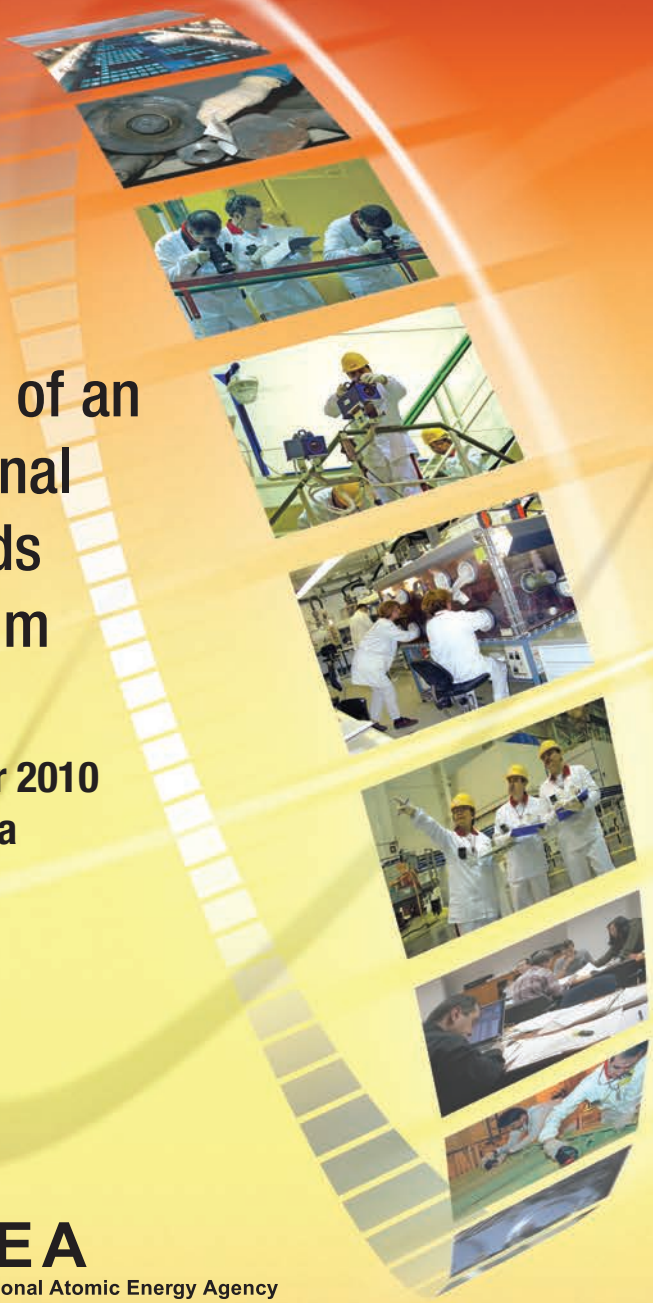
Preparing for Future Verification Challenges



Summary of an International Safeguards Symposium

1–5 November 2010
Vienna, Austria

IAEA
International Atomic Energy Agency

PREPARING FOR FUTURE VERIFICATION CHALLENGES

PROCEEDINGS SERIES

PREPARING FOR FUTURE VERIFICATION CHALLENGES

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ORGANIZED BY THE INTERNATIONAL ATOMIC ENERGY AGENCY
IN COOPERATION WITH
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AND THE EUROPEAN SAFEGUARDS RESEARCH
AND DEVELOPMENT ASSOCIATION
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FOREWORD

IAEA safeguards symposia are important forums for substantive and detailed interaction between the Secretariat of the IAEA, its Member States and the international community on safeguards and verification issues. The 11th Symposium on International Safeguards, Preparing for Future Verification Challenges, was held in Vienna, from 1 to 5 November 2010. 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 aim of the symposium was to help the IAEA to prepare for future verification challenges by engaging in dialogue and information exchange with Member States, technical experts, the nuclear industry and members of the broader safeguards and nuclear non-proliferation community.

The main topical areas of this symposium were drawn from the Department of Safeguards' Long Term Strategic Plan (2012–2023). Discussions ranged from conceptual considerations such as safeguards approaches and performance evaluation to issues of organizational culture, knowledge management and professional development.

