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Changes to the IAEA's Safeguards System – The State-Level Concept

Through comprehensive safeguards agreements (CSAs) the IAEA is charged with both the right and obligation to ensure that safeguards will be applied on all nuclear material within the territory of a state for the exclusive purpose of verifying that such material is not diverted to nuclear weapons or other nuclear explosive devices. It is a fact of life, however, that the IAEA operates in a budget constrained environment, so in discharging its safeguards obligations it must do so with the goal of maximising both efficiency and effectiveness. This is spelt out in several places in CSAs, as well as in the Additional Protocol (AP).

The perennial challenge for the IAEA is finding the right balance between meeting the expectations of its Member States (and the international community more broadly) that it ensures states are honouring their safeguards obligations, and doing so as efficiently as possible without diminishing safeguards effectiveness or the objectiveness of its safeguards conclusions. As such, IAEA safeguards approaches have, by necessity, evolved over the years in response to changes in the proliferation risk profile of the nuclear fuel cycle, and in verification technologies and techniques.

Since IAEA safeguards verification activities began in the early 1960s the IAEA has sought to use objective criteria to set the form and scope of its verification activities. These criteria became increasingly formalised over time, leading in the late 1980s to the development of a standardised compilation of inspector guidance known as the 'safeguards criteria', focussed at the facility level. The safeguards criteria were intended to demonstrate non-discrimination in the application of safeguards in different states by applying a high degree of uniformity in safeguards application based on types and quantities of nuclear material and facility types. During inspections, decisions regarding nuclear material sampling plans and verification methods were made with reference to the safeguards criteria.

A very significant step in the evolution of safeguards followed the discovery in Iraq in 1991 that, while its declared nuclear material and activities had been accounted for through IAEA verification activities, Iraq had a clandestine nuclear weapons development program supported by an undeclared enrichment program. Given the obligation on the IAEA to ensure that safeguards are applied to all nuclear material (not just declared nuclear material), the discovery in Iraq clearly meant new approaches were required. Accordingly, safeguards were strengthened to equip the IAEA with the tools and information necessary to verify the absence of undeclared nuclear material and activities – a significant component of which was the AP, adopted in 1997.

The AP by itself was not enough for the IAEA to draw conclusions on the absence of undeclared nuclear material and activities; it had to make use of the full range of available information of safeguards relevance in order to build a complete picture of each state's nuclear activities and capabilities[4]. The process for collecting and evaluating this information was concluded in the early 2000s and is known as 'information-driven safeguards'. With the combination of information-driven safeguards, the verification tools available to the IAEA for states with an AP , and the results from nuclear material inspections (using the safeguards criteria), the IAEA is equipped to draw what is known as the 'broader conclusion' for a state that, not only is all declared nuclear material accounted for, but there are no undeclared nuclear materials or activities. For states without an AP the IAEA is not able to draw the broader conclusion, but information-driven safeguards are still useful for building a fuller picture of the activities and capabilities of such states.

The use of objective facility-specific safeguards criteria had the advantage that inspection results were amenable to quantitative statistical evaluation. As such, inspection reports could be subject to simple forms of quality control to ensure uniformity, and the evaluation of inspection goal attainment produced results that could be communicated to Member States in simple terms. The disadvantage of this approach was that safeguards implementation was very prescriptive. It resulted in inspection resources being concentrated on states with the greatest numbers of facilities, with limited scope to consider the overall risk profiles in determining the distribution of inspection effort. In a world where the quantity of safeguarded nuclear material is increasing, if the IAEA were to continue to follow such prescriptive approaches it may reduce the confidence of its verification conclusions.

The use of safeguards criteria, information-driven safeguards, and (where applicable) the AP had proved very effective over several years and met the needs of the time, but it became increasingly apparent that continuing to use these in the same way was not sustainable. In November 2010 at the IAEA Safeguards Symposium, the Deputy Director-General for Safeguards, Mr Herman Nackaerts, launched the Long Term Strategic Plan (LTSP) for the IAEA Department of Safeguards. A major focus of the LTSP was the further evolution of the IAEA's safeguards system away from the prescriptive criteria-based safeguards approaches focussed at the facility-level, to a state-level concept. The state-level concept is a holistic approach to safeguards implementation using a safeguards system that is fully information-driven – i.e. making greater use of all safeguards-relevant information available to the IAEA, both facility-specific information from reports and inspections, and state-specific information about nuclear activities and capabilities. The state-level concept will be applied not only to safeguards evaluations, but also to planning and in-field implementation (i.e. frequency, intensity and inspection scope).

Elements of a state level concept have been applied by the IAEA for some time. So, how does this differ from the way safeguards have been applied by the IAEA to now? The answer lies in both the breadth of information used and how it will be used. The IAEA plans to diversify the types of information it uses, and take account of a broader range of state-specific factors which have hitherto been under utilised. Examples of factors the IAEA might use include: the effectiveness of the state's accounting and control system; a state's record of adherence to safeguards requirements; a state's

4 This includes: information supplied by the State pursuant to safeguards obligations; information obtained by the IAEA through verification activities; open-source information (e.g. analysis of scientific publications, satellite imagery); and information from third parties.

transparency and cooperation with the IAEA; and characteristics and international inter-dependencies of the state's nuclear fuel cycle. It is important to appreciate that consideration of factors such as these is not new; in fact, some of the factors listed here are described in the model safeguards agreement[5] concluded in 1972 that forms the basis of all CSAs.

