INTEGRATED SAFEGUARDS – AUSTRALIA'S VIEWS AND EXPERIENCE

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ABSTRACT

Australia is the first State in which integrated safeguards are being applied. As such, Australia's experience will be of interest to other States as they consult with the IAEA on the modalities for the introduction of integrated safeguards in their jurisdictions. In January 2001, the IAEA approved an integrated safeguards approach for Australia on a State-as-a-whole level. This approach relies *inter alia* on unannounced inspections, and on complementary access to provide the necessary level of assurance as to the absence of undeclared activities. The purpose of the paper is to outline Australia's experience with strengthened safeguards and Australia's views on the implementation of integrated safeguards. Other matters discussed include the logistics of complementary access and unannounced inspections.

INTRODUCTION

Australia's role in the development of integrated safeguards Australia has had a pioneering role in assisting the IAEA to develop the procedures and methods for strengthened safeguards, both before and after the conclusion of Australia's additional protocol. Australia played a key role in the negotiation of the model Additional Protocol, and made ratification a high priority in order to encourage early ratification by other States. Australia was the first State to ratify an additional protocol, on 10 December 1997, and was the first State in which the IAEA exercised complementary access, managed access under the additional protocol, and complementary access to a uranium mine. Consequently Australia has undergone three full cycles of evaluation under strengthened safeguards measures, enabling the Agency to conclude it was appropriate to commence implementation of integrated safeguards.

From strengthened safeguards to integrated safeguards From the early 1990s, the IAEA, with the assistance of Member States, has been engaged in a major undertaking to strengthen and streamline its safeguards system. The principal directions of the strengthened safeguards system currently under development are to:

- shift the focus of verification activities from declared inventories and flows of nuclear material at individual facilities, towards safeguards approaches based on evaluation of the State as a whole;
- provide credible assurance of the absence of undeclared nuclear material and activities in the State concerned; and
- diversify the methods of verification and detection, introducing methods based upon quite different principles (such as environmental sampling and satellite imagery), resulting in a more robust safeguards system.

From the outset, it was recognised that under a strengthened safeguards system the IAEA would need greater rights of access at declared sites and elsewhere, greater capabilities to acquire and analyse information, and the deployment of new technologies, particularly environmental sampling (which had proven to be highly effective in Iraq). Many of these elements required additional legal authority for the IAEA, and this has been given expression through the model Additional Protocol (INFCIRC/540), agreed in the Board of Governors in May 1997, which serves as the model for each State to conclude

with the IAEA an individual protocol additional to its safeguards agreement (which for States under comprehensive safeguards is based on INFCIRC/153).

Substantial work has been undertaken, and is ongoing, developing the safeguards approaches, procedures, technologies, quality assurance systems, evaluation methodologies and reporting modalities required to ensure that the strengthened safeguards system will be effective in practice. At the same time as this work proceeds, attention is also being given to the next major stage in the evolution of IAEA safeguards, *integrated safeguards*. Integrated safeguards refers to the optimum combination of all safeguards measures available to the IAEA under comprehensive safeguards agreements and additional protocols which achieves the maximum effectiveness and efficiency within available resources.

Under classical safeguards, the level of verification effort takes into account the possibility that undeclared nuclear activities may exist undetected. Thus, for example, the timeliness goal for detection of diversion of spent fuel incorporates the assumption that an undeclared reprocessing plant may exist ready to use in processing diverted material immediately after diversion. The basis of integrated safeguards is that classical and strengthened safeguards are self-reinforcing and to some extent redundant – as strengthened safeguards establish credible assurance of the absence of undeclared nuclear activities, particularly enrichment and reprocessing, a corresponding reduction should be possible in the intensity of classical safeguards effort.

The IAEA has determined that the introduction of integrated safeguards can be considered if there are positive results from the implementation of both classical and strengthened safeguards activities. For each State, therefore, progress to integrated safeguards is a *two-stage process*, the first stage of which is to meet the requirements of strengthened safeguards.

IMPLEMENTATION OF STRENGTHENED SAFEGUARDS

State evaluation Central to the strengthened safeguards concept is the State Evaluation, a comprehensive analysis by the IAEA of all the information available to it regarding the nuclear program of each State. A substantially increased amount of information is available to the IAEA as a result of safeguards strengthening measures, including:

- information supplied by the State itself, under its safeguards agreement, under its additional protocol, and voluntarily;
- information from the IAEA's verification activities, including inspections and complementary access;
- open source and related information; and
- information provided by third parties, such as export data.

