ADDRESSING VERIFICATION CHALLENGES

Proceedings of an International Safeguards Symposium Vienna, 16–20 October 2006

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European Safeguards Research and Development Association

INMM

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PROCEEDINGS SERIES

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PROCEEDINGS OF AN INTERNATIONAL SAFEGUARDS SYMPOSIUM ON ADDRESSING VERIFICATION CHALLENGES
ORGANIZED BY THE
INTERNATIONAL ATOMIC ENERGY AGENCY
IN COOPERATION WITH THE
INSTITUTE OF NUCLEAR MATERIALS MANAGEMENT
AND THE EUROPEAN SAFEGUARDS RESEARCH
AND DEVELOPMENT ASSOCIATION
AND HELD IN VIENNA, 16–20 OCTOBER 2006

INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA, 2007

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Sales and Promotion, Publishing Section
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http://www.iaea.org/books

Printed by the IAEA in Austria
August 2007
STI/PUB/1298

IAEA Library Cataloguing in Publication Data

International Safeguards Symposium on Addressing Verification Challenges (2006 : Vienna, Austria)
Addressing verification challenges : proceedings of an International Safeguards Symposium on Addressing Verification Challenges / organized by the International Atomic Energy Agency in cooperation with the Institute of Nuclear Materials Management and the European Safeguards Research and Development Association and held in Vienna, 16–20 October 2006. — Vienna : The Agency, 2007.
p. ; 24 cm. (Proceedings series, ISSN 0074–1884)
STI/PUB/1298
ISBN 978–92–0–104707–6
Includes bibliographical references.

1. Nuclear arms control — Verification — Congresses. 2. International Atomic Energy Agency — Congresses. I. International Atomic Energy Agency. II. Institute of Nuclear Materials Management. III. European Safeguards Research and Development Association. IV. Series: Proceedings series (International Atomic Energy Agency).

IAEAL 07–00487

FOREWORD

IAEA safeguards symposia are important forums for detailed interaction between the Secretariat of the IAEA, its Member States and the international community on safeguards and verification issues. Coming at the beginning of efforts to mark the IAEA's 50th anniversary in 2007, this symposium was held in Vienna, from 16 to 20 October 2006, in cooperation with the Institute of Nuclear Materials Management and the European Safeguards Research and Development Association. The aim was to address verification challenges to the IAEA safeguards system that have emerged, or intensified, since the previous symposium in 2001. Reflecting developments since then, the programme for the 2006 symposium was developed to cover five topics: current challenges to the safeguards system, further strengthening of safeguards practices and approaches, improving the collection and analysis of safeguards information, advances in safeguards techniques and technology, and future challenges

These proceedings contain the addresses given at the opening session, the technical plenary session and the closing session. The summary provides an overview of the oral presentations at the 21 sessions of the symposium. The invited papers presented during the various topical sessions, as well as papers exhibited at the poster session, are available on the attached CD-ROM.

The IAEA gratefully acknowledges the cooperation and support of the organizations and individuals involved in this symposium.

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SUMMARY*

The symposium on international safeguards, Addressing Verification Challenges, was held in Vienna from 16 to 20 October 2006, with the aim of assessing the challenges to the IAEA safeguards system that have emerged, or intensified, since the previous IAEA safeguards symposium in 2001. Some 500 nuclear safeguards and verification experts from more than 60 countries and international organizations attended the event. In all, 129 papers were presented in 21 sessions. There were 14 keynote speeches and 110 oral presentations. A total of 65 papers were presented as posters. In addition, 16 commercial suppliers of safeguards relevant equipment and technology presented their wares and capabilities.

The symposium was organized by the IAEA in cooperation with the Institute of Nuclear Materials Management (INMM) and the European Safeguards Research and Development Association (ESARDA). The symposium provided an important forum at which related issues could be discussed, the IAEA could showcase some of its ongoing work and the experts present could provide inputs of fresh thinking.

A summary of the symposium sessions, drawn from the papers presented, is given below.

1. OPENING PLENARY

The symposium was opened with an introductory statement by M. ElBaradei, Director General of the IAEA, and remarks by N.-J. Nicholas, Vice President of the INMM, and J. Joly, President of the ESARDA. Keynote presentations were then given by A.S. Minty, Governor for South Africa on the IAEA Board of Governors; A. Piebalgs, Commissioner for Energy of the European Commission; S.I. Kislyak, Deputy Minister for Foreign Affairs of the Russian Federation; R. Ekéus, Chairman of the Stockholm International Peace Research Institute; and Y. Matsuo, Managing Director of Japan Nuclear Fuel Limited.

A main theme of these introductory addresses, variously taken up by the keynote speakers, was that the nuclear non-proliferation regime, centred on

* The opinions expressed in this summary — and any recommendations made — are those of the participants and do not necessarily represent the views of the IAEA, its Member States or the other cooperating organizations.

the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), is under stress and facing new challenges. The political and non-proliferation landscape has changed dramatically over the past decades, especially since the NPT entered into force in 1970. One significant factor is increasing globalization, which complicates the already difficult and responsible task of seeking to ensure that nuclear material and infrastructure are used exclusively for peaceful purposes. In this respect, although the IAEA safeguards system has been strengthened considerably in recent years, safeguards constantly aim at moving targets and should continue to do so to remain relevant.

Particularly significant is the expected resurgence and expansion of nuclear energy. This is to be welcomed, because energy and development proceed in tandem, but it will result in wider dissemination of nuclear technology — some of it highly sensitive. This is especially disturbing at a time when some countries seem to think it 'fashionable' to shield themselves from perceived security threats by acquiring a nuclear fuel cycle or even nuclear weapons capability and when the threat of nuclear terrorism looms large. The root causes of the tensions underlying such developments need to be addressed. Solutions lie largely outside the remit of the IAEA or of other organizations, such as the INMM and the ESARDA, that are concerned with enhancing nuclear material security, with seeking to develop synergies between non-proliferation, nuclear security and safety cultures, and with applying best practices in the field of verification and safeguards. Nevertheless, the symptoms and the causes of tensions need attention. To address satisfactorily those that are relevant to the IAEA's verification mandate, adequate political support, resources and verification tools are essential. In this context, it is crucial to continue to strengthen the IAEA's ability to detect undeclared nuclear material and activities in contravention of safeguards agreements.

A.S. Minty maintained that for developing countries the only guarantee against the use of nuclear weapons is the abolition of such weapons — nuclear non-proliferation and nuclear disarmament are two sides of the same coin. That some States have failed to recognize and act upon this has undermined the NPT. So has the growing resort to unilateralism and unilaterally imposed prescriptions. The only sustainable way of addressing international security issues is through multilateral means, in accordance with the United Nations Charter. In this regard, the IAEA is the appropriate multilateral mechanism for addressing verification issues and challenges. It should be left to do its work unfettered by pressure, hindrance or interference. All States should support the IAEA in its verification tasks, including further improvements to the effectiveness and efficiency of the strengthened safeguards system. The Board of Governors' Advisory Committee on Safeguards and Verification provides a

valuable forum at which these issues can be usefully addressed. However, the Committee should not become a focus for arguments in favour of punitive actions.

A. Piebalgs highlighted the interests and activities that the IAEA and the European Commission share, for example, the promotion of nuclear research and development, the dissemination of technological information, the promulgation of safety standards and safeguards implementation. The European Commission is adapting its safeguards to meet existing conditions, building complementarity with the IAEA and developing the next stage of the relationship for integrated safeguards. In the latter context, the IAEA and the European Commission have always been able to cooperate successfully, and it is very gratifying that high level contact between them has recently resumed.

He was pleased to note that the additional protocol to the existing safeguards agreements is in force for all 25 Member States of the European Union. In his view, a comprehensive safeguards agreement and an additional protocol to this agreement (based on the Model Additional Protocol as documented in INFCIRC/540 (Corrected)) represent the current global non-proliferation standard. Looking to the expansion of nuclear energy, safeguards are crucial to nuclear non-proliferation, while nuclear safety and security are also important dimensions. Any expansion of nuclear energy will require attention on all three fronts. The European Commission stands ready to strengthen its cooperation with, and support of, the IAEA on all three fronts.

S.I. Kislyak accepted that the nuclear non-proliferation regime is under stress, but not that sluggish nuclear disarmament is the cause. He saw disarmament as active and ongoing and the real threats as coming from new kinds of challenges — nuclear terrorism, illicit trafficking and black marketeers — that require multilateral responses. In this respect, no organization is better placed to act than the IAEA. Its confidence building role is unique.

He believed that the NPT should continue to be the cornerstone of nuclear non-proliferation efforts. All States should subscribe to additional protocols to safeguards agreements, which greatly enhance the IAEA's ability to detect undeclared nuclear material and activities. Such ability would be very important for the expected renaissance of nuclear energy. Although this renaissance has many positive aspects and should be welcomed, the IAEA safeguards system should be suitably equipped to respond to new demands and concepts, which could include international nuclear fuel cycle facilities. The time has come for ideas such as these, which should help to mitigate fears that the nuclear fuel cycle is becoming a tool of political pressure.

R. Ekéus shared the view that progress on nuclear non-proliferation depends largely on progress on nuclear disarmament. The Comprehensive Nuclear-Test-Ban Treaty and the proposed Fissile Material Cut-off Treaty, robust verification, export controls and physical protection are important corollaries. These are also vital for addressing such potential threats as nuclear terrorism. In the area of verification, multilateral approaches continue to be the best option, whether treaty based or, in extreme cases such as Iraq in the early 1990s, prescribed by the United Nations Security Council. Unilateral measures lack symmetry and are not uniformly applied.

Y. Matsuo recalled that nuclear power is vital for Japan, with its limited natural resources, and described the development of Japan's extensive nuclear power programme. He outlined the history of safeguards inspections in Japan and its proven record of nuclear transparency, stating that its ongoing ambition is to be a model of nuclear non-proliferation. He also outlined future nuclear plans, in particular achieving full-scale operation of the Rokkasho reprocessing plant in 2007 and the expected startup of the JMOX mixed oxide fuel fabrication plant in 2012.

2. TECHNICAL PLENARY

Elements of the opening themes were taken up or developed in the technical plenary. Presentations were made by A.M. Scheinman, Assistant Deputy Administrator for Nonproliferation and International Security, United States Department of Energy/National Nuclear Security Administration; L.J. Keen, President, Canadian Nuclear Safety Commission (CNSC); J. Carlson, Director General, Australian Safeguards and Non-Proliferation Office (ASNO) and Chairman of the Standing Advisory Group on Safeguards Implementation (SAGSI); L.A. Vinhas, International Relations Officer, Brazilian National Nuclear Energy Commission (CNEN) and Special Advisor to the CNEN President for Safeguards; A. Djaloeis, Special Advisor to the Chairman of the Nuclear Energy Regulatory Agency of Indonesia and Professor of Nuclear Physics, Andalas University, Padang, West Sumatra, Indonesia; and K. Murakami, Director, Operations Division C, Department of Safeguards, IAEA.

A.M. Scheinman addressed major challenges and opportunities for the IAEA safeguards system. Challenges have arisen from, inter alia, non-compliance with safeguards obligations by a small number of States, the spread of sensitive nuclear fuel cycle capabilities and the rising demand for nuclear energy as a carbon free source of power. To maintain confidence in the safeguards system, strategies are needed that will lower the risk of future

safeguards crises and allow the system to remain adaptable to a changing international environment. The goal of a stronger safeguards system should not be just to respond to crises but to help avoid crises. Safeguards enhancements should provide timely warning of non-compliance, that is, before domestic political decisions have been taken to obtain weapons or to acquire significant capabilities.

He urged all non-nuclear weapon States party to the NPT to bring a comprehensive safeguards agreement into force as required under the Treaty. The universal acceptance and implementation of the additional protocol to safeguards agreements should be pursued vigorously. This is supported by the President of the United States of America (USA). The USA is prepared to assist any State in this regard. The legislation providing for the USA to bring its additional protocol into force is currently before the US Congress and is expected to pass shortly.

Regarding the spread of sensitive nuclear fuel cycle capabilities, the USA proposes restricting the transfer of enrichment and reprocessing technology and equipment beyond those States already in possession of them. Suppliers should provide reliable fuel supply assurances. These issues are under discussion internationally. Looking to the rising demand for nuclear energy, the USA has proposed the Global Nuclear Energy Partnership (GNEP) as a comprehensive strategy to restructure the nuclear fuel cycle and introduce proliferation resistant fast reactor and fuel cycle technologies, using the most advanced international safeguards technologies and systems. GNEP facilities in the USA would be eligible for safeguards.

L.J. Keen presented the Canadian perspective on safeguards. She noted that the IAEA safeguards system has responded well to challenges and has acted as the effective early warning system that it was intended to be. The exit from the non-proliferation regime by the Democratic People's Republic of Korea has demonstrated how effective safeguards and verification are seen to be in detecting proliferation activity.

The main areas of importance for Canada are effectiveness, efficiency and transparency. Effectiveness requires information and access, and assures citizens of the exclusively peaceful uses of nuclear energy. Efficiency requires risk informed decisions for the sound allocation of resources and the early incorporation of proliferation resistance in design and construction, so that IAEA efforts can concentrate on where the risks are greatest. Openness and transparency include the public, and for the IAEA this includes its Member States since ultimately they control its activities and finances.

Canada received its broader safeguards conclusion[1] in 2005 and intends to maintain it. This will require continuous improvement in an era of rapid expansion of the nuclear industry. One problem foreseen is the adequate supply of qualified personnel, with the CNSC's resources growing at about 12%. The CNSC is looking at internal training programmes and internships.

J. Carlson discussed defining the IAEA safeguards mission. He noted that the IAEA safeguards system has operated for some 35 years, but that debate continues to arise over issues such as safeguards objectives, IAEA inspection authority and the nature and scope of safeguards conclusions. A shared understanding of the safeguards mission is essential.

IAEA safeguards are defined by relevant agreements and instruments and by the way the IAEA Board of Governors, the IAEA Secretariat and Member States apply them. The basic instruments governing safeguards include the IAEA Statute, the NPT, the model comprehensive safeguards agreement (as documented in INFCIRC/153 (Corrected)) and the Model Additional Protocol. The interrelationships of these instruments are critical, especially that between the NPT and the IAEA safeguards system. Under comprehensive safeguards agreements, safeguards measures focus on nuclear material. The IAEA's authority to investigate activities has been questioned, unless nuclear material is involved. However, Member States now expect soundly based IAEA conclusions on the absence of undeclared nuclear material and activities to supplement conclusions on the non-diversion of declared nuclear material. Therefore, pursuant to the Model Additional Protocol, the IAEA has the ability to look at a broader range of information in order to detect indicators of undeclared nuclear material and activities in the State as a whole.

Other issues considered were the safeguards conclusions that the IAEA is able to draw and the required standard of proof for concluding that a nuclear programme is non-peaceful. In practice, it is difficult to establish that a nuclear programme is exclusively peaceful. The IAEA safeguards conclusion on the absence of undeclared nuclear material and activities should be soundly based, but cannot be certain. (It is impossible to prove a negative.) In ambiguous

[1] The IAEA draws the broader safeguards conclusion for a State based on a comprehensive evaluation of the results of its verification activities relevant to the safeguards agreement and additional protocol and of all safeguards relevant information available to it about the State's nuclear and nuclear related activities. Where the IAEA has found no indication of the diversion of declared nuclear material from peaceful nuclear activities and no indication of undeclared nuclear material or activities, the conclusion is drawn that all nuclear material remained in peaceful activities in the State.

situations, it is up to the Board of Governors and States to consider the implications. The Board can report to the United Nations Security Council if it is unable to verify that there has been no diversion of declared nuclear material to nuclear weapons or for purposes unknown.

L.A. Vinhas addressed the side effects of the safeguards measures adopted to strengthen the IAEA safeguards system. Recent measures, particularly those implemented under additional protocols, have focused on enhancing the effectiveness of the safeguards system — for example, more emphasis on design information verification procedures and on the policy relating to the 'starting point of safeguards' (defined as the point in the nuclear fuel cycle from which full safeguards requirements specified in comprehensive safeguards agreements start to apply to nuclear material). However, insufficient attention has been paid to assessing the costs and impacts of these safeguards measures on States and operators in terms of human and financial demands. Any additional requests for information should emphasize quality and relevance, rather than quantity. It is important that there be a proper balance between the implementation of safeguards on less relevant nuclear materials and installations and the costs involved.

Allowing for varying interpretations of requirements can involve 'constructive ambiguities', giving a wider range of approaches than one single interpretation. Diverging perspectives that are open to change and evolution are necessary in changing circumstances.

A. Djaloeis addressed safeguards challenges from the point of view of a developing country. IAEA safeguards are vital for stopping the proliferation of nuclear weapons, as stipulated in the NPT. However, success depends on the willingness of States to sign the NPT, to conclude a comprehensive safeguards agreement and an additional protocol with the IAEA, and to cooperate with the IAEA in safeguards implementation.

The history of nuclear energy, from the weapons use in 1945 and especially the Atoms for Peace speech of 1953, led to the foundation of the IAEA in 1957 and has led to the development of peaceful nuclear applications. The NPT included provisions that have not been followed up on, especially the disarmament provision.[2] This continues to cause animosity among States party to the NPT who have made non-proliferation commitments under the treaty and expect the nuclear weapons States to follow through on their commitments.

[2] Pursuant to Article VI of the NPT, each party undertakes to pursue negotiations in good faith on effective measures relating to the cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a treaty on general and complete disarmament under strict and effective international control.

The NPT review conferences have repeatedly emphasized that the nuclear weapon States are not disarming. In particular, the NPT review conference in 2000 laid down a supposedly agreed upon route to the elimination of nuclear weapons. Developing countries see this as an unfair divergence between developed countries and others. This issue strengthens the hand of those opposed to international cooperation and development.

K. Murakami addressed the IAEA's experiences with the implementation of the additional protocol to safeguards agreements and of integrated safeguards[3] in the Member States of the European Union (EU). The additional protocol for 13 non-nuclear weapon States and two nuclear weapon States of the EU entered into force on 30 April 2004. Eight of the newly acceded States of the EU have additional protocols in force, and three of the accession States have recently acceded to the safeguards agreement with EU Member States (as documented in INFCIRC/193). Furthermore, two States currently with an operative small quantities protocol (SQP) to their safeguards agreements[4] are expected to accede to INFCIRC/193.

The European Commission is party to these safeguards arrangements and participates in implementing the additional protocols in various ways. Ten of the EU Member States have delegated most safeguards responsibilities to the European Commission. The continuously evolving legal framework is a major challenge for the IAEA, which has devoted substantial resources to planning and implementing safeguards in the EU. The IAEA's goal is to be able to draw the broader safeguards conclusion for most of the EU Member States by 2008.

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[3] Integrated safeguards represent the most effective and efficient combination of traditional and strengthened safeguards measures, including the measures under additional protocols. Integrated safeguards can only be implemented in a State that has a comprehensive safeguards agreement and an additional protocol in force or otherwise applied and for which the IAEA has been able to a draw the broader conclusion that all nuclear material remained in peaceful activities.

[4] Many States with comprehensive safeguards agreements in force but with little or no nuclear material have concluded an SQP, which holds in abeyance the implementation of most of the detailed safeguards procedures. In 2005, the IAEA Board of Governors decided that SQPs should remain part of the safeguards system but that the standard text of the model SQP would be modified and the criteria for eligibility changed. These modifications and changes have the effect of (i) making an SQP unavailable to a State with an existing or planned facility, (ii) requiring States to provide initial reports on nuclear material and notification as soon as a decision has been taken to construct or to authorize construction of a nuclear facility and (iii) allowing for IAEA inspections.

In addition, the preparation of revised cooperation arrangements for inspections is under way.

3. TOPICAL SESSIONS

The following pertinent topics were addressed in presentations delivered at 18 sessions held in parallel:

— Current challenges to the safeguards system;
— Further strengthening safeguards practices and approaches;
— Improving the collection and analysis of safeguards information;
— Advances in safeguards techniques and technology;
— Future challenges.

3.1. Current challenges to the safeguards system

Presentations in session 3 addressed the current challenges facing the international community with regard to nuclear proliferation and safeguards, and proposed methods, tools and programmes for coping with these challenges. Citing examples of challenges encountered in the past, it was suggested that we learn from our successes, implement evolving technology and strengthen existing political mechanisms. Emphasis was placed on the importance of strengthening the overall framework of safeguards — for example, by encouraging States to bring their additional protocols into force, by adopting the recent modifications to the standard text of the model SQP and by strengthening the overall fabric of the nuclear non-proliferation regime. A methodology was described that uses a broad array of new technologies and political science to help with the verification of treaty compliance. Some explanation was also given about the use of network models to help to identify potential pathways for the transfer of sensitive technology and thus eliminate or reduce such transfers. Touching on the education aspects of nuclear non-proliferation, a presentation covered recent developments in safeguards and non-proliferation curricula at Swedish universities.

In sum, the presenters identified steps that the international community could take to address current challenges, namely, (i) strengthen the agreements that are in place and bring all players, large and small, into the non-proliferation regime; (ii) learn from past successes and utilize appropriate technologies to ensure that the nuclear non-proliferation treaties already in force are adhered to and that future ones are verifiable; (iii) develop tools and methods to help to identify sources of clandestine transfers of sensitive nuclear

technology and components; and (iv) foster greater awareness and understanding of safeguards and nuclear non-proliferation through education.

3.2. Further strengthening safeguards practices and approaches

The five sessions of the symposium dedicated to this topic covered wide ranging experiences in implementing existing arrangements for 'traditional safeguards'; the implementation of strengthened safeguards measures, including those under integrated safeguards; and safeguards implementation at new, complex and/or future types of facilities and at spent fuel repositories.

In session 6, presenters placed emphasis on improvements in the effectiveness and efficiency of safeguards implementation that States expected to see, on new general criteria that should be taken into account and on new verification tools. Other presenters described their experiences and the difficulties encountered in applying safeguards at large plants affected by policy changes relating to the starting point of safeguards and by efforts to develop recommendations for evaluating the decommissioned status of light water reactors, research reactors and critical assemblies. A further presentation focused on developing safeguards measures for the final disposal of spent fuel. Although an encapsulation plant and an underground repository are still some years off, R&D work is advancing and safeguards considerations need to be addressed in a timely manner.

Session 9 included presentations on the implementation of short notice random inspections (SNRIs), including arrangements at a fuel fabrication plant in Spain, and on the development and implementation of integrated safeguards. Random inspection regimes were successfully introduced at power reactors in Japan in 2004 and at fuel fabrication plants in 2005. With the reduction of the frequency of SNRIs under integrated safeguards at Japanese low enriched uranium (LEU) fuel fabrication plants, one challenge facing operators is to continue to maintain the high quality of inspection support.

Progress on implementing integrated safeguards was reported for Japan and Canada, two States with large nuclear programmes. Key to the successes has been the active, ongoing involvement and cooperation among the IAEA, the relevant Governmental authorities and the facility operators. This was also the experience of the ESARDA Working Group on Integrated Safeguards, established to provide the European safeguards community with expert advice on this topic and to provide a forum for information exchange.

Presentations in session 12 covered experiences in implementing safeguards obligations, including but not limited to those under an additional protocol. Emphasis was placed on the critical importance of the unequivocal and legally binding non-proliferation commitments of States and on the role of

regional and State systems of accounting for and control of nuclear material (RSACs and SSACs, respectively), especially the interface with the IAEA. Such interaction was essential, not only for day-to-day safeguards implementation, but also for helping to identify the scope for enhanced effectiveness and efficiency. Importance was also attached to the training and other support that the IAEA could give States to help them meet their safeguards obligations.

Presentations in session 16 dealt variously with enrichment issues, developed against the backdrop of the hexapartite safeguards project (HSP) for commercial gas centrifuge enrichment plants. The HSP was conducted in the early 1980s to develop an approach for applying effective and efficient safeguards to commercial enrichment plants without compromising sensitive information. Clearly, the HSP approach was developed in a political and technological framework radically different from that associated with today's gas centrifuge enrichment plants. Consideration is being given to improving and modernizing safeguards implementation at these enrichment plants, especially with regard to attaining the safeguards objectives of the timely detection of the diversion of declared nuclear material and the detection of the undeclared production of high enriched uranium (HEU) and LEU. There was notable consistency among the several safeguards approaches presented at the symposium.

Session 18 included presentations on safeguards implementation at reprocessing plants and on the transfer of spent fuel to dry storage. The Rokkasho reprocessing plant in Japan has been an active safeguards task for the IAEA since the early 1990s and represents one of the IAEA's largest safeguards endeavours in terms of the quantity of safeguarded material, equipment costs and human resources. The IAEA initiated a continuous inspection regime in March 2006, as plant startup progressed to the process areas. As the RRP moves towards full-scale operation, expected in 2007, among the prerequisites for successful safeguards implementation will be good communication, coordination and cooperation among all parties involved. That was also true of the successful accomplishment, in 2003, of an improvement plan for the Tokai reprocessing plant in Japan, through which the effectiveness and efficiency of safeguards implementation have been increased.

An IAEA presentation introduced a new safeguards policy for the transfer of spent fuel to dry storage for States under integrated safeguards. It also described a safeguards approach for such transfers involving unannounced inspections to confirm the operator's declarations of spent fuel activities. The approach also covers maintaining continuity of knowledge during the transfer to dry storage through unannounced inspections, unattended instruments or continuous observation by inspectors.

Canada presented the integrated safeguards approach that it has proposed for transfers of spent fuel at multi-unit CANDU generating stations, developed under a Canadian support programme task and successfully field-tested by the IAEA in 2004. Also presented were safeguards concepts for transfers of spent fuel from wet storage to on-site dry storage in Germany, where recent legislation had triggered the construction of on-site dry storage facilities at reactors. The safeguards concepts involve sealing, optical surveillance and radiation monitoring.

3.3. Improving the collection and analysis of safeguards information

Presentations in sessions 4, 7 and 10 demonstrated that information collection, analysis and evaluation are central to modern, information driven safeguards. Although the information related methodology continues to evolve, challenges remain in areas related to data, tools, skills, methods, processes and resources. The IAEA Safeguards Information System Re-engineering Project (IRP) is crucial to enabling the IAEA to transform diverse data into available, lasting knowledge. Sustained support is required for this multi-year project with a multi-million dollar price tag.

Presentations illustrated that the safeguards relevant information required from States has changed significantly since the early days of safeguards, giving rise to new challenges. Fresh approaches are being developed to address the accuracy and reliability of information, to enhance the quality of information obtained from States, to provide States with software support and to offer them training in performing quality control.

The IAEA has developed an integrated information portal to integrate web data, data streaming and visualization tools, and to provide easy access from almost any location. The European Commission recently overhauled its nuclear material accountancy system, which provides a common system for EU Member States and a common contact point with the IAEA. Brazil is developing a new State-wide nuclear material accountancy system that will link facility operators, State authorities, the Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials (ABACC) and the IAEA in order to provide more reliability, security and efficiency. A presentation described the implementation of safeguards in Bangladesh, which is being carried out through the regulatory body of the Bangladesh Atomic Energy Commission.

Open sources of information are highly relevant to strengthened safeguards. Current research focuses on such challenges as the variety of formats in which information appears, on non-English language information sources, on ‘grey literature’ and on the filtering of duplicate information. The

indicators and signatures that guide searches and evaluations need to be kept up to date. Issues being addressed are information overload, open versus closed societies, continuous contextual awareness and responding to urgent information requests.

The IAEA is developing a tool ('n-VISION') to meet the needs of advanced information analysis. Major challenges are the large volume of information involved, distributed databases and the availability of specialized analytical resources. Speakers also reported progress in further developing and improving information systems, in training and in Member State commitments pertinent to safeguards relevant information. Note was taken that the IAEA is developing an improved system for analysing nuclear trade related data, which will take account of the varying information formats, languages, security needs and data storage in both structured and unstructured formats. The system will also provide user enhanced information extraction mechanisms, including visualization and analysis tools.

An overarching theme was that, both now and for the long term, the IAEA is committed to better, broader and deeper information collection and analyses of safeguards relevant information. Human expertise should continue to play an indispensable role in all these domains.

3.4. Advances in safeguards techniques and technology

Presentations in sessions 5, 8, 11, 13, 14, 17, 19 and 20 addressed advances in safeguards techniques and technology. Strengthened safeguards have enabled a wide range of analytical sciences to make greater contributions to achieving safeguards objectives. The IAEA continues to benefit from technological progress in computing power and software, cost effectiveness, miniaturization and portability.

Clearly, environmental sampling has become a cornerstone of international safeguards. Improvements were reported in the high standards already achieved by the IAEA Network of Analytical Laboratories, located in Member States, and in further developing analytical techniques. These included multi-technique approaches that allow for several kinds of analysis to be carried out on a single particle, and evaluation methodologies such as cluster analysis that can be used to determine if particles in different samples have the same origin.

Other presenters discussed advances in safeguards equipment. The next generation of unattended and remote monitoring equipment, and also containment and surveillance devices, will have enhanced integrity and authenticity against high threat levels (e.g. through secure tamper indicating enclosures and devices) and also additional instrument functionality (e.g. location stamped information). The development of laser surface technology

for item authentication, using a low cost scanning laser to rapidly read the equivalent of a natural 'fingerprint' on the surface of any item, was reported as a breakthrough in security technology with potential application to safeguards.

There were reports on the development of improved verification techniques for enrichment plants and plutonium handling facilities. These include a laser item identification system that continuously tracks the flow of UF_6 cylinders around an enrichment facility and 'intelligent' data evaluation packages that integrate the network of verification and monitoring systems used at reprocessing plants. Such systems will require the highest levels of reliability.

Commercially available satellite imagery is increasingly being used in safeguards implementation. Enhancements were reported through object based analysis and the use of thermal infrared and hyperspectral imagery. Note was also taken of the potential for better interpretive aids for the detection, classification and monitoring of nuclear facilities and for automation of analysis.

In the area of destructive analysis (DA), development work is directed towards obtaining more information on the nature and history of samples through the analysis of characteristic parameters (e.g. impurities, isotope abundance, microstructure). It was noted that the analysis of microparticles requires highly skilled analysts and state-of-the-art equipment. In particular, the analysis of metallic impurities in nuclear material could provide more information about the history of a sample. For data interpretation, the further development of databases containing parameters from materials originating from known processes is vital.

Speakers described advances in non-destructive assay (NDA) methods and advanced verification tools. Examples were given of advanced verification tools for spent fuel in wet storage, including the digital Cerenkov viewing device (DCVD) and the safeguards MOX python (SMOPY) that can distinguish between spent mixed oxide (MOX) fuel and spent LEU fuel and confirm burnup. Improved NDA equipment can help the IAEA with regard to complementary access and in investigations related to illicit trafficking in nuclear material.

The Novel Technologies Project provides a mechanism to help the IAEA to identify innovative technologies with potential application to safeguards. A promising example is optical stimulation luminescence, which would use the radioluminescent qualities of building materials to identify locations where radioactive materials have been stored.

3.5. Future challenges

Looking to the future, presentations in session 15 addressed how the international community might support the expanded, peaceful uses of nuclear energy, consistent with non-proliferation objectives. In this context, the main goals and benefits of the proposed GNEP were described, including how the concept could be applied to nuclear weapons States, in particular the USA. Such initiatives could have a fundamental impact on the future expansion of nuclear energy and would incorporate, by design, both reduced proliferation risk and enhanced verification ability. The role of the international community in such initiatives should be considered.

Still on the theme of proliferation resistance, the integration of pertinent features into the facility design at the prototype MONJU fast breeder reactor was described, including the use of real-time remote process and system monitoring. Another presentation discussed how the integration of proliferation resistance systems with facility designs might be analysed for vulnerabilities, noting that extrinsic features such as regulation and management controls are also required.

A presentation on clandestine procurement networks and trade in sensitive equipment and technologies suggested solutions to these phenomena, but acknowledged that there could be no complete guarantee of the absence of such clandestine activities. On this theme, the IAEA presented the goals and functions of the Nuclear Trade Analysis Unit (NUTRAN), located within the Department of Safeguards.

