Arming Ukraine and how to mitigate risks of illicit diversion of weapons and conflict escalation: a US perspective

Gabriela Iveliz Rosa Hernández

Since the beginning of Russia's invasion of Ukraine, the Biden administration has committed over $22 billion in security assistance to Ukraine in less than a year. The United States and its allies have rushed to provide Ukraine with the capability to defend itself, retake its territory from Russian forces, and secure it. Entering the 10 month of a war of attrition, there is little to suggest that Russia will cease attacking Ukraine or that either side will seek a negotiated settlement in the near future. As a result, the Biden administration and allied governments will likely continue to support Ukraine with further military supplies in the foreseeable future. "Our focus is on continuing to do what we've been doing, which is to make sure that Ukraine has in its hands what it needs to defend itself, what it needs to push back against the Russian aggression, to take back territory that's been seized from it since February 24th, to make sure as well that it has the support economically and on a humanitarian basis to withstand what's happening in the country

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every single day. That's our focus", said Secretary Anthony J. Blinken on 5 December. America's partners in Europe have pledged over $8 billion in terms of weapons and financial assistance for military purposes for Ukraine.

Yet, arming any country comes with serious risks that should not be ignored and need to be considered at various stages. First, the risk of *arms diversion* needs to be considered and mitigated. Arms diversion often refers to legal arms transfers being diverted to the illicit market. Tackling this risk will allow the United States, its partners, and the Ukrainian authorities to assure the international community that they are aware of the risks involved and that they are being proactive to counter them. Although there is little evidence to suggest that Western weapons are being diverted outside of Ukraine in the current phase of the conflict, there is a risk is that military equipment donated by the West or left behind by Russian forces might fall into the illicit trade after the conflict ends. The second main risk is that of *conflict escalation*. To avert a geographical expansion of the war, the United States and its allies have pursued a policy of restraint in delivering only certain military systems to assist Kyiv in taking back its territory. They have also placed limits on acceptable targets for the arms they provide, while also demanding assurances from Kyiv that these weapons will not be used to strike inside Russia itself. If the West is to continue its restrained and calculated approach when it comes to arming Ukraine, effective monitoring and verification may contribute to escalation management.

Diversion

In late October 2022, the United States released its strategy to counter the illicit diversion of certain advanced conventional weapons in Eastern Europe. The United States is the largest contributor of military assistance to Ukraine. While the strategy represents the first steps towards mitigating the risks of arms transfers to Ukraine, it mainly focuses on cross-border trafficking and not the transfer of weapons between the Ukrainian Ministry of Defence and non-affiliated defence units within Ukraine. The plan is tailored to the capture of US weapons by Russian forces which are at the greatest threat to be diverted according to the US State Department. Special attention is paid to MANPADS (Man-Portable-Air-Defence Systems) and ATGMs (Anti-Tank Guided Missiles) due to their lethality, portability and advanced technology.[1] In other words, the plan is concerned with protecting US technology rather than preventing the misuse of weapons—a situation that is common to US monitoring practices for security assistance.

US monitoring practices focus on a stockpile inventory approach.[2] The non-governmental group, Civilians in Conflict, has long voiced serious concerns with end-use-monitoring, a practice that deals with verifying the location of certain defence articles, assures that they are in control of the nominated receiver/user, and confirms their physical security. Laws to prevent the misuse of US military assistance to other countries do exist. The longstanding 'Leahy laws' apply to US military assistance to Ukraine. These laws prohibit the US Department of Defense (DoD) and State Department from providing military assistance when there is "credible information that a unit has committed gross human rights violations". Yet the application of the law relies on the credibility of both the source and the allegation itself. In the case of Ukraine, Kyiv and Washington signed an agreement in late 2021 that gave assurances that Ukraine would not transfer military assistance to any domestic military units that the US deemed as prohibited to receive such assistance through the Leahy laws. Thus, monitoring the use of these weapons was left to the government of Ukraine.

The US DoD end-use monitoring practices are largely designed for a peacetime environment, after all, inspectors verify where the weapons are located. In order, therefore, to deal with the specific situation in Ukraine, the following approach has been adopted. Since May 2022, the DoD's Inspector General has had to provide a report within 120 days, a report on end-use monitoring efforts within 45 days, and an unclassified report every 30 days detailing defence articles and services provided to Ukraine. These unclassified reports focus on the accountability of equipment. In September 2022, Congress allocated $2 million specifically for oversight tasks although the effectiveness of these initiatives are yet to be seen.

Currently, any checks on weapons in Ukraine occur through transfer points and in country-weapons depots, and normally involve tracking via serial numbers. However, due to safety issues, US inspectors have only been able to

perform two inspections since February. As a result, US and Ukrainian authorities are relying on COVID-era enhanced monitoring methods that employ scanner technologies to download inventory information remotely, supplemented by reporting by Ukrainian officials.

While it is in Ukraine's interest to be seen to be transparent in such monitoring practices, given its dependency on western military assistance, the US interagency plan is mostly based on trust and building the capacity of the Ukrainian Government. It also seems likely that the US authorities would be reluctant to halt or reduce military assistance to Ukraine simply due to the discovery of poor accounting practices, given that Ukraine is fighting against what the US and its partners believe to be a brutal war of aggression. The reality is that any decision to decrease support for Ukraine could deeply affect cohesion within NATO and would particularly face strong dissent from its northeastern flank. However, the US could employ other measures to help improve the situation short of sanctioning assistance.

Other issues with the interagency plan include a lack of focus on small arms and light weapons (SALWs), thousands of which have been transferred by the United States together with millions of rounds of ammunition. SALW represent a particular diversion risk since they are easily carried elsewhere. Yet perhaps the greatest threat for illicit weapons diversion may be Russian SALWs left behind in liberated territories by Russian forces after the conflict ends.[3] Accounting for Russian weapons left behind will require a higher level of coordination with the Organisation for Security Cooperation in Europe (OSCE), which can help improve the management of conventional ammunition stockpiles upon the request of a participating state.

As the war continues, it seems likely that joint US-Ukraine oversight initiatives will become more institutionalized. The newly released US National Defense Authorization Act (NDAA) requires that the DoD Inspector General, in conjunction with other organisations, to submit a report to Congressional authorities. This report will, among other things, specify whether or not there are any gaps in the oversight activities and funds for assistance to Ukraine, descriptions of any known incidents of misuse of assistance to Ukraine, and lessons learned from the oversight practices used in relation to Ukraine.[4] Congress should pay special attention to such reports and work with Ukrainian officials as they further implement new measures to improve their capacity to safely absorb these weapons deliveries. A shorter report could also be released to the public to further the involvement of civil society at both ends of the supply chain, i.e., in both Ukraine and the United States. Increasing US State Department funding for inspectors in Ukraine through supplemental assistance can also ensure further inspection of assistance shipments, depending on battlefield circumstances.

That is not to say that Ukrainian authorities have not already taken steps to seek to properly account for the military assistance provided to them. Once weapons enter Ukraine, the Ukrainian authorities track them using several databases, including a NATO logistics and account control system, while some weapons possess GPS trackers.[5] Foreign experts have also been invited to Ukraine as observers. Nonetheless, concerns about the issue from foreign partners prompted politicians and lawmakers in Ukraine to establish a special monitoring committee of their own: on the 19 July 2022, the Verkhovna Rada, the parliament of Ukraine, created a temporary oversight committee to track the use and receipt of arms transferred to their country by international partners.

These developments show that Ukraine is willing to work with partners to institutionalise the oversight initiative. Moreover, during the Ukrainian summer counter-offensive, Ukraine's Ministry of Defence announced that fighters from the territorial defence forces in the liberated regions were required to hand over their weapons to designated storage locations. In addition, in September, Ukraine's Security Service also neutralized a criminal group and seized a large arsenal of weapons including an ATGM.

There is no doubt that oversight practices in Ukraine face serious limitations due to the insecurity caused by the ongoing war. Yet the benefits to Ukraine of getting this right extend beyond the security implications of preventing the illicit circulation of arms in Ukrainian society. Transparency and verifiable oversight practices can also be tools against misinformation and contribute to Ukraine's post-conflict stability. Ukrainian civil society experts also have a key role to play in ensuring oversight and advising the Ukrainian Government via workshops, roundtables, and/or working groups on the security concerns regarding

weapons deliveries. Creating a space for Ukraine's vibrant civil society allows for a level of accountability that will result in a stronger Ukrainian state. This is precisely why ensuring oversight of military assistance should not become a partisan issue in the United States nor a political issue at the European level.

