

Design Matters: The Past, Present and Future of the INF Treaty

Introduction

In a discussion with journalists on 20 October 2018, US President Trump announced that the United States would seek to withdraw from the 1987 Intermediate-Range Nuclear Forces (INF) Treaty, blaming Russian violations of the treaty as the reason for the decision. Both countries allege the other has violated the treaty. However, US withdrawal from the treaty, combined with the lack of progress in extending New START (Strategic Arms Reduction Treaty), which is designed to limit the number of strategic weapons in US and Russian arsenals, arguably represents the most severe crisis in nuclear arms control for several decades.

Numerous experts have explored the geopolitical and strategic ramifications of US withdrawal from the Treaty. Pavel Podvig, for example, has argued that Russia's violation fails to 'reach the level that would justify destruction of a key disarmament agreement, most likely bringing irreparable damage to the larger arms control architecture'. Others have suggested that withdrawing from the Treaty represents an 'own goal' for the United States and that it risks undermining the broader international arms control architecture. US officials, on the other hand, have argued that triggering the 60-day notification period for withdrawal (which US Secretary of State Mike Pompeo announced on 4 December 2018) is warranted by Russia's alleged noncompliance. Pompeo's ultimatum states that Russia must return to 'full and verifiable compliance' with the INF Treaty or the United States would provide its official

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notification of withdrawal from the Treaty, in accordance with Article XV, par. 2. As outlined in the Treaty, withdrawal enters into effect six months after this notification, which must include ‘a statement of the extraordinary events the notifying Party regards as having jeopardized its supreme interests’.

While much has been made of the political failures that have contributed to this crisis, what has been largely ignored in the debate is the part played by weaknesses in the structural design of the INF Treaty itself. This article examines the structural design of the INF Treaty and argues that its flaws—specifically the sunset of its verification regime in 2001—has contributed to the difficulty in addressing allegations of noncompliance within the current arms control framework. This design flaw also conditions the prospects for the INF Treaty regime moving forward amid heated debates concerning the appropriateness of withdrawal, amendment or replacement of the Treaty and the respective consequences for the future of nuclear arms control.

Origins of the INF Treaty

The INF Treaty was designed to address ‘intermediate nuclear forces’—ground-launched ballistic missiles (GLBMs) and ground-launched cruise missiles (GLCMs) with ranges of between 1,000 and 5,500km—and their destabilizing consequences in the European theatre. From the outset of informal, bilateral negotiations in 1980 to limit intermediate forces, verification of an agreement to address these types of weapons represented a central concern. Six years of formal negotiations took place concerning the timeline and benchmarks related to the removal of intermediate systems, their deployment beyond Europe and the inclusion and design of the verification regime, as well as the creation of the Special Verification Commission (SVC) ‘to meet at the other party’s request’ as a forum to resolve implementation and compliance issues (Article XIII). The Commission was also charged with interpreting the Protocol on Inspection and outlining the characteristics and use of inspection equipment.

In its first two decades, the INF Treaty represented a significant—and, arguably, the signature—achievement of arms control. Following the Washington Summit in 1987, approximately 2,600 missiles were dismantled during the three-

year elimination period. The INF Treaty was also part of a broader suite of European and transatlantic arms control agreements, including the 1992 Treaty on Conventional Armed Forces in Europe (CFE) and 1991 Strategic Arms Reduction Treaty (START I). As Daryl Kimball and Kingston Reif note, the INF Treaty also ‘marked the first time the superpowers had agreed to reduce their nuclear arsenals, eliminate an entire category of nuclear weapons, and utilize extensive on-site inspections for verification’. The Treaty was also multilateralised following the end of the Cold War with the inclusion of Belarus, Kazakhstan and Ukraine.

The design of the verification regime

Among arms control agreements, the INF Treaty embodied a credo repeated often by President Reagan in the course of arms control negotiations: ‘trust but verify’ or, in the original Russian, ‘Doveryai, no proveryai’. As a consequence, the inspection procedures outlined in the Treaty to verify compliance were both numerous and robust.

The protocols on ‘Inspection’ and ‘Elimination’ outlined several on-site inspection processes. These included baseline inspections to compare the site against data provided during an initial comprehensive data exchange, as well as six-monthly information exchanges facilitated by the Nuclear Risk Reduction Centres, closeout inspections of INF facilities as they are taken offline, a limited number of short-notice inspections of declared and formerly declared INF facilities, and elimination inspections to confirm that the procedures outlined in the Agreed Statement on Inspection (1988) were being followed. The inspection regime included a number of requirements vis à vis notification procedures as well as annual quotas concerning the number of inspections allowed. In the first three years of the Treaty, each Party was allowed 20 inspections in each year. In the following five years, this was reduced to 15 inspections before a further reduction to 10 inspections per year in the final five years of the inspection regime ending in 2001.

The Treaty also allowed the United States to undertake continuous portal monitoring—an intrusive verification measure for monitoring missile assembly plants—of any Soviet facility manufacturing a GLBM with a rocket stage ‘outwardly similar’ to a stage of a GLBM limited by the Treaty. The

Soviet Union received a similar right to monitor the US facility that formerly built the Pershing rocket motor.

The INF regime in practice

By 2011, however, the United States believed that Russia was an INF compliance concern. These concerns were raised in several meetings with Russian diplomats throughout 2013 and in July 2014 the United States officially accused Russia with violating the Treaty. In the 2014 edition of its Compliance Report, the US State Department alleged that Russia began the covert development of a mobile, intermediate-range, ground-launched cruise missile designated as 9M729 (SSC-8) in 2008, and that this weapon system was not in compliance with Russia's INF obligations not to 'possess, produce, or flight-test' missiles prohibited by the Treaty. The basis for this conclusion remains unclear but the US government has at various times noted that the missile system has been flight-tested as a ground-launched cruise missile to ranges prohibited by the Treaty. From the US perspective, these relatively low-cost and survivable capabilities provide Russia with more options to strike allied military targets and populations without consuming Russia's inventory of strategic offensive weapons and theatre-strike resources, such as sea-launched cruise missiles. Following repeated denials from Moscow that such a weapon existed, the United States in 2016 called the first meeting of the SVC for thirteen years to address Russian compliance issues—and the 30th such meeting of the Commission since the inception of the Treaty. Another meeting of the SVC followed in December 2017.

During both SVC meetings, Moscow denied that the weapon system was in breach of the Treaty and little progress was made to address the alleged INF violations. Moscow has also subsequently accused the United States of violating the Treaty through the deployment of missile defence systems to Eastern Europe. Specifically, Russia argues that the Mk-41 launch system for air defence missiles can also be used to fire cruise missiles. In December 2017, Moscow also claimed that Japanese acquisition of US-built Aegis Ashore systems also constituted a breach of the Treaty. Since then, the allegations and counter-allegations from both sides have done little to alleviate concerns over the viability of the Treaty.

Over the past two years, US policy-makers have put the re-

sponsibility for INF issues squarely in Moscow's corner. Andrea Thompson, US Under Secretary of State for Arms Control and International Security, remarked that, 'Either you rid the system, rid the launcher or change the system where it doesn't exceed the range, in a verifiable manner'. Similarly, the Director of National Intelligence, Daniel Coats stated, 'Russia has shown no sign that it is willing to acknowledge its violation, let alone return to full and verifiable compliance'.

Design matters

One of the intriguing, if unsurprising, aspects of remarks from US policy-makers is the focus on verification as part of a remedy to Russian noncompliance with the INF Treaty. As mentioned above, the INF Treaty's inspection regime had three stages. The first lasted three years and supported the elimination of intermediate-range forces. The second and third stages each lasted five years, with a gradual drawdown in the number of on-site inspections allowed by each side. After 13 years, in 2001, the inspection regime for verifying INF commitments ceased (Article XI, par 5, par. 6). Following the sunset of the verification regime, portal monitoring at a missile factory in Votkinsk, Russia, continued on the basis of treaty commitments in New START, but the United States and Russia no longer had the right to conduct on-site inspections at the INF facilities identified via the information exchanges outlined in the Treaty text.

