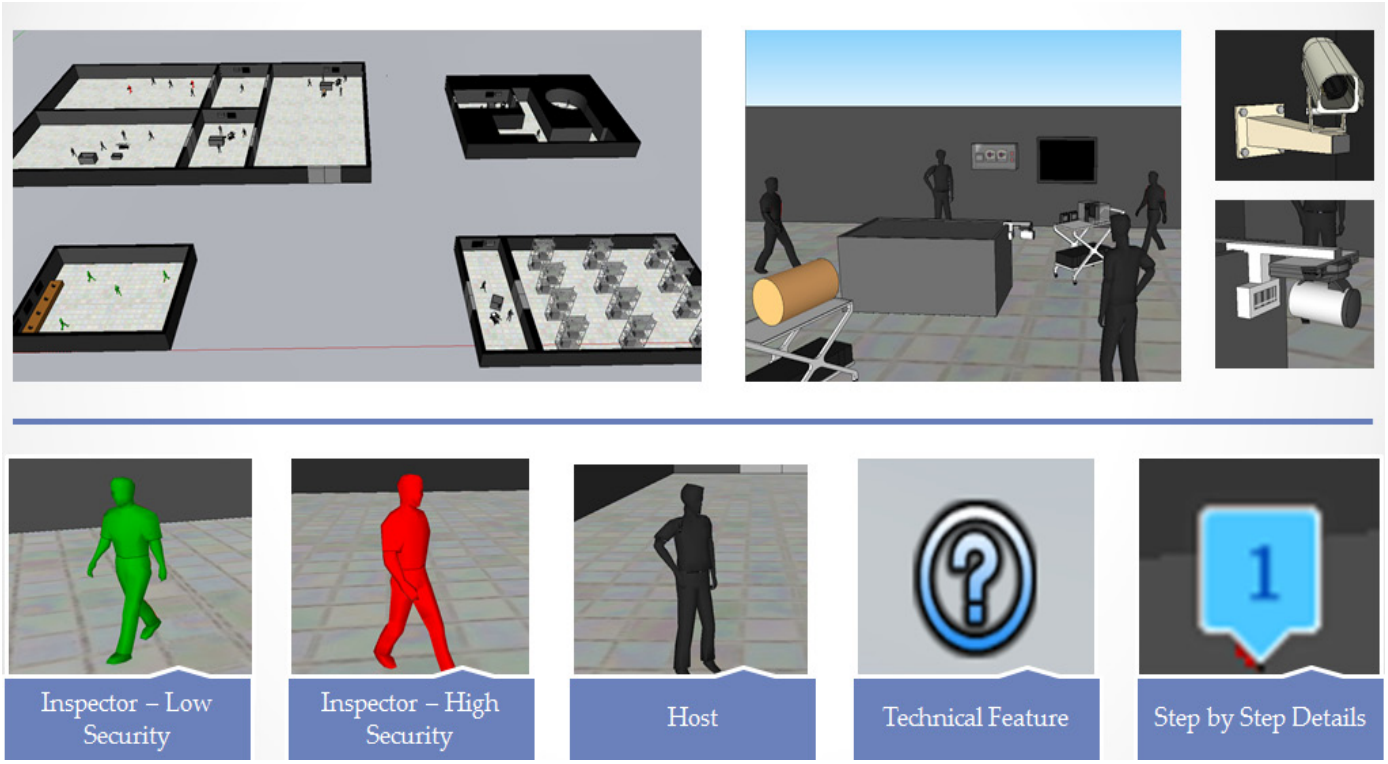
The purpose of making 3D models of disarmament facilities is threefold. They can facilitate collaborative analysis on how disarmament verification systems have been developed, they may enable cooperative development of these systems, and they can increase understanding of multilateral nuclear disarmament options.

From a Bilateral to a Multilateral Verification Process

The United States and Russia have worked for decades to establish mutually acceptable means for verifying nuclear arms reductions. This process continues to evolve. Today, the New START Treaty – which reduces numbers of nuclear warheads and delivery vehicles in the two countries to their lowest levels since the 1950s – is verified through on-site inspections, a unique identifier (UID) tagging system, and 'national technical means' (for example, satellite monitoring).

Though the two countries have made progress in their mutual verification efforts, the methods they currently use are designed for monitoring reductions of large numbers of nuclear weapons. Furthermore, New START does not allow for the direct verification of the dismantlement of nuclear warheads. Rather, it focuses on verifying the destruction or conversion of delivery vehicles. As a novel element of New START, actual warheads can be counted by inspectors as covered reentry vehicle elements attached to the front section of a missile. However, this does little to deal with the problem of the possible clandestine stockpiling of nuclear warheads that may be removed from a missile slated for destruction and stored elsewhere.

Figure 1: Disarmament Facility 3D Model Snapshots and Component Details



Designing a system that will satisfy the needs of all parties involved requires addressing many challenges. Developers must attempt to balance the needs of inspectors –who may come from countries that themselves possess nuclear weapons or those that do not – and the host state. By possibly involving inspectors coming from states without nuclear arsenals or states with developing nuclear arsenals, the risk of inadvertently divulging proliferative nuclear weapon information through disarmament verification is elevated and must be managed through complex inspection arrangements, remote monitoring, tagging and sealing, and, potentially, authentication mechanisms. As states and organizations continue to present new ideas for balancing verification and classification needs, 3D visualization can serve as one of several tools for strengthening understanding of how to develop options for verifying multilateral nuclear disarmament. It could also serve as a unique tool in the planning and design process by offering designers a realistic and flexible viewing platform.

A 3D Approach

3D visualization was developed over a century ago and has been used in many different applications since then. Charles Wheatsone, an English physicist and inventor, began dabbling with stereoscopy (a method of 3D imaging still used today which involves combining 2D images to create the perception of 3D depth) as early as 1838. Stereoscopy played major roles throughout history, including during World War II when it altered the imagery intelligence landscape and changed the very nature of deception in warfare. Warring states could no longer use 2D deception tactics such as creating floating outlines of ships to throw off spy planes.

With the development of computer graphics in the late 20th century, it became possible to generate original 3D models, both of real objects and of purely digital creations. In the United States today, national laboratories such as Los Alamos are teaming up with digital animation artists to create detailed and realistic models of facilities, equipment, and vehicles. These virtual models and environments are now being tested for use in applications such as nuclear safeguards simulations and emergency response support. Digital 3D modeling has become a powerful and versatile tool whose applications are limited only by the scope of a user's imagination.

3D Disarmament Facility Models with Google SketchUp

The 3D models in this study visualize publically available information on different proposed systems for verifying multilateral nuclear disarmament, including the UK-Norway Initiative, the Integrated Facility Monitoring System, and two variations of the Trilateral Initiative concept. The 3D models are digital representations of generic disarmament-related facilities, that is, they are general templates containing elements of a typical facility rather than depictions of real, existing facilities. Basic 2D floor plans provided by the different initiatives were combined with typical facility dimensions to create these generic template views. Such a visualization approach can allow for analysis and refinement of a system at a general conceptual level before the next step of tailoring elements to a real facility with live dimensions, which can also be aided with the same 3D modeling tools. All of the 3D models in this project are therefore generalized, conceptual visualizations, and their level of detail and accuracy can be improved over time through further cooperation with the designers and developers of the various systems.

Since each of the systems uses inspectors and technology in different ways, a unique 3D model was generated for each system. Within each 3D model, key components such as loading bays, cells, cameras, infrared illuminators, security doors, meters, receivers, tagging and sealing stations, monitoring stations for inspectors, and inspector access areas are shown. Inspectors operating in an area under less security with freer operability are shown in green, inspectors operating in a high security area are shown in red, and host personnel are shown in black. All key technical features in each model can be clicked on for more information, and numbered flags describe the step-by-step process for the warhead or fissile material's chain of custody. The models enable flexible viewing of each system by allowing users to zoom out for a comprehensive facility view, and zoom in to any point of the facility for a more detailed view of components.