Through the State Evaluation process the IAEA seeks to establish a thorough understanding of the State's nuclear and nuclear-related activities, including the consistency of declared activities with the nuclear program as a whole, and identifying questions and inconsistencies requiring further explanation. An important aspect is the identification of possible indicators of undeclared nuclear activities and how to acquire and recognise such indicators. All of these matters are taken into account in reaching a conclusion about the absence of undeclared nuclear material and activities in the State.

While the undertaking of a State Evaluation is not dependent on the conclusion of an additional protocol, without a protocol it would be of limited value. Obviously a wider range of information becomes available to the IAEA once a protocol is in place—and the evaluation is more meaningful as

it can be used more efficiently in the planning of the IAEA's verification activities, such as the resolution of any questions or inconsistencies.

The State Evaluation is the subject of ongoing review—the initial analysis is used to identify areas requiring further clarification, including through the conduct of safeguards activities such as complementary access and environmental sampling, and the results of these activities are fed back into the evaluation process.

Expanded declaration A major step in the State Evaluation process is submission by the State concerned of initial declarations in accordance with its protocol provisions, including a full and comprehensive declaration of all safeguards relevant activities that have been conducted in the State.

This process was simpler for Australia than might be the case for many other States, as Australia had already spent a number of years clarifying and extending its knowledge of its nuclear history in preparation for the additional protocol, and had already submitted a trial expanded declaration to the IAEA. Even so, this was not a straightforward exercise as Australia's nuclear research site, Lucas Heights, has been involved in nuclear activities since the 1950s, and much of the early history has been lost. It was necessary to go through an iterative process in which Australia supplied all of the available information and the IAEA investigated and sought clarifications and expansion. This provided the IAEA with useful experience of some of the practical difficulties involved in reconstructing the history of a nuclear site and early programs.

As regards provision of the wider range of information required under the additional protocol, Australia was well placed because the relevant legislation—the Safeguards Act—had been drafted more widely than required solely to implement the basic safeguards agreement. The Act covers not only nuclear material, but also nuclear-related materials, equipment and technology, to give the fullest effect to NPT commitments and to reflect commitments under various bilateral agreements. Thus legal and administrative frameworks were already in place for collecting most of the additional information required under the protocol.

Complementary access Complementary access is an essential part of strengthened safeguards, involving extensive access at nuclear sites and locations with nuclear-related activities to establish the absence of undeclared activities, and access elsewhere in the State where there are questions or inconsistencies to resolve. As Lucas Heights is a government site, providing the IAEA with complementary access presents no difficulty. However, the government could not guarantee access at privately owned locations, and a key step in ratifying the additional protocol was to amend the Safeguards Act to ensure the IAEA could be given access for protocol purposes at *any* location in Australia.

Prior to conclusion of the additional protocol, Australia had cooperated with the IAEA in the trial of protocol measures, including access along complementary access lines. Since Australia's protocol entered into force, as at the time of writing this paper (29 June 2001) the Agency has exercised complementary access on 13 occasions, 11 times at Lucas Heights and twice elsewhere in Australia. One of the complementary accesses at Lucas Heights was on a "managed access" basis.

All but two of the complementary accesses were requested during a routine safeguards inspection. For 9 of the complementary accesses at Lucas Heights, inspectors gave two hours notice, and were given access within this period. For the managed access and a complementary access not associated with an inspection, the IAEA had foreshadowed its request well in advance to allow sufficient time for appropriate arrangements to be established.

One of the cases of complementary access away from Lucas Heights involved a location in South Australia, some 1100 km distant. Notice was given during a routine inspection at Lucas Heights, for access 24 hours later. The other complementary access was to the Ranger uranium mine in the Northern Territory, a remote location difficult to reach particularly by public transport. Notice was given during a routine inspection at Lucas Heights, for access five days later. Even with five days' notice there were difficulties arranging transport.

CONDITIONS FOR THE INTRODUCTION OF INTEGRATED SAFEGUARDS

As noted above, progress to integrated safeguards is a two-stage process, the first stage of which is to meet the requirements of strengthened safeguards.