Good progress was also reported on the IAEA's implementation of a comprehensive quality management system (QMS) in the Department of Safeguards, based on the ISO 9001:2000 standard. The process approach being followed under the departmental QMS will contribute to soundly based safeguards conclusions and thus to credible assurances to the international community that States are complying with their safeguards obligations.

4. CLOSING PLENARY

The closing plenary of the symposium (session 21) included presentations by J. Carlson, in his capacity as Chairman of SAGSI; J. Cooley, Director of the Department of Safeguards, Division of Concepts and Planning, at the IAEA; and R. Schenkel, Director General, Joint Research Centre of the European Commission. Closing remarks were given by O. Heinonen, Deputy Director General, Head, Department of Safeguards, IAEA.

J. Carlson presented the SAGSI perspective on the 'safeguards revolution' of recent years, a term he emphasized was not an exaggeration. SAGSI supports moving away from traditional safeguards implementation towards State level integrated safeguards approaches tailored to individual States.

The broadening of available verification measures, including activities directed at detecting undeclared nuclear material and activities, requires greater adaptability at the implementation level. Efficiencies can be achieved in routine inspection by optimizing the use of skilled inspectors for those activities of greatest verification value. Reducing inspections should not be an aim in itself, and SAGSI underscores the essential contribution of inspector presence and observational skills to safeguards effectiveness. SAGSI recommended for further study the unpredictable, occasional use of intensive inspections as an alternative to routine inspections or when more intensive inspections are needed, and the building up of a group of specialist inspectors who would be drawn upon to supplement routine inspection activities.

J. Cooley reviewed the evolution of the strengthened safeguards system, including the new legal authority under the additional protocol; the expanded technological capabilities such as environmental sampling, satellite imagery and remote monitoring; the vital importance of broader information collection and analysis; and the role of State level approaches to safeguards implementation and integrated safeguards.

Current challenges to safeguards implementation being addressed include implementing additional protocols in a rapidly increasing number of States, drawing the broader safeguards conclusion and moving to integrated safeguards for additional States, and safeguarding large, complex facilities. Actions by the international community to further strengthen the safeguards system could include the conclusion and implementation of comprehensive safeguards agreements by all non-nuclear weapon States, the full implementation by States of all existing safeguards obligations under safeguards agreements and additional protocols, the fulfilment by States of their voluntary reporting commitments, the modification of existing SQPs in line with the Board's 2005 decision, and the conclusion and implementation of additional protocols by all States. She stressed that safeguards maintains an essential forward looking momentum, with the aim of being able to meet all future challenges.

R. Schenkel presented his perception of the highlights of the symposium. There was consistent recognition that the nuclear non-proliferation regime is at a crossroads but that the IAEA safeguards system has shown the capacity to react and adapt when confronted with challenges and should continue to do so. In the changed political and non-proliferation landscape of our times,

multilateral approaches and robust verification mechanisms are crucial to the resolution of nuclear proliferation related problems. It was widely accepted that the additional protocol, together with a comprehensive safeguards agreement, should become the verification standard under the NPT.

With the expected future expansion of nuclear energy, safeguards must 'stay ahead of the game' through a combination of traditional and strengthened safeguards and verification activities, technological development and appropriate training. Perhaps the most challenging task is to develop and maintain highly qualified and motivated inspectors and analysts who can cope with the new challenges of an information driven safeguards system.

O. Heinonen agreed that the non-proliferation regime is being tested and has to stay ahead of the major trends related to nuclear non-proliferation — notably, the increased dissemination of nuclear technology, the desire of a few States to acquire nuclear weapons technology and the existence of clandestine procurement networks. Key priorities are:

— Implementation of new safeguards approaches;
— Optimization of safeguards technology;
— Pursuit of novel technologies;
— Enhancement of environmental sampling and satellite imagery capabilities;
— Intensified information collection and analysis;
— Maintenance of an efficient and secure information infrastructure.

He stressed the importance for the IAEA of the continued support and engagement of its Member States and the safeguards community. He noted that the symposium had been an excellent contribution to these ends and thanked all those involved.

OPENING PLENARY

(Session 1)

Chairperson

O. HEINONEN
IAEA

Technical Secretary

J. HILLERMAN
IAEA

ADDRESSING VERIFICATION CHALLENGES

M. ElBaradei
Director General,
International Atomic Energy Agency,
Vienna

It is my pleasure to welcome you to our tenth major safeguards symposium, held in cooperation with the Institute of Nuclear Materials Management and the European Safeguards Research and Development Association. Our last symposium was held in October 2001, and I am sure you are all aware of the many changes that have taken place since that time and the new challenges that we are facing.

Safeguards activities are probably the most difficult task entrusted to an international organization. To determine all the details of a country's nuclear programme is a daunting challenge that raises a number of questions: What level of assurance do you need? How do you draw assessments from the facts? How do you distinguish between technical data and future intentions? These are difficult issues that we have been grappling with, particularly in the past few years.

We are seeing an increase in nuclear power around the globe as a result of shortages of energy and concerns about energy independence and climate change. On the one hand, this is good, because without energy there is no hope for development, and nuclear energy can certainly play an important role in the lives of the 2.4 billion people who currently have no access to modern energy systems. On the other hand, it means that nuclear know-how and nuclear technology will continue to spread to more and more countries, and that there will be an increasing number of nuclear engineers, nuclear physicists and radiochemists. The knowledge that is available can be applied for both peaceful and, unfortunately, non-peaceful purposes.

We are still investigating the clandestine network discovered a few years ago. While we now understand most of that network, we still have to determine exactly who received what, when and where. The fact that designs for centrifuges and possibly even weapons can be contained on a CD-ROM makes our challenge much more difficult. In my view, over reliance on export control is not a viable option.

We have also seen an increase in the number of countries interested in developing nuclear fuel cycle capabilities: sensitive fuel cycle activities, reprocessing and above all enrichment. In some cases, this makes economic sense. In

others, however, it seems that countries might be hedging their bets in order to have the know-how should they need to develop their own deterrence. This creates many new challenges for both the international community and the IAEA, because verifying enrichment or reprocessing facilities is quite difficult, and the so-called conversion time is extremely short. Thus, we are dealing with what I call 'virtual nuclear weapon States'.

An issue that I have been talking about for a number of years is the need to develop a new international or multinational approach to the fuel cycle in order to avoid a situation with nine nuclear weapon States and another 20 or 30 States having the capacity to develop nuclear weapons in a very short period of time.

Unfortunately, the political environment has not been very secure, and in the past decade or so there has been temptation for countries to develop nuclear weapons. We saw this in Iraq and in the Libyan Arab Jamahiriya, and we have now seen a nuclear test in the Democratic People's Republic of Korea (DPRK). There seems to be a movement towards countries looking into the possibility of protecting themselves through nuclear weapons.

Why this is happening is obviously a different issue. What we need to remember is the linkage between nuclear disarmament and non-proliferation. Many articles have appeared recently discussing the existing situation, where some countries continue to rely on nuclear weapons, or even try to develop new weapons, while at the same time telling others that such weapons are not for them. The logic of this view is not clear.

Although a Comprehensive Test Ban Treaty has been developed, it has been shelved for the past ten years. Would a legally binding ban on testing have changed the behaviour of the DPRK? Perhaps.

It is also important to remember that safeguards activities, though fundamentally technical in nature, are carried out in a politically charged environment. Indeed, we have seen that verification activities might make the difference between war and peace. This puts the additional responsibility on our — and your — shoulders to make sure that we are providing the results of our verification activities as objectively and impartially as possible.

The security dimension — that is, nuclear terrorism — also presents a new challenge, because State systems of accounting for and control of nuclear material are no longer simply tools for safeguards, but now provide information relevant to physical protection as well.

Obviously, our job is to make sure that countries with comprehensive safeguards agreements are conducting all their nuclear activities exclusively for peaceful purposes. We are probably the only organization that must sit in judgement of its Member States. This relationship is sometimes difficult: although we rely on the financial and political support of Member States, we

must stand our ground when necessary. Many of our activities aim at detecting possible undeclared activities, which was not really our focus before 1991, when we uncovered the Iraq programme, but is now a major part of our activities. While we must still be concerned with declared activities, particularly sensitive activities, our key challenge today is detecting possible undeclared activities. This requires that we look at whether we are receiving all the information we need. Unfortunately, in many respects we are not.

For example, we do not receive systematic information from the Nuclear Suppliers Group on exports and imports, which constitutes an obvious a gap in the system. Moreover, we do not always have all the access we need. Although the additional protocol does allow us increased access, such protocols are in force in only 78 of the over 180 countries that are party to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). And that is nearly a decade after the model protocol was agreed. Without the protocol, as I have said, we are hampered in our ability to detect undeclared activities. To give you an example, right now in the Islamic Republic of Iran, without the protocol we cannot look into R&D activities that do not directly involve nuclear material, although R&D is very important for projecting Iranian capacity building.

Financial resources are another key issue. Our budget is only $130 million, on the basis of which we are supposed to verify the nuclear activities of the entire world. For comparison, some $1 billion reportedly was spent by the Iraq Survey Group in that country alone. Our budget, which is comparable with that of Vienna's police department, cannot provide us with the resources required to be independent, or to buy our own satellite monitoring imagery or crucial instrumentation for our inspections. Our laboratories here in Vienna still are not equipped for state-of-the-art analysis of environmental samples.

One of the new issues we are facing today arose in the Islamic Republic of Iran. If you are going to reconstruct the history of a programme that has been undeclared for 20 years, even the measures of the additional protocol are not sufficient. On the one hand, a country is fulfilling the legal dimensions of its safeguards agreement, but on the other hand, we cannot provide the required assurances to the international community. Hence we have been talking about the need for transparency measures in certain situations — for example, interviewing people and having access to documents. Such measures are not strictly required by the additional protocol, but without them we cannot move forward.

Another challenge arises when a country has already begun weaponization activities. How do we verify that weapons have been dismantled, weaponization structures have been destroyed and custody has been taken of weapon design information? We had that kind of involvement in South Africa.

Later came Iraq (although in Iraq we had a different mandate from the Security Council) and then the Libyan Arab Jamahiriya. And we will certainly face the question in the DPRK.

These are some of the issues that illustrate how important it is for the system to stay ahead of the game. Our focus is on a moving target. We cannot continue to operate on a business as usual basis, nor can we continue with mechanical or mechanistic operations. The safeguards structure is an important tool for peace and security.

We recently moved from a system based on facility verification to a State level safeguards approach. We have also introduced an integrated safeguards approach, which is more cost effective and enables us to provide better assurances. These assurances can never be absolute, both because of the limitations of the system and because of the political dimension. We do not engage in reading the future intentions of countries, because we are not equipped to do so and because future intentions can change. I mentioned the Libyan Arab Jamahiriya, which a few years ago was considered to be a country with an undeclared programme. This is no longer the case: it is now regarded to be in compliance with its safeguards agreement.

How we can make sure that we have up-to-date information? Access is the key. Environmental sampling and satellite monitoring are extremely useful tools, but there is no substitute for being on the ground. We have seen how important this is in the many countries where we are physically present, doggedly asking questions until we understand what is really going on.

As I mentioned, environmental sampling and satellite monitoring are new tools that we are now using almost routinely. Moreover, we are continuing to work with you to develop new verification tools. Unfortunately, our modest financial resources require us to rely on Member States for the support programme. While ideally we would have our own programme, we are now taking the initiative and providing you with the specifications of what we need, rather than simply having you tell us what you have, as was the case in the past. Among the exciting and challenging new tools that we are looking at is wide area environmental sampling, which would help us in detecting undeclared activities. On-site sampling and analysis to determine the nature and history of relevant material would be a significant advance for us, as would improved analysis of particles from environmental sampling to derive with precision the history and nature of the material.

Each of the issues I have mentioned presents its own challenges, and I am sure that you will be discussing these issues in depth. We are here this week to explain some of our work to you. More importantly, however, we would like your input and ideas. Are we doing our job well? How can we improve? What do we need to do to make a better system? The large number of participants

here is an indication of how much importance the international community attaches to safeguards activities.

Last year, the high level panel established by the UN Secretary-General referred to IAEA safeguards as an "extraordinary bargain". It was gratifying to hear how much we are credited with doing on our limited budget. The Norwegian Nobel Committee referred to our work as being of incalculable importance. Again, this is good to hear. But I always remind my colleagues that we cannot rest on our laurels, and that we must always remember that there is room for improvement. This is the real purpose of this symposium: to determine how we can continue to be effective and relevant, and a valuable instrument to help the international community deal with nuclear weapons proliferation.

I wish you success and a pleasant stay.

OPENING STATEMENT

N.-J. Nicholas
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I am delighted to be here representing the Institute of Nuclear Materials Management (INMM), which, along with the European Safeguards Research and Development Association, is cooperating with the IAEA to organize this international safeguards symposium. I know I can speak for everyone in the INMM in congratulating Director General ElBaradei and the entire IAEA for both their tremendous accomplishments and their much deserved recognition by the Nobel Committee. This is an extraordinary achievement, and one in which everyone who labours in the field of non-proliferation can take pride.

Today's security environment is marked by the end of the Cold War and terrorist attacks that have left deep scars in every part of the world. For the international community, working to stem the proliferation of nuclear weapons must rank among the highest priorities in this new environment. As developments in the Islamic Republic of Iran and the Democratic People's Republic of Korea demonstrate, the non-proliferation regime faces enormous pressures. These developments have been balanced by recent successes, notably the proliferation rollback in the Libyan Arab Jamahiriya. To meet current and future challenges, we must first understand the emerging threats, then develop new tools and verification techniques to strengthen the non-proliferation regime, and finally discover new approaches to problems that extend beyond the Treaty on the Non-Proliferation of Nuclear Weapons.

The INMM's purpose is to provide a global forum to explore and understand challenges to nuclear materials management in this changing environment. Member of the INMM spearhead advances in nuclear materials management and disseminate best practices in nuclear safeguards and security.

I am proud of the INMM's ongoing cooperation with the IAEA, and I hope to see many of you in Tucson, Arizona, at the next INMM Annual Meeting, to be held from 8 to 12 July 2007.

I am thrilled to be here during one of the events celebrating the 50th anniversary of the IAEA. I am looking forward to stimulating discussions this week. As we take up these heightened challenges to verification, I hope we can sharpen our focus more than ever on strengthening international safeguards.

DEVELOPING A NON-PROLIFERATION CULTURE

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1. INTRODUCTION

The European Safeguards Research and Development Association (ESARDA), which was created in the late 1960s, has been actively involved in developing and promoting safeguards for more than 35 years. We are therefore pleased to be cooperating with the IAEA and the Institute of Nuclear Materials Management in the organization of this symposium.

2. NON-PROLIFERATION CULTURE

I would like to propose the development of a 'non-proliferation culture' as a key principle. I define a non-proliferation culture as the characteristics and attitudes of organizations and individuals that: (i) relate to the protection against the diversion and theft of nuclear material and the provision of information about research and development related to the nuclear fuel cycle; and (ii) receive the attention warranted by their significance.

3. UNIVERSAL FEATURES

The non-proliferation culture has three universal features: (i) policy commitments at the State level; (ii) the organizational framework and commitments; and (iii) the attitudes and behaviour of the staff members of these organizations. These aspects should be considered as a whole, and they should demonstrate transparency with respect to States' exclusively peaceful nuclear activities and contribute to establishing confidence among States and regions of the world.

3.1. State level commitments

Government legislation is the highest level at which a non-proliferation culture should be based, since it is the State that establishes non-proliferation policy. Comprehensive safeguards agreements, additional protocols and export controls on dual use goods are proactive contributions to non-proliferation. The State develops the legislative and regulatory framework, establishes a competent authority and clearly specifies responsibilities.

3.2. Organizational commitments

The second feature of a non-proliferation culture relates to the organizational framework and commitments. The high level policies of an organization determine the working environment and the attitudes and behaviour of individual staff members. In this context, organizations should make their responsibilities well known and understood through non-proliferation policy statements; they should set objectives, express management involvement and provide orientation to the staff regarding non-proliferation issues.

Managers have a specific role to play in this regard. They should establish practices in accordance with well defined policies and objectives, and identify responsibilities for defining and controlling working practices.

3.3. Individual behaviour and attitudes

The third feature of a non-proliferation culture concerns the staff members of an organization and their attitudes and behaviour relative to non-proliferation. For example, staff members should adopt a rigorous and careful approach to work and maintain constant vigilance and an interrogatory attitude.

4. SYNERGIES

The cultures of nuclear non-proliferation, security and safety interface with one another and are mutually supportive. These cultures exhibit strong similarities: they are based on similar principles, similar types of organization are involved and each of these cultures requires commitments at both the State level and at the level of top management within organizations. While it is not possible to combine the cultures of non-proliferation, security and safety into one culture, they should coexist and be mutually supportive.

5. CONCLUSIONS

Synergy between the cultures of nuclear non-proliferation, security and safety should be developed. Each of these cultures represents a key principle and, as such, can help to establish confidence among States and regions of the world. To the public, these cultures should represent professionalism, competence and responsibility by all parties involved.

STRENGTHENING SAFEGUARDS: A DEVELOPING COUNTRY PERSPECTIVE

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It is indeed a pleasure for me to address this symposium on the important issue of international safeguards. My presentation today will provide a perspective from South Africa as a developing country and should not be interpreted as the definitive position of developing countries on the issue of safeguards. At the same time, it should also be noted that many academics, politicians, civil society formations as well as some governments in the developed world share the views and concerns of South Africa and other developing countries concerning these matters.

For all of us, and for developing countries in particular, the IAEA remains an important vehicle, in accordance with its objectives, presented in Article II of its Statute, to "seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world". At the same time, we recognize and accept that this potential contribution of atomic energy should not be used "in such a way as to further any military purpose".

It is therefore not surprising that the development of safeguards has been one of the central activities of the IAEA since its inception almost 50 years ago. I am sure that we would all agree that the most significant development in this area in the past half century has been the negotiation and adoption of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) during the late 1960s and early 1970s, which brought about a new legal foundation for the implementation of safeguards by the IAEA in the States party to the Treaty.

Much progress has been made in the universalization of this treaty. However, 36 years after its entry into force, a number of States party to the NPT have yet to take the first basic step in concluding a comprehensive safeguards agreement with the IAEA, as required under Article III of the NPT. In addition, a few have also opted not to join the NPT.

Non-nuclear-weapon States party to the Treaty, the majority of which are developing countries, benefit from the NPT in two important ways. First, the threat posed by the further proliferation of nuclear weapons is constrained. Second, under Article IV of the NPT there is a promise of the promotion of

nuclear energy for peaceful uses and of the transfer of technology, materials and equipment to those countries that could greatly benefit from its use. Many interpret Article IV to be about the promotion of nuclear power. This is certainly true, but the requirements for developing States are in many instances more basic — the peaceful use of nuclear energy in health, agriculture and industry has the potential to affect and improve the situations of millions of people. However, South Africa believes that this potential is underutilized and that the only sustainable way forward is to focus on transforming the budget procedure of the IAEA to incorporate the technical cooperation fund into the regular budget and to enlarge its allocation.

There is increasing concern, especially among developing countries, at the growing resort to unilateralism and unilaterally imposed prescriptions. For all of us, multilateralism and multilaterally agreed solutions, in accordance with the Charter of the United Nations, provide the only sustainable method of addressing disarmament and international security issues. In this regard, developing countries believe that the multilateral mechanism established by the IAEA is the most appropriate way to address verification and safeguards issues and challenges.

Developing countries have consistently emphasized that the IAEA is the sole competent authority in the field of nuclear safeguards and verification. It is therefore our duty to fully support the IAEA in fulfilling this mandate. South Africa attaches great importance to the role, authority, impartiality and integrity of the IAEA and would not wish to do anything that would reduce or undermine its solemn responsibilities. We believe it is imperative that the IAEA be permitted to undertake its verification work without undue pressure, hindrance or interference of any kind.

Notwithstanding the view of some that the IAEA's budget should reflect zero real growth, we have the shared responsibility to ensure that we allocate sufficient resources to enable the IAEA to implement its ever increasing safeguards mandate. As this is a shared responsibility, we should not resort to voluntary funding of safeguards and related activities, as doing so could diminish our collective approach to safeguards and impact on the multilateral nature of the IAEA.

Developing countries believe that the basic and inalienable right of all States to develop research, production and use of atomic energy for peaceful purposes should be without any discrimination and in conformity with their respective legal obligations. Therefore, nothing should be interpreted in such a way as to inhibit or restrict the right of States to develop atomic energy for peaceful purposes. Developing countries also believe that States' choices and decisions in the field of peaceful uses of nuclear technology and their fuel cycle policies must be respected. Just like developed countries, developing countries

also have a sovereign right to make their own decisions consistent with their national priorities and interests.

In terms of exercising the inalienable right to the peaceful use of nuclear technology, States party to the NPT have undertaken to pursue nuclear programmes for peaceful purposes only, in conformity with their obligations under Articles I–III of the NPT. In verifying the non-diversion of nuclear energy from peaceful uses to nuclear weapons or other nuclear explosive devices, non-nuclear-weapon States must conclude INFCIRC/153 type safeguards agreements with the IAEA. It is the responsibility of the IAEA, as the competent authority, to verify, in accordance with these types of agreement, the fulfilment of the obligations assumed under the NPT by these State parties.

With the experience gained from the implementation of the safeguards system, we should be prepared, as in the past, to deal with all identified shortcomings that place a constraint on the effective implementation of this system. In this regard, through the 'Programme 93 + 2' negotiations, we agreed to strengthened safeguards as a result of our experience with the IAEA's verification work undertaken in Iraq.

An Advisory Committee on Safeguards and Verification has been established by the Board of Governors to consider further improvements to increase the effectiveness and efficiency of the safeguards system. The mandate of this Committee provides us with an opportunity to evaluate and possibly agree on recommendations that could improve the safeguards system. We should all cooperate with the Chair of the Committee, Ambassador Taous Feroukhi, to enable the Committee to successfully conclude its work.

The focus of the IAEA's investigation is not to provide arguments or reasons for punitive actions to be taken. The focus is rather to facilitate a process whereby corrective action can be taken, within a reasonable time, to enable the IAEA to verify non-diversion.

The global non-proliferation and disarmament regime faced some serious challenges during the 1990s. The end of the Cold War and the revelations about the existence of secret nuclear weapons programmes and illicit procurement networks provided the drive for strengthening the IAEA's safeguards system. This acknowledgement of the limitations inherent in the traditional safeguards system led to an extensive review and strengthening of the system. We can therefore confirm that the IAEA, today, possesses greater capabilities to detect the diversion of nuclear materials to non-peaceful purposes and clandestine activities.

With regard to the assurance of non-diversion of nuclear material to military uses, developing countries have stated their strong conviction that the total elimination of nuclear weapons is the only absolute guarantee against the use or threat of use of nuclear weapons. This obvious truth does not seem to

have an impact on the thinking of major nuclear-weapon States who, notwithstanding the agreement reached at the 2000 NPT Review Conference that unlinked general and complete disarmament from the elimination of nuclear weapons and that specifically provided a road map to eliminate these weapons, have since continued to insist on retaining a role for nuclear weapons in their military doctrine. This position is wrong and dangerous. Indeed, it is this position that is creating a serious crisis for the NPT. It is also undermining the strengthened review process that we all agreed to in 1995 in exchange for the indefinite extension of the NPT.

South Africa's position on the mutually reinforcing processes of nuclear non-proliferation and nuclear disarmament is widely documented and shared by developing countries. The total elimination of all nuclear weapons is our common objective, and therefore the issues of nuclear disarmament and nuclear non-proliferation are inextricably linked to each other. Our concerted efforts to prevent the proliferation of nuclear weapons should be matched by a concurrent effort to eliminate, in a verifiable and irreversible manner, all nuclear weapons and to achieve universal adherence to the NPT.

South Africa recognizes and supports the legitimate right of all States to utilize the atom for peaceful purposes. At the same time, we are of the view that having capabilities that could also be utilized to develop nuclear weapons places on those States concerned a special responsibility to build confidence with the international community that would remove any concerns about nuclear weapons proliferation. South Africa believes that such States need to ensure that the IAEA is able to verify that these capabilities are being used for peaceful purposes only, including through the mechanisms available under the additional protocol for strengthened safeguards.

In our view, the additional protocol remains an important instrument to build confidence and to provide assurances regarding the continued peaceful application of nuclear energy.

South Africa therefore strongly supports universal adherence to IAEA safeguards agreements. South Africa not only destroyed the nuclear explosive devices developed by the previous government and closed its dedicated facilities, but also gave the IAEA free access to information, materials, facilities and staff on an 'any time, any place' basis, which is more than is legally required under the additional protocol. South Africa further participated in the scheme approved by the IAEA Board of Governors in 1993 for the voluntary reporting of the export and import of specified equipment and non-nuclear material, similar to that which was later provided for in Annex II of the additional protocol.

The additional protocol signed by South Africa on 13 September 2002 has indeed placed an extra burden on the country in terms of the comprehensive information to be submitted and kept up to date. This is quite an onerous obligation to discharge. However, South Africa believes that this additional burden is far outweighed by the advantages in terms of strengthening the goals of nuclear disarmament and nuclear non-proliferation.

For many developing countries, particularly those with very limited or no nuclear facilities, the added burden of implementing a protocol additional to their safeguards agreements is indeed a complicating factor that needs to be carefully considered by this symposium. A central question in this regard is whether the additional burdens that may be imposed through the strengthened safeguards system are commensurate with the potential non-proliferation benefits that can be derived from it and proportional to the country's nuclear capabilities and the potential threat of diversion to non-peaceful activities.

The illicit transfer of nuclear and nuclear related dual use technology and materials that could be used in the development of weapons of mass destruction remains of serious concern to the international community and poses a serious threat to the nuclear non-proliferation regime. Delegates may be aware that the South African Government, in cooperation with other countries and the IAEA, undertook an investigation with regard to the contravention of South Africa's Non-Proliferation of Weapons of Mass Destruction Act, 1993 (Act No. 87 of 1993) and Nuclear Energy Act, 1999 (Act No. 46 of 1999). These investigations were undertaken in the context of the so-called Khan network, as well as information obtained following the announcement by the Libyan Arab Jamahiriya of the abandonment of its nuclear weapons programme. As a result of these investigations, a number of individuals have been arrested and charged with contravening South African legislation by importing, exporting, possessing and producing certain controlled items without the necessary permits or authorization.

During the course of our investigations, shipping containers were found at one company containing components of a centrifuge uranium enrichment plant, as well as related documentation. These containers were sealed by the South African Police Services and transported to a secure site, where they were also placed under IAEA seals. The investigation has been concluded, and the matter is currently before the courts.

The experience of the illicit trade in nuclear technology to manufacture nuclear weapons presents a serious challenge to the NPT, as the Director General reminded us at that time. It is of course important to tighten controls over nuclear material, technologies and equipment to prevent nuclear weapons proliferation and illicit trafficking. However, experience has shown that no

control regime, no matter how comprehensive, can fully guarantee against abuse. The success of such controls remains dependent on the following:

— Information sharing and cooperation among the relevant parties;
— Information sharing and cooperation with the IAEA by all parties.

This does not mean, however, that we should not continue to focus on and improve controls and legislation governing nuclear material, equipment and technology. But critical in this context are the issues of penalties for contravening such legislation and the unequal treatment of offenders in different countries. We need to initiate a process to work towards the harmonization of our respective penal clauses to ensure a more universal and consistent approach that is commensurate with the nature and scale of the offence.

At the same time, our investigations have illustrated the great and indispensable value of the IAEA in terms of verifying our own assessment, securing the relevant equipment and supporting documentation, and providing support to the investigative process.

It is important to focus on the capacity to detect illicit activities as well as the necessary investigations. This capability is not reflected in the formal legislation or regulations but relies on the availability of resources as well as training. This requires the necessary political will and prioritization, which normally emanates from multilateral discussions and negotiations, which can often be a long process. Like democracy within countries, it creates a holistic democratic and inclusive global society.

In conclusion, what we should strive for is not to place further limitations on the peaceful application of the atom by those who have already committed themselves not to pursue the nuclear weapons option.

Exactly a year ago, the Nobel Committee in Oslo awarded the Nobel Peace Prize to Dr. Mohamed ElBaradei and to the IAEA. We rejoiced at the time, but we also recognized the importance of the award for the work of the IAEA and the integrity and professionalism of its Director General.

Recently, we concluded the 50th Regular Session of the IAEA General Conference, inspired by the original concept of ‘atoms for peace’. Our challenge now is to realize a world with ‘atoms only for peace’.

THE EUROPEAN COMMISSION AND THE GLOBAL VERIFICATION CHALLENGE

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First and foremost, let me thank the organizers for giving me the opportunity to address you here today. Permit me also to wish the IAEA a happy 50th anniversary on behalf of the Euratom Community, which will celebrate its own 50th anniversary next year. The Euratom Community was founded by the European Atomic Energy Treaty, more commonly known as the Euratom Treaty, which is one of the founding treaties of the European Union (EU). Its Preamble calls upon the Community to associate other countries with its work and to cooperate with international organizations concerned with the peaceful development of nuclear energy. Almost 50 years on, this sentiment remains as apt now as it was then.

1. INTRODUCTION

The IAEA and the Euratom Community have several objectives in common, among which are the promotion of research, the dissemination of technical information, the establishment of safety standards to protect the health and safety of workers and the general public, and, of particular relevance to this symposium, the safeguarding of nuclear materials. I hope that you would agree with me that these subjects remain topical today.

In fact, the current geopolitical situation in the energy field resembles that which existed when the Euratom Treaty and the IAEA's Statute were being drafted. The issue of security of energy supplies is once again high on the agenda. We are witnessing an international race to secure energy supplies. The EU and the many States that share the EU's concerns have embarked upon reviews of their energy mixes. The development of low carbon energy sources, the adoption of new energy technologies and the improvement of older technologies could all contribute to the mitigation of existing concerns. In this context, the European Commission recently published a Green Paper intended to provoke a far reaching debate in Europe on energy generation and energy needs.

Having provided you with a brief overview of the current energy situation, I will move on to examine the role of the Euratom Community in meeting future energy challenges, first at the European level and then at the international level, with an emphasis on the importance of international cooperation. I will then focus on cooperation between the IAEA and the Euratom Community, before addressing safeguards and the broader issues of nuclear security and nuclear non-proliferation.

2. NUCLEAR DEVELOPMENT IN EUROPE

Today, nuclear energy produces one third of the EU's electricity. However, nuclear energy can only supply a greater part of Europe's — and the world's — energy demand if concerns relating to safety, security and non-proliferation can be satisfactorily addressed.

One key element of our policy is the safe closure and decommissioning of reactors that are at the end of their operating lives, or that cannot be upgraded to an appropriate level of safety. The Commission intends to publish a recommendation to the Member States of the EU to ensure that sufficient funding is available for the safe and secure decommissioning of such reactors.

The EU enlargement of 2004 was accompanied by an agreement supported financially by the Community for the early shutdown of less reliable plants, such as in Slovakia with the closure of two units in Bohunice, and in Lithuania with the shutdown of Ignalina. Bulgaria, a future EU Member State, has also taken on reactor closure commitments for Kozloduy during the negotiation of its Treaty of Accession.

The sustainable management of radioactive waste and spent fuel forms another key element of our policy, which responds to the public's concerns about the management of nuclear waste. The Euratom Community, in collaboration with industry, is developing a broad approach to the scientific and technical challenges posed by the management of long-lived, high level waste and spent fuel.

The Euratom Treaty provides the framework for legislation on radiation protection in the EU, chiefly through the Directive on basic safety standards, the next update and strengthening of which is in the process of being prepared by the Commission for 2007. I would also like to report that the political commitment made with regard to the IAEA Code of Conduct on the Safety and Security of Radioactive Sources has been translated into European law by the Directive on the control of high activity sealed sources, enacted in 2005.

