

Safeguards in Iran: prospects and challenges

Iran's nuclear programme is steadily steaming ahead, despite a host of diplomatic initiatives to curtail it. Its uranium enrichment programme continues to thrive, with Iranian scientists seemingly overcoming technological hurdles at an increasing pace. At the same time, there are comparably few safeguards on the programme. Iran has suspended the application of its Additional Protocol—a safeguards pact designed to give some assurance that no undeclared activities are going on—and is only giving very limited inspector access to its nuclear facilities. Diplomatically, the West and Iran is at a stalemate, glaring at each other across an ever widening nuclear divide. Given the seriousness of this situation, have Iran, *and the West*, done everything in their power to reach an amicable solution?

Diplomatic channels have been iced over since the 2005 election of President Mahmoud Ahmadinejad, but unofficial channels remain open. A number of these were organized by the Pugwash Conferences on Science and World Affairs in 2008. The author participated in one of these channels, and this article outlines some his impressions. First, though, it is necessary to review the status of verification today.

Limited access and lost knowledge

The state of safeguards in Iran can be summarized in one word: 'inadequate'. The country is applying so-called comprehensive safeguards, an almost forty year-old declaration and inspection scheme which is sadly anything but comprehensive. The scheme is based on material accountancy at declared facilities. There are many nuclear activities that fall outside the scope of these safeguards: centrifuge research and development, uranium mining, even the drawing up of new nuclear infrastructure. Since they focus on declared facilities, they logically offer limited protection against the establishment of undeclared fuel cycle facilities. This point was proven beyond doubt in Iraq in the early 1990s.

Revelations that Iraq had developed a nuclear programme throughout the 1980s eventually led to a safeguards reformation, which culminated with the adoption of the so-called Additional Protocol in 1997. The new safeguards system is designed to have a reasonable chance of detecting undeclared facilities in the state. Iran never signed the Additional Protocol in 1997. This meant that the International Atomic Energy Agency (IAEA) had no knowledge of the undeclared construction of a substantial nuclear fuel cycle within the country. When uncovered, Iran's clandestine fuel cycle took many by surprise. (Safeguards are discussed in-depth later in this

In this issue ...

Andreas Persbo recalls discussions with Iranians, while Sir Hugh Beach ponders the state of the nuclear safeguards regime. Plus Verification Watch, Science and Technology Scan and VERTIC News and Events.

issue).

Iran reacted by showing transparency. Presumably, the Iranian calculus was that if they were seemingly transparent about their operations, the IAEA investigation would finish quickly. So consequently, on 18 December 2003, Iran signed the Additional Protocol. Shortly thereafter, it brought it into force provisionally. Inspectors were allowed in to examine the country's nuclear fuel cycle in greater detail. However, Iran's cooperation was reactive rather than proactive during this process and the IAEA had to tease information out of the Iranians one bit at a time.

Over time, the IAEA developed a relatively clear picture of Iran's nuclear activities. Yet, many questions continued to plague the programme. The Agency did not get access to all individuals and documentation. Some sites were drastically modified or even razed before inspections could occur. And there were troubling military connections to the programme; connections that have yet to be explored.

In 2005, relations between Iran and the West broke down, and the IAEA found itself in a verification ice-age. Iran stopped applying the Additional Protocol, and reverted back to the old safeguards order. As the information tap was turned off, the IAEA started to lose knowledge about what was happening inside the country. The Director-General persistently called on Iran to show transparency going beyond its present obligations. His argument, in a nutshell, is that confidence cannot be restored unless Iran opens up its books. Without full disclosure, the IAEA is unlikely to be satisfied. Without transparency, international concerns will remain.

Intractable politics of verification

Iranian participants in the Pugwash dialogue were acutely aware of how important effective verification, as well as stringent monitoring, is to the solution to the Iranian nuclear issue. After all, the Iranian government persistently points out that all *declared* material is accounted for and in peaceful use. The safeguards system deployed at their uranium enrichment facility will detect very small deviations from de-

clared quantities. This provides some, but far from all, assurance sought by states concerned by Iran's nuclear progress.

The issue now is not so much whether declared material has been diverted, rather it is *whether all material has been declared*. An additional matter of concern is what Iran intends to do with its declared stockpile in the years to come. The first issue can be resolved through a re-application of the Additional Protocol. Enhanced monitoring will give inspectors some knowledge about how materials are used, but it will not tell them *how materials are intended to be used*. The second issue can only be resolved through a combination of intensive dialogue and Iranian restraint.

In the 2008 Pugwash dialogue, Iranian participants seemed to be convinced that there could be benefits from normalized nuclear relations; in particular in respect to safety cooperation. These individuals said that they could be willing to consider cooperation on technical and institutional safeguards, but that it was paramount that any cooperation does not hinder their technological progress. In the hallways of many Western governments, these arguments have little appeal.

It can be argued that there is a *structural* confidence deficit in Iran's intentions. The country's foreign policies have, rightly or wrongly, led to the country being widely distrusted in many other parts of the world. This distrust has a direct bearing on the nuclear issue, and by extension on the degree of transparency and accountability that Iran needs to afford in the coming years if it is interested in solving the problem.

It is not clear how this deficit can be eliminated. Since it's structural, it's also chronic, and only explicit and direct government policy can redress it. No matter how much policy-makers in Tehran desire it, it simply will not vanish with time.

The cessation of Iran's enrichment activities would help. Today, however, there is virtually no incentive

to discuss suspension. Indeed, one participant in the Pugwash dialogue even suggested that the UN Security Council, instead of demanding suspension, lift all resolutions and focus their efforts on discussing Iran's future nuclear fuel cycle. This would in effect move the West's 'nuclear red line' so that it reflects Iran's current capabilities, including its present uranium enrichment capacity, an obvious no-go in many Western conference rooms. Iran's present enrichment infrastructure is more than capable of supporting a small nuclear weapons programme.