Mitigating escalation through monitoring

Much has been written about what escalation means and how the current conflict has the potential to expand geographically. For most commentators, the worst form of escalation would be something that leads NATO member states into a direct conflict with Russia. Such escalation concerns are at the forefront of President Joe Biden's approach to arming Ukraine. The implementation of this approach is essentially based on assurances, declarations and the verifiable modification of equipment. The key to mitigating escalation risks is continuing a restrained and calculated approach when arming Ukraine even with the uncertainty that may bring.

Currently, Washington perceives that the risk of escalation is so pervasive that the Biden administration has resisted pressure to send civilian inspectors too deeply into Ukraine. According to the Washington Post, American specialists conduct weapon inspections unarmed. This policy would need to be re-evaluated if inspectors were to be sent closer to the front lines. However, the Biden administration is concerned about the risk that Moscow would interpret armed inspectors as American involvement in the war.

In May, President Biden clarified in a *New York Times* op-ed that the United States would continue to arm Ukraine so that it could "be in the strongest possible position on the negotiating table" and be able to deter and defend itself against future aggression. The Biden administration also declared that it would neither encourage nor enable Ukraine to strike "beyond its borders". US government policy has been based on giving Ukraine the weapons that "are relevant for the current fight". Concurrently, US policy seeks to avoid the possible geographical expansion of the conflict. While the United States has provided an unprecedented amount of military assistance in a short amount of time, the assistance still falls short of Ukrainian requests. By late August, the focus of US security assistance packages became the medium-to-long-term needs of the Ukrainian military. This means that the assistance will take months or even years to be delivered to Ukraine.

Since the beginning of the conflict, despite claiming that it is involved in a proxy conflict with NATO (including deeming NATO-provided equipment as a viable military target), Russia has tried to establish red lines (for example, warning Washington not to supply longer-range missiles to Kyiv) and taken steps to avoid a direct war with NATO. In recent months, several military incidents with potential escalatory pathways have been effectively managed by all parties. In October, for example, the UK revealed that a Russian fighter jet had released a missile in the Black Sea in the near vicinity of an unarmed British spy plane, which had alerted Moscow of its flight path and unarmed status. UK Defence Minister Ben Wallace told the UK parliament that he had spoken to Russian Defence Minister Sergey Shoigu who investigated the incident and reported back that it had been a technical malfunction.

Overall, the US DoD is providing military assistance to Ukraine through two main authorities: the Ukraine Security Assistance (USAI) and the Presidential Drawdown Authority (PDA).[6] Through PDA, the DoD delivers equipment to Ukraine from its own inventories, while through USAI, the DoD procures equipment from the defence industry to provide Ukraine assistance. The goal of this latter programme is to provide standard systems to the Ukrainian military that are "easier to sustain and maintain". However, since procuring these systems could take years, the aim is to develop effective national defences to deter Russia in the longer term. Hence, the Biden administration's approach to arming Ukraine does not only focus on the present conflict, but also seeks to deter Russia from attacking Ukraine in the future.

The curious case of the HIMARS munition

In the initial periods of the war, the High Mobility Artillery Rocket System (HIMARS) was one of the top items on Ukraine's wish list. The HIMARS is considered a long-range precision-fire launcher that can typically provide an extended range behind enemy lines. Together with intelligence sharing, the HIMARS mobile launcher has boosted Ukraine's

ability to strike Russian ammunition depots and logistics hubs inside Ukraine. Although the delivery of the launcher itself was not a dilemma, the decision about what munition to send with it did provoke US concerns. What US officials were seeking to avoid was enabling Ukraine to strike deep into Russia.

Hence, to quell the risk of conflict escalation, the US set both limitations and verification measures. Ukraine was provided with Guided Multiple Launch Rocket System (GMLRS) munitions of six rounds that can strike up to 70 km, rather than longer-range Army Tactical Missile System (ATACM) munitions that can strike up to 300 km. More recently, the *Wall Street Journal* revealed that the United States also modified the HIMARS mobile launchers so they are unable to fire long-range missiles, should Kyiv choose to acquire them from another state or manages to produce them domestically. These verifiable modifications reveal a significant degree of restraint in consideration of conflict escalation and help dispel misinformation about US intentions. For instance, Ukraine's attack on the Saki airbase in Crimea in August that damaged Russian aircraft and ammunition stockpiles prompted multiple assumptions about clandestine US security assistance.

The limitations and verification aspects of the HIMARS mobile launcher and munitions are not only essential tools for implementing President Biden's policy of restraint when it comes to military assistance to Ukraine, but they also have deeply geopolitical implications. It could be argued, for example, that Ukraine could use ATACMs to only strike targets within Ukraine. And, indeed, in October, in its bid for new long-range rockets, Ukraine offered the United States a veto over striking inside Russia. Reportedly, the US has still not approved the request out of concern about how Moscow would react to the transfer.

The US asserts that the guided rockets it has delivered to Kyiv can reach most of the targets on the existing battlefield. "So, in terms of this capability, but again, with other capabilities as well, we're looking at what the battlefield needs are. And it's our assessment that with the existing GIMLRS capability that they have on the HIMARS and that we're providing more of . . . they can reach the vast majority of targets on the battlefield", said Deputy Assistant Secretary of Defense Laura K. Cooper on 4 October.

Assurances: What are they good for?

Declarations and assurances are useful tools when it comes to military assistance to Ukraine and should play a larger role in the future. Declassifying information in a strategic manner can also serve to weaken Russia's ability to use US arms transfers to Ukraine as a pretext or justification for further escalation. Since the beginning of the conflict, the United States has actively sought assurances from Ukraine that certain equipment would not be used to target mainland Russian territory. To date, the United States has maintained that Ukraine has abided by those assurances. Following Ukraine's attack on the Saki airbase, the DoD was quick to assert that no US weapons were used in the attack.

However, Ukraine's recent long-range attacks on Engels and Dyagilevo airbases, deep inside Russia and that host strategic bombers, raise question marks over those assurances—even though both Ukraine and the United States have been quick to assert that the attacks were not enabled by the United States. Prior to this, Ukrainian forces struck the Kerch Strait Bridge in October. Again, it was reported that no US weapons were used, and publicly, US officials have been cautious in their remarks about such attacks, while reiterating that Crimea is part of Ukraine. Admittedly, declarations are difficult to verify especially since Ukraine is an active combat zone, but they can be used to avoid miscalculation and misinterpretation.

Yet these declarations should be paired with other deconfliction measures. Amidst this backdrop, there are a variety of measures that Washington and its allies can also take to avoid a direct confrontation with Moscow while continuing to support Ukraine. Early in the war, for example, the Pentagon and Russia's Ministry of Defence established a de-confliction hotline. In addition, Russian Minister of Defence Sergey Shoigu and the US Secretary of the DoD Lloyd Austin have spoken multiple times. The US Joint Chief of Staff Mark Milley and General Staff Chief Valery Gerasimov have spoken as well. However, deconfliction cannot work unless both parties come to the phone and use it productively. The Biden administration must also continue to conduct silent diplomacy to ease tensions, while exchanges between high-ranking military officials and their Russian counterparts should continue, despite efforts by some NATO allies to discourage them. In short, the United States should continue its calibrated

approach to provide Ukraine with the military equipment it needs to make gains and sustain them.

Conclusion

The timing of when Kyiv and Moscow return to the negotiating table looks set to be decided by the developments on the battlefield. In the meantime, Washington, Kyiv, and their European partners have a vested interest in alleviating the diversion and escalation risks posed by military assistance to Ukraine. While the initial short-term initiatives to mitigate these risks appear to have been relatively successful, a long-term strategy will require higher levels of coordination and greater amounts of resources devoted to the task at hand. It is not too early to think about how oversight initiatives and escalation management will contribute to post-conflict stability in Ukraine.

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Endnotes

1. Author's private briefing with US State Department, 27 October 2022.
2. Author's interview with expert on the arms trade, December 2022.
3. Interview with Flemish expert on the arms trade, September 2022.
4. NDAA, 6 December 2022, p.1136.
5. Author's interview with US Department of State official, 27 October 2022.
6. Another security assistance channel is known as Foreign Military Financing which allows the president of the US to "finance procurement of defense articles and services for foreign countries and international organizations".