A unique feature of this project compared with other 3D modeling work in the nuclear field, is its usage of Google SketchUp, which is a simplified 3D modeling suite with many

automated functions. The programme allows the relatively quick construction of either a specific or generic dismantlement facility which can then be populated with the numerous technical components involved in verifying the dismantlement process. Such components can either be constructed manually or imported from Google's 3D warehouse, an open online library of 3D objects created by SketchUp users all over the world. For instance, a wide range of freely shared 3D objects such as virtual CCTV cameras and even handheld Geiger counters can be simply imported from the library into a facility model to save time and energy.

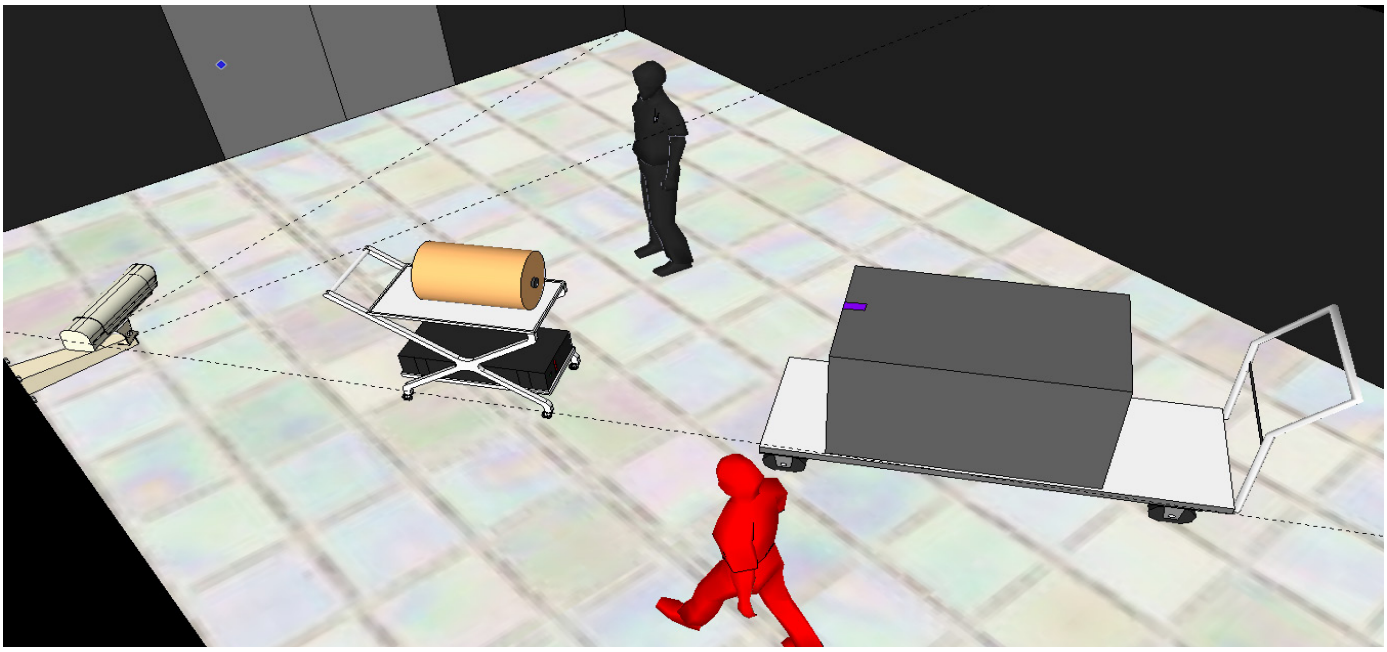
The method of 3D modeling used in Google SketchUp is straightforward. On a 3D axis, two-dimensional polygons are drawn first, and then they are 'pulled' into 3D with Google's (patented) push-pull tool. The automated nature of the tool significantly speeds up the development of the 3D model. A key feature of SketchUp is that all lines and polygons can be set to realistic dimensions. As a user draws, he or she can type in specific measurements, and SketchUp will automatically snap a model to those dimensions. As a result, users can quickly generate realistic virtual environments that offer an accurate platform for planning and design purposes. Additionally, if a real facility is being modeled and even greater accuracy is desired, models in SketchUp can be paired with satellite imagery and terrain data from Google Earth in order to adequately account for detailed factors such as ground sloping.

Seeing environments, facilities and components in 3D should allow for easier, and better, comparisons, analysis, and revisions of proposed systems for verification.

Project Details

The proposed systems modeled in this study each offer different approaches to verifying nuclear disarmament on a multilateral level. The UK-Norway Initiative takes a very hands-on approach with the use of on-site inspectors that are thoroughly involved in the warhead dismantlement process, and even possibly based on-site within a dismantlement facility. While this approach provides the benefit of a higher level of verifiability, it also places a larger burden on the shoulders of the host state, which must manage the security measures necessary to balance intrusive inspections and provide escorts for inspectors in high security areas. The 3D model of the UK-Norway Initiative helps to show how inspectors would monitor the warhead chain of custody from the moment it undergoes authentication until it completes the phases of dismantlement and its components are placed in secure storage. In addition, the 3D model helps to show where and how other technical elements of the UK-Norway Initiative such as the information barrier (an instrument that

Figure 2 Example of 3D Model Design Support: Camera Placement and Field of View Refinements



verifies the authenticity of the warhead) play their respective roles at different phases in the process.

In contrast to the UK-Norway Initiative's more inspector-based approach, the Integrated Facility Monitoring System (IFMS) developed by Los Alamos National Laboratory emphasizes remote monitoring of warhead dismantlement through an elaborate network of cameras, tags, and sensors. Such an approach enables verification by inspectors located off-site, and allows the host state a greater degree of control during the verification process. The 3D model of the facility featuring the IFMS allows viewers to better understand the role that each of the numerous camera systems play, as well as how the different camera systems function together as a coherent whole to ensure verified disarmament.

Distinct from both the UK-Norway Initiative and IFMS, the Trilateral Initiative does not focus on monitoring the dismantlement of warheads. Rather, it focuses on the conversion or disposition of fissile material from nuclear weapons. This initiative was instigated by the United States and Russia to investigate the possibility of sustained IAEA verification in the nuclear weapon reduction process. While the study produced useful findings, the procedures were never formally implemented. However, the 2000 Plutonium Management Disposition Act between the United States and Russia has more recently called for the two countries to 'take all necessary steps to conclude an appropriate agreement with the International Atomic Energy Agency' on verification of each side's disposition programme. Therefore, we can conceivably hope to see the work of the Trilateral Initiative being built upon in the foreseeable future.

Two separate 3D models were created for the Trilateral Initiative concept: one model to show how verification might be carried out with the use of an information barrier (which featured in the original Trilateral Initiative concept), and another model to show how verification of fissile material disposition might work without an information barrier (as envisioned by the revised Trilateral Initiative since the development of the barrier process will require more time before it satisfies all parties). The second model, therefore, visualizes a basic framework for how only declassified forms of fissile material would be verified by the IAEA or another multinational verification body.

As we continue to build more concrete measures for verifying multilateral nuclear disarmament, 3D modeling could help reveal opportunities for improving these proposed systems, and over time may assist in enabling collaborative development across initiatives by providing concrete visuals for analysis and discussion.

Future Work

Looking ahead, further research and development in 3D modeling for verification could help lead to cost savings, more efficient planning, and greater collaborative development of multilateral nuclear disarmament mechanisms. While the 3D models in this study proved useful in improving understanding of the different strengths and vulnerabilities of each of the nuclear disarmament initiatives touched on above, the full utility of 3D modeling in this area is yet to be realized. The same tools and techniques used to create generic facility models in this study could also be applied to real disarmament facilities within states.