Where this state-level concept will also differ from previous practices is in application. The evaluation of all safeguards-relevant information on a state will be used for planning and implementing inspection efforts optimised for each state, rather than letting the numbers and types of nuclear facilities determine this. The safeguards criteria could still be used, but more flexibility may be built in to vary sampling plans and verification methods, allowing more scope for inspectors to focus on other indicators associated with potential diversion paths. This will be complemented by improvements in safeguards evaluations at IAEA headquarters where state evaluations will be more analytical and collaborative, making use of core evaluation groups of inspectors and analysts. As noted by Deputy Director-General Nackaerts the state-level concept will require an evolution in institutional culture from an accounting to an investigative and analytical approach.

The IAEA plans to develop and test a conceptual framework and tools for the evolving state-level concept in 2011 and 2012. The IAEA recognises it will be critical to communicate to Member States why the state-level concept is important and how it will operate. Currently, the reasons for variations in safeguards implementation between states are quite understandable to states, as differentiation is primarily on the basis of quantities and types of nuclear material and facilities. In contrast, the state-level concept will use the same objective processes for all states for evaluating and planning safeguards, but there may be variations (that do not exist currently) between states in the frequency and scope of verification activities. In a world where the quantity of safeguarded material is increasing, business as usual is not sustainable. If the IAEA were to continue to follow the same prescriptive approaches it would be difficult to do so within constrained resources without reducing confidence in its verification conclusions. As noted above, the IAEA is charged with the obligation of ensuring that states honour their safeguards obligations, and to do so in a cost-effective manner whilst maintaining safeguards effectiveness. The improved state-level concept has the potential for significant efficiency gains, while maintaining and perhaps improving safeguards effectiveness.

Fukushima Dai-ichi Nuclear Accident

The Tohoku Pacific Earthquake of magnitude 9.0 struck the north-eastern part of Japan at 2.46 pm on 11 March, 2011. Of the six nuclear reactors at the Fukushima Dai-ichi Nuclear Power Plant, the three reactors operating at the time shutdown automatically and the remaining three were already off-line for maintenance at the time of the earthquake. The back-up diesel generators on-site started emergency operation as soon as off-site power was lost.

5 IAEA, INFCIRC/153, paragraph 81.

The tsunami generated by the massive earthquake breached the 6 metre high seawall, intended to protect the power plant from tsunamis, and badly damaged the site. The diesel generators providing emergency power to the reactors were damaged by the resulting inundation. According to the Japanese Nuclear and Industrial Safety Agency all power on-site was lost at 3:41 pm local time. Less than one hour after the earthquake struck the three operating reactors shutdown.

The loss of site power, off-site power and diesel back-up generators was within the design basis accident for the facility, but the assumption was that one of the three sources of power would return relatively quickly. When diesel back-up generators failed catastrophically, battery back-ups powered the operational site pumps for a limited period of time (8-24 hours). As power to the Fukushima Dai-ichi Nuclear Power Plant had not been restored before battery power was expended, all six of the reactors were left without essential power.

The most urgent issues related to the three reactors that had been operating at the time – Units 1, 2 and 3; these reactors required continuous cooling after emergency shut-down to allow for the reactors to cool down. In addition to the reactors, there was the matter of maintaining cooling for the spent fuel ponds associated with each of the six reactors at the site as well as the common spent fuel pool.

The fuel elements containing the pellets of enriched uranium within the pressurised reactor core are clad with a zirconium alloy called Zircaloy. At high temperatures, zirconium reacts aggressively with steam to produce zirconium oxide and hydrogen. In the absence of adequate cooling, temperatures in the reactor pressure vessels increased and pressure built up to unsafe levels. Due to the rapid build-up of pressure, steam was vented from the reactor pressure vessels, without going through a ‘scrubber’ which would have removed the hydrogen, and the entrained hydrogen collected in the upper part of the secondary containment of the reactor building. In units 1 and 3, as the hydrogen reached an elevated concentration in air, it ignited and resulted in explosions that severely damaged the reactor buildings. Vents were opened in the sides of units 5 and 6 to prevent similar explosions from occurring there.

At the end of the reporting period the Tokyo Electric Power Company (TEPCO) and the Japanese government were working to limit further releases of radioactive material. Reactor units 1, 2, and 3, which were operating at the time of the earthquake, had suffered significant core damage and were still not in a state of cold shutdown as of 30 June 2011. Work was ongoing to develop storage for contaminated waste water and to immobilise on-site contamination.

The accident at the Fukushima Dai-ichi Nuclear Power Plant highlighted the need for effective communication to states and relevant organisations (e.g. IAEA) of information on emergency incidents. Furthermore, the information must be adequately detailed and contextualised to allow this information to be interpreted in a way that ensures an appropriate response. Incomplete information and a poor understanding of that information at a time of information overload, as is likely to occur during an emergency, can make it very difficult to isolate the key matters requiring an active response.

The crisis surrounding the Fukushima Dai-ichi reactors was an important time for ASNO as we worked to provide briefings for Ministers and senior officials on the technical aspects of the accident, placing the reporting in context and ensuring the technical accuracy of the consular advice provided to the public. ASNO ensured technical experts were available 24 hours a day during the initial two week period of the crisis.

While primary responsibility within the Australian Government on nuclear safety and radiation issues rests with the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), the expertise within ASNO proved to be a very valuable resource for DFAT more broadly and we were able to make a significant contribution to DFAT's responses to the evolving crisis.

Building Momentum for a Fissile Material Cut-off Treaty

The negotiation of a multilateral Fissile Material Cut-off Treaty (FMCT) is widely seen as one of the crucial steps toward nuclear disarmament, and is a priority for the Australian Government. The central element of an FMCT would be a ban on the production of fissile material for use in nuclear weapons. An effectively verifiable FMCT would have important benefits for international security – by helping to curtail a nuclear arms race, and by reinforcing the international nuclear safeguards system. It would complement the CTBT. The CTBT impedes development of nuclear weapons by prohibiting testing; the FMCT would impose a quantitative cap on the fissile material available for weapons use.