The UNSGM Capstone Exercise: Simulating a biological weapons investigation

Stefan Kloth, Anja Blasse, Ines Miceli and Ines Mergler

The topics of bioterrorism and the use of biological weapons have remained relevant, especially in the context of a deteriorating global security situation. However, in comparison to chemical weapons, biological weapons have (luckily) not been extensively used in the recent past. Any new use therefore would likely present a precedent, and would need to be investigated with special scrutiny.

The United Nations Secretary-General's Mechanism for Investigation of Alleged Use of Chemical and Biological Weapons (UNSGM) provides the opportunity to conduct an independent investigation of biological incidents and is, currently, also the only existing option available. Since the creation of the Organization of the Prohibition of Chemical Weapons (OPCW), there exists an institution for verification of breaches of the Chemical Weapons Convention. In contrast, there is no agreement so far to establish a comparable mechanism as part of the Biological Weapons Convention. Consequently, the UNSGM has a unique position within the non-proliferation regime. As a UN Member States mechanism, it is dependent on the engagement of Member States that provide support by offering for instance training to strengthen the UNSGM and its capabilities.

As part of those efforts, the Robert Koch Institute (RKI), funded by the German Federal Foreign Office, organized a 10-day field exercise in September 2022 to simulate a mission under the UNSGM. The so-called Capstone Exercise was only the second exercise for the UNSGM and therefore received considerable attention. The previous exercise, also organized by the RKI, took place in 2014. The main cooperating partners for the Capstone Exercise were the United Nations Office for Disarmament Affairs (UNODA), since it is the custodian of the mechanism, and the Swedish Defence Research Agency

(FOI), which helped to prepare for and evaluate the exercise. In addition, the event was supported by various German institutions with equipment, observers, role players and general input for the creation of the exercise.

The planning phase

The Capstone Exercise was divided into a planning phase and several mission phases. As a guiding framework, the organizing team used the so-called UNSGM Guidelines and Procedures, which provide information on the activation of the mechanism and recommendations for the preparation and implementation of a possible mission. In addition, they explain the different tasks and functions of the stakeholders involved (Secretary General, Member States, expert consultants, qualified experts and laboratories). The UNSGM Guidelines and Procedures nevertheless give the mission team flexibility to adapt to the actual mission and its needs.

During the first part of the Capstone Exercise, a small number of participants, including the head of mission, prepared a mission plan based on a fictitious scenario they had been presented with. Such a mission plan might generally consist of a command and control plan, an interview plan, a sampling plan, and a resource requirements and equipment plan. Due to the COVID-19 pandemic, the exercise organizers decided to simulate this phase of the mission virtually as a table top exercise (TTX) in 2020. The subsequent field exercise was then conducted in person from 19-28 September 2022 in Berlin.

The overall aim of the Capstone Exercise was to simulate a UNSGM investigation as realistically as possible, including the various steps, stakeholders and the equipment needed for a mission. By using an online platform for simulation exercises provided by Training in Aid Ltd, the field exercise still included hybrid elements in order to increase the participants' immersion into the scenario. The platform served both as a channel for the mission team to communicate with other stakeholders and to simulate media pressure that would be expected during a real mission due to the high level of public interest in the ongoing investigation.

The mission phases

Just as in a real mission, the Capstone Exercise covered the various phases of an investigative mission, which the organizers divided into pre-mission, mission and post-mission. The pre-mission phase offered the exercise participants the opportunity to get to know each other, to establish a chain of command and to prepare for their deployment. The mission team consisted of representatives from 16 states and included a variety of expertise with specialists of various professional backgrounds. In addition to setting up the team structure, the pre-mission phase also focused on selecting and preparing equipment for transport, which had been provided by the exercise organizers based on the plan that had been developed during the TTX. The participants of the exercise were then sent to the fictional host country to gather facts regarding the reported incident.

During their mission, the team had to pass border controls, negotiate with the host country, interview *inter alia* potential witnesses or representatives of international organisations, and collect samples. Having in mind the political scrutiny that any evidence has to withstand, every step needed to be documented in order to ensure the chain of custody. Like on a real mission, the participants had to deal with unexpected developments and adapt their planning accordingly. This included *inter alia* an unforeseen press conference and a demonstration by a nationalist activist group that was protesting against the UN mission. UNODA and a member of the United Nations Department for Safety and Security (UNDSS) supported the mission team during critical situations.

The interviews and sampling sites likewise provided challenges for the mission team. Interviewees partly belonged to a vulnerable population group or had to be interviewed under the restrictions of an isolation ward. The sampling sites were contaminated with a fictitious pathogen, and relevant evidence needed to be identified and documented in detail. As part of the sampling activities, the respective sub-team also needed to define their work areas and wear personal protective equipment to be able to collect samples in the so called 'hot zone' – the contaminated area. A proper decontamination afterwards was necessary for individual safety and to prevent the spread of the pathogen. The collected samples had to be prepared for transport to three selected designated laboratories where the samples would be analysed. Finally, the team members were asked to write a report based on both their observations and a fictitious laboratory report they received.

The need for collaboration among stakeholders

The Capstone Exercise was developed to fulfil two main objectives. To begin with, the exercise was intended to identify

potential gaps in the current training programme for qualified experts. In addition, the exercise created an opportunity to simulate the collaboration between the main stakeholders involved in a UNSGM mission. Such collaboration would likely occur at three levels.

First, within the mission team itself, which is built from a number of qualified experts selected by their Member States to be listed on a specific UNSGM roster that is maintained by UNODA. For the exercise, 19 of those experts were chosen by UNODA. The mission team can be expected to be very diverse, including for example experts in medicine, veterinary medicine, plant health, microbiology, chemistry, toxicology, and epidemiology (as suggested in Appendix IX of the UNSGM Guidelines and Procedures), but also law enforcement.

Second, an investigation mission is dependent on various UN entities, coordinated by UNODA that serves as custodian for the UNSGM. The so-called UN Internal Task Force consists of various UN branches such as the UN Department for Safety and Security (DSS), the UN Department of Operational Support (DOS), the UN Department of Political and Peacebuilding Affairs (DPPA), and the UN Office for Legal Affairs (OLA). Collectively they support the mission during the preparations and throughout the deployment.

Third, expert consultants and designated laboratories are a crucial part of the mission, and just like the qualified experts they are listed on a UNSGM roster. The expert consultants offer further professional expertise to support the mission team. The selected designated laboratories are responsible for the analysis of the collected samples. Hence, a close coordination between the laboratories and the mission team is crucial to ensure that the samples can be analysed properly and that the results can withstand critical questioning. Both a small number of expert consultants and three designated laboratories were available during the Capstone Exercise and supported the mission team when requested.

The successful collaboration of all those stakeholders will present, amongst other factors, a critical part of any future investigation mission. Bearing in mind the short time that might be available to prepare a UNSGM mission once the mechanism is activated, procedures and roles need to be clear for every person involved. In addition, considering the complexity of a potential UNSGM mission, opportunities to train for a possible future investigation are of the utmost importance. In recent years, several countries have offered training courses for qualified experts, but further training programmes would be beneficial.

Outcomes

All of the participants of the Capstone Exercise had received training in the context of the UNSGM, ranging from a UNSGM basic training to skilled training courses in leadership, interviewing and hostile environment awareness trainings (HEAT). The exercise thus provided an opportunity for the participating experts to test the acquired skills, to contribute their expertise and to experience an entirely fictious mission. The actions of the mission team in turn were observed by a number of evaluators. Together with the results from the TTX in 2020 and feedback received from the participating stakeholders, an evaluation report (expected to be published in the first quarter of 2023) will aim to summarize the outcomes of the Capstone Exercise. As part of a broader lessons learned process, the report is also intended to provide input regarding the further development of the training programme offered to qualified experts.

Looking at the complex nature and political significance of the UNSGM, it will be important to continuously prepare for a potential future investigation. Training qualified experts remains only one pillar that is needed to enhance the capabilities of the UNSGM. Other aspects include the need to strengthen designated laboratories, closer coordination of the different stakeholders and ensuring the readiness of equipment.

