

Strengthening biological disarmament at the BWC 7th Review Conference

Verification is not on the agenda for the 1972 Biological Weapons Convention when its parties gather in Geneva during December this year for their Seventh Review Conference. Yet there is plenty on the agenda that, if agreed, can strengthen this pioneering regime of biological disarmament. The task for the parties is to put flesh on the treaty's somewhat emaciated skeleton. Some way down the line this process may reach the stage of considering how compliance with the treaty's obligations can be more reliably assured, and perhaps even verified. But for the moment all talk of verification is off limits, except as a distant goal. This results from the painful breakdown of negotiations—which ran from 1995 to 2001—for a protocol to strengthen the compliance regime of the Biological Weapons Convention (BWC). The current stalemate on the issue has been intensified by the United States' conviction that the treaty was unverifiable then, and has become even more unverifiable now due to technological developments since those negotiations ended.

The European Union, however; 'remains committed to identifying effective mechanisms to enhance and provide confidence in compliance with the Convention, including possible verification measures.' A broadly similar view prevails among the 'JACKSNNZ' group (Japan, Australia, Canada, [South] Korea, Switzerland, Norway, New Zealand), which feels that verification is still desirable, but now attainable only in the long-term. Much conceptual ground-work is needed first, and a potential new working group on compliance may prove acceptable as the next step in 2012-2015. The JACKSNNZ formed an impressive coalition of the like-minded at the Sixth Review Conference in 2006 and its members are looked to again by friends of the treaty for creative ideas and practical initiatives at the seventh review meeting this year.

The Group of Non-Aligned Movement and Other States (NAM) expresses a seemingly more urgent note: 'The high importance the Group attaches to an effective and verifiable BWC, implemented in a comprehensive manner, cannot be over-emphasized'. And among

In this issue...

Nicholas Sims looks ahead to the Seventh Review Conference of BWC parties in December, while Mikael Shirazi and Andreas Persbo discuss the importance of the IAEA's Additional Protocol in preventing the clandestine development of uranium enrichment facilities. Plus, Verification Watch, Verification Quotes and a special Science & Technology Scan with a travel report on the CTBT's 2011 Science & Technology Conference by Kristiane Roe Hammer.

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its members, India has recently stressed that verification of compliance is ‘critically important’. But the NAM appears to be too preoccupied at present with another treaty issue to translate its ostensibly pro-verification stance into tangible policy proposals. It is instead focusing on ‘comprehensive implementation’, understood as removing obstacles to trade and promoting civil applications of microbiology (which comes under the BWC Article X commitment to international cooperation in disease prevention and other peaceful uses).

For all three groups, then, verification will remain an elusive long-term goal until the US alters its position on the supposed unverifiability of the BWC.

Ambitious realism

But even with verification off the agenda, there is no shortage of practical proposals for the Seventh Review Conference.

Ambitious realism was the ‘guiding principle’ of Ambassador Paul van den IJssel’s well-received acceptance speech when the Dutch representative was nominated to the presidency of the conference on 7 December 2010. He was clear that the Biological Weapons Convention needs to be further strengthened by consensus, and that this consensus must be sought through flexibility and through sharing ideas as widely as possible in the run-up to the conference so as to avoid any last-minute surprises. The ambassador advised the parties to ‘Be creative: look for synergies and mutually beneficial solutions, rather than trade-offs and compromises’. Since then, he has chaired a reasonably productive Preparatory Committee (13–14 April), and maintained the theme of making best use of those 14 working days in December: ‘We need to create the space to build the future of the Convention.’

Ambitious realism translates into incremental steps to strengthen the BWC well beyond those attainable at the Sixth Review Conference in 2006. There was renewed hope after that meeting that the treaty had pulled itself out of the trough into which it had sunk and was setting out on the road to recovery. Plain-speaking by Kofi Annan, in an inspirational speech to the conference delivered as he came to

the end of ten years as UN Secretary-General, had encouraged delegates to overcome the debilitating deadlocks of 2001–02. Much adroit diplomacy followed. The result was an outcome document adopted by consensus, recording concrete decisions as well as the first final declaration agreed by a review conference since 1996.

However, the consensus achieved in 2006 was only possible because sights were deliberately set low. That was right, for the Sixth Review Conference. But it would not be right for the seventh. Hence the significance of Ambassador Paul van den IJssel’s acceptance speech. Governments preparing for the December conference in Geneva must be realistic, but also ambitious. They must seek consensus, not in the status quo, but over ways of strengthening the treaty. Strengthening will be incremental; as the treaty regime flowing from the BWC continues to evolve, it must still step delicately around such ‘unmentionable’ words as secretariat and verification, and it has to rely on political commitments not legally-binding obligations—but development must be deliberate, not left to chance. Everyone must raise their sights.

What then does the Seventh Review Conference need to achieve in order to steer the recovering BWC along a trajectory of constructive evolution through its next five years? A good start would be to recognise that the notion that the world can achieve biological disarmament cheaply is as dangerous an illusion as it has always been. The BWC needs a modest degree of institutional investment, as the world’s foremost defence against the weaponization of disease; the upcoming review conference should equip it accordingly. That will mean building on the limited achievements of 2006 and taking them further.

Institutional investment: renewing the Implementation Support Unit (ISU)

For instance, the Seventh Review Conference needs to build on the breakthrough that enabled the sixth to create an Implementation Support Unit (ISU) of three full-time posts within the Geneva Branch of the UN Office for Disarmament Affairs. These posts were funded for four years (2007–2011) after which the innovation was to be evaluated by the Seventh Review Conference. At the Preparatory Committee

on 14 April, Pakistan requested a consolidated report to be made available to parties well in advance of the upcoming conference so that they can review what has been achieved and take a decision on the ISU's future in December. This request was granted.

That decision should be for renewal; and judging by the warm appreciation for the ISU expressed at recent BWC meetings, its renewal will be one of the least contentious decisions facing the Seventh Review Conference. But it still cannot be taken for granted.

The ISU was given an administrative role in support of BWC meetings and was tasked to assist in two particular aspects of the treaty's ongoing life: the quest for universality (helping to persuade the hold-outs to ratify or accede) and the distribution of information received under the Confidence-Building Measures. As an information service, the ISU plays a vital role in helping existing parties understand better what is involved in implementing the BWC and informing prospective parties of what they would need to do if they were to join. It keeps a compendium of national approaches to implementation and a store of relevant legislative texts and other national documents. It is a clearing-house for offers of help and requests for assistance, and keeps in touch with relevant parts of the UN and other international organisations, as well as with the national authorities or other BWC contact points in governments.

The ISU should have its resources increased so that it can do these jobs even better. A possible expansion of its professional staff from three to five is widely supported. Some would go further, and cost estimates are being prepared. Voluntary funding from generous governments to augment the core budget should be formalised. The 2006 mandate could usefully be rationalised, even if it cannot be substantively changed while the largest contributors to its budget (US and Japan) remain suspicious of any tendency towards task-expansion on the part of the ISU.

Institutional investment: beyond the ISU

The ISU's creation, albeit for just four years with just three people, was a breakthrough because it was the first success

in the long campaign to remedy the BWC's notorious institutional deficit. The BWC has no technical secretariat or inspectorate or executive council or director-general or scientific advisory board at its disposal, such as are all found in the Organization for the Prohibition of Chemical Weapons headquartered at The Hague (and in many other treaty forums). Having no comparable BWC institutions, even on a smaller scale, risks sending the unintended signal that biological weapons are somehow less of a threat to the world than chemical weapons and deserve less attention.

Yet a fully-fledged agency or organisation is unattainable. Even a 'standing secretariat' for the BWC, as recommended by Hans Blix's WMD Commission in 2006, is unacceptable to timorous governments (an ISU sounds less threatening than a secretariat.) So what are the next attainable steps in remedying the BWC's institutional deficit?

An Annual Meeting?

Currently, the BWC is sustained by its five-yearly review conferences and an intersessional process consisting of an annual Meeting of States Parties advised by experts on selected topics. The practice of meeting every year is therefore well established, but its effectiveness in managing the BWC regime has been hobbled by the tight constraints imposed on the Meeting of States Parties in 2002 and 2006. Now the time is ripe for the Seventh Review Conference to take the next logical step, recognize the BWC Annual Meeting for what it is, and allow it to take decisions across a wider agenda so that the regime can be considered in a comprehensive manner.