The Conference on Disarmament (CD) is the multilateral forum in which most countries believe an FMCT should be negotiated. However, decisions by the CD require consensus among its Members. Despite strong multilateral support for FMCT negotiations, in the UN General Assembly since the early 1990s and more recently through the consensus outcome of the 2010 Nuclear Non-Proliferation Treaty Review Conference, lack of consensus in the CD on the purpose and form of an FMCT has continued to prevent negotiations. Frustrations with the prolonged impasse in the CD to carry out productive work and desire to find a way forward on an FMCT have grown markedly in recent years.

In this context, Australia, working with Japan, has sought to build momentum towards FMCT negotiations in the CD by arranging a series of expert-level meetings in Geneva to discuss key aspects of a verifiable ban on fissile material production. Three meetings of three days each in February, March and May–June 2011 focussed first on definitions as they would be applied in a treaty, for fissile material and its production, and then on the nature of mechanisms needed to verify a ban on fissile material production for use in nuclear weapons. The first two meetings were chaired by Australia's Permanent Representative to the United Nations and the Conference on Disarmament in Geneva, Ambassador Peter Woolcott. ASNO experts participated actively in the expert meetings, and supported the Australian Permanent Mission in Geneva to facilitate their conduct.

The three expert meetings conducted in 2010–2011 did not seek to negotiate any elements of an FMCT, but rather provided an opportunity for interested countries to exchange views on this important issue. Around two-thirds of the CD's 65 Member States participated in these events.

Different views have been put over the years on what should be included in the definition for fissile material used in an FMCT, and on what nuclear activities are parts of its production. As well as reviewing the various options, the expert discussions provided some indicators on how differing views on definitions might be reconciled. For example, the definition of 'fissile material' could be based on the IAEA's existing definition of 'unirradiated direct-use material', taking into account that activities with some other nuclear materials would be relevant to its production.

In relation to verification, during the expert discussions four particular objectives were commonly raised. These were to verify that production of fissile material is as declared; that fissile material is not diverted for use in nuclear weapons; that there is no undeclared production of fissile material; and that fissile material production facilities formerly used for nuclear weapons purposes are dismantled or converted to permitted uses.

Many participants in the expert meetings expressed the view that safeguards concepts and methods already used by the IAEA in NPT non-nuclear-weapon states could be adapted to verify an FMCT. Main challenges in this task would be to focus routine verification efforts on various nuclear activities based on the risk they may pose to the object and purpose of an FMCT; to ensure that mechanisms for detecting and investigating possible undeclared production of fissile material are effective in all participating states; and to apply verification where nationally sensitive information may be present.

The expert-level meetings have been widely appreciated for helping re-energise discussions and lift the quality of exchanges in the CD on issues relating to the proposed FMCT. They demonstrated to many participants that when discussions are focussed on substantive issues, both the value of the proposed treaty and the confidence brought by new verification measures become clearer.

As Foreign Minister Rudd told the CD on 1 March 2011, "the FMCT is not an end in itself, but a means to a greater end — a world free of nuclear weapons." Australia considers negotiations are now long overdue.

Nuclear Security Summit: Towards Seoul 2012 and beyond

United States President Obama's Prague speech on 5 April 2009 called for a new international effort to secure all vulnerable nuclear material around the world within four years. This effort was the focus of the inaugural Nuclear Security Summit (NSS) held in Washington DC on 12–13 April 2010, attended by 47 states as well as the United Nations, the IAEA and the European Union. This Summit brought together the largest gathering of world leaders convened by a United States President since 1945 and produced a communiqué and work plan that provides a strong mandate for international cooperation to address the threat of nuclear terrorism and the Prague speech goals. ASNO was active in negotiating the communiqué and work plan and preparing Australia for the summit. The then Director General ASNO, John Carlson, was Australia's summit Sherpa. The new DG ASNO, Robert Floyd is Australia's current Sherpa and

ASNO's Stephan Bayer remains Australia's sous-Sherpa. The Republic of Korea has agreed to host a second summit in Seoul, in late March 2012. As was done during the Washington summit, Seoul will also host parallel meetings involving industry and nuclear security experts.

Tangible results

The Washington Summit has already accelerated progress in threat reduction programs with Chile, Kazakhstan, Poland and the Ukraine having secured or returned high enriched uranium (HEU) to suppliers, and Russia shutting down a plutonium production reactor. Not only have once-off actions taken place, but many countries have moved to make solid long-term investments in nuclear security with the establishment of a number of nuclear security centres of excellence including centres in Japan and the Republic of Korea. These are in various stages of development, and the IAEA will hold a meeting seeking to coordinate these centres of excellence in order to maximise their collective input.

Australia is already well advanced in satisfying the summit work plan, having ratified the amendment to Convention on the Physical Protection of Nuclear Material (CPPNM), converted its HEU-based medical isotope production to low enriched uranium (LEU) fuel and targets, implemented rigorous domestic security standards, joined international security partnerships, and maintained regional outreach and capacity building programs, including strong interaction with the IAEA. Australia nuclear agencies also have significant international expertise to offer on nuclear security – they chair the International Technical Working Group on Nuclear Forensics (ANSTO chair) and the Information Exchange Meeting under the Code of Conduct on the Safety and Security of Radioactive Sources (ANSTO chair), and play an active role in developing international nuclear security guidance documents for the protection of nuclear and radioactive materials.