This book contains the addresses and statements given at the opening session and the closing session. It also summarizes the technical plenary session, the oral presentations, the forums and the panels at the 37 sessions of the symposium. The invited papers presented during the various topical sessions as well as papers exhibited at the poster sessions and the forum and panel summaries are available on the IAEA web site.

The IAEA gratefully acknowledges the cooperation and support of the organizations and individuals involved in the symposium. The IAEA officer responsible for this publication was M. Nicholas of the Division of Concepts and Planning.

EDITORIAL NOTE

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D. Waller

Deputy Director General,
Department of Management,
International Atomic Energy Agency

Ogden Nash, writer and humorist, jokingly said, “Progress might have been all right once; but it’s gone on far too long.” Well, not so when it comes to safeguards! The environment in which the IAEA conducts nuclear verification needs and welcomes, indeed it demands, continuous progress. And it is to that end that this periodic rendezvous, the Symposium on International Safeguards, gathers together those most expert, those most interested, those with the most at stake, when it comes to safeguards.

Our objective at these gatherings, whether participating as a representative of a Member State, academia, industry, a non-governmental organization, the IAEA’s Secretariat, or from elsewhere in the non-proliferation community, is to take stock of that progress and to consider ways to build on it — particularly in the light of the challenges ahead — and to thereby enhance the effectiveness of the international safeguards regime. As you have just heard, this is the eleventh in the series of safeguards symposia. The first one was held back in 1970, hosted by the Federal Republic of Germany in Karlsruhe. Earlier that year, the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) had entered into force, bringing a vast increase in the scope and extent of IAEA safeguards. Against that backdrop, that first symposium sought to review available experience in applying safeguards, discuss results of R&D and broaden the exchange of information. That symposium was well attended and viewed as having been extremely valuable; and, thus, the series we continue this week was born.

So, a warm welcome to all of you — and not only to those here in this room, but also to those in neighbouring conference rooms and on the Internet, to whom these proceedings are being streamed. Thank you all very much for your participation in this critical endeavour. And, of course, a special thanks to the IAEA’s co-sponsors, the INMM and ESARDA. You will be hearing shortly from their Presidents, Scott Vance and Elina Martikka.

The most recent of the previous symposia in this series — the one held in 2006 — provides a good baseline against which we can measure the latest advancement in safeguards, both within the IAEA itself and in the broader world. Within the IAEA, the most fundamental change has been in its senior-most leadership. Yukiya Amano was, of course, elected Director General last September

and took up office nearly a year ago. As many of you know, his experience in the world of non-proliferation and disarmament diplomacy is long, deep and impressive. It has included his active participation in all NPT review conferences since 1995 and the chairmanship of the 2007 Preparatory Committee.

I first met him during his tenure as Ambassador and Director-General of the Disarmament, Non-Proliferation and Science Department at the Foreign Ministry in Tokyo, where he was seen as the 'go-to guy' on verification and other nuclear issues. He became Japan's Permanent Representative to the IAEA in 2005 and almost immediately was elected Chairman of the Board of Governors. He continued to serve here as Japan's Ambassador until his election last year as Director General.

And, more recently, in fact just two months ago, Herman Nackaerts was appointed Deputy Director General in charge of the Department of Safeguards, succeeding Olli Heinonen. Herman has been in the Safeguards Department since 2006, having joined the IAEA after more than two decades in senior positions in the European Commission. Within the Section for Euratom Safeguards, he was, at various times, in charge of Strategy and External Relations, Logistics and Information Technologies, and Safeguards Inspections.

By the way, the change in the IAEA's senior leadership goes even further. New Deputy Directors General have recently been appointed to head each of the IAEA's three other technical Departments — those dealing with nuclear energy, nuclear applications, and nuclear safety and security — as well as a new Head of the Department of Technical Cooperation. These — together with several recent or pending Director-level appointments — represent the most wide-ranging change in senior leadership in the IAEA's history.

We've also experienced physical change. We meet today in a building whose construction had only just begun in 2006. Although the symposium that year was held here at the Vienna International Centre, it took place in what we call the Rotunda or C Building, with the plenary sessions in our old Board of Governors' Room. Well, as you may have seen, that C Building is now largely shrouded in white protective drapes, behind which our landlord, the Austrian Government, is engaged in an intensive process of asbestos removal. It was in conjunction with that undertaking, and the growing shortage of meeting and conference space, that Austria generously provided this new facility — the 'M Building'. But physical change these past four years has not been limited to here at Headquarters. In a 2007 report, the IAEA's Board of Governors was advised that the Secretariat's ability to provide independent and timely analysis of safeguards samples was deteriorating and at serious risk. This, the report warned, was due to ageing technical infrastructure and the concern about increasingly obsolete equipment in the Safeguards Analytical Laboratory (SAL) located at our facility in nearby Seibersdorf.