At the very least it should be empowered to take 'concrete and practical decisions', as Chile advocated at the Preparatory Committee on 14 April. Setting up working groups, allocating their tasks and dates of meetings are management or housekeeping functions which the Annual Meeting ought to be allowed to perform from 2012. Some major issues—science and technology, CBMs, cooperation in peaceful uses of microbiology under Article X—should be recurrent items on its agenda. This would be a natural evolution from the 2007-2010 practice of receiving a report every year on progress towards BWC universality, and another on the work of the ISU. It need not preclude BWCRC-7 deciding

on an Intersessional Work Programme of topics allocated to the Annual Meeting in particular years, provided this pattern is more flexible than in 2003-05 and 2007-10 and allows space for more recurrent agenda items.

A well-structured BWC Annual Meeting, dealing comprehensively with the ongoing life of the treaty, could do much to strengthen this disarmament treaty regime. But first the Review Conference needs to define its management role and the limits of its authority. This modest institutional investment would have the further benefit of enabling future conferences at five-year intervals to focus more sharply on longer-term review.

An Accountability Framework?

BWC parties exist in a treaty relationship, accountable to one another (and beyond, to the wider international community) for their actions. They strengthen the treaty when they demonstrate their compliance with BWC obligations regularly, as a matter of good practice, not waiting for raised voices of accusation. This good practice could best be organised within an Accountability Framework. Each party will decide how it demonstrates its own compliance, within a framework built around the Articles of the treaty; but there must be an opportunity for them to consider one another's reports systematically, and to request and provide clarifications in a forum devoted to collective scrutiny. This forum could most conveniently be provided by accountability sessions at the Annual Meeting, an idea originally proposed by Canada in 2005. It could build on the practice of reviewing compliance through national reports, first requested in 1979, but make systematic what has hitherto been patchy (few reports submitted) and wholly devoid of collective scrutiny at the first six review conferences.

Accountability and collective scrutiny ought to give life to the treaty as an ongoing enterprise. Carefully prepared sessions organised over a four-year cycle should promote a developing sense of common purpose and shared experience within the BWC, as well as helping to allay doubts and resolve uncertainties over compliance.

They could also help defuse a potentially disruptive controversy over BWC Article X. This concerns whether a spe-

cific mechanism within this treaty is needed—as Cuba on behalf of the Non-Aligned Movement (NAM) has urged since 2009 in the face of, notably, US and UK opposition – to promote international cooperation in the peaceful uses of microbiology. The Accountability Framework could be used to demonstrate how much parties are already doing to honour Article X, with clarifications offered as necessary. It would then be easier to consider calmly what, if anything, a new BWC mechanism dedicated to the full implementation of Article X could add.

The Article X controversy has been complicated by argument over what counts as 'full' implementation and, less explicitly, by disagreement over how separable Article X should be from the rest of the treaty. A specific mechanism as advocated by Cuba, and, even more so, a standing committee for resolving disputes over biotech or pharmaceutical export denials as sought by Iran, are unlikely to win consensus support; but in the meantime they appear to undermine the long-held NAM insistence on the indivisibility of the BWC as a single integrated treaty in which no one Article should receive disproportionate attention.

A science and technology forum?

Science and technology do not stand still. BWC-relevant developments should be assessed and discussed collectively, but this seldom happens. One institution often proposed is a Scientific Advisory Panel or Network, which could advise parties at each BWC Annual Meeting. In its continuing absence, alternatives should now be sought. The Seventh Review Conference needs to set aside time within its 14 working days for collective assessment of the science and technology papers submitted for the review. Parties should also decide how best to organize a forum for regular collective assessment between review conferences, bringing together delegations and their experts annually (or at other agreed intervals) to keep pace with developments. They might, for instance, look at the BWC implications of nanotechnology one year and synthetic biology another. Convergence of chemistry with the life sciences is another area of relevance, with implications for BWC-CWC cooperation at the scientific level. Science and technology review is written into the BWC, in Article XII, but unless the Seventh Review Conference makes enough space for this task in its

own and subsequent agendas, and creates a forum for collective assessment it will continue to be neglected.

A suitably empowered Annual Meeting, an Accountability Framework and a new forum for reviewing science and technology papers would constitute useful and practical components of institutional investment in the BWC.

Confidence-building measures

Next, a review of the BWC's Confidence-Building Measures (CBMs) is long overdue. These measures involve parties annually exchanging information through the UN on a wide variety of issues including such things as human vaccine production facilities, unusual outbreaks of disease, past offensive BW programmes and relevant legislation in force. These information exchanges were launched in 1986-1987 and were expanded (from four CBMs to seven, with some other changes) in 1991, but have remained fossilized for 20 years since. Most states still ignore them. But, in the absence of verification, they are nevertheless a solid contribution to increasing transparency for the minority of states, now just over 70, which do engage in the CBM process. They are much better than nothing, especially when governments report fully on important CBMs such as their biodefence programmes and laboratories with high biosafety levels.

The sixth BWC review conference in 2006 was expected to update the CBMs but got itself entangled in a succession of procedural deadlocks so agreed very little on this issue beyond authorising the ISU to assist in their distribution. Instead, it referred them to its successor, for 'comprehensive attention'. New risks, threats, and security challenges continue to emerge. Meanwhile significant advances in the life-sciences are now coupled with knowledge and technology becoming increasingly available, accessible, and affordable. So it is all the more necessary that CBMs receive, this time, the 'comprehensive attention' that they deserve.

At a minimum, the Seventh Review Conference should update the forms on which parties report, and make it easier for CBM returns to be shared and used. Canada has offered to translate them into all UN languages. Good work has been done since 2009 by the governments of Germany, Norway, and Switzerland working as a trio with experts from

VERTIC, the London School of Economics and elsewhere through a series of Geneva Forum seminars and an e-platform to build consensus on desirable changes to the CBMs.

These proposed revisions address detailed wording for the existing seven CBMs. A more fundamental issue is, however, whether these seven are the most effective measures or whether an entirely new approach superseding the present CBM mechanism would do more to generate confidence. This issue needs to be addressed in a new working group, perhaps one of several: compliance measures and Article X have also been suggested as needing a working group apiece. Such groups could work in the interval between reviews, making useful progress alongside the Annual Meetings, as occurs in other treaty processes. Indeed, the Annual Meetings might be authorized to mandate them, if the Seventh Review Conference has not done so already. They could also be authorized to be flexible when deciding on the number of days allocated to each meeting to ensure that valuable discussion time is directed towards the most pressing issues.

Universality

The BWC has only 164 parties. Mozambique's accession on 29 March 2011 was the first since the Cook Islands in 2008. There are still 15 signatures (all but one dating from 1972) awaiting ratification, and a further 16 states have never even signed. A few have rooted objections, but most seem only to need sustained persuasion at a high level and offers of implementation assistance.

The Sixth Review Conference entrusted the responsibility for promoting universality to the Chairs of successive Meetings of States Parties (the Pakistani, Macedonian, Canadian and Chilean ambassadors) who reported every year through the Intersessional Process of 2007-2010. The seventh conference will have to decide whether the Chairs need more help. Alternatively the presiding officers of the conference and its main committees could form a continuing troika of Netherlands, Indonesia and Hungary to pursue universality. In any case, a more closely-targeted effort should be made to recruit to the BWC at a minimum all those parties to the 1993 Chemical Weapons Convention (CWC) that have not yet ratified or acceded to the BWC, as it is barely conceiv-

able that they can live with their CWC obligations but find those flowing from the BWC unacceptable. The number of hold-outs from the BWC should be reducible to single figures long before the next review conference in 2016.

Conclusion

The Seventh Review Conference must temper ambition with realism, but its sights must not be set as low as those of 2006. The BWC treaty regime needs strengthening, by consensus; and such consensus is within reach. There are distinct prospects for an agreement on reinforcing this regime, to make it less fragile and steer its evolution through 2012-2016.