3. EURATOM INTERNATIONALLY

The drafters of the Euratom Treaty recognized that the Euratom Community would be an actor on the international stage and accordingly included provisions that have allowed the Community to become a party to many international agreements. Today I would like to highlight our status in some of the IAEA's major conventions. Euratom is party to both of the major international conventions on nuclear safety — the Convention on Nuclear Safety and the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. In addition, Euratom will shortly accede to the Convention on Early Notification of a Nuclear Accident and to the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency.

The Euratom Community has also been party to the Generation IV International Forum since 2003. This year, Euratom acceded to the Framework Agreement for International Collaboration on Research and Development of Generation IV Nuclear Energy Systems, and the Commission's Joint Research Centre was designated as the implementing agent. Let me also express the European Commission's strong appreciation of the constructive role that the IAEA has played in support of the international fusion research project ITER.

The Community's assistance programmes have long provided practical support for nuclear safety and security in third countries. For well over a decade, the Commission has financed improvements to nuclear safety in the candidate states and the new Member States via its Phare programme. In the wider neighbourhood, during the same period, the Commission has allocated €1300 million to the upgrading of nuclear safety and security in the newly independent states via the TACIS programme. The new external assistance instruments being prepared for the financial period 2007–2013 will continue to support such projects.

4. TECHNICAL COOPERATION WITH THE IAEA

The Commission has a long history of fruitful technical cooperation with the IAEA; this cooperation ought to be maintained or even strengthened wherever international efforts need consolidation. Indeed, in the very near future the IAEA and the European Commission may agree to a sort of charter outlining areas where their cooperation can be enhanced as well as the means for achieving this goal.

The Commission is active in the technical standards committees dealing with the transport of radioactive material, nuclear safety, radioactive waste and

radioprotection, and is studying the possibility of co-sponsorship of the document proposed by the IAEA setting out the fundamental principles underpinning these four areas. The European Commission is also particularly active in the ongoing review of the Basic Safety Standards.

In the area of safeguards R&D, I believe that I can state without fear of contradiction that the IAEA is very satisfied with the assistance that it receives from the Commission's programme of nuclear safeguards support. The other main beneficiary of this programme is the Commission's own safeguards inspectorate. In fact, much of the support provided to the IAEA under the programme was first pioneered within the EU, where Euratom has long safeguarded the full nuclear fuel cycle. I hope that this cooperation will continue in a way that allows the IAEA inspectors and the Commission's own safeguards inspectors to derive the maximum benefit from it.

5. SAFEGUARDS

I have briefly sketched out the contours of the working relationship that exists between the IAEA and the Euratom Community to provide a better perspective on the closest part of the relationship — nuclear safeguards.

Let me also place Euratom safeguards and IAEA safeguards in the European Community in a historical perspective. The Euratom Treaty and the IAEA Statute were drafted around the same time; therefore, it is not altogether surprising to find similarities between the two, not least in the field of safeguards. The Euratom Treaty entered into force on 1 January 1958, and its system of safeguards inspections, executed by inspectors from the Commission, was up and running by 1960. The Commission thus possesses almost 50 years of practical experience in conducting safeguards inspections, across the full nuclear fuel cycle. Euratom safeguards per se have a twofold objective: the Commission shall satisfy itself that civil nuclear materials are not diverted from their intended uses and it shall satisfy itself that obligations assumed by the Community with a third state or international organization are complied with. This twofold objective, though not identical to the IAEA's objectives, also contributes to their achievement.

The Community's safeguards relationship with the IAEA began nearly 30 years ago in 1977, when the Community's Treaty on the Non-Proliferation of Nuclear Weapons (NPT) safeguards agreement entered into force. As with all NPT safeguards agreements, the State system of accountancy and control — in Euratom's case, the existing supranational system of accountancy and control — and the IAEA are assigned their respective roles by the agreement.

Of course, during the time that Euratom and the IAEA have been working together, one or the other partner has desired, on occasion, to modify its way of working; however, after discussion it has always proved possible to continue working together in an effective partnership. Having carried out safeguards activities for nearly 50 years, it is only natural that the Commission from time to time should seek to adapt its safeguards practices to the prevailing political and technical climate. Indeed, the Commission is currently engaged in an extensive consultation process with the EU Member States and the IAEA with a view to updating the implementation of Euratom safeguards.

Safeguards cooperation with the IAEA has been very fruitful for many years. Building on the complementarities between the two institutions, the Commission intends to further strengthen such cooperation. In this context, I very much welcome the recent intensification of high level contacts between the IAEA and the European Commission, which should result in a substantial strengthening of cooperation between the institutions. I have noted that a technical meeting is also being held in the margins of this symposium with the same purpose. This closer cooperation will be carried out in a spirit of partnership, respecting the existing legal constraints while increasing the effectiveness of our actions.

The EU considers that comprehensive safeguards agreements together with additional protocols constitute the current worldwide verification standard. Within the EU, the additional protocol is in force in all 25 Member States. In addition to the declarations required under the NPT Safeguards Agreement and its additional protocol, the Commission and the Member States also volunteer information outside this legal framework. All this is testament to the EU's commitment to providing guarantees that civil nuclear material is not diverted to military purposes. We are also keenly aware that new proliferation challenges have emerged since the advent of the additional protocol, and therefore the Commission closely follows and fully supports the deliberations of the IAEA's Advisory Committee on Safeguards and Verification.

The primary task facing Euratom and the IAEA is discussing, agreeing on and managing the next stage of our relationship — the implementation of integrated safeguards. Since they started submitting the declarations under the additional protocol, the European Commission and the EU Member States have been doing their utmost to provide the IAEA with access to locations and with the information it needs to be able to satisfy itself of the absence of undeclared materials and activities.

6. THE BROADER PROLIFERATION CHALLENGE

All of us gathered together in this room know very well that safeguards are only one weapon in the armoury for fighting the spread of nuclear explosives. Effective physical protection is another indispensable weapon. Euratom is a party to the Convention on the Physical Protection of Nuclear Material. We believe its recent amendment represents a major strengthening of the international provisions in the area, and I can assure you that the Commission and the Member States of the EU are working on rapidly acceding to it.

Nuclear export controls present an essential barrier to the spread of sensitive nuclear equipment and technologies to those who would cheat on their international non-proliferation commitments. The Commission sets the legislative framework for export controls in the Community and is currently working to update this legislation to increase its effectiveness and to comply with the latest international measures, including those in UN Security Council resolution 1540.

Countries with rapidly rising energy needs cannot be denied responsible access to nuclear energy. How can newly emerging nuclear countries be assisted while ensuring that the transferred nuclear materials, equipment and know-how are used exclusively for peaceful purposes? The Commission has a keen interest in this question owing to its extensive competencies in relation to supply of nuclear material. It thanks the Director General for having organized the recent special session on the subject and looks forward to further elaboration of some of the initiatives presented there. Nevertheless, the Commission recalls that these initiatives should not distort market mechanisms and should allow EU Member States to respect the Euratom Treaty.

The Commission appreciates the IAEA's activities aimed at combating illicit trafficking in nuclear and radioactive materials, including the International Catalogue of Sealed Radioactive Sources and Devices, or Source Catalogue, to which it is pleased to have been able to contribute technically. Illicit trafficking is a global problem, and the Illicit Trafficking Database represents the best means of understanding the true extent of the problem. We are also pleased that the IAEA is associating itself with international collaboration in the field of nuclear forensics. The Commission also wonders whether an international database of the characteristics of nuclear materials, analogous to the Source Catalogue, combined with a new international norm requiring producers to feed the database could constitute a new area for consolidating international efforts in this area.

7. CONCLUDING REMARKS

In conclusion, the Commission believes that any expansion of nuclear energy in the world needs to be accompanied by a strengthening of the global regimes addressing safety, security and non-proliferation, adding new elements whenever new challenges arise. For its part, the Commission stands ready to shoulder its share of the load.

I would like to close by thanking you for your attention, recalling that the European Commission is fully committed to significantly strengthening its cooperation with the IAEA and will remain fully supportive of any initiative the IAEA takes to render nuclear energy safer, more secure and more acceptable to the public at large. With this in mind, I wish you a fruitful exchange of views during the remainder of this symposium.

THE ISSUE OF FURTHER STRENGTHENING IAEA SAFEGUARDS ACTIVITIES

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Thank you very much, Mr. Chairman. I would like to thank you for the invitation to address this timely forum. We look forward to the benefits to be derived from discussions at the technical and political levels that will take place during this symposium. In particular, we welcome new ideas, creative thinking and possibly new proposals on how to address the challenges we all face. In my brief presentation, I would like to focus on existing challenges, rather than offer ready-made solutions, since no State can claim to have a 'magic wand' and the ability to formulate a panacea for all problems.

We have entered the 21st century with the nuclear non-proliferation regime (and the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) on which it is based) under stress. The regime has been challenged both politically and physically. The issue of the lack of full compliance by States with their safeguards obligations has been looming. Much of the discussion of nuclear non-proliferation issues has been politicized and, as far as we are concerned, sometimes overly politicized. In his presentation, Ambassador Minty addressed the views of a number of countries on the so-called decoupling of nuclear disarmament from the non-proliferation issue. Looking at the issue from the perspective of authorities in Moscow, we do not view this in the same way, since, even as we speak, nuclear disarmament is taking place and armaments are being destroyed, especially in my country. Certainly more could be done, but these issues should be discussed at forums other than this symposium, which offers opportunities to focus on ensuring that all States that have made non-proliferation commitments fully comply with these commitments.

New challenges are emerging, such as the threat of nuclear materials and nuclear weapons falling into the hands of terrorists. This challenge could not have been predicted some three decades ago when the NPT was evolving. But the terrorist threat is now very real. Therefore, the issues of how to secure, verify and account for the nuclear materials circulating worldwide are becoming more and more crucial. In this context, the IAEA has a unique role to play, because no State can act alone. Multilateral approaches are the only

way to succeed. We need to keep in mind that those engaged in illicit trafficking and other illicit activities related to nuclear materials and radioactive sources are trying to exploit the dynamics of globalization and are doing so much faster than governments are able to come to grips with the problems and to cooperate in curtailing these illicit activities and preventing future ones. In this context, we acknowledge the IAEA's activities in addressing illicit trafficking issues, which are interrelated with its safeguards activities.

We are also facing a relatively new challenge associated with the black market. Illicit trafficking in nuclear materials and nuclear technologies has become a real trend. The IAEA is doing a good job of trying to better understand the phenomenon and how to combat this trade. However, apart from the non-proliferation verification activities, the scale of these problems is such that we need multilateral approaches and multilateral preparations. The IAEA (and no other organization) is best suited to address these issues.

We believe that the NPT should be the cornerstone of all future efforts. The Treaty provides the legal and structural basis for implementing all the steps needed to combat 'traditional' non-proliferation challenges as well as new challenges. There has been much discussion, especially in academia, about doomsday scenarios for the NPT within the next few years. We take exception to this, because the choice we have to make is simple: either we actively build upon the NPT and the verification system it has created, or we all face degradation of predictability and security in the world. Should there be a lack of controllability with respect to a political–military situation, this could lead to the use of force involving, say, a nuclear weapon or some other instrument of choice to deal with these problems. We believe that the choice of building up the NPT is the only one available for the world community to follow.

Let me now turn to the unique role of the IAEA. The IAEA cannot act as a policeman; it can only help all the States party to the NPT to establish 'confidence building measures' — notably, safeguards agreements and additional protocols that States enter into voluntarily. By showing that it has nothing to hide, a State helps to increase predictability and reliability and to engender trust in what it is doing today or what it plans to do in the future. The Russian Federation, as a State and as the current Chair of the G-8, is working together with other G-8 States to make the non-proliferation commitments made pursuant to safeguards agreements and additional protocols the universally accepted norm worldwide. To date, 78 States have acceded to the additional protocol. But while this is a significant number, it is not sufficient. We are working with many States to help in this regard, but often the approaches adopted by the non-nuclear-weapon States are overly politicized on these issues. There are sometimes linkages that are not warranted by realities on the ground.

We understand that the IAEA faces financial problems and that it requires additional resources. The individual States that have placed their nuclear installations under the IAEA safeguards and that have opened up their nuclear activities for verification measures under the additional protocol also incur significant financial burdens. But we believe that, overall, any such burden is a small price to pay for securing economic and social development through the provision of reliable nuclear energy. At the same time, when there is a lack of transparency, there are concerns about States' compliance with their commitments under the NPT. The cooperation with States where there are open issues should not be curtailed, and efforts should be made to resolve these issues. We think there is no alternative today to this approach. Nobody has invented a safeguards system for today and for the future. We are all serious about developing nuclear energy worldwide.

One of the central issues discussed at the recent St. Petersburg summit of the G-8 was energy security. Nuclear energy was an important topic in these discussions. It was agreed that fossil fuels are exhaustible and that nuclear energy will be a source of development for many States, developed and developing. Therefore, the use of nuclear energy is likely to increase over the next few decades. Currently, nuclear power is generating energy in more than 30 States; over the next 20 or 30 years, that figure could double or even triple. The question is, Is the IAEA safeguards system ready for that level of expansion? As members of the United Nations and of the IAEA, what are we, as States, doing to help the IAEA to meet current challenges and to prepare for future challenges?

A key issue to be considered is that over the period 2020–2040 there could be 800–900 reactors in operation, rather than the approximately 400 reactors that are under the safeguards system today. The Director General has spoken on the issue of resources, and it is important that the Member States address this issue. The IAEA must have the resources to conduct the verification activities that Member States want it to, and new approaches are therefore needed to address this issue. There are various options. One such option has been dealt with here at this symposium — namely, implementation of integrated safeguards, which can help the IAEA to reduce expenditures.

A second option relates to the use of future, advanced technologies. What kinds of reactor should be phased in over the next 10–20 years? We need to focus on those reactors that would provide more security and fewer proliferation risks, and that are 'safeguards friendly'. The IAEA is exploring several possible developments, including the proposal from my country regarding future reactors. In this context, we hope that the requirements for safeguarding new generations of nuclear reactors will be a prime focus of discussion at this symposium.

There is yet another important issue that concerns not only future nuclear energy development but also the role of the IAEA safeguards system relative to nuclear fuel cycle technologies. Currently, there is debate of political importance concerning the issue of uranium enrichment which is being discussed at the IAEA. When looking at the world and trying to forecast the nuclear energy structure of the next few years, we see that many States have a desire for independent nuclear fuel cycle capabilities. Why? One possible explanation is that often there is a lack of certainty that fuel will be available when needed, and that it is essential to ensure that the supply of fuel does not become an instrument of political pressure. These arguments are often advanced regarding the wisdom of developing nuclear fuel cycle capabilities throughout the world. We think that a much better approach can be developed, and in this context we are grateful to Dr. ElBaradei, who initiated discussion of this issue several years ago. This is not a particularly new discussion; it began at the IAEA some 20 years ago with the International Nuclear Fuel Cycle Evaluation (INFCE) programme that, among other things, analysed the nuclear fuel cycle from the point of view of non-proliferation. But maybe the international approach is something that one can adopt now. The time has come for careful consideration of these ideas.

As far as the Russian Federation is concerned, we are willing to play a pioneering role in this field. The President of the Russian Federation has proposed the creation of a multilateral fuel cycle centre in the country. We have already selected a site in Angarsk, where we are ready to build a multilateral centre that would be open to States interested in obtaining enrichment services. Implementation would not be a simple task. There are a number of financial, legal and practical organizational matters to be discussed, one of which is verification. From the outset, it was decided that the centre would be entirely under IAEA safeguards, and we hope that the IAEA will help us to develop this concept more fully. Several States have already expressed an interest in working with us on this issue, and we hope that this will be a future trend for developing nuclear fuel cycle services. We are not asking for a monopoly, nor are we are calling for a monopoly. We are offering a centre that would provide multilateral approaches, in order to ensure that fuel services would be available to interested States on a non-politicized basis. We are looking to the IAEA for assistance as the sole multilateral body concerned with nuclear energy.

To sum up, we envisage the future renaissance of nuclear energy worldwide; this will be healthy for the environment. The Russian Federation is among those States that would support safe, predictable and reliable cooperation in this field. At the same time, the expansion of nuclear energy will bring new challenges to the IAEA, because the further development of nuclear energy requires the concurrent development of a predictable and reliable

IAEA safeguards system to help ensure that nuclear energy is being used exclusively for peaceful purposes. These issues need to be addressed, and we are looking forward to the discussions during this symposium. The Russian Federation will certainly continue to assist in the IAEA's safeguards efforts, particularly through the provision of the services of our laboratories and training courses.

MULTILATERAL VERIFICATION: A WORKING REMEDY FOR PROLIFERATION

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All parties to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) have undertaken not to provide fissionable material to any non-nuclear-weapon State (NNWS), unless the material is subject to IAEA safeguards. From the outset in 1970, the safeguards, which constitute a form of verification, were designed based on the understanding that all NNWSs party to the NPT were entering the Treaty with the best of intentions. Thus it was taken for granted that no State having signed and ratified the NPT would try to circumvent the basic provisions of the Treaty, whether as a recipient or provider of nuclear material. Accordingly, the verification system (i.e. the safeguards provisions) was designed to build confidence and to be carried out under the presumption of innocence. Not even US President Ronald Reagan's cautionary dictum "Trust, but verify" applied fully during these early years, although it was recognized that the two notions were mutually reinforcing.

The strengthening of the idea and principles of non-proliferation was initially promoted in essential harmony and progressed rapidly during the 1970s and 1980s, with France and China joining the NPT, and well into the 1990s, after the dissolution of the Soviet Union. During most of the 1970s and 1980s, and even up until the indefinite extension of the NPT in 1995, the differences among the participating States primarily concerned the matter of vertical proliferation, in other words, the implementation of Article VI. Non-nuclear-weapon States, especially among the non-aligned countries, expressed concern and disappointment about the development of new weapons and the slow pace of nuclear arms reduction as carried out by the nuclear-weapon States (NWSs). Even States outside the NPT — India and Pakistan — underlined the discrepancies between the rights and duties of the NWSs and those of the NNWSs as a rationale for not joining the Treaty.

1. THE CASE OF IRAQ AND SECURITY COUNCIL ENGAGEMENT

The relative harmony and confidence in the practice and safeguarding of the commitment not to proliferate broke down when it became known in 1991 that Iraq, a State party to the NPT and hitherto a country in good standing with the safeguard regime, had violated its commitments under the Treaty over a number of years. The IAEA, with its credibility shaken, reacted with commendable speed by quickly developing the Model Additional Protocol. This must be counted as a considerable achievement. Iraq's action had demonstrated a basic flaw of the NPT: without formally violating the provisions, a NNWS could acquire fissionable material and, under the umbrella of credibility provided by NPT membership, assemble sensitive components for a nuclear weapon in order to exercise its formal right to withdraw from the Treaty and to emerge with a nuclear weapons capability. The Democratic People's Republic of Korea (DPRK) has taken this route, and there are those who fear that the Islamic Republic of Iran may follow in these footsteps.

Following Iraq's aggression against Kuwait in 1991, the Security Council adopted resolution 687 (1991), which constituted the provisions for the ceasefire between Iraq and the international coalition for the liberation of Kuwait led by the United States of America. This resolution and the follow-up resolutions, especially resolutions 707 and 715, created the framework for a new set of verification arrangements of unprecedented sharpness and precision to be carried out by the United Nations Special Commission (UNSCOM) and the IAEA. Resolution 1284 (1999), establishing the United Nations Monitoring, Verification and Inspection Commission (UNMOVIC), further enhanced the rights of the international weapons inspectors. It can be argued that, with the combined IAEA/UNSCOM/UNMOVIC verification regime, optimal verification of compliance with the disarmament and non-proliferation obligations of States has been achieved.

Last spring the US investigation of Iraq's weapons of mass destruction (WMD) programme, carried out by the Iraq Survey Group, reached the conclusion that, in essence, all prohibited WMD and related items had been identified and eliminated under the control of UNSCOM and the IAEA during the period from 1991 to 1998. In the political turmoil following the publication of this report, especially the indignation and criticism directed against the US administration for having overstated the WMD threat prior to the conflict in Iraq in 2003, the good news was generally overlooked, namely, that the United Nations attained a near 100 per cent success rate in its task after the liberation of Kuwait, with the complete disarmament of Iraq and the establishment of a watertight monitoring system.

2. VERIFICATION OF IRAQ'S COMPLIANCE

According to the disarmament plan outlined by the Security Council, Iraq was obliged to declare all its holdings of WMD and related items, including production and research facilities. It fell upon UNSCOM and the IAEA to verify the correctness of the declarations. However, from the outset, Iraq did not declare in full its holdings. In response, the weapons inspectors developed methods and techniques to detect and identify the reality behind the smokescreen of false and misleading declarations, a task made more difficult as the Iraqi regime chose to block and harass the inspectors. The Security Council responded by providing the inspectors with additional rights and intrusive authority (inter alia, Security Council resolution 707 (1991)). Thus the original task of the inspectors, to verify Iraq's declarations and inspect *declared* assets, had to be expanded to an investigation, search and detection mode with a focus on *undeclared* activities and facilities. This constituted a challenge to Iraq's sovereignty. The Council addressed that problem by limiting the authority of designation of undeclared sites to UNSCOM, a subsidiary organ of the Council, thus stressing the technical and non-political character of the IAEA inspections.

Because of repeated efforts by the Iraqi authorities to hide capabilities, the United Nations inspectors had to make use of a wider range of verification tools than normally applied. Among the verification methods applied in Iraq were investigation of banking documents and other documentary evidence to identify the money trail concerning the procurement of prohibited items and names of foreign suppliers, a tailor-made export–import mechanism, a mobilized international network of high quality laboratories, and access to high resolution satellite and aerial surveillance imagery through U-2 high altitude reconnaissance aircraft as well as close range photographs from helicopters, both of which had been put at the disposal of United Nations inspectors.

Efforts by the Iraqi authorities to block or deny the inspectors access to designated sites were overcome through reactions by the Security Council in statements warning of "serious consequences", commonly understand as direct military action. The frequency of Iraqi challenges decreased when UNSCOM introduced modalities for immediate unconditional and unrestricted access for inspectors while taking into account legitimate Iraqi concerns for its sovereignty and security.

3. TREATY BASED VERIFICATION

Iraq is an example of verification and compliance measures imposed by the Security Council. Such measures are designed to respond to the specific character of a given situation. In contrast, treaty based verification and monitoring provisions (as in the Chemical Weapons Convention, the Comprehensive Nuclear-Test-Ban Treaty (CTBT) and, of course, the NPT) are intended to give all parties to a treaty equal treatment. Treaty verification aims at creating a level playing field in treaty compliance bodies. Dialogue, consultation, clarification/baseline inspections, routine monitoring inspections, challenge inspections and fact finding missions are tools of a treaty executive body, ultimately supported by the final option of referring serious instances of non-compliance to the Security Council for enforcement. Thus the compliance structure of disarmament treaties covers the whole political spectrum from cooperative verification to the adversarial mode of verification imposed by the Security Council, as in the case of Iraq.

For a State that has concluded that it has no interest in acquiring nuclear weapons, it is natural to join the NPT, both to strengthen the general principle of non-acquisition and to encourage other State parties to stay with the Treaty and those States that are not party to the Treaty to join it. This is also an element of the efforts aimed at strengthening the idea of non-proliferation as an international norm with an impact also outside the Treaty membership. The purpose of the accompanying safeguards agreements, in this context, is to enable State parties to make judgements about compliance with Treaty provisions and to create confidence in the principles reflected in the Treaty. This implies, however, that if there were a violation of the Treaty and the non-proliferation regime, as we now have experienced in the case of the DPRK, it could have ripple effects, especially in the regions concerned. This could weaken the trust in and support for the regime. The examples of the DPRK and the network of A.Q. Khan demonstrate that States or State authorities can be major proliferators. The economy of the DPRK has all the characteristics of that of a failed State. This means that the normal controls are not in place and cannot function, and as such a government is unwilling or unable to prevent the misuse of its facilities or of territory under its jurisdiction. Regarding the DPRK, it is difficult to see how any verification system other than one developed on the basis of the UNSCOM/IAEA model in Iraq could be effective.

4. NON-STATE ACTORS, PROLIFERATION AND NON-TREATY NORMS

Multilateral arms control treaties are increasingly being supplemented and supported by other measures. These measures generally lack symmetry, reciprocity and universal participation. However, they are responses to new developments in the security environment, such as the actions taken by Iraq, mentioned previously, and more recently by the DPRK. A major recent concern relates to the emergence of new non-State actors. International terrorism has moved from narrowly defined targeting to existential attack aiming at massive destruction. Nuclear weapons would be ideal in this respect — the ultimate instrument for mass terrorism. Terrorists have no return address, and deterrence is not effective against suicidal threats. When fighting terrorism involving WMD, a primary concern must be achieving selective denial of access to technologies and materials that could be used by non-State groups for acts of mass terrorism. Failed or rogue States may allow terrorists to acquire nuclear weapons. However, it is also possible that in other countries with lax control, nuclear weapons such as sub-strategic or tactical weapons, or major components thereof could be bought or stolen. Crude nuclear designs may be partly accessible in the open literature and on the Internet or bought from a network like that of A.Q. Khan. There may even be a possible market for nuclear weapons scientists and technicians who are without gainful employment. However, even if the design elements can be assembled by a terrorist network, the acquisition of fissile material would constitute a major obstacle in the acquisition of nuclear weapons. It is difficult to imagine that even a well-funded terrorist organization would be able to set up a centrifuge enrichment facility without the help of government structures. Terrorists would have to search for possible material, preferably highly enriched uranium, on the black market. Thus the defence against nuclear terrorism must begin with the protection of nuclear weapons and materials in every country and every facility that has them. Substantive strengthening of the non-proliferation regime could be achieved by setting restrictions on the acquisition of the nuclear fuel cycle. Instead, arrangements guaranteeing the reliable supply of fuel to civil nuclear reactors must be made. As a board member of the Nuclear Threat Initiative (NTI), I would like in this context to remind you of NTI's offer in support of Director General ElBaradei's proposal of an independent, non-discriminatory nuclear fuel bank to be run by the IAEA. This would help to ensure that civilian nuclear energy programmes could not be exploited for military purposes. Also, States that are not party to the NPT should undertake the same obligations as all the members of the Nuclear Suppliers Group, namely, to restrict deliveries of all weapons sensitive material.

With its resolution 1540 (2004), the Security Council has created a normative umbrella over these policies by deciding that all States should refrain from providing any form of support to non-State actors that attempt to develop, acquire or use WMD and related means of their delivery. However, the resolution is not supported by verification arrangements and mechanisms for evaluating the effectiveness of States' measures or for helping States to implement their obligations, such as monitoring and controlling sensitive technologies, materials and equipment within their territories. This reflects the insistence by many States that denial of access to dual use technology should only be sought when the technology concerned is very likely to be misapplied.

5. ARTICLE VI AND DISARMAMENT

It must not be overlooked that for the general health of the non-proliferation regime, the many restrictions undertaken by or imposed on the NNWSs through the NPT should be matched with respect to the NWSs. Little could be more harmful to the regime than if NWSs such as China, the Russian Federation or the United States of America were to make real plans for the development, production and deployment of new types of nuclear weapon. Maintaining a moratorium on nuclear testing is therefore indispensable. A return to treaty based arms control should not be delayed. First of all, and increasingly urgent, is the entering into force of the CTBT, where a US initiative in the form of ratification would be indispensable. The United States of America could also reduce the strain imposed on the non-proliferation regime by its proposed strategic nuclear partnership agreement with India by insisting that India sign and ratify the CTBT.

Leadership by the NWSs is missing regarding the concrete negotiations in the Conference on Disarmament aiming at the conclusion of a Fissile Material Cut-off Treaty (FMCT).

Such a return to treaty based efforts to strengthen the policies and principles of non-proliferation through the careful application of verification measures would be sustainable and restore trust in verified non-proliferation within the international community, making it possible to stop the march towards the weaponization of civil nuclear technology, a technology much in demand as a remedy to energy insecurity and the supposed coming era of global warming.

JAPANESE INDUSTRY'S COOPERATION WITH IAEA SAFEGUARDS

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1. INTRODUCTION

Japan experienced two atomic bomb attacks — at Hiroshima and Nagasaki — at the end of World War II. On the one hand, Japan is a country that understands the disastrous effects of atomic bombs to be a matter of the greatest importance. On the other hand, not long after the bombings, Japan became aware of the huge potential of nuclear energy.

In 1955, Japan began nuclear research and development (R&D) activities. In the same year, the Atomic Energy Basic Law was concluded, which limits all research to peaceful purposes only.

In the early stages of its nuclear programme, Japan imported technologies and materials from Canada, France, the United Kingdom and the United States of America. Japan accepted IAEA safeguards inspections under the bilateral cooperation agreements set up with each country.

Today, under the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), Japan receives the strengthened safeguards on all nuclear facilities based on the comprehensive safeguards agreement and the additional protocol. The civil nuclear industries — such as utility companies, nuclear fuel manufacturing companies and nuclear fuel cycle operators, such as Japan Nuclear Fuel Limited (JNFL) — completely accept the strengthened safeguards. At the same time, they cooperate towards more effective safeguards application. We are confident that Japan's record of the peaceful use of nuclear energy could be a model for the IAEA's intended goals.

This paper briefly summarizes the history and the current status of the use of nuclear energy in Japan in conjunction with the IAEA safeguards system.

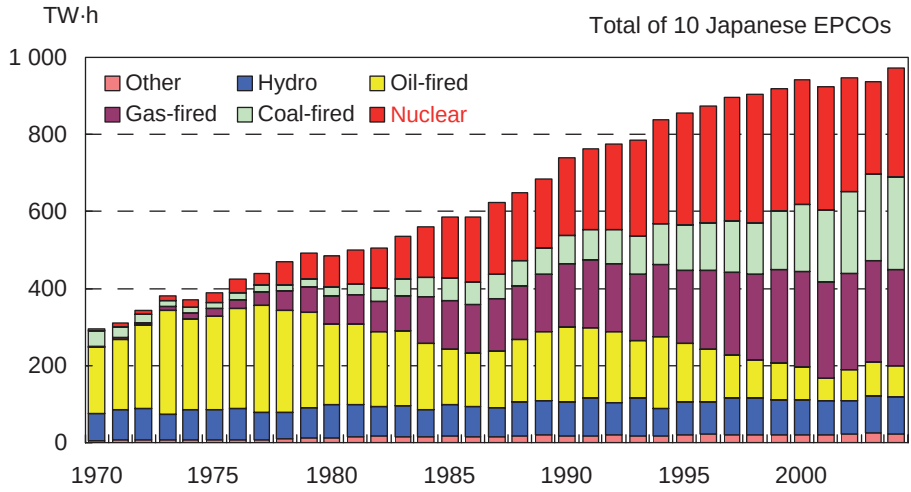


FIG. 1. Nuclear power generation since 1970.

2. JAPAN'S NUCLEAR POWER PROGRAMME

2.1. History of nuclear power in Japan

In 1955, Japan began R&D activities aimed at the peaceful use of nuclear power. The research, development and utilization of nuclear science and engineering are strictly limited to peaceful purposes by the Atomic Energy Basic Law of Japan.