On the other hand, one Western participant held, quite strongly, that there nevertheless is a need to look into alternatives to suspension, such as an upper limit on the number of installed centrifuges throughout Iran.

Some in the West would probably settle for a reapplication of the Additional Protocol. But it is far from clear whether the US or, for that matter, Israel would feel more secure with an Iranian move in that direction.

So should we forget about the protocol?

The protocol still plays an important part. It is difficult to argue that increased transparency is a *step in the wrong direction*.

Decision makers in Tehran are critically aware how important this instrument is for the IAEA's mission. At Pugwash's table, however, no one would step up and advocate effective verification as a part of the solution to the problem. Instead, any reapplication of the Additional Protocol seems to be tied to a set of Iranian demands. First and foremost the recognition that Iran should be allowed to continue to enrich uranium during negotiations with the West.

Iran would also want to see some tangible offers on the table before even considering reapplication, in particular concrete moves towards some normalization of relations with the US. But the West is not likely to move an inch before Iran shows some flexibility in its nuclear policy. Admittedly, it is difficult to see any short term movement on this issue.

And what if Iran reapplies the protocol?

A provisional application of the Additional Protocol opens up the scope for further investigations by the IAEA into Iran's past activities. This is a lengthy process and will be complicated by Iran's past violations under its safeguards agreement. It will continue the process of bridging the confidence gap, but for many governments, it simply won't be good enough.

In 2007, VERTIC, thanks to a grant from the Joseph Rowntree Charitable Trust, outlined a set of technical proposals on how Iran and the West could cooperate efficiently and effectively on resolving outstanding issues. These proposals were developed in close collaboration with a number of Western governments as well as some Iranian institutions. They were extensively reviewed by the very people that were supposed to do the tough job of building confidence, and were deemed lawful, practical and implementable.

Since then, the political climate in Tehran has hardened considerably—and selling the pressing need for more transparency, more accountability, and more monitoring has become more difficult. But the sell needs to be done. Because without further transparency, this issue will continue to cast a shadow on Iran's nuclear programme for many years to come.

Andreas Persbo

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Verification Quotes

'...giving a "clean bill of health" is as impossible for the IAEA as for a doctor. Small bugs can hide'. Hans Blix, former IAEA Director-General, discussing further inspections in Iran.

'we got hung up on verification, and the North could not expect that we were going to agree to – you know, we were just going to take the documents that they presented us with and, you know, assume they were gospel. We need to be able to verify'. State Department Spokesperson Robert Wood on the verification effort in the Democratic Peoples Republic of Korea.

Verifying the NPT: a civil society perspective

Verification is a process of finding out whether a state party is doing what it has promised to do. If there is a potentially serious consequence to the breach of a commitment, and if it is strongly suspected that such a breach has occurred, verification has to be all the more stringent.

This article will examine verification provisions under the 1968 Nuclear Non-Proliferation Treaty (NPT). Under this treaty, states are required to enter into safeguards agreements with the International Atomic Energy Agency (IAEA) which then has the job of verifying compliance with these agreements.

The IAEA's role and function

The IAEA has a tough job for two reasons. First, its verification role has to compete, both politically and in terms of resources, with its other primary role, which is promoting the peaceful uses of nuclear energy. And it is tough, secondly, because the agency is trying to prove a double negative i.e. that such and such a country is not, somehow, somewhere, trying to cheat on its promise not to try and build a nuclear weapon. Some 40 states, mostly in Western Europe or the Americas, have significant nuclear activities that need to be checked.

The Agency is governed by a 35-member Board of Governors, drawn from the member states with the most advanced nuclear technology and others that are the principal producers of nuclear source material. It has a Secretariat based in Vienna, headed by an Egyptian diplomat, Mohamed ElBaradei—winner of the Nobel Peace Prize for 2005—whose third and last term as Director General ends in November 2009.

The agency has regional offices in Toronto and Tokyo and research laboratories in Austria, Monaco and Trieste. Its budget for 2009 is €296 million, of

which €117 million is for nuclear verification and a further €24 million for its work on nuclear safety and security. The Agency has 2300 professional and support staff drawn from more than 90 countries. 560 of these are inspectors, the largest number in the Agency's history.

Its role in 'safeguarding' the atom

All non-nuclear weapon states parties to the NPT are required to conclude a comprehensive or 'full-scope' safeguards agreement with the IAEA. This means that they should declare to the IAEA all their nuclear facilities and all nuclear materials. These are subject to verification—'safeguarded'—by the IAEA to make sure there is no hoarding of significant quantities of nuclear material for warlike purposes.

Traditional safeguards focus on accountancy and control of nuclear materials. In addition to nuclear book-keeping, the Agency also uses passive 'containment and surveillance' measures such as tamper-resistant seals and surveillance cameras. This way, the Agency knows, at least in principle, the quantities and locations of all declared fissile material.

Limitations of comprehensive safeguards

When agreed in the 1970s classical safeguards were considered an adequate political compromise in balancing intrusiveness and thoroughness with financial costs and respect for national sovereignty. In time serious shortcomings came to light. The worst was that the IAEA could only monitor materials and facilities *declared to it* by states parties, allowing would-be proliferators to develop substantial undeclared nuclear capabilities without being spotted. While a so-called special inspection could be requested in cases where there was strong suspicion of cheating, these have been difficult to invoke. Such inspections

have taken place once in Romania (on the invitation of the Romanian government), but when one was ordered in 1993 for North Korea, the country simply refused to accept inspection.