For those not so familiar with SAL, it has two main components: the Nuclear Material Laboratory, which performs destructive analysis of both nuclear and radioactive environmental samples, and the Clean Laboratory, which screens and performs analysis on essentially non-radioactive environmental samples. An overall remediation plan was presented to the Board in 2008. It consisted of two phases. First was the acquisition of a large geometry secondary ion mass spectrometer, SIMS for short. And, to house it, an extension to the existing Clean Laboratory — to be built on land provided by the Austrian Government immediately adjacent to the existing facilities. And, second, the construction of a new Nuclear Material Laboratory on this new parcel of land. The overall remediation project was given the unwieldy name "Enhancing Capabilities of the Safeguards Analytical Services", leading, of course, to the birth of yet another acronym — ECAS.

The ground breaking ceremony for the extension to the Clean Laboratory took place at the end of March this year — an event the Director General used to underscore the high priority he assigns to maintaining and enhancing our independent analytical capabilities. Construction of the Clean Laboratory extension is now well under way. The mass spectrometer has been procured and the first factory tests successfully completed. IAEA staff are undergoing training, and the Laboratory is expected to be fully operational in the first half of next year. As far as the new Nuclear Material Laboratory is concerned, award of the contract for detailed design and engineering is on schedule to occur in December. This will support ground breaking and start of construction in the summer.

Although there is strong support among Member States for ECAS, the project is heavily dependent on voluntary contributions in what is, needless to say, a most challenging economic environment. Thus far, generous contributions have been pledged by the Czech Republic, the European Commission, Germany, Ireland, Japan, the Republic of Korea, Spain and the USA. Considerably more funding will have to be secured, but we hope to be able to move ahead on schedule.

In the four years since the 2006 symposium, the advancement in related technology has also continued. In that regard, I often find myself trying to explain the IAEA's safeguards system to those having little familiarity with our work, beyond what is in the news. I tell them that in the early years, safeguards inspectors were a bit like 'green eyeshade' accountants, checking to be certain that an inventory of nuclear material that had been provided to us by a country was all present and accounted for. But, as I explain, over the years this has evolved — especially following the 'wake-up call' in the early 1990s that came with the discovery of the clandestine weapons programme in Iraq. Since then, our typical inspector has increasingly become less accountant and more forensic investigator. And, this evolution is, of course, thanks in large part to continuing progress in the

relevant technologies — both those related to inspections themselves, and to the evaluation of the information gained from our ever-increasing variety of sources. New, sophisticated tools can be used to mine data from the Internet, including satellite images. And forensic Googling has become a key part of the safeguards culture. Of course, enhanced capabilities such as these also bring challenges — particularly in terms of processing and securing the enormous increase in the volume of raw data.

The physical presence of inspectors at facilities will always remain crucial. However, these advancements increasingly enable our inspectors to perform here at the Vienna International Centre (VIC) more of the work that previously could only be performed at nuclear facilities scattered around the world. And there is no question that this offers us opportunities for savings in terms of reduced travel costs and less of the inspectors' time spent in transit. And reducing costs is vital, particularly given the severe restrictions on our financial resources — more about that in a moment. But what about changes in the broader world since 2006? There has, of course, been a litany of encouraging external developments related to safeguards, and the parallel subject of disarmament. You are well aware of these events, but, for the sake of context, let me quickly mention some of the key ones.