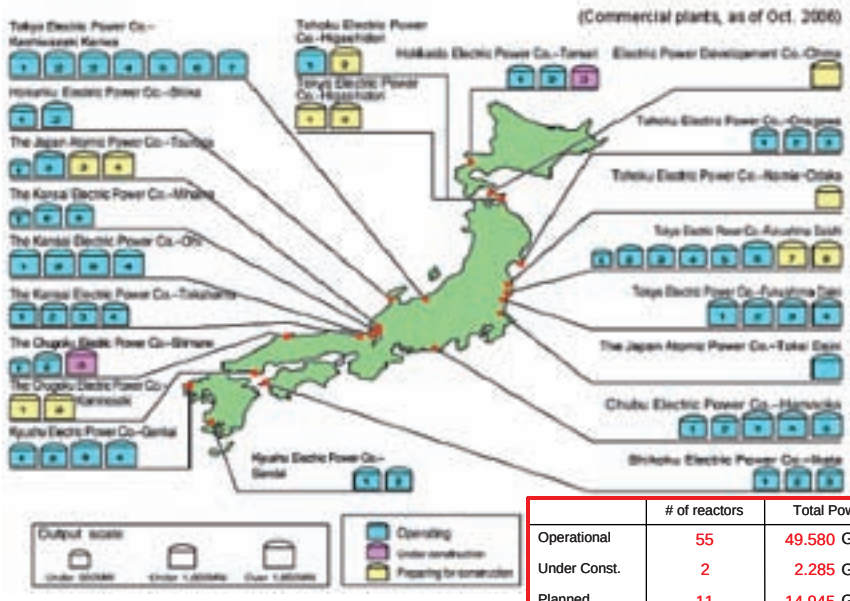
In 1966, Japan's first commercial nuclear power plant — the Tokai-1 (GCR), imported from the United Kingdom — began operation. Today, 55 commercial nuclear power plants are in operation, with a total generating capacity of 49.58 GW(e). Nuclear power supplies about 30% of the country's total electricity demand. Japan also has various research reactors, such as JRR-3, JRR-4, JMTR, HTTR, JOYO and MONJU.

2.2. Increase of nuclear power generation

Figure 1 shows the increase of nuclear power generation since 1970.

2.3. Nuclear power plants in Japan

Figure 2 shows the locations of nuclear power plants in Japan. All of the plants are located on the coast.



	# of reactors	Total Power
Operational	55	49.580 GWe
Under Const.	2	2.285 GWe
Planned	11	14.945 GWe
Total	68	66.810 GWe

FIG. 2. Nuclear power plants in Japan.

2.4. Energy self-sufficiency of countries

Figure 3 shows the energy self-sufficiency of selected countries around the world.

2.5. Japan's greenhouse gas emissions

Figure 4 shows Japan's Kyoto Protocol target for 2008–2012: the target is a 6% reduction of the base emissions in 1990.

2.6. Forthcoming LWRs

Two nuclear power plants based on light water reactors (LWRs) are under construction, totalling 2.285 GW(e). Another four plants are being reviewed by the regulatory authority, totalling 5.844 GW(e). An additional seven nuclear power plants are planned, totalling 9.101 GW(e).

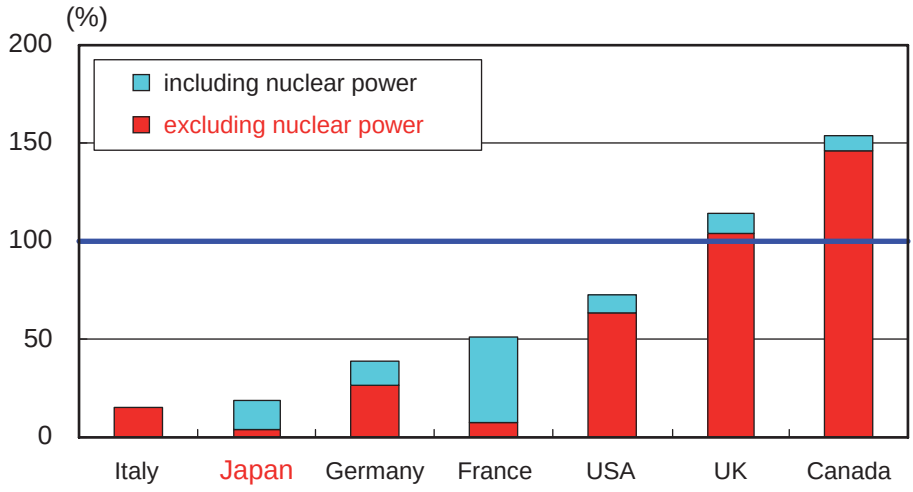


FIG. 3. Energy self-sufficiency of selected countries.

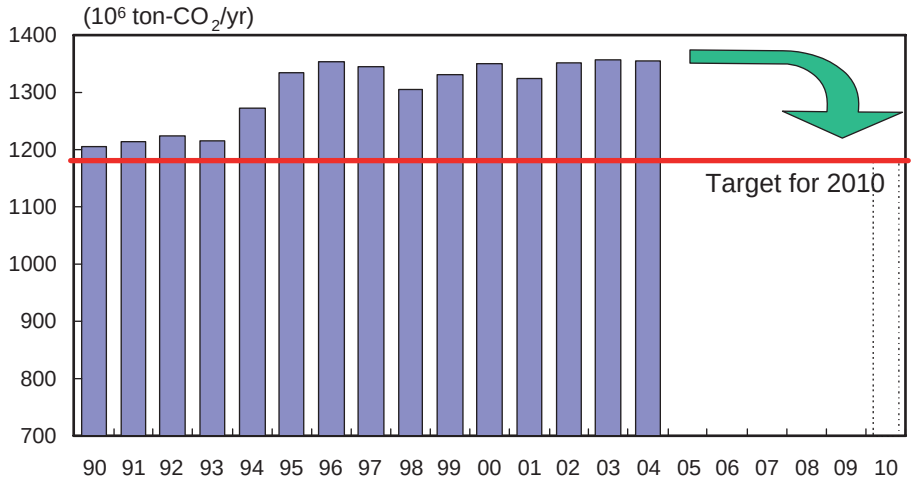


FIG. 4. Japan's Kyoto Protocol target for 2008–2012.

3. JAPANESE PLUTONIUM RECYCLING

3.1. Nuclear programme based on recycling

As Japan is short of domestic energy resources, its nuclear power programme has been based on plutonium recycling. More than 7000 t of spent

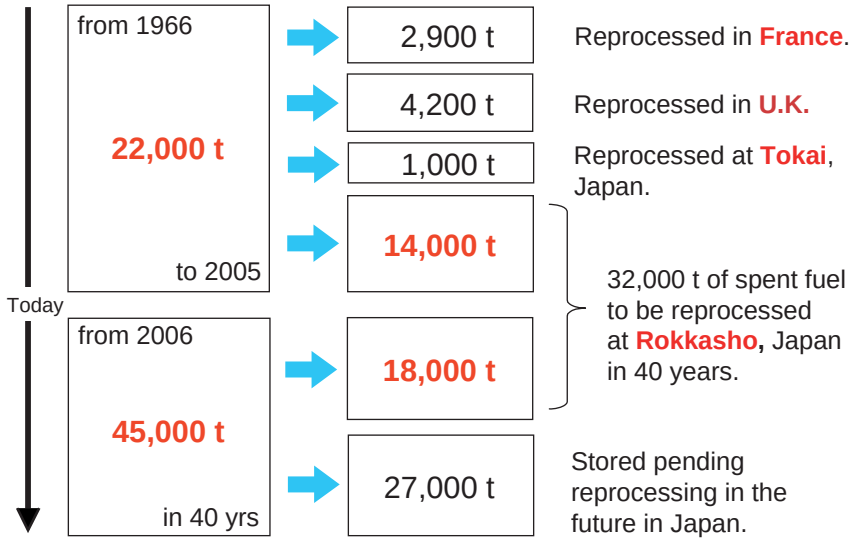


FIG. 5. LWR spent fuel scheduled to be reprocessed.

fuel has been sent to Europe for reprocessing. Approximately 1000 t of spent fuel has been reprocessed at the Tokai reprocessing facility. At Rokkasho, a commercial reprocessing plant with a rated capacity of 800 t/a, tests using actual spent fuel have begun.

3.2. LWR spent fuel to be reprocessed

Figure 5 shows the LWR spent fuel that is scheduled to be reprocessed.

3.3. JNFL reprocessing plant

The JNFL reprocessing plant at Rokkasho has a capacity of 800 t U/a (with spent fuel storage of 3000 t U). Its construction costs were approximately $19.9 billion (2.19 trillion yen). No separate pure plutonium exists at the plant (PuO_2 is recovered as a mixture with UO_2). Figure 6 illustrates the process used at the Rokkasho reprocessing plant.

3.4. Master plan of test operation of the reprocessing plant

Figure 7 shows the master plan of the test operation of the JNFL reprocessing plant at Rokkasho.

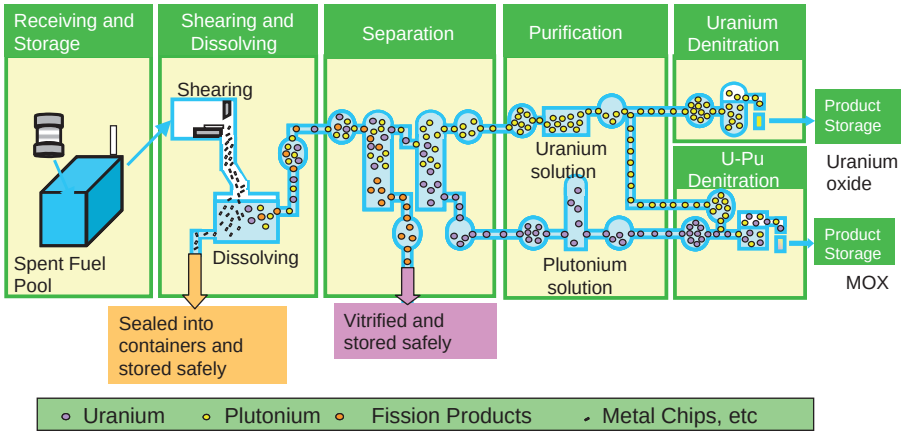
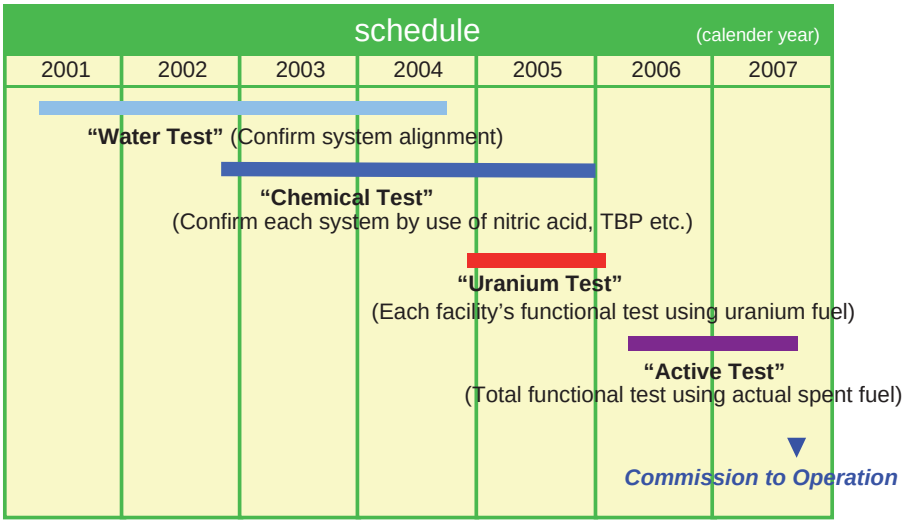


FIG. 6. Process used at the Rokkasho reprocessing plant.



(*) Construction was started in Apr. 1993.

FIG. 7. Master plan of test operation of the Rokkasho reprocessing plant.

3.5. JNFL mixed oxide fuel plant

A commercial mixed oxide (MOX) fuel plant to serve Japanese electric power companies, with a maximum capacity of 130 t HM/a, is planned. The fuel plant will be located adjacent to the Rokkasho reprocessing plant. The MOX

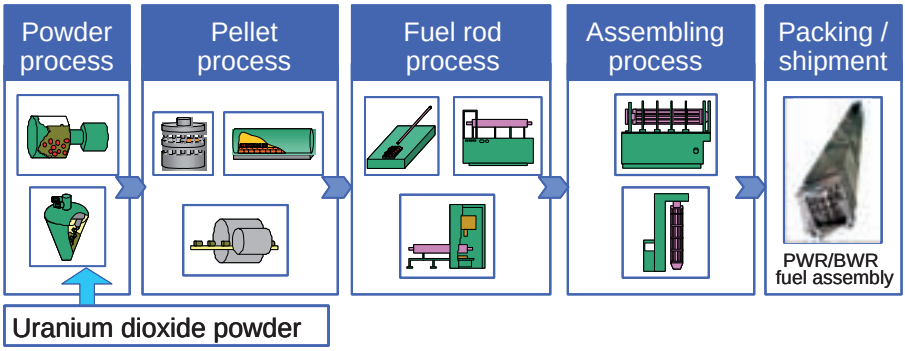


FIG. 8. Process outline of the JNFL MOX fuel plant.

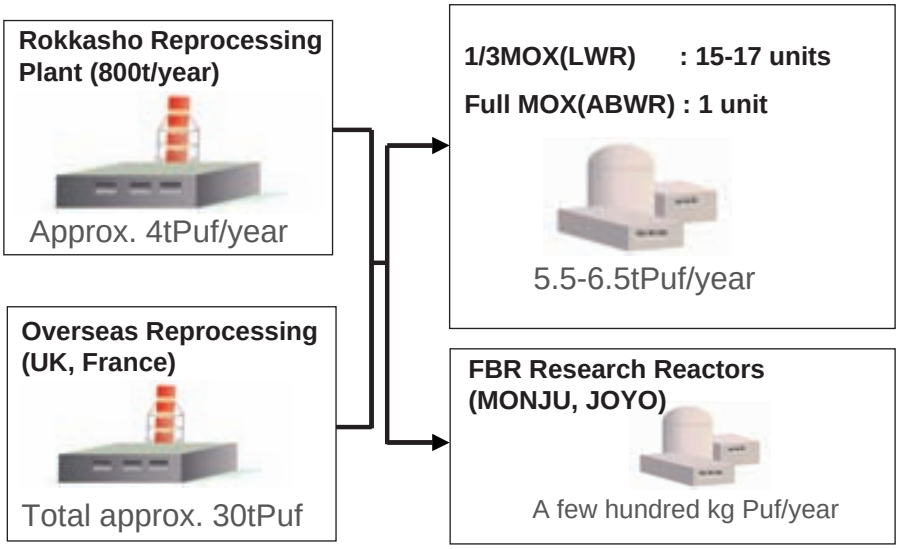


FIG. 9. Plutonium balance in Japan.

powder is to be transferred through an underground tunnel from the reprocessing plant to the MOX plant. The MOX plant has been undergoing a safety evaluation by the regulatory authority since April 2005. The start of operation is planned for April 2012. Figure 8 illustrates the process to be used at the MOX plant.

3.6. Total scheme of plutonium balance in Japan

Figure 9 illustrates the plutonium balance in Japan.

4. APPLICATION OF THE IAEA INTEGRATED SAFEGUARDS SYSTEM IN JAPAN

4.1. History of safeguards in Japan

The first IAEA inspections of Japan's nuclear research reactors and facilities took place in 1964. In 1976, Japan ratified the NPT, and one year later Japan and the IAEA concluded a comprehensive safeguards agreement under the NPT. In 1999, the additional protocol took effect in Japan. In 2004, the integrated safeguards system was applied at those of Japan's LWRs without MOX fuel and at spent fuel storage facilities, research reactors and critical assemblies. In 2005, this system was expanded to include LWRs with MOX fuel and low enriched uranium fuel fabrication facilities.

4.2. Integrated safeguards for Japan

The integrated safeguards for Japan include the provision of information concerning 250 facilities and 5000 accountancy reports. The safeguards are based on the additional protocol and include complementary access and broader access.

The safeguards conclusion for 2005 was as follows:

— All nuclear material in Japan was being used for peaceful activities.
— There was no indication of undeclared nuclear material or activities.
— There was no indication of undeclared production/processing of nuclear material at declared facilities.
— There was no indication of diversion of declared nuclear material.

5. IAEA SAFEGUARDS TECHNOLOGIES APPLIED AT THE ROKKASHO REPROCESSING PLANT

For Japan to be internationally recognized to reprocess the spent fuel and to reuse the recovered plutonium as MOX fuel in reactors, these activities should be verified as being for peaceful purposes only.

5.1. Transparency

'Full scope' IAEA safeguards have been applied at the plant. These were validated by the IAEA during plant construction: the IAEA confirmed that the plant was constructed in accordance with the design documents. The plant has

FIG. 10. On-site laboratory with mass spectrometry. (Photo courtesy of the Nuclear Material Control Centre.)

24 h/d inspection by resident IAEA inspectors. Inspectors independently collect and evaluate the operator's data regarding plutonium and are given access to all parts of the plant for inspections. The IAEA conducts independent analysis using the on-site laboratory (see Fig. 10).

5.2. Safeguards measures

The following state-of-the-art safeguards technologies are applied at the JNFL reprocessing plant:

- A solution measurement and monitoring system (SMMS) that uses liquid levels, densities and temperatures in the tanks;
- A plutonium inventory measurement system (PIMS) that detects neutrons emitted by plutonium powder;
- A non-destructive assay (NDA) system: a waste crate assay system (WCAS), the Rokkasho hulls monitor system (RHMS) and a vitrified canister assay system (VCAS);
- Integrated containment and surveillance (C/S), with monitoring by cameras and radiation detectors;
- An on-site laboratory used by inspectorate analysts for sample analyses (e.g. mass spectrometry).

5.3. Japanese fast breeder reactor design

The fast breeder reactor (FBR) design used in Japan has the following characteristics:

— 1.5 GW(e) with only two loops;
— Reactor vessel and building smaller than that of MONJU;
— Na-cooled MOX fuel;
— 12 Cr steel for shorter piping;
— Intermediate heat exchanger (IHX) combined with primary pump;
— Double tube steam generator (SG);
— Oxide dispersion strengthened (ODS) ferrite steel cladding for high burn-up;
— Demonstration with smaller size in 2025;
— Feedback from MONJU and JOYO;
— More competitive than advanced LWRs.

5.4. Japanese fast breeder reactor cycle design

The operation of the FBR should be well coordinated with the fuel cycle design. Advanced and simplified aqueous reprocessing and fuel manufacturing technologies with higher proliferation resistance include:

— Aqueous method based;
— Crystallization for uranium recovery;
— Simultaneous extraction of uranium, plutonium and neptunium;
— Lower DF without purification;
— Recovery of MA for burning in the FBR core;
— Uranium to plutonium content ratio adjusted in the nitric acid;
— MA added to the MOX pellet;
— More economically competitive than PUREX for LWRs.

6. CONCLUDING REMARKS

From the viewpoints of energy security and the prevention of global warming, the peaceful use of nuclear power has been and will continue to be very important. The nuclear fuel cycle is crucial to maintaining Japan's nuclear power generation. Regarding nuclear non-proliferation, transparency is critical for Japan's fuel cycle. We are aiming to be a model of the peaceful use of nuclear technologies.

To date, a large number of research projects have been conducted and considerable financial and human resources have been invested to develop the very effective safeguards system and non-proliferation technology. Today the results of these efforts are applied at the Rokkasho reprocessing plant. The IAEA's experience in applying a safeguards system at a large scale nuclear fuel cycle business in Japan would be helpful and instrumental to the future practices in the world.

TECHNICAL PLENARY

(Session 2)

Chairperson

J. COOLEY
IAEA

Technical Secretary

A. HADFIELD
IAEA

INTERNATIONAL SAFEGUARDS: CHALLENGES AND OPPORTUNITIES

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1. INTRODUCTION

Good afternoon and thank you for the introduction. I would like to use my time today to discuss challenges to the IAEA safeguards system and actions that the United States of America is taking to help address them. The challenges arise from: (i) safeguards non-compliance by a handful of States, (ii) the spread of sensitive nuclear fuel cycle capabilities and (iii) the rising demand for nuclear energy as a carbon free source of power.

In considering international safeguards against these challenges, we should be guided by at least two goals: to pursue strategies that lower the risk of a future safeguards failure and to preserve the ability to adapt safeguards to a changing international environment. Meeting these goals is essential if we are to retain confidence in the safeguards system over the next half century. I will address each challenge.

2. SAFEGUARDS NON-COMPLIANCE

The vast majority of States abide by their safeguards commitments. A few States have not. Clearly, improvements to the IAEA's ability to uncover safeguards violations must be a priority. The additional protocol to safeguards agreements serves a critical purpose in this regard, and its universal acceptance and full implementation should be pursued vigorously. This goal was given expression by US President George W. Bush in his 11 February 2004 speech to the National Defense University, and it is shared by the IAEA Director General and many others represented here today.

President Bush also called for a new IAEA committee to "strengthen the capability of the IAEA to ensure that nations comply with their international obligations". We are encouraged by the Board of Governors' decision to

establish such a committee and welcome the opportunity it provides to recommend safeguards enhancements.

As a broad goal, we should aim for a culture of compliance. Those States party to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) that have not done so should bring into force a comprehensive safeguards agreement as required under the Treaty. The additional protocol should be universally applied. The United States of America is prepared to assist any State in this regard.

3. THE SPREAD OF SENSITIVE FUEL CYCLE CAPABILITIES

In his 2004 speech to the National Defense University, President Bush also called on the international community to take effective action to guard against the possibility that States party to the NPT could acquire and put sensitive fuel cycle facilities to illegitimate use. This challenge is almost as old as the nuclear age itself. Facilities for enriching uranium or reprocessing spent fuel can be used for weapons. To address this concern, the United States of America proposes restricting transfers of enrichment and reprocessing technology and equipment beyond those States already in possession of them. For States that decide not to pursue enrichment and reprocessing, the United States of America proposes that suppliers provide reliable fuel assurances.

These recommendations are under discussion internationally, for example, in the Nuclear Suppliers Group, the Group of Eight (G8), and at the IAEA, including the recent IAEA Special Event on assurances of supply and non-proliferation held in Vienna. It is noteworthy that all the fuel assurance proposals on the table address concerns over the uncontrolled spread of enrichment and reprocessing capabilities. Each presumes and seeks to enable an expansion of the use of nuclear power worldwide.

4. NUCLEAR ENERGY RENAISSANCE AND SAFEGUARDS

Nuclear energy is the most mature non-fossil technology capable of generating power on a scale needed to sustain global economic growth. But in a world of increasing nuclear energy use, the risks of its misuse could increase with it.

To facilitate nuclear energy's renaissance, the United States of America proposes the Global Nuclear Energy Partnership (GNEP), which is a comprehensive strategy to restructure the fuel cycle. It is designed to reduce proliferation risks in the nuclear fuel cycle by introducing new, proliferation resistant

fast reactor and fuel cycle technologies and by consolidating spent fuel and reducing stocks of separated civil plutonium. The GNEP also proposes new small and medium sized reactors tailored for the electricity grids of developing economies and made robust against nuclear terrorism, as well as a framework for fuel supply and spent fuel take back as an alternative to the high cost of producing and managing the disposition of nuclear fuel. Among the stated goals of the GNEP are the development and deployment of the most advanced international safeguards technologies and systems. We recognize that investments in this area are needed and likely overdue.

The GNEP can help to catalyze this investment in safeguards. Through the GNEP, we anticipate pursuing cutting edge systems for nuclear material measurement, process monitoring, modelling, and containment and surveillance, which would allow for robust, reliable unattended and remote monitoring. This work should complement IAEA methods and practices.

An expanding safeguards technology base can also help to address anticipated increases in the demand for IAEA safeguards resources, for example, as a result of a number of new enrichment plants; India's commitment to place a broad list of civil nuclear facilities under safeguards; and eventually the wider distribution of nuclear reactors to many more countries. The GNEP facilities in the United States of America would be made eligible for IAEA safeguards.

Building the safeguards systems and requirements for GNEP facilities is not something the United States of America can accomplish alone. We have no monopoly on the world's nuclear energy systems. We anticipate, therefore, working in partnership with other technology holders and with the IAEA to design facilities to accommodate safeguards and to develop safeguards technology for use by the IAEA. This cooperation will take advantage of several mechanisms, including the US Program of Technical Assistance for Safeguards, to which the United States of America contributes over $14 million annually, and the existing or new safeguards cooperation arrangements that we maintain with roughly a dozen foreign partners.

5. TOWARDS A BROADER VIEW OF SAFEGUARDS

Safeguards enhancements, as a principle, are needed to improve confidence that non-proliferation obligations are being met. In safeguards terms, confidence implies accuracy and completeness, but also timely warning of non-compliance. Early warning is essential to pre-empt major instances of non-compliance, preferably before domestic political decisions to proliferate are rendered or significant capabilities are acquired.

This poses a challenge for traditional safeguards, which by definition and practice link non-compliance determinations to evidence of nuclear material diversion or of undeclared nuclear activities. Certainly, the additional protocol, together with, for example, analysis of commercial satellite imagery and open source information, provide the IAEA with a more complete picture of activities within a State.

Modest proposals for the international community include: (i) more formalized sharing of information between the export control regimes and the IAEA Secretariat; and (ii) IAEA consultations with suppliers if inspections reveal items that may have been illicitly acquired or appear on watch lists circulated by nuclear suppliers.

In addition, better integration of safeguards and export control information, which to a limited extent is already under way, can provide indications of illicit intent before a diversion or a clandestine plant is discovered. This would also be consistent with the shift in safeguards emphasis from strict material accounting to the evaluation of information from many sources and for the State as a whole.

6. CONCLUSION

As a final note, a major strength of the safeguards system is its capacity to adapt and evolve. Using the experiences accumulated over the past decade and a half, significant safeguards advances have been achieved — but always in response to crisis. An even stronger safeguards system should to do more — it should help to avoid a crisis. That is our goal and our challenge. Thank you.

PRINCIPLES IN SAFEGUARDS: A CANADIAN PERSPECTIVE

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1. INTRODUCTION

To begin, I would like to thank the IAEA for organizing this symposium. I also would like to salute the European Safeguards Research and Development Association and the Institute of Nuclear Materials Management for their cooperation in bringing about this event.

In fact, this symposium comes at an important time in the life of the IAEA, since we are about to mark the 50th anniversary of the creation of the IAEA, in July 2007. Over that time, the IAEA has taken on many responsibilities. One of the most significant of these — and the one that brings us here today — is the responsibility to verify that States are in compliance with their respective safeguards obligations, thereby providing the international community with an independent conclusion concerning the peaceful, non-explosive use of nuclear energy.

2. HEADLINES

Of course, the safeguards and verification environment is constantly evolving. This symposium is taking place at a time when the international community is responding to the challenges presented by the Democratic People's Republic of Korea (DPRK) — challenges that are giving rise to questions relating to the IAEA's safeguards mandate.

3. OVERVIEW

This afternoon, I would like to offer a Canadian perspective on safeguards and verification — as we see the situation now, and as we see the work ahead. I will also discuss Canada's strong commitment to the Treaty on

the Non-Proliferation of Nuclear Weapons (NPT) and our safeguards agreement, including the additional protocol.

I will begin with some thoughts on international safeguards, given questions that have arisen as a result of the DPRK's test. Then, I will comment on good practices as they relate to the international safeguards system at the global level and at the State level. Keeping in mind the subject of this symposium, I would like to discuss three principles that are essential to the success of the safeguards system: effectiveness, efficiency, and openness and transparency. My last major topic will be the recent broader safeguards conclusion that was attained by Canada and how it links to my country's next steps. I will conclude with a few ideas about the need for continuous improvement of safeguards.

4. THE SAFEGUARDS SYSTEM WORKS

My view is that the safeguards system works. Why, given the current situation, do I say this? Because the DPRK had to choose explicitly to leave the safeguards system to pursue its nuclear ambitions; it had to turn away from the entire international community and from the kind of commitment, accountancy and transparency that is the basis of the system. This is an important point, as there is some criticism, often just implied, that the safeguards system is ineffective because it does not do things for which it has neither the capacity nor the authority.

The system enables States to demonstrate that they are meeting their obligations concerning the peaceful use of nuclear energy, including reporting of nuclear materials under their jurisdiction. If they choose to end those obligations, they do so before the community of nations. That choice and the safeguards system in general both help to provide early warnings to the international community about potential problems. They signal situations that deserve more attention and deeper analysis.

The safeguards system makes it possible for information — and cases where there is a lack of information — to become visible. And it is then up to the relevant authorities to use that information to determine how best to respond.

5. MODELLING GOOD PRACTICES

I know that I do not need to describe the details of the safeguards system to this audience. However, I do want to underscore some elements of the

system — elements that are particularly relevant to our discussions. In particular, through the safeguards system, the international community and individual States have a vehicle to determine and demonstrate that nuclear materials are being used in peaceful activities, and this enables awareness of situations where that might not be the case or where gaps exist.

One of the most important evolutions in the IAEA's safeguards system in recent years has been the emergence of the State level perspective in safeguards implementation and evaluation. This is an excellent example of innovation. By utilizing a State level perspective in drawing its conclusions, the IAEA has recognized that many States have coherent systems for dealing with nuclear issues — and that a State level approach can be both more efficient and more effective.

That same spirit of innovation is shown when we are alert to good practices that enable the IAEA or national regulatory agencies to achieve our goals more effectively and efficiently, and with openness and transparency. For this reason, the Canadian Nuclear Safety Commission (CNSC) is committed to developing advanced safeguards equipment or techniques aimed at strengthening the effectiveness and efficiency of safeguards implementation generally, but with a priority of achieving improved safeguards implementation in Canada.

Now, let me comment on each of the three principles in detail.

6. EFFECTIVENESS

Effectiveness is the first principle that I would like to mention — one focused on doing the right things and doing them well. This is particularly relevant to the IAEA safeguards system, because we all want and need it to be effective. And there is room for continuous improvement. For example, we see the need to map out the processes that underlie the safeguards conclusions.

Clear processes have to be involved in determining annual implementation plans, ensuring that those plans are effectively implemented, undertaking State evaluations and reporting on each of these elements. Continued progress in that direction would build on the recognized importance of effectiveness within the IAEA in general and the Department of Safeguards in particular.

I note that the Director General's Standing Advisory Group on Safeguards Implementation (SAGSI) has done a great deal to promote the use of quality management principles within the Department of Safeguards, which is critical to the achievement of effectiveness.

7. EFFICIENCY

Efficiency is the second principle of a system with integrity that I would like to discuss in relation to safeguards. As those of us in regulatory agencies know, you cannot be everywhere, all the time. An efficient organization is one that recognizes risk and allocates its resources and priorities accordingly, on the basis of a sound assessment of those risks. This is even more pressing for nuclear regulatory agencies when rising concerns about the potential for terrorism have meant much greater attention to nuclear safety and security.

At the national level, States must have effective regulatory frameworks that are responsive to the risks associated with the use of specific nuclear materials at specific locations. We cannot treat all situations in the same way. The scale and pace of our regulatory efforts have to depend on the level of risk, which is the case in Canada. The IAEA must do the same if it is to achieve the effective and efficient implementation of its verification mandate.

This would not be a new direction for the IAEA. Risk assessment was inherent in the traditional safeguards approaches. Assessments of the nature and quantity of nuclear material influenced the frequency and intensity of verification efforts.

The IAEA must now do the same as in the context of State level assessments. The IAEA has a relatively fixed level of resources for its safeguards efforts. It makes sense to apply the concepts of differentiation and adaptability in establishing truly risk informed approaches to the best use of those resources. It makes sense to show the international community that the IAEA is focusing its verification efforts where the potential risks are greatest.

This becomes even more important at a time when the nuclear industry is poised for growth around the world. With plans in the works for new electricity generating facilities in many countries, for example, now is the time to ensure that the owners and operators of those facilities know what we expect from them. Good communication of our expectations today will enable those operators to respond efficiently to our requirements and those of the IAEA tomorrow.

8. OPENNESS AND TRANSPARENCY

The final principle that I would like to raise this afternoon is actually a linked pair of concepts: openness and transparency. For our part in Canada, the CNSC strives to be as transparent as possible in our work to regulate Canada's nuclear industry. Openness and transparency promote public understanding of

the decision making process, which is particularly important in a field with the profile that the nuclear industry has.