Of course, sunset (or termination) clauses are not unusual in arms control and nonproliferation agreements. The Non-Proliferation Treaty (NPT), START frameworks, and test ban treaties have all included sunset clauses that provide an endpoint to member states' respective commitments. So, why include a sunset clause in an agreement? In theory, sunset mechanisms are meant to make negotiations more likely to succeed by limiting the parties' future obligations. Unlike many agreements, however, the INF Treaty does not have a sunset clause for the treaty as a whole (Art. XV, par. 1). Instead, the INF Treaty lasts in perpetuity (or until such time as one party withdraws) but without a verification mechanism 13 years after its inception.

To some extent, this design feature can be explained by the

focus on INF facilities that existed in the 1980s, with no contingencies made for the potential of parties to the Treaty building new facilities and/or capabilities—at least not without parties leaving the Treaty entirely ‘if it decides that extraordinary events related to the subject matter of this Treaty have jeopardized its supreme interests’ (Article XV, par. 2).

The reality of the INF verification regime’s sunset clause presents three discrete challenges to policy-makers in addressing post-sunset violations and noncompliance.

First, attributing noncompliance has been complicated by the lack of an inspection regime. In the case of the SSC-8 missile system first deployed in 2008, attributing noncompliance to Russia and communicating the allegation of a breach to allies and Moscow took four years. While both Russia and the United States have adequate national technical means to analyse one another’s capabilities, uncertainty remains surrounding weapon capabilities and effects—particularly systems that are limited on the basis of range that might otherwise look similar to smaller-range and larger-range systems. It is also worth considering the ‘selection effects’ associated with the decision to develop and deploy an INF (or INF-adjacent system). If a verification regime had existed during the development phase of a new INF system, it may have influenced the decision to develop it in the first place, given the reputation costs associated with a Treaty breach. Indeed, a number of analysts have suggested that the Russian decision to build and deploy the SSC-8 reflected bureaucratic politics as well as long-standing concerns surrounding the viability of the INF framework amid the continued development of intermediate-range nuclear and non-nuclear forces in China, India, Pakistan and others. Without the verification regime, attribution of the breach only occurred during flight-testing and deployment of the system.

Second, there is limited information available concerning weapon system capabilities to create new standards for compliance. For agreements that limit rather than ban weapons systems, parties to an agreement need a basis to measure weapon characteristics in order to attribute compliance or breaches. Without an inspection architecture, fewer weapon systems are available to inspect and discussions of technical specifications related to missile and payload capabilities are

more limited—and there is no mandate to provide them. The negotiators of the INF Treaty in the 1980s had detailed knowledge of weapon characteristics, in general, and of INF characteristics, specifically. These characteristics informed the benchmarks and timeline for the destruction of 2,600 missiles. Today, the characteristics and measurement of modern intermediate-range forces has become a point of debate that has reached an impasse. Given advances in technology, it may also represent a moving target for scientists and engineers tasked with designing technical verification measures. Russian allegations related to US missile defence systems, for example, reveal the extent of the problem in deciding where intermediate-range forces begin and end. In sum, it remains unclear how to operationalise a measurable verification regime and how to build a workable institutional apparatus (à la the SVC) to support it.

Third, the sunset of the verification regime has meant that the scope and nature of any renewed verification process are up for debate. There is, of course, no mandate within the existing Treaty framework to restart the inspection regime. But, if a new verification regime is deemed desirable negotiators face a central question: should the INF’s verification regime look the same as the historical version, or should it be replaced with something new and improved? Advances in both verification technology and techniques suggest that there may be considerable benefits to using new tools and practices. However, new methods may require different types of access throughout a missile’s lifecycle across production, deployment, movement, storage and dismantlement phases that parties may be reluctant to provide.

The second and third challenges suggest that there is need for innovation in how arms control is conceptualised in the 21st century—for INF systems and beyond. This is complicated by a return to an era of strategic competition involving parties outside of Moscow and Washington. China, India, Pakistan and North Korea all possess missiles that would fall into the prohibited INF category. This has led to calls, but little progress on, a new, multilateralised INF arms control regime. The growing use of these systems by states that were largely outside of the arms control frameworks of the Cold War may also make clear the need to reconsider the viability of arms control regimes that privilege symmetrical agreements given

the variation in threat and vulnerability faced by each state.

Future of the INF

With these concerns in mind, the existing design of the INF Treaty also conditions the success of potential solutions related to the continuation, amendment, withdrawal or replacement of the Treaty. There are four options facing Washington and Moscow—each with their intrinsic costs and benefits. The first is to continue to muddle through the status quo INF Treaty regime without an adequate verification regime to monitor compliance, but keeping the existing treaty architecture intact. This outcome would represent a climb-down for the United States and potentially require concessions from Moscow. The second option is to amend the Treaty regime and reach an understanding concerning a reinvigorated inspection regime. The statements made by senior US officials suggest that this would be necessary for the INF Treaty's survival. The third option is for the United States, Russia, or both to withdraw from the Treaty, thereby removing all Treaty obligations within the next six to eight months. Should withdrawal occur, however, Washington and Moscow face the decision of whether to revisit arms control for intermediate-range forces, individually, or as part of broader strategic arms control negotiations. This final, and perhaps most challenging, option would offer an opportunity to renegotiate the verification and enforcement architecture concerning intermediate-range forces, as well as broaden the membership to other states. It remains to be seen which option policy-makers choose.

Conclusions

Put simply, the INF Treaty represents a singular achievement of Cold War arms control and may be the first casualty of arms control in an era of strategic competition. While policy-makers call for 'full and verifiable' compliance, the facilities for verification within the existing INF architecture no longer exist. As a consequence, policy-makers face hard choices concerning the information and tools that are needed to rebuild the verification regime, should they decide to do so, and the costs and benefits of pursuing a bilateral arms control regime that many other states have ignored.

While this conclusion may lead to pessimism, there are several reasons to be optimistic. First, Schelling and Halperin's

logic concerning the mutual benefits provided by arms control still apply. Arms control—and particularly arms control with strong verification and enforcement mechanisms—can reduce the probability of war by addressing uncertainty, reducing the cost of war and mitigating arms race instability. Second, in pursuit of these goals, there are now large numbers of arms control frameworks from which to draw lessons and comparisons. There is considerable variation in their structural design—particularly the scope, membership, enforcement and flexibility of agreements—with attendant consequences on compliance. Indeed, the contemporary debate concerning the INF Treaty reflects a key lesson learned by negotiators in the past that policy-makers should bear in mind today: design matters.

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Verification Watch

IPCC: new findings released and refined tools on the way

Larry MacFaul

In October, the Intergovernmental Panel on Climate Change (IPCC) released a Special Report on Global Warming of 1.5°C. The key message of the report is that ‘limiting global warming to 1.5°C would require rapid, far-reaching and unprecedented changes in all aspects of society. With clear benefits to people and natural ecosystems, limiting global warming to 1.5°C compared to 2°C could go hand in hand with ensuring a more sustainable and equitable society’.

The IPCC was established in 1988 by the United Nations Environment Programme and the World Meteorological Organization, and currently has 195 member states. Its purpose is to provide the international community with regular scientific assessments on climate change, including on its current and projected level, potential consequences, and on adaptation and mitigation measures. It also provides tools for monitoring greenhouse gas emissions. The work of the IPCC is based on a large number and range of regular scientific papers that span several disciplines.