Thanks to Google SketchUp's ability to visualize real dimensions, the programme and these techniques could help provide cost-effective support for designing more tailored verification systems for national facilities. Decisions regarding checkpoint placement, camera positioning, door seal distribution, and inspector procedures could be greatly supported by using this 3D modeling technique that can visualize external and internal dimensions with accuracy to the centimeter. In addition, live inspection exercises could benefit from initial 'practice runs' in a virtual environment to help reveal procedural difficulties early on and enable live exercises to run more smoothly•

TAMARA PATTON

Tamara Patton is a visiting researcher at the Stockholm International Peace Research Institute. She has worked as a Research Assistant at the Center for Nonproliferation Studies and at the Naval Post Graduate School's Common Operational Research Environment (CORE) Laboratory•

Safeguards: the view from the NPT PrepCom

Every five years, the conference of parties to the Non-Proliferation Treaty (NPT) reviews the operation of the treaty to assess whether the commitments made under the 'three pillars' of non-proliferation, disarmament and peaceful uses of nuclear energy are being realized. The next Review Conference will be held in 2015. NPT parties have already started to report on steps they have taken to implement the actions agreed in the final document adopted at the previous Review Conference in 2010. The first session of the Preparatory Committee (PrepCom) for the 2015 Review Conference was held in Vienna from 30 April to 11 May 2012. The event gathered 110 states out of the 189 NPT parties.

Representatives of civil society who were also present welcomed a 'smooth' and 'remarkably positive atmosphere', noting that, in the words of Rebecca Johnson of the Acronym Institute, 'as a result, states parties were able to move very rapidly through all of the items on the agenda.' Part of the discussions was devoted to non-proliferation—including the role and implementation of IAEA safeguards. During this section of the talks, states delivered statements and submitted substantive working papers to account for progress made and to highlight their expectations for 2015.

Status of safeguards implementation

According to Article III.1 of the NPT, each non-nuclear-weapon state party to the treaty undertakes to accept safeguards, as detailed in an agreement to be negotiated and concluded with the IAEA, for 'the exclusive purpose of verification of the fulfilment of its obligations assumed under the Treaty' and 'with a view to preventing diversion of nuclear energy from peaceful uses to nuclear weapons or other nuclear explosive devices.'

NPT safeguards ought to be comprehensive, as they are applied on all nuclear material in all peaceful nuclear activities. Their objective, as stated in comprehensive safeguards agreements concluded between NPT states and the IAEA, is the 'timely detection of diversion of significant quantities of nuclear material from peaceful nuclear activities to the manufacture of nuclear weapons or of other nuclear explosive devices or for purposes unknown, and deterrence of such diversion by the risk of early detection.'

During the PrepCom, many NPT parties reaffirmed that safeguards are a fundamental component of the non-proliferation regime. Their discussions, however, raised a number of issues related to their implementation.

Implementation of the CSA and Additional Protocol

Comprehensive safeguards agreements (CSA) and additional protocols—a voluntary instrument enhancing the measures in CSAs—constitute the legal basis for safeguards implementation. They list the rights and obligations of states and the IAEA. They detail how states should provide nuclear material accounting reports to the agency, and information on the design of nuclear facilities and on nuclear and nuclear-related activities. A CSA also lays out the modalities of IAEA on-site verification—including visits and inspections. Since concluding a CSA is obligatory for all non-nuclear weapons states parties to the NPT, Action 25 of the final document adopted by the 2010 Review Conference urged all states that had not done so to conclude the agreement without further delay.

The additional protocol, in contrast to the CSA, is concluded on a voluntary basis. The protocol is based on a model text adopted in 1997 and is designed to provide the IAEA with more information on states' nuclear activities, and greater access to them as well. It is intended to enable the agency to draw the conclusion that all nuclear material has remained in peaceful activities. In particular, it provides that the agency will have complementary access to certain locations in order to assure the absence of undeclared nuclear material and activities, to resolve any question on the correctness and completeness of the information provided by the state, and to confirm the decommissioned status of a place where nuclear material was customarily used.

So, when only a CSA is being implemented, the IAEA can conclude on the correctness, but not completeness, of states' declarations. But when a CSA is coupled with an additional protocol, the agency is able to draw a broader conclusion—on both correctness and completeness. Action 28 of the 2010 final document encouraged all states parties to bring into force additional protocols as soon as possible and to implement them provisionally pending their entry into force.

The IAEA Assistant Director General for Policy, Rafael Grossi, noted in his statement to the PrepCom, 'since the 2010 Review Conference, further progress has been achieved with regard to the number of states adhering to comprehensive safeguards agreements and additional protocols. But more still needs to be done.' Six states have brought a CSA into force during the last five years. Among the 14 states that have yet to do so, six have signed an agreement and two have had agreements approved by the IAEA's Board of Governors. For the remaining six, no draft CSA has been submitted to the IAEA Board for consideration. Consequently, achieving universal entry into force and implementation of CSAs remains a goal for both NPT states and the IAEA.

Support for the additional protocol's implementation was also reaffirmed at the PrepCom. The chairman's summary of the meeting's discussions underlined that 'many states parties noted that comprehensive safeguards agreements were not sufficient for the IAEA to provide credible assurances regarding the absence of undeclared nuclear material and activities. They noted that implementation of an additional protocol […] strengthened the Agency's ability to provide assurances of the absence of undeclared nuclear material and activities in a state, and provided increased confidence about the state's compliance with its obligations under the treaty'. A number of states parties, noted that they considered, as they had already done in the 2010 final document, that the current verification standard under Article III of the NPT was a CSA together with an additional protocol. That article imposes the conclusion of 'an agreement to be negotiated and concluded with the International Atomic Energy Agency in accordance with the Statute of the International Atomic Energy Agency and the Agency's safeguards system'. States such as the members of the European Union and of the so-called Vienna Group of Ten (composed of Australia, Austria, Canada, Denmark, Finland, Hungary, Ireland, the Netherlands, New Zealand, Norway and Sweden) would like the Review Conference to agree on a common interpretation of article III to include the additional protocol, and not only a CSA.

Political support for the instrument was backed up by the number of additional protocols being implemented. Since the 2010 Review Conference, 14 states have brought a protocol into force, bringing the overall number to 116.

The Nuclear Suppliers Group also took a step towards universalizing the additional protocol in 2011, albeit not as firmly as it could have done. The group revised its guidelines for nuclear transfers to mention that 'suppliers will make special efforts in support of effective implementation of IAEA safeguards for enrichment or reprocessing facilities, equipment or technology and should […] authorise transfers, pursuant to this paragraph, *only when the recipient has brought into force a Comprehensive Safeguards Agreement, and an Additional Protocol based on the Model Additional Protocol or, pending this, is implementing appropriate safeguards agreements in cooperation with the IAEA, including a regional accounting and control arrangement for nuclear materials, as approved by the IAEA Board of Governors*' (emphasis added) The regional accounting and control arrangement for nuclear material was included due to the resistance of some NSG members, especially Brazil, to recognize the additional protocol as the current verification standard. They insisted on an implicit reference to the Brazilian-Argentine Agency for accounting and control of nuclear materials (ABACC), which is therefore recognized as a temporary alternative to the additional protocol. However, the guidelines foresee that conclusion of the latter is the ultimate goal, as the term 'pending this' indicates.

During the PrepCom, the Vienna Group of Ten noted the important and useful role that the NSG plays in the development of national export control policies and encouraged the application of its guidelines. It went further than the NSG with respect to the additional protocol, however, by suggesting that 'new supply arrangements for the transfer of source

or special fissionable material or equipment or material specially designed or prepared for the processing, use or production of special fissionable material to non-nuclear-weapon states *should require, as a necessary precondition, acceptance of the IAEA full-scope safeguards and an additional protocol based on the model INFCIRC/540*' (emphasis added).

Resistance to the additional protocol's full universalization was also expressed beyond the NSG. The 2010 final document language put forward by the Non-Aligned Movement (NAM) did not change; once again, the NAM emphasized that 'it is fundamental to make a clear distinction between legal obligations and voluntary confidence-building measures and that such voluntary undertakings shall not be turned into legal safeguards obligations.' States such as Brazil, Egypt, Argentina and Venezuela continue to insist that they will not agree to any additional safeguards burden as long as there is no further progress towards universal and irreversible disarmament among the NPT nuclear-weapon state parties. Such political arguments thus remain a serious obstacle to the universal uptake of the additional protocol.