In 2008, a Commission of Eminent Persons (the '20/20 Commission'), under the Chairmanship of former Mexican President Ernesto Zedillo, laid out what it saw as the challenges the IAEA would face up to that year, 2020, if not beyond. The report called for strengthened IAEA safeguards with "access to additional information, sites and people, along with the money, qualified personnel and technology" that it needed. It also devoted an entire chapter to what it called "Substantive and Rapid Progress in Nuclear Disarmament". And, by the way, we are very pleased that one of those 20/20 Commissioners, former Australian Foreign Minister Gareth Evans, a highly valued friend of the IAEA, is with us and will address the symposium in this opening session. The following year, 2009, saw the entry into force of two new nuclear weapon free zones, in Africa and Central Asia, bringing an additional 58 countries under the umbrella of such zones and adding momentum to the consideration of such treaties elsewhere. That, too, was the year in which a newly elected US President spoke in Prague of "America's commitment to seek the peace and security of a world without nuclear weapons" and called for "more resources and authority [for]…international inspections". In awarding him its Peace Prize later that year, the Norwegian Nobel Committee remarked that "[His] vision of a world free from nuclear arms has powerfully stimulated disarmament and arms control negotiations."

Also in December of 2009, the report of the Australian–Japanese Commission on Nuclear Non-Proliferation and Disarmament was issued.

This time, Gareth Evans had served as one of the two co-chairs. His commitment to both the important work of that commission and, thereafter, to 'selling' it around the world was extraordinary. I will defer to him to summarize the report. Then, in April of this year, leaders of nearly fifty countries — together with Director General Amano and the UN Secretary General, as special invitees — gathered for the Nuclear Security Summit. These Heads of State and Government reaffirmed the essential role of the IAEA and pledged to ensure that it had the resources to do its job properly. Shortly thereafter, back in Prague, was the signing of the Russian and US New START treaty. And, that was followed in short order by the successful conclusion of the NPT Review Conference, with over sixty actions agreed on across the three pillars of that treaty — disarmament, verification and technology transfer. There was express reaffirmation of the IAEA's role in verification and the promotion of peaceful uses.

Meanwhile, the number of countries that have additional protocols in force has risen to over one hundred. That, of course, greatly strengthens the IAEA's ability not only to detect any diversion of declared nuclear material but also to detect the presence of any material or activities that have not been declared. It is quite a litany, and those are just the highlights. On a personal note, in the midst of all this — in spring of last year — I received a telephone call from former US Secretary of State George Schultz. In recent years, we have come to know him — together with Henry Kissinger, former Senator Sam Nunn and former Defense Secretary William Perry — as the "Four Horsemen", for their powerful call for the elimination of nuclear weapons. Schultz said that he was heading to Moscow in a few days to join the other 'Horsemen' for talks with Russian President Dmitry Medvedev. He said he would like to stop in Vienna en route to Moscow. And he asked me to host a luncheon for him — here at the VIC — so that he could have the benefit of engaging with a group of the Ambassadors to the IAEA. Schultz interacted with those Ambassadors for two and a half hours, and his message regarding the elimination of nuclear weapons was strong.

Ladies and gentlemen, one might assume that all these external calls for strengthening safeguards, and for providing the resources necessary to do so, would translate into ample funding to meet the IAEA's increasing safeguards workload. Yes and no. But, before explaining that ambivalent answer, let me put the issue of funding in perspective by repeating the fact that the annual budget for our safeguards work worldwide — approximately €150 million — is less than the annual budget of the police department of the city of Vienna. 'Yes', the IAEA's Member States have provided some additional funding over the years. They have consistently recognized the uniqueness and importance of its verification mandate. And, many have noted the 'value for money' they get from their annual investment. But, particularly in these times of financial crises, with massive budget cutting exercises under way in many of our Member States, any

significant increase for the foreseeable future is unlikely. Many Member States will continue to advocate — as they have for much of the past quarter century — for a budget policy urging ‘zero growth’ in funding for the United Nations and other international organizations, across the board. The financial area, unfortunately, is one in which progress is less apparent. But financial constraints only make it all the more necessary to find innovative and constructive solutions to future verification challenges. How do we best prioritize our limited resources so as to provide maximum confidence that nuclear material worldwide is being used exclusively for peaceful purposes? Your deliberations this week are critically important in helping us address these issues. I thank you, again, for your commitment.

OPENING STATEMENT

H. Nackaerts

Deputy Director General,
Head of the Department of Safeguards,
International Atomic Energy Agency

The nuclear landscape is constantly evolving. Global interest in nuclear power generation is increasing. We can expect growing international nuclear cooperation between States, with an expansion of trade in nuclear and related equipment, items and materials.