The IPCC is best known for its periodic comprehensive assessment reports on the state of available scientific, technical and socio-economic knowledge on climate change. IPCC reports are written in varying levels of technical detail according to their intended audience and are policy neutral. The assessment report process brings together a large number of authors, reviewers and approvers to draw findings from the scientific literature. There have been five assessment reports since 1990. The sixth is due for release in 2022.

The organisation also provides special reports such as the one released in October. It was prepared in response to an invitation from the seminal UN climate negotiations in Paris in 2015, which agreed to pursue efforts ‘to limit the temperature increase to 1.5°C above pre-industrial levels’. It therefore asked the IPCC to prepare a report focusing on the impacts of global warming of 1.5°C above pre-industrial levels and global

greenhouse gas emission pathways, in the context of strengthening the global response. As with other IPCC reports noted above, the publication was produced through a series of scoping, review and approval procedures and is the result of a large number of contributors (93 coordinating and lead authors and review editors as well as 133 contributing authors).

While the overall prognosis is sombre—for example, ‘Climate-related risks to health, livelihoods, food security, water supply, human security, and economic growth are projected to increase with global warming of 1.5°C and increase further with 2°C’—the report largely adopts a positive, opportunity-focused approach. It achieves this by first presenting the benefits of keeping to 1.5°C for each of its major findings rather than the increased dangers of going beyond this threshold.

The special report approaches the issue in a systematic manner. It starts by explaining trends in temperature trajectories, proceeds to potential impacts and concludes with options for response measures. It provides key findings on each major theme. For example, on the state of temperature change it finds that ‘Human activities are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels, with a likely range of 0.8°C to 1.2°C. Global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate. (high confidence)’. On impacts, in particular when considering the difference between a 1.5°C and 2°C increase, it states ‘Climate models project robust differences in regional climate characteristics between present-day and global warming of 1.5°C, and between 1.5°C and 2°C. These differences include increases in: mean temperature in most land and ocean regions (high confidence), hot extremes in most inhabited regions (high confidence), heavy precipitation in several regions (medium confidence), and the probability of drought and precipitation deficits in some regions (medium confidence)’.

On impacts, the report states ‘Limiting global warming to 1.5°C compared to 2°C is projected to lower the impacts on terrestrial, freshwater and coastal ecosystems and to retain more of their services to humans (high confidence)’. It adds, ‘There is high confidence that the probability of a sea ice-free Arctic Ocean during summer is substantially lower at global warming of 1.5°C when compared to 2°C’ although ‘Sea level rise will continue beyond 2100 even if global warming is limited to 1.5°C in the 21st century (high confidence)’.

In terms of response measures to the above challenges, the report states ‘Pathways limiting global warming to 1.5°C with no or limited overshoot would require rapid and far-reaching transitions in energy, land, urban and infrastructure (including transport and buildings), and industrial systems (high confidence). These systems transitions are unprecedented in terms of scale, but not necessarily in terms of speed, and imply deep emissions reductions in all sectors, a wide portfolio of mitigation options and a significant upscaling of investments in those options (medium confidence)’.

The report notes the significance of these actions from the perspective of economies, financial systems, human capacity and institutional constraints, specific regional characteristics, socio-economic issues, technology and societal acceptability. It also includes some options for how such transitions can be implemented (for example, by mobilisation of private funds by institutional investors) and likely costs for limiting global warming to 1.5 degrees: ‘around \$2.4 trillion between 2016 and 2035, representing about 2.5% of the world GDP (medium confidence)’.

The quotes above demonstrate the cautious approach taken by the IPCC when presenting findings; each one is qualified with a level of confidence and grounded in an evaluation of underlying evidence and agreement.

The IPCC findings from the special report have been fed into the current UN negotiations in Katowice, Poland, which are ongoing at the time of writing. The Katowice negotiations are also meant to develop further the framework for measuring and assessing action taken on climate change by countries. The tools for monitoring, reporting and verification used by the international climate regime have evolved over successive conferences and years. The job of developing these tools has a been a vast, complex and often contentious endeavour,

especially when it related to which countries should carry out what types of tracking, and for what purpose. Nevertheless, countries have generally come to recognise the key benefits of such tools in addressing climate change and substantive progress has been made in their development. In essence, these tools have two main functions: to provide transparency and confidence in the actions each country is taking, thereby addressing the challenges of collective action; and to provide decision-makers and implementers with the baselines and ongoing data that can be used to assess the effectiveness and impacts of climate activities. This information can be used to learn lessons and to refine actions and improve later efforts. In this vein, over recent years, there have been increasing attempts to introduce methodologies to track policy actions on mitigation and financial support.

However, a core activity in tracking and understanding the issue of climate change is the scientific and practical endeavour of greenhouse gas monitoring. Efforts to monitor these gases have been ongoing since the early days of discussions on the problem of climate change. The IPCC does not produce methodologies on monitoring policy activities or the financing of such activities, but it does, as noted above, provide guidance on greenhouse gas monitoring.

Next year will see the release of the ‘2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories’. The IPCC says the 2006 guidelines are methodologically sound, and therefore a fundamental revision is unnecessary. However, refinements are required to take into account scientific advances ‘that have matured sufficiently since 2006’. In particular, the IPCC has found that new data can be used to inform emissions factor development for certain categories and gases (emission factors are defined by the UN climate change agreements as ‘the average emission rate of a given greenhouse gas for a given source, relative to units of activity’). The IPCC believes such refinement ‘will help all UN Framework Convention on Climate Change Parties use good practice inventory methodologies based on up-to-date scientific knowledge’. Ultimately, having better data means better decisions can be made on how to deal with the challenge of climate change in the most effective, efficient and fair way.

Update on the Group of Governmental Experts on nuclear disarmament verification

Noel Stott

Following the adoption of UN General Assembly Resolution 71/67 in December 2016 (with the support of 177 states), the UN Secretary-General established a Group of Governmental Experts (GGE) to consider the role of verification in advancing nuclear disarmament. The UN Secretary-General selected 25 governmental experts from the following countries on the basis of geographical distribution: Algeria, Argentina, Chile, China, Finland, France, Germany, Hungary, India, Indonesia, Japan, Kazakhstan, Mexico, Morocco, Netherlands, Nigeria, Norway (Chair), Pakistan, Poland, Russia, South Africa, Switzerland, United Kingdom and the United States.

Under operational paragraph six of resolution 71/67 all UN member states were also invited to submit their views on ‘the development and strengthening of practical and effective nuclear disarmament verification measures and on the importance of such measures in achieving and maintaining a world without nuclear weapons’. Many have done so—as discussed below. To date, the GGE has met in Geneva for two five-day sessions—in May 2018 and November 2018—and another session is earmarked for 2019.

Typically, a GGE’s discussions and debates are confidential until a final report is submitted to the General Assembly. In this case, however, the GGE chairperson—Norway—has provided progress reports to UN member states, including in August 2018 to the Conference of Disarmament’s Subsidiary Body I and during the General Assembly’s (UNGA) First Committee on Disarmament and International Security meeting on 18 October 2018. Briefings were also held within the context of the 1968 Treaty on the Non-Proliferation of Nuclear Weapons (NPT) review cycle. In addition, an informal workshop was held at Wilton Park in January 2018 to discuss nuclear disarmament verification in general and to draw to the attention of group members issues that the GGE might want to discuss. A report of this workshop is available on Wilton Park’s website. Another informal meeting of the Group at Wilton Park is planned for January 2019. This article provides an update on these developments.

Overview of submissions pursuant to UNGA Resolution 71/67

The submissions received as at 31 July 2017 are available on the website of the UN Office for Disarmament Affairs (UNODA). Additional suggestions received after this date were also posted on the website but only in the language of submission. All 28 submissions, including one by the European Union, are also contained in a report by the UN Secretary-General, ‘Nuclear disarmament verification’ (A/72/304).