A second limitation relates to the dual nature of nuclear power and the constraints of international law. Presently, states are allowed to assemble what could make up many of the elements of a nuclear weapons programme as long as they declare them to be for peaceful purposes and subject them to safeguards. Having mastered all of the relevant technologies, a state could then legally withdraw from the NPT on three months' notice and begin to produce nuclear weapons without breaching international law. This is what North Korea did in effect, and what it is feared Iran may be planning to do some time in the future.

A third weakness of classical safeguards lies in the fact that the amount of verification of any state party is determined by the size of its nuclear industry, not by the likelihood of its non-compliance. This has led to the wastage of resources on verifying states with large, well developed nuclear industries, like Canada, that are not of proliferation concern, while distracting attention from those that are, such as Iran.

A desire for reform...

The great impulse for reform of the safeguards system was the discovery in 1991 of just how close Iraq had come to acquiring nuclear weapons—despite having been subject to nuclear safeguards for almost twenty years. In December 1993, the Board of Governors launched a new programme. The first part involved activities that could be initiated by the IAEA within its existing mandate while the second part contained measures that would be possible only by establishing a stronger legal basis. The latter evolved into the Additional Protocol.

...drawing on existing authority...

In 1995, the IAEA started to ask more from states with full scope safeguards agreements. This included requesting additional information on facilities that formerly contained nuclear materials subject to safe-

guards but no longer did so, or which were expected to do so in future; increasing the level of remote monitoring of movements of nuclear material; expanding the use of unannounced inspections; and collecting environmental samples at sites to which the Agency already has access. These efforts have been aided by the greater use of open source information, including commercial satellite imagery, as well as by intelligence provided by third parties and increased information supplied by states parties themselves.

... and designing the Additional Protocol

In May 1997 the Board of Governors agreed a Model Additional Protocol. This extends states parties' declaration and reporting obligations to the entire nuclear fuel cycle. These obligations stretch all the way from nuclear mining and processing to the storage of nuclear waste. The Protocol also expands the IAEA's rights to conduct inspections of nuclear industries, most importantly through *complementary access*. This means the Agency can inspect any part of a declared nuclear facility instead of only designated strategic points. Complementary access can be coupled with *short-notice access* to all facilities at a nuclear site and with the possibility of collecting environmental samples outside declared locations. The Additional Protocol increases the IAEA's capacity to ensure that states parties' declarations are complete, as well as improving its prospects for detecting undeclared nuclear material and activities. This offers a vastly improved basis for deterring a state from engaging in prohibited activities.

So now everything is solved?

After a decade of efforts, the record of strengthened safeguards is mixed. Those activities that fall under the IAEA's existing authority have been slow to develop. As for the Additional Protocols, by March 2009, 131 had been approved by the Board of Governors, 119 had been signed and only 90 had been brought into force.

The failure of particular states to adopt strengthened safeguards does not necessarily mean they intend to

acquire nuclear weapons. It may simply result from legislative or other technical difficulties, incompetence, bureaucratic indifference or political concerns.

Some hold-outs, such as Brazil, in full compliance with their existing obligations, resent being pressed to accept increased verification when other countries retain nuclear weapons, despite being bound under Article VI of the NPT to work towards their elimination, or when others have attempted to acquire nuclear weapon capabilities under cover of safeguards.

Another factor in the slow take-up rate of additional protocols is a lack of concern about the dangers of nuclear proliferation, most commonly among states that have relatively minor nuclear activities. To ease the burden on those states, the IAEA has developed a Small Quantities Protocol, which involves simplified procedures for states that have little or no amounts of nuclear material to report.

There is also resistance to strengthened safeguards from states concerned about the much higher degree of transparency and intrusiveness involved. This is particularly evident among the nuclear weapon states. In addition to excluding all of their weapon-related nuclear activities from any safeguards they have offered little, if anything, in the way of expanded voluntary safeguards on their peaceful nuclear activities. And it must be said that there is resistance within the IAEA to inspecting the nuclear weapon states as this is seen as unnecessary. After all, what's the point of inspecting a country that is already legally entitled to possess nuclear armouries? Other countries, like Brazil again, are concerned that commercial proprietary information may be at risk from the new measures required by the Additional Protocol.

Dr Mohamed ElBaradei argues that the only way, ultimately, to prevent non-nuclear weapons states from illicitly acquiring their own high enriched uranium or plutonium for weapons purposes is to restrict any enrichment and reprocessing activity by individual states. He has suggested a multinational assurance of supply mechanism that would be uni-

versal, equitable and non-political. Prime Minister Brown, in his talk at Lancaster House on 17 March 2009, gave strong support for this idea and proposed a clear and proactive role for the IAEA with an increase in powers and resources. Almost half of the countries that enrich uranium already do so in joint ventures commercially. In addition, the five NPT-acknowledged nuclear weapons states have already stopped producing fissile material for weapons purposes and say they are ready to negotiate a treaty forbidding this. If such a treaty was universally adopted there would be no strategic need for national enrichment and reprocessing plants. For states newly seeking nuclear power, enrichment makes no economic sense anyway. It is an expensive operation, subject to large economies of scale, and enriched uranium fuel is readily available on the international market. If a state's primary motivation for seeking nuclear power is energy security (rather than strategic security or national pride), then it should concentrate on the technologies it really needs for this purpose, reactors, nuclear safety equipment and waste disposal.