It is possible, however, to tackle more technical difficulties that impede implementation of strengthened safeguards in some states. In Action 29 of the 2010 final document, the Review Conference encouraged the IAEA to 'further facilitate and assist the states parties in the conclusion and entry into force of comprehensive safeguards agreements and additional protocols', and called on 'states parties to consider specific measures that would promote the universalization of the comprehensive safeguards agreements.'

During the PrepCom, a number of states 'highlighted the need to provide guidance and assistance in order to develop national processes and to build the required legal and institutional domestic infrastructure' (as noted in the chairman's summary). A side-event on member state assistance for IAEA safeguards was held in the second week of the PrepCom, during which several states and VERTIC explained how they can provide legislative and technical assistance to states willing to implement an additional protocol. The IAEA also presented the updated version of the 'Guidance for States implementing CSA and additional protocols' (available on the IAEA website), and reminded states of the possibility for them to invite IAEA missions to review their national systems of accounting for and control of nuclear material.

Effectiveness and efficiency of the safeguards system

In action 32 of the 2010 final document, NPT states parties recommended that 'IAEA safeguards should be assessed and evaluated regularly. Decisions adopted by the IAEA policy bodies aimed at further strengthening the effectiveness and improving the efficiency of IAEA safeguards should be supported and implemented.' Along those lines, the 2010 IAEA General Conference urged the agency secretariat to continue to 'improve the effectiveness and efficiency of safeguards through the use of a State-level approach in the planning, implementation and evaluation of safeguards activities', and 'ensure that the transition to integrated safeguards is given high priority.'

The secretariat, especially the Department of Safeguards, has worked to further optimize the safeguards system over recent years (see T&V No. 134). Safeguards tend to be increasingly information-driven, as the agency tries to make the most effective use of all the information it gets from states' declarations, its own verification activities, as well as open source and third-party information. State-level approaches are being developed for all states with CSAs in force: under such approaches, the IAEA evaluates all the information relevant to a state's nuclear programme and takes into account country-specific factors, instead of considering only nuclear material accounting data on a facility-by-facility basis.

Implementation of 'integrated safeguards' is also a priority of the Department of Safeguards. They are applied in states for which the agency has concluded that all nuclear material has remained in peaceful activities. In these instances, instead of systematically applying all the safeguards measures provided in CSA and additional protocol, the agency seeks to implement an optimum combination based on the assumption that assurance on the absence of undeclared activities, obtained from previous IAEA verification activities, allows for a reduction of on-site verification for less sensitive facilities.

Those concepts and approaches should help the agency to focus its verification activities where they are needed and carry out 'smarter safeguards', as Jill Cooley of the IAEA Department of Safeguards said at a workshop meeting in October 2011. NPT states parties welcomed such efforts during the PrepCom. The chairman's summary noted that 'a number of States Parties welcomed the work being undertaken by the IAEA in the conceptualisation and the development of State-level approaches to safeguards implementation and also welcomed the implementation of State-level integrated safeguards approaches by the IAEA.' However, more financial, technical and political support is required from NPT states so that the agency can properly perform its increasing verification tasks. On the financial side, the zero real growth requirement imposed on the IAEA budget may eventually challenge the organization's effectiveness. As VERTIC's Andreas Persbo warned in February 2012, 'while it is undeniably important to always seek efficiencies, member states risk cutting too deep, leaving the IAEA in the best case unable to respond to an increased workload, and in the worst scenario actually forced to scale down on its verification activities.'

States also need to be more cooperative in the day-to-day implementation of safeguards. The IAEA Deputy General for Safeguards, Herman Nackaerts, insisted in July 2011 that all states should 'regard the Agency as a partner with whom they share the same objectives, rather than as a "necessary irritant" and safeguards as a "burden that must be borne."' He added that 'the more a state cooperates and "goes the extra mile", the less likely it will be for us to need to undertake routine, in-field verification activities.'

National, bilateral and regional systems have an especially important role to play in facilitating safeguards implementation. The European Union underlined during the PrepCom that 'further measures to improve the effectiveness and efficiency of the IAEA safeguards system are required, including the reinforcement of State and regional systems of accounting for and control of nuclear materials' (see working paper on implementation of the 2010 Review Conference conclusions and recommendations for follow-on actions). The EU noted that its regional system, Euratom, had 'continued to develop its partnership arrangements with IAEA […]' and that 'close cooperation and coordination of inspection activities at European Union installations by the European Atomic Energy Community and IAEA constituted an effective and efficient tool with which to apply safeguards in European Union member States […]'.

Finally, while political support to the agency's role was reaffirmed during the Prepcom, failure to agree on a safeguards resolution during the 2011 General Conference has raised doubts over IAEA member states' will to maximize the agency's effectiveness. No consensus could be reached on a safeguards resolution in 2011 as states were unable to agree on a mention of disarmament, information-driven safeguards or on the voluntary nature of the additional protocol. Political divisions within the General Conference and the Board of Governors thus have yet to be overcome.

Conclusion

Discussions during the PrepCom have shown that NPT states parties largely value the IAEA's role within the non-proliferation regime. Steps have been taken to universalize the legal framework that enables the agency to carry out its missions, and states have expressed support for the work that the organization has been undertaking to strengthen its verification capacities. Political divisions between states and a reluctance to fully provide the agency with adequate means to fulfil its role nonetheless slow down implementation of more effective and efficient safeguards. NPT states parties should understand that the extent to which the IAEA can effectively contribute to non-proliferation objectives largely depends on them. As Article II of its Statute reads, the agency 'shall ensure, so far as it is able' that nuclear energy is not used to further military ends. Consistent and coherent support by states is all the more important given that safeguards compliance issues are still on-going in Iran, North Korea and Syria•

Sonia Drobysz

Sonia is a Pro Bono Consultant to the Arms Control and Disarmament Programme, VERTIC (2012). She is currently carrying out a Phd in international law at University Paris I Panthéon-Sorbonne•

Verification Watch

Iran and the IAEA: access to Parchin?

David Cliff, London

On 8 June, the International Atomic Energy Agency (IAEA) and Iranian officials held the latest in a string of meetings over recent months to discuss access rights to nuclear sites in Iran where suspect activities are alleged to have taken place. Top of the IAEA's priority list is the Parchin nuclear site south-east of Tehran. In November 2011, the IAEA noted that experiments and testing with potential relevance to nuclear weapons development (particularly involving high explosives) may have been conducted at Parchin in the years after 2000.

The director-general of the IAEA, Yukiya Amano announced in May that he was hopeful an inspection deal would be reached, but the talks on 8 June did not produce this result, and IAEA efforts to secure access to Parchin remain unsuccessful – despite an apparent attempt by Iran to adopt a more conciliatory tone with the international community, and especially with the 'P5+1' group of countries, over the first half of this year.

In its latest report on safeguards implementation in Iran (dated 25 May 2012), the IAEA noted that based on satellite imagery, 'buildings of interest to the Agency' at the site appear to have been recently subject to 'extensive activities that could hamper the Agency's ability to undertake effective verification' there. The Institute for Science and International Security (ISIS) also highlighted suspected 'sanitization activity' at Parchin (including, most recently, the demolition of two buildings) that raise concerns of an attempt by Iran 'to destroy evidence of alleged past weaponization activities.' As ISIS note, it may be the case that Iran is 'attempting to raze the site prior to allowing an IAEA visit.'

Given the controversy over Parchin, and the array of other concerns of suspected Iranian nuclear weapons-related research and development, the P5+1 are sure to have been closely following the talks between Iran and the IAEA. They, too, have been engaged in intense diplomacy with Iran over recent months as part of a separate, but parallel, effort to resolve ongoing concerns over the nature of the Iranian nuclear programme. Initial talks in Istanbul in March between the P5+1 and Iran seemed to go well – however two additional rounds of talks, in Baghdad and Moscow, have failed to reach an agreement and no further official talks are planned.

With no inspection deal and the collapse of multilateral talks, the diplomatic track might run out of steam very soon. Iran's recent activities at Parchin suggest that the Islamic Republic is making a concerted attempt to cover-up evidence of some sort. Meanwhile, its refusal to admit IAEA inspectors to the site, while nonetheless expressing a willingness to reach a deal, suggests that its intention is to keep the Agency in a holding pattern until any covering-up activities have been fully implemented.