The Capstone Exercise presented an opportunity for discussion and reflection on the specific skills needed to conduct a UNSGM mission and regarding potential critical issues that could evolve in planning and conducting an investigation. Overall, it was determined that the exercise was a great success and that the mechanism is operational. Also, during the exercise and in the aftermath, opportunities to further strengthen the mechanism through training, exercises and workshops were identified. It is now up to the UN Member States to seize the momentum and plan the next steps together with UNODA to ensure that the UNSGM is best prepared for a possible mission to investigate the use of biological weapons.

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Verification Watch

The 10th NPT Review Conference and nuclear disarmament verification

Noel Stott

The 10th Review Conference of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) concluded on 29 August 2022 without an agreed outcome. However, a deeper reading of the draft texts, indicates a number of areas where progress was made.

The failure has been mainly ascribed to Russia's objection to text about its control over Ukrainian nuclear facilities, although other states, such as South Africa, accredited the lack of consensus of a 'substantive outcome', to the refusal by the States Parties who possess nuclear weapons, especially the P5 (the United States, Russia, UK, China and France), to agree to any tangible progress on the implementation of agreed nuclear disarmament commitments. As Cesar Jaramillo of Project Ploughshares points out, "even if Russia had not blocked consensus, the final document would have been devoid of any serious commitment to change the policies that most other NPT states parties were clamouring to see changed".

However, according to Ambassador Gustavo Zlauvinen of Argentina, the President of the Review Conference, notwithstanding the failure to adopt an outcome document by consensus, overall the Review Conference had been "meaningful", with "delegations engaged in discussions on very complex issues, and their work should not be diminished". He further states that, "we managed, somehow, to begin to find a common understanding of the main NPT-related problems and on how we should reflect them in the final document".

Such issues included nuclear risk reduction strategies, negative security assurances and the role that women ought to play at all levels of disarmament and non-proliferation discussions. States Parties also agreed to establish a Working Group to review and make recommendations on how to improve the effectiveness, efficiency, transparency, accountability, coordination and continuity of the review process.

Another and important case in point is the issue of nuclear disarmament verification (NDV), with the final draft text resulting from the discussions in the Main Committees and Subsidiary Bodies, committing States Parties to the strict application of the principles of irreversibility, verifiability and transparency in relation to the implementation of their disarmament obligations under the Treaty. The Conference was expected to reaffirm the importance of effective and credible nuclear disarmament verification while reiterating the need for nuclear disarmament verification to conform with international law and the principles laid out in the final document of the first special session devoted to disarmament in 1978. Importantly, according to the final draft text, States Parties would have also committed themselves "to strengthen [their] support for initiatives to develop multilateral disarmament verification and capacity-building in support of nuclear disarmament . . . and to further conceptual and practical work on nuclear disarmament verification, taking into account the importance of partnerships between nuclear-weapon States and non-nuclear-weapon States . . .".

The first consolidated draft of the outcome document recognised that further work is required to ensure the irreversibility of nuclear disarmament. As a first step, States Parties were "encouraged to exchange information on how they apply the principles of irreversibility in relation to the implementation of their Treaty obligations, in order to build understanding of when and where irreversibility measures can be put into practice in reaching and maintaining a world free of nuclear weapons".

According to the final draft text, the Conference would have also noted the work undertaken by the Group of Governmental Experts established under General Assembly resolution 71/67 to consider the role of verification in advancing nuclear disarmament, and the adoption by the General Assembly of resolution 74/50, which established a group of governmental experts to further consider nuclear disarmament verification issues. This latter group of governmental experts has so far held two substantive sessions this year—in February and in September—and is currently deliberating on a range of issues, including the future possibility of a UN-related body establishing a Group of Scientific and Technical Expert on Nuclear Disarmament Verification and how relevant capacities can be built up amongst all states to be able to participate in verification activities in a meaningful way.

Finally, if an outcome document had been agreed, it would almost certainly have noted the non-governmental organisations' contributions to activities and initiatives on nuclear disarmament verification and encouraged broad participation by all States Parties. Importantly, for organisations such as VERTIC, the value of positive interaction with civil society, research centres, academia and affected communities during the review cycle, and greater engagement with non-governmental organisations in the pursuit of nuclear disarmament and nuclear non-proliferation objectives, would have been formally recognised.

Often, States Parties and other stakeholders measure the success or failure of a Review Conference by its ability to produce a consensus final report and action plan. Perhaps this should not be the sole yardstick. Rather, the question should be whether the common understandings reached, can be taken forward during the Preparatory Committee meetings scheduled for 2023 in Vienna, 2024 in Geneva and 2025 in New York, as well as the next Review Conference in 2026. Such common understandings include, for example, the need for capacity-building in support of nuclear disarmament verification and for further conceptual and practical work in relation to disarmament verification—something that several organisations, including VERTIC, are currently engaging in.

Modelling North Korea's enrichment programme

Grant Christopher

Much is still unknown about the extent of North Korea's enrichment programme. Prior to the construction of the gas centrifuge enrichment plant at Yongbyon, the main open source for the existence of a North Korean enrichment programme was a US government assessment that led to the collapse of the Agreed Framework in 2002. There was also support for an assessment in the US Government that highly enriched uranium (HEU) was detected on materials taken out of North Korea in 2006-2007. No associated facilities were positively identified until the 2010 delegation visit to the uranium enrichment workshop (UEW). Satellite imagery showed that this facility doubled in size in 2013-2014. In 2020, the Center for Nonproliferation Studies, in collaboration with Ankit Panda, identified the Kangson site as associated with the gas centrifuge enrichment programme.

The technology shown in the 2010 visit was consistent with a P2-type centrifuge, acquired via the A. Q. Khan network. To estimate the extent of the North Korean enrichment programme analysts have developed two types of models. In the first type of model, the UEW at Yongbyon is the main centrifuge facility with the addition of only a pilot plant. In this scenario, Albright takes Hecker's estimate of 2000 P2-type centrifuges observed in the UEW and assumes a four-stage enrichment process and operational challenges with the centrifuges. This reduces a 5 SWU/centrifuge by a third for a total SWU/year for the plant of 6,500 from 2010 to 2015 and 10,000-13,000 from 2016.

In the second scenario, there is a second large clandestine centrifuge facility that may be Kangson or another facility not yet identified in open sources. Albright in this scenario assumes the clandestine facility becomes operational from 2005-2010 with a comparable size to the UEW for total SWU/year of 26,000. Hecker, under this scenario, assumes a pilot plant with two cascades (660 centrifuges) and a SWU/centrifuge of 4. The UEW then has 8,000 SWU/year from 2010-2015 and 16,000 SWU/year from 2016 onwards. A clandestine facility is constructed in 2013-2014 and expanded in 2017-2018 for a total 35,000 SWU/year. Hecker's analysis is based on North Korea's annual production capability of rotors, with two flow-forming machines between them capable of producing 1500 P2 rotors/year.

Without any additional evidence these remain reasonable scenarios. However, the North Korean centrifuge programme is now twenty years old. During this time, it is realistic to assume that some research and development (R&D) into advancing centrifuge technology in North Korea has taken place. The P2-type centrifuge, for example, has been used in multiple countries connected with the A.Q. Khan network where such advances have been made. In Libya and Iraq, a working enrichment programme was never started, however, while in Pakistan and Iran, the gas centrifuge enrichment programmes have been ongoing for two decades. The Iranian programme has made several advances in design which have remained central to international negotiations about the Iranian nuclear programme. Pakistan's programme is also thought to have improved its centrifuges.

Improvements in centrifuge design require more than proficiency in the technology. The most advanced centrifuges in the world use carbon fibre rotors which are lighter than the

maraging steel rotors used for most P2 designs. While North Korea uses carbon fibre in its missile programme and possesses filament winding machines for the process, there is no evidence of procurement of the grade of carbon fibre required for rotor manufacturing. However, there is not enough information in open sources to rule this out. In addition to improvements in materials, advanced centrifuge designs also may add bellows to extend the length of the rotor section. This allows rotation of the centrifuge at super-critical speeds, increasing the enrichment potential per centrifuge.