A dozen different proposals to assure the supply of enriched uranium fuel have been tabled to date. These include a fuel bank under IAEA auspices, now supported by 31 governments, and a Russian plan to donate a sizeable amount of low enriched uranium produced by its enrichment facility at Angarsk for guaranteed supply to any country meeting criteria determined by the IAEA. But some developing countries see such proposals, despite their voluntary nature, as a Trojan horse. Almost all of the ideas for guaranteed fuel supply have emerged from the ranks of the existing technology holders. One notable exception was a suggestion made by the Gulf Cooperation Council last year for an extra-regional enrichment centre, perhaps in Switzerland, to supply enriched uranium fuel to all the states of the Gulf. UAE, Bahrain, Jordan and Saudi Arabia this year all affirmed an intention to forgo sensitive indigenous fuel-cycle technologies.

Verification in practice: South Africa

In the early 1990s South Africa declared that it had dismantled an arsenal of six nuclear devices, together with all its nuclear weapon production facilities, and sought IAEA verification. This was the first time the Agency had been involved in such an exercise, requiring it to deal with information relating to actual nuclear weapons development. The Agency had access to both the civil nuclear facilities and what was left of military nuclear facilities after the South Africans had dismantled them. Having inspected installations, materials and documents the Agency was able to declare in 1994 that the history of South African fissile material production had been fully accounted for and that all remaining material had been put under safeguards. This shows that the IAEA can, and perhaps under certain conditions even *should*, play an important role in the verification of nuclear disarmament.

Verification in practice: Iraq

IAEA verification activity in Iraq was even more intensive and ground-breaking. After the 1990 Persian Gulf War, the Agency was tasked by the Security Council to work with in parallel with the UN Special Commission (UNSCOM), and verify that Iraq was disposing of its nuclear capabilities. Not only did the IAEA conduct wide-ranging inspections to ensure that Iraq had declared all of its nuclear activities—the most intrusive the Agency had ever conducted—but it also took part in supervised and verified destruction of designated nuclear facilities. Thus it was able to close the file on Iraq's nuclear capability and certify its verified destruction.

When UN inspectors re-entered Iraq in late 2002 under the aegis of the UN Monitoring, Verification and Inspection Commission (UNMOVIC), the IAEA was allowed to continue with its nuclear brief. Again it was able to verify, with more confidence than UNMOVIC was in regard to CBW, that the nuclear file remained closed and that Iraq did not have nuclear weapons or the capability to produce them rapidly. After the US invasion of Iraq the

Agency was again allowed to return for a time and verify that all the nuclear material remaining there when the war started was still accounted for. It also found that much of the previously inspected and sealed nuclear equipment had been dismantled and found its way into scrap yards in Jordan and the Netherlands.

The IAEA gained invaluable experience from its work in Iraq. It was able to use and refine new techniques, particularly environmental sampling, which have been of benefit in implementing strengthened safeguards generally. It also learned lessons from being involved in the type of hostile verification environment that it does not normally encounter (except to some extent in North Korea). It was also able to develop appropriate verification protocols for intrusive inspections, participate in multidisciplinary inspections and training exercises, and get another foretaste of the tasks involved in verifying complete nuclear disarmament. Finally, it was able to deal with intelligence information supplied by permanent members of the Security Council, which purported to reveal Iraqi nuclear weapons development, but which proved false or misleading. This improved the credibility of the IAEA's verification judgements.

Verification in practice: North Korea

Unlike the cases of South Africa, Iraq, Iran and Libya, where the IAEA, like many others, was surprised about the extent of the nuclear weapon-related activities, in North Korea the Agency actually discovered the cheating. In 1993, soon after the country's comprehensive safeguards agreement entered into force, the IAEA began routine inspections to verify the initial data declaration submitted by North Korea. The Agency discovered inconsistencies which the North Koreans were unable to explain. As a result the Agency invoked its right to a special inspection, for the second and last time. The North Koreans refused, setting off a continuing compliance crisis.

However, the IAEA was soon re-invited but rather than carrying out its usual verification tasks, the Agency was asked to verify a freeze on the nuclear

programme in accordance with the 1994 US-North Korea 'Agreed Framework'. Under this new agreement, it was asked to seal the nuclear facility at Yongbyon and safeguard the nuclear materials there. But it was never allowed to complete its initial work, that of verifying North Korea's declaration. In 2002 its inspectors were expelled, its remote surveillance cameras disabled and the seals at Yongbyon broken.

In 2003, following American claims that it had started a covert uranium enrichment programme, North Korea gave its three months notice and withdrew from the treaty. Thereafter, events progressed quickly. In 2005, North Korea publicly declared that it possessed nuclear weapons. In October 2006, the North Korean foreign minister announced that his country was planning to conduct a nuclear test and three days later the Comprehensive Nuclear Test Ban Treaty Organization detected a magnitude 4.2 seismic event north of Kimchaek in North Korea. The North Korean government announced shortly afterward that they had completed a successful underground test of a nuclear fission device. This seems to have been true—with resulting yield of about 1 kilotonne of TNT equivalent or less. Given the relatively small yield, international observers quickly speculated that the test was a failure.

Despite the gradual escalation in tension, talks between China, North and South Korea, the US, Russia and China have been in progress, on and off, since 2003 (also known as the six party talks). Five rounds of talks produced little progress until February 2007, when North Korea agreed to shut down and disable its nuclear facilities in exchange for fuel aid and steps towards the normalization of relations with America and Japan. But last August North Korea stopped disabling its nuclear facilities. This followed a disagreement with Washington over how to verify North Korea's past nuclear activities, a process which is necessary if the international community is to be assured that the north is denuclearized. They denied having agreed to allow collection of nuclear samples as part of the process, and six-party talks in

December failed to resolve this dispute. But verification is likely to be a political cover. Talks are likely to have failed due to deeper political reasons. In January North Korea said it would denuclearize only after the establishment of formal diplomatic relations with the US, cessation of Washington's 'hostile policy', and removal of the US protective nuclear umbrella over South Korea.