There is a very real and growing danger that an IAEA inspection of Parchin (if or when such access is agreed), will have minimal verification significance – but nonetheless provide an opportunity for Iran to argue that it represents evidence of its cooperative intent. The investigation of suspected nuclear weapons-related activities is not an everyday verification task for the IAEA, but in this case it is a priority. To lessen the chance of making any inspection of Parchin an exercise of little verification value, it should happen without further delay, and – critically – without any further confidence-eroding activities from Iran on the ground•

Chemical weapons take centre stage in Syria

Meghan Brown, London

As the situation in Syria continues to escalate, the presence of stockpiles of chemical weapons in the country is causing deep concern among the international community. Syria is understood to have started developing a chemical weapon programme in the 1970s and since then has steadfastly re-

fused to accede to the Chemical Weapons Convention (CWC) and thereby join the Organisation for the Prohibition of Chemical Weapons (OPCW). Accession to the CWC would require that Syria undertook not to develop, produce, stockpile, transfer, or use chemical weapons. Furthermore, Syria would be responsible for making regular declarations of any existing stockpiles and progress on their destruction, and would be subject to inspection of facilities that produced scheduled chemicals.

The executive director of the James Martin Centre for Nonproliferation Studies in Washington DC reported on the BBC that Syria has one of the world's largest chemical weapons stockpiles. A handful of open sources shed some light on the extent of the Syrian chemical weapon programme and the locations of some of the many storage and production facilities. But, according to the Nuclear Threat Initiative's Syria Country Profile, there are up to 50 different facilities which manufacture or house chemically-armed artillery shells or rockets that are ready to use. Their presence will complicate any attempts to resolve the ongoing unrest in Syria.

The number and variety of proposed solutions for ending the troubles in Syria show the complexity of the problem. Arms-length solutions, such as arming rebels with no international presence in Syria, may end up strengthening Al Qaeda affiliates that have been entering Syria from Iraq, and allow the diversion of chemical weapon stockpiles to terrorists. On the other hand, resistance leaders have recently announced that their members include a number of military defectors that have knowledge of the chemical weapon programme, and that they have a detailed plan to secure stockpiles within hours of the regime falling. There is growing evidence however, that Islamic militants have joined the resistance.

Over the last several months, the international community has also tabled options for more direct, boots-on-the-ground intervention. A U.S. Pentagon spokesman suggested in February that a ground force of 75,000 armed troops would be required to secure Syria's chemical weapons, but Global Security Newswire reports that there is no combat-ready Western force in the vicinity. Another report from The Voice of Russia describes an American plan to send 5,000 monitors from Russia and other states that support the al-Assad regime, solely to safeguard these stockpiles while avoiding any involvement in the domestic political struggle. Initially, 3,000 monitors would be sent to safeguard six warehouses with chemical agent stockpiles that are stored in large accessible tanks, with an additional 2,000 monitors joining them later. Despite Russian and Chinese opposition, airstrikes against the al-Assad regime and against the chemical weapons facilities have been suggested, according to reports by Global Security Newswire and Reuters.

All of these courses of action, however, face a similar obstacle. Even if the international community reaches an agreement to send regime-friendly monitors there is no public record of the locations, facilities or quantities of all of the chemical weapons that require safeguarding.

The proposed airstrikes present additional obstacles. If airstrikes are used against the Assad regime, without sound knowledge of production and storage facilities locations, they could potentially unleash toxic gases, even if some of the chemicals might be vaporized by an explosion's high temperatures. And even if international forces used their limited knowledge of the programme to target some of the known chemical weapons sites, such an operation would require vast resources, according to the James Martin Centre.

Although the situation in Libya presented similar concerns due to the known existence of chemical weapon stockpiles, Libya ratified the CWC in 2003 and the international community had access to its official declarations—although it recently came to light that small caches did remain undeclared, probably in an administrative oversight.

Action and inaction are both potentially costly options in Syria, however as the security situation continues to deteriorate, the likelihood of diversion of chemical agents continues to grow, strengthening the case to push for universalization of the CWC all the more energetically•

Avian influenza puts spotlight on dual-use research concerns

Meghan Brown, London

The completion of two major research projects at the end of last year unleashed a storm of debate over the safety and security of both carrying out and publishing research related to Avian Influenza (H5N1) and other potentially dangerous pathogens. Both studies examined the genetic composition of the virus, which is not easily transmitted between mammals in its current natural form, and determined that very few genetic mutations would be required to enable easy transmission among humans, synthesizing a more dangerous form of the virus along the way.

Initially, the US National Science Advisory Board for Biosecurity (NSABB) determined that this research should be redacted to omit details of the methodology before being published, but the World Health Organization (WHO), and eventually the NSABB, recommended that both studies should be published in full.

The first study, carried out in the US by Yoshihiro Kawaoka, was published on 3 May this year in the journal Nature. The second study, carried out in the Netherlands by Ron Fouchier, was granted a Dutch Export Permit as required by the Dutch Government under EU Dual-Use Research Regulations in line with Article III of the Biological Weapons Convention (BWC) in mid-April and the paper was published in Science on 21 June.

The debate over the biosecurity implications of the research has continued for several months and includes a wide range of opinions and actors. Ron Fouchier stated in a recent interview with Science that rogue states and terrorist groups will not have the technical knowledge required to reproduce the results, or if they do the research will not have much added value for them. Alexander Kelle, however, argued in a Bulletin of the Atomic Scientists column, that the biosecurity threat is very real, and should take precedence over the research.

The risks associated with carrying out the research – whether the results are published or not – include the accidental or intentional release of the mutated virus, which could have grave global repercussions. These concerns led to a temporary moratorium on further research pending more discussion on biosafety and biosecurity measures. Despite these concerns, the WHO, and many scientists and academics firmly believe that the public health benefits of this research warrant its publication, and that further research should take place. However, while the studies have now been published, the moratorium on research that alters the H5N1 virus continues, with no end in sight.

Notably absent from the ongoing debate, however, has been the BWC. The BWC Implementation Support Unit's (ISU) background document on 'New scientific and technological developments relevant to the Convention', released ahead of the BWC Seventh Review Conference held in December 2011 – in the midst of the publication debate – noted that the avian influenza research is an important development concerning the BWC. Yet no BWC representatives were invited to take part in a closed WHO Technical Consultation held last February. The meeting report acknowledged broader concerns such as biosecurity, but participants agreed that it was up to scientists and public health officials to decide how research findings should be released, and how to ensure the safety of lab samples.

The 2012 Chair of the BWC inter-sessional process has announced, in a letter to states parties, that the ISU has proposed the preparation of a background paper on the subject for its annual Meeting of Experts that will take place 16-20 July, 2012. This will allow BWC representatives to consider dual-use research concerns ahead of the second meeting that the WHO announced will take place toward the end of the year. The latter meeting will be a much broader discussion that will include public health authorities, government agencies, scientists, security communities, international agencies and the public. It is intended to address the wider concerns raised by dual-use research, and find solutions to existing management gaps. Furthermore, it will be a good opportunity for the BWC to present its findings and ensure that biosecurity concerns are carefully considered in any future policies and legislation•

Wilton Park conference on verification

Andreas Persbo, Steyning

Last week, VERTIC and Wilton Park held their second conference on verification, this time focusing on arms control and disarmament verification. The first conference was held in June 2011 to mark VERTIC's 25th Anniversary. Since Wilton Park conferences are held in strict confidence, no names or affiliations can be mentioned in this article. Nevertheless, this report will attempt to summarize the main themes coming out of the meeting.

The first point that came out from the discussion is that the verification community has changed over the last few decades, it has become much bigger, and the debate has deepened. In 1986 - by the time VERTIC was founded - the only intergovernmental organization dealing with verification was the International Atomic Energy Agency (IAEA). Now, several more bodies exist. In the words of one participant, 'the field of verification has come of age'.