These documents indicate the willingness and current capacity of those states to participate in verification research activities, their experience, as well as the resources and facilities that they could make available in the future. Many of the submissions recognise the role that effective verification measures can play in enhancing transparency and mutual trust, especially when identified and developed collectively. Others stress the need to take into account non-proliferation obligations, while at the same time, emphasizing the importance of broadening the availability of specialised skills for nuclear disarmament verification.

Most of the submissions underscore the need to draw on the theoretical research, practical activities and facilities of relevant initiatives and entities, both past and present. Some of these initiatives have specifically sought to construct a robust and credible international verification regime while others offer valuable insights for future endeavours.

Previous and current initiatives mentioned include inter alia the Quad Nuclear Verification Partnership; the US-UK technical cooperation for arms control; the Trilateral Initiative between the United States, the Russian Federation, and the International Atomic Energy Agency; the International Partnership for Nuclear Disarmament Verification (IPNDV); the European Atomic Energy Community (EURATOM); Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC); the European Safeguards Research and Development Association (ESARDA); and the work recently undertaken by the High-Level Fissile Material Cut-off Treaty Expert Preparatory Group. A number of the submissions also mention existing UN disarmament machinery as a viable approach for taking forward disarmament verification.

Some states, including the United States, France and Aus-

tralia, recognise that the current global situation does not appear to allow for further reductions in nuclear weapon arsenals in the short term, nor comprehensive nuclear disarmament negotiations in the foreseeable future. They nonetheless argue in their submissions that the current strategic context presents an opportunity to undertake long-term collective research into innovative solutions to the complex challenges associated with the verification of treaties that may be agreed to, and implemented, in the future. Many of the submissions allude to potential research activities that could eventually lead to the development of practical and effective multilateral nuclear disarmament verification measures designed to be acceptable to all.

Collective research identified as crucial, ranges from academic (theoretical) studies to technical and practical experiments that are solution orientated. These include inter alia: whether or not current safeguards measures would be sufficient to provide the confidence necessary to maintain a world without nuclear weapons when applied to all states; systems to detect non-compliant behaviour; the feasibility and effectiveness of different verification measures; the potential future role of the International Atomic Energy Agency (IAEA); technological information barriers and technology authentication procedures; technologies that address security, safety and non-proliferation challenges when one or more nuclear-armed and non-nuclear armed states are involved; material production and control, warhead storage, dismantlement and disposition; and surveillance technologies, sealing systems, environmental sampling, nuclear measurement equipment, geospatial information analysis, statistical methodologies and sample planning.

Other states are more cautious. While, for example, China and the Netherlands, recognise the importance of research activities (such as those listed above), they point out that the aim of such research should not be to develop a universal verification model given that there are different phases of nuclear disarmament—from reductions to the complete global elimination of nuclear weapons. Research would thus need to take into account different disarmament scenarios. In addition, and importantly, such work should not prejudge the nature and scope of any eventual nuclear disarmament instrument, including the verification elements specific to that instrument—or as argued by Pakistan, ‘verification can be best addressed in the context of a specific treaty regime as

opposed to [in] a generic and abstract manner’.

Overview of the GGE discussions

The first GGE session in May 2018 examined the Group’s goals and scope, and exchanged views on how verification could contribute to achieving and maintaining a world without nuclear weapons. The Group also interrogated principles for nuclear disarmament verification and in particular considered the relevance today of the list of 16 principles for verification identified by the UN Disarmament Commission in 1988. Other past and present verification mechanisms, initiatives and technical exercises reviewed included those undertaken by ABACC, the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organisation (CTBTO), the IAEA’s safeguards system, the verification regime of the Chemical Weapons Convention implemented by the Organisation for the Prohibition of Chemical Weapons (OPCW), and those under the Strategic Arms Reduction Treaty—the nuclear arms reduction treaty between the United States and the Russian Federation (New START). Presentations were also received on the UK-Norway Initiative, the QUAD Nuclear Verification Partnership and the IPNDV.

Importantly, the interrelationship between verifiability, transparency and irreversibility was debated. Also noteworthy was the affirmation that while practical work on nuclear disarmament verification can offer valuable input and ‘prepare the ground’ for future treaties, ultimately verification arrangements would have to be germane to a specific treaty’s obligations. On the role of non-nuclear weapons states, most members of the GGE stressed the importance of their involvement in fostering an inclusive process and their ability to offer valuable insights given their experiences in implementing IAEA safeguards. However, others argued that only parties to the treaty concerned should be given a role in its verification.

During this first session, the chairperson encouraged GGE members to submit working papers and also tabled his own non-paper sketching out capacities for nuclear disarmament verification. A number of such papers were drafted by members and distributed to the group as a whole. They focussed on the ‘what’ (what could constitute effective and adequate nuclear disarmament verification?); the ‘how’ (to what extent can lessons be drawn from past experiences?); and the ‘who’ (who should carry out verification and how should it be or-

ganised?). These papers were discussed during the second session in November. The second session also went into more detail of what is understood as constituting verification, including definitions and principles.

Next steps

It is likely that the third and last session of the GGE will be held in April 2019, before the third preparatory meeting of the NPT in New York from 29 April-10 May 2019. It will aim to produce a consensus report, to be presented to the UNGA seventy-second session, under the item entitled 'General and complete disarmament'.

Thus, there are several months to go before the Group reaches a conclusion and the path forward becomes clearer. An outcome that contains the following elements could provide a strong basis for the further development of innovative, inclusive and robust verification approaches: an affirmation of the need for the further development by states collectively and individually of nuclear disarmament verification concepts, methodologies and techniques; that the United Nations itself and its associated organisations have an important role to play as does civil society; and that there is a need for on-going and increased co-operation and co-ordination of research into such methodologies at the national, regional and multilateral levels.

While nuclear-armed states have a primary responsibility for nuclear disarmament, the need to continue the pursuit of scientifically valid verification methodologies in a systematic and participative manner also requires the inclusion of states without nuclear weapons. In other words, all states have a stake in developing irreversible, transparent and verifiable measures and ultimately in ensuring the maintenance of a world without nuclear weapons. This can only be achieved through initiatives that involve both states and non-states in an atmosphere conducive to dialogue, consultation and capacity-building. The GGE established under UN General Assembly Resolution 71/67 is a worthwhile starting point.

Strengthening the effectiveness and improving the efficiency of IAEA safeguards

Noel Stott

On 21 September 2018, the 62nd regular session of the International Atomic Energy Agency (IAEA) General Conference concluded with a variety of resolutions adopted to further strengthen the IAEA's work in the areas of nuclear science and technology, safety, security, safeguards and technical cooperation. The General Conference, which takes place annually, drew more than 2,500 participants, including delegates from 153 of the 170 IAEA Member States, as well as other international organisations, non-governmental organisations and the media.

The 2018 resolution on strengthening the effectiveness and improving the efficiency of safeguards

While most states agree that the effective implementation of the IAEA's safeguards system is central to the nuclear non-proliferation regime and the enhancement of international peace and security, the text of the annual resolution has often been contentious. This year was no different, although the discussion was perhaps overshadowed by two other events: the efforts being made to denuclearise the Korean Peninsula and the withdrawal of the United States in May 2018 from the Joint Comprehensive Plan of Action (JCPOA).

The safeguards debate often centres on whether a Comprehensive Safeguards Agreement (CSA) together with an Additional Protocol (AP) should be considered the international gold standard of safeguards for all non-nuclear armed States Parties to the 1968 Treaty on the Non-Proliferation of Nuclear Weapons (NPT), and how transparent and inclusive the process of strengthening this system ought to be.

In addition, and in some senses more importantly, differences of opinion continue to be expressed regarding the implementation of state-level safeguards approaches by the IAEA. Under the State-level concept (SLC), the IAEA has evolved from implementing the exact same safeguards measures at a particular type of facility in all states, to an approach known as the 'State Level Approach (SLA)'.