An Accountability Framework would be a major achievement: the most significant reinforcement to be put in place since the BWC entered into force in 1975. It would give substance to an otherwise tenuous relationship between parties under this treaty, creating a forum for demonstrating and clarifying one another's compliance. But even if such institutional investment proves a step too far in 2011, more modest achievements are still of value. A working group on compliance may have to suffice for the next few years, while cautious governments take time to decide what kind of compliance measures are acceptable for the BWC. They have to bear in mind the failure of the Protocol negotiations of 1995-2001, the longstanding US insistence that the BWC is unverifiable, and the relegation of 'possible verification measures' to a distant future even by their erstwhile champions in the EU. This heightened sensitivity over anything to do with verification is one reason why, to the frustration of many of its friends, the evolution of the BWC moves forward at a painfully slow pace.

Yet some progress is possible. On 22 December 2011 specific decisions should be attainable on relaxing outdated constraints on the agenda, functions and mandate of a BWC Annual Meeting—allowing it to take 'concrete and practical decisions' on managing the intersessional process, organizing collective assessment of relevant science and technology developments, renewing the mandate of the ISU and increasing its resources, updating the existing CBM forms and procedures, and setting up working groups to address compliance, Article X, as well as the fundamental issue of

how confidence is best generated and whether the present CBM mechanism should be superseded.

These decisions could be mutually reinforcing. Together, they would meet Ambassador van den IJssel's declared goal of 'a comprehensive consensus outcome that substantially improves the operation of the Convention.' They should be pursued with vigour and persistence—and a prudent awareness of the alternative situation whereby the Seventh Review Conference clings to the status quo or, worse still, fails to reaffirm the body of extended understandings and agreements so painstakingly built up through BWC review conferences right back to 1980. This failure could happen if the NAM blocks adoption of a final document that does not satisfy its expectations over a specific mechanism for implementing Article X, or if the conference becomes deadlocked over the resumption of negotiations on a legally-binding instrument (Iran had wanted this explicitly added to the conference agenda but was persuaded to let it be finessed into vaguer language at the Preparatory Committee). A hopeful sign is that the most recent NAM statement refers to starting negotiations, rather than resuming the old ones. This forward-looking approach is more realistic. It gets away from the familiar pattern of blame-games over the now-distant BWC debacles of 2001; blame-games which have done nothing but exacerbate US-NAM tensions in an otherwise more promising atmosphere.

Grafting verification on to an existing disarmament treaty is much harder than including it in the first place. If verification provisions are ever added on to the BWC it is likely to require the negotiation of a legally binding instrument. In the meantime, there is much that can be done to strengthen the treaty regime, by modest institutional investment and other incremental measures, building on the foundations laid by earlier review conferences. That is the essential function of the Seventh Review Conference.

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Centrifuge production and the Additional Protocol

In early April 2011, a nondescript industrial plant 50km west of Tehran, named TABA, came under public scrutiny when it was revealed as being a significant centrifuge manufacturing site—apparently unbeknownst to the International Atomic Energy Agency (IAEA). As the technology involved has become ever more accessible, centrifuge-driven uranium enrichment has emerged as a significant proliferation risk. It is therefore worthwhile to consider the IAEA's ability to monitor the construction of these specialised machines. This issue is especially illustrative of the added value of the IAEA's Additional Protocol to the process of confirming the exclusively peaceful nature of countries' nuclear energy programmes. The Additional Protocol is a powerful legal instrument developed in the 1990s to complement member states' Comprehensive Safeguards Agreements (CSAs). This article considers the proliferation risks involved in centrifuge production and the merits of the Additional Protocol with respect to two countries, Iran and Brazil, neither of whom implement the updated safeguards techniques, but who both possess the ability and will to manufacture centrifuges.

The proliferation dangers of centrifuge technology

It is often considered that the most difficult stage in the production of nuclear weapons is acquiring the necessary fissile material: either plutonium or highly enriched uranium (HEU). In the past, acquiring these materials usually involved building and running a nuclear reactor (to make plutonium), or a gaseous diffusion plant (for HEU). Both required very substantial industrial capabilities. However, with the spread of gas centrifuge technology in the past three decades, the potential route to HEU has become both significantly less challenging—and less conspicuous.

Like the diffusion method, the gas centrifuge technique separates the two isotopes that make up uranium, concentrating the crucial U-235 from the very slightly heavier U-238. In nature, uranium consists almost entirely of U-238 (at around 99.3 per cent) and therefore requires processing

in order for the weapons-usable U-235 to be separated out. To be useful in 'light water' reactors, the raw material must be converted into uranium hexafluoride gas and subsequently 'enriched' in the separation process to consist of 3-5 per cent U-235 particles (known as low enriched uranium, or LEU). Natural uranium can be used in other reactor types after some processing. Nuclear weapons require HEU at about 90 per cent enrichment. Enriching with the centrifuge process involves injecting uranium hexafluoride gas into cylinders rotating tens of thousands of times per minute. The effect of centrifugal force pushes the U-238 closer to the outer wall of the machine, with U-235 particles tending towards the centre, which is then siphoned off. Each machine can only perform a very small amount of enrichment. An effective enrichment plant therefore requires large numbers of centrifuges linked together in so-called 'cascades'.

The older gaseous diffusion system requires thousands more painstaking steps, which take place in immense facilities using significant amounts of energy, and emitting large amounts of heat. In contrast, centrifuges on average perform the same amount of enrichment in significantly fewer steps, consuming smaller amounts of electricity. Centrifuge facilities therefore tend to be less conspicuous. They are typically much more compact, without the easily identifiable electrical and cooling systems associated with gaseous diffusion plants, or heat emissions detectable to infrared imaging systems. It may be possible to trace uranium hexafluoride gas accidentally released from a centrifuge enrichment plant, but these emissions are normally very small.

The number of centrifuges required to produce enough fissile material for a weapon depends on the design and efficiency of the centrifuges themselves—measured in kilograms of 'separative work units' per year (kg SWU/yr). This can range from lower than two kg SWU/yr for less advanced models to machines (currently confined to Europe or the United States) operating at 100 kg SWU/yr and above.

As a rule of thumb, it requires about 100,000–120,000 kg SWU to produce enough LEU per year for an average sized nuclear reactor. In contrast, it requires only 6,000 kg SWU to produce enough HEU for one weapon a year (known as one ‘significant quantity’, defined by the IAEA as 27.8 kg of 90 per cent enriched uranium).

The potency of gas centrifuge technology in terms of proliferation risks is therefore clear: these are machines capable of producing ‘significant quantities’ of fissile material in relatively low numbers and with a small footprint, thus making them a good bet for states wanting to develop nuclear weapons-usable material without being detected. However, centrifuges are complicated machines, requiring very specialised technical capabilities. One of the major difficulties is that even the slowest centrifuges spin at rates requiring unusually durable materials—ranging from aluminium alloys for older machines and maraging steel (a particularly strong type of steel) to modern ultra-strong carbon composites. These materials require precision machine tools to shape and strengthen them. The high-speed motors and their variable-frequency power supplies (which adapt the electrical current available from the power grid into an output of much higher frequency) also need to be specifically adapted for use in centrifuges.

Centrifugal safeguards standards

Under the 1968 Nuclear Non-Proliferation Treaty (NPT), non-nuclear-weapon states’ obligations on centrifuge manufacturing fall under two IAEA safeguards regimes: those with Comprehensive Safeguards Agreements (CSAs), and those who further implement the strengthened measures of the Additional Protocol to their CSAs.

Though each non-nuclear-weapon state’s CSA is individual, all follow the form and content of a standard text, ‘INFCIRC/153’, which obliges a country to provide information on all nuclear material and facilities, and to allow agency inspectors to verify these declarations. The resulting verification regime focuses largely on nuclear material accountability to check the accuracy of declared materials in declared facilities. According to Article 8 of INFCIRC/153, this guarantees the IAEA information on only those facilities ‘relevant to safeguarding such material’. The definition of

‘facility’ is articulated in Article 106 to include reactors, conversion plants, fabrication plants, reprocessing plants, isotope separation plants, separate storage installations, or any location where significant amounts of nuclear material is customarily used. As such there are no requirements regarding centrifuge production facilities. CSAs were designed in an age when centrifuge enrichment technology was still in its infancy. The underlying assumption was that the production of HEU through conspicuous gaseous diffusion plants would be readily detectable, and that the proliferation risk came instead from the diversion of material from declared facilities.