More work to do internationally on treaties

In a welcome development, 13 states (including six from the NSS) have ratified the amendment to the CPPNM since the Washington summit. However, of the 145 signature states to the CPPNM, only 48 have ratified the amendment, being only half of the 96 ratifications required before the amendment will enter into force for each State Party. Less than half of the NSS Participating States have ratified the amendment. Clearly, there is much to be done both inside and outside the NSS to progress this important convention. A commitment by the NSS Participating States to work internationally to reach entry into force of the amendment by 2014 would be a welcome development. Similarly, close to half of the NSS Participating States have not ratified the International Convention for the Suppression of Acts of Nuclear Terrorism, including Australia.

Seoul and beyond

Leaders attending the Seoul summit will seek to re-affirm the commitments made at the Washington summit, but also direct their attention to the recently included programs and initiatives through the intersessional meetings of sherpas and sous-sherpas.

The ongoing success of addressing nuclear security threats depends not on the work of the Participating States alone, but on the participation of all states. Regional outreach by NSS Participating States will be vital. Mechanisms such as the recently formed

Asia Pacific Safeguards Network could usefully assist regional coordination of nuclear security outreach and capacity building. The IAEA must also be adequately resourced and given a clear mandate to continue to play a central role in the international nuclear security architecture.

The upcoming summit in Seoul will be held at the halfway point towards achieving the four-year goals espoused by United States President Obama in Prague. Much more remains to be done by NSS Participating States and the nations of the world to secure nuclear materials.

International Atomic Energy Agency Fuel Bank

On 3 December 2010, the International Atomic Energy Agency (IAEA) Board of Governors authorised the establishment of an IAEA Low Enriched Uranium (LEU) Fuel Bank.[6] The fuel bank, and indeed fuel cycle multilateralisation more broadly, has the potential to reduce the desire and need of some countries to establish indigenous enrichment or reprocessing, and thus reduce the proliferation risk.

A number of countries and organisations, including the US, UAE, EU, Kuwait, Norway and the non-government Nuclear Threat Initiative (NTI), have seen the potential of the fuel bank and contributed money to make it a reality with approximately US$160 million donated to cover initial operating expenses and purchase/delivery of LEU. The NTI were a significant driving force in the creation of the fuel bank with a contribution of US$50 million, contingent on IAEA Member States contributing a further US$100 million.

The concept behind the IAEA Fuel Bank is that there would be a supply of LEU owned and managed by the IAEA suitable for the production of reactor fuel. If an IAEA Member State finds their LEU supply disrupted for predominantly commercial reasons, they can call on the IAEA LEU bank to get additional reactor fuel. The plan is that the fuel bank would maintain enough LEU to meet fuel fabrication requirements for one full core of a 1000 MWe pressurised water reactor, or three annual reloads.

LEU fuel from the fuel bank would only be available to eligible IAEA Member States for power generation at standard market prices, paid in advance. To be eligible, a Member State would need to fulfil the following criteria:

- The Member State would need to experience an LEU supply disruption and be unable to secure LEU from the commercial market, or through State-to-State arrangements, or by any other such means.
- The IAEA would need to reach the conclusion that there has been no diversion of declared nuclear material and there are no issues relating to safeguards implementation in the requesting State.
- The Member State must have a comprehensive safeguards agreement in force, thereby requiring the application of IAEA safeguards to all its peaceful nuclear activities.

6 http://www.iaea.org/Publications/Factsheets/English/iaea_leureserve.html, Factsheet: IAEA, Low Enriched Uranium Reserve, International Atomic Energy Agency.

If these three criteria are met, the Director General of the IAEA will approve the Member State's request for fuel from the bank.

The IAEA fuel bank is not designed to replace traditional supply arrangements, but rather provide assurances to Member States that they will have access to fuel in the event of unforeseen problems with their standard supply chain. However, it may be that other unilateral or multilateral fuel banks are developed to complement, and possibly replace, current supply arrangements.

In advance of the authority to establish a specific IAEA Fuel Bank, on 27 November 2009 the Board of Governors approved a Russian initiative to establish a reserve of LEU to provide to the IAEA for Member States. This is a separate yet complementary scheme whereby the fuel stockpile is owned by the Russian Federation, and will be made available to the IAEA for transfer to the identified Member State when required. On 1 December 2010 the Russian Federal Atomic Energy Agency (Rosatom) announced the fuel bank was stocked with 120 tonnes of LEU, with the fuel stored at the International Uranium Enrichment Centre in Angarsk, Russia.[7]

Obligated Nuclear Material

Fuel banks, and their built in supply conditions, do not impact on uranium suppliers, such as Australia, unless suppliers choose to become party to the fuel bank arrangements. In this regard, one consideration for uranium suppliers, including Australia, will be how obligated material would be tracked through a fuel bank or multinational facility, including the possible impact on bilateral agreements. For instance, would there be a requirement for a bilateral agreement with each of the operating/partner countries as well as the end-user? Or would it be possible to have assurances indirectly via the Member State's agreement with the IAEA?

Nuclear accountancy and associated reporting obligations will need to be agreed so that reporting requirements are consistent regardless of supplier country. There would also need to be agreement on treatment of reporting generated, such as: would the information be available to all Member States, to Member State(s) specifically on their obligated nuclear material, or some other predetermined group? And, what information would be available in each instance? It is likely that agreed reporting obligations will be similar to existing arrangements falling under bilateral agreements.

Where to from here?