Another main point relates to the massive strides in technology development over recent decades. One participant thought that the verification community has not 'scratched the surface' of the use of technology, and 'neither have governments'. In this age, it is important to re-think the proportions between distance monitoring and on-site inspection. In addition, technology forms a bridge to youth, who need to be attracted to work in this field. A next generation of professionals is needed as many present verification tasks are for perpetuity and verification regimes are designed to 'be around for ever'.

It was remarked though that technology alone has never been solely relied upon to provide effective verification. Rather, effective verification is supplied by a number of techniques working together. It was also said verification practice is evolving towards more cooperative and innovative uses of technology.

A third point was related to resources. First, governments cannot be expected to 'generate ideas' in an environment of shrinking budgets. In addition, it may be necessary to think about lowering the general verification burden for small states with low or no levels of industry and to reduce or streamline reporting requirements.

The issue of verifying the Biological Weapons Convention was also discussed. One participant argued that the inspections in Iraq were 'carried out against conventional wisdom'. In the participant's view, the perception that the treaty is unverifiable is firmly entrenched. The myth, it was argued, is that inspections do not work, whereas proof indicates that inspections compelled Iraq to eventually admit to having a

VERTIC blogs, April - June 2012

'Department of Safeguards releases documents'
Andreas Persbo , 29 March 2012

'The Iranian nuclear crisis: growing stockpiles and rising stakes'
David Cliff, 4 April 2012

'Clearing the fog surrounding nuclear security'
Hugh Chalmers , 26 April 2012

'VERTIC appearances at the NPT PrepCom'
Andreas Persbo, 3 May 2012

'Guest post: Norway to host second disarmament verification simulation'
Ibrahim Said Ibrahim, 9 May 2012

'The 1925 Geneva Protocol goes digital'
Angela Woodward, 17 May 2012

'Coalition of the unwilling?'
Grete Luxbacher, 24 May 2012

'Safety and security over biological waste'
Rocio Escauriaza Leal, 31 May 2012

'Iran, the IAEA and the Parchin problem'
David Cliff, 7 June 2012

'A surprising gift'
Jasmin Kaisla, 15 June 2012

'Wilton Park conference on verification'
Andreas Persbo, 26 June 2012

'United States v Bond: The Finale'
Yasemin Balci, 28 June 2012

biological weapons programme.

There is also some evidence for civil society monitoring in this field. The establishment of the BioWeapons Monitor initiative of the Bioweapons Prevention Project was raised, although it is far from achieving the role of its counterparts in the landmine and cluster munition regimes and some states still struggle with civil society involvement in the BWC regime at all. But this does not mean that one could not envision a greater role for civil society verification of CBRN obligations in the future, especially given the opportunities offered by advances in information technology.

The meeting also discussed the proposed weapons of mass destruction free zone for the Middle East. In the view of participants, this process is 'novel'. Without doubt, the 'initiative has to come from the Middle East'. One of the main challenges will be to integrate verification efforts relating to all weapons systems (nuclear, biological and chemical) as well as the verification systems relating to ballistic missiles. And there will be a trade-off when choosing between a regional and an international organisation to carry out verification activities.

The meeting also heard reflections on the future of the UK-Norway Initiative on nuclear warhead dismantlement verification, of which VERTIC was part until 2010. In the view of some participants, the value of the initiative is mostly related to issues of multilateralism, civil society, and technological development. We heard that some participants want to ensure that the effort is 'concrete and relevant'.

The organizers and participants considered the conference to be a great success. VERTIC intends to continue cooperation with Wilton Park and to host more verification-themed conferences in the coming years•

Student verification exercises

Andreas Persbo, Oslo

As noted on page 13, the 2012 Wilton Park Conference on verification discussed, among many other matters, how to attract new talent to the field of verification. One participant argued that technology applications in particular tend to enthuse the youth. The emerging generation of verification specialists has grown up with smart phones, instant messaging, and has no recollection of life before the internet. So, at least, it was argued.

To some degree, this kind of engagement is already happening. The Norwegian Institute for Energy Technology (IFE), together with the University of Oslo, has for the second year running held a number of student verification exercises aiming to get an aspiring generation up to speed with the issues.

It started last year, in June 2011, when King' s College London sent a team of young students to the IFE facility near Lillestrom, Norway, to replicate a previous experiment held by the United Kingdom and Norway in 2009 on verifying nuclear warhead dismantlement. The budget was smaller, the means more modest, and the time for preparation shorter. Yet, the students used the same technologies, faced the same questions, and had to apply the same techniques as their senior government counterparts. Despite the limitations, the students experienced a full simulation, and did come up with some interesting results (see Kristiane Roe Hammer, 'Student-led warhead dismantlement exercise held in Norway' followed by Hugh Chalmers, 'Student VEREX: a host perspective' on the VERTIC Blog, 24 June and 29 July 2011).

The second round of students from King's as well as a team of students from the University of Hamburg travelled to Oslo in June 2012, to run the exercise again. Interestingly, there is now a sense of competition amongst the groups of students. Each new batch wants to do better than the last, which means that they are putting their energy into finding innovative solutions to verification questions. Most of the Hamburg University students had a strong scientific back-

ground. They tended to emphasize technological solutions to most problems. For instance, they quickly organized the work into sub-groups (so that non-destructive assay staff from both sides, for instance, would find joint solutions and then report them back to the group as a whole). They also used an Etherpad (collaborative drafting software) to quickly feed results into the inspection protocol. The more policy-oriented King's College group focused on political process, which has its own benefits.

Both groups quickly realized that it is easy to talk about verification solutions, but considerably more difficult to make them practicable. As Kristiane Hammer put it last year, 'Even after studying non-proliferation and dismantlement exclusively for close to a year, the exercise put a lot of things into perspective and showed how difficult verification can actually be. In this field it is easy to become very detached from practicalities'.

Undeniably, Norway is showing the way forward in terms of disarmament education. This will be an interesting initiative to follow in the coming years•

Verification Quotes

'The most desirable plan would be to urge the weapons' current custodians to remain in place during any transition of power, and to place the sites under the supervision of an international contingent that could monitor the weapons' security, as decisions were made about how to manage or destroy them in the future.'—Leonard Spector, Deputy Director, James Martin Centre for Nonproliferation Studies, commenting to the BBC on the stockpiles of chemical weapons in Syria, 18 June 2012. Where is the OPCW when you need it? That's right, Syria have not signed the Chemical Weapons Convention.

'[T]he added confidence provided by safeguards when reinforced by an Additional Protocol, will facilitate the full support and confidence of the international community and at the same time ensures the credibility of IAEA safeguards system'.—H.E. Ambassador Hamad Al Kaabi, Permanent Representative of the United Arab Emirates to the IAEA, during the NPT PrepCom 2012 in Vienna. As we were sitting next to him when he made the remark we very strongly agree, rather than just strongly agree.

'Our experience so far demonstrates that the New START's verification regime works and will help push open the door to new and more complicated verification techniques in the future' —Rose Gottemoeller, acting undersecretary of state for arms control and international security, testifying to the US Senate in June 2012. Good testimony. It should be recalled, however, that a simple solution is often more appealing than a more complicated one.

'Sometimes the verification community is a bit like Lucy in the Skies with Diamonds. (Laughter). Hey, we're doing Beatles analogies, aren't we?'—A Wilton Park participant whose identity must be protected at all costs talks about what makes the verification community tick. We are not sure we agree fully, but it was funny.

Science & Technology Scan

Cyberspace: To monitor or be monitored?

Meghan Brown, London

Cyber security concerns have affected everyone from lone personal computer users to corporate and government workers using large networks. Recently, however, cyber security has emerged as an area that has important implications for existing arms control treaties, as well as the possibility that cyber space itself may also require some kind of international mechanism since cyber technologies can be used as weapons against states by other states or by non-state actors.

High-profile viruses, and in particular, Flame and Stuxnet have recently been the subject of international attention and a number of news reports. The New York Times reported that the Stuxnet virus was a tool created by the United States as part of an operation that started in the George W. Bush administration and gathered steam under the Obama administration. Stuxnet was designed to target specific hardware that is contained in Iranian Nuclear facilities. The Institute for Science and International Security (ISIS) reported that up to a thousand of Iran's centrifuges at the Natanz fuel enrichment plant were taken out of service as a result of Stuxnet.