In the Iranian programme, IR-1 designs were first tested in the late 1990s and the more advanced P2-types were tested circa 2009. Iran has developed and deployed over 1000 IR-6 designs, which has double the enrichment potential of the P2, and also has an advanced IR-9 model in development with 6-10 times the enrichment potential of the P2. The developments in Pakistan are less well understood, but the P3 and P4 are thought to have double and four times the enrichment potential of the P2 respectively. Both of these programmes, however, use carbon fibre rotor technology.

There is no supporting evidence for a centrifuge R&D programme in North Korea, but the opacity of activity inside the country means that without additional information we can neither confirm nor rule this out using open sources. However, based only on known facilities in North Korea's enrichment programme, using P2-type centrifuges, the country may have produced hundreds of kilograms of HEU. Advances in the centrifuge programme imply greater uncertainty in the stocks of North Korean fissile material. This in turn would complicate any potential negotiations with North Korea (see Trust and Verify 169) and estimates of its nuclear arsenal.

Endnotes

1. This article is adapted from a section of a paper submitted by the author to the 2022 Alva Myrdal Conference.
2. In this analysis the rotor is assumed to be the choke-point centrifuge component and other components such as bellows, bearings and magnets are unconstrained relative to centrifuges.

Implementation Watch

The work of VERTIC's National Implementation Measures programme in support of BWC implementation since the Eighth Review Conference

Thomas Brown and Sonia Drobysz

The Ninth Review Conference of the Biological and Toxin Weapons Convention (BWC) was held in Geneva, Switzerland, from 28 November to 16 December 2022. Staff from VERTIC's National Implementation Measures (NIM) programme attended the Conference, presenting on the most recent work of the programme during side-events on 2 and 13 December. This important international meeting was an opportunity for States Parties to discuss measures to strengthen the BWC. (At the time of writing the outcome of the Review Conference was unknown but will be covered in a future edition of *Trust & Verify*). It further provided an opportunity to reflect upon the work of the NIM programme in support of BWC implementation since the last Review Conference in 2016.

States Parties must give effect to the BWC at the national level by adopting, reviewing, updating and implementing comprehensive laws and regulations. Since the Eighth Review Conference, the NIM programme has continued to support this process by providing cost-free tailored knowledge sharing, legal analysis and legislative drafting assistance to interested states to strengthen national frameworks for the BWC. The NIM programme has contributed to projects with the BWC Implementation Support Unit and UNODA to strengthen BWC implementing legislation in a number of countries.[1] The side event to the Ninth Review Conference held on 2 December showcased legislative assistance activities for implementation of the BWC under the current project funded by the Norwegian Ministry of Foreign Affairs, including recently published tools and highlighting recent experiences of working with three countries on BWC legislative implementation.

The analysis of existing legislation is an important component of legislative implementation of the BWC, because

it allows states to examine which legislative measures are necessary to fully implement their international obligations. To support legislative analysis of states' legislation to implement the BWC, VERTIC's NIM programme published the 'Survey template of National Implementation Measures for the 1972 BWC and biological weapons-related provisions of relevant international instruments' in May 2021. This tool, developed in-house after the establishment of the NIM Programme in 2008, underwent a major revision in 2020. It identifies 137 distinct measures that are relevant for the implementation of the BWC and is accompanied by a 'survey overview' template that provides a place to summarise the survey's main findings and formulate recommendations to strengthen legislation. The template is currently available in English, French and Spanish, with translation into Arabic and Russian expected in the near future. On the basis of this template, NIM staff have developed BWC legislation surveys for 146 states since the programme's inception, to further legislative implementation of the Convention.

The NIM programme has continued to provide tailored assistance for drafting new legislation during workshops in capitals or online using legislative drafting tools developed in-house and supplying examples of legislation in force to identify best legislative and regulatory practices. One of these tools is the upcoming revised Model Law for implementation of the BWC. This will be a revised version of 'VERTIC's Sample Act for National Implementation of the BWC', with publication expected in January 2023. This document has been used in engagements worldwide that have led to the drafting of new or amending legal texts, some of which are now in force.

Finally, NIM staff have been involved in research and analysis to support implementation of the BWC. They have continued to contribute articles on BWC legislation in VERTIC's flagship publication *Trust & Verify* and other ad hoc publications on the topic. Recently, the project team has been working on a project aiming to refute misconceptions about biological weapons and related legal frameworks funded by the Counter Proliferation and Arms Control Centre (see the article in this edition of *Trust & Verify*).

Through continued engagement with all relevant stakeholders including states, the donor community whose funding for civil society is crucial, international and regional organisations and civil society partners, it is hoped the team can make a significant contribution to strengthening implementation of the BWC over the next five years.

Endnotes

1. The team is grateful to the Norwegian Ministry of Foreign Affairs, Global Affairs Canada, the European Union CBRN Risk Mitigation Centres of Excellence Initiative and BWC Extended Assistance Programmes, the United States Department of State with CRDF Global, and the UK Foreign and Commonwealth Development Office for the support of their work since the last review conference.

Addressing misconceptions about chemical and biological weapons and related legal frameworks

Thomas Brown

A key part of VERTIC's National Implementation Measures (NIM) programme's mission is to support the implementation of the Biological Weapons Convention (BWC) and Chemical Weapons Convention (CWC). However, during the course of the programme's work it has become evident that engagement with these two treaties is often hampered by misconceptions, which can undermine trust in them. The BWC and the CWC contain concepts that can be challenging to understand from a technical, scientific and legal perspective, leading to misconceptions among relevant stakeholders. Such misconceptions can lead to misunderstandings of important obligations or processes and can similarly undermine the work of international organisations with responsibility for implementation, such as the Organisation for the Prohibition of Chemical Weapons. Misconceptions are also sometimes used by nefarious actors in disinformation campaigns to discredit the international framework to prevent the proliferation of biological and chemical weapons and stymy efforts to strengthen it.

To address this challenge, the NIM team is now in the final stages of completing a report and a related webpage that form the primary outputs of a project funded by the UK Counter Proliferation and Arms Control Centre. These resources refute misconceptions about chemical and biological weapons and related international instruments that VERTIC staff have identified through interactions with states and other stakeholders over 20 years' work on these treaties, and from other sources such as the media. Each misconception is broken down into an explanation of the misconception and its implications, and how

to address it. The misconceptions are then disproved through factual and legal discussions, supported by expert commentary.

The webpage and draft report were showcased at a side event to the Ninth BWC Review Conference in Geneva, on 13 December. During this event, speakers shared their experience coming across misconceptions, explored the importance of challenging them, and provided information disproving common misconceptions related to the BWC and biological weapons. Afterwards, the report will be finalised in early 2023, before being published in English, French, Spanish, Arabic, Russian and Chinese. It is hoped that these resources will provide tangible benefits for a wide range of stakeholders and further adherence to, implementation of and compliance with the BWC and CWC.

Science & Technology Scan

Post-quantum cryptography

Grant Christopher

On 5 July 2022, the US National Institute of Standards and Technology (NIST) published the winners of a multi-year contest of post-quantum cryptography (PQC) candidates. Post-quantum cryptography is a necessary cyber-defence for the advent of quantum computing and will be critical to securing the future of electronic communications. Four algorithms were selected by NIST to be standardised and eventually integrated into global digital infrastructure. The specific vulnerability to asymmetric encryption using public-private keys—which underpin global electronic communications—has been known since 1995, with the discovery of Shor's algorithm. Shor's algorithm is a quantum algorithm that a sufficiently powerful quantum computer could use to break asymmetric encryption. If this were available today it could wreak havoc on the internet, diplomatic and military communications, financial transactions and create risks for critical infrastructure.

Yet, quantum computing that is good enough to break current standards in cryptography may be decades away (Trust and Verify 165). However, current data is vulnerable due to 'store now, hack later' attacks where archived data could be decrypted e*n masse*. All data currently encrypted with asymmetric standards could be decrypted by a sufficiently powerful quantum computer once it becomes available. To mitigate this, a race to certify and roll-out PQC standards is underway.

There are several necessary developments for quantum computing to be able to break asymmetric encryption. These include improving the quantum bit (or qubit) with quantum error correction, increasing the number of usable qubits, and developing the quantum-classical computing interface. A cryptographically relevant quantum computer, which has enough power to overcome current encryption algorithms, will require over 2000 error-corrected qubits. Not all quantum computers are a threat to encryption. There are some varieties of quantum computer with thousands of qubits, such as those that use 'quantum annealing,' which cannot solve decryption problems. The number of qubits in the most powerful quantum computers (of the type that can use Shor's algorithm) keeps advancing year on year and currently numbers in the hundreds.