It is undesirable for every state that has either a nuclear research or power program to establish its own enrichment and reprocessing facilities. The international community has long recognised the need to reduce the spread of sensitive nuclear technologies (i.e. enrichment and reprocessing); fuel banks – and the underlying fuel assurances that are part of the bank – and multinational enrichment facilities are viable options which have the potential to minimise the spread of enrichment and reprocessing technologies.

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7 http://www.iaea.org/newscenter/news/2010/leureserve.html, "Russia Inaugurates World's First Low Enriched Uranium Reserve", International Atomic Energy Agency, 17 December 2010.

Some uranium supplier countries (such as Australia) supply under bilateral safeguards agreements that include assurances and conditions additional to those required under IAEA safeguards agreements, such as requiring supplied nuclear material to be accounted for (or “tracked”) separately. If such suppliers were to consider supplying uranium to a multinational facility there are aspects to how the facility would operate that would need to be clarified, such as what forms of assurances which would need to be given before supplying uranium to a fuel bank. Importantly, if and how obligated nuclear material would be accounted for within a multinational facility, whether it is an enrichment facility, a fuel bank or a reprocessing facility, would be an important question to address.

Australia strongly supports the non-proliferation value of fuel cycle multilateralisation. Taking an international approach to the fuel cycle to protect sensitive nuclear technologies and ensure the security of nuclear fuel supply makes a valuable contribution to non-proliferation and there are a number of parallel initiatives looking at achieving exactly this. However, an international fuel bank or a multinational enrichment facility or similar endeavour will only succeed with international support and strict adherence to IAEA safeguards.

Destruction of Old Chemical Weapons at Columboola

Most Australians would not be aware that Australia had chemical weapons on its territory during World War II (WWII), for defence purposes to provide for a response in-kind if that proved necessary. The weapons were never used in warfare. The majority of these munitions were designed to be filled with nitrogen or sulphur mustard or phosgene. All chemical weapons remaining in Australia after WWII were either shipped back to their country of origin (US or UK), dumped at sea, buried underground, or the chemical agents destroyed and the casings mutilated. None of these methods of disposal were prohibited at that time.

The Chemical Weapons Convention (CWC) defines old chemical weapons (OCW) as those chemical weapons manufactured between 1925 and 1946 and that are no longer usable. The CWC does not require States Parties to recover OCW buried prior to 1977 or dumped at sea before 1985. However, if any OCW resurface or are excavated, they must be declared to the Organisation for the Prohibition of Chemical Weapons (OPCW) and destroyed in accordance with the provisions and principles outlined under the CWC.

The OPCW is responsible for the global implementation of the CWC. Its mandate includes verification of States Parties’ declarations of OCW and to determine if they meet the definition of OCW under the Convention.

Verification under the CWC requires on-site inspection of OCW munitions and visual examination to ensure that they are not usable as chemical weapons and were not manufactured post-1946. Both criteria are needed to rule out their classification as ‘chemical weapons’ under the Convention, which would require more stringent reporting and destruction obligations as compared with those required for OCW.

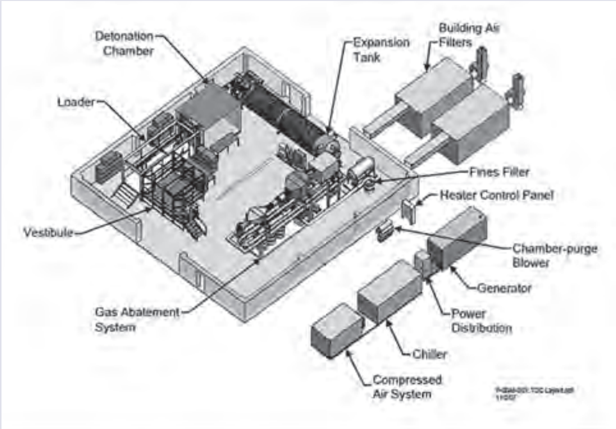
Excavation of 105mm OCW projectiles at Columboola, QLD, 2009 (Photo: Department of Defence).

The 144 OCW projectiles (of US origin) discovered during mining preparations at Columboola, QLD in June 2009, on a former World War II munitions depot site, were suspected of containing the chemical warfare agent sulphur mustard. In addition, their age and condition, uncertainty about explosive components and their location on private property were integral to the manner in which the destruction project evolved, requiring all munitions to remain on-site throughout the entire process.

Defence, in consultation with ASNO, managed the execution of a plan of action to secure, characterise, destroy and dispose of the OCWs. To ensure the safety of people and the environment, the project was conducted in accordance with state, national and international legal requirements (notably those of the CWC). Defence consulted with, and briefed, mine owners and operators, state government and environmental stakeholders and concerned residents in the nearest towns on an on-going basis, and reassured them that safety would be given the highest priority.

Australia's Defence Science and Technology Organisation assisted with specialist tasks, including deployment of its Mobile Analytical Facility for the on-site analysis of soil and other samples to determine the extent of any contamination as well as conducting studies to determine the radius of impact should any of the munitions leak or explode during their removal from the storage site to the destruction location 100 metres away.

The best method for destruction was assessed to be explosive detonation given the possibility of explosive components being present and of breakdown of the sulphur mustard, complicating any removal and subsequent hydrolysis. However, as Australia does not have a chemical weapon destruction facility, a Transportable Detonation Chamber (TDC) was imported from the United States and erected on-site at Columboola for use as a temporary destruction facility.



Simplified process flow diagram for the Transportable Detonation Chamber (TDC) (Image: Copyright CH2MHILL)

Defence was also provided with assistance from the US Government including personnel, equipment and expertise. US experts characterised the munitions' contents and overpacked the munitions into propellant charge cans in preparation for destruction. The results of X-ray and Portable Isotopic Neutron Spectroscopy indicated that 140 of the 144 munitions were filled with sulphur mustard.