Back to Africa

In the meanwhile, the IAEA were active in Libya. But its role was different again. When Libya announced in December 2003 that it had decided to abandon its WMD programmes, the US and UK had already been in consultations with the Libyan government and had carried out inspections of Libyan nuclear facilities. Agreement was reached in January 2004 on a division of responsibilities: the IAEA would work to verify and dismantle Libya's capabilities while the UK and US would remove and/or destroy the various components.

The Libyan experience added further to the IAEA's verification repertoire. In addition to inspections, the Agency was able to use its increasingly powerful environmental sampling techniques. The Libyan programme, like that of Iran, was in part supplied by the illegal nuclear smuggling ring led by A.Q. Khan, 'father' of the Pakistani nuclear weapon programme. So the IAEA started to be able to track the extent and nature of his activity.

And so, Iran

Iran's Safeguards Agreement came into force in 1974, but in the 1980s it launched a secret uranium enrichment programme, also with help from the A.Q. Khan network. In its plant at Natanz there are underground buildings sized to contain 50,000 gas centrifuges. An exile group blew the gaff in August 2002, although Western intelligence agencies already knew. When IAEA inspectors finally got there they documented 14 different ways in which Iran had violated its safeguards agreements over a period of 18 years. Iran's nuclear activities make no economic sense. No other country has built a uranium enrich-

ment plant without having a working reactor to load the material into. It would be far cheaper to buy enriched uranium, as Iran is already doing for its officially recognised reactor built by the Russians at Bushehr. The United States, Britain and four other powers have offered Iran civil nuclear cooperation as part of a package of incentives to try to persuade Tehran to stop uranium enrichment. These incentives have all been unsuccessful.

But the most damning evidence of a weapons programme came from the hard drive of a computer, turned over to an American embassy in the Middle East by a walk-in defector in 2004. In addition to descriptions of one of the steps in converting uranium ore into gaseous form for use in centrifuges, there were designs for a ballistic missile re-entry vehicle to carry an object just like a nuclear warhead and others suggestive of explosive triggers to compress highly enriched uranium spheres into a critical mass. This evidence has never been satisfactorily examined. The most plausible conclusion is that Iran is aiming to achieve a nuclear weapons capability, if not the weapon itself. But this may well be less for deterrence than for the prestige that such advanced technologies can bestow.

Despite the constraints of the situation, the IAEA has carried out its verification activities in Iran well. The Agency was able to reveal, for instance, that centrifuge equipment was contaminated with uranium enriched to a much higher level than the Iranians admitted. This forced them to admit that the equipment had been imported and not made in Iran. The Agency was further able to verify that the source of the enriched uranium was not Iran. If and when Iran's Additional Protocol is implemented (see 'Safeguards in Iran: prospects and challenges' in this issue), the Agency stands to gain experience for the first time in applying those measures to a state that is already widely suspected of non-compliance.

Conclusion

Over the last two decades, the IAEA has showed a remarkable ability to adapt to change. Moreover, the safeguards system is in good health. While the IAEA is better equipped for the job than ever before, a lot of work remains to be done. The most pressing item on the to-do list is to ensure that the organization is adequately funded. Year after year, it's completing a mammoth task on a shoestring budget. Before looking at the future, the organization needs an adequate budget, and funding stability.

On the operational side, the IAEA should maintain its emphasis on putting the strengthened safeguards system fully in place before attempting to identify further improvements.

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Verification Watch

Return to testing times on the Peninsula

Things can quickly turn extremely sour when national security is at stake. Relations between the Democratic People's Republic of Korea (DPRK) and its counterparts in the diplomatic 'six party' talks dipped sharply in 2008, following US demands that the DPRK undergoes strict verification measures to enable compliance to be monitored with a number of action points agreed with the 'six parties'. A mild disagreement quickly spiralled out of control—and tensions peaked violently after the UN Security Council took action on a DPRK missile test in April 2009. To mark the end of the nuclear disablement plan, Pyongyang told the IAEA to leave the country on the first available flight. A US experts group was expelled shortly thereafter.

The cameras at Yongbyon, North Korea's main nuclear facility, have now been switched off, the seals have been broken, and the inspectors' accommodations are echoing empty.

In the immediate aftermath of the ejection of inspectors, several commentators highlighted the DPRK's ability to quickly ramp up plutonium production.

Sig Hecker, a renowned scientist with many trips to the DPRK under his belt, has estimated that North Korea had produced between 40 and 50 kilograms of separated plutonium by the time it began to disable its nuclear facilities. He estimates that the North has enough material for at most eight nuclear weapons. In addition, spent fuel currently in wet storage or in the process of being unloaded could contain up to an additional 12 kilograms of weapons-usable plutonium.

The fuel rods could be reprocessed in as little as six months, leaving North Korea with an estimated stockpile of some 50-60 kilograms of material by the end of 2010. The stock is small, but enough to sustain a limited testing programme, as well as a weaponized arsenal of half a dozen warheads or less.

Mirroring Hecker's assessment, the Institute for Science and International Security (ISIS) has estimated that North Korea's total stockpile is now somewhere between 33 and 55 kilograms of plutonium. The ISIS calculations are summarized in the box below.

Date	Separated plutonium
1989-1992	0-10 kg
2003-2004	20-28 kg
2005-2006	13-17 kg
Total:	33-55 kg

However, it should be cautioned that there are huge uncertainties in all estimates. Many critical parameters of the reactor, such as the burn-up, the load factor, and the thermal efficiency, are unknown. The reactor in Yongbyon has a maximum power of 20 megawatts-thermal. The power has high peak-to-average, with most power generated in the bottom half of the core. This causes unusually high isotopic concentrations of higher actinides, including ^{240}Pu in the reactor core.