A positive result—an initial IAEA's conclusion of the absence of undeclared nuclear material and activities in a State—would be based on the following conditions:

- the State has concluded an additional protocol;
- the State has complied in a timely manner with all the requirements of its safeguards agreement and the additional protocol;
- the IAEA has conducted a comprehensive State Evaluation;
- the IAEA has drawn a conclusion of non-diversion of declared nuclear material in the State;
- the IAEA has implemented complementary access as necessary, to resolve questions and inconsistencies identified during the information review process, and to assure the absence of undeclared nuclear material at sites and other locations specified in the protocol, and has found no indications of undeclared nuclear material or activities in the State.

This conclusion would be maintained, and should be enhanced, by ongoing implementation of the additional protocol and continued satisfactory resolution of any further questions and inconsistencies.

In Australia's case, the series of complementary accesses, combined with the results of environmental sampling and information analysis, assisted the IAEA in concluding there is no indication of undeclared nuclear material or activities in Australia and that the expanded declaration was correct and—most importantly—complete. Once the IAEA had arrived at a credible level of assurance that there are no undeclared nuclear activities in Australia, it became possible for the IAEA to make a statement to that effect in its Safeguards Implementation Report (SIR)[1].

WHOLE-OF-STATE APPROACH

The evaluation of the State as a whole has a central place in developing integrated safeguards approaches. The classical safeguards system has been characterised by a uniform approach to safeguards implementation, exacerbated by the facility-by-facility approach. This has had unfortunate consequences for inspection resources, with effort being expended in a mechanistic way based on the category and amount of nuclear material in each facility. Although INFCIRC/153 safeguards agreements provide for flexibility, taking account of factors such as the characteristics of the State's

1. The SIR for 2000 stated that for seven States (which included Australia), each of which has a comprehensive safeguards agreement *and* an additional protocol in force or being provisionally applied, the Agency found no indication of diversion of nuclear material placed under safeguards or of the presence of undeclared nuclear material or activities in these States.

nuclear fuel cycle, its international interdependence, and the effectiveness of the national safeguards system, in practice opportunities for flexibility have not been used to advantage.

Integrated safeguards however provide the opportunity for greater cost-efficiency, to take account of State-specific circumstances. Rather than treat each facility type identically regardless of the State in which it is located, the facility can be considered in its broader context. For example, the proliferation potential of an inventory of high enriched uranium (HEU) at a research reactor will depend on factors such as: whether that is the only HEU in the State concerned; whether further processing would be required to upgrade the HEU for weapons use; if so, whether the State is known to have the necessary processing capability; and so on. It might be judged that a lesser safeguards intensity is appropriate in a State where there is just one holding of such material than in a State with a number of such holdings. In the latter case, the safeguards approach might be determined by considering all relevant facilities collectively rather that just repeating the same safeguards measures at each facility. It is likely no two States will have identical circumstances, and therefore the implementation of safeguards will vary from one State to another. This will have to be done, however, in a transparent way, using objective criteria, to avoid any suggestion of discrimination. The methodologies for this are being developed by the IAEA in consultation with Member States.

THE INTEGRATED SAFEGUARDS REGIME FOR AUSTRALIA

Australia has five Material Balance Areas (MBAs), the principal one covering the 10 MWt research reactor at Lucas Heights and the associated inventory of fresh and irradiated HEU fuel. Under classical safeguards, generally Australia was subject to annual Physical Inventory Verifications (PIVs) for the four MBAs at Lucas Heights, plus quarterly interim inspections, making a total of four inspections a year (PIVs for the different MBAs were conducted concurrently with each other or with interim inspections in other MBAs), although there was a period when the fresh fuel inventory exceeded 1 SQ (Significant Quantity)[2], requiring monthly inspections.

Under strengthened safeguards, this pattern of four inspections a year was maintained, with the addition of complementary accesses, which in most cases have been undertaken at the Lucas Heights site.

Under the integrated safeguards regime now being applied, the timeliness period for irradiated fuel has been changed from 3 months to 12 months, eliminating the quarterly interim inspections. The four inspections each year have been replaced by one PIV (including comprehensive Design Information Verification activities), and an *average* of one unannounced inspection. The objectives of the unannounced inspection include, to verify the fresh and spent fuel inventory and if possible the core fuel, and to confirm facility design information, the declared operation of the reactor, and the absence of undeclared activities. The term "average" is important—to maintain deterrence, once the unannounced inspection has taken place, there will always be the possibility of a further unannounced inspection in the same year. Where possible, fuel transfers will be verified during the PIV or unannounced inspection(s), but the IAEA has indicated that if necessary additional inspections may be undertaken for this purpose.