Importantly, a transparent, open approach demonstrates the non-discriminatory nature of the decision making process. It promotes greater acceptance of the decisions and conclusions of regulators. The same is true for the IAEA. Openness and transparency are necessary elements of the IAEA's safeguards system. It is essential that we all understand the basis on which the IAEA draws its safeguards conclusions. It is equally essential that the processes underlying those conclusions are non-discriminatory. This becomes particularly important as the IAEA increasingly introduces qualitative consideration into the evaluation process.

We are pleased to note that steady progress is being made in this regard, particularly through the evolution of the Safeguards Implementation Report. We are also pleased to note the emphasis that the IAEA is placing on the need for openness and transparency on the part of States in order for the IAEA to effectively implement its safeguards system and draw safeguards conclusions.

But let us be clear that the need for openness and transparency extends well beyond regulatory agencies or the IAEA. In particular, we should expect the nuclear industry to be ready to deal with citizens and stakeholders in an open manner to meet the expectations of citizens and communities.

9. THE CANADIAN APPROACH TO REGULATION

The three principles that I have just described — effectiveness, efficiency, and openness and transparency — are ones that are strategic objectives in the organization that I lead, the CNSC. Canada has a large nuclear programme over which the CNSC has regulatory authority in many areas. The Government of Canada has assigned four mandates to the CNSC:

- Regulation of the development, production and use of nuclear energy in Canada;
- Regulation of the production, possession, use and transport of nuclear substances, and the production, possession and use of prescribed equipment and prescribed information;
- Implementation of measures respecting Canada's international nuclear commitments, which takes place in collaboration with Canada's Department of Foreign Affairs and International Trade and includes the responsibility to implement the safeguards agreements between Canada and the IAEA;

— Dissemination of scientific, technical and regulatory information on the CNSC and on nuclear substances.

Our broad scope for action and our role as the sole nuclear regulator in Canada means that we are able to bring a holistic approach to all this work. In working to fulfil our vision of being one of the best nuclear regulators in the world, we also have the benefit of a modern legislative and regulatory framework, the Nuclear Safety and Control Act, which came into effect in 2000 and which specifically addresses safeguards.

The timing of the new legislation was important, as we are seeing substantial growth in all areas of the Canadian nuclear industry, with plans now under way for new nuclear power plants, new mines, possible new refineries and new facilities to deal with nuclear waste.

10. THE CANADIAN CONCLUSION

While we have a wide-ranging set of responsibilities, the one of importance here today is our specific responsibility to implement the safeguards agreements between Canada and the IAEA. We were pleased that, in September 2005, the IAEA drew the broader safeguards conclusion for Canada that all nuclear material remains in peaceful activities. Our primary challenge now is to ensure that the IAEA can maintain this broader safeguards conclusion annually. I say this because it is not clear how much effort will be needed.

What we do know is that it took a considerable effort on the part of the CNSC, the IAEA and Canadian industry over a five year period to achieve the broader safeguards conclusion. We also know that we would not expect to see the same level of effort required to maintain it.

There will be substantial work ahead as the CNSC works with the IAEA and Canadian industry to implement a State level integrated safeguards approach in Canada. This is an important undertaking, and one that must proceed on the basis of an agreed approach that establishes implementation priorities and reflects existing available resources.

The CNSC sees the need to go beyond this by strengthening our capability to draw an independent conclusion for Canadians that nuclear material in Canada is appropriately accounted for and is solely in peaceful, non-explosive use. Our creation of the Directorate of Security and Safeguards is a step forward in integrating the various elements of our security mandate in our operational programme. Part of that work, which is already a domestic priority, is better placing the CNSC to act on our national security mandate. We

have a base there with initiatives such as new security regulations related to nuclear facilities and our work on controls of radioactive sources.

11. CONCLUSION: MOVING FORWARD

I would like to conclude my remarks with a few final comments. I noted that next year will mark the 50th anniversary of the IAEA. We all appreciate that the work of ensuring the peaceful, non-explosive use of nuclear energy exists now in a more complex world, with more complex technologies and more facilities to regulate than was the case in 1957. This goes well beyond situations like the one in the DPRK, as notable as it is. For example, in that era there was little thought that non-State actors would pose nuclear threats.

The different and changing world of today underlines the importance and relevance of the safeguards system. It is not enough to put the onus for improvement of the safeguard system solely on the IAEA. It is critical that States do their part to continually improve their regulatory frameworks to achieve effectiveness, efficiency, and openness and transparency, both in terms of national audiences and to demonstrate engagement in, and support for, the safeguards system.

For that interplay of national and international progress to take place, the IAEA and States need to be able to respond to the lessons learned from our previous verification experiences and to identify new technologies that will achieve better results, whether at the national or the international level.

I can say that Canada is moving towards strengthening our own national capability in the verification field. The CNSC intends to ensure that Canada has a robust integrated regulatory compliance approach that includes a national verification system. Ensuring the effectiveness of that approach, whether in one country or internationally, depends on a focus on effectiveness with objective, risk informed decision making, as well as efficient, transparent, well defined processes through which conclusions are drawn and regularly and appropriately reported to stakeholders.

Greater transparency can only help us in that regard. National regulatory authorities responsible for safeguards and verification need to be as effective and as efficient as possible. There are several ways that this can be achieved. Benchmarking good practices that are in use by others and self assessment on the basis of the IAEA guidelines for a State system of accounting for and control of nuclear materials — the relevant international standard — are two means that will undoubtedly bear fruit.

As well, the Secretariat's recently established advisory service for a State system of accounting for and control of nuclear material (SSAC) represents an

important contribution. This international peer review process enables SSACs to receive expert advice and recommendations for improvement. In this regard, I note that Canada intends to take advantage of this service at an appropriate time.

Progress on these and other challenges will enable the IAEA to do more and do it better for the benefit of people around the world as it prepares for the next 50 years of ensuring 'Atoms for Peace'.

DEFINING THE SAFEGUARDS MISSION

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1. INTRODUCTION

The IAEA's comprehensive safeguards system has been in operation for some 35 years. After this time, it might be thought that all issues regarding the safeguards mission have been clarified. However, issues continue to arise, for example, with respect to the IAEA's inspection authority, its safeguards objectives and the scope of its conclusions. Any uncertainty in these areas could have a detrimental effect on the IAEA's safeguards operations and even its credibility.

The nature of the IAEA's safeguards mission — what the safeguards system is seeking to achieve — can be considered at a number of levels: What is required under the Treaty on the Non-Proliferation of Nuclear Weapons (NPT)? What is required under safeguards agreements? What are the expectations of the international community?

The safeguards mission is defined both by the relevant agreements and instruments, and by the practice of the Board of Governors, the Secretariat and States in implementing them. The four basic instruments describing safeguards and setting out the objectives of the safeguards system are (i) the IAEA's Statute, (ii) the NPT (see Ref. [1]), (iii) the model comprehensive safeguards agreement (INFCIRC/153 (Corrected) [2]) and (iv) the Model Additional Protocol (INFCIRC/540 (Corrected) [3]). The interrelation of these instruments is critical, especially the relationship between the NPT and the IAEA's safeguards system. Here, it should be noted that the application of these instruments is not static but is subject to Board and State practice, which evolves over time.

There are differences between the terms of the Statute, the NPT and safeguards agreements, which could affect the scope of safeguards activities and hence the IAEA's ability to draw conclusions, including determinations of non-compliance. This highlights a key issue, namely, whether the apparent divergence between provisions of the NPT and safeguards agreements indicates that safeguards are intended to cover something less than the non-proliferation commitments provided for in the Treaty. While there is no doubt

that activities by a non-nuclear-weapon State (NNWS) party to the NPT aimed at the development of nuclear weapons — including those described as 'weaponization activities' — constitute non-compliance with the Treaty, the IAEA's authority to investigate weaponization activities absent some 'nexus' to nuclear material has been questioned.

A further issue of fundamental importance concerns the nature of the conclusions the IAEA is able, and can be expected, to draw. Does the IAEA have to show that a nuclear programme is non-peaceful? Conversely, is the IAEA able to establish definitively that a nuclear programme is for exclusively peaceful purposes?

2. DEFINING THE SAFEGUARDS MISSION: THE BASIC DOCUMENTS

Under the NPT, NNWSs undertake inter alia not to manufacture or otherwise acquire nuclear weapons or other nuclear explosive devices (NPT Article II [1]). They also undertake to accept safeguards:

- In accordance with the IAEA's safeguards system;
- For the exclusive purpose of verification of the fulfilment of its obligations assumed under this Treaty;
- With a view to preventing diversion of nuclear energy from peaceful uses to nuclear weapons or other nuclear explosive devices. (NPT Article III.1 [1].)

Thus the NPT foresees a broad mission for IAEA safeguards: the verification of obligations assumed under the Treaty, particularly not to divert nuclear energy to nuclear weapons.

The NPT then refers to matters that safeguards are to cover:

- "Procedures for the safeguards required by this Article shall be followed with respect to source or special fissionable material …";
- "The safeguards required by this Article shall be applied on all source or special fissionable material in all peaceful nuclear activities within the territory of such State …." (NPT Article III.1 [1].)

This focus on nuclear material is understandable — after all, the manufacture of nuclear weapons requires nuclear material. Nuclear material is readily categorized and quantified, and lends itself to the accountancy based verification approaches that had already become well established by the late

1960s. The prevailing view at that time was that an attempt to manufacture nuclear weapons would necessarily involve diversion of declared nuclear material and/or the misuse of declared nuclear facilities. Hence it was thought the NPT objectives could be met through verifying declared nuclear material and facilities.

Accordingly INFCIRC/153 (Corrected) [2] was drafted in terms of safeguards procedures to be applied to nuclear material. The "Basic Undertaking" in paragraph 1 of INFCIRC/153 (Corrected) refers to the "undertaking by the State to accept safeguards … on all source or special fissionable material in all peaceful nuclear activities within its territory …". However, the process of paraphrasing Article III.1 of the NPT introduced an apparent divergence from this Article. As discussed, under Article III.1, the purpose of verification is not limited to nuclear material, but encompasses "the fulfilment of [the State's] obligations assumed under this Treaty" relating to diversion of nuclear energy to nuclear weapons.

Not too much should be made of this apparent difference. Clearly, nuclear weapons cannot be manufactured without nuclear material, so Article III.1 sets out the basic requirement that safeguards procedures should apply to all the nuclear material in the State. This means an obligation to declare all nuclear material so that safeguards procedures can be applied on it. It does not mean that safeguards procedures are limited to nuclear material. As will be discussed, verification also needs to encompass relevant non-nuclear materials and items in order to be able to draw conclusions about the absence of undeclared nuclear material.

INFCIRC/153 (Corrected) itself defines the IAEA's safeguards mission, albeit in the context of that document's focus on nuclear material. The document provides that the IAEA has the right and obligation to ensure safeguards are applied on all nuclear material in the State to verify that such material is not diverted to nuclear weapons or nuclear explosive devices (Ref. [2], paragraph 2). This basic statement is elaborated further in the description of the "objective of safeguards", namely:

> "… the timely detection of diversion of significant quantities of nuclear material from peaceful nuclear activities to the manufacture of nuclear weapons or of other nuclear explosive devices or for purposes unknown ...." (Ref. [2], paragraph 28.)

3. THE SAFEGUARDS MISSION: A PROCESS OF EVOLUTION

The interpretation of INFCIRC/153 (Corrected) [2], in terms of safeguards implementation and the expectations of the international community, has evolved over time, and continues to do so.

From the terms of the NPT, it is clear that INFCIRC/153 (Corrected) does not represent the full extent of the IAEA's verification mandate. Under the NPT, the State has accepted "the IAEA's safeguards system". This is an evolutionary system, a system whose content is under continuing development — as shown by the fact that when the NPT was concluded INFCIRC/153 (Corrected) did not exist, in signing on to the NPT States accepted a commitment to a system that was then undefined.

To find major elements of the safeguards system it is necessary to go outside INFCIRC/153 (Corrected) — upwards, to decisions of the Board of Governors, and downwards, to the IAEA's Safeguards Manual, safeguards criteria, the integrated safeguards conceptual framework and associated documentation, and so on. The point is that there is considerable flexibility in the IAEA's safeguards system, and the Board of Governors and the Secretariat are able to adapt the system to meet changing circumstances. This adaptability is a key strength, essential to maintaining and improving the effectiveness of the safeguards system.

Until the 1990s, the principal task of safeguards was generally seen as being to confirm the correctness of States' declarations. As noted above, it was thought that any undeclared nuclear material/activities would be revealed through diversion of declared nuclear material or misuse of declared facilities. Hence the focus of safeguards agreements was on nuclear material, nuclear accountancy and regular inspections.

Since the early 1990s, following the discovery of Iraq's clandestine nuclear weapons programme, the emphasis has turned to detection of undeclared nuclear material/activities, referred to as confirming the completeness of States' declarations. It is now recognized that if a State has undeclared nuclear material/activities, it is quite likely there will be no obvious links between these and the declared nuclear programme.

One expression of this broadening of focus — of fundamental importance in the evolution of the safeguards system — was the development of the Model Additional Protocol (INFCIRC/540 (Corrected) [3]). With INFCIRC/540 (Corrected), the IAEA and Member States have recognized that, in order to make the safeguards system more effective, the IAEA's verification authority needs to go beyond the application of safeguards procedures to nuclear material.

INFCIRC/540 (Corrected) has extended the IAEA's authority into a number of areas where nuclear material would not normally be present, such as the manufacture of centrifuge components, heavy water, nuclear grade graphite and shielded flasks, and the construction of hot cells. The rationale for this is clear: the IAEA can — and should — look at broader information that strengthens the IAEA's ability to verify and draw conclusions regarding nuclear material in the State concerned. This encompasses procedures to find indicators of undeclared nuclear material and nuclear activities, or indicators of diversion or proposed diversion of nuclear material.[1]

In parallel with the introduction of INFCIRC/540 (Corrected), the IAEA has been developing a new range of verification methods and technologies, including information collection and analysis, environmental analysis, use of satellite imagery and so on. Information analysis now has a central place in the evaluation of States for safeguards purposes and consequent decision making, looking at questions such as: What are the acquisition paths available to a State? What are the possible indicators of undeclared nuclear activities? What is the optimal safeguards strategy for detecting such activities?

With the emphasis now being given to undeclared nuclear activities, the safeguards system is reflecting more closely the intent of the NPT, that verification should have a view to preventing diversion (NPT Article III.1 [1]). Of course, safeguards as such cannot prevent diversion, except through the deterrent effect of the risk of detection. Prevention is likely to require the intervention of the international community, but effective intervention depends on timely warning. The IAEA's duty to the international community is, where possible, to provide warning before, not after, a nuclear weapons programme has proceeded beyond the point where intervention can be effective.

4. NUCLEAR WEAPONIZATION[2]

Issues concerning the scope of verification and timely warning are directly relevant to the issue of weaponization. 'Weaponization' is shorthand for the range of activities, in addition to the acquisition of fissile material, necessary for the manufacture of a nuclear weapon or nuclear explosive device. The manufacture of nuclear weapons obviously requires nuclear material, but many preparatory activities do not. Some relevant non-nuclear materials and

[1] In contemporary practice the term 'diversion' includes both removal of nuclear material from safeguards and failure to declare nuclear material.

[2] For a more detailed discussion of this topic, see Ref. [4] .

activities are 'dual use', that is, taken in isolation they do not necessarily indicate an intention to manufacture a nuclear weapon. While such an activity may be ambiguous, however, it may be less so in the context of other information about the State (e.g. the discovery of undeclared nuclear material/activities).

Whether the State is known to have direct use material, or the capability to produce it, is an essential aspect of assessing the significance of apparent weaponization activities — but it should not be overlooked that weaponization activities may themselves be an indicator of the existence of undeclared nuclear material/activities, as yet undetected.

The Secretariat has suggested that "absent some nexus to nuclear material the Agency's legal authority to pursue the verification of possible nuclear weapons related activity is limited" [5]. What is a sufficient nexus? Clearly, development of nuclear weapons must at some stage involve nuclear material. The conduct of certain activities by a State may be a clear indication of intent to misuse nuclear material. The IAEA has a responsibility to provide timely warning of diversion of nuclear material to nuclear weapons, and so cannot ignore activities that indicate preparation for diversion, or indeed that diversion involving undeclared nuclear material/activities may have already occurred without detection.

In considering the IAEA's rights and responsibilities in this area, it is important to distinguish between the following:

— The IAEA's legal authority — its right of access to locations in a State to investigate possible weaponization activities and its responsibility to draw conclusions.
— The IAEA's detection capabilities — detection of some of these activities could be very difficult. This should not be confused with the right to investigate, but it can affect the level of assurance the IAEA is able to provide in this area.

By their nature, many weaponization activities will be difficult to detect. Here, there are two issues: how to identify specific locations for investigation and how to detect indicators at such locations. A further difficulty is that even after investigation the activity may remain ambiguous — the outcome may be inconclusive. Because of the inherent difficulties, the international community must accept that the IAEA may not be in a position to resolve particular suspicions, and also that it might miss indications of certain activities. In most cases the IAEA will not be in a position to provide absolute assurance of the absence of weaponization activities — although also in most cases State evaluation should show there is no reason to believe such activities may exist.

The difficulties in detecting weaponization activities need to be taken into account in drawing safeguards conclusions. Absent unusual circumstances, safeguards non-compliance should be regarded as a strong indicator of proliferation intent.

5. SAFEGUARDS CONCLUSIONS AND THE STANDARD OF PROOF

The detection of wholly undeclared nuclear material/activities is much more of a challenge than confirmation of the correctness of declarations. As already mentioned, it has been necessary to develop a new range of verification methods and technologies. Although these techniques can be viewed as being 'technical' in nature, decisions on which measures should be applied and the intensity of their application — how much is 'enough' to fulfil the safeguards mission — involve qualitative judgement. Safeguards implementation requires a judgement on what is required to be done, which needs to be guided by a clear understanding of the safeguards mission. This in turn can be guided by an understanding of the kind of conclusions the IAEA is able to reach.

The IAEA reports in the annual Safeguards Implementation Report (SIR) whether it found any indication of diversion or any indication of undeclared nuclear material/activities. The results of the IAEA's activities are then used to support conclusions.

Traditionally, the IAEA expressed its conclusions in terms of declared material:

> "All the information available to the Agency supports the conclusion that the nuclear material and other items placed under safeguards remained in peaceful nuclear activities or were otherwise adequately accounted for."

Once the IAEA began to implement safeguards measures under the additional protocol, however, there was an expectation that it would also draw a conclusion about the absence of undeclared nuclear material/activities. The IAEA did this for the first time in the SIR for 2000, when it reported:

> "In 2000, for seven States, each of which has a comprehensive safeguards agreement and an additional protocol in force or being provisionally applied, the Agency concluded that *all nuclear material in those States had been placed under safeguards and remained in peaceful nuclear activities or was otherwise adequately accounted for*. This conclusion is based on the evaluation of all information acquired in implementing safeguards

> agreements and additional protocols and of all other information available to the Agency for each of the above States. In the course of that evaluation, 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" [emphasis added]. [6]

It is essential that the IAEA's conclusions on the absence of undeclared nuclear material/activities are credible. The international community must be confident that the absence of indicators does not simply reflect an inadequate or ineffective verification effort. The IAEA is devoting considerable effort to the development of verification methods that will provide a credible result. In this regard, credibility will depend on a number of factors: that the verification methods are appropriate, that they are implemented appropriately in each case (which involves issues of quality assurance) and that the IAEA's practices are adequately understood by the international community.

It is essential for States to understand what the IAEA means by a conclusion on the absence of undeclared nuclear material/activities. Such a conclusion is not unqualified — it is important not to confuse credible assurance with certainty. It is never possible to prove a negative with absolute certainty. For at least the past 30 years, the IAEA has recognized that it is necessary to draw its conclusions on the balance of probabilities. There has been a substantial effort to ensure the credibility of the conclusions drawn, but it is recognized that seeking higher levels of assurance rapidly falls victim to the law of diminishing returns.

One aspect of conclusions about undeclared nuclear material/activities concerns the significance of the detection of such material/activities, and whether their existence constitutes diversion. Is it sufficient for the IAEA to show a failure to declare nuclear material or nuclear activities, or is something more required, such as evidence of nuclear weapon intent?

It is most unlikely that inspectors will catch a State red-handed, for example, by finding a nuclear weapon or nuclear material in the form of nuclear weapon components. It is more likely that a State facing exposure in such an obvious way would deny access, preferring to argue whether lack of cooperation constitutes non-compliance, and to be able to maintain some ambiguity about its actions. For this reason, the reference in INFCIRC/153 (Corrected), paragraph 28 [2], to diversion to "purposes unknown" is very important. The framers of INFCIRC/153 (Corrected) realized that the standard of proof should not be set unrealistically high.

Further, INFCIRC/153 (Corrected) provides that the Board may report to the United Nations Security Council if it finds that the IAEA is not able to

verify that there has been no diversion to nuclear weapons (Ref. [2], paragraph 19). Broadly speaking there are two possible scenarios here:

— Inspectors find that nuclear material is unaccountably missing (and self-evidently, the purpose for which the nuclear material may be being used is not known).
— Inspectors find undeclared nuclear material, without satisfactory explanation; that is, the reason (purpose) for the failure to declare is not known.

In either case it is essential for the Board to have the opportunity to consider the matter without delay.

This understanding of what it is the IAEA needs to demonstrate should help to guide what the IAEA needs to do in its verification activities — in other words, to clarify the IAEA's safeguards mission. To 'prove' the existence of a nuclear weapon programme is too demanding — detection of weaponization activities will be very difficult, or if they are detected their purpose may be ambiguous. Depending on the circumstances, the existence of undeclared nuclear material/activities should raise a presumption of diversion — especially if direct use material, enrichment or plutonium separation is involved. The more additional information the IAEA can gather, the better; this will help to make the judgement of whether a weapon purpose is plausible in the circumstances. Detection and investigation of apparent weaponization activities need to be part of the IAEA's remit, but are not essential to support a finding of diversion/non-compliance.

6. CONCLUSION

The NPT reflects the expectations of the international community as to compliance with the non-proliferation obligation and verification of this compliance. The NPT provides that the safeguards system is to verify fulfilment of the obligations assumed under the Treaty "with a view to preventing diversion of nuclear energy to nuclear weapons". Accepting safeguards procedures on nuclear material is an essential mechanism for demonstrating compliance with the non-proliferation obligations, but it is by no means the full extent of these obligations. With the adoption of INFCIRC/540 (Corrected) [3], both the IAEA and Member States now appreciate that, for the IAEA to fulfil its mandate, safeguards procedures cannot be limited to nuclear material, but need to encompass related matters that support conclusions about nuclear material.

It is essential to avoid unrealistic expectations. On the one hand, States should be made aware of limitations in safeguards capability, especially since, notwithstanding good progress, the development of capabilities to detect undeclared nuclear activities is still at a relatively early stage. On the other hand, if the international community does not investigate matters of serious concern to States — such as indications of weaponization — this will adversely affect credibility. Apparent weaponization activities may indicate preparation for diversion, or that diversion (including activities involving undeclared nuclear material) has already occurred but not been detected. This is a matter the IAEA cannot afford to neglect.

It is also important that the standard of proof for safeguards conclusions not be too high. The framers of INFCIRC/153 (Corrected) [2] were realistic in their use of language such as "purposes unknown" and "not able to verify". The responsibility to provide timely warning and a requirement for certainty could well be mutually exclusive: by the time certainty is established, it may be too late.

Whether governments have confidence that a State's nuclear programme is exclusively peaceful is a matter of judgement made, not on the basis of certainty, but on the balance of probabilities. The situation is more likely to be one of ambiguity, rather than conclusive evidence. Once inspectors find they are unable to verify that there has been no diversion to nuclear weapons — or that there has been diversion to purposes unknown (which includes use of nuclear material in activities whose purpose is uncertain) — it is for the Board of Governors and governments to consider the implications and what is necessary to rebuild confidence.

For the safeguards system to be credible, a close correlation is needed between safeguards outcomes and the expectations of the international community. It is essential to all parties that the safeguards system is able to provide confidence about a State's performance of its peaceful use commitments — or to provide timely warning if there are grounds for concern. A shared understanding of the safeguards mission — the objectives of the safeguards system — is essential to avoid misunderstandings and failure.

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STRENGTHENING THE SAFEGUARDS SYSTEM: SIDE EFFECTS OF THE SAFEGUARDS MEASURES

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1. INTRODUCTION

The IAEA safeguards system has an indispensable role to play in the field of nuclear non-proliferation and the peaceful uses of nuclear energy. However, safeguards implementation should not be considered the main objective of nuclear energy or an end in itself. The central objective of nuclear energy is to improve the quality of life of the population and to contribute to sustainable development in States through the use of nuclear energy and its application for food and agriculture, human health, medicine, industry, water resources management, protection of the environment and generation of electricity. The objective of the IAEA safeguards system is to provide credible assurances to the international community that States are honouring their commitments to use nuclear energy exclusively for peaceful purposes. Therefore, safeguards implementation must not be an obstacle to the development of nuclear energy and its applications, and should have as a permanent goal to minimize impacts on the operation of nuclear facilities.

However, over the past several years measures have been adopted to strengthen the IAEA safeguards system that have focused mainly on the enhancement of the effectiveness of the system. Less attention has been given to assessing the costs of these measures and their impact on the States and on nuclear facility owners and operators. Also, the impact of these measures on the IAEA safeguards system, in terms of human and financial resources, appears not to have been comprehensively evaluated.

This paper seeks to raise the discussion of safeguards measures, taking into account alternative views and considering political, financial and technical aspects, with the expectation that this discussion will contribute to further strengthening the effectiveness and efficiency of the IAEA safeguards system. In this regard, this paper describes specific 'side effects' of safeguards measures and policies in order to stimulate the discussion.

2. EXAMPLES OF SIDE EFFECTS

The development of measures for strengthening the effectiveness and the efficiency of the safeguards system is a continuous process. Thus, this paper does not intend to criticize initiatives for strengthening the system. Rather, it aims to point out the importance of analysing the possible impact of a new proposed safeguard measure or policy from a broad perspective that includes technical, legal, political and diplomatic aspects, since these aspects are all relevant to safeguards. It is also necessary to take into account the legal framework for non-proliferation and safeguards — specifically, the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), the Structure and Contents of the Agreements between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons (INFCIRC/153 (Corrected)), and the Model Protocol Additional to the Agreement(s) between State(s) and the International Atomic Energy Agency for the Application of Safeguards (INFCIRC/540 (Corrected)). These legal instruments contain several constructive ambiguities, allowing for different interpretation.

2.1. Non-discriminatory safeguards implementation

The adoption of further measures to strengthen the safeguards system, which are usually applied only to non-nuclear-weapon States (NNWSs) party to the NPT, has increased the gap between the safeguards measures applied in these States and those applied in the other States.

Side effect: One side effect of safeguards measures is the intensification of the discriminatory character of the NPT and the safeguards system. Consequently, difficulties arise with respect to the acceptance of these additional measures by the public and by the political authorities — particularly by members of congressional bodies, who frequently express concern about why the State should continue to accept additional obligations derived from the treaties or agreements that it signed while other States remain free of any obligation.

The universal and non-discriminatory application of comprehensive safeguards and the adoption of concrete and irreversible steps towards nuclear disarmament and fissile material cut-off are measures that would help to reduce or eliminate this side effect and to eliminate the discrimination in safeguards implementation that currently exists between NNWSs party to the NPT and other States.

2.2. Quantity of information and the analysis system

Article 8 of INFCIRC/153 (Corrected) established that "The Agency shall require only the minimum amount of information and data consistent with carrying out its responsibilities under the Agreement. Information pertaining to *facilities* shall be the minimum necessary for safeguarding *nuclear material* subject to safeguards under the Agreement". The Model Additional Protocol (INFCIRC/540 (Corrected)) reinforces this concept in paragraph 4 of the Preamble: "Whereas the frequency and intensity of activities described in this Protocol shall be kept to a minimum consistent with the objective of strengthening the effectiveness and improving the efficiency of the Agency safeguards".

However, some members of the international community have the incorrect perception that the more information the IAEA receives, the more effective it will be with respect to verification and safeguards. There is a general belief that the IAEA needs to receive or obtain more and more information to be able to fulfil its safeguards responsibilities.

Following the trends described above and considering that information analysis has a central role to play in the safeguards State evaluations, a vast quantity of information has been supplied to or obtained by the IAEA that must be analysed.

Side effect: A second side effect of strengthening measures is the overloading of the IAEA information analysis system and the concurrent need to enhance its analysis capabilities, albeit at a prohibitive cost.

It would be more effective and efficient if the IAEA were to receive or obtain more qualified and relevant information, rather than large quantities of information. The establishment of criteria to select the information to be analysed, based in the criteria of quality and relevance, would contribute to increasing the effectiveness and the efficiency of the information analysis system.

2.3. Safeguards at sensitive facilities and proliferation risks

The development or improvement of safeguards approaches applied to sensitive nuclear fuel cycle facilities, particularly centrifuge enrichment facilities, to strengthen the safeguards system could include broader access of inspectors to information and places in such facilities.

Side effect: These measures could increase the risks of proliferation and the risks associated with the preservation by the facility of its technological secrets and strategic and commercial information.

To minimize these risks, the facility operator could identify what information effectively needs to be protected, and the IAEA could restrict its request to this minimum information and its access to that necessary for fulfilling its responsibilities. In this context, it would be possible to negotiate safeguards approaches and procedures that would allow the IAEA to apply effective and efficient safeguards and allow the State and the facility operator to protect the technological secrets and strategic and commercial information.

2.4. Safeguards on less relevant nuclear material and facilities

The rigidity in the safeguards implementation associated with the new policies regarding conversion facilities could imply the application of increasing safeguards to nuclear material and facilities considered less relevant from the standpoint of proliferation risks.

Side effect: A side effect of these measures could be the unnecessary increase of the costs of safeguards implementation.

These additional costs could be reduced with the adoption of more flexible safeguards criteria, to allow for the concentration of the safeguards measures on relevant nuclear material and facilities, thereby providing for a more efficient use of scarce resources.

2.5. IAEA initiatives to mitigate side effects

Over the past several years, the IAEA has taken several initiatives, such as the use of advanced technologies, the development of new safeguards approaches, the implementation of integrated safeguards and State level integrated safeguards approaches, that have helped to reduce the impact of the side effects on the State and facility operators.

For example, the use of environmental sampling, satellite imagery and unattended and remote monitoring systems has helped to reduce the side effects concerning increased proliferation risks and the preservation of technological secrets. These technologies have also helped to reduce the costs and impacts of measures on States, nuclear facility owners and operators, and have allowed the IAEA to obtain the information necessary to apply effective and efficient safeguards.

3. CONCLUSION

During the development of a new safeguards measure or policy and before it is proposed, it is very important to analyse the possible impact(s) of

the measure on States, facility operators and owners, and on the IAEA safeguards system. This should be done from a broad perspective that includes technical, legal, political, diplomatic and cost-efficiency aspects, in order to avoid undesirable side effects.

NUCLEAR SAFEGUARDS CHALLENGES FROM THE POINT OF VIEW OF A DEVELOPING COUNTRY

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1. INTRODUCTION

First of all, let me express my sincere appreciation and gratitude to the IAEA, in particular to the organizing committee, for having extended an invitation to me to speak at this symposium on such an important topic, namely, international nuclear safeguards. It is indeed an honour and a privilege for me personally to speak in front of such a distinguished and honourable audience.

I shall take this opportunity to briefly present my personal views and thoughts, both as an Indonesian and as a person from a developing country, on challenges facing nuclear safeguards today as a vital component of the worldwide efforts towards nuclear non-proliferation and disarmament, with a fervent hope for the total elimination of nuclear weapons in the foreseeable future. This vision was eloquently and compassionately expressed by the 'founding father' of the IAEA, US President Dwight D. Eisenhower, in his famous 'Atoms for Peace' address in 1953.