With the discovery of Saddam Hussein’s secret nuclear weapons programme in the aftermath of the 1991 Gulf War, it became clear that it was necessary to address possible clandestine uranium enrichment—with centrifuge production being an important component. Partly as a result of this discovery, the Additional Protocol was developed and opened for voluntary signature in 1997. It is a legal instrument that provides the IAEA with more information and wider access rights, thereby strengthening its ability to verify that a country is not producing material for nuclear weapon purposes.

The document ‘INFCIRC/540’ describes the standard obligations required under an AP. In contrast with INFCIRC/153, this document specifies in Article 2.a.(iv) that the participating state must provide the IAEA with a description of the scale of operations involved in centrifuge production. According to Annex I of INFCIRC/540, centrifuge production is described as the manufacture of centrifuge rotor tubes or the assembly of gas centrifuges. These activities are further detailed in Annex II, which describes the purpose, general design, and component set of gas centrifuges. Such constituent parts include: rotor assemblies, rotor tubes, bellows, baffles, top and bottom caps, magnetic suspension bearings, molecular pumps, motor stators, centrifuge housings, and scoops, among others.

As well as indigenous manufacturing capabilities, the protocol also brings into focus the other way of acquiring centrifuges (or their constituent parts)—import from foreign trade partners. Article 2.a.(ix) of INFCIRC/540 outlines

the state's responsibility, when requested, to provide information to the IAEA on the identity, quantity, and location of the intended use of all the materials and equipment listed in Annex II that have been acquired from abroad. The information generated by these requirements enables the IAEA to develop a fuller understanding of a member state's uranium enrichment programme. It thus becomes possible to draw comparisons between centrifuge production rates and centrifuge deployment in declared facilities: for instance, if more centrifuges are manufactured than deployed, the IAEA will be able to flag the discrepancy for further investigation.

The CSA and the AP differ not only in terms of the information flow that they can generate but also in the level of access for inspectors. According to Article 76.a of the model CSA text (INFCIRC/153), the IAEA is guaranteed access only to 'any location where the initial report or any inspections carried out in connection with it indicate that nuclear material is present.' There is a provision in Article 73 of INFCIRC/153 for 'special inspections', which give the agency the right to visit 'locations in addition to the access specified'—a vague definition which John Carlson, a member of VERTIC's International Verification Consultants Network, interprets as 'anywhere in the state' if there are 'circumstances giving rise to suspicion.' This could conceivably include certain centrifuge manufacturing plants. Historically, though, the special inspection tool (which, according to Article 77, must be obtained in agreement with the inspected state party) has been of little value. It has only been invoked by the IAEA on one previous occasion. This was against North Korea in 1992, and access was then denied. INFCIRC/540 (the model Additional Protocol) makes an important contribution in this area by outlining a system of 'Complementary Access' to inspectors. This expands the rights of the Agency to make visits to centrifuge manufacturing plants according to Article 4.a.(ii), for the purpose of resolving 'a question relating to the correctness and completeness of the information provided [...] or to resolve an inconsistency relating to that information.' There is no need to obtain agreement from the party and notification of a visit can be as short as 24 hours.

Though INFCIRC/540 specifies that the IAEA 'shall not

mechanistically or systematically seek to verify' information provided by the state, its ability to make informed judgments about a proliferation risk is substantially increased, and a state's corresponding ability to shield important information from it is substantially diminished. With respect to the monitoring of centrifuge production, the salient points of the Additional Protocol are Article 2.a.(iv)'s enshrined principle of information provision as a matter of routine, and Article 4.a.(ii)'s enshrined principle of Complementary Access as of right. This has important consequences, explored below, for states that produce centrifuges, as is made clear by the examples of Iran and Brazil, both of whom possess the indigenous capacities to manufacture these machines, but neither of which currently implement the Additional Protocol.

Iran: AP, the option-limiter

The controversy and uncertainties surrounding Iran's uranium enrichment programme are well-known and well-documented. The Islamic Republic has signed an AP, but has not yet ratified it. Nevertheless, Iran implemented the protocol on a voluntary basis between 2003 and 2006, but cut off cooperation in retaliation to the IAEA Board of Governors vote to report Iran to the UN Security Council. During this time the Agency learnt a great deal about the Iranian nuclear infrastructure; since then, however, relevant knowledge about centrifuge production capabilities has deteriorated markedly.

It is therefore not difficult to appreciate the interest generated, when, at a press conference in Washington, DC, an Iranian opposition group announced the discovery of the previously-undocumented role of a facility named TABA in producing centrifuge parts for Iran's controversial uranium enrichment programme. TABA apparently manufactures 'casing, magnets, molecular pumps, composite tubes, bellows, and centrifuge bases' primarily for the current generation of machines—but also for emerging next-generation centrifuges. Ali Asghar Soltanieh, Tehran's envoy to the IAEA, refuted any allegations of concealment, pointing out that Iran's safeguards obligations did not necessitate any provision of information about the plant to the IAEA. Rather, they required only the 'inspection of centrifuge machines.' This is indeed broadly in line with the require-

ments of the CSA as described above, which strictly speaking concerns itself only with the nuclear materials flowing within the machines.

The disclosure, however, highlights the proliferation risk resulting from the limited reach of the CSA. TABA is located in a nondescript industrial park and offers few distinguishing features. The facility's generic name—a Farsi abbreviation of 'Towlid Abzar Boreshi Iran', meaning 'Iran Cutting Tools Company'—also gives little away. This lack of transparency and openness over their centrifuge manufacturing capabilities offers the Iranian authorities the possibility—should they so choose—of secretly sending centrifuges to a undeclared enrichment installation to produce weapons-grade fissile material, whilst appearing to fulfil their safeguards obligations.

Enrichment facilities can be relatively small and largely indistinguishable from other industrial plants, or outright hidden as in the case of Iran's underground Qom enrichment facility. The Qom plant was uncovered in September 2009 as a result of Western intelligence-gathering operations; its existence was previously a secret. In an atmosphere so fundamentally degraded by a lack of trust between the principal actors, the possibility that any small and inconspicuous enrichment facility could be discretely producing weapons-usable material is a serious consideration.

It is a possibility that Iran's 2007 decision to suspend an essential commitment to the IAEA regarding the declaration of new facilities has made concerns over undeclared facilities significantly more acute. The commitment in question is set out in the modified Code 3.1 of Iran's Subsidiary Arrangements, to which it acceded in 2003 and which the CSA specifies cannot be unilaterally modified without the IAEA's consent. The result of the suspension, which the IAEA reportedly did not agree to, is that Iran has reverted to an outdated requirement that any new facility need only be declared six months prior to the introduction of nuclear material, rather than as soon as the decision to construct it is taken. The option therefore exists for Iranian authorities to begin construction on sites that can house centrifuge cascades, and even to outfit them with this equipment, without violating any its safeguards obligations. Of course,

if undeclared enrichment begins, this is no longer true. But many of the crucial steps taken to get to this point in operating a clandestine HEU-producing programme (the undeclared industrial development of centrifuges and their deployment in undeclared enrichment plants) will have been taken with little risk.

The power of the AP is to close off such windows of opportunity and thereby build confidence among countries. INFCIRC/540 states clearly the IAEA's right to be supplied with information regarding centrifuge production facilities, and its right to access these facilities. The result is an important reversal of responsibility, away from the IAEA having to press for data and onto the state itself to provide the information in a routine manner.

Brazil: AP, an option limited

The Brazilian centrifuge programme began as a covert project in 1979 at the behest of the military government that dominated Brazilian political life until 1985. A research team, under the direction of the Brazilian navy, developed over the next decade a centrifuge technology in which rotors spin not on the usual metal pin bearings, but on electromagnetic bearings, allowing the rotating and fixed parts in the machine to operate without any point of contact. This is designed to eliminate sources of friction which reduce efficiency and durability, and recent enrichment capacities have been placed at 10 kg SWU/yr. Construction of these machines takes place at the navy's Aramar Experimental Centre, outside São Paulo. Brazil has ambitious plans to attain an enrichment capacity at its main deployment site at Resende, near Rio de Janeiro, of 300,000 kg SWU/yr by 2014, and up to one million kg SWU/yr by 2030.