At the same time, many Member States are expecting more from the IAEA and its Safeguards Department. For example, new roles for the IAEA are being discussed in the field of disarmament, and our safeguards activities are now increasing rapidly in India. Moreover, a number of important issues fill the agenda of IAEA Board meetings: we have outstanding issues to resolve with the Islamic Republic of Iran (Iran) and the Syrian Arab Republic, and the Democratic People's Republic of Korea (DPRK) ceased all cooperation with the IAEA last year. All this will significantly affect the IAEA's safeguards system in the years ahead, offering both challenges and opportunities to the IAEA and its Member States.

Our main, overall challenge, however, remains to further enhance our capability to detect early any possible undeclared nuclear material and activities in a State. So, how can technology, science and innovation help us meet these challenges and help us remain a leader in verification and safeguards, keeping us one step ahead of those who want to defeat the system? Clearly, we need to address the proliferation risks that originate from the wider use of sensitive nuclear technology, particularly by enhancing the detection of the misuse of enrichment and reprocessing technologies. We can do this, partly, by improving and making better use of technological innovation.

The likely emergence of new types of nuclear reactor along with complex and large scale facilities will require the IAEA to develop dedicated safeguards approaches, techniques and equipment well in advance, so that safeguards can be built into the original design of the facility. Here, it will be important that the IAEA works with States and facility providers, as well as operators, to design and operate 'safeguards friendly' nuclear installations in ways that facilitate efficient and effective verification. The task of establishing and maintaining a pool of cutting-edge technical instrumentation for verification is a challenging one. We continue to strive for improvements in the reliability, precision, versatility and standardization of equipment. Instruments need to be sufficiently robust to

work in the field and must be user friendly for inspectors. The same is true for containment and surveillance technologies.

Having state of the art verification technology has also become an important requirement for the detection of clandestine nuclear activities. Here, we do need to strengthen our capabilities, especially with regard to satellite imagery, information analysis and environmental sampling. The increasing number of special or environmental samples we are taking, in turn, requires us to improve our laboratory capabilities and to expand the network of analytical laboratories operating in a number of Member States. Some of the necessary improvements are already under way through implementation of the Enhancing Capabilities of the Safeguards Analytical Services (ECAS) project, which was mentioned by David Waller earlier. This involves the enhancement of our analytical services through the modernization of the Nuclear Material Laboratory at Seibersdorf and the extension of the Clean Laboratory, which is part of the Environmental Sample Laboratory.

The need for the IAEA to independently assess the composition and characteristics of nuclear materials, or other materials that are relevant to safeguards, will become a focus of future technological development. In this respect, we would benefit from access to enhanced analytical and forensic techniques. These would enable us, for instance, to date nuclear material, to determine the origin of nuclear material or to look for traces of undeclared activities, indeed to answer any number of safeguards relevant questions with which our inspectors may be confronted. In this respect, the IAEA would also benefit from access to the forensic databases of Member States.

Nothing can substitute for the presence of inspectors on the ground. And, indeed, on-site access is the main ‘added value’ this organization can provide. Nevertheless, the availability of remotely acquired information can be extremely useful to make our work more effective and efficient. In this respect, we will soon be benefitting from our next generation surveillance system, designed to provide a modern and secure environment that will allow us to easily record and store authenticated and tamperproof surveillance data, and to transmit them to IAEA Headquarters here in Vienna.

Clearly today the processing, analysis and evaluation of safeguards relevant information back at Headquarters has become an essential part of the IAEA’s safeguards regime. This includes the identification of indirect as well as direct indicators. Here, I am thinking of trade patterns, procurement and R&D activities carried out by a State of concern. The identification of such indicators enables us to build up a more complete picture of a State’s nuclear activities and to do so more quickly and efficiently. To help us acquire, process, analyse and disseminate all this information, we will be gradually implementing a new system of ‘integrated analysis’. We have established the foundation of this approach

through the IAEA Safeguards Information System Re-engineering Project, or IRP. We are also pursuing mobile communication systems that will enable us to achieve near real time information exchange between inspectors in the field and analysts at Headquarters. And as we implement these improvements, we need to exercise constant vigilance to ensure the protection of sensitive information by strengthening our information security procedures, infrastructure and policy.