The impact and arrival of quantum computing is particularly hard to estimate due to the number of technical hurdles that must be overcome. Cryptographically relevant quantum computing may arrive within a decade or so if the technology can mirror the trajectory of rapid-progress tech such semiconductor computing, or many decades later if the technical problems are intractable in a similar trajectory to nuclear fusion.

Classical computers will remain relevant after the transition to quantum computing occurs. First, data storage and processing will be handled by a classical computer, while the scarce resources of a quantum computer will be reserved for problems only it can solve. Classical computers will also continue to develop, possibly continuing to adhere to Moore's law (that as a result of the number of transistors on a microchip doubling every two years, it is expected that the speed and capability of computers will increase every two years). This means that 'quantum supremacy', where a quantum computer is more powerful than the best available classical supercomputer, will be a moving target.

To mitigate the risks of quantum computing, PQC standards will be rolled out as soon as possible. The algorithms

selected by NIST contain difficult mathematical problems that are not known to be solvable by quantum algorithms, such as lattice-based methods. Four algorithms have been chosen to hedge against a future vulnerability, such as a flaw discovered in the algorithm or a new quantum method of solution (although this is not thought to be possible for some selected algorithms).

How exactly this will impact arms control and verification is unclear. VERTIC and the James Martin Center for Nonproliferation Studies have recently commenced a project, funded by the US Department of State to, among other things, examine these questions. There is particular interest in the impact of arms treaty verification data and safeguards data, which includes the system of transfer, storage and what is retained in the data. As such, plans for PQC for information management systems, data exchange and telemetry for treaty-relevant activities is highly relevant today.

Centre News

National Implementation Measures

Sonia Drobysz, Yasemin Balci, Thomas Brown and Suzanna Khoshabi

The National Implementation Measures (NIM) team has organised and participated in numerous meetings and events in the second half of 2022, both in-person and virtually. It has also continued to execute its work under a number of ongoing global projects, and started a new project.

EU CBRN Centres of Excellence (CoE) projects

The NIM team completed its work under two EU CBRN CoE projects, Projects 61 and 67, and is continuing to work on Project 81.

Co-Programme Director for National Implementation, Sonia Drobysz, virtually joined the Final Project Meeting for EU CBRN CoE Project 67, '*Strengthening CBRN Waste Management Capabilities in South-East and Eastern European Countries*', on 7-8 September. The meeting brought project partners and beneficiary country representatives together to discuss and celebrate the successful delivery of the 4-year project. Sonia presented on outcomes on CBRN waste management legislation under Work Package 1 of the project.

NIM Legal Officer Thomas Brown travelled to Bali to join the Closing Event for EU CBRN CoE Project 61, '*Sound Management of Chemicals and their Associated Wastes in South East Asia*' on 28-29 November (see photo 1). Thomas presented on VERTIC's activities and outputs under Work Package 1, on the legislative aspects of chemicals management in partner countries.

Sonia took part in two events under the ongoing EU CBRN CoE Project 81, '*Enhanced Biosecurity in South East Asia*'. She remotely participated in a Capacity Building Workshop on confidence building measures for the Biological Weapons Convention (BWC) for Laos on 3-4 November, in her capacity

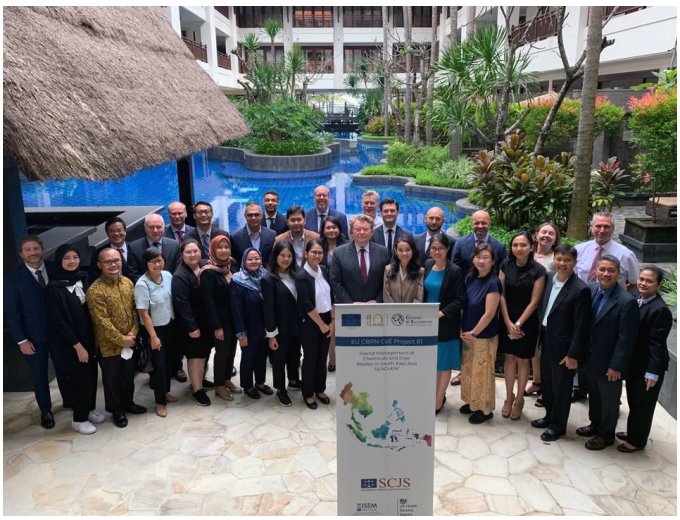

Photo 1: Project 61, closing meeting, Bali, November 2022

Photo 2: Sonia at the Simulation Exercise, Udon Thani, November 2022

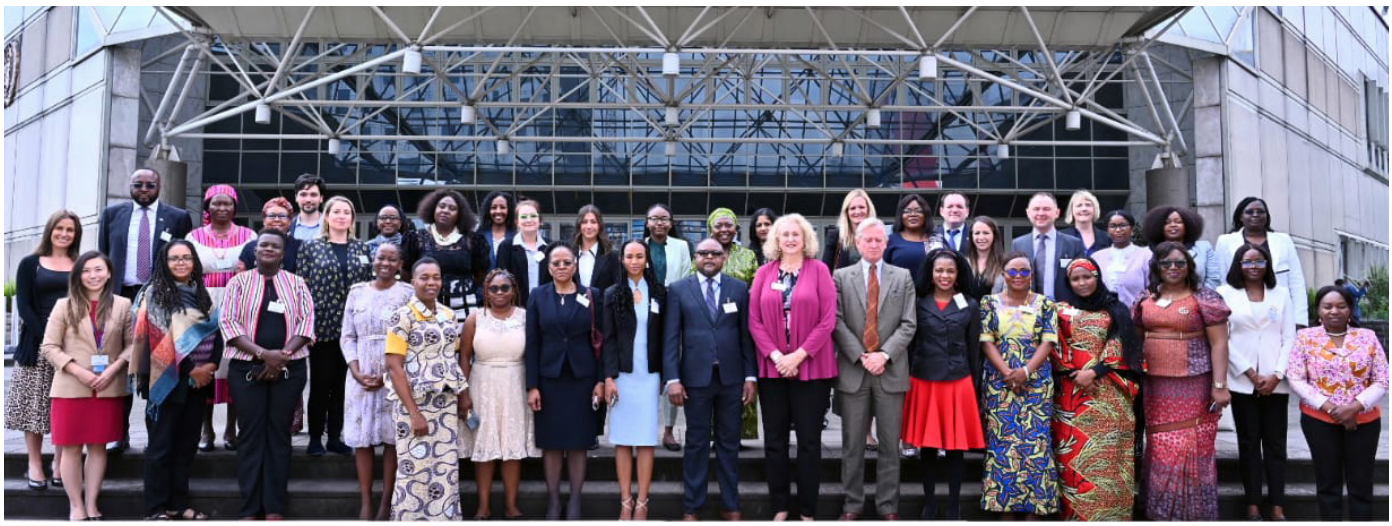

Photo 3: Participants at the Regional Women's Conference on Preventing the Proliferation of WMD to Non-State Actors, Addis Ababa, October 2022

as key expert under the project. Sonia presented on the findings of Laos' BWC legislation survey, as part of NIM's work under Work Package 2 of the project. Sonia also travelled to Udon Thani, Thailand, on 14-18 November to join a Simulation Exercise on biological threats and to meet with project partners and national representatives to discuss legal aspects of the project (see photo 2).

Sonia also presented on biosafety and biosecurity activities in South East Asia during a EU CBRN CoE side-event at the BWC Ninth Review Conference in Geneva on 28 November.

Legislative assistance for national implementation of the BWC and CWC

The team has continued our work on the project funded by the Norwegian Ministry of Foreign Affairs to provide legislative assistance for national implementation of the BWC and CWC, with ongoing engagement with partner countries on awareness raising, legislative analysis and legislative drafting.