My comments and conclusions are expressed in my own personal capacity and are based on my observations and previous experience, first as an experimental nuclear physicist and university lecturer in Europe, and later as Deputy Chairman of Indonesia's National Nuclear Energy Agency (BATAN), and then as Chairman of the Nuclear Energy Regulatory Agency (BAPETEN), a position I held until last year. The latter two appointments constitute two of the key posts for the development, application and control of the nuclear energy programme in Indonesia. During my career in the Government, I have also had opportunities to interact with many nuclear leaders in both developing and technologically developed countries, on either a bilateral or a multilateral basis, such as within the framework of the intergovernmental forum of the Regional Co-operative Agreement (RCA) in the Asia–Pacific region under the aegis of the IAEA.

2. NUCLEAR ENERGY: WEAPON OR PLOUGHSHARE?

The deployment of nuclear weapons by the United States of America during World War II served, in my view, as a spectacular — and hopefully unique — milestone in the history of human civilization. In 1945, for the first time in history, a small group of scientists and engineers succeeded in developing and applying a technology to unleash the awesome power of nuclear energy in the form of a weapon with immense destructive power. Also for the first time in the history of humankind, a small group of people at the top level of a national government decided to deploy such a terrible weapon of mass destruction to defeat their enemy, with devastating results. The enormous heat and the tremendous nuclear radiation released by the explosions devastated both of the target cities of Hiroshima and Nagasaki, and posed serious risks to human health and the environment for many years to come. As a result, the Japanese Government was left with no choice but to submit an unconditional surrender to the Allied Forces, thus putting a sudden end to World War II.

Looking back 53 years in history, to 1953, Eisenhower, then the President of the most powerful country on earth, the United States of America, startled the whole world, friends and foes alike, with his visionary, moving and compassionate address to the 470th Plenary Meeting of the United Nations General Assembly in New York, which later became known as the 'Atoms for Peace' speech. In this address, Eisenhower stated that: "The United States would seek more than the mere reduction or elimination of atomic materials for military purposes. It is not enough to take this weapon out of the hands of the soldiers. It must be put into the hands of those who will know how to strip its military casing and adapt it to the arts of peace". As a great soldier and seasoned army general with proven success on the battlefield during World War II, Eisenhower was gravely concerned about the proliferation of nuclear weapons among the victorious countries — France, the Soviet Union and the United Kingdom. This trend, if unchecked, could pose a serious threat to humankind and the earth as a whole. He expressed his sincere desire, not only for the total abolition of nuclear weapons, but also for the use of nuclear energy solely for the prosperity of humankind. This desire is reflected clearly in his closing words: "…the United States pledges … to devote its entire heart and mind to finding the way by which the miraculous inventiveness of man shall not be dedicated to his death, but consecrated to his life". These are strong words and a clear message. Indeed, in my view, Eisenhower was a great man of extraordinary character, a soldier of courage but full of human love, a leader with a great vision and mission, a shining example that should be followed by all those holding powerful leadership positions in the world today!

How does the 'nuclear world' look today from the point of view of a developing country, 53 years after the famous 'Atoms for Peace' address? On the peaceful development side, I dare believe that Mr. Eisenhower would approve of the progress that has been achieved since 1953. In his address Eisenhower said: "Experts would be mobilized to apply atomic energy to the needs of agriculture, medicine and other peaceful activities. A special purpose would be to provide abundant electrical energy in the power-starved areas of the world".

Following his proposal, the IAEA was established in 1957. Knowledge and the application of nuclear energy for peaceful purposes have increased rapidly, pushed primarily by intensive scientific research and technology development conducted mainly in wealthy and technologically advanced countries. Today, about one sixth of the world's electricity is generated by nuclear power plants, with remarkable increasing trends in the Asia–Pacific region and encouraging signs of a renaissance on the American and European continents. Through bilateral and multilateral international cooperation, especially through technical assistance and cooperation programmes with the IAEA, many countries in the developing world have also derived increasing benefits from the application of nuclear energy in solving their national development problems, such as in the areas of food and agriculture, human health, industrial processes, environmental care and water resources management. Indeed, in this respect, despite the many difficulties and shortcomings, nuclear energy has brought considerable blessings to many parts of the developing world. Nevertheless, in my view, the IAEA and the developed world should still do a lot more to assist these countries to strengthen their efforts towards sustainability, especially in ensuring their long term national energy supply security, in parallel with environmental care. Important issues such as public information and education about the benefits and risks of nuclear energy, nuclear and radiological safety and security, dissemination and preservation of nuclear knowledge, and national capacity building in terms of human resources and scientific facilities need to be adequately addressed and existing problems must be properly solved.

On the non-peaceful side — the military applications of nuclear power — I have reason to believe that Mr. Eisenhower would not be as satisfied with the developments of the past half century. In fact, he would likely be anguished at what some of the powerful world leaders are doing today, including those in his own country, the United States of America. Fifty-three years have passed since Eisenhower announced his noble vision and mission to the assembly of world leaders at the United Nations. In essence, he wanted more than just a world free of nuclear weapons, he wanted to see the world's scientists and engineers working to develop ways and means so that nuclear energy, "this greatest of

destructive forces can be developed into a great boon, for the benefit of all mankind". His message is one of universal fellowship and the desire for fairness, justice and prosperity for all. But today's world is still far from achieving Eisenhower's dream, as forthrightly expressed by one leader from the developing world, Tun Dr. Mahathir Mohamad, former Prime Minister of Malaysia:

> "We are still living in a primitive world. We still subscribe to the killing of people as an instrument of policy. We have descended so low that even a blatant assassination is acceptable. The great powers are spending huge sums of money on perfecting and perfecting again their instruments of murder even as they decry the innovation in their attacks against those who terrify them....There is presently no New World Order, only the Old World Order where might is right and the Devil takes the hindmost". [1]

Against the background of Eisenhower's address and the comments of Tun Dr. Mahathir Mohamad, let me now, again from the viewpoint of a developing country, look at the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), which is a legal basis of the IAEA's international nuclear safeguards system. In its spirit at least, this treaty, with its three pillars — disarmament, peaceful utilization of nuclear energy and non-proliferation — elegantly encapsulates the noble wish, vision and mission of Eisenhower. If rigorously implemented by all States party to it, with the genuine intention of eliminating nuclear weapons, the achievement of a world free of nuclear weapons surely would not be unrealistic. If all existing nuclear weapons could be turned into 'ploughshares' and, at the same time, the concept of possessing nuclear weapons as a military instrument could be rendered obsolete or irrelevant, the peaceful use of nuclear energy would then serve as the central, and finally the sole, pillar of the NPT for the benefit of humankind worldwide. This, in my view, should be the true spirit and the ultimate mission of the NPT, as seen and expected from the perspective of a developing country.

Unfortunately, the noble spirit of the NPT has not materialized in either words, as expressed in the text of the treaty, or deeds, as seen in its implementation. On the basis of the world's nuclear weapon situation on 1 January 1967, the NPT divided the world into two groups: those that already had nuclear weapons, better known as the nuclear-weapon States (NWSs) — China, France, the Soviet Union, the United Kingdom and the United States of America — and those that did not, the non-nuclear-weapon States (NNWSs), constituting the rest of the world. From the beginning, the NNWSs, including almost all the world's developing countries, have been required to give up their sovereign

right to develop nuclear weapons, and yet no binding obligations have been imposed on the NWSs to eliminate theirs.

The NPT requires the NNWSs to conclude comprehensive safeguards agreements (CSAs) with the IAEA within 18 months of becoming a Party to the NPT. Under the banner 'Trust, but verify', these States, in accordance with the IAEA specifications, are obliged to submit initial and annual comprehensive reports, which are later subjected to independent verification by the IAEA. Soon after the discovery of clandestine nuclear weapon activities in Iraq, the CSA was complemented by the additional protocol (AP), which essentially gives the IAEA additional rights to information and inspection access to ensure the correctness and completeness of the States' reports. In parallel, the verification methodology and technology and other related techniques are continually improved and implemented, with the aim of creating 'air tight' blocks to prevent the NNWSs from possessing nuclear weapons.

But what progress has been made in disarmament? Can the 'nuclear genie' be put back into the bottle? Mr. Srinivasan, former Chairman of the Atomic Energy Commission and former Member of the Planning Commission of the Government of India, writes:

> "In recent times, there is weariness to talk about universal nuclear disarmament, dismissing this goal as utopian. Sadly some of the recent actions of the sole super power, the United States, suggest that use of nuclear weapons is contemplated under certain circumstances. Development of new nuclear weapons with special features is being pursued. Recent events have shown that the United States can achieve its global agenda using extremely sophisticated and formidable conventional military prowess". [2]

Considering this comment together with the 'Atoms for Peace' address by Eisenhower and the sentiment of Tun Dr. Mahathir Mohamad, it would not be surprising if some were to interpret the current situation as being one where the NPT and the increasingly sophisticated safeguards verification system are being used by NWSs to retain their nuclear weapon hegemony.

3. NUCLEAR ENERGY AND DEVELOPING COUNTRIES

To get a better understanding of the perspective of the developing world, particularly with respect to nuclear weapons and nuclear safeguards, let me briefly describe some of the basic issues faced by developing countries, in

general, in their efforts to develop and apply nuclear sciences and technology. Nuclear scientists and engineers in the developing world are still generally regarded as belonging to an esoteric group. Their scientific facilities and working environments are generally still far from being adequate, despite the fact that their activities must be performed in a competent manner to reduce the associated safety and security risks to a tolerable level, in accordance with the required international standards. Thus, in my view, the creation and maintenance of an environment conducive to the healthy growth of nuclear energy activities is one of the basic tasks for the strategic thinkers in the developing world. In this context, there are at least three fundamental issues that need to be adequately addressed by developing countries: general nuclear awareness, national political will and government commitment, and national nuclear capacity.

Within developing countries, awareness of the benefits and risks of nuclear energy is generally still confined to those working in government nuclear research institutes or agencies. In Indonesia, for example, the term 'nuclear energy' generally has negative connotations, presumably owing to widespread spread information on the catastrophic consequences of the explosions in Hiroshima and Nagasaki in 1945 and the severe accident at the Chernobyl nuclear power plant in 1986. Thus, the foremost challenge for a nuclear energy programme in a such a country is to effectively and efficiently communicate the benefits and risks of nuclear energy, not only to the public, but also, and more importantly, to the top decision makers in the executive branch (i.e. relevant government sectors) and the legislative branch (members of the central and local parliaments), to the academic community and to potential user groups in the government and the private sector. Here, the bilateral and multilateral cooperation with the IAEA and with technologically advanced countries plays an important role, as experts assigned by these foreign institutions are generally regarded as authoritative, impartial and credible sources of information and expertise.

Inadequate nuclear awareness in the executive (government) and legislative bodies, as in the case of Indonesia, generally leads to hesitation in declaring the firm political will and national commitment that are required. Frequent changes in the social, economic and political environment often lead to changes of national development focuses and priorities, which in turn make it difficult to formulate a consistent set of policies, strategies and programmes on nuclear energy, and to implement them with the required level of funding.

In the case of Indonesia, for example, despite 30 years of intensive and tireless efforts by the BATAN to push the Government to prepare for the introduction of nuclear power, the country so far has not demonstrated the firmness of political will or the commitment required to send an unambiguous signal,

together with concrete practical implications, as to whether or not it will go nuclear! This experience clearly demonstrates that without strong nuclear awareness, it is hardly possible to achieve the required political will and national commitment, which in turn makes it difficult to obtain the necessary political and financial support. The second challenge, therefore, is to persuade the government and legislative bodies to give their political will and support to a long term national nuclear energy programme, and then consistently implement it with adequate political and financial support.

In my view, the most difficult challenge is to develop and use the necessary national nuclear capacity to advance nuclear sciences and technology, on the one hand, and to utilize the acquired or developed technologies, to ensure their nuclear and radiological safety and security, to train and educate the human resources, and to disseminate relevant information to the stakeholders, on the other hand. To accomplish those goals, the country needs to develop adequate legislation, institutions, facilities and human resources.

Based on my experiences and observations in Indonesia, despite intensive technical cooperation with the IAEA and technologically advanced countries, the three challenges mentioned above seem to be still too complex to be successfully overcome in the near future. This is primarily due to the fact that higher priority is constantly being given to other national development programmes as dictated by the social, economic and political situation in the country. Despite many years of efforts spearheaded by nuclear institutions such as the BATAN and BAPETEN, nuclear awareness, political will, and national commitment and support are still far from satisfactory. But without long term planning and a clear vision, followed by a consistent set of policies, strategies and programmes implemented in an integrated and concerted national effort, where the relevant government and legislative agencies, academic and educational institutions and user community consistently work hand in hand for an extended period of time, it is difficult to see how a developing country could succeed in developing and implementing a major nuclear energy programme — such as for the generation of electricity, with its associated supporting industries — on a sustainable basis.

With respect to nuclear weapons, the official policy and strategy of Indonesia have been and remain focused on the achievement of a single mission, namely, to realize the commitment to eliminate nuclear weapons entirely from the earth. As the country with the largest Muslim population in the world — friendly to the Muslim world, to the East and to the West — and as an active member of the Non-Aligned Movement, Indonesia is in principle surrounded by friends. The country thus does not feel any need for such a terrible weapon of mass destruction. In addition, as is generally the case in the developing world, it would also make no sense for Indonesia to have a nuclear

weapon programme, because such a programme would entail enormous costs and efforts, and, in view of the IAEA safeguards, would be very difficult to keep secret.

For these reasons, Indonesia, as a developing and peace loving country, has demonstrated from the beginning its commitment to the genuine spirit and vision of the NPT by setting a shining example with its compliance as a State party to the NPT. It is worth noting that in August 2003, after four years of hard work in cooperation with the IAEA inspectors, Indonesia became one of the first three countries in the world to conclude integrated safeguards with the IAEA. Surely this example should be followed by all other peace loving countries.

4. INTERNATIONAL NUCLEAR SAFEGUARDS AND CHALLENGES

Having briefly presented a view of the global progress of human efforts to promote peaceful uses of nuclear energy and to eliminate nuclear weapons, and having briefly described the nuclear energy situation in Indonesia as one typical of a developing country, let me now turn to specific issues concerning international safeguards and the challenges of today. I shall take the viewpoint of Indonesia as an independent and sovereign developing country.

In contrast to the wealthy and technologically developed countries, most countries in the developing world are former colonies that became independent after World War II. They continue to struggle desperately to provide the basic necessities for their people, such as adequate food, clothing, housing and health care. It is also worth pointing out that the majority of the world population, today over 6 billion, lives in this developing part of the world — in Africa, Asia and Latin America. These people still live in poverty, some even in extreme poverty, with average incomes that are only a small percentage of those in the developed world — despite the fact that many of these countries are endowed with an abundance of natural resources. Political independence alone is apparently not a sure ticket to the expected blessings of justice and prosperity. From the start, the leaders of the newly born countries have been confronted with enormous challenges, both internal and external, in ever tougher and more complex regional and international competition.

Viewed from this perspective, the reason why the leaders of a developing State or non-State actors would want to possess nuclear weapons is not clear. I am convinced that these countries or individuals, in their own thinking and logic, must have very strong reasons for doing what they are doing. I am convinced that the motivation for the possession and reckless use of nuclear or

radiological weapons will remain as long as humankind fails to adequately address and eliminate the root causes of the extreme actions of those State or non-State actors. In this context, strengthening security and safeguards worldwide would involve huge costs and efforts, but would surely fall short of accomplishing the mission.

In the above context, it should be added that, since a greater number of nuclear weapons increases the chances of their inadvertent or reckless use by a small group of people in power, it is indeed difficult to understand why the majority of people in any country, in the developing or developed world, would continue to tolerate their government's developing or clinging to these terrible weapons. Indeed, nuclear weapons and nuclear weapon material should be eliminated without delay, as this would also give an absolute assurance that they would never fall into the wrong hands.

4.1. First challenge: Shifting the prevailing unfair paradigm

For nuclear weapons and nuclear safeguards, the first, and most difficult, challenge, in my view, is to identify how world leaders can replace the prevailing paradigm — "nuclear weapons only for the few, not for others" — with a new one based on Eisenhower's vision, namely, "ban nuclear weapons from the planet earth, and turn existing ones into ploughshares". There should be a new emphasis on 'win–win' approaches undertaken in a genuine spirit of fair play, for the common safety, security and prosperity of all human beings. In my view, the challenge of shifting the prevailing paradigm to one that is more fair needs to be addressed first and urgently, as this is crucial for the sustainable success of other efforts.

4.2. Second challenge: Removing or reducing the prevailing discrimination

In principle, the NPT places heavier moral burdens on the shoulders of the NWSs. These States are morally obliged to dismantle all existing nuclear arsenals (i.e. disarmament), in addition to the universal requirement to refrain from nuclear proliferation, horizontal and vertical. Had humankind acted rigorously in this spirit, the world could have been free of nuclear weapons a long time ago.

The reality, both in words and in deeds, so far has not reflected the true spirit of the NPT. The NNWSs, in my judgement, have been discriminated against in two ways. First, with respect to non-proliferation, these States are obliged to accept inspections on all their nuclear installations, whereas the 'nuclear haves' are exempted from this obligation. Second, with respect to

nuclear disarmament, the NWSs are left to their own discretion, without a time frame, without a watchdog, without transparency or means of verification.

Increasing pressure has been placed on the NNWSs to become party to the NPT and conclude the complete package of safeguards agreements with the IAEA (a CSA and an AP), and more and better methodologies and techniques are being developed and applied to ensure non-proliferation in these NNWSs. At the same time, however, complaints and proposals from the NNWSs on implementation of disarmament, as reflected inter alia in the previous NPT Review Conferences, have not succeeded in effecting significant changes in the attitude of the NWSs.

The related challenge to the international nuclear safeguards would be, in my view, to find ways and means to provide the IAEA, with all the resources available to it, with the mandate to serve as the 'global non-proliferation watchdog'. The motto "Trust, but verify" under the same or similar terms and conditions of the CSA and the AP should apply equally to NNWSs and NWSs. On the non-proliferation issue, this would put the NNWSs and the NWSs on the same footing and, at the same time, would constitute a credible, competent and independent mechanism to prevent both horizontal and vertical proliferation. Furthermore, it would also be highly desirable to give the IAEA, as a start, a mandate to take stock of existing nuclear weapon arsenals. This information could then serve as a concrete and transparent basis for a complete and time-bound disarmament under the 'watchful eyes' of the IAEA.

4.3. Third challenge: Universalizing the CSA and the AP

Correct and complete information on the absence of 'nuclear weapon activities' in any Member State can only be acquired through the IAEA safeguards verification mechanisms after the State in question has concluded a CSA and an AP with the IAEA. In this connection, there are, in my view, two basic challenges to international nuclear safeguards. The first is persuading all the States party to the NPT to conclude a complete package of safeguards agreements with the IAEA — that is, both a CSA and an AP. One constructive way would be for the IAEA — preferably with the help of the NWSs — to apply a 'carrot and stick' strategy. Special for the developing world, those countries demonstrating good compliance could, for instance, be granted extra assistance in their nuclear power programmes by the IAEA. The second challenge would be to find attractive incentives to get those countries that are still outside the NPT, with or without joining the NPT, to conclude a CSA and an AP or similar arrangements with the IAEA.

4.4. Fourth challenge: Further improving the detection and verification technology

Last but not least, it is obvious that new ways of improving the existing methodology and technology of detection and verification should be continuously sought. However, in view of the rapid progress in science and technology, the increasing sophistication of information technology, and the changing focus and priorities in the economic, political and defence interests of countries or blocs of countries in the international arena (e.g. as reflected in the reversal of the US policy towards India), improvements in the detection and verification techniques and instrumentation alone will not suffice to effectively curb nuclear proliferation on the global scale. History teaches a good lesson: just as some countries have succeeded in developing nuclear weapon arsenals from the expertise acquired from NWSs, other countries or non-State groups could, in principle, acquire nuclear weapons from those that already have them. The world seems to be getting smaller every day, and the boundaries between countries have practically disappeared. Consequently, as long as the motivation of State or non-State actors to possess nuclear and radiological weapons remains strong, illicit trafficking of nuclear material, technologies and other related materials and equipment is bound to take place, despite the expected worldwide improvements in export and import controls. The reason is very simple: in the words of an old Minangkabau proverb, "The gun may be improved and polished indefinitely, but if it is not used by the right person with the right intent, the thieves can flee in glee".

5. CONCLUDING REMARKS

In conclusion, along with the vision of President Eisenhower, let me quote the words of Mr. Tadatoshi Akiba, the Mayor of Hiroshima: "The abolition of nuclear weapons is no less important than the abolition of slavery….We are fighting the idea that a small group of men should have the capacity to launch Armageddon….Our immediate objective is the elimination of nuclear weapons, but our long-term vision is a 'spiritual home for all people'. We need this planet to be filled not with weapons of mass destruction but with compassion" [3].

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THE ADDITIONAL PROTOCOL AND INTEGRATED SAFEGUARDS: IMPLEMENTATION IN THE EUROPEAN UNION — THE EXPERIENCE OF THE IAEA

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1. INTRODUCTION

Derived from the IAEA Statute, the purpose of IAEA safeguards is to verify that States are complying with their commitments made under safeguards agreements with the IAEA. To this end, the IAEA draws independent, timely and soundly based conclusions about the non-diversion of declared nuclear material and, if an additional protocol is in force or being otherwise applied, about the absence of undeclared nuclear material and activities in the State as a whole. As reported in the Safeguards Statement for 2005, as of 31 December 2005, 70 States had both a comprehensive safeguards agreement (CSA) and an additional protocol in force or being otherwise applied. Twenty-five Member States of the European Union (EU) were among the 70 States. Fifteen of the non-nuclear-weapon States (NNWSs) in the EU had acceded to the multilateral safeguards agreement with the European Atomic Energy (Euratom) Community and the IAEA, and two European nuclear-weapon States (NWSs) had a voluntary offer safeguards agreement and an additional protocol in force. Eight of the accession States of the EU still had a CSA with an additional protocol in force that was concluded bilaterally with the IAEA. Table 1 shows the status of the safeguards agreement in force for each of the EU Member States as of 31 May 2006.

Under a CSA pursuant to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), the IAEA has the right and obligation to ensure that safeguards are applied, in accordance with the terms of the agreement, to all source or special fissionable material in all peaceful nuclear activities within the territory of the State, under its jurisdiction or carried out under its control anywhere, for the exclusive purpose of verifying that such material is not diverted to nuclear weapons or other nuclear explosive devices in contravention of the safeguards agreement [1].

TABLE 1. STATUS OF SAFEGUARDS AGREEMENTS CONCLUDED IN EU STATES (AS OF 31 MAY 2006)

EU State	Comprehensive safeguards agreement in force (as of 31 May 2006)	AP in force since	SIR year in which broader safeguards conclusion was drawn for the first time	State level integrated safeguards approach in force since	Remark
UK	INFCIRC/263	2004	Not yet drawn		NWS, NS
France	INFCIRC/290	2004	Not yet drawn		NWS, NS
13 EU NNWSs[1]	INFCIRC/193	2004	Not yet drawn	SLAs are under preparation at different stages in each State	NNWS, Austria, Finland and Sweden are NS, others are side letter States
Estonia	INFCIRC/193	2005	Not yet drawn	SLA under preparation	AS, NNWS
Slovakia	INFCIRC/193	2005	Not yet drawn	SLA under preparation	AS, NNWS
Hungary	INFCIRC/174	2000	2002	Dec 2004	AS, NNWS, NS
Slovenia	INFCIRC/538	2000	2002	Nov 2005	AS, NNWS, NS
Poland	INFCIRC/179	2000	2003	Jan 2006	AS, NNWS, NS
Lithuania	INFCIRC/413	2000	2003	SLA under preparation	AS, NNWS, NS
Latvia	INFCIRC/434	2001	2003	SLA under preparation	AS, NNWS, NS
Czech Republic	INFCIRC/541	2002	Not yet drawn	SLA under preparation	AS, NNWS, NS
Cyprus	INFCIRC/189	2003	Not yet drawn	SLA under preparation	AS, NNWS, SQP, NS
Malta	INFCIRC/387	2005	Not yet drawn	SLA under preparation	AS, NNWS, SQP, NS

Note: AP = additional protocol, AS = EU accession State, NNWS = non-nuclear-weapon State, NWS = nuclear-weapon State, NS = non-side letter State, SIR = Safeguards Implementation Report, SLA = State level approach, SQP = small quantities protocol.

[1] Austria, Belgium, Denmark, Finland, Germany, Greece, Italy, Ireland, Luxembourg, the Netherlands, Portugal, Spain, Sweden.

For a State to meet its obligation under a CSA with an additional protocol in force, the IAEA must be able to draw the conclusion that all nuclear material in the State remained in peaceful activities. This so-called broader conclusion is reached by drawing conclusions regarding the non-diversion of declared nuclear material and the absence of undeclared nuclear material or activities in the State as a whole. To this end, the IAEA carries out a comprehensive evaluation of the results of its verification activities under the relevant safeguards agreement and additional protocol, and of the findings from its analysis of all information available about a State's nuclear and nuclear related activities. The conclusion relating to the absence of undeclared nuclear material and activities can be drawn for a State only when these activities have been completed and the IAEA has found no indication that, in its judgement, would give rise to concern regarding possible nuclear proliferation.

Once the IAEA has drawn this broader safeguards conclusion for a State, its activities under the CSA and additional protocol are streamlined, and a State level integrated safeguards approach is established and applied. Such an approach is developed on a non-discriminatory basis, using safeguards verification objectives common to all States with a CSA and an additional protocol in force. The approach also takes State specific features into account, such as the effectiveness of the State (or regional) system of accounting for and control of nuclear material (SSAC/RSAC) and the features of the State's nuclear fuel cycle.

2. LEGAL FRAMEWORK FOR IAEA SAFEGUARDS IMPLEMENTATION IN THE EU: A CHRONOLOGY

In 1957, in Rome, six European States (Belgium, France, Germany, Italy, Luxembourg and the Netherlands) signed the Treaty Establishing the European Atomic Energy Community (Euratom). In particular, Euratom was established mainly to promote research and development (R&D) in the use of atomic energy for non-military purposes and to ensure that nuclear material would not be used to manufacture nuclear weapons. In the 1970s, Denmark, Ireland and the United Kingdom joined Euratom. In 1973, the NNWSs of the European Community and Euratom concluded a safeguards agreement with the IAEA pursuant to the NPT (INFCIRC/193 [2]). This agreement provides that the IAEA, Euratom and the NNWSs party to the Treaty shall cooperate to facilitate the implementation of safeguards while avoiding duplication of safeguards activities. To this end, the agreement has a protocol that deals with several aspects of cooperation between the IAEA and Euratom. The agreement came into force in 1977. The two NWSs — the United Kingdom and

France — concluded separate voluntary offer safeguards agreements with Euratom and the IAEA (INFCIRC/263 [3] and INFCIRC/290 [4], respectively). In 1981, Greece became the tenth member of Euratom, followed by Spain and Portugal in 1986 and by Austria, Finland and Sweden in 1995; the Euratom membership then comprised 15 States.

In 2004, the addition protocol for the 13 NNWSs entered into force, as did the modified additional protocol for France and the United Kingdom. (Additional protocol measures applied in a NWS focus mainly on information provided with respect to nuclear material and activities that have linkages to NNWSs.) In December 2005, Estonia and Slovakia acceded to the safeguards agreement (INFCIRC/193), as did Slovenia in September 2006. The additional protocols and the safeguards agreement (INFCIRC/193 and additions) for 16 NNWSs and that for all other EU Member States are the legal basis for implementing safeguards in the EU.

As provided for in the text of the additional protocol for the EU Member States, ten of the NNWSs have delegated implementation of certain provisions of the additional protocol to the European Commission of the European Communities (EC) through side letters ('side letter States'), whereas three other 'non-side letter States' (Austria, Finland and Sweden) have not done so. In 2004, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia also joined the EU. At the time of joining, all ten accession States had in force individual CSAs with the IAEA, seven of them including an additional protocol. Eventually, all of the EU accession States will accede to the safeguards agreement (INFCIRC/193) and will exercise the option to delegate, or not delegate, certain responsibilities regarding provisions of the additional protocol to the EC.

In 2002, the IAEA drew the broader safeguards conclusion for Hungary and Slovenia and in 2003, for Poland, Lithuania and Latvia. In 2004, it reaffirmed the conclusions for all of these States and began implementing integrated safeguards in Hungary and Slovenia based on their State level approach (SLA). Since March 2006, an SLA has been in force in Poland. At the end of 2005, all EU Member States had an additional protocol in force, and for five States (Hungary, Latvia, Lithuania, Poland and Slovenia) the IAEA had drawn the broader safeguards conclusion for each State prior to its accession to the EU.

Table 1 shows the status with respect to safeguards agreements, additional protocols and the implementation of State level integrated safeguards in the EU as of May 2006.

3. IAEA AND EC COOPERATION FOR SAFEGUARDS IMPLEMENTATION FOR NNWSs PARTY TO INFCIRC/193

Negotiations between the IAEA, Euratom and five NNWSs of the then European Community regarding a safeguards agreement pursuant to the NPT began in 1971. Although the agreement (INFCIRC/193 [2]) was signed by both organizations and the five NNWSs in 1973, it entered into force only in 1977 after protracted and difficult exchanges between the IAEA and Euratom.

When the IAEA and Euratom began implementing safeguards in the NNWSs of the then European Community, there was friction between the two organizations and unnecessary duplication of verification activities occurred. In 1979, both organizations agreed to use 'observation' and 'joint team' arrangements for inspecting nuclear installations. It was expected that the joint team regime would obviate unnecessary duplication of work while permitting each organization to reach its goals. In reality, duplication of effort continued because the safeguards agreement required that IAEA inspectors perform independent verification activities while simultaneously observing the activities of the EC inspectors. In practice, both Euratom and the IAEA performed their activities with the aim of verifying States' compliance with their nuclear non-proliferation commitments.

In 1991, a joint Euratom–IAEA working group recommended discontinuing the observation and joint team arrangements and initiating a new partnership approach to enable both the IAEA and Euratom to meet their responsibilities under INFCIRC/193 in the most effective and efficient manner. The group also recommended the re-evaluation of the role of the Liaison Committee that had been created under the agreement and its relationship to its subsidiary bodies. On 28 April 1992, the EC Commissioner for Energy, Mr. Cardoso e Cunha, and IAEA Director General Hans Blix endorsed the recommendations of the working group and signed the New Partnership Approach (NPA).

Through the NPA, the observation and the joint team regimes were replaced by cooperation arrangements, namely, 'one-job, one-person', which would allow each organization to draw its own independent safeguards conclusions. The two organizations also agreed to develop common safeguards approaches, inspection procedures, activities, use of instruments, methods and techniques. In addition, both organizations agreed to share analytical capabilities, R&D resources, the training of inspectors and the common use of technologies — the latter intended to replace, to the extent possible, the physical presence of the inspectors with equipment working in an unattended mode.

Since 1992, the NPA arrangements have served both organizations and the EU well, and the synergies of Euratom and the IAEA, as expected, have

been largely realized. However, during 2004 and through 2005, while Euratom's safeguards approaches (under the Euratom Treaty) were being reshaped, the support from the EC with respect to providing inspection resources and the supply and maintenance of safeguards equipment declined. Unfortunately, there was a noticeable drop in the level of support for the maintenance and replacement of joint use equipment, particularly surveillance systems.

In May 2005, following a meeting held between IAEA Director General M. ElBaradei and A. Piebalgs, Commissioner for Energy of the European Commission, the EC reinstituted its support of IAEA inspection activities. In 2005 and 2006, the IAEA held meetings with the EC at the working level to discuss safeguards approaches for specific facility types and continued consultations on the provision and maintenance of joint use equipment. The IAEA is aware that the safeguards system of the EC continues to be a subject of discussion within the Commission and the EU. However, the IAEA continues to effectively implement safeguards agreements and additional protocols in the appropriate EU Member States without interruption.

In April 2004, the additional protocol came into force simultaneously in 15 EU States and the IAEA had to provide resources within a very short period of time in order to prepare for its implementation concurrently.