In addition to the inspections outlined above, there will be five or six complementary accesses each year, mainly at the Lucas Heights site, but also encompassing uranium mines and LOFs (locations

2. For HEU a Significant Quantity is uranium containing 25 kg of U-235.

other than facilities). In most circumstances it is expected that complementary accesses would be carried out when inspectors are in Australia for routine inspections.

In future the inventory of unirradiated HEU is not expected to exceed 1 SQ. If this does occur, the Agency has foreshadowed a return to monthly inspections, or the use of remote monitoring in conjunction with further unannounced inspections. This is a case where the State-as-a-whole approach is important—a substantial increase in safeguards effort might not be warranted if (as in Australia's case) this was the only HEU inventory in the State and the excess over 1 SQ was small.

The overall savings in inspection effort are expected to be about 45% (a reduction from 18 to 10 PDI[3]) a year. However, this depends on whether additional inspections are required to verify fuel transfers—this is an area where Australia considers remote monitoring could be very useful, as discussed below.

SOME IMPLEMENTATION ISSUES

Participation of national inspectors in inspections and complementary access Under Australian law, IAEA inspectors have no authority to enter property unless they have the permission of the occupier or they are accompanied by a national (ASNO) inspector. A national inspector can if necessary obtain a warrant from a magistrate to enter property, and can call on police assistance. Although difficulties are unlikely to arise, it is Australian policy that IAEA inspectors should be accompanied by national inspectors, to ensure full cooperation is extended to the IAEA, and to ensure that the Government is immediately aware if there are any difficulties.

Australia has a large land mass, and the logistical challenge of arranging a complementary access to a distant part of Australia on short notice can be difficult to meet. As noted above, arranging transport to a uranium mine proved difficult even with five days' notice. Australia anticipates that requests for complementary access to remote locations should be infrequent—otherwise this could cause practical difficulties.

Unannounced inspections These are not unique to either strengthened or integrated safeguards—the standard safeguards agreement (INFCIRC/153) provides for a proportion of routine inspections to be unannounced. However, the value of unannounced inspections—ie inspections whose timing is unpredictable to the State or the facility operator—has been particularly recognised in the context of integrated safeguards.

It should be appreciated that unannounced inspections do not necessarily—or usually—mean *immediate* access. A distinction is made between the initiation of the inspection—arrival of inspectors at the facility—and the time in which the inspectors require access to the area to be inspected.

In determining the required access time, the IAEA should take account of practical matters—availability of operators' personnel essential to the conduct of the inspection, any requirement for national inspectors to be present (as discussed above), and so on. There needs to be a careful balance between the objectives of the inspection and these practical considerations. If the scenario the inspection is intended to address would remain detectable over a period—eg modifications to plant that would take days to reverse, environmental traces that could be detected weeks or even months after the event—this can be factored into the required access period. Indeed, in many situations it may be possible to provide some advance notice of the inspection. To the extent

3. Person days of inspection.

consistent with the requirement for detection capability, the principal aim should be *unpredictability* rather than surprise.

In Australia's case, the IAEA has agreed to provide three hours' notice of required access pursuant to an unannounced inspection. Notice would normally be given at 7.00 am of an inspection to commence at 10.00 am that day. This is consistent with the travelling time required for national inspectors to reach Lucas Heights from ASNO's office in Canberra (a distance of 275 km), and reflects the Agency's judgment that any undeclared activity at the Lucas Heights site could not be concealed within that time. If for any reason national inspectors are delayed in reaching the site, the inspection can commence in any event after three hours.

Remote monitoring After some initial enthusiasm, the IAEA now seems cautious about using remote monitoring because of problems related to reliability and cost. Remote monitoring has not been included in the integrated safeguards approach for Lucas Heights, though the Agency recognises that remote monitoring could be a useful "enhancement" to routine inspections.

Australia considers that problems with remote monitoring can be overcome by well designed systems, and is proposing a remote monitoring installation to address the verification of fuel transfers at Lucas Heights—the loading of spent fuel shipping containers, and the receipt of fresh fuel. If the Agency needs to undertake additional inspections for these purposes, this would negate the savings in inspection effort introduced by integrated safeguards. Australia's remote monitoring proposal is under discussion with the Agency.