Each SLA is designed specifically for a particular state based on factors such as its nuclear fuel cycle activities and capabilities, its system for accounting and control of nuclear

material and its safeguards agreement with the IAEA.

Some states, including the Russian Federation, question the IAEA's application of the SLC, and in particular, its use of information not directly acquired through safeguards activities. Their worry is that the IAEA Secretariat may have shifted from nuclear material accountancy to assessments based on other sources, including intelligence. These states are concerned that false or politically motivated information could be deliberately fed to the IAEA in this process. Accordingly, the use of such sources has the potential to call into question the objective and non-political nature of the IAEA oversight mechanism.

Other states believe that the use of 'external' information sources is consistent with the IAEA Statute and if a state has information that could indicate an NPT violation, it has a responsibility to other States Parties to inform the Agency. In addition, these states are generally open to all forms of enhanced information gathering and analytical capabilities and technologies that improve the IAEA safeguards system, given that these safeguards are a fundamental component of the nuclear non-proliferation regime.

The above concerns remain despite the tabling by the IAEA Director General of a supplementary explanatory document (Supplementary Document to the Report on the Conceptualization and Development of Safeguards Implementation at the State Level (GOV/2014/41)) and his assurance at the September 2014 Board of Governor's meeting that the SLC would not entail the introduction of any additional rights or obligations on member states or the IAEA, and would only be applied strictly within the scope of each state's IAEA safeguards agreement.

In an attempt to further clarify the situation, the resolution as adopted on 21 September 2018 on 'Strengthening the Effectiveness and Improving the Efficiency of Agency Safeguards', states clearly that the SLC is neither a substitute for the Additional Protocol nor a way for the IAEA to obtain the information and access provided for in an Additional Protocol from a state without one.

It also makes clear that safeguards-relevant information is to be 'only used for the purpose of safeguards implementation pursuant to the safeguards agreement in force with a particular State – and not beyond it'.

The resolution further notes the Director General's report to the Board of Governors in September 2018 on the experience gained and lessons learned in the implementation of state-level safeguards approaches for states under integrated safeguards. Importantly, however the resolution, requests the Director General, to take into account 'questions and issues raised by some Member States, [and] to keep the Board of Governors fully informed through additional timely reports for discussion by Member States'.

Implementation Watch

US sanctions against Iran before the International Court of Justice

Sonia Drobysz

On 3 October 2018 the International Court of Justice (ICJ) ordered the United States to ease sanctions it had re-imposed on Iran after withdrawing from the 2015 Joint Comprehensive Plan of Action (JCPOA) on the 8 May. The judges did not request the United States to lift all of the 8 May sanctions, but to remove any resulting impediments to the free exportation to the territory of Iran of goods and/or services required for humanitarian needs and the safety of civil aviation.

Iran submitted the application to the ICJ against the United States on 16 July 2018, bringing the Iranian nuclear issue into the realm of the principal judicial organ of the United Nations for the first time. The re-imposed US sanctions and restrictive measures targeting, directly or indirectly, Iran, Iranian companies and/or Iranian nationals had previously been lifted under the 2015 JCPOA, which was adopted by a group of States, including the US and Iran, and provides for reciprocal commitments to ensure the exclusively peaceful nature of Iran's nuclear programme.

Iran's claims were not based on multilateral instruments such as the JCPOA or UN Security Council (UNSC) Resolution 2231, which endorses the JCPOA, urges its full implementation, and decides on the mechanism to terminate the provisions of previous UNSC resolutions imposing sanctions on Iran. Rather, the Islamic Republic contended that the United States had, as a result of the 8 May decision, breached multiple obligations under the Treaty of Amity, Economic Relations, and Consular Rights concluded between Iran and the US in 1955 and entered into force in 1957. To protect its rights under the treaty until the Court's final decision on the merits of the case, Iran simultaneously requested the ICJ to indicate a series of provisional measures addressed to the United States, including the immediate suspension of the implementation and enforcement of all of the 8 May sanctions. The 1955 bilateral treaty was invoked by Iran as the sole legal basis for the dispute. Its purported violation is also the object of a separate case before the Court, which concerns a

series of US legislative, executive and judicial acts taken throughout 2016 against Iranian assets within US territory in response to Iran's alleged sponsorship of terrorism.

During the oral proceedings on provisional measures, the US denounced Iran's 'legal manoeuvring' and argued that the nuclear sanctions case did not concern the interpretation or application of the Treaty of Amity but was, notwithstanding Iran's declared legal stance, exclusively related to the JCPOA. Since the plan of action provides for a specific political dispute settlement mechanism excluding resort to the ICJ, the United States contested the court's jurisdiction. The US legal counsels also disputed the plausibility of Iran's claims under the treaty and explained how the measures Iran sought would irreparably prejudice the United States; how provisional measures were not required to avoid irreparable prejudice to Iran; and how those measures would amount to an interim judgment on the merits of the case.

In the 3 October order, the Court considered that the JCPOA's dispute settlement mechanism did not exclude the applicability of the Treaty of Amity's mechanism with respect to measures falling within the treaty's material scope; and confirmed its *prima facie*—i.e. not definitive as regards the merits of the case—jurisdiction under the treaty. Noting the ongoing impact of the US sanctions on a number of Iranian activities with 'little prospect for improvement', the Court recognised the real and imminent risk that irreparable prejudice could be caused to Iran's rights and unanimously decided to indicate the limited provisional measures noted above.

The decision raises a number of legal and political issues related in particular to the background to the case, the Court's reasoning, the consequences of the decision, including the US reaction, and the extent to which the JCPOA and UNSCR 2231 are relevant and applicable. Such issues have been discussed in greater details by others including the Court's judges and will deserve further consideration by the ICJ during the merits phase. The latter should not be affected by the 3 October decision by the United States to terminate the Treaty of Amity, which will take effect in a year.

Error in US biological weapons law leads to dropping of criminal charges

Yasemin Balci

On 2 February 2017, a man visited a hospital in Fannin County, Georgia in the United States, worried that he had exposed himself to ricin, a toxin that is naturally found in castor beans and for which there is no antidote. When law enforcement officers arrived, they found a bottle in his car that tested positive for this toxin.

The man, known to be a member of a white supremacist group, was charged with violating section 175b(c) of Title 18 of the United States Code (18 USC 175b(c)). This section makes it a federal crime to possess a biological agent or toxin that is a 'select agent' without having registered with the Secretary of Health and Human Services. The defendant did not have the required registration.

However, the defendant's lawyers argued that the charges should be dismissed, as section 18 USC 175b(c) only referred to the select agents in a federal regulation titled 42 CFR 73.4, which did not list ricin. Ricin only appeared in the full list of select agents in 42 CFR 73.3. The prosecution admitted that this was a legislative error, but insisted that 'Congress intended to criminalise the unregistered possession of ricin, and to conclude otherwise would lead to absurd results'.

The District Court judge sided with the defendant's literal interpretation. While the legislative history of 18 USC 175b(c) might show that Congress intended to criminalise the unregistered possession of ricin, the language of 18 USC 175b(c) clearly excluded ricin. According to the judge, it was not for the Court to rectify this legislative error, but for Congress. He noted that Congress had had ample time to do so, with 14 years having passed since the last amendment to that regulation.

This case highlights how challenging yet crucial it is to draft watertight legislation in order to secure convictions of those that misuse biological agents and toxins—and not just in the United States, but all States Parties to the Biological and Toxin Weapons Convention. As noted by the Fannin County sheriff, 'we have some legislative work to do'.