US Experts preparing OCW for safe storage before destruction at Columboola (Photo: Department of Defence).

External view of the building containing the Transportable Detonation Chamber at Columboola. (Photo: Department of Defence)

In September 2010, the OPCW conducted an inspection at Columboola. ASNO, together with Defence, facilitated the inspection to verify Australia's declaration. This was the first inspection of its kind in Australia. The proposed destruction method using a TDC was also discussed and confirmed by the OPCW to be in full accordance with the CWC.

Despite the heavy rain and floods in late 2010 and early 2011, the TDC was built on-site over an eight week period. All 144 OCWs were safely destroyed during April and May 2011.

The search for other possible OCW burial sites continues at Columboola and covers a total area of 724 hectares. Once completed, this will open the way for coal-mining operations to commence safely in the area with a high degree of confidence that no other munitions will be encountered.

OPCW Director-General, Ambassador Ahmet Üzümcü with the Minister for Defence, Mr Stephen Smith (Photo: Copyright OPCW).

In June 2011, the Honourable Stephen Smith, Minister for Defence, visited the OPCW headquarters in The Hague where he met with the Director-General, Ambassador Ahmet Üzümcü. Defence Minister Smith confirmed the completion of destruction of the OCW at Columboola and emphasised that the goals of eliminating all chemical weapons and preventing their re-emergence made a vital contribution to global efforts aimed at enhancing peace and security. Director-General Üzümcü commended Australia for its consistent support for the work of the OPCW.

Approaching the Final Destruction Deadline for Chemical Weapon Stockpiles

As the final extended destruction deadline approaches, the Organisation for the Prohibition of Chemical Weapons (OPCW) is sailing in unchartered territory. There are no provisions in the Chemical Weapons Convention (CWC) for the existence of chemical weapons after 29 April 2012, yet possessor states have admitted that destruction of chemical weapon stockpiles will not be complete by this date.

A fundamental objective of the CWC is the complete elimination of all existing chemical weapons (i.e. demilitarisation). Complementary to this is the prevention of their re-emergence (i.e. non-proliferation). The CWC entered into force on 29 April 1997 and prescribed that all chemical weapons must be destroyed within ten years, that is, by 29 April 2007. However, provisions were made in an Annex to the CWC allowing for a maximum five-year extension to 29 April 2012. The CWC does not contain any provisions to address the existence of chemical weapons after that date.

Seven States Parties have declared their possession of chemical weapons. By late 2010, for category one chemical weapons[8], the United States had destroyed approximately 84% of its chemical weapon stockpile and Russia had destroyed approximately 49% of its stockpile. Iraq has faced technical issues during the demilitarisation process. Completion of destruction activities in Libya has been delayed. Albania, India and one other State Party, have completed their demilitarisation programmes. All declared chemical weapon stockpiles have been secured, inventoried and verified by the OPCW. All declared chemical weapon production facilities have been inactivated and are subject to systematic verification through on-site inspection and monitoring by the OPCW.

The largest chemical weapons possessor states, the United States and Russia, have confirmed that they will be unable to complete the destruction process by the extended deadline of 29 April 2012. The commitment of these States to the task is clear, however, persistent technical problems, environmental issues and funding shortfalls have brought delays.

OPCW consultations related to the possessor states' inability to meet the deadline have been underway since 2009. Initial discussions concluded that a technical change to the CWC would not gain the support of all States Parties. Subsequent discussions have focussed on expanding confidence-building and transparency measures, and establishing a 'planned completion date' specific to each possessor state. A draft decision has been proposed which incorporates these measures while allowing for the continuation of the CWC's current provisions for destruction. However, it is unfortunate that early agreement on a course of action has eluded States Parties. Discussions and consultations will continue with the aim of finalising a decision for approval by the Sixteenth Session of the Conference of the States Parties in December 2011.

Missing the destruction deadline is not likely to have serious international peace and security implications provided there is provision for continued verification of destruction facilities and stockpiles. It is of paramount importance that possessor states destroy their chemical weapons stockpiles as quickly as possible. Failure of States Parties to reach agreement on the way forward may impact the OPCW and State Parties' responsiveness to other important issues of relevance to the CWC.

Australia's Uranium Production and Exports

Statistics related to Australia's exports of Uranium Ore Concentrates (UOC) are listed in Table 1 below.

Australia's Reasonably Assured Resources (RAR) of uranium recoverable at costs of less than US$80 per kilogram uranium were estimated to be 1 223 000 tonnes U as at December 2009, which represents 46% of world resources in this category.

8 Paragraph 16 of Part IV(A) of the Verification Annex to the CWC determines that for the purposes of destruction of declared chemical weapons they are divided into the following categories: Category 1: chemical weapons on the basis of Schedule 1 chemicals and their parts and components; Category 2: chemical weapons on the basis of all other chemicals and their parts and components; Category 3: unfilled munitions and devices, and equipment specifically designed for use directly in connection with employment of chemical weapons.

This is based on estimates for Australia by Geoscience Australia in *Australia's Identified Mineral Resources 2010* and for other countries as reported by the OECD Nuclear Energy Agency in 'Uranium 2009: Resources, Production and Demand'.
In 2010, the Ranger and Olympic Dam mines were, respectively, the world's second largest (6% of world uranium production) and seventh largest (4% of world uranium production) uranium producers.[9] Overall, Australia is the third largest uranium producer after Kazakhstan and Canada.