Let me turn now to how we see the IAEA's conceptual approach evolving. It is true to say that prevailing safeguards concepts and approaches were largely developed some twenty or more years ago and are still very much prescriptive and criteria driven. It is clear to us within the IAEA, and has been for some time, that we need to further develop our conceptual approach to safeguards implementation — an approach that makes better use of all information available to the IAEA in defining State-specific approaches and associated verification activities. In that respect, we have been helped by the different strengthening measures agreed upon in the 1990s and the approval of the Model Additional Protocol in 1997, which has enabled us to gain access to a much wider range of information and locations. Our challenge today is to apply safeguards more effectively and more efficiently at a time of rising demand for our services and a static IAEA Regular Budget. In other words, we need to further optimize the use of our resources by avoiding unnecessary effort and focusing instead on that which is most important. But, at the same time, we must not compromise our ability to draw independent and soundly based safeguards conclusions, and we must continue to apply safeguards in a fair and non-discriminatory manner to all States.

This is why we need to move further away from an approach that is narrow, prescriptive, criteria-driven and focused at the facility level to one that is more objectives driven, customized and focused at the State level. This makes sense because we need to be guided by objectives rather than procedures, concerned with outcomes rather than process. The IAEA's implementation of safeguards for any given State, therefore, needs to be flexible and driven by all the safeguards relevant information available to us about that particular State — information that we derive from obligatory State declarations and other reports, from the IAEA's own verification activities and from all relevant sources. It is upon an evaluation of all this information that we plan and implement our verification activities and ultimately draw our safeguards conclusions for each State.

This 'State evaluation process' is a dynamic, robust and iterative process. The evaluation results are then used as the basis for planning subsequent safeguards activities. The results of those activities, in turn, are themselves assessed and any follow-up actions identified – for example, whether additional information is required or further verification activities need to be conducted. So, if the information and evaluation change, so does our safeguards' approach

in that particular State. Thus, safeguards implementation at the State level is "information driven". Let me be clear here as to what we are not proposing. We are not proposing to implement a different safeguards system, or to discriminate against certain States or categories of States. All States will remain subject to the same rules and overall objectives as before — subject to the agreements they have signed with the IAEA.

There are also implications of this new approach for the IAEA. We will need to revise some of our business processes and responsibilities as well as make changes to the organization itself. In addition, the skill sets within the Department of Safeguards and of the inspectors themselves need to be enhanced. Instead of just being accountants, our staff also need to be investigators and analysts — professionals who are curious, with broad experience; who are persistent but diplomatic; who exercise sound professional judgement; and who can report their findings in a clear and impartial way. In addition, the IAEA as a whole needs to adopt a truly 'one house' approach, whereby synergies between departments are fully exploited.

Let me turn briefly to our legal authority. In order to provide credible assurances to the international community, it is clear that we require adequate legal authority to conduct our verification work effectively. Here, we are not necessarily seeking new powers. Rather, we need to ensure that we are making full use of the legal authority already available to us. Are we, for example, making full use of the authority granted to us under comprehensive safeguards agreements, especially in those States where an additional protocol is not in force? This is an area we would like to explore further. We also need to encourage more States to sign up to — and bring into force — an additional protocol, especially those with significant nuclear activities. And we need more States with small quantities protocols to amend or rescind them in line with the Board of Governors' decision of 2005.

In recent years, a number of developments have tested the nuclear non-proliferation regime, such as the DPRK's nuclear tests, the ongoing concerns over Iran's nuclear programme, issues raised by non-Parties to the NPT and the growing influence of non-State actors. All this has put a strain on the NPT which, in turn, puts pressure on the Treaty's executive verification body, namely, the IAEA. I look forward to hearing what Gareth Evans has to say on the wider issues of nuclear non-proliferation and disarmament, and possible roles that the IAEA might play.

All these developments highlight the evolving nature of the IAEA's operating environment and the importance of adapting to change and continually improving both the effectiveness and the efficiency of the safeguards system. There are other factors to consider too. For instance, as we move forward, our staff training will need to reflect the evolution in institutional culture required

by our new conceptual approach. To continue to attract staff of high calibre, we will have to compete with industry and national administrations over a small and potentially shrinking pool of qualified nuclear professionals. And — understandably, in this time of financial hardship — we are also faced with the prospect of an IAEA budget that is not increasing commensurately to meet the global challenges faced by the IAEA.