Homemade Chemical Weapon Used in Louisiana

Cedric Aperce

On 24 September 2018, the United States District Court for the Western District of Louisiana sentenced a 24-year-old soldier to 135 months in prison and 5 years of supervised release for manufacturing, possessing and detonating a chemical weapon. The case raises important questions on controlling toxic chemicals and the safety of first responders to chemical weapon incidents. Fellow soldiers had caught the defendant filming the explosion of a plastic container emanating smoke and a 'bleach-like' odour in the Kisatchie National Forest on 12 April 2017. The military investigation team noticed a brown semi-circular area of deadened vegetation at the site. Collected rock samples burst the plastic bag in which they were placed and an unknown substance started melting the latex gloves used by the investigators. A Hazardous Materials team was rapidly dispatched to decontaminate the scene and treat the initial investigators for breathing difficulties and skin burns.

Questions arise as to how the defendant freely obtained the main chemical component of his weapon: chlorine—a toxic chemical used in commerce and industry, but with potential chemical weapons applications. Such toxic chemicals are inherently difficult to monitor and verify due to their dual-use character. The United States implements the Chemical Weapons Convention (CWC) in its national legislation, but since chlorine is not a scheduled chemical under the Convention (and, as a consequence, under US legislation), it is not subject to the verification measures foreseen by Article VI of the CWC. However, under the CWC's 'general purpose criterion', toxic chemicals like chlorine are considered chemical weapons except where intended for purposes not prohibited under the Convention, 'as long as types and quantities are consistent with such purposes'. Another takeaway from this case is the difficulty of safeguarding first responders to chemical weapon incidents. Several investigators were affected by chemical residues—including one who endured permanent injuries resulting in medical discharge from the military—despite the involvement of several local and federal agencies, and the deployment of a specialised hazardous materials team.

This article is abridged, an additional paragraph appears in the ebook version of Trust & Verify. - Editorial team.

Compliance Watch

UK financial sanctions watchdog publishes first annual review (abridged)

Christina Rotaru

The UK's Office of Financial Sanctions Implementation (OFSI) published its first annual review in October. The OFSI was set up in March 2016 as part of the Treasury Department to ensure that financial sanctions are properly understood, implemented and enforced in the United Kingdom. It provides relevant information and guidance to businesses, issues licences and investigates breaches of financial sanctions. The review covered OFSI's activities in the financial year 2017-18 and noted its future priorities, and included the following key points:

The UK remains committed to ensuring that sanctions remain a 'robust, proportionate, and effective' foreign policy tool—a situation that is expected to continue after the UK leaves the EU as part of the 'deep partnership' proposed by the UK on foreign policy and national security.

In 2017-18, the UK implemented 29 financial sanctions regimes for reasons including preventing terrorist financing, preventing nuclear proliferation, human rights abuses and the violation of national sovereignty, as well as the misappropriation of assets. As of 3 April 2018, 2,077 people and entities were targets in 26 financial sanctions regimes and appeared on OFSI's Consolidated List. 122 of those were added to the list during the 2017-18 financial year, primarily in the regimes applied to North Korea and the Islamic State (also called ISIL, ISIS or Daesh). In 2017-18, the UK brought in 'avoidance of delay' provisions for UN sanctions as part of the Policing and Crime Act 2017. These provisions allow the UK to implement new UN sanctions regimes and listings immediately after the relevant resolution has been adopted. OFSI has since implemented 18 such listings.

A new regime was also created for Burma in response to widespread human rights violations by its military and security forces, with the first financial sanctions listings added in June 2018. Under the Terrorist Asset Freezing etc. Act 2010, OFSI reports to Parliament quarterly on its operation of the UK's asset freezing regime. In January 2018, the Treasury made

a new order under the Anti-Terrorism, Crime and Security Act 2001 (The Andrey Lugovoy and Dmitri Kovtun Freezing Order 2018), which extended an asset freeze against two Russians accused of carrying out the 2006 killing in London of former Federal Security Service officer Aleksandr Litvinenko. As of September 2017, £12.8 billion of frozen funds were held by UK businesses, excluding the value of other frozen assets and 16 UK properties subject to an asset freeze. The regime with the highest value of frozen assets was Libya (£12,061,000,000), followed by Iran (nuclear proliferation) (£502,500,000), Syria (£161,100,000), Egypt (£24,400,000), Ukraine (Sovereignty) (£18,200,000) and Others (£9,200,000).

In 2017-18 OFSI received a total of 122 reports of suspected breaches of financial sanctions, with a reported value of around £1.35 billion. While OFSI can impose monetary penalties for serious breaches, such powers apply only to offences that occurred after 1 April 2017 (when the law was introduced). No penalties were imposed in 2017-18 but a number of cases are under investigation where a penalty may be appropriate. OFSI anticipates imposing such monetary penalties in 2018-19, although the majority of cases will continue to be resolved by enforcement activity short of a penalty. In August 2017, OFSI extended the scope of the reporting obligation from 'relevant institutions' to 'relevant businesses and professions'. The Sanctions and Anti-Money Laundering Act 2018 provides the framework for these reporting requirements and offences, which will continue once the UK leaves the EU.

OFSI licences and authorisations enable individuals and businesses to carry out permissible transactions—such as meeting basic needs, humanitarian aid and payment of legal fees—that would otherwise be against the law. OFSI issued over 50 new licences in 2017-18, the majority of which were for payment of legal fees, and nearly 100 amendments. The most licenses issued were for Libya (15), Egypt (13), Others (13), and Ukraine (Misappropriation) (10). Three authorisations and five amendments to authorisations were also issued over the same period. With its publication of the FAQs Guidance for the Charity Sector in October 2017, OFSI remains committed to working closely in 2018-19 with the charity sector and the Department for International Development

to raise awareness of the potential availability of licences and authorisations on humanitarian grounds.

Over the last financial year, as part of its awareness raising activities, OFSI engaged with high-priority sectors—financial services, NGOs, export and import and legal—and had first contact with new sectors to improve industry compliance. OFSI representatives spoke at over 60 public events over this period in the UK, the United States and Europe, and engaged with partners multilaterally through the EU, UN, G7, OECD and the E3 (UK, France and Germany), and bilaterally with the Crown Dependencies, the Overseas Territories, EU member states and other partners. Several guidance documents were issued during the year and digital communications were also enhanced with OFSI making significant contributions to subscribers via its alert system, and through its blog and LinkedIn page.

Standard Chartered Faces \$1.5bn fine for Iran sanctions violations

Christina Rotaru

The British multinational banking and financial services company Standard Chartered may face a new fine of up to \$1.5bn from the US Department of Justice (DOJ) for allegedly enabling customers to breach US sanctions against Iran.

The investigation into Standard Chartered has focused on allegations that it permitted clients with Iranian interests to conduct US dollar transactions through Standard Chartered Bank after 2007, despite US sanctions against Iran prohibiting it from doing so. In 2012, Standard Chartered paid the DoJ \$667m for violating those sanctions and entered into a deferred prosecution agreement (DPA) with US regulators to avoid criminal charges. In the previous investigation, the bank was found to have helped customers to circumvent the sanctions by changing banking codes, replacing references to sanctioned entities in payment messages and deleting payment data. The initial DPA reached with US regulators and the term of an independent monitor appointed to oversee the bank's effort to improve compliance have since been extended three times and are now set to expire at the end of 2018.

US authorities are presently looking into whether the bank continued to breach sanctions by processing US dollar transactions for Iran-controlled entities even after the DPA was signed. The new charges concern whether Standard Chartered permitted Iranian customers to move money through Dubai, and the extent to which any such activities were shared with relevant US authorities in 2012. If Standard Chartered is found to have breached its DPA, the bank could face further fines and a criminal prosecution.

According to a Standard Chartered spokesperson the bank is fully cooperating with the investigation, which the DOJ is conducting with other agencies, including the Manhattan District Attorney and the New York Department of Financial Services. The investigation is expected to be resolved by the end of 2018.