The second test

On Monday, 25 June 2009, North Korea tested its second nuclear device. This move had been anticipated by some, but far from all, international observers. There have been various estimates on the explosion's yield. Initial reports of a detonation in the range of 4-8 kilotonnes of TNT equivalent seem highly exaggerated.

Initial VERTIC estimates, using a generic Mb to yield hard rock formula, pointed to a detonation of about 2.2 kilotonnes. However, after consultations with seismologists around the world, the revised VERTIC assessment is that it is *more likely than not* that the yield was between 1.6-2.2 kilotonnes. It is not known what yield the DPRK aimed at, but it is reasonable to assume that it was testing a design in the 4 kilotonne range.

The Comprehensive Nuclear Test Ban Organization's seismic assets performed well, with proper identification and attribution within a couple of hours. The error ellipses were small enough to allow for the deployment of an on-site inspection, had the treaty been in force.

Atmospheric modelling predicted noble gas capture within a few weeks of the event. However, the radionuclide network did not register the presence of Xenon in the atmosphere. This was unexpected, but does not mean that the system did not work as designed. There are many reasons why noble gases may not have escaped the explosion: one being that the test might have been conducted deep underground. One seismologist VERTIC talked to estimated that the test might have been carried out at a depth of about 800 meters. If so, very little nuclear debris would have been carried to North Korea's borders.

Egypt: untangled administrative woes

People in the safeguards business know that a well functioning State System for Accountancy and Control (SSAC) is essential for proper safeguards implementation. Over the last five years, this theorem has been proven in Egypt. The IAEA was used to work with the Egyptian Atomic Energy Authority (EAEA), and had for many years assumed that their counterpart had absolute authority over all matters nuclear. However, in 2004, IAEA officials were surprised to learn that there was not one, but two, Egyptian authorities responsible for nuclear activities in the country. In addition to the EAEA, the Nuclear Material Authority based in El Qattamayah, Cairo, popped up with responsibility for, amongst other things, uranium mining. It also transpired that Egypt did not have an independent regulatory authority on its territory, a standard good governance measure.

The problem was sorted through the issuance of a presidential decree, which in 2006 gave the EAEA the necessary authority to carry out a state wide investigation of Egypt's fissile material holdings. Egypt is now in the process of finalizing a fresh nuclear law, which

will transfer all fissile material holdings to a newly created independent regulator. Meanwhile, environmental sampling carried out in 2007-2008 revealed low and high enriched uranium particles at the Inshas facility. Reportedly bewildered, the Egyptian authorities believed that the particles could have entered the country through contaminated radioisotope transport containers. The IAEA will continue to seek to clarify this issue as part of its ongoing verification activities.

Great leaps in chemical disarmament

On 26 March 2009, the Indian government informed the Organization for the Prohibition of Chemical Weapons (OPCW) that it had completed verified dismantlement of all its chemical armouries.

In terms of declared global stocks of schedule 1 chemicals, that is materials that were either produced as a weapon or have a high potential of being used as one, the OPCW reports that more than 43 percent have been destroyed. Moreover 52 percent of schedule 2 chemicals (those posing a significant risk to the object and purpose of the convention) has also been verifiably destroyed.

Stockpile reductions in the Russian Federation and the United States are also steadily progressing. As of 31 March 2009, Russia had destroyed 12,065 metric tonnes of its schedule 1 chemicals. This is approximately 30 per cent of its arsenal. The United States has eliminated roughly 16,500 metric tonnes. On 6 May 2009, it announced that about 60 percent of its arsenal had been verifiably destroyed.

Both Russia and the United States must complete destruction operations by April 2012. Both countries are likely to miss this deadline by a number of years. Indeed, the United States has acknowledged this while Russia claims to be able to meet its obligations under the convention.

In 2007, 426 inspections were conducted at 258 facilities or sites in 59 countries. This amounted to some 22,000 inspector days in the field.

Monitoring in the climate regime

18 months ago, the UN climate change conference in Bali launched a process to enhance implementation of the climate change convention. The 'Bali Action Plan' addresses four main issues including mitigation, adaptation, technology and financing and contains the basis for shaping the post-2012 climate change regime. Negotiations are underway and are meant to result in an agreement at the next main climate conference, in Copenhagen, December 2009.

The climate regime has long included quite extensive monitoring and review systems encompassing both quantitative (e.g. emissions estimates) and qualitative (e.g. policies and measures) information. The monitoring system covers both developed and developing countries, but to differing extents, due to these countries' respective capacities.

As a number of observers have noted, the plan identifies a range of actions by countries that should be measurable, reportable and verifiable (MRV) including mitigation commitments or actions by developed countries; mitigation actions by developing countries; as well as technology, financing and capacity building support provided for developing countries' actions.

Enhancing the role of MRV can strengthen the regime in several ways. It provides a foundation for generating consistent and comparable information on action taken. It can measure overall and individual state's progress. It can bolster confidence in the regime's

credibility. By allowing parties to demonstrate what action they have taken, an effective MRV system can foster trust between them. These systems also allow for sharing of experience and can provide helpful feedback on efforts. They could also perform a function in linking developing country action and support for this action.

Over the negotiating period states, civil society and other organisations have put forward numerous proposals on mitigation and financing, which include MRV-able components. The components can draw on current systems such as the greenhouse gas inventories and national communications. Some proposals may need other procedures to be established, such as new types of registries for reports on climate change action, which would further expand the international institutional arrangements needed to coordinate and manage the regime.