Sonia participated in a Coordination Workshop for the project, '*Supporting Universalization and Effective Implementation of the BWC in Africa*', organised by UNODA and the BWC ISU, in Geneva from 26-27 July. The team also organised two legislative drafting workshops with Botswana and the State of Palestine under the Extended Assistance Programme (EAP) of the EU Council Decision in Support of the BWC, in cooperation with the BWC Implementation Support Unit (BWC ISU). The workshop with Botswana took place from 4-6 July, and the workshop with the State of Palestine took place from 7-9 November. Both were conducted in hybrid format, with national participants joining in-person and VERTIC and UNODA staff joining remotely.

NIM Associate Legal Officer Suzanna Khoshabi gave a presentation on UN Security Council Resolution 1540 and Export Control in Africa as part of the *Regional Women's Conference on Preventing the Proliferation of WMD to Non-State Actors*, organised by UNODA and the Government of Namibia, in Addis Ababa from 12-13 October (see photo 3). Suzanna also attended the 27th *Conference of States Parties to the CWC* in The Hague, from 28-29 November, where she delivered the Joint NGO Statement on Full National Implementation of the CWC via a video recording.

Suzanna and Sonia also attended the *BWC Ninth Review Conference* in Geneva from 28 November – 2 December, where Sonia delivered VERTIC's statement during the informal NGO session (see photo 4). NIM held a side-event on 2 December presenting its legislative assistance activities for

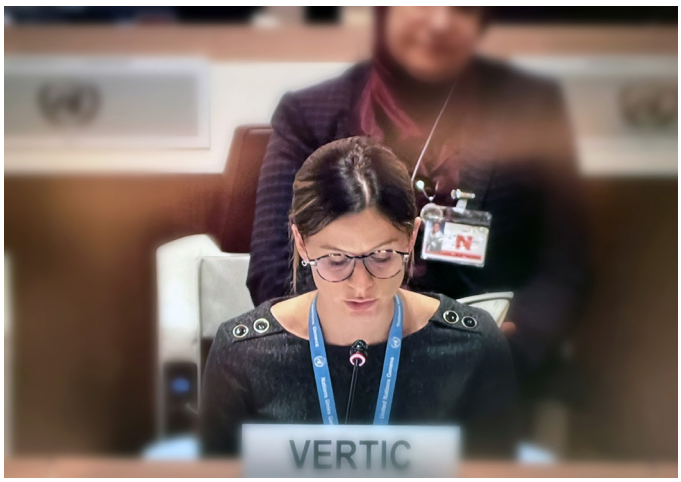

Photo 4: Sonia delivering VERTIC's statement to the BWC Review Conference, Geneva, November 2022

implementation of the BWC under the project. The team also discussed coordination of its activities with partners such as UNODA, and highlighted our experiences of working with three countries on BWC legislative implementation.

Other events and activities

Sonia delivered a lecture on physical protection and illicit trafficking of nuclear material at the *2022 International School of Nuclear Law* on 29 August in Montpellier, France, and participated in a panel discussion on nuclear security and safeguards on 30 August. She also participated in a virtual lecture series hosted by Chatham House, in partnership with the Moroccan Ministry of Health, on '*Preventing, Detecting and Responding to Bioterrorism Threats at Points of Entry in Morocco*'. She delivered a lecture on international regulations and export controls relating to biological weapons and materials on 21 September.

Suzanna attended the T.M.C Asser Instituut and the OPCW Training Programme on Disarmament and Non-Proliferation of Weapons of Mass Destruction in The Hague from 19-23 September.

Sonia and Thomas participated in a *Conference on the COVID-19 Pandemic: Lessons Learned* in Tbilisi, Georgia, from 3-7 October (see photo 5). It was organised by the Biosafety Association of Central Asia and the Caucasus (BACAC) alongside the EU CBRN CoE Initiative, the US Department of State Biosecurity Engagement Program and the National Center for Disease Control and Public Health. Sonia and Thomas led two pre-conference sessions exploring lessons from the COVID-19 outbreak for the BWC regime and a main conference session on general legislative trends from the pandemic. They also held a roundtable discussion to seek input of regional experts for an upcoming white paper on legislative recommendations in relation to COVID-19.

Other NIM news

The NIM team commenced working on a project, '*Addressing misconceptions about chemical and biological weapons and related legal frameworks*', in September 2022, funded by the Counter Proliferation and Arms Control Centre of the UK Foreign, Commonwealth and Development Office. The team organised a side-event at the BWC Ninth Review Conference in Geneva on 13 December, to discuss related misconceptions (with a focus on BWC-related misconceptions) and to showcase resources developed under the project.

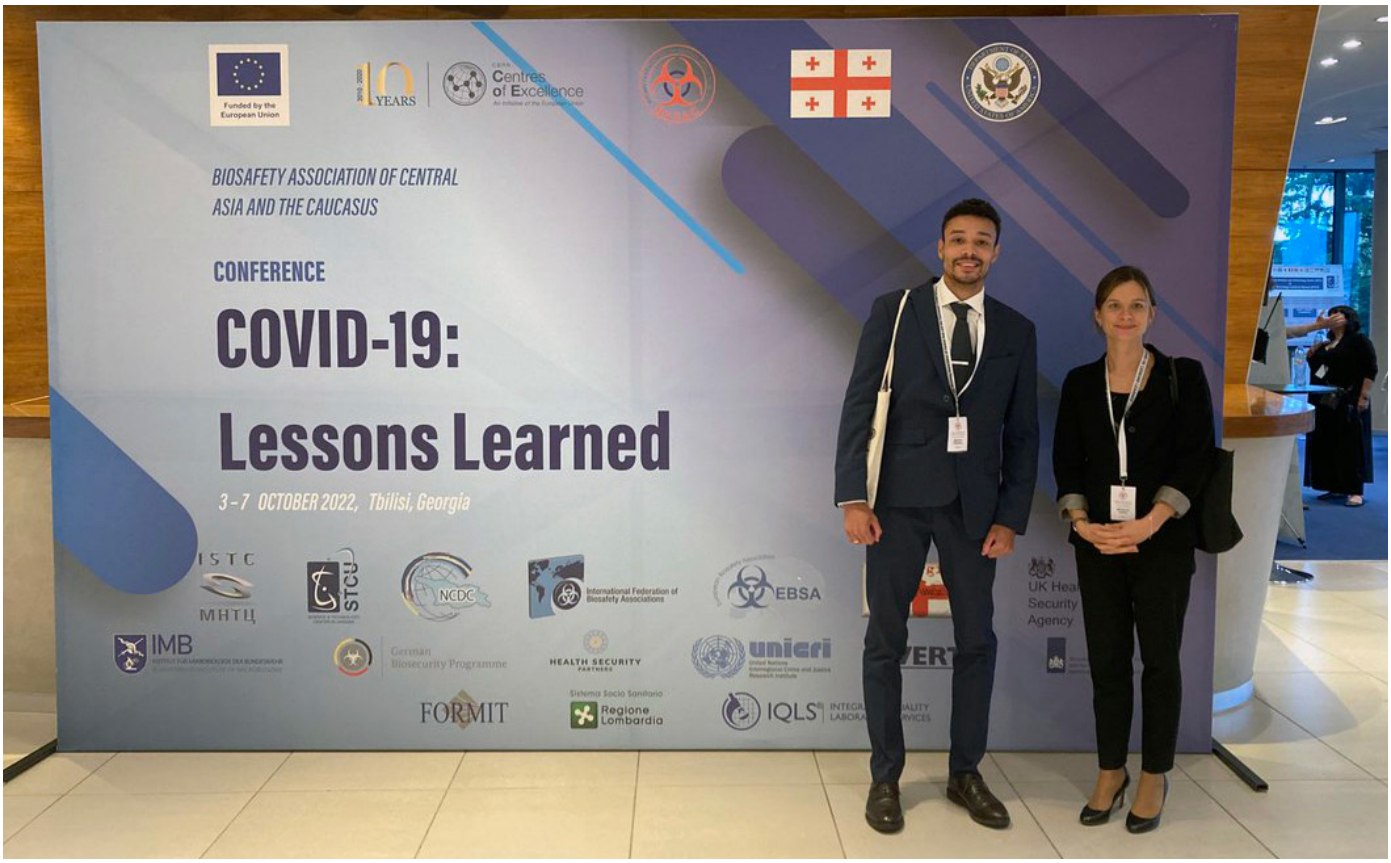

Photo 5: Thomas and Sonia at the BACAC Conference, Tbilisi, October 2022

The NIM team completed its work on a project to promote universalisation and implementation of the International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT), implemented by the UN Counter-Terrorism Centre of the UN Office of Counter-Terrorism and the UN Office on Drugs and Crime. In September the team finalised a *study on reasons and challenges of UN Member States for not becoming party to ICSANT* and tools for its effective implementation.