The government officials that admitted US involvement in Stuxnet would not comment on involvement in Flame. However, experts from cyber security firms Symantec and Kaspersky Labs have claimed that there are areas of code in both viruses that are identical and that they are the product of collaborating teams. Unlike Stuxnet, Flame's goal was to acquire massive amounts of data, including audio files, screen shots and passwords rather than to decommission equipment in nuclear facilities. Flame was even able to alter electronic documents on infected systems.

The Centre for Strategic and International Studies (CSIS) has published a long list of less prolific but significant cyber incidents since 2006 that includes the May 2007 cyber-attacks on Estonian government networks that disrupted online services and banking, and that likely originated in Russia, and a similar but less disruptive cyber-attack on Georgian computer networks in August 2008. In a 2010 incident, internet traffic from approximately 37,000 networks was exposed for around a 20 minute period when it was routed through China, apparently due to a telecommunications firm error.

The increasing number, complexity and potential of cyber incidents has led to high level discussions about regulating cyberspace itself either through an international convention, a system of confidence building measures, or some other type of arrangement. To that end, VERTIC Senior Researcher Larry MacFaul recently attended a conference at Wilton Park that looked at drawing lessons from existing multilateral security regimes to apply to the regulation of cyber space.

There is a strong consensus that cybersecurity is an important issue, but little consensus on how it should be addressed. This is partly due to differing ideologies and conceptions of information security and partly due to the speed of change and advanced technical nature of some areas of cyber space. One of the many issues identified focuses on the question of verification that is made especially difficult due to attribution problems that can mask the identities and locations of perpetrators.

Nevertheless, some international and regional agreements, and other mechanisms, have been put in place, or are under discussion. The US and Russia, for example are adapting a hotline through the Nuclear Risk Reduction Centre to report cyber incidents (the original hotline was designed to report tests that might be perceived as hostile acts to prevent nuclear war). The Budapest Convention on Cybercrime, for example, has 34 ratifiers. But although it currently covers fraud, child pornography, copyright and network security, it does not address cyber-attacks by or against states. Other multilateral efforts include a Draft African Union Convention on the Establishment of a Credible Legal Framework for Cyber Security in Africa, and a joint Chinese and Russian proposal for an International Code of Conduct

for Information Security.

Meanwhile a series of international conferences – starting with the 2011 London Conference on Cyberspace, followed by Budapest this year and Seoul in 2013, as well as discussions in other forums, look for long term multilateral solutions to ensuring cybersecurity•

A surprising gift

Jasmin Kaisla, London

Sometime last year, administrators at the US National Aeronautics and Space Agency (NASA) got a surprising call from colleagues at the National Reconnaissance Office (NRO). They told them to head over to a facility owned by the aerospace company ITT Excelis to pick up some hardware that the NRO, which operates the US fleet of spy-satellites, no longer needed.

In a clean-room at the ITT Excelis site, NASA technicians found two Hubble-sized telescopes, with complete lenses and control mechanisms (the cameras and the control software had been removed). The two telescopes are allegedly leftover hardware components from a cancelled NRO program called Future Imagery Architecture (FIA). Loretta DeSio, the spokeswoman for the NRO, confirmed that the two telescopes were built in the late 1990s and early 2000s, which would match with the FIA program.

It is sometimes said that satellite intelligence enabled modern arms control, and it is known that major states rely heavily on multi-spectral satellite imagery for verification purposes. It is not known, however, how sensitive these satellites are. The handover of these two NRO satellites to NASA, however, reveals some interesting technical details, which will serve to enhance our understanding of the use of satellites as so-called 'national technical means' of verification.

The two telescopes have an 1/20th wave aperture that is 2.4 meters wide (the same size as Hubble) and have an additional manoeuvrable mirror for the purpose of boosting image sharpness. The two telescopes also reportedly have a shorter focal length (f/1.2) than Hubble (f/2.3), which gives it a wider angle of view (one might think of the telescopes as two giant microscopes rather than being a camera with a zoom-lens). Matt Mountain, the Director of the Space Telescope Science Institute, called the telescopes' optics 'astounding', while Loretta DeSio confirmed that the hardware represented an upgrade of Hubble's optical technology.

With the NRO satellites, it may be possible to achieve a resolution of some 10-15 centimetres per pixel looking down on the earth from an altitude of about 300 kilometres. This is much sharper than anything commercially available (Google Earth, for instance, can achieve 50 centimetres per pixel at best). It is also slightly sharper than previous estimates of what spatial resolution the US can expect from its well-known KH-11 class of reconnaissance satellites.

A finer spatial resolution enables satellites to detect such things as distributed soil, vegetation, radiation emitted from heated structures, discharge of warm water plumes from nuclear reactors and components of aerosols, gas plumes and effluents. For instance, twelve years ago, Professor Bhupendra Jasani argued in the Verification Yearbook that, "if underground facilities have been constructed … stressed vegetation that grows on earth-covered bunkers could be distinguished from normal vegetation, since root growth, drainage and soil conditions are different". To view detail at this level would be very useful for verification organizations.

But it is perhaps this potency that makes their inclusion unlikely. Possessor nations, of which there are but a few, will be unwilling to share their technological edge. Nations might be uncomfortable knowing that images of sensitive installations could be broadly circulated. While diplomats and experts fuzz, however, imagery resolution is likely to continue to improve to the point where science meets fiction. At some point, also, the resistance to sharing very high quality imagery will probably erode. It would be worthwhile for intergovernmental organizations to plan for the day when such imagery becomes the norm rather than the exception•

VERTIC News & Events

Arms Control and Disarmament Programme

The Arms Control and Disarmament Programme has continued work on VERTIC's multilateral disarmament verification project, and is currently preparing for the next conference in this series that will take place in London in August. This spring also saw the start of a project on universalization of the Additional Protocol that is funded by the UK Foreign and Commonwealth Office.

In addition to on-going projects, the team has participated in a number of other events. David Cliff attended a roundtable discussion with the International Network of Emerging Nuclear Specialists at the US Embassy in London on 12 April. Andreas Persbo travelled to Prague on 16-17 April where he addressed a Czech Foreign Ministry Conference on the Prague Agenda.

In May, the team travelled to Vienna to attend the Non-Proliferation Treaty Preparatory Committee meeting. While at the conference, on 8 May, VERTIC gave a presentation on its Additional Protocol project during a side event hosted by the US Department of Energy. The same day, VERTIC held a side event with ISS Africa on disarmament verification by intergovernmental organizations. David Cliff spoke about the advantages of multilateral approaches to disarmament verification, and David Keir presented on the technical challenges and opportunities in future multilateral nuclear disarmament verification.

VERTIC also began considering new areas of interest in verification this spring, as Larry MacFaul attended a conference at Wilton Park from 28–30 May with a number of industry and government representatives focusing on developing confidence building measures in cyber space. Mr MacFaul gave a presentation examining what lessons can be learned from existing international mechanisms and agreements in the fields of security and shared resource management. Andreas Persbo also travelled on 28 May, to Edinburgh, Scotland, to address a UNA Scotland conference on the proposed WMD-free zone in the Middle East.

June has seen Andreas Persbo, David Keir and David Cliff travel to Oslo for two Student Verification Exercises with participants from King's College and the University of Hamburg. The exercises focused on verified warhead dismantlement, and were closely modelled on a 2009 on-site inspection exercise held under the UK-Norway Initiative. Back in London, David Cliff attended an International Atomic Energy Agency talk on 14 June, and the ACD team attended a workshop at the Royal United Services Institute on Iran on 15 June.

Finally, David Keir, Larry MacFaul and Andreas Persbo, along with NIM team members Scott Spence and Angela Woodward, participated in the VERTIC/Wilton Park conference on 'Verification in the 21st century–technological, political and institutional challenges and opportunities', see the conference article on page 13 for more information.

National Implementation Measures Programme

This quarter, the NIM team completed five legislation surveys on implementation of the Biological and Toxin Weapons Convention (BWC) and reviewed two draft bills.