As well as being fit to regulate effectively whatever types of action are decided on, the design and application of the MRV systems will need to take into account developing countries' varying capacities for carrying out monitoring and reporting. The range of procedures in the current and proposed MRV toolbox should allow for this flexibility. In addition, developing countries will, in several cases, need capacity building and financial and technological support from developed countries to get the appropriate monitoring and reporting systems up and running.

A few words from the executive team

VERTIC is continuing to develop all its programmes and is in particular grateful for the continuing support from its governmental and charitable funders. Over the last year, their unwavering support has enabled us to develop and expand our operations to other regions of the world. VERTIC now has a staff member based in the Asia-Pacific region which considerably strengthens our presence in that critically important part of the world. We continue to have a staff member based in The Hague.

Organizational growth can only come with foresight, vision, and a willingness to take risks. We aim to continue to diversify our funding streams, to ensure that we are financially viable in the tough days ahead.

Work should be challenging, and the challenge should be fun. And this is why we should aim to put our employees first when it comes to our daily operations. A number of policy changes will be rolled out over the coming months, making VERTIC an ever more inspiring workplace. This will enable us to provide even better services to our clients in the months and years ahead.

IAEA to elect a new leader

Mohamed ElBaradei has run the International Atomic Energy Agency for 12 years. But in 2008, he decided to step down from the top post and put a full stop to an impressive Viennese career spanning almost three decades. Who will take over after this capable Egyptian diplomat? This question has nagged many in Vienna over the last few months.

Five candidates have stepped forward: Yukiya Amano of Japan; Luis Echávarri of Spain; Abdul Samad Minty of South Africa; Ernest Petrič of Slovenia; and Jean-Pol Poncelet of Belgium.

Yukia Amano was the front-runner throughout most of 2009. At a secret straw-poll held at the IAEA's headquarters on 9 June 2009, he reportedly secured 20 votes in his favor. The runner-up, Abdul Minty, mustered 11 votes and four IAEA member states rallied around Luis Echávarri.

Some Vienna sources say that both the Russian Federation and China oppose the election of Yukia Amano. The Japanese ambassador commands strong support from Western nations. Most developing nations on the Agency's board, however, support ambassador Minty, whereas Echávarri seems to draw his support from a splinter group of Latin-American states. The situation has not changed much from the previous round of secret balloting in March 2009, where Amano also fell one vote short of receiving the Board's endorsement.

The divisions on the board over ElBaradei's successor is yet another indication that the Vienna spirit—where key decisions were made by consensus—is seriously dented. Over the past five years, the board has been forced to tackle many difficult issues, such as verification and monitoring of nuclear programmes in Iran and Syria, disagreement over the future of the safeguards regime and a chronic lack of operational funds. The incumbent Director-General needs to possess a broad skill-set if he is to lead this large organization. He needs to be a competent diplomat and a adept administrator. But above all, he needs vision and determination.

Germ in the DPRK?

An 18 June 2009 report by the International Crisis Group sheds some detail on what is known about North Korea's biological weapons programme. This is, in a nutshell, not much. The reclusive state is believed to have some stocks of anthrax, plague, cholera and smallpox. And the report details three possible production sites: the No. 25 factory in Chŏngju, the Central Biological Weapons Research Institute in Pyongyang and a plant in the City of Munch'ŏn, Kang'wŏn Province.

Since there is a significant knowledge gap in respect to North Korea's biological weapons capabilities, the report falls short of making any firm determinations. It does note, however, that North Korea acceded to the 1972 Biological Weapons Convention (BWC) on 13 March 1987. Under this convention, North Korea must not stockpile microbial or other biological agents of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes. North Korea is also not allowed to keep delivery vehicles designed to use such agents or toxins for hostile purposes or in armed conflict.

The report asserts that 'verification of BWC compliance is extremely difficult under any circumstances due to the dual-use nature of biotechnology and the problem of differentiating between offensive and defensive BW research programs'. It suggests that the DPRK has to 'disclose facilities, technologies, materials and equipment', presumably to BWC states parties, before its compliance can be determined.

The potential for DPRK non-compliance with the biological weapons convention is just part of a wider problem with the regime governing the production, stockpiling and use of biological weapons, namely the lack of a solid confidence-building, monitoring and verification regime. Consultations on a draft protocol to the BWC in the late 1990s suggested three central elements: 'mandatory declarations', 'non-challenge visits', and 'non-compliance concern investigations'. But discussions on a verification protocol ended abruptly after the 2000 US election.



Science & Technology Scan

The European Commission's Joint Research Centre (JRC) in Iprsa, Italy continues to develop exciting and innovative tools for nuclear safeguards inspectors. The Nuclear Security Unit (NSU), the same group that invented a laser based system for automatic change detection within nuclear facilities, has modified their technology for outdoor use. The Outdoor Verification System (OVS) is designed for the verification of large nuclear facilities.

When safeguard inspectors return to a complex nuclear facility such as a reprocessing plant after a couple of months, it is close to impossible to determine whether parts of the facility have been modified between inspections. Minor design changes are not immediately visible to the human eye, but they may hold the key in revealing clandestine nuclear activities.

The solution is made up of just two hardware components and some intelligent software. A digital camera and a laser capable of measuring the distance between

itself and an object up to 1 km away (with an accuracy of 1.5cm) are fitted to a transportable platform. The laser scans its surroundings and creates a digital, geometrically accurate 3D copy of its environment. The camera gives the digital model its colour. Now run a couple of scans at different locations within a facility and you have a 3D snapshot in your computer. Safeguards inspectors can then take a virtual flight around the facility and conduct verification analysis from any perspective.