The military origins of the programme, its secrecy before the advent of democratic government, a late accession to the NPT in 1998, and the 2005 admission by a former president that Brazil had previously sought to develop nuclear weapons to counter competition from Argentina all point to the need for a robust verification regime that instils confidence in the peaceful ambitions of the programme as it exists today. Currently, this work is done through the 1991 Quadripartite Safeguards Agreement, which joins together Brazil, Argentina, the IAEA and ABACC (the Brazilian-

Argentine Agency for Accounting and Control of Nuclear Materials) to mandate the application of nuclear safeguards. Analogous to the CSA, this ad hoc arrangement does not offer the extended measures provided by the AP, as described above, with the exception of some provisions for unannounced inspections. Monitoring, performed by both ABACC and the IAEA, focuses on flows of nuclear material and provides access only to those facilities through which significant amounts of such material passes. It seems likely that another possible route to fissile material may be opened up with the Brazilian navy's development of nuclear-powered submarines, in which uranium enriched as high as 10 per cent by centrifuges at Aramar will power a reactor outside the reach of safeguards. Although the US has made efforts to persuade Brazil to give up on these plans, it was not successful, and negotiations with the IAEA to establish appropriate verification measures are ongoing. This is an eventuality that neither the CSA nor AP address directly, and for which entirely new arrangements will need to be developed.

Despite these substantial capabilities and ambitious plans, implementation of the Additional Protocol has been resolutely dismissed by Brazil, with the country's 2008 National Defense Strategy rejecting it until further progress in disarmament is made by the NPT nuclear weapons countries. Brazilian officials have offered a variety of other reasons—revolving primarily around an unwillingness to allow inspectors access to the commercially sensitive electromagnetic bearing technology, and the fact that it is an unnecessary measure in a country with a solid non-proliferation record which constitutionally prohibits nuclear weapons development (Brazil has also joined the Treaty of Tlatelolco, which establishes a Latin American nuclear-weapon-free zone, and ratified the Comprehensive Test Ban Treaty, which Iran has only signed). Analysts suspect the main reasons for opposition are military in nature, with the navy unwilling to grant extended access rights to the centrifuge manufacturing facilities in Aramar that are co-located with non-nuclear submarine R&D activities. This is despite the fact that Article 7 of the AP outlines clearly a state's right to request 'managed access' to protect proprietary information, and that the IAEA Department of Safeguards (in charge of the practical application of safeguards) has had regular access

to sensitive technologies throughout its history without leaking them.

Many of the same clandestine enrichment options are therefore as open to Brazil as they are to Iran - without, however, the associated IAEA reports, UN resolutions or Security Council sanctions. Most observers, such as Jeffrey Lewis, director of the East Asia Nonproliferation Programme at the Monterey Institute of International Studies, or Condoleezza Rice during her term as US Secretary of State, seem not to question Brazil's commitment against nuclear proliferation. Ad hoc measures, such as the Quadripartite Agreement and a future system to monitor enriched uranium production for nuclear powered submarines, are deemed to be imperfect but adequate safeguards measures - despite the lack of scrutiny on centrifuge production at Aramar. Crucially though, this type of safeguards development can only occur in an atmosphere with a certain level of trust; such as that which generally characterises the IAEA's relationship with Brazil.

One of the most important benefits of AP implementation is to lessen the impact of the wider political atmosphere. Should relations take a turn for the worse, the principles of information provision as a matter of routine and Complementary Access as of right allow for confident conclusions to be drawn over the use of centrifuge technology regardless of political context. With the IAEA thus somewhat shielded by the AP from the vagaries of international tensions over policy and intent, it is able to focus with greater freedom on states' technical centrifuge capabilities, allowing for more reliable judgements on proliferation risk to be made. The effectiveness of the IAEA's verification regime is diminished, however, by the selective and voluntary implementation of AP requirements in 'suspect states'—much as the theoretically powerful CSA Special Inspection tool is often rendered impotent in practice. Universalization of the Additional Protocol should therefore be a central goal in strengthening the global nuclear non-proliferation regime.

Mikael Shirazi and Andreas Persbo



Divided IAEA refers Syria to UN Security Council

In early June, the Board of Governors of the International Atomic Energy Agency (IAEA) voted to refer Syria to the United Nations Security Council, as a result of ongoing concerns that the country previously attempted to secretly construct a nuclear reactor. The decision came in the wake of the latest report on Syria by the director-general of the IAEA, which noted that a facility in a remote part of the Syrian desert, destroyed by an Israeli air raid in September 2007, was ‘very likely’ a nuclear reactor—which should have been declared to the IAEA.

The IAEA report, released in late May, focused primarily on the desert ‘Dair Alzour’ site, which Syria claimed to be an unused military facility under construction. The report noted that the facility appeared to instead be a nuclear reactor configured to produce weapons-usable plutonium rather than electricity, and that it was being built with the assistance of North Korea. The facility was ‘comparable to those of gas-cooled graphite moderated reactors’ of the North Korean type, the report said, and was supported by an infrastructure configured for this type of reactor. Environmental samples taken from the site by IAEA inspectors in June 2008 (the only such visit allowed by Syria since the bombing) also found particles of uranium; the Agency dismissed Syria’s claims that these originated from the Israeli munitions that destroyed the site based on an analysis of their ‘morphology and distribution.’ The report further explained that the IAEA’s repeated requests for access to relevant sites had not been granted by the Syrian authorities.

Though the report concluded that the Dair Alzour facility was ‘very likely’ a nuclear reactor, it stopped short of making any further recommendations for action. The decision as to what action would result was, consequently, left with the IAEA’s Board of Governors, where opinion was markedly split. Ultimately, of the 35-member Board, 17 countries voted for referral to the UN Security Council, 6 voted against, 11 abstained, and one was absent.

The move to find Syria in non-compliance with its safeguards obligations and to refer the case to the UN Security Council was spearheaded by the United States, whose intelligence services were the first to publicly allege, in 2008, that Dair Alzour was the location for the construction of a nuclear reactor of North Korean design. The US resolution in the Board was co-sponsored by 12 other nations (many European states plus Australia, Canada, and South Korea) and was supported in the vote by four more: Cameroon, Japan, Singapore, and the United Arab Emirates (UAE). Among the eleven abstentions were Argentina, Brazil, Chile, India, South Africa and Peru. Russia and China were among the six who voted against referral. The referral therefore passed without an absolute majority in the 35-seat body, and entailed the opposition of two of the five permanent veto-wielding members of the UN Security Council.

After the vote, the US Ambassador to the IAEA Glyn Davies said it was a necessary outcome of Syria’s actions, which ‘represents one of the most serious safeguards violations possible’, whilst the White House press secretary Jay Carney lauded the move as a ‘significant action by the international community to uphold the non-proliferation rules of the road.’ But with opinion among Security Council members split, while the IAEA vote represents a clear rebuke of Syria, the prospects for any further action remain highly uncertain.

Mikael Shirazi, London

New START: inspections and data-sharing begin

The New START treaty between the US and Russia entered into force on 5 February 2011. The first inspections under this agreement followed soon after in April this year. According to the US State Department, a US inspector team landed in Russia on 13 April to begin the initial on-site inspections of Russian nuclear facilities—making them the first on-site inspections of their kind since 2009 when the previous Strategic Arms Reduction Treaty (START I) be-

tween the US and Russia expired.

Under the new agreement, the right to conduct on-site inspections starts 60 days after entry-into-force. The treaty permits both countries to hold 18 inspections per year, divided among the other party's declared facilities—which in Russia amount to 35. Verification is a key component of the New START treaty. The pact will not lead to significantly lower numbers in terms of deployed nuclear warheads; its central aim is rather to increase confidence through data-sharing and information exchange, which should help to improve predictability and transparency.

According to the Nuclear Threat Initiative, a non-profit organization focused on arms control and non-proliferation, Russia has already met the numerical limits of the New START pact and could expand its nuclear arsenal without violating the treaty. New START limits each party to 1,550 warheads on 700 deployed strategic warhead delivery systems. Warhead numbers released 45 days after the treaty's entry-into-force, as the deal requires, showed that Russia currently fields 1,537 warheads and 521 deployed intercontinental ballistic missiles, submarine-launched ballistic missiles and heavy bombers. The US, on the other hand, has 1800 warheads on 882 delivery systems.

The next step under the treaty is for both countries to put their heavy bombers on show, no later than 120 days after entry-into-force. The two sides must also stage an initial demonstration on telemetry equipment (used to monitor the performance and progress of missiles in flight), no later than 180 days after entry-into-force.