Standard Chartered is not the only European financial institution to be penalised for breaching US extraterritorial sanctions. In 2014, French bank BNP Paribas paid a record \$9bn fine, while Germany's Commerzbank signed a £1.45bn settlement with the US regulator in 2015.

DPRK Sanctions Evasion Tactics at Sea Continue

Cristina Rotaru

Despite the recent thaw in relations between Washington and Pyongyang, North Korea appears to be continuing to exploit weaknesses in global shipping registries to facilitate illicit maritime activities. Because roughly 90 per cent of world trade is seaborne, such illegal behaviour poses major reputational business risks to flag States, as well as additional financial and security-related costs associated with non-compliance under relevant UN Security Council sanctions. Open registries, in particular, face frequent exploitation, since North Korean-controlled vessels often use so-called flags of convenience to mask inconvenient ties (see *Trust & Verify* No.161). Ships may also engage in 'flag-hopping'—the frequent change of flag to obfuscate ties to North Korea—making it difficult for national authorities to keep track of their activities.

This is a preview. The full version of this article continues in the ebook version of Trust & Verify. Apologies - Editorial team.

Science & Technology Scan

'Hardware Hack' allegations highlight risks with global technology supply chain

Alberto Muti

Allegations of a high-profile hack by China on server motherboards intended for the US market emerged in October 2018. While details of the attack are still vague and contested, if confirmed, it could potentially grant China deep and long-term access to data and server operations used by a range of high-profile US companies, including Amazon (which builds and operates data centres for the US Government, including intelligence agencies) and Apple, as well as banks and US government contractors. This adds to ongoing security concerns about Chinese manufacturers Huawei and ZTE, which is also part of a wider US-China trade dispute. These latest allegations highlight the trust and verification issues inherent in the global supply chain for components of technological equipment and IT infrastructure.

The allegations centre on claims that a small microchip has been added to Super Micro Computer (Supermicro) motherboards manufactured in China. Disguised as a different kind of electric component, the chip would be able to interface with the 'baseboard management controllers'—the piece of hardware that administrators can use to remotely control individual servers, even during a computer crash or shutdown, to inject malicious code into the server's code. The chip would also be able to 'call home', contacting remote servers abroad that would send additional instructions to the now-compromised server, or extract information when needed. This kind of hack could potentially provide the perpetrators with hidden, long-term and deep access to operations: they could exfiltrate data, including encryption keys, circumvent software security measures and tamper with software run on the machine. The original article describing the attack claims that it was carried out by China's People's Liberation Army between 2014 and 2015 with the aim of targeting high-value corporate secrets and national security data.

Third-party investigators hired by Amazon as due diligence prior to the acquisition of a company specialising in the processing and compression of video files found the secret chips installed on the company's servers, triggering a US

Government investigation. The hacked motherboards were manufactured in China for a leading US-based company, whose products can be found on many industrial servers worldwide. Apple and Amazon, as well as the US Department of Homeland Security and the UK's General Communications Headquarters, have all rebutted the allegations. Indeed, all parties explicitly named in the article have denied being victim of hardware manipulation.

The cybersecurity community is divided by the story, with some experts casting doubt on its veracity, especially because of a lack of independent verification and reporting on the matter. For example, no pictures of the manipulated motherboards or samples of code and data from the 'secret' microchip have been made public on the web, contrary to normal practice in the cybersecurity community. Other experts noted that the described method of attack was credible and consistent with known state-led cyber-espionage. Cybersecurity researcher Nicholas Weaver, writing for *Lawfare* described the article as a 'sobering wake-up call' regardless of whether the specific story is true.

Concerns about hardware integrity are not new. A wide range of possible approaches for hardware manipulation have been identified that target computers, servers and smartphones, some of which are significantly easier to implement than the alleged hack that hit Amazon, Apple and others. This is a particularly sensitive issue given the globally distributed supply chain for hardware. Even when products are designed and engineered in Europe or the United States, components are mainly manufactured in China and Southeast Asia. It is estimated that China alone makes 75 per cent of the world's mobile phones and 90 per cent of its personal computers.

Moving the manufacture of such components back 'in-house' is thought to be unfeasible, not least because of the impact on the price of technological goods, which would increase considerably. Thus, governments apparently have little option but to place their trust in components manufactured abroad, including in countries with whom they do not necessarily share tight security relationships. Furthermore, the supply chain extends to cover software development, assembly of goods, and shipment, and each of these steps may be com-

promised.

According to international cyber security expert Bruce Schneier, “We can’t trust anyone, yet we have no choice but to trust everyone”. Trust in the presence of risk has historically been a lynchpin of international arms control efforts, some of which have come with innovative approaches to solve logistically and technologically complex verification challenges. The breadth of the global supply chain would certainly make it extremely difficult to introduce global monitoring systems as extensive as those devised for the nuclear or chemical industries. Nonetheless, future efforts aiming at mitigating this supply chain problem may look at arms control for principles and lessons learned.

Measuring explosives in nuclear weapons

Andreas Persbo

Research efforts on ways to verify the dismantlement of nuclear explosive devices often focus on measuring the fissile material pit residing in the centre of the weapon. How to get access to this metal and under what conditions they can be measured are the subject of continuing research and debate. However, what if the non-nuclear components could be measured instead?

This is precisely what four Chinese scientists—Huang Meng, Zhu Jianyu, Wu Jun and Li Rui—proposed in a recent paper, ‘Determining Age of High-Explosive to Support Nuclear Warhead Dismantlement Verification’ in the journal *Applied Radiation and Isotopes*. The idea is simple: to measure chemical explosives that are removed during dismantlement. As the explosives stay close to a source of radiation, they will react and form nuclei. These new nuclei will be more abundant the longer the chemicals remain near the pit. The researchers found that Carbon-14, sometimes referred to as radiocarbon, was the most promising nuclei to measure to determine the source of the explosive. Radiocarbon dating is a standard scientific technique used to determine the age of materials and objects found in nature.

The researchers found that the abundance of radiocarbon in explosives surrounding plutonium pits is higher than that observed near uranium pits. While not surprising, given that plutonium is much more active than uranium, this means that explosives coming from these type of weapons are more

difficult to measure. The authors also highlight that it may be possible to derive the mass of fissionable material when using this method, and so recommended the application of some ‘information barrier’ on the measurement.

The research is not based on the measurement of real explosives, but instead used a simulation: a Chinese-developed Monte Carlo neutron-photon transport code called the JMCT. If this measuring approach is deemed useful, the simulation will need to be validated by live measurements.

More information: Huang Meng, Zhu Jianyu, Wu Jun and Li Rui, Determining Age of High-Explosive to Support Nuclear Warhead Dismantlement Verification, *Applied Radiation and Isotopes*, <https://doi.org/10.1016/j.apradiso.2018.10.010>

Timely monitoring of ships using Copernicus

Andreas Persbo

The accessibility of free satellite imagery has spawned a wealth of new monitoring initiatives. A recent paper by Urša Kanjir, a guest researcher with the Institute of Anthropological and Spatial Studies in Slovenia, proposes using Sentinel-2 data to track migrant vessels in the Mediterranean Sea. In a well-argued submission, she describes the process in which freely available imagery can be used to monitor ships in a ‘timely and consistent manner’.

The Sentinel-2 mission consists of two satellites, 2A and 2B, which were launched by the European Space Agency in 2015 and 2017, respectively, as part of the EU’s earth observation programme, Copernicus. Intended for use in areas such as forest monitoring and natural disaster management, the satellites operate in 13 spectral bands, from visible to short-wave infrared, with a 10, 20 and 60-metre spatial resolution. Data is free to access and use, and is refreshed several times a day.

This is a preview. The full version of this article continues in the ebook version of Trust & Verify. Apologies - Editorial team.