NIM also published in August an addendum to a fact sheet on the International Health Regulations (IHR), focusing on their application to hMPXV (the human version of the monkeypox virus) as a "public health emergency of international concern".

In partnership with the United Nations Disarmament Research Institute, the NIM team started preparatory work for the development of a BWC implementation database, under a project funded by the US Department of State.

Verification and Monitoring

Alberto Muti, Grant Christopher and Noel Stott

Building capacity for nuclear disarmament verification

VERTIC received financial assistance from the Norwegian Ministry of Foreign Affairs to continue to build the capacity of countries in Africa, Central Asia and Latin America to contribute to nuclear disarmament verification (NDV). As reported previously, the first phase of the project resulted in three emerging disarmament verification hubs in these regions, each of which developed an Action Plan for future activities. The objective of the second phase of this project is to embed and sustain these regional hubs, and to facilitate regional perspectives on the conceptual, policy and technical issues pertinent to nuclear disarmament verification, incuding the concept of 'irreversability'. The hubs will also undertake outreach activities to enhance awareness among students and young professionals of nuclear disarmament and non-proliferation as a field of study, and thus contribute to building expertise amongst the next generation of professionals.

In August, VERTIC arranged and hosted a side-event at the Tenth Review Conference (RevCon) of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). The event was co-hosted with Norway, UNODA, Brazil, Kazakhstan and NPSGlobal. Speakers included Ambassador H.E. Gustavo Zlauvinen, President of the RevCon as well as the outgoing Deputy to the High Representative for Disarmament Affairs, Tom Markram. At this event, a publication titled, 'Regional Hubs for Research and Capacity-Building on Nuclear Disarmament Verification', was launched. This report describes the process VERTIC undertook to implement the first phase of the project, its impact as well as the next steps decided on by the participants in each region.

Further Strengthening Safeguards

VERTIC, together with the Vienna Center for Disarmament and Non-Proliferation (VCDNP), is implementing a project in support of the International Atomic Energy Agency. It will provide insight and recommendations to improve outreach in universalising comprehensive safeguards agreements (CSAs) among non-nuclear-weapon states as well as the amendment or rescission of small quantities protocols (SQPs).

Understanding irreversibility in global nuclear politics

VERTIC, King's College, the Center for Strategic and International Studies, the European Leadership Network and the University of York have secured funding to generate new insights on the conceptual and empirical levels that can aid a more informed understanding about nuclear irreversibility in the context of the NPT Review process and beyond.

Conceptualizing a Cooperative Aerospace Monitoring Regime Based on Satellite Imagery and Unmanned Aerial Vehicles

With funding from the US Department of State, the VM programme is currently examining what lessons can be learned from the implementation of the Open Skies Treaty that could be applied to a future arrangement. This project includes an exploration of the technical and political feasibility of co-operative Unmanned Aerial Vehicle (UAV) monitoring; the feasibility of validating commercial satellite imagery for co-operative monitoring; the geographic regions in which co-operative aerial monitoring may be viable; and, the status of aerial sensors and sampling equipment that could be included under a new arrangement.

Supporting the UN Secretary-General's Mechanism for Investigation of Alleged Use of Chemical and Biological Weapons (UNSGM)

VERTIC is currently developing a resource matrix, pairing the resources required for a UNSGM field investigation of alleged use, with international organisations and other international bodies that may possess these and may be able to provide them to UNODA in case an investigation were to be called.

Other activities

The European Safeguards Research and Development Association board approved, Dr Grant Christopher as the vice-chair for its Verification Technologies working group.

In November, VM staff participated in the 11th edition of the EU Non-Proliferation and Disarmament Consortium conference. Organised by the Istituto Affari Internazionali (IAI), the conference gathered together non-proliferation and disarmament experts from governmental and non-governmental institutions worldwide.

During this period, staff attended the IAEA's Symposium on International Safeguards**.** Alberto Muti participated in various sessions that examined future safeguards operating environments. Grant Christopher presented his research on the impact of the darknet on safeguards and participated in a panel on 'Strengthening Confidence in the Absence of Undeclared Activities'.

In October, Grant Christopher participated in the inaugural conference of the newly established **Alva Myrdal Centre for Nuclear Disarmament** in Uppsala, Sweden, where he also presented research on a new model for the North Korean nuclear fuel cycle.

During the NPT Review Conference, VERTIC, co-hosted with the UK Government a seminar in which safeguards assistance providers explained their expertise, and NPT member states exchanged their experiences in seeking and receiving assistance on IAEA Safeguards.

Interns

The VM programme welcomed two interns from Bradford University: Kwadwo Safo Siaw-Adane and Victor Iyamu. While Kwadwo is assisting with research into the potential for co-operative overhead monitoring in Africa, Victor is focussing on the concept of 'irreversibility' as a key principle of multilateral nuclear disarmament.

Compliance Mechanisms and Measures

Angela Woodward and Cristina Rotaru

North Korean maritime sanctions

The Compliance Mechanisms and Measures (CMM) Programme's work on implementing UN Security Council sanctions on North Korea continued into the third and fourth quarters of 2022. The team is involved in training activities with states and other relevant maritime stakeholders involving in implementing the sanctions. Operating as part of a consortium together with the James Martin Center for Nonproliferation Studies (CNS) and King's College London, the CMM team continued to develop information and training materials on sanctions implementation pertaining to due diligence in sanctions implementation and to ship registry operations.

CMM's project mandate focuses primarily on research of UN Security Council maritime sanctions-related issues, particularly on matters related to their legal implementation, but also includes identifying new trends in sanctions evasion tactics, examining case studies of enforcement and compiling best practices of effective national implementation.

Maritime confidence- and security-building measures in the Asia-Pacific

The CMM programme has begun a joint project with the Asia-Pacific Leadership Network (APLN) on preventing dangerous maritime incidents and unintended escalation in the Asia-Pacific, supported by the US Department of State.

The project is engaging Asia-Pacific policy practitioners and experts in a substantive dialogue on mitigating military incidents at sea and reinvigorating the call for urgent maritime confidence building and crisis-avoidance measures in the Asia-Pacific.

The project draws on VERTIC's expertise in confidence- and security-building measures and the APLN's network of political, diplomatic and military leaders, senior government officials, scholars and opinion leaders across the Asia-Pacific region. Angela is a New Zealand member of APLN and serves on the APLN Board.

Outreach and external relations

In light of the Covid-19 pandemic-induced travel restrictions continuing in much of the world, the CMM programme's work during 2022 has continued to take place online. Assistance, training and similar instructional activities that would otherwise be delivered during in-person conferences and meetings have been rescoped for delivery online, and participation in network events has similarly moved to online conferencing platforms, although attendance at some in-person events gradually recommenced this period.

Angela Woodward, based in New Zealand, participated in the Ninth Meeting of the Council for Security Cooperation in the Asia-Pacific (CSCAP) Study Group on Nonproliferation and Disarmament in the Asia-Pacific meeting, held during 26-28 July in Ho Chi Minh City, Vietnam. Angela gave a presentation on nonproliferation regime developments. Former VERTIC Executive Director, Dr Trevor Findlay, was also at the meeting.

Angela will take part in a panel session on 'The quest for international limits and rules on autonomous weapons systems' on 15 December during the 2022 Conference on Robotic Learning, being held in Auckland, New Zealand. Angela will speak on lessons learned from other weapons systems and disarmament efforts in navigating the challenges of regulating other weapons systems of concern and the importance of scientific communities contributing to the development and implementation of such regulation. The panel is being organised by the New Zealand Ministry of Foreign Affairs and Trade.

CMM Programme Researcher Cristina Rotaru departed VERTIC in September 2022 to take up a Senior Sanctions Advisor position at the UK HM Treasury. Cristina made substantive contributions to our sanctions projects over her four years at VERTIC as a committed researcher and applied her technical skills to the development of new e-learning initiatives developed by the project consortium (including the James Martin Centre for Nonproliferation Studies and King's College London). We wish her all the best in her new role.

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building trust through verification

Mission statement

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

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