TABLE 1: UOC EXPORT AND NUCLEAR ELECTRICITY STATISTICS

Item	Data
UOC Exports	
Total Australian UOC exports 2010–11	6950 tonnes
Value Australian UOC exports	A$610 million
Australian exports as % world uranium requirements[10]	~8.7%
No. of reactors (1000 MWe) these exports could power[11]	~33
Power generated by these exports	~230 TWh
Expressed as percentage of total Australian electricity production[12]	~88%

Worldwide, uranium mining currently provides about 70% of global industry requirements, with the balance coming from down-blending of excess weapons material, stockpiles and reprocessing. In 2011 world uranium consumption is expected to increase as the commissioning of new nuclear generating capacity in China, India, the Russian Federation and Taiwan is expected to more than offset lower consumption in Japan and Germany associated with the closure of nuclear capacity following the Fukushima Dai-ichi nuclear accident. Over the longer term uranium spot prices are expected to be strong due to the forecast increase in nuclear power worldwide, and uncertainty surrounding the possible extension of the US–Russia Megatons to Megawatts program, due to expire in 2013. New mines will be necessary to meet current, as well as future increases in demand.

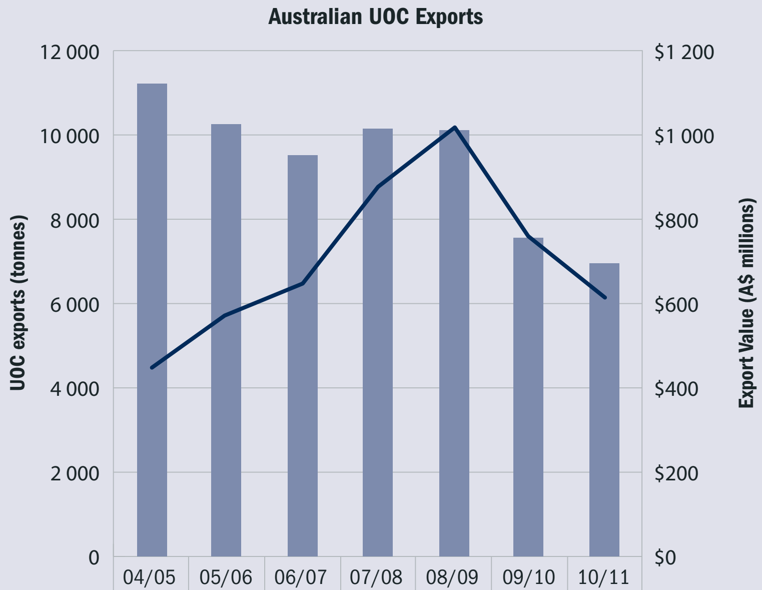
9 Australian production compared with data on global uranium producers from the World Nuclear Association's World Uranium Mining (April 2011)—www.world-nuclear.org/info/inf23.html.

10 Based on 2011 world requirements of 68 971 tonnes uranium (World Nuclear Association's World Uranium Mining, July 2011).

11 Based on a comparison of TWh of nuclear electricity generation and uranium required, for countries eligible to use AONM. Source: World Nuclear Association's "World Nuclear Power Reactors and Uranium Requirements", http://www.world-nuclear.org/info/reactors0711 (1 July 2011).

12 Australia's gross electricity generation in 2010–11 is estimated to be 260 TWh. Source: Australian Energy, National and State Projections to 2029–30—Statistical Tables, ABARE Research Report March 2010.

FIGURE 1: QUANTITY AND VALUE OF AUSTRALIAN UOC EXPORTS



	04/05	05/06	06/07	07/08	08/09	09/10	10/11
UOC exports (tonnes)	11 215	10 253	9 518	10 140	10 114	7 555	6 950
Value (A$ millions)	$475	$545	$658	$882	$1,033	$758	$610

Australia's nuclear safeguards policy

The Australian Government's uranium policy limits the export of Australian uranium to countries that are a party to the Nuclear Non-Proliferation Treaty (NPT), have an Additional Protocol in force and are within Australia's network of bilateral safeguards agreements. These bilateral safeguards agreements are designed to ensure that IAEA safeguards and appropriate nuclear security are applied, as well as a number of supplementary conditions. Nuclear material subject to the provisions of an Australian safeguards agreement is known as Australian Obligated Nuclear Material (AONM). The obligations of Australia's agreements apply to uranium as it moves through the different stages of the nuclear fuel cycle, and to nuclear material generated through the use of that uranium.

All of Australia's safeguards agreements contain treaty-level assurances that AONM will be used exclusively for peaceful purposes and will be covered by safeguards arrangements under each country's safeguards agreement with the IAEA.

In the case of non-nuclear-weapon states (NNWS), it is a minimum requirement that IAEA safeguards apply to all existing and future nuclear material and activities in that country. In the case of nuclear-weapon states (NWS), AONM must be covered by safeguards arrangements under that country's safeguards agreement with the IAEA, and is limited to use for civil (i.e. non-military) purposes.

The principal conditions for the use of AONM set out in Australia's safeguards agreements are:

- AONM will be used only for peaceful purposes and will not be diverted to military or explosive purposes (here military purpose includes: nuclear weapons; any nuclear explosive device; military nuclear reactors; military propulsion; depleted uranium munitions, and tritium production for nuclear weapons)
- IAEA safeguards will apply
- Australia's prior consent must be sought for transfers to third parties, enrichment to 20% or more in the isotope ^{235}U and reprocessing[13]
- fallback safeguards or contingency arrangements will apply if for any reason NPT or IAEA safeguards cease to apply in the country concerned
- internationally agreed standards of physical security will be applied to nuclear material in the country concerned
- detailed administrative arrangements are applied between ASNO and its counterpart organisation, setting out the procedures to apply in accounting for AONM
- regular consultations on the operation of the agreement are undertaken
- provision is made for the removal of AONM in the event of a breach of the agreement.