Currently, the IAEA is implementing safeguards, including the additional protocol, in EU Member States under the legal frameworks mentioned above. In sum, there are two NWSs with voluntary offer agreements and additional protocols, and 23 NNWSs party to INFCIRC/193, Add. 8, or to individual bilateral CSAs with an additional protocol. There are also States with and without a side letter option for delegating certain responsibilities regarding provisions of the additional protocol to the EC; States for which broader safeguards conclusions have been drawn or have yet to be drawn; and States with and without State level integrated safeguards approaches in place.

4. IAEA EXPERIENCE IN ADDITIONAL PROTOCOL IMPLEMENTATION IN THE EU

In accordance with Article 25 of the Protocol of INFCIRC/193 [2], the IAEA/Euratom Liaison Committee reviews the performance of safeguards implementation in the EU on a senior management level (the High Level Liaison Committee) and deals with the details of implementation by assigning this task to the Low Level Liaison Committee. The traditional structure of the two committees, particularly the Additional Protocol Working Group, has

proved important for cooperation with the IAEA in implementing the additional protocol.

Before the additional protocols entered into force in the EU, Finland and the Netherlands volunteered to participate in tests for the preparation of expanded declarations and in conducting complementary access trials at the end of the 1990s. Performance of complementary access activities was simulated on the basis of both 2 and 24 h advance notification. The EC support provided at that time was highly appreciated by the IAEA. A few years later, Finland and Hungary, and more recently also the United States of America, offered support to the IAEA in arranging training for IAEA inspectors on complementary access at nuclear sites and locations in their countries.

In October 2004, the EU Member States party to INFCIRC/193 and the EC submitted their first expanded declarations, under Article 2 of the Model Additional Protocol [5]. The IAEA reviewed the declarations, and analysed and evaluated the information for consistency, correctness and completeness. In addition, the IAEA has reviewed and evaluated the majority of responses to more than 350 of its requests for clarification that were made under Article 2.c of the Model Additional Protocol [5]. In 2005 and 2006, the EU Member States party to INFCIRC/193 and the EC submitted the annual updates of their declarations in accordance with Article 3 of the Model Additional Protocol.

Based on all information collected and analysed, the IAEA performs a safeguards State evaluation. State evaluations are central to the process by which safeguards conclusions are drawn. Safeguards State evaluation and review is a continuous process. Evaluations, conclusions and recommendations for follow-up actions are periodically documented in an internal State evaluation report, which is reviewed by an interdepartmental and multi-disciplinary IAEA committee.

As of the end of 2005, EC inspectors had been present at 45 complementary access visits performed in EU Member States since their additional protocol entered into force. During complementary access, the IAEA made visual observations, utilized radiation measurement devices and took swipe samples. Inspectors from the EC participated in IAEA complementary access activities with no major difficulties, and the EC as well as the EU Member States cooperated closely in providing clarifications. Some issues, such as the use of photography to complement visual observation and inconsistent results of environmental sample analysis for certain nuclear sites and locations, are still being resolved. The IAEA has requested States to provide explanations about past nuclear activities performed at these nuclear sites or locations.

The IAEA will be able to draw soundly based conclusions on the non-diversion of declared nuclear material and on the absence of undeclared nuclear material and activities for individual EU Member States as soon as the

analysis and evaluation of all available safeguards relevant information has been finalized. Drawing the broader conclusion that all nuclear material placed in peaceful activities for one of the NNWSs still requires the analysis and evaluation of findings of more complementary access activities that will be performed over the coming years. It is expected that the IAEA will draw the broader conclusion for some of the EU Member States with small scale or no significant nuclear activities by 2007.

5. NEW SAFEGUARDS FRAMEWORK IN THE EU

The EC has prepared new safeguards approaches for implementing Euratom Treaty safeguards in the EU. It is hoped that the EC will soon discuss, at an appropriate level, the approaches with the IAEA so that the coordination of activities by both organizations can be established. In April 2006, the EC prepared and distributed to Member States a document entitled "Implementation of the Euratom Treaty Safeguards". The document outlines the new framework for Euratom safeguards, which focuses on the audit of the quality and performance of the system of nuclear material accounting and control used by facility operators, supplemented by reduced and selected on-site verifications. In May 2005, the EC confirmed that it intends to develop new cooperation arrangements with the IAEA but that in the meantime it will continue to be present during each IAEA inspection and provide the necessary support. A revised Cooperation Arrangement, if established, would be a legally binding document, like the NPA, and would have to be approved by the parties to the safeguards agreement. This would help to avoid any repetition of the decline in the EC's participation in inspection activities as well as the deterioration of support for equipment supply and maintenance that occurred during the past two years.

The IAEA cannot revert to a pre-NPA situation. The IAEA's ability to draw independent safeguards conclusions not only at the facility level but also at the State level needs to be maintained and strengthened. The IAEA will use its standard procedures for the resolution of anomalies and for periodic remeasurement of nuclear material kept under successful containment and surveillance (C/S) measures. The IAEA needs enhanced cooperation as well as direct and parallel communication with the facility operators and State representatives. The new framework for Euratom safeguards still requires discussion of important issues between the IAEA and the EC.

6. IMPLEMENTATION OF INTEGRATED SAFEGUARDS IN EU ACCESSION STATES

In 2005, further progress was made in strengthening the effectiveness and improving the efficiency of IAEA safeguards in several areas, such as the implementation of integrated safeguards, the development of safeguards approaches, procedures and technologies, and cooperation with SSACs/RSACs. On 30 April 2004, when additional protocols entered into force in 15 EU Member States, additional protocols were already in force for 7 of the 10 new accession States. In 2005, the IAEA performed 14 complementary access visits in new accession States. State level integrated safeguards so far have been implemented in Hungary, Slovenia and Poland and will be implemented shortly in Latvia and Lithuania. The savings in inspection effort realized by the IAEA under integrated safeguards compared with traditional safeguards depend primarily on the number and type of nuclear facilities and the inventory and flow of nuclear material in a State.

Arrangements for short notice random inspections (SNRIs), including the setup of a mailbox system for submission of accountancy data, were discussed with each State, and appropriate procedures were established. Measurement systems working in an unattended mode, complemented with surveillance, remote monitoring and remote data transmission options, were taken into consideration to improve the efficiency and effectiveness of IAEA safeguards. Member States of the EU such as Hungary, Poland or Slovenia could serve as models for the implementation of State level integrated safeguards in other EU Member States.

7. IAEA VISION OF SAFEGUARDS IMPLEMENTATION FOR NNWSs OF THE EU

The NPA has proved its necessity and should remain in place until the EC, the IAEA and the relevant EU Member States have agreed on revised cooperation arrangements.

The EC's new framework for safeguards should be introduced gradually to ensure that there is no loss of safeguards effectiveness in the EU. Inspectors from the IAEA should be able to carry out the necessary activities as required, in accordance with the IAEA safeguards criteria and guidelines for drawing safeguards conclusions with regard to the non-diversion of declared nuclear material and the absence of undeclared nuclear material and activities in each of the NNWSs of the EU.

Technical cooperation between the IAEA and the EC should be maintained, particularly with respect to the procurement of safeguards equipment and supplies, and equipment maintenance.

As the IAEA is rapidly moving towards integrated safeguards implementation in all EU States, it will streamline its activities and enhance its safeguards activities through the increased use of safeguards schemes such as SNRIs with mailbox provision of operational data of the relevant facilities, remote monitoring of safeguards data generated by installed C/S systems or measurement devices and complementary access activities. When implementing SNRIs and complementary access, which are essential elements of integrated safeguards, the IAEA will require exceptional flexibility on the part of the EC facility operators and State authorities regarding the scheduling of inspections and the provision of inspectors with prompt access to nuclear sites and other locations. In this respect, direct and parallel communication with the facility operators or facility based safeguards officers will be of high importance in maintaining the IAEA's independence in drawing safeguards conclusions.

For those EU Member States that do not yet have an SLA in force, the process of strengthened safeguards implementation continues. As soon as the broader conclusion can be drawn for an individual EU Member State, an appropriate SLA will be implemented.

8. SUMMARY

For the next few years, the IAEA will face the challenge of implementing safeguards in the EU under a variety of legal frameworks. It has the difficult tasks of evaluating States' nuclear programmes (some with a history of intentions towards nuclear weapon development programmes), of drawing soundly based conclusions on the non-diversion of declared nuclear material and on the absence of undeclared nuclear material and activities, and of implementing integrated safeguards in all of the (currently) 23 NNWSs of the EU. These processes will also incorporate the evaluation of the information provided by France and the United Kingdom under their additional protocols.

Thus far, the IAEA has experienced no major difficulties in the implementation of additional protocols in the EU Member States, including in the new accession States. It is expected that outstanding issues will be resolved in due course. The quality of the additional protocol declarations has been acceptable. Requests by the IAEA for clarifications and amplifications sent to States have been responded to positively. The States have cooperated in arranging complementary access with 2 or 24 h advance notification and in providing additional information whenever required. Some States have

provided assistance and support with respect to IAEA inspector training on complementary access activities. All this has been possible only through close cooperation between the staff of the IAEA and the EC.

However, the implementation of integrated safeguards in EU Member States imposes certain difficulties because of the complex and diverse nuclear fuel cycle structure. In order for the IAEA to be able to draw broader conclusions for individual EU Member States and to annually reaffirm these conclusions under an integrated safeguards regime (including the conclusion regarding the absence of undeclared nuclear material and activities in each EU Member State), it is essential to ensure complete independence of the IAEA in conducting its verification activities. In addition, there must be direct and parallel communication with State representatives and facility operators, and flexibility in scheduling routine inspection activities, in particular SNRIs and complementary access.

The IAEA remains ready to discuss possible changes to its cooperation arrangements with the EC, noting that any move away from the NPA should be made only after agreement has been reached on arrangements that would give full consideration to the operational and financial issues necessary for ensuring that safeguards continue to be implemented effectively and efficiently. Integrated safeguards implementation for EU Member States has been possible and successful through the dedicated efforts of the staff of the IAEA and of all parties involved.

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THE SAFEGUARDS REVOLUTION: CONTRIBUTIONS AND PERSPECTIVES OF THE STANDING ADVISORY GROUP ON SAFEGUARDS IMPLEMENTATION*

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1. INTRODUCTION

It is no exaggeration to describe the ongoing changes to the IAEA safeguards system as revolutionary. In the past decade, safeguards have moved from a relatively routine system operating in a seemingly benign environment to a system undergoing radical change, having to reinvent itself to respond to major challenges. The process of revolution needs to be ongoing. The conceptual framework for the new safeguards system has been developed, but this framework has to be consolidated through new implementation practices. There is much more to be done if the safeguards system is to be successful in meeting current and future challenges.

The traditional comprehensive safeguards system was introduced in the early 1970s, following the conclusion of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). The rationale underlying the safeguards system then was very different from that of today. At that time it was thought that proliferation would require diversion of safeguarded nuclear material and misuse of safeguarded nuclear facilities. It was considered beyond the capability of most States to establish a wholly clandestine nuclear fuel cycle, independent of safeguarded nuclear material and facilities. Thus it was thought that an

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effective system was a matter of applying suitably rigorous safeguards procedures to declared material and facilities.

During the 1970s and 1980s, the traditional safeguards system developed in conditions of apparent stability, where the main challenge was seen as resource allocation — how to manage a steadily growing workload with a relatively static budget. During this period the traditional safeguards system developed, with emphasis on nuclear materials accountancy and on verifying the correctness of declared nuclear material inventories. The organizational culture developed around the use of quantitative and relatively mechanistic procedures. This culture was reinforced through a particular policy perspective, specifically, that avoiding discrimination required uniformity in safeguards implementation.

Yet this apparent stability proved to be dangerously misleading. Beneath the surface, clandestine nuclear programmes remained unrecognized and undetected. By the time of its discovery, following the 1991 Gulf War, Iraq's clandestine nuclear programme had been growing for over a decade undetected by safeguards. The discovery of this programme prompted a review of the safeguards system to identify ways and means of strengthening it.

Today it is recognized that the greatest single safeguards challenge is the detection of undeclared nuclear materials and activities. In IAEA terms, this is expressed as requiring that safeguards should provide assurance of the completeness as well as the correctness of States' declarations. The development of new methods, approaches and technology — and a new safeguards culture — is needed to respond to this challenge.

In contrast to the previous uniformity, the new safeguards are underpinned by a State level approach (SLA), designing safeguards implementation to address the acquisition paths available to each State and other State specific factors. At the same time, new techniques and detection technologies are being developed. Verification activities directed at the possibility of undeclared activities are being developed, reflecting new ways of thinking. The SLA, coupled with the broadening of available verification measures and techniques, will require greater adaptability at the implementation level — more options will be available to inspectors, and there will be less emphasis on routine inspection activities and much more emphasis on observation skills.

A significant revolutionary aspect of safeguards development is the enhanced use of expert judgement in drawing safeguards conclusions. Conclusions about the absence of something (e.g. undeclared nuclear materials and activities) can never be as definitive as conclusions based on quantitative methods applied to a finite problem — the verification of a declared inventory. For the new safeguards conclusions to be credible, a number of conditions need to be satisfied: that States understand the process for looking for indicators of

undeclared activities and accept it as appropriate; that States are satisfied that the process is being applied at the requisite standard; and that States are satisfied that judgements are exercised and conclusions drawn in a suitably disciplined, non-discriminatory way. All of this involves new approaches compared with the traditional quantitative system, including analysis of a broader range of information, and a quality assurance system to ensure appropriate standards of implementation and decision making.

The Standing Advisory Group on Safeguards Implementation (SAGSI) comprises a group of safeguards experts — currently numbering 18 — appointed by the Director General to advise him on safeguards implementation issues. SAGSI was founded in the mid-1970s, following the establishment of the safeguards system set out in INFCIRC/153. In the early years, among other things SAGSI was instrumental in developing safeguards design parameters such as the 'significant quantity', establishing timeliness goals and developing the format for reporting on safeguards performance in the Safeguards Implementation Report (SIR). Following the 1991 Gulf War, SAGSI, in collaboration with safeguards technical experts both within and outside the Secretariat, helped to develop the strengthened safeguards measures in 'Programme 93+2'. These ideas and concepts for the strengthened safeguards system eventually led to the implementation of the 'Part I' and then the 'Part II' measures of the additional protocol. SAGSI has also played a significant role in working with the Secretariat to conceptualize and develop integrated safeguards facility approaches as well as the SLA.

The sections that follow touch on SAGSI's recent contributions to the safeguards revolution, describe more fully some key concepts that underlie the continuing safeguards revolution and outline SAGSI's views on the further development of the safeguards system.

2. SAGSI'S REVIEW OF THE SAFEGUARDS CRITERIA

A major characteristic of traditional safeguards has been uniformity in implementation: essentially the same inspection activities were applied at similar facilities in different States, with limited differentiation between States. As a consequence, inspection efforts were concentrated in those States with the largest fuel cycles. While some considered such a situation to be the price for a technically based, non-discriminatory system, many others considered that the allocation of safeguards efforts that had evolved represented an inefficient use of scarce resources, particularly as none of the States accounting for the greater proportion of the safeguards efforts was considered to pose a significant proliferation risk.

Though in recent years the concentration of inspection resources in the three States accounting for the largest proportion of these resources has eased, for many the perception remains that traditional safeguards are inherently inefficient, because they do not provide a mechanism for prioritizing safeguards efforts in areas considered to present the highest proliferation risk. The safeguards criteria — which specify the safeguards activities required at each facility — were seen as a major factor contributing to this situation.

The Secretariat has established safeguards criteria for each type of facility under safeguards. Originally the safeguards criteria were developed to assist in the evaluation of safeguards performance; however, over time the criteria came to specify the scope, the normal frequency and the extent of the verification activities needed to achieve the inspection goals for each type of facility. Thus the criteria were used for planning and implementing verification activities as well as for evaluating the results from them. This resulted in a number of rigidities being built into the safeguards system.

In 2003 the Secretariat sought a substantial increase in the IAEA's budget, particularly for the implementation of safeguards. In the context of the debate over this increase, the Board of Governors' Programme and Budget Committee called for: "A review of the modernization and the flexibility and cost-effectiveness of safeguards working methods …. The aim of this exercise shall be to enhance the effectiveness and efficiency of the IAEA's safeguards system, while maintaining its credibility."

At the time of the Board of Governors' approval of the budget increase, and in response to the above call, the Director General stated that the Office of Internal Oversight Services would evaluate the effectiveness and efficiency of the safeguards programme, while SAGSI would be asked to undertake a specific technical review of the safeguards criteria. The Director General stressed that the primary driving force in the IAEA's verification work must always be effectiveness and objectivity.

Accordingly, the Director General asked SAGSI to review the role, structure and content of the IAEA's safeguards criteria, and to make recommendations for any specific changes that would improve the efficiency of safeguards while maintaining the ability of the safeguards system to provide credible assurance of the non-diversion of nuclear material from declared activities and, as appropriate, the absence of undeclared nuclear activities.

The terms of reference for the review asked SAGSI to focus on light water reactors and on-load reactors — including transfers of spent fuel from such facilities — and research reactors/critical assemblies. In addition, SAGSI looked at storage facilities, with particular reference to spent fuel storage, and fuel fabrication facilities. Collectively, these various facilities accounted for

some 78% of the IAEA's inspection effort (as measured in person-days of inspection).

The review of the role and structure of the safeguards criteria required SAGSI to go beyond the facility types referred to in the terms of reference and to examine a number of generic issues, such as new processes and documentation for integrated safeguards. In addition, SAGSI examined a number of 'cross-cutting' issues, that is, issues affecting a number of facility types.

Although SAGSI focused particularly on efficiency issues, efficiency and effectiveness are not mutually exclusive, and SAGSI has recommended a number of efficiency improvements that would also result in increased effectiveness.

In carrying out its review, SAGSI identified key concepts and principles that should remain substantially unchanged under either traditional or integrated safeguards, areas where flexibility would be possible in appropriate circumstances and factors to be considered in recommending any changes to safeguards criteria/approaches. These concepts and principles include the following:

— Nuclear materials accountancy will remain a safeguards measure of fundamental importance.
— Safeguards measures should cover all plausible acquisition paths.
— Where an acquisition path involves declared nuclear material or facilities, detection of diversion is not to be solely dependent on verification activities relating to the undeclared segments of the acquisition path.
— The benefit of unpredictable (i.e. to the State/operator) inspections and verification activities.
— The importance of the IAEA being able to reach independent safeguards conclusions.

Another key principle is the essential contribution of inspector presence to safeguards effectiveness, which is discussed below.

During the criteria review, SAGSI discussed and debated at length topics ranging from the arcane details of safeguards approaches at specific facility types to new, and in some cases radical, concepts for safeguards planning, implementation and evaluation. It is the new ideas and concepts, and where they might take the safeguards system in the future, that are the focus of the remainder of this paper.

3. THE NEW IDEAS: FURTHERING THE REVOLUTION

SAGSI found that the safeguards criteria remained broadly appropriate for the circumstances of traditional safeguards, but recommended a number of efficiency improvements, including:

— Greater use of unattended and remote monitoring technologies;
— Different ways of achieving timeliness, including randomized inspections;
— The importance of unpredictability through random/unannounced/short notice inspections.

SAGSI concluded that a criteria driven approach is not appropriate for integrated safeguards. Instead, the basis for safeguards implementation should be an SLA developed and documented for each State. New processes should take the place of the criteria — SAGSI recommended giving effect to the SLA through an annual safeguards implementation plan, supported by what SAGSI termed 'inspector instructions'.

While the safeguards objectives remain similar for all States, SLAs are intended to reflect the optimal combination of safeguards measures for each State, taking into account State specific factors and adjusting safeguards intensity accordingly, for example, through specifying selected safeguards measures and the facilities to be inspected.

SAGSI recommended against using 'criteria' in integrated safeguards. In place of the safeguards criteria, SAGSI advised the Secretariat to develop an SLA for each State, an annual safeguards implementation plan (AIP) for the State and operational level documents setting out the activities for meeting the verification objectives for facilities selected for inspection (and, where appropriate, providing choices of means of meeting the objectives). In subsequent discussions with the Secretariat, it was agreed that the AIP, giving effect to the SLA, would provide the basis for safeguards planning, implementation and evaluation. The AIP and the operational level documents would serve the function of the inspector instructions that SAGSI had proposed.

SAGSI emphasized that it was essential to avoid carrying over to integrated safeguards the rigidities found in traditional safeguards. Appropriate adjustments must be made for State specific factors; otherwise, safeguards efforts under integrated safeguards will ultimately be determined, as with traditional safeguards, mainly by quantities of material and numbers of facilities.

Although SAGSI highlighted the need to move away from uniform application of safeguards, it also drew attention to the need to ensure IAEA wide standards of effectiveness. Consistency of process is very different from —

and should not be confused with — uniformity of implementation. The traditional safeguards criteria, which specify only one way of applying safeguards implementation parameters, are not appropriate for integrated safeguards, since integrated safeguards involve the optimum combination of measures, requiring selection among possible measures. This, in turn, will require the development of new methodologies for safeguards evaluation, including broadening the range of information that can be taken into account in evaluating nuclear programmes – an area requiring considerable further development.

Since the Criteria Review, SAGSI has continued to work with the Secretariat on the development of the concept and application of the SLA, which has become the foundation for integrated safeguards.

3.1. A State level approach is also important for traditional safeguards

For a State under traditional safeguards, the extent to which State level factors can be reflected in the SLA will be more limited than in the case of a State with an additional protocol in force and for which the IAEA has drawn the broader safeguards conclusion. However, SAGSI concluded that the State level factors set out in INFCIRC/153 paragraph 81 should be considered for all States subject to comprehensive safeguards. Recent experience shows that in making adjustments for State specific factors, the safeguards system must be capable of increasing, as well as reducing, safeguards intensity. As States remaining under traditional safeguards will be the exception rather than the norm, an important aspect of the SLA will be assessing the adequacy of the standard facility level safeguards approaches for such States.

Evaluation for integrated safeguards should not be based on implementation criteria. Instead, evaluation should be based essentially on whether and how the verification objectives specified in the SLA were met, as indicated by the results of the activities carried out under the AIP.

Under traditional safeguards, the safeguards criteria had become associated with a rigid approach both to implementation and particularly to evaluation. The ‘checklist’ approach used for evaluation had also led to a predominantly ‘checklist’ approach to safeguards implementation. A primary objective of evaluation under integrated safeguards is to ensure that safeguards in the State are implemented in accordance with the SLA and the AIP. SAGSI continues to work with the Secretariat to develop and refine evaluation concepts for integrated safeguards.

3.2. Integrated safeguards involve continuing cultural change

The rigidities in traditional safeguards implementation are the result of uniformity — a particular vision of achieving non-discrimination under the conditions of traditional safeguards. Under integrated safeguards, in addition to adaptability in developing SLAs, the broadening of available verification measures will require greater adaptability at the implementation level; more options will be available to inspectors, and there will be less emphasis on routine inspection activities. Verification activities directed at the possibility of undeclared nuclear activities involve new ways of thinking.

Moving from uniform implementation strictly defined by criteria involves moving to a result oriented culture, while upholding non-discrimination values. This will also require greater application of expert judgement and decision making at all stages and levels of safeguards implementation. As discussed, major change is also required in safeguards evaluation.

Achieving substantial change while maintaining the effectiveness, quality and overall non-discriminatory character of safeguards implementation and evaluation is a complex matter that requires the right strategies and management commitment. Change *is* taking place — the IAEA has already made good progress in these directions — but taking the process forward, broadening and accelerating it, will be a continuing challenge.

Reducing inspections should not be an aim in itself. Achieving efficiencies in routine inspection tasks enables prioritization of inspector time, optimizing the use of the skilled inspector resource in activities of the greatest verification value. SAGSI emphasized the essential contribution of inspector presence to safeguards effectiveness. There are many tasks that can be performed effectively only by an inspector, and the observational skills of the inspector are assuming increasing importance.

Achieving efficiencies in safeguards implementation is not only a matter for the IAEA, greater cooperation between the IAEA and States is required. Greater cooperation between the IAEA and State systems of accounting for and control of nuclear material (SSACs) can significantly improve efficiency through cooperative endeavours. In addition to ensuring that SSAC data are timely and accurate, areas for cooperation include the use of unattended and remote monitoring, mailbox approaches for reporting data, the conduct of joint inspections and enabling unannounced/short notice inspection. Many States are already active in these areas, but there is more to be done. SAGSI noted that these activities require a high level of commitment and competence on the part of SSACs.

SAGSI is currently working with the Secretariat to develop new guidelines for SSACs, including a revision of the Guidelines for States' Systems

of Accounting for and Control of Nuclear Materials (IAEA/SG/INF/2), which will be published in the International Nuclear Verification Series as the top level SSAC Guidelines document and supported by a series of other guideline implementation documents, including the Nuclear Material Accounting Handbook and ISSAS Mission Guidelines.

Further efficiencies could come from the concept of infrequent intensive verification, which SAGSI recommends for further study. This concept builds on the advantages of unpredictability in verification. The concept could be used as an alternative to the normally defined level of routine inspections, resulting in net savings. This would involve a trade-off between further reductions in routine inspections and unpredictable but occasional and intensive inspections. The concept could also be used to supplement routine inspections, providing flexibility to introduce more intensive inspections in response to emerging circumstances.

Associated with the concept of infrequent intensive inspection is the concept of a safeguards operational support team (SOST) — also recommended for further study. The SOST would comprise a group of specialist inspectors who could be drawn upon to supplement routine inspection operations. The Secretariat already does this on an ad hoc basis; with SOST this would be established on an ongoing basis.

4. FURTHER DEVELOPMENT OF THE SAFEGUARDS SYSTEM

The new ideas and the ongoing revolution in safeguards will continue to develop in a dynamic international nuclear context that may see significant expansion and growth in the use of peaceful nuclear technologies and continued challenges to the non-proliferation regime from a small number of States. The IAEA safeguards system, working on behalf of the international community, must continue to provide confidence in the peaceful uses of nuclear energy. SAGSI expects to continue to contribute to the ongoing safeguards revolution by considering key technical questions surrounding the implementation of IAEA safeguards. Some of these questions are identified in the following paragraphs.

Peaceful nuclear activities are expected to grow overall and, importantly for safeguards, to expand into new regions. The safeguards system will have to keep pace; but it is unlikely that safeguards growth can be linear with the increase in global nuclear activities. The concepts outlined in the SLA, which permit the development and implementation of 'intelligent' safeguards, will be essential to meet the demands to maintain a credible system that is both effective and efficient. Will the Secretariat be able to ensure that the SLA to

safeguards implementation and evaluation continues to evolve to reflect experience gained as well as the development of new safeguards relevant equipment and technology? Will the safeguards system remain credible?

Experience to date has shown that greater use of information and advanced technologies are essential elements of the safeguards system, and these can be expected to increase in importance in the future. What expected advances in the fields of information collection and analysis can be employed by the Secretariat? What are the essential technologies needed to strengthen the safeguards system, and how can they best be employed? Given the continuing importance of research and development (R&D) in this area, how can we ensure there is an appropriately structured R&D programme reflecting the needs and priorities of the safeguards system?

Wider acceptance of the additional protocol and more States coming under integrated safeguards will contribute to effectiveness and efficiency gains for the safeguards system. Experience gained in the implementation of integrated safeguards can be expected to improve safeguards implementation, leading to additional gains in both aspects of safeguards. What additional adjustments to safeguards implementation are warranted?

New fuel cycle concepts, such as assured fuel supply, multilateral fuel cycle centres and new partnerships, can all have a major impact on the use of safeguards resources. Until there is further development of these ideas, it is unclear how they might impact on safeguards, but it is clear they must be developed in concert with the safeguards community to ensure the optimal use of safeguards resources. How can we ensure that safeguards considerations have an appropriate influence on the fuel cycle choices facing the international community?

The lessons learned from the proliferation activities of a few States and the revelation of an illicit nuclear trade network have illustrated that the possibility of clandestine facilities and associated undeclared materials and activities are real threats that must be addressed by the safeguards system. How can the safeguards system enhance its ability to detect these undeclared nuclear materials and activities? What are the impacts on the safeguards system of the possibly widespread availability of, for example, centrifuge designs?

In short, what will the safeguards system look like in five or ten years? How can the current system build a sound foundation to support the international nuclear enterprise of 2036, 30 years from now? If history is a useful guide, consider the safeguards implemented in 1976 with those implemented under the current system. The changes have been dramatic, even if the fundamentals are the same. There is every reason to believe that the safeguards system will continue to evolve, with periods like the recent one in which the pace of change can be truly characterized as revolutionary.

IAEA SAFEGUARDS: ROLLING STONE OR GATHERING MOSS?

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1. INTRODUCTION

For the IAEA safeguards system to remain relevant to the non-proliferation regime, it has to continue to evolve to respond to rising challenges. This presentation will first highlight past challenges and how the safeguards system has evolved to address them to date. Current and upcoming challenges will then be described, including how they are being addressed or how the IAEA is positioned to further evolve the safeguards system to address them.

2. SAFEGUARDS STRENGTHENING

Clearly, the past 15 years have seen a major change in the safeguards system. The challenges of the early 1990s, including the dissolution of the Soviet Union, the completeness exercise in South Africa and the discovery of Iraq's clandestine nuclear weapons programme, led to a thorough review of the system and to major changes across the board to strengthen it, particularly its ability to detect undeclared nuclear activities. These strengthening measures can be characterized as (i) new legal authority, (ii) advanced technologies, (iii) broader information sources and (iv) a State level approach (SLA) to safeguards.

2.1. New legal authority

The Model Additional Protocol (INFCIRC/540 (Corrected)) has provided the IAEA with the tools to more fully address the safeguards system's objectives of verifying the completeness and correctness of States' declarations so that it can provide credible assurance of the non-diversion of declared nuclear material and the absence of undeclared nuclear material and activities. By requiring States to provide information and access on both the front end

and the back end of the nuclear fuel cycle, as well as on nuclear related research and development (R&D), manufacturing and exports, the IAEA has the ability to construct as complete a picture as possible of a State's nuclear programme, to ensure consistency of all the relevant information available and to draw the necessary safeguards conclusions.

2.2. Advanced technologies

2.2.1. Environmental sampling

Environmental sampling is the most important technical measure that the IAEA has introduced to detect undeclared nuclear activities. Since 1996, the IAEA has collected over 5000 environmental samples in connection with inspections, design information verification (DIV) visits and complementary access. To support the environmental sampling programme, the IAEA's Network of Analytical Laboratories (NWAL) has been extended to include 14 laboratories in eight Member States with the capability to perform low level isotopic and radiometric measurements.

2.2.2. Remote monitoring

The installation and operation of unattended detection equipment with remote transmission of safeguards data have strengthened effectiveness by providing for continuous inspection coverage and timely data review, and have improved efficiency by reducing inspector time in the field. To date, there are over 125 surveillance and radiation monitoring systems installed in the field, with remote transmission capabilities.

2.2.3. Satellite imagery

Satellite imagery is being used as an important information source to effectively plan verification activities in the field, to confirm the operational status of facilities and to resolve questions with minimal expenditure of inspector time and no burden to the State. An imagery unit with professional analysts has been established within the Department of Safeguards, and currently the IAEA has contracts with some ten commercial imagery product suppliers.

2.3. Broader information sources

Also in this time frame, the IAEA started taking full advantage of all the information available on States' nuclear programmes. This includes (i) information provided by States under their safeguards agreements or on a voluntary basis, such as equipment exports under the Voluntary Reporting Scheme, (ii) information derived from the IAEA's verification activities in the field, including inspections, DIV visits and complementary access, and (iii) information from all other sources, including IAEA non-safeguards databases, reports from research institutions, scientific literature, trade publications and satellite imagery.