On 26 June, VERTIC co-organized a workshop with UNLirec in cooperation with the Ecuadorian Ministry of Defence on the implementation of the BWC and UNSCR 1540- related provisions, in Quito, Ecuador.

NIM staff presented at a CBRN Centres of Excellence Workshop in Bangkok, Thailand on 2 April and attended a meeting on the mammalian transmissibility of H5N1 at the Royal Society in London on 3 April. We also discussed legal issues relating to a 'Non-Lethal Weapons' training exercise held in New Zealand with the country's Ministry of Defence in Wellington, New Zealand on 4 April and gave a presentation during the 7th Annual Conference of the Asia-Pacific Biosafety Association in Bali, Indonesia from 26 to 27 April.

NIM staff participated in meetings convened by the Government of Madagascar on the implementation of UNSCR 1540, on the occasion of the UNSCR 1540 Committee's in-country visit, which took place in Antananarivo and Toamasina, from 22 to 24 May.

We also presented at the International Conference on Biosafety and Biosecurity organized by the Moroccan Biosafety Association in Rabat from 24 to 26 May and at the Chemical Security workshop in Amman, Jordan from 4 to 6 June. Finally, the NIM team contributed to a Compliance and Verification workshop via teleconference on 5 June and attended a meeting on the Third Review Conference of the Chemical Weapons Convention in London on 27 June.

The OECD's Nuclear Energy Agency published an article by Scott Spence, NIM Programme Senior Legal Officer: 'Legal aspects of the control and repression of illicit trafficking of nuclear and other radioactive materials – Is there a need for an international convention?' in the Nuclear Law Bulletin (Volume 2012/1, No. 89, June 2012).

Environment Programme

During the spring, the programme continued to carry out research on Artic affairs. This work focused on the policies, regulations and standards that currently affect the Artic, or may come to play a role in the region. The research and analysis is being compiled for an upcoming VERTIC Brief. The programme also attended a meeting on 9 May at the International Institute for Strategic Studies, London, where Paul Berkman, Fulbright Scholar and Research Professor at the University of California Santa Barbara, and the former Head of the Arctic Ocean Geopolitics Programme at the University of Cambridge, spoke on international law and the Artic.

In addition, the programme carried out research to identify what lessons can be drawn from experiences in building international environmental agreements for on-going efforts to develop confidence building measures between states in cyber space. The research also examined whether cyber security issues are affecting the operation of environmental treaties. The results were delivered, along with observations on arms control treaties, in a presentation to the Wilton Park conference on cyber security in June—highlighted in the ACD programme news above.

VERTIC Reflections

As you may have read in programme news, we have just completed a strategic review of all our programme activities. This is a rare meeting, happening every three years, and involves the entirety of the organization: its staff, its trustees and its advisors. Over a couple of days of intensive discussions, we set out the strategic direction of the venture, and set concrete targets for the Executive Director to aspire to. The last plan was a great success: we exceeded our fundraising targets by a wide margin and nearly doubled the size of the organization. We managed to revive our internship programme and have managed to bring young people into paid positions in this field.

Unsurprisingly, there are things we can do better. Our work on the environment has been lagging behind for years, and is struggling to gain traction with the funders. We have not managed to bring the Verification Yearbook into print. We still have to get better in ensuring that our staff has a decent work-life balance.

So we will make changes in the coming months. The main change may be a complete reorganization of our programmes, although this is still being debated internally. We may also review the role of our advisory network – aiming to bring these gifted individuals closer to our day-to-day operations.

We in London are very much looking forward to the Olympics, and the excitement that this will bring. Of course, we are all dreading traffic chaos on the London Underground. But thankfully, though, this is for the Mayor of London, and not yours truly, to sort out.

Andreas Persbo, Executive Director

Grants and administration

In this quarter VERTIC secured a grant from the Norwegian Royal Ministry of Foreign Affairs for NOK 200,000 for a two day Verification Conference held at Wilton Park, London in June 2012. The Foreign and Commonwealth Office (FCO) also awarded VERTIC a grant of £130,000 for its project on 'Universalization of the Additional Protocol'. VERTIC previously completed a pilot stage for this project in November 2011. The FCO is also providing on-going support for VERTIC's project on 'Legislative Assistance to Ensure Non-Proliferation of NBC Weapons'.

In June 2012, VERTIC held a strategic review meeting to plan the future direction of the organisation for the period 2013- 2016. All VERTIC staff members were present at the meeting. The trustees and members of VERTIC's International Verification Consultants Network were also represented at the meeting.

VERTIC's internship programme continues to thrive and attract strong applicants. We currently have Meghan Brown supporting the Arms Control and Disarmament Programme and Jasmin Kaisla as intern to the office of the Executive Director. Finally, we would like to thank Ariane Tabatabai and Nayive Corzo for their contribution to VERTIC over the past few months•

VERTIC
Development House
56–64 Leonard Street
London EC2A 4LT
United Kingdom

tel +44 (0)20 7065 0880
fax +44 (0)20 7065 0890
website www.vertic.org

Registered company no. 3616935

Registered charity no. 1073051

building trust through verification

VERTIC is an independent, not-for-profit nongovernmental organization. Our mission is to support the development, implementation and effectiveness of international agreements and related regional and national initiatives. We focus on agreements and initiatives in the areas of arms control, disarmament and the environment, with particular attention to issues of monitoring, review and verification. We conduct research, analysis and provide expert advice and information to governments and other stakeholders. We also provide support through capacity building, training, legislative assistance and cooperation.

PERSONNEL Mr Andreas Persbo, *Executive Director*; Ms Angela Woodward, *Programme Director*; Dr David Keir, *Senior Researcher*; Mr Larry MacFaul, *Senior Researcher*; Mr Scott Spence, *Senior Legal Officer*; Mr Hassan Elbahtimy, *Researcher*; Mr Rocío Escauriaza Leal, *Legal Officer*; Ms Yasemin Balci, *Associate Legal Officer*; Mr David Cliff, *Researcher*; Ms Unini Tobun, *Administrator*; Ms Renata Dalaqua, *Consultant* (2011-12); Ms Sonia Drobysz, *Consultant* (2010-12); Ms Greta Luxbacher, *Consultant* (2012-13); Mr Ryoji Sakai, *Consultant* (2012-13); Ms Meghan Brown, *Intern* (May-July 2012); Ms Jasmin Kaisla, *Intern* (May-July 2012).

BOARD OF DIRECTORS Gen. Sir. Hugh Beach; Dr Wyn Bowen; Rt Hon Lord Browne of Ladyton; Rt Hon James Arbuthnot MP; Dr Owen Greene; Dr Edwina Moreton; Mr Nicholas A. Sims.

INTERNATIONAL VERIFICATION CONSULTANTS NETWORK Dr Nomi Bar-Yaacov; Ambassador Richard Butler; Mr John Carlson; Ms Joy Hyvarinen; Dr Edward Ifft; Dr Odette Jankowitsch-Prevor; Mr Robert Kelley; Dr Patricia Lewis; Dr Robert J. Matthews; Professor Colin McInnes; Professor Graham Pearson; Dr Arian L. Pregenzer; Dr Rosalind Reeve; Dr Neil Selby; Minister Victor S. Slipchenko; Dr David Wolfe.

CURRENT FUNDERS Department of Foreign Affairs and International Trade Canada, Joseph Rowntree Charitable Trust, Norwegian Ministry of Foreign Affairs, UK Foreign & Commonwealth Office (Strategic Programme Fund), US Department of State (Federal Assistance Award).

TRUST & VERIFY is published four times per year. Unless otherwise stated, views expressed herein are the responsibility of the author and do not necessarily reflect those of VERTIC and/or its staff. Material from *Trust & Verify* may be reproduced, although acknowledgement is requested where appropriate.

EDITOR Larry MacFaul
DESIGN Richard Jones
PRODUCTION Andreas Persbo

ANNUAL SUBSCRIPTION RATES Free. To subscribe to the electronic version of *Trust & Verify*, please enter your e-mail address in the subscription request box on the VERTIC website. Subscriptions can also be requested by contacting unini.tobun@vertic.org

VERTIC