Centre News

National Implementation

Programme staff

Since July, our National Implementation Measures (NIM) team has been working across projects to foster implementation of chemical, biological, radiological and nuclear (CBRN) international instruments.

The programme's expertise in the implementation of the Biological Weapons Convention (BWC) brought us to Geneva for the 2018 BWC Meetings of Experts in August. Programme Director Sonia Drobysz spoke at a side-event on EU legislative assistance in BWC implementation, while Legal Officer Cédric Apercé presented on the different approaches to national implementation in a US-organised side-event. Mr Apercé also delivered the Joint NGO Statement on national implementation to the plenary meeting.

As part of our legislative assistance work on the implementation of UN Security Council Resolution 1540 (UNSCR 1540) and its strategic trade aspects, Senior Legal Officer Yasemin Balci participated in a capacity-building workshop on strategic trade control enforcement under the framework of UNSCR 1540 on the 20-22 August in Lusaka, Zambia.

On the 19-20 September, Mr Apercé attended the 2018 Stockholm Security Conference, which discussed the implications of emerging technologies on international security, and the appropriateness of arms control frameworks.

In early October, NIM staff facilitated a workshop in Casablanca, Morocco, on biosafety and biosecurity in Mali. This formed part of the 'National Biosafety & Biosecurity Implementation Measures in Mali' Phase II Project, funded by Global Affairs Canada and co-implemented with the International Federation of Biosafety Associations (IFBA) and the Malian Association for Biosafety and Biosecurity (MABB).

This quarter, the NIM team also continued implementing the legal work packages of EU CBRN CoE Project 61 on the management of chemicals in Southeast Asia, and Project 53 on strengthening biosafety and biosecurity in Central Asia.

We conducted legal research and analysis, participated in a regional workshop for Central Asian States Parties to the BWC on scientific and practical implementation issues, in Almaty, Kazakhstan, on the 23-24 October, and published our report on emergency response planning in Central Asia.

EU CBRN CoE Project 67 on CBRN waste management work in Southeast and Eastern Europe gathered all of its consortium members and partner countries together for its Kick-Off Meeting in Podgorica, Montenegro, on the 19-20 October. Ms Balci participated as the legislative non-key expert in this meeting, during which plans for project implementation were shared and discussed.

Verification and Monitoring

Programme staff

During this period, the programme completed its project on 'Strengthening the Open Skies Treaty: A Technical, Legal and Policy Analysis' supported by the US Department of State, while continuing its work on 'Examining technology and associated procedural needs for international bio-forensic investigations strengthening biological weapons investigations'.

In August, the programme began a three-year project on nuclear disarmament verification measures for the achievement and maintenance of a world without nuclear weapons. In addition to seeking to develop and strengthen such measures, the project will also consider how to take forward the work of the Group of Governmental Experts (GGE) established by UN General Assembly Resolution 71/67 to consider the role of verification in advancing nuclear disarmament, once it concludes its work in 2019. The project focuses on engaging with a group of non-nuclear weapon states on their potential involvement in international verification research activities. It is funded by the Norwegian Government.

Under this project, on 31 October, VERTIC, together with the United Nations Office for Disarmament Affairs (UNODA), held a seminar on capacity building for nuclear

disarmament verification during the UN General Assembly's First Committee on Disarmament and International Security meeting in New York. Speakers included: Ms Hana Cervenka, First Secretary of the Permanent Mission of Norway to the United Nations, Geneva; Mr Reto Wollenman, Deputy Head of Arms Control, Disarmament and Non-proliferation Section, Federal Department of Foreign Affairs, Switzerland; Mr Marcelo Camara: Head of the Division of Disarmament and Sensitive Technology, Ministry of External Relations, Brazil; and Ms Ingrid Kirsten, Senior Research Associate, Vienna Center for Disarmament and Non-Proliferation, Austria. The seminar was chaired by Mr Ioan Tudor, chief of UNODA's WMD Branch.

Building on our long-standing activities to strengthen and facilitate non-proliferation norms and controls globally, the programme, under a grant from the UK's Foreign and Commonwealth Office, hosted a training workshop on the implementation of IAEA Safeguards in the Uranium Mining Sector in Namibia. The training workshop covered the general topic of nuclear disarmament and non-proliferation and control of nuclear materials. Its particular focus was the key IAEA Safeguards reporting and inspection requirements that apply to uranium mines and related regulatory matters.

In November, Senior Researcher Alberto Muti travelled to Vienna to attend the 9th annual meeting of the Asia-Pacific Safeguards Network (APSN), where he discussed VERTIC's work with interested states. While in Vienna, Alberto also participated in the IAEA Symposium on International Safeguards, where he provided an overview of VERTIC's work on capacity building for safeguards implementation and Safeguards-Security-Safety (3S) integration. Team members also attended the 62nd Annual IAEA General Conference in September in Vienna. Later in the quarter, under the same work strand, Senior Researcher Noel Stott met with Malawi's Atomic Energy Regulatory Authority and other stakeholders to discuss options for building national awareness and capacity on safeguards implementation and uranium mining.

Alberto Muti and Larry MacFaul attended the Fourth Review Conference of the Chemical Weapons Convention in November and contributed to a side event organised by the Government of Sweden, on 'Support to States Parties' efforts to combat the threat of chemical terrorism'. Alberto presented the results of a recent VERTIC pilot study on the

IAEA experience of supporting international nuclear and radiological security efforts. The study reflects on how lessons learned in that context could be applied by the OPCW to support chemical security efforts worldwide and combat the threat of chemical terrorism. Other speakers on the issue of chemical security included the Swedish Ambassador, the Head of the Office of Strategy and Policy at OPCW and a representative from the Government of Kenya.

Finally, the team is happy to report that on 23 September the Director of the VM programme became the proud father of a baby girl. Fellow staff are excited to welcome their newest non-proliferation expert.

Special Projects

Programme staff

During this period we welcomed Cristina Rotaru, who joined the team as a Researcher on 10 July. With our team now at full strength, we pressed on with research concerning legal issues arising in sanctions implementation.

Angela participated in a workshop on North Korean maritime sanctions implementation, held in Suva, Fiji on 2-3 July, where she gave a presentation on states' obligations under the relevant UN Security Council resolutions.

Angela also participated in a public talk on the Treaty Prohibiting Nuclear Weapons, convened by the New Zealand Institute of International Affairs, at the University of Canterbury on 18 July, which Celeste Donovan also attended.

Finally, Angela met with officials from New Zealand's Ministry of Foreign Affairs and academics from Victoria University of Wellington, in Wellington on 1 August, before participating in a Public Advisory Committee on Disarmament and Arms Control meeting on 2 August. She spoke to the 'Women in Law' student group at the University of Canterbury on careers in public international law on 14 August.

Grants and administration

Central staff

On 12-13 November, VERTIC held its triennial Strategic Review with staff, trustees and advisors. We are grateful to all that attended this review, which will help chart the future direction of the organisation.

Several new projects have been started since the last edition of *Trust & Verify*: three within the Verification and Monitoring programme and one by the National Implementation Measures programme. The Swedish Ministry of Foreign Affairs is funding a study on lessons to be learned from the IAEA nuclear security regime when applied to chemical security; the Norwegian Ministry of Foreign Affairs is funding a three-year project on capacity building for nuclear disarmament verification; and Global Affairs Canada is funding a three or four-year project on verification solutions for North Korea. In addition, the United Nations is supporting our implementation work by funding two implementation actions in Lebanon and Nepal.

We are grateful to all our funders for their support for our work.

Finally, VERTIC also warmly welcomes Dr Ian Davis as the new assistant editor of *Trust & Verify*. Ian is the Executive Editor of the SIPRI Yearbook and an experienced human security and arms control consultant and writer.

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