Kristiane Roe Hammer, London

Libya misses CW destruction deadline, OPCW expresses concern

As the conflict between Muammar Gaddafi's regime and the rebel-led resistance movement continues in Libya, concerns have grown over the chemical weapons stockpile still in the country. In May, the Executive Council of the Organisation for the Prohibition of Chemical Weapons (OPCW) expressed its concerns over the materials, 'par-

ticularly regarding their security and destruction within the established deadlines.' Libya acceded to the 1993 Chemical Weapons Convention (CWC) in 2004, and subsequently declared its stockpile of chemical agents, munitions and production facilities to the OPCW (which is the implementing body of the treaty), before embarking on a programme to destroy them. By 2010, the OPCW reported that the country was making progress towards full compliance with its obligations under the convention, but the recent uprising and subsequent NATO military involvement has led to an atmosphere of uncertainty over the remaining chemical stockpiles.

Soon after the outbreak of hostilities in February, a number of concerns arose over Libya's chemical weapons. Firstly, Muammar Gaddafi's ability to maintain control over the weapons stockpiles (a key concern for the OPCW); and, secondly, his ability to deploy them against the rebels. One unnamed US official questioned whether the Libyan government was 'in full control' of the facilities in question. In March, Libya's permanent representative to the OPCW assured the organisation's director-general, Ambassador Ahmet Üzümcü, of his country's commitment to the implementation of the CWC, and maintained that the situation regarding the chemical weapons to be destroyed remained 'unchanged and under control.'

An OPCW spokesperson reported that before the popular revolt broke out, the Libyan government had disposed of some 55 per cent of its mustard agent stockpile and that the remaining 45 per cent (11.25 metric tonnes) of mustard agent remained in storage. A further 556 metric tonnes of precursor chemicals are also estimated to be in Libyan possession.

The OPCW conducts twice-yearly inspections in Libya, and is tasked with monitoring the destruction of the munitions and chemical agents. But given the difficult situation that has developed in Libya this year, a spokesperson for the organization said in March that the OPCW could not itself make judgements on the security of the Gaddafi regime's stockpile. However, according to American intelligence officials, forces loyal to Gaddafi have increased security levels around the principal stockpile storage site, which was under close scrutiny by Western satellites. It is reportedly sur-

rounded by a barbed wire fence and a protective berm.

In early May, as hostilities in Libya continued, Ambassador Üzümcü reminded Libya ‘of its international obligation to meet its destruction deadlines’ and reiterated that the responsibility for the physical security of chemical weapons in Libya ‘rests entirely with the Libyan Government.’ Later that month, Libya requested an extension of its destruction deadline, which passed on 15 May. Ambassador Üzümcü responded by saying that the issue was ‘being considered by the [OPCW’s] Executive Council.’ Given the volatility of the situation in Libya, questions over stockpile security and destruction timetables are likely to exercise the OPCW for some time yet.

Mikael Shirazi, London

Indonesia and Liberia join EU timber scheme

May 2011 saw the signing of EU Voluntary Partnership Agreements (VPAs) on illegal timber by both Indonesia and Liberia. The decisions by these countries to join the VPA scheme marks an important step forward and also highlights the importance of considering the links between ongoing initiatives against illegal logging and the burgeoning UN activities on deforestation and climate change. A VPA is a binding trade agreement between the EU and a 3rd country. The initiative falls under the EU’s Forest Law Enforcement, Governance and Trade (FLEGT) Action Plan. Adopted in 2003, this plan consists of a set of measures to curtail illegal logging and its associated trade, while improving access to EU markets for a partner country. Its core aspects included providing support to timber-producing countries, giving support for private-sector initiatives to promote corporate social responsibility; creating safeguards for financing and investment, and addressing the problem of conflict timber.

Indonesia has some 133.6 million hectares of forested land and annual timber-related exports from the country are valued at around \$9.7 billion each year. After five years of negotiations, the VPA between Indonesia and the EU will see regulation come into effect in March 2013. Since September 2010, the Indonesian Government has made all timber production subject to a national timber Legality Assurance System (LAS), indigenously known as the Sistem

Verifikasi Legalitas Kayu (SVLK), which includes independent auditing against a multi-stakeholder legality standard. SVLK uses an ‘operator-based licensing’ system or certification approach. A number of Conformity Assessment Bodies, known as Lembaga Verifikasi, have been established to ensure the compliance of the 4,500 timber exporters, processors, timber traders and timber producers in the country. These bodies are themselves validated by an Indonesian accreditation body. Indonesia’s system for guaranteeing timber legality will now need to be linked to the Legality Assurance System specified by the EU’s VPA, which will require some external support and expertise.

For its part, Liberia today retains some 4.3 million hectares of forested land after years of misappropriation. This constitutes over 50 per cent of West African rainforest. As part of extensive reforms since 2003, Liberia has reviewed its regulatory framework of the forest sector and overhauled its Forestry Development Authority (FDA). Through wide civil society participation, Liberia has outlined the legislative and regulatory requirements that timber products must now be verified against to ensure their legality. Liberia’s VPA Legality Assurance System is to be based on its existing national wood tracking system, LiberFor, which has been operating in Liberia since 2008. Liberia will need support in the implementation of LAS as it is operationalized over the coming years, with the first FLEGT licences anticipated in 2014.

The EU considers REDD—the UN-led set of initiatives to reduce emissions from deforestation and degradation—as complementary to their efforts under FLEGT. The signing of the Indonesian and Liberian VPAs should, it is hoped, highlight the importance of FLEGT and encourage the many different stakeholders involved in climate and forest governance to learn from the experience of VPA negotiations. Most importantly, as VPA and REDD activities grow, stakeholders will need to ensure that measures carried out under these two instruments serve to reinforce—and not duplicate or undermine—the aims of the other: ongoing learning and communication between the various communities involved will be paramount.

Joseph Burke, London



CTBT science & technology conference travel report

In June, the Comprehensive Nuclear-Test-Ban Treaty Organization held its Science and Technology Conference 2011 (S&T2011) at the elegant Hofburg Imperial Palace in Vienna. Over 800 participants from all over the world gathered for three days of test ban verification science and technology.

The Comprehensive Nuclear-Test-Ban Treaty (CTBT) prohibits parties from conducting nuclear test explosions. It was opened for signature in 1996. However, though 182 countries have signed the treaty and 154 have ratified it, it has not entered into force. This is because nine out of 44 countries identified in an annex to the treaty have yet to ratify it: until all 44 of these states have ratified, the treaty cannot come into force. The hold-outs are China, Egypt, Indonesia, Iran, Israel and the United States, who have signed the CTBT, and the Democratic People's Republic of Korea, India and Pakistan, who have yet to even sign. Even though the treaty has not entered into force, signatories are bound by it under Article 18 of the 1969 Vienna Convention on the Law of Treaties, which states that signatory states have an obligation to desist from any acts that would defeat the objective and purpose of a treaty that they have signed.

To verify compliance with the treaty, the CTBT uses a three-pillar verification system consisting of: an 'International Monitoring System' (IMS), an International Data Centre; and an on-site inspection regime. Much of the IMS is already in operation with about 80 per cent of the 337 planned worldwide facilities currently monitoring the globe for signs of nuclear explosions. The IMS is comprised of four different technologies to detect explosions: seismic, hydroacoustic, radionuclide and infrasound detectors. All the information from these stations is instantly transmitted to the International Data Centre at the CTBTO's headquarters in Vienna where it is compiled and distributed to the member states.

The S&T2011 conference built on the CTBTO's '2006 Symposium on Synergies with Science', and its '2009 In-

ternational Scientific Studies' conference. The goals of the meeting were to discuss and explore advances in science and technology relevant to test ban verification, and also to encourage partnerships and knowledge transfers between the CTBTO and the broader scientific community.

The first day of the conference welcomed keynote speakers Dr Richard Garwin and Dr David Strangway. Dr Garwin worked in the lab of Enrico Fermi and with Edward Teller to develop the first hydrogen bomb before going on to become scientific advisers to the US government on the safety of nuclear weapons and arms control. Dr Strangway was responsible for the geophysical aspects of NASA's Apollo missions. In the Q&A session that followed their lectures, Dr Garwin explained how the 1949 Soviet nuclear test was only revealed two years later, while today we can get information on nuclear explosions immediately.