Australia currently has 22 nuclear safeguards agreements in force, covering 39 countries plus Taiwan (see Appendix B).[14]

Accounting for Australian uranium

Australia's bilateral partners holding AONM are required to maintain detailed records of transactions involving AONM. In addition, counterpart organisations in bilateral partner countries are required to submit regular reports, consent requests, transfer and receipt documentation to ASNO. ASNO accounts for AONM on the basis of information and knowledge including:

- reports from each bilateral partner
- shipping and transfer documentation
- calculations of process losses and nuclear consumption, and nuclear production
- knowledge of the fuel cycle in each country
- regular reconciliation and bilateral visits to counterparts
- regular liaison with counterpart organisations and with industry
- IAEA safeguards activities and IAEA conclusions on each country.

13 Australia has given reprocessing consent on a programmatic basis to the UK, France and Japan. Separated Australian-obligated plutonium is intended for blending with uranium into mixed oxide fuel (MOX) for further use for nuclear power generation.

14 Twenty-seven of the countries making up this total are European Union member states.

Australia's uranium transhipment security policy

For countries with which Australia does not have a bilateral safeguards agreement, but through which Australian uranium ore concentrates (UOC) are transhipped, there must be arrangements in place with such states to ensure the security of UOC during transhipment. If the state is:

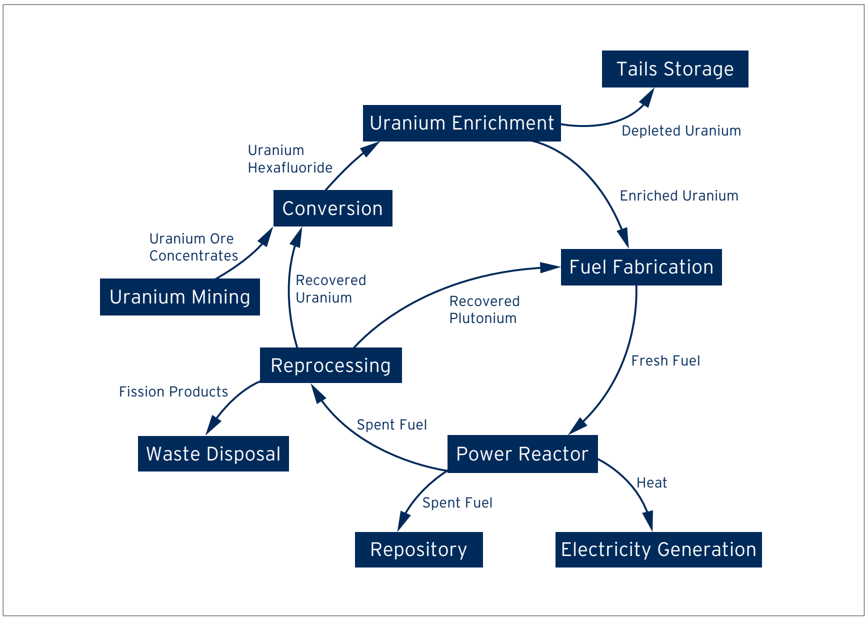
- a party to the Convention on the Physical Protection of Nuclear Material (CPPNM)
- has adopted the IAEA's Additional Protocol on strengthened safeguards
- and acts in accordance with these agreements;

then arrangements on appropriate security can be set out in an instrument with less than treaty status[15]. Any such arrangement of this kind would be subject to risk assessment of port security.

For states that do not meet the above requirements, treaty-level arrangements on appropriate security may instead be required.

15 See page 26 of ASNO's 2008–09 Annual Report for more details on the establishment of this policy.

FIGURE 2: CIVIL NUCLEAR FUEL CYCLE



A characteristic of the nuclear fuel cycle is the international interdependence of facility operators and power utilities. It is unusual for a country to be entirely self-contained in the processing of uranium for civil use. Even in the nuclear-weapon states, power utilities will often go to other countries seeking the most favourable terms for uranium processing and enrichment. It would not be unusual, for example, for a Japanese utility buying Australian uranium to have the uranium converted to uranium hexafluoride in Canada, enriched in France, fabricated into fuel in Japan and reprocessed in the United Kingdom.

The international flow of nuclear material means that nuclear materials are routinely mixed during processes such as conversion and enrichment and as such cannot be separated by origin thereafter. Therefore, tracking of individual uranium atoms is impossible. Since nuclear material is fungible—that is, any given atom is the same as any other—a uranium exporter is able to ensure its exports do not contribute to military applications by applying safeguards obligations to the overall quantity of material it exports. This practice of tracking quantities rather than atoms has led to the establishment of universal conventions for the industry, known as the principles of equivalence and proportionality. The equivalence principle provides that where AONM loses its separate identity because of process characteristics (e.g. mixing), an equivalent quantity of that material is designated as AONM. These equivalent quantities may be derived by calculation, measurement or from operating plant parameters. The equivalence principle does not permit substitution by a lower quality material. The proportionality principle provides that where AONM is mixed with other nuclear material and is then processed or irradiated, a corresponding proportion of the resulting material will be regarded as AONM.

Director General ASNO, Robert Floyd and Director General, State Atomic Energy Corporation (ROSATOM), Sergey Kirienko concluding the Exchange of Letters on Administrative Arrangements under the Australia-Russia Nuclear Cooperation Agreement.