2.4. A State level approach to safeguards

A State evaluation process has been developed to use all of the information available about a State's nuclear programme to plan, implement and evaluate safeguards activities for the State. This is referred to as 'information driven' safeguards. A comprehensive State evaluation, involving a comparison and assessment of all of the information available, is conducted to provide as complete a picture as possible of a State's nuclear and nuclear related activities. An important element of the State evaluation is identifying issues requiring follow-up. The findings from the evaluation are used as the basis for drawing safeguards conclusions. For a State with a comprehensive safeguards agreement and an additional protocol in force, the objective is to draw a broader conclusion regarding both the non-diversion of declared nuclear material and the absence of undeclared nuclear material and activities in the State as a whole. With the broader safeguards conclusion, it is possible to optimize implementation of all safeguards measures available under comprehensive safeguards agreements and additional protocols. This is known as integrated safeguards.

3. RESPONDING TO CHALLENGES

As the Director General said in his opening statement during the Opening Plenary, the IAEA cannot rest on its laurels. The safeguards system has to continue to respond to new challenges, both to the organization and to the implementation of effective safeguards.

3.1. Challenges facing the IAEA

Simply put, the IAEA needs a full complement of competent, motivated staff members who have access to the data and equipment necessary for performing all of their verification and evaluation activities within the given budget.

3.1.1. Succession planning

On the staffing side, the IAEA has been working hard on succession planning in the context of identifying skills needed in different positions, staff development to attain these skills and timely recruitment in the light of retirement of senior staff members. Specifically, all positions of section head, unit head and senior inspector have been reviewed to identify qualified staff members who could assume these positions through rotation or promotion in the near term as well as recruitment needs. Work plans have been developed for individual staff members to reflect the experience and training required to qualify for these key positions. Skill sets are also being identified for the different level of inspectors (i.e. P3, P4 and P5), so that it is clear to everyone what knowledge and experience are required to be considered for the next level. The aim is a transparent process. In parallel, the Department's training programme is being reviewed and updated to support the development effort.

3.1.2. Department reorganization

In terms of working internally more effectively and efficiently, the Department is being reorganized, in particular to implement the SLA concept. Traditionally, the sections within the Safeguards Operations Divisions were organized along facility types, with units responsible for specific facility types (e.g. a group inspecting reactors and a group inspecting enrichment plants). In 2005, the Operations Divisions were reorganized and are now aligned according to States, where the same team is responsible for safeguards implementation for a single State. The IAEA is currently working on reorganizing the Support Divisions to be able to interface effectively with and support the Operations Divisions. The IAEA is aiming to develop the 'one stop shop' approach so that inspectors only have to go to one place/one desk for evaluation support, one desk for inspection equipment, etc.

3.1.3. ISIS Re-engineering Project

In the area of information access, the centrepiece of the development effort is the ongoing IAEA Safeguards Information System (ISIS) Re-engineering Project (IRP), a project critical to the future of the Department. Much of the safeguards data and many applications are on a dedicated mainframe system that is over 25 years old. Other databases and applications are on stand-alone systems spread throughout the Department. It has been clear for a number of years that a new, integrated system is needed to effectively and efficiently address all of the Department's data and processes.

The objective of the IRP is to integrate all of the safeguards data and applications and thereby improve access to all necessary data, both at IAEA headquarters and in the field. This is the largest technical project ever undertaken within the IAEA, and while it is a serious challenge, it is obviously a great opportunity for improving effectiveness and efficiency. The project started in July 2005 and is expected to run 3.5 years and to cost approximately $35 million (half coming from the regular budget, the other half from extrabudgetary funds). During 2006, the focus has been on taking inventory and determining what has to be transferred (e.g. there are many old applications that are no longer needed), on defining architectural standards and IT security requirements (a key issue), and on developing plans for migration (i.e. the order of transfer and how long to run parallel systems). The implementation phase is now starting. Donations for funding this project are still being accepted.

3.1.4. Quality management system

The implementation of a Departmental quality management system (QMS), compliant with the ISO 9001:2000 standard, will improve effectiveness and efficiency across all of the Department's activities and, more importantly, support the provision of soundly based safeguards conclusions. The IAEA has been laying the groundwork for this project since 2001, when QMS awareness training for staff members began. Training has continued, with courses tailored for managers, new and experienced inspectors, and support staff. But it took two reviews of the Department in 2003–2004, one by the Standing Advisory Group on Safeguards Implementation (SAGSI) and one by an external group of experts, both with strong recommendations for implementing such a system, to get things moving. In 2004, quality managers were appointed in each division to work with the Department quality manager. The Departmental quality policy was approved in late 2004, a gap analysis guided by the ISO 9001:2000 standard was completed in early 2005, and internal quality audits and

management reviews began in early 2006. To date, four audits have been conducted and continual process improvement working groups have started. All the components are now in place to drive the system forward.

3.2. Challenges to safeguards implementation

A major task for the IAEA is the implementation of additional protocols for more and more States. Currently there are 78 States with additional protocols in force. For those States, the challenges are the drawing of the broader safeguards conclusion and the implementation of integrated safeguards. Currently, integrated safeguards are being implemented for ten States, and concepts and integrated safeguards approaches continue to evolve as experience is gained.

The IAEA is also being challenged to develop and implement safeguards for large, complex facilities as well as for different types of facility. For example, the ten year project to develop a safeguards approach for the Rokkasho reprocessing plant in Japan was completed at the beginning of 2006, and active testing of the facility began shortly thereafter. Most of the safeguards equipment has been installed and is in use, and routine inspections have started. Significant resources will continue to be required for verification activities as well as for maintaining and upgrading the plant specific safeguards instrumentation. Work has started on the development of the safeguards approach for the mixed oxide fuel fabrication plant at Rokkasho (JMOX project); this will also require considerable resources (development effort and installed equipment). In addition, work is expected to resume on the Chernobyl conditioning facility project. Then there are the large gas centrifuge enrichment facilities planned for France and the United States of America, as well as the safeguards activities associated with the agreement between India and the United States of America. To add one more challenge, safeguards implementation for the Democratic People's Republic of Korea (DPRK) could resume in the near future, requiring substantial resources.

In the area of new safeguards approaches, the IAEA is working on approaches for pebble bed reactors and for verifying the decommissioned status of facilities. Work has recently started on an integrated safeguards approach for geologic repositories. All of this work is being conducted with the help of Member States through their support programmes.

Another key challenge related more to the State evaluation process is addressing clandestine supply and procurement networks. The Nuclear Trade Analysis Unit (NUTRAN) was established in late 2004 within the Department of Safeguards and is the focal point for the receipt of procurement network related information (e.g. export denials of sensitive equipment, unsuccessful

procurement attempts, companies/individuals involved). It was set up to investigate, accumulate and analyse this information. Studies are being conducted on specific procurements, individual companies and possible illegal networks. This team supports the State evaluation efforts of the IAEA. This is an area where additional support is being requested from Member States, both for provision of information and for the development of tools and methods.

4. FURTHER STRENGTHENING THE SAFEGUARDS SYSTEM

Specific recommendations for further strengthening the safeguards system can be identified in categories similar to those presented above for the strengthening measures of the 1990s — namely, (i) legal authority, with the conclusion and implementation of existing safeguards instruments, (ii) expanded technical capabilities and (iii) broader sources of information.

4.1. Legal authority

With respect to measures associated with the IAEA's legal authority, the goal is simple: to strengthen the safeguards system by making full use of existing legal instruments. All non-nuclear-weapon States are required to conclude a safeguards agreement within 180 days of becoming a party to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). There are currently 30 States that have yet to comply with this obligation. As noted in the Safeguards Implementation Report (SIR) over the past several years, the IAEA cannot draw a safeguards conclusion for these States. In terms of existing safeguards agreements, examples where States are not meeting all their obligations include the granting of long term multiple entry visas (as called for in subsidiary arrangements or additional protocols) and the timely submission of reports under comprehensive safeguards agreements or of declarations under additional protocols. States are also being requested to fulfil all of their voluntary commitments, such as reporting on exports of separated neptunium and americium.

Another legal instrument that could serve to strengthen the system is the modified small quantities protocol (SQP) to comprehensive safeguards agreements. The original SQP held in abeyance many of the provisions of the safeguards agreement. The Secretariat sought more information and access to strengthen the basis upon which safeguards conclusions could be drawn for States with an operative SQP. In deliberations in 2005, the Board of Governors decided that the SQP should remain part of the safeguards system but should be subject to modification of the standard text and criteria which, among other

things, require an initial report of nuclear material holdings and provide for inspections. All States with existing SQPs have been asked to accept the modified standard text; to date, nine States have done so. The Secretariat is providing training seminars and has prepared written guidance to assist States in this regard. Last but not least in this category is a recommendation for all States to conclude an additional protocol. As the Director General has stated repeatedly, it is only with all measures under a comprehensive safeguards agreement and an additional protocol that the IAEA can effectively address the completeness and correctness of States' declarations.

4.2. Expanded technical capabilities

4.2.1. Environmental sampling

As has been described in the SIR for the past several years and in reports to the Advisory Committee on Safeguards and Verification of the Board of Governors (Committee 25) in 2006, the number of environmental samples collected by inspectors in the field has increased dramatically over the past few years. This high level of environmental samples is expected to continue, due in part to ongoing investigations and in part to the larger number of complementary access activities being conducted. Sample collection and how samples are sent through the NWAL have been optimized as much as possible, but additional capacity is needed, particularly for particle analysis. One recommendation is to expand the NWAL. Specifically, States have been requested to add capacity to laboratories within the existing network or qualify new laboratories as part of it. This is a financial commitment for a State, since the amount the IAEA pays for sample analysis is only a fraction of the actual cost. In parallel, a second recommendation is to expand the capabilities of the IAEA's Safeguards Analytical Laboratory, in particular to turn around high priority samples with timely, high sensitivity analyses.

4.2.2. Satellite imagery

A second area for the expansion of technical capabilities is in satellite imagery. The majority of imagery used to date by the Department of Safeguards has been high resolution optical imagery. However, optical imagery alone cannot reveal all the pertinent indicators of possible undeclared nuclear activities. Other types of imagery and analytical tools that would be useful for the Department's analysts include (i) high resolution synthetic aperture radar (SAR), (ii) geographic information systems to allow correlation and analysis of safeguards related information with a geographical dimension stored in various

systems, (iii) radar imagery processing techniques and (iv) change detection tools to identify differences between two images over time or between an image and a drawing. The specific recommendation is for Member States to support the IAEA in obtaining these different types of imagery and advanced analytical tools, and to assist with training in imagery analysis and use of the tools.

4.2.3. Novel technologies

A third area for the expansion of technical capabilities is the use of 'novel technologies' by inspectors in the field for the detection of undeclared nuclear activities. Novel technologies are defined as those in which the methodology has not been previously applied to safeguards applications. Techniques based on the detection of emanations associated with nuclear processes are being investigated. These include the sampling and monitoring of specific solid, liquid and gaseous material to provide new methods and approaches for the detection of undeclared nuclear activities from distances ranging from hundreds of meters to many kilometres. On the basis of IAEA priorities and resources, a limited number of projects have been selected and cooperation with Member States has been initiated to develop these technologies for possible use in the field. Among the possibilities being studied are (i) laser induced breakdown spectroscopy (LIBS) to determine the nature and history of compounds and elements found on sites, (ii) optical stimulation luminescence (OSL) to determine whether an undeclared location has been used previously for storing radiological material and (iii) light detection and ranging (LIDAR) to detect the presence and nature of nuclear fuel cycle process activities at suspect locations.

4.3. Broader information sources

The provision of additional information on nuclear material and activities would also contribute to further strengthening the safeguards system. Provision by a State of information on past nuclear activities, upon the request of the IAEA, is for the purpose of clarifying the correctness and completeness of the State's declaration concerning current nuclear material and activities. The need for such information is identified through the State evaluation process. It should be emphasized that the provision of historical information falls within existing legal authority — specifically, it was a Part 1 safeguards strengthening measure approved by the Board in 1995. Other types of information sought from States on a voluntary basis include exports of specific equipment and non-nuclear material, export denials, relevant information from commercial

suppliers and information on the disposition of sensitive equipment and components from decommissioned facilities.

Another mechanism that would provide for a more uniform approach would be amendment of the annexes of the Model Additional Protocol. Article 16.b. of the Model Additional Protocol provides that the lists of the annexes may be amended by the Board upon the advice of an open ended working group of experts established by the Board. Any such amendment would take effect four months after adoption by the Board for all States with additional protocols. The Secretariat thinks it is time to consider including some additional activities, technologies and materials relevant to safeguards in the annexes (e.g. use of accelerator driven systems). It is important to recognize and address advances in nuclear technology. For example, the list of specified equipment and non-nuclear material upon which Annex II was based has been updated six times since the Board approved the Model Additional Protocol in 1997.

5. CONCLUSION

What has been described in this paper covers only major near term challenges and ongoing work. A brief mention is warranted of some of the longer term issues where the safeguards system is likely to play a key role, namely, (i) multinational nuclear fuel cycle facilities that are currently being discussed in the context of assurances of nuclear fuel supply, (ii) a future role in other disarmament initiatives (e.g. the proposed Fissile Material Cut-off Treaty) and (iii) more nuclear fuel cycle facilities associated with a 'nuclear renaissance'.

Is the IAEA safeguards system 'a rolling stone' or is it 'gathering moss'? It should be clear from the work in progress that the safeguards system is indeed a rolling stone; however, not one that is rolling out of control down a hill or off a cliff. Rather, the IAEA and its safeguards system have direction, conviction and a plan to remain a viable, critical element of the non-proliferation regime for many years to come. And the IAEA counts on support from all Member States in fulfilling that mission.

SYMPOSIUM HIGHLIGHTS*

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1. INTRODUCTION

Good morning and thank you for the introduction. It is a great pleasure for me to return to my roots in the area of safeguards. I am glad to see so many partners and friends from previous efforts in safeguards and in R&D to support the IAEA. When I was asked to make this presentation, I was not sure whether I should consider it an honour or a duty. This might be the most important presentation for you, since I offer you a potential blueprint for your mission report. With so much information in this report, your superiors may consider this your most comprehensive report. I leave that judgement up to you.

2. CURRENT CHALLENGES TO THE SAFEGUARDS SYSTEM

What were the major messages of the presentations on the first day? Obviously, the nuclear non-proliferation regime is under stress. You can reformulate that message, depending on whether you are an optimist or a pessimist. Another important message is that multilateral approaches, combined with robust verification, are crucial. It was also stated that the real challenge for the IAEA currently is in the area of detecting undeclared nuclear activities. Also, on-site inspections are considered key, but they require information and access. It remains questionable whether the IAEA will be able to obtain all of the necessary information and access.

The IAEA needs to stay ahead of the game. All of the evolution in safeguards implementation that has occurred underscores that we need to anticipate, to be faster and to be better in detecting and tracing indicators. I will say more about that later. In addition, we are encountering the expansion of nuclear technology and nuclear energy, as well as the more intensive use of

* The opinions expressed in this summary — and any recommendations made — are those of the participants and do not necessarily represent the views of the IAEA, its Member States or the other cooperating organizations.

nuclear energy and the spread of nuclear fuel cycle facilities to more countries. We may be faced with future challenges in these areas. More and more countries are becoming interested in enrichment technology, and if activities in a State were to go undeclared for a time, the additional protocol to safeguards agreements might not be sufficient for confidence building. Additional transparency measures may be called for.

Regarding the development of the peaceful uses of nuclear energy, global trust and respect are essential. The cultures of nuclear non-proliferation, security and safety must coexist, and synergies need to be further developed. Global strengthening efforts to achieve predictable and reliable nuclear safety, security and safeguards systems are under way. I recall, in this context, a special session of the IAEA General Conference held this year (2006).

Safeguards implementation has become more sophisticated in adapting and reacting to changing circumstances. This could be seen in a slide presented this morning. Also, in the presentation by John Carlson, we learned how the interpretation of document INFCIRC/153 (Corrected) [1] could potentially evolve.

Cooperation between States and the IAEA is fundamental to safeguards implementation. Member States now expect the IAEA to be able to draw soundly based conclusions regarding the absence of undeclared nuclear material and activities to supplement conclusions regarding the non-diversion of declared nuclear material.

Regarding the additional protocol to safeguards agreements, undoubtedly this is an excellent confidence building measure and should become, together with a comprehensive safeguards agreement, the verification standard under the Treaty on the Non-Proliferation of Nuclear Weapons (NPT). A strengthened safeguards system should function as an early warning system and provide sufficient time to react to new circumstances.

3. FURTHER STRENGTHENING SAFEGUARDS

What is expected of the IAEA? The IAEA needs to communicate more with its Member States whenever new obligations are introduced, such as the additional protocol to safeguards agreements, and provide a clear explanation of both the requirements and the benefits involved for the community and for safeguards assurances. The IAEA also needs to perform an effective 'baseload' safeguards implementation and deploy some of the resources in recognition of the risks involved.

Regulators and authorities should also model and emulate good practices in a culture of compliance. There was an interesting statement by one presenter

that Japan's intent is to become a model of the peaceful uses of nuclear technologies. Another presenter made a very clear statement about Canada's intent to maintain the broader safeguards conclusion that the IAEA drew in 2005, under an agreed State level approach.

Relative to all States, those States that possess the technology usable for nuclear weapons have a special requirement to establish confidence in their nuclear activities. For example, South Africa provided the IAEA with greater access and more information than was required in connection with its nuclear weapons dismantlement programme.

The situation in Europe was also touched upon briefly. Statements were made that the European Commission is adapting its safeguards to meet current conditions, building complementarity with the IAEA, particularly with regard to the introduction of integrated safeguards. The IAEA is also working with Member States of the European Union (EU) to implement the additional protocol and integrated safeguards in a timely manner. The goal is to be able to draw the broader safeguards conclusion for most EU Member States within two years. We at the Joint Research Centre will continue to support the IAEA in the future with R&D.

For the expected expansion of nuclear energy, States and the IAEA should use the lessons learned from early consideration of safeguards in the design and construction of new facilities. It is encouraging to see that many of the new initiatives are actually taking place. The IAEA must begin right now to address future safeguards situations — for example, for the years 2020 and 2030, taking into consideration reactor types, new safeguards approaches and technologies.

How can we meet the current challenges? First, it is important to strengthen the agreements already in place, bringing all the players together, whether large or small, into the nuclear non-proliferation regime. We should learn from past experiences, employing suitable technologies to ensure that the appropriate treaties are adhered to and verifiable. We should develop tools to identify sources of clandestine transfers of sensitive technology and components. As J. Cooley mentioned in her presentation, this is one of the IAEA's major objectives. Furthermore, we need to foster greater awareness and understanding of nuclear non-proliferation and safeguards issues among industry, the public and the various players in the field through education.

As several presenters stressed, information driven safeguards are an important issue. Information collection and evaluation are essential components of modern safeguards, and we need to develop an all-source information collection, analysis and evaluation system.

There was an interesting presentation by the Director of Safeguards of the European Commission about the revised nuclear material accountancy

system that serves as a common system for EU Member States and a common contact point for the IAEA.

The importance of the IAEA Safeguards Information System (ISIS) Re-engineering Project was stressed, since it will allow the IAEA to transform diverse data into available and lasting knowledge. Additional support for this project is absolutely essential.

Open source information research is addressing new challenges, including contextual awareness, duplicate information and quick responsiveness. The IAEA is developing the 'n-VISION' tool to meet the needs of advanced information analysis. Human experts will continue to play a key role in that endeavour.

Good progress was reported on the implementation of the additional protocol and the move to integrated safeguards, including for States with large, complex nuclear programmes. Broader safeguards conclusions were drawn for Japan in 2004 and for Canada in 2005. The active involvement of and cooperation among the IAEA, State authorities and facility operators is essential. States with less safeguards experience especially appreciate the IAEA's assistance in understanding and meeting their safeguards obligations.

Much effort continues to be given to refining so-called traditional safeguards implementation as well as to developing and implementing new, strengthened safeguards approaches. States expect to see noticeable improvements in the effectiveness and efficiency of the safeguards system. Random inspection regimes have been introduced successfully in Japan at power reactors and fuel fabrication plants, and preparations for their implementation in Canada and in EU States are under way.

4. ADVANCED SAFEGUARDS TECHNIQUES AND TECHNOLOGY

Several presenters described safeguard implementation for the Rokkasho reprocessing plant in Japan. This is one of the IAEA's largest safeguards endeavours in terms of the quantity of safeguarded material, equipment costs and human resources involved, a point highlighted in the presentation by J. Cooley. In March 2006, the IAEA initiated a continuous inspection regime at the plant as startup progressed to the process areas. As the plant moves to full operation in 2007, the IAEA's success will require communication, coordination and cooperation by all parties involved.

There were interesting presentations about the Hexapartite Safeguards Project and its relationship to current centrifuge enrichment plants. It was noted that in the area of centrifuge enrichment plants, additional optimization

and improvements could be achieved. There was notable consistency in the safeguards approaches described in several presentations on this topic.

Strengthened safeguards have presented opportunities for the application of a much wider range of analytical sciences for helping to achieve safeguards goals. The IAEA continues to benefit from technological progress in computing power and software, cost effectiveness, miniaturization and portability. Environmental sampling is an obvious example. It is an important safeguards measure, and from several presentations it could be seen that there have been notable improvements in environmental sampling, particularly with respect to the sensitivity and selectivity of the techniques and the evaluation methodology. As a result, high standards have been achieved by the Network of Analytical Laboratories that assists the IAEA in its analysis of nuclear materials and environmental samples.

The next generation of unattended verification, remote monitoring and containment and surveillance (C/S) equipment will have many interesting features that will increase detection capacity and also make the task of the inspector easier. For example, commercially available satellite imagery is increasingly being used for safeguards implementation. Enhancements were reported, through object based analysis, for the exploitation of thermal infrared and hyperspectral imagery; there is also the potential for better interpretive aids for the detection, classification and monitoring of nuclear facilities and even for automated analysis. This latter area remains important, particularly for the IAEA's efforts to detect undeclared nuclear activities.

The IAEA Novel Technologies Project was described as a mechanism for identifying innovative technologies that could have application to safeguards, particularly for detecting undeclared activities. Some promising examples are laser induced breakdown spectroscopy to determine the nature and history of compounds and elements at a site, and optical stimulation luminescence to determine whether an undeclared location has been used for storing radiological material. The IAEA also reported good progress in the implementation of a comprehensive quality management system, based on the ISO 9001:2000 standard, in the Department of Safeguards.

5. FUTURE CHALLENGES

The IAEA will continue to face challenges with respect to nuclear terrorism, illicit trafficking and other risks to the security of nuclear facilities. Several initiatives were reported to help to address these challenges, such as the Global Nuclear Energy Partnership for restructuring the nuclear fuel cycle and for introducing proliferation resistant fast reactors and fuel cycle technologies.

As noted, other noteworthy initiatives were described at a recent special session of the IAEA General Conference. Essentially, all of these initiatives have the same objectives with respect to the expanding use of nuclear energy: (a) to strengthen security measures for the benefit of all States, (b) to reduce the nuclear proliferation risks and (c) to strengthen the safeguards system by design. In addition, the IAEA needs to pay particular attention to how some of the sensitive nuclear fuel cycle facilities are being operated.

6. CONCLUSION

The nuclear non-proliferation regime is at a crossroads. Initially, I used a more neutral formulation. We shall see what will occur in the near future with respect to the Democratic People's Republic of Korea, the Islamic Republic of Iran and possibly other countries. The safeguards system has shown its capacity to react and adapt through technological developments and through the introduction of the additional protocol. However, it is absolutely essential that more and more States bring into force their additional protocol.

It is expected that nuclear energy will be more widely used. This will involve, among other things, Generation III reactors, nuclear fuel cycle facilities, geological repositories and the development of Generation IV systems. Each of these has its own list of challenges, but successfully addressing these challenges is not an impossible task. To repeat: safeguards need to stay ahead of the game. In particular, the issues related to the expected expansion of nuclear energy need to be addressed in an appropriate manner. Modern safeguards implementation will comprise both traditional safeguards and more information driven verification measures.

Some key technologies were mentioned relative to information gathering, integration and analysis, such as those for broad, open source collection and analysis and for satellite imagery. Communication and alert systems are extremely important for delivering the relevant information to the right person in a timely manner. The importance of unattended remote monitoring was underscored. I think greater emphasis will be placed on the verification of the use of facilities, thus the modelling of processes and the use of environmental swipes will be extremely important in providing indicators of the actual use of facilities.

New verification technologies will be required, in particular for the Generation IV systems where not only plutonium but also minor actinides are recycled. Possibly the most challenging task for the IAEA is to train inspectors and analysts with respect to these developments. It is essential that we have

highly qualified and motivated inspectors and analysts, in particular to cope with the new challenges of information driven safeguards.

REFERENCE

[1] The Structure and Content of Agreements between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons, INFCIRC/153 (Corrected), IAEA, Vienna (1972).

CLOSING STATEMENT

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Let me begin with reference to the opening statement by the IAEA Director General and the remarks made by the keynote speakers that the non-proliferation regime currently faces a broad array of challenges. Some people refer to the regime as being 'in crisis', which might be too strong a statement, but it is certainly being tested.

The Treaty on the Non-Proliferation of Nuclear Weapons (NPT) was ratified more than 30 years ago. Since then, the world has undergone rapid social, political and economic changes, which have resulted in a changing non-proliferation landscape. Developments in the three pillars of the NPT — disarmament, technology transfer and verification — have not necessarily been even.

The IAEA has a particular role to play with respect to technology transfer and verification. Although one might argue that there has been slow progress with regard to disarmament, it is my belief that we should continue to improve nuclear verification methods and techniques to keep up with the changing non-proliferation landscape. If we fail to do so, we will impact not only international safeguards but also the future prospects of peaceful nuclear applications. During the past two decades we have seen three major developments related to nuclear non-proliferation:

— Increased dissemination of nuclear technology and nuclear 'know-how', particularly in the light of renewed interest in nuclear power;
— A renewed drive on the part of a few States to acquire technology suitable for nuclear weapons purposes;
— The emergence of clandestine procurement networks.

As we all agree, under the NPT regime there is nothing illegal about a State having enrichment or reprocessing technology. However, we should ensure that nuclear material and infrastructure are not used for illicit and non-peaceful purposes. Better control of access to nuclear fuel cycle technology is

being explored through initiatives such as multinational approaches for enrichment and reprocessing.

We cannot address the detection of clandestine efforts to acquire nuclear weapons or the operation of clandestine nuclear procurement networks through discrete initiatives. To address these issues, the IAEA requires global support for effective nuclear verification. We also need to be able to tap into the latest verification technology.

In the context of the changing non-proliferation landscape, the IAEA must continuously pose the following questions. As we look to the future, what can be done to assure ourselves and our Member States that the IAEA, as the international nuclear verification organization, is 'staying ahead of the game'? With the global reach of our responsibilities and the continuous need to sift through vast amounts of information, how can we be sure that we are looking in all the right places? And how do we prioritize, using our limited resources to the best advantage?

Our objective is to provide credible assurances to the international community that States are honouring their safeguards obligations. We have identified several key priorities for a robust verification system:

— Implement new safeguards approaches to deal with new challenges, new facility types and new operating conditions;
— Optimize safeguards equipment and technology development, inter alia, to further improve existing detection capability;
— Pursue R&D on novel technologies for the detection of undeclared activities;
— Enhance environmental sample analysis capabilities;
— Enhance the IAEA's existing satellite imagery acquisition and analysis capabilities;
— Broaden and intensify information collection and analysis capabilities;
— Maintain an efficient and secure safeguards information infrastructure.

J. Carlson, R. Schenkel and J. Cooley have just provided excellent summaries of the 2006 symposium on international safeguards. From the wealth of topics that have been covered during the symposium, I am confident that we can develop the tools necessary to respond to these challenges. Clearly, in the area of R&D the IAEA depends entirely on the contributions of the Member States, and to that end the Member State Support Programmes play a key role. But you, as developers, are the backbone of the safeguards system.

Many papers have been presented here with excellent ideas that have provoked great interest. Although the symposium is drawing to a close, I see that our work will (and must) continue after today. The safeguards community

is not a closed one, and we have seen this week that if we continue to exchange ideas and interact with one another, we will be better equipped to achieve our objectives.

I would like to thank you, on behalf of the IAEA, for your contributions to the 2006 symposium on international safeguards. Your continuous support and engagement is vital for us to ensure that "atoms are used only for peace".

OVERVIEW OF THE PROGRAMME

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2	Technical Plenary	J. COOLEY, IAEA A. HADFIELD, IAEA
3	Current Challenges to the Safeguards System	J. CASTERTON, Canada T. KILLEEN, IAEA
4	Improving Collection and Analysis of Safeguards Information 1	M.-G. ALBERT, France C. DE WIT, IAEA
5	Advances in Safeguards Techniques and Technology 1 — Future Technology	K. NAITO, Japan L.P. MELO MOITTA, IAEA
6	Further Strengthening Safeguards Practices and Approaches 1 — Safeguards Approaches	G. STEIN, Germany T. JEFFREY, IAEA
7	Improving Collection and Analysis of Safeguards Information 2	G. DAHLIN, Sweden S. MUNOZ, IAEA
8	Advances in Safeguards Techniques and Technology 2 — Neutron Techniques	K. VAN DER MEER, Belgium E. FRANKLIN SABURIDO, IAEA
9	Further Strengthening Safeguards Practices and Approaches 2 — Safeguards Approaches and Integrated Safeguards	S. FERNANDEZ MORENO, Argentina A. BROODRYK, IAEA
10	Improving Collection and Analysis of Safeguards Information 3	B. JASANI, United Kingdom A. EL GEBALY, IAEA
11	Advances in Safeguards Techniques and Technology 3 — Spent Fuel Verification	B. BURROWS, United Kingdom S. JUNG, IAEA
12	Further Strengthening Safeguards Practices and Approaches 3 — R/SSAC	T. VARJORANTA, Finland M. MAHMOUD, IAEA
13	Advances in Safeguards Techniques and Technology 4 — General	H. BOECK, Austria J. INJUK, IAEA
14	Advances in Safeguards Techniques and Technology 5 — DA	K. MAYER, EC K. MAUNULA, IAEA
15	Future Challenges	T. SHEA, United States of America T. NEWTON, IAEA
16	Further Strengthening Safeguards Practices and Approaches 4 — Enrichment	M. MARZO, Brazil W. BUSH, IAEA

Session	Title of Session	Session Chair/Technical Secretary
17	Advances in Safeguards Techniques and Technology 6 — Reprocessing	S. TSALAS, EC G. MORRIS, IAEA
18	Further Strengthening Safeguards Practices and Approaches 5 — Reprocessing, Spent Fuel Transfer	R. WEH, Germany I. PEREZ HERRERA, IAEA
19	Advances in Safeguards Techniques and Technology 7 — Environmental Sampling	E. KUHN, Germany T. AYERS, IAEA
20	Advances in Safeguards Techniques and Technology 8 — Containment and Surveillance	J. MATTER, United States of America M. DOYLE, IAEA
21	Closing Plenary	G. ANDREW, IAEA T. MORIARTY, IAEA
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References made in symposium papers to the organizational structure of the Department of Safeguards refer to the situation as it existed in October 2006. Since then, the support divisions of the Department have been reorganized. Effective 1 January 2007, the support divisions are as follows:

- Division of Safeguards Information Management (SGIM) comprising the following sections:
  - Customer Service and Operations (ICO);
  - Information Architecture and Projects (IAP);
  - Information Collection and Analysis (ICA);
  - Declared and Statistical Information Analysis (IDS).
- Division of Technical Support (SGTS) comprising the following sections:
  - Technical Support Coordination (TTS);
  - Inspection Logistics (TIL);
  - Surveillance, Seals and Remote Monitoring (TSR);
  - Attended and Unattended Non-destructive Assay (TAU).
- Division of Concepts and Planning (SGCP) comprising the following sections:
  - Concepts and Approaches (CCA);
  - Process Design (CPD);
  - Programme and Resources (CPR);
  - Safeguards Training (CTR).

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INTERNATIONAL ATOMIC ENERGY AGENCY
VIENNA
ISBN 978–92–0–104707–6
ISSN 0074–1884