Yet the point is that this snapshot is then used as a reference for any subsequent safeguard visits where the procedure has to be repeated. Because of the high geometrical accuracy of the system, small changes such as new pipes and different containers are reliably highlighted by the software. OVS makes invisible changes visible and, undoubtedly, this technology will become another indispensable part of the Additional Protocol toolset.



News & Events

Environment

The environment programme has been assisting Chatham House with the design and implementation of its indicators project which measures the extent and effectiveness of the response to illegal logging and related trade. The indicators cover government policy and development, private sector policy and development and what is known about the extent of illegal logging.

The pilot phase of the project, recently completed, assessed progress (including baseline and trend data) in Cameroon, Indonesia, Vietnam, UK and US. The pilot phase report was released in June 2009 and includes results of the country assessments, a description of the project methodology and lessons learned.

VERTIC carried out this work in collaboration with Chatham House researchers and partner organizations in the pilot countries.

Larry MacFaul, along with Sam Lawson, presented pilot project findings at the Chatham House Illegal Logging Update and Stakeholder Consultation meeting, 23-24 June 2009, which was attended by some 200 participants from government, NGOs and the private sector. The project is currently moving into its full phase, covering an additional seven countries. Monitoring of the indicators will take place biennially.

The environment programme has continued to monitor activities in the climate change field and examine linkages between its forestry and climate change work.

Arms Control and Disarmament

The arms control and disarmament programme has continued its work on the verified dismantlement of nuclear arms, as well as its projects on the implementation of the 1996 Comprehensive Nuclear Test Ban Treaty. However, the programme has focused on the UK-Norway Initiative. Together with its project partners, VERTIC presented the progress of the past year to the NPT PrepCom on 8 May 2009. The meeting was well attended with some 55 participating national diplomats as well as inter- and nongovernmental staff. There was continued interest in the project and its results from a wide selection of nuclear- and non-nuclear weapon states.

The programme continued to participate in the process. In mid-May, Hassan Elbahtimy and Andreas Persbo went to Norway to observe and contribute to the exercise 'dry run'. This helped ensure effective game-play later in June, when the exercise went live.

In the coming months, the programme will evaluate the outcome of the exercise. It is expected to convene a workshop later this year, where high- and lowlights as well as next steps will be discussed.

In addition, the programme made several presentations to various meetings and seminars in the United States and in Switzerland. Of particular interest was the meeting on a verified Fissile Material Cut-Off Treaty, hosted by the Stockholm International Peace Research Institute, in Geneva on 25 May 2009.

The programme continued to prepare its report on the 2008 CTBTO integrated field exercise in Kazakhstan. In May 2009, Andreas Persbo and Mark Hibbs submitted an article on the legacy of Mohamed ElBaradei to the *Bulletin of Atomic Scientists*.

On 3 June 2009, the programme was pleased to welcome Ambassador Tibor Toth to the Centre for a briefing on the DPRK nuclear test and its implications for the Comprehensive Nuclear Test Ban Treaty.

National Implementation

Over the last few months the NIM programme has been focusing on producing new materials. The BWC factsheet and VERTIC's Sample Act are now available in Russian, thanks to kind assistance from the government of Canada.

The programme has also produced a new factsheet (*VERTIC Factsheet No. 10*), which provides guidance on establishing or designating a BWC National Authority. This factsheet is now available in English, French and Spanish on the NIM website (www.vertic.org/NIM) and it will soon be available in Russian.

The programme is also finalizing a new implementation tool: the '*Regulatory Guidelines to implement the 1972 Biological and Toxin Weapons Convention and Related Requirements of UN Security Council Resolution 1540*'. This tool will aim to provide assistance to states wishing to develop their BWC implementing legislation further. This includes BWC related requirements such as biosecurity, biosafety, licensing of activities with controlled biological agents and toxins, and transfer permits.

Additionally, NIM staff have participated in various seminars. VERTIC was present at two UNSCR 1540-Committee awareness-raising workshops: one held in Vanuatu in April and more recently in a workshop held in Sri Lanka in June. Programme staff also participated in a workshop on Biosafety and Biosecurity, held in Uganda in June.

VERTIC's NIM staff are now preparing to attend the 2009 BWC Meeting of Experts, which will be held in Geneva at the end of August.

The programme is preparing legislation surveys of countries' existing legislation for the prevention of the misuse of biological agents and toxins.

Grants & Administration

VERTIC underwent transition in April-June 2009. Andreas Persbo was promoted to Acting Executive Director on 10 June 2009, and Angela Woodward was appointed Programme Director the same day. For the time being, her executive responsibilities will be limited to the National Implementation Measures Programme. However, it is foreseen that she will also manage the organization's activities in the chemical and biological weapons field. VERTIC is very grateful to Angela for her inspirational leadership during her time as Executive Director and pleased that she has decided to stay on in her new role. This arrangement means that Angela can now devote more time to develop and manage the NIM programme. It also gives funders and partners the assurance that VERTIC will conduct business as usual in the coming years.

VERTIC has agreed to implement two new grants. The organization is very grateful to the Norwegian Ministry of Foreign Affairs for a grant of NOK 350,000 for a project on *supporting the CTBT's provisional entry into force through communicating the readiness of the CTBTO and the verification regime* and a grant of NOK 150,000 on the *verification of nuclear disarmament*.

VERTIC is also putting in place new IT-based management tools to keep better track of our diverse and complex project portfolio. In addition, the administration team is working on setting up a secure FTP server for internal and external document management. The server has undergone maintenance, which reduced the amount of spam hitting our accounts by almost 50 percent. Finally, a warm welcome to interns Jasper Pandza, who will be with us in June and July, and Velislava Zhivkova, who will be us in July and August.

building trust through verification

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ISSN 0966-9221