Verification measures for uranium mines Under classical safeguards uranium production was considered to be "before the starting point of safeguards". Verifying production at a uranium mine on any rigorous basis would require continuous inspector presence. Since any diverted ore or source material would have to pass through many downstream processes, each of which offers some opportunity for detection, before attaining a form suitable for nuclear explosive use, it was not considered cost-effective to extend safeguards to uranium mines.

During the development of strengthened safeguards, it was considered that the possibility of verification of uranium production was worthwhile as a complement to conventional safeguards, and the additional protocol provides for broad reporting requirements and complementary access at mines. Although accountancy-type measures are not practicable, appropriate verification measures could identify questions or inconsistencies indicating the need for wider investigation in the State concerned. At one extreme is the discovery of totally undeclared production, ie an undeclared mine, or a mine incorrectly declared to be closed down. Perhaps a more plausible scenario is the under-stating of production. Australia is assisting the Agency in developing verification approaches and techniques that could identify such a situation, including use of satellite imagery and environmental sampling to date production.

Failure to maintain the conditions for the implementation of integrated safeguards One issue being addressed is, what would be the consequences if the IAEA is unable to resolve significant questions and inconsistencies in a State in which integrated safeguards are being applied. Leaving aside evidence of non-compliance—which would be reported in due course to the IAEA's Board of Governors and if necessary the Security Council—if the situation is merely one of suspicion or uncertainty, should the IAEA revert to the full range of classical safeguards measures, as well as continuing to apply strengthened safeguards measures? The IAEA has concluded that in these circumstances it must have the ability to increase the intensity of routine safeguards measures. Exactly what the Agency does, however, should be decided on a case-by-case basis—in many cases a blanket

return to routine safeguards might make no sense. Of course, any such action by the Agency could be contentious, as the State concerned would resent apparently accusatory action. This is an argument for flexibility in safeguards, moving away from the rigid parameters of the classical system, so the Agency can fine-tune its handling of each particular situation without necessarily appearing to cast aspersions on the standing of the State concerned.

CONCLUSIONS

The classical safeguards system provides a high degree of assurance that there is no diversion of nuclear material from declared activities. The objective of complementing classical safeguards with strengthened safeguards measures is to provide the IAEA with *credible assurance* of both the non-diversion of nuclear material from declared activities and the absence of undeclared nuclear material and activities. Since assurance of the absence of undeclared nuclear material and activities can never be absolute—it will never be possible to definitively prove a negative—it is recognised that the degree to which strengthened safeguards measures provide such credible assurance will not lend itself to quantitative assessment. The IAEA will be required to use its judgment, which should be as objective, reliable and definitive as possible.

For the safeguards system to provide the necessary degree of assurance to the international community, it is essential that there is a clear understanding on the part of States of the IAEA's new approaches and methodologies, and the way it makes evaluations and reaches conclusions. In addition to the development of new verification techniques, substantial effort is being devoted to the development of quality assurance systems, and appropriate ways of reporting the IAEA's conclusions to Member States.

The development of strengthened safeguards measures—and even more so the development of integrated safeguards—is very much a work in progress. In fact it is an iterative process—inevitably the approaches developed will require refinement in the light of practical experience.

Major issues being addressed include, how to ensure the verification activities undertaken by the IAEA are sufficient to support a credible conclusion of the absence of undeclared nuclear activities? This involves both establishing the appropriate methodology and ensuring the methodology is implemented at an appropriate quality standard. As one sub-set of this point, there is the question of how to select locations for complementary access, especially how to ensure this is not done in a "mechanistic or systematic" way. An important group of issues concerns how to implement integrated safeguards in a flexible manner, based on State-specific factors, incorporating the expert judgment of the Agency, in a way that avoids accusations of discrimination, and delivers the required credibility.

Clearly the effective implementation of integrated safeguards presents a series of challenging tasks both for States and the Agency. The importance of doing this successfully cannot be overstated: the general application of strengthened safeguards measures is essential to providing the international community with assurance that NPT commitments are being met—and integrated safeguards are essential to achieving this in a cost-efficient manner. It is very much in the interest of all States to participate constructively with the Agency in this effort.