The conference had 80 oral presentations in total, as well as three panel discussions and over 200 poster presentations on five conference themes: (1) the earth as a complex system; (2) understanding the source of a nuclear explosion; (3) advances in sensors, networks and observational technologies; (4) advances in computing, processing and visualization for verification applications; and (5) creating knowledge through partnership, training and information/communication technology.

One of the most timely topics on the conference's agenda examined the 11 March 2011 Japanese earthquake, subsequent tsunami and their implications for the CTBT. The IMS was one of the first systems to measure and report on the earthquake and quickly warned about the coming tsunami. With the ensuing crisis at Japan's Fukushima nuclear power plant, all four techniques currently in use in the IMS registered one or more effects of the 9.0 magnitude earthquake. UN Secretary-General Ban Ki-moon, in his video address to the conference, emphasized that, even before entering into force, the CTBT was already saving lives.

During the concluding session of the conference Tibor Tóth, Executive-Secretary of the CTBTO, announced that another conference will be held in 2013. Lassina Zerbo, the Project Executive of the S&T2011 and Director of the CTBTO International Data Centre Division, emphasized that the conference was not only scientific, but also about policy and diplomacy. As he put it, 'we are working on trying to do what the diplomats have talked about. Bridging science and technology and diplomacy is one of the CTBTO's most important tasks and in the words of Austria's Vice Chancellor, Michael Spindelegger, 'the CTBT's entry-into-force is long overdue and necessary'. As the S&T2011 clearly showed, the science community is doing their job in making the treaty verifiable; the rest is up to the diplomats and politicians.

Kristiane Roe Hammer, Vienna

NNSA begins test verification experiments

In early May, the National Nuclear Security Administration (NNSA)—part of the US Department of Energy—conducted the first in a series of experiments designed to develop more advanced techniques for detecting 'low-yield' nuclear tests. Designed to improve the ability to monitor countries' adherence to the restrictions specified by the Comprehensive Nuclear-Test-Ban Treaty (CTBT), the so-called 'Source Physics Experiments' (SPE) are seeking to more clearly distinguish between small nuclear explosions and events that produce similar signals, such as conventional explosions and small earthquakes.

Nuclear test monitoring capabilities rely primarily on the measurement of explosion phenomena, including characteristic seismic, infrasound, radionuclide, and hydroacoustic signals. The SPE programme is looking to deepen understanding of these phenomena, and to develop 'predictive, physics-based modelling and analysis' rather than 'observationally-based empirical models' that can suffer from gaps in knowledge and understanding. According to an SPE planning document from last year, the first seismic experiment—begun in May at the Nevada National Security Site—was designed to collect data including 'time domain reflectometry to measure explosive performance and yield, free-field accelerometers, extensive seismic arrays, and in-

frasound and acoustic measurements.' This should lead to a better understanding of emplacement, deployment, and processing techniques for sensors, as well as to improvements in yield estimation. The experiment was conducted 180 feet (about 55 metres) below ground using 220 pounds (approximately 100 kilograms) of chemical high explosives. The location was the Nevada site's Area 15, which previously hosted the 'Hard Hat' and 'Piledriver' nuclear tests in the 1960s. The granite of Area 15 provides a 'fairly homogeneous and well-documented geology' and an opportunity to improve 'understanding of how fractures, joints, and faults affect seismic wave generation and propagation.'

According to NNSA chief Anne Harrington, the test would 'validate and improve seismic models and the use of new generation technology' in monitoring low-yield nuclear explosions while enabling the US to observe the terms of the CTBT (which it has signed but not yet ratified). The project is being pursued in partnership with Los Alamos National Laboratory, Lawrence Livermore National Laboratory, Sandia National Laboratories and the Department of Defense's Defense Threat Reduction Agency. Though the US has yet to ratify the CTBT, it has observed a moratorium on nuclear testing since 1992. A White House bid to secure ratification of the treaty in the US Senate failed in 1999, but the Obama administration has signalled that it intends to pursue a second attempt at ratification in the Senate in the near future, see *Trust & Verify*, no. 132 (which also details recent tests by the CTBT Preparatory Commission to improve monitoring of nuclear explosions).

Mikael Shirazi, London

Developments in 'lab-on-a-chip' technology

An EU-funded research project has developed a chip that can screen water for biological pathogens. The device could help to prevent, or limit, a bio-attack on drinking water supplies. The tiny chip could improve response times by eliminating the need for specialised and time-consuming laboratory analysis.

The 'DINAMICS' project (short for 'diagnostic nanotech and microtech sensors') began in 2007 and involves researchers from 12 institutes across eight different European coun-

tries. Four years and €7.14m later, the project has developed a prototype that recognizes and binds pathogenic DNA from water samples. The project has developed two different ways of reading pathogenic DNA. One is by applying chemiluminescence to make the bound DNAs emit light that can be interpreted by a computer. The other turns the bound DNAs into electric signals. With this method it is also possible to measure intensity, since the magnitude of the signals will be proportional to the concentration of pathogenic DNA in the water sample.

The project team likes to refer to their sensor as a ‘lab-on-a-chip’ since the technology can get the same information instantly from the water sample that would otherwise require laboratory analysis. This should save time, resources and money. The civilian medical industry has showed great interest in the project, and the chip will also soon be commercialized for use in medical diagnosis. What’s more, the chip has the potential to be fully networked: the system could be set up so that authorities receive an alert through e-mail or a text message if water samples are abnormal.

Other institutes around the world are also engaged in research on water monitoring devices. Oregon State University, with a grant from the US Army Research Laboratory, have reported the successful use of magnetic ‘nanobeads’ to detect chemical or biological agents. This device is reportedly hand-held and 1,000 times smaller than those in current use.

Meanwhile, the Fraunhofer institute in Germany has developed what they call the AquaBio Tox. This bio-sensor detects hazardous material in water through monitoring the behaviour of microorganisms in a ‘box’ with a highly sensitive camera system. The microorganisms have been modified to produce a protein that has red fluorescence which changes when it comes in contact with toxic substances.

A successful terrorist attack on water supplies using a biological agent could have disastrous effects. Curiously, however, DINAMICS project coordinator Christian Mittermayer told VERTIC that the drinking water industry is not showing much interest in the project, presumably because there is no regulatory pressure to monitor drinking water

Verification Quotes

‘OPCW inspections are today accepted as a norm in the global chemical industry, and this contributes significantly to the confidence among states parties in our verification regime.’

OPCW Director-General Ahmet Üzümcü on the 2000th inspection of a declared chemical facility under Article VI of the Chemical Weapons Convention. The inspection was carried out at an industrial plant in the Republic of Korea on 21 April 2011.

‘We believe that you need to increase confidence that countries are complying with their obligations and effectively implementing the convention. As you know, the US government does not think that a verification protocol would achieve that objective. That, however, doesn’t mean we think that the objective is not important or that there’s nothing to be done. Very much to the contrary.’

Laura Kennedy, the US ambassador to the Conference on Disarmament in Geneva, speaking on the US administration’s attitude toward verification of the BWC.

‘We pledge to share widely the benefits of our unprecedented monitoring system through mass collaboration, education and capacity development. All the benefits of a system and a regime which are not possessed by any of us, but belonging to all of us.’

Executive-Secretary of the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), Tibor Tóth, addressing participants at the CTBTO’s Science & Technology Conference 2011 at the Hofburg Imperial Palace in Vienna, Austria, on 8 June.

for this purpose. But, as these new ‘lab-on-a-chip’ devices are small, mobile and easy to use out in the field, they could be a great help for first responders in cases where there is suspicion of an attack using a biological weapon. If the parties to the 1972 Biological Weapons Convention decide to re-open the verification file and want to explore ways to conduct environmental monitoring, this technology is undoubtedly one to keep an eye on.

Kristiane Roe Hammer, London

VERTIC 25th Anniversary Conference

In early June, VERTIC held its 25th anniversary conference at the Wilton Park conference venue in heart of the West Sussex countryside. The conference—titled ‘Uncertain futures: where next for multilateral verification’—was a joint undertaking by VERTIC and Wilton Park, with funding provided by the governments of Norway and Sweden. It brought together some 50 participants from governments, intergovernmental organizations and civil society groups (including, of course, VERTIC itself). All discussions were held under Chatham House rules. Wilton Park is an independent branch of the UK Foreign and Commonwealth Office and was established in 1946.

Eight sessions were convened over the three day conference, each focusing on a particular aspect or theme of multilateral verification in the arms control & disarmament and environmental fields. The opening session, which focused on the role and relevance of multilateral verification, heard from the conference’s two keynote speakers; Vitaly Matsarski, Coordinator of the Reporting Data and Analysis Programme at the Secretariat of the UN Framework Convention on Climate Change, and Tibor Tóth, Executive Secretary of the Comprehensive Nuclear-Test-Ban Treaty Organization. The second session addressed ‘confidence, credibility and security’ in multilateral verification regimes.

The second day of the conference involved four sessions addressing, respectively: ‘how much verification is enough’ to verify compliance with—and adherence to—different treaty regimes and international undertakings; state tolerances to multilateral verification; the political and scientific interface of multilateral verification; and the role of civil society in the development of verification regimes. The third and final day of the conference discussed the effectiveness of current arms control and environmental verification regimes—and wrapped up with a concluding session bringing together the observations emerging from the conference. Each of the conference sessions involved two speakers, before a roundtable discussion.

The conference brought together many of the leading practitioners and writers from the field of international agreements. Attendees came from both the developed and developing world, ensuring a range of viewpoints and experiences were heard and discussed. Each session, the conference organizers were pleased to note, enjoyed a very high level of engagement in the roundtable sections. The thematic approach across a broad range of regimes allowed participants to learn, reflect and look ahead to challenges and opportunities in using multilateral instruments for a more secure and sustainable world. VERTIC is extremely grateful to the conference speakers, participants and the staff at Wilton Park for making the conference proceed so smoothly and enjoyably.

Arms Control and Disarmament Programme

The last three months have been a busy period for the VERTIC Arms Control & Disarmament team. In April, following his presentation to the Carnegie Nonproliferation Conference, VERTIC’s Executive Director, Andreas Persbo, participated in a CTBT workshop meeting in Washington, DC, organised jointly by VERTIC and the British American Security Information Council (BASIC). April also saw Mr Persbo attend a seminar in Glion, Switzerland, on ‘Optimizing the IAEA Safeguards System’ and a meeting of the ‘Colombo Initiative’ on verified missile dismantlement in Sofia, Bulgaria. Larry MacFaul also travelled on behalf of the ACD programme in April—to Geneva, where he presented on ‘The Elements of Successful Verification System’ at an UNIDIR-organized conference on space security.

In May, Andreas Persbo travelled to Brussels to participate in the inaugural meeting of the European Non-Proliferation Consortium, a network of non-proliferation-focused European think-tanks established by the Peace Research Institute Frankfurt, the Stockholm International Peace Research Institute, the International Institute for Strategic Studies and the *Fondation pour la Recherche Stratégique*. In addition to a number of ‘kick-off’ meetings, the network is tasked

with organizing two European non-proliferation conferences (in 2012 and 2014), producing a variety of issue papers, managing a consortium website and delivering an EU seminar on a WMD-free zone in the Middle East.

In June, aside from the VERTIC Wilton Park conference (which all ACD staff attended), Andreas Persbo travelled to Sandia National Laboratory in Albuquerque, New Mexico, for a meeting of the Colombo Initiative, as well as to Berlin for a conference on dual-use technology transfers organized by the University of Hamburg's Institute for Peace Research and Security Policy. June also saw Mr Persbo participate in a student-led reconstruction of the UK-Norway Initiative verified warhead dismantlement exercise in Norway. Finally, Larry MacFaul attended a meeting at the end of June on the Nuclear Non-Proliferation Treaty at the Foreign & Commonwealth Office in central London. Over the last three months the ACD team has also been engaged in research and analysis for a funder.

National Implementation Measures Programme

During this quarter, the NIM team conducted one legislative drafting workshop, completed six legislative surveys, and worked on the universality of the Biological Weapons Convention (BWC). NIM staff also prepared a Sample Act to implement the BWC for states with a civil law tradition in French, which is available on the VERTIC website.

The team gave presentations at the Organisation for the Prohibition of Chemical Weapons (OPCW) Workshop 'Chemical Weapons Convention Protection against Chemical Weapons and Prevention of Terrorist Use of WMD Related Materials' in Cavtat, Croatia, 9-10 April. They also gave a statement and interview at the OPCW Seminar on the 'OPCW's Contribution to Security and Non-Proliferation of Chemical Weapons' in The Hague, the Netherlands, 11-12 April. Staff attended the Second General Meeting of the Chemical Weapons Convention Coalition (CWCC) in The Hague on 13 April, where the Director-General of the OPCW, Ambassador Ahmet Üzümcü, affirmed VERTIC's role in working with the OPCW on the implementation of the Chemical Weapons Convention through assistance to parties. NIM staff attended the Preparatory Committee for the Seventh Review Conference of the BWC in Geneva,

Switzerland from 13-15 April and participated in the 'International Workshop on Developing Practical Proposals for the Seventh Review Conference of the BWC' in Montreux, Switzerland, 9-10 April.

The NIM team contributed to a 'National Focal Points roundtable for the Chemical Biological Radiological Nuclear (CBRN) Centres of Excellence' in Bangkok, Thailand from 10-13 May. They also gave a presentation at the 'Countering Biological Threats' conference that was organised jointly by the United States and Georgia in Tbilisi, Georgia, 17-19 May. NIM staff also participated in a BWC implementation workshop organised by the 'European Union Joint Action in support of the BWC' in Chisinau, Moldova from 21-24 June. Lastly, NIM staff conducted several sessions on national implementation of the BWC at the 'Regional Workshop on National Implementation of the BTWC and CBMs for East Asian-Pacific Region countries' during 27-28 June and on BWC confidence-building measures at the 'Regional Workshop on Preparations for the Seventh Review Conference of the BWC' during 30 June-1 July, both convened in Manila, the Philippines.

Environment Programme

In the April-June period, the Environment Programme undertook research on linkages between international trade policies and the climate change regime. The programme continued to monitor developments in negotiations on governance structures for international climate finance. It also monitored discussions among countries on verification systems in the UN climate convention negotiations.

Larry MacFaul attended meetings on support mechanisms for climate change and forest governance initiatives, including in Portcullis House, London. He also participated in Chatham House's 18th Illegal Logging Update and Stakeholder Consultation Meeting, 20-21 June. The meeting sessions covered a range of topics including the EU's timber regulation; forest certification; the Liberia VPA; the Central African Republic VPA; Indonesia; agricultural commodities; and REDD. Presentations from the meeting are available on the Chatham House website www.illegal-logging.com.

Grants and Administration

The Foreign & Commonwealth Office (FCO) agreed to a grant of around £43,000 for a pilot project on the universalization of the IAEA Additional Protocol. The FCO Board has agreed to the full amount subject to VERTIC completing the six month pilot phase. VERTIC also received another grant during this period for Arms Control and Disarmament work.

On 11 May 2011, VERTIC held a meeting of the Board of Trustees. Lord Des Browne of Ladyton was elected to be a trustee.

Ronald Nelson, a VERTIC Board member since 2010, passed away on 9 May 2011. VERTIC mourns his passing and extends its deepest condolences to his family and friends. Scott Spence attended his memorial service in South Dakota on 24 June.

On 1-3 June 2011, VERTIC held a conference at Wilton Park to mark VERTIC's 25th Anniversary. The conference was funded by the governments of Norway and Sweden. VERTIC is grateful to its funders for their continued support.

We would like to thank our outgoing interns Mikael Shirazi and Kristiane Hammer who complete their internships at the end of June, as well as Joseph Burke who completed his internship with VERTIC at the end of May. All three have made outstanding contributions to the organization.

building trust through verification

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

PERSONNEL Andreas Persbo, *Executive Director*, Angela Woodward, *Programme Director*, Larry MacFaul, *Senior Researcher*, Scott Spence, *Senior Legal Officer*, Hassan Elbahtimy, *Researcher*, Rocío Escauriaza Leal, *Legal Officer*, Yasemin Balci, *Programme Assistant*, David Cliff, *Researcher*, Unini Tobun, *Administrator*, Sonia Drobysz, *Volunteer* (November 2010-October 2011); Joseph Burke, *Intern* (January-May 2011); Mikael Shirazi, *Intern* (March-June 2011); Kristiane Roe Hammer, *Intern* (May-June 2011).

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