So, ladies and gentlemen, yes, the challenges are numerous and substantial. But I believe the IAEA has the right vision, the proper conceptual approach and the motivated staff necessary to tackle those challenges, overcome them, and move forward as a modern, effective and efficient organization serving global security. But in order to do so, we need the help of all of you.

We need Member States to fully meet their safeguards obligations and facilitate the IAEA's work by providing timely, correct and complete information, and by demonstrating transparency. In particular, I would like to call on all Member States to ensure that their State system of accounting for and control of nuclear material (SSAC) has the necessary legal authority to do its job properly and that it is fully cognizant of all nuclear and other relevant activities in the country. Indeed, we need to find ways to enhance our cooperation with SSACs and regional systems of accounting for and control of nuclear material, and to better utilize the safeguards expertise and capabilities that reside within our Member States.

We need the assistance of the scientific and technical community to provide us with the requisite technologies to keep us at the cutting edge of information collection, analysis, equipment, and verification capabilities. The continued assistance of Member State Support Programmes will remain vital in helping us to stay at the cutting edge of verification technologies.

We welcome and fully support the numerous initiatives launched by Member States, such as the USA's Next Generation Safeguards Initiative, aimed at promoting the strengthening of nuclear safeguards worldwide, and the support provided by Member States to build our new laboratories in Seibersdorf, and last but not least, the tremendous support provided through the different Member State Support Programmes. We also need the help of think tanks, non-governmental organizations and academia to provide critical analysis of our activities and to help us build wider international support for the work of this IAEA and its contribution to non-proliferation.

I have every expectation that this symposium will prove to be a success. I appreciate your participation, and the various expertise and ideas that you bring to the table. In addition to the political and financial support we receive from Member States, we need your practical and intellectual support. By bringing together the leading experts in the field from across the world, this safeguards symposium aims to provide an opportunity for stakeholders to jointly explore

possible solutions to the various current and future challenges that confront us, and thereby to support the IAEA's verification mission. Today, I have made clear our determination to accelerate the IAEA's move towards a safeguards system that is fully driven by the use of all the safeguards relevant information available to us.

By not implementing safeguards in a one-size-fits-all approach, but, instead, by being responsive to change and flexible in our approach, we can ensure the more efficient implementation of more effective safeguards. In this way, the IAEA, with your support, can continue to play a vital role within the nuclear non-proliferation regime in the years ahead.

OPENING STATEMENT

S. Vance

President,
Institute of Nuclear Materials Management
Chicago, Illinois,
United States of America

It is with great pleasure that I join the representatives from the IAEA and the European Safeguards Research and Development Association to welcome you here on behalf of the Institute of Nuclear Materials Management. All of us are very pleased that you have joined us to consider future verification challenges.

Established in 1958, INMM has been assisting nuclear materials management professionals to prepare for future challenges for over 51 years. While we do not focus exclusively on verification, this is a significant aspect of nuclear materials management, and INMM fully supports the goals of this safeguards symposium. If you are unfamiliar with INMM, we are an international professional organization that is dedicated to the advancement of nuclear materials management in all its aspects and the promotion of research in the field of nuclear materials management. We seek to do this through the establishment and support of professional standards, education, professional recognition and the dissemination of information. If you have an interest in promoting excellence in nuclear materials management, I encourage you to consider attending our next Annual Meeting, which will be held 17–21 July 2011, in Palm Desert, California, United States of America.

I commend the organizers of this symposium for the comprehensive discussion that they have planned. Scheduled sessions include discussions of the potential impact of a variety of organizational and technological changes and how they may affect the implementation of effective verification.

As I considered these topics myself, it occurred to me that we may have some of the most significant future challenges of any generation that has considered how to implement effective nuclear material verification. I came to this conclusion based on the reality that we are at the emergence of not only technological and political changes that will affect this work, but actually a complete change in attitude about information. To illustrate this point, consider a comparison between your parents, yourself and your children. Like me, you may remember the emergence of email and have witnessed first-hand the birth of the ability to instantly send someone a request for information. This concept

continues to be somewhat elusive to my parents, but it is actually hopelessly archaic to the next generation. My sons now carry their smart phones and are constantly texting information back and forth to their contacts. They expect that everyone they know be constantly and instantly available. What does this have to do with nuclear material verification? I suggest that this represents a radical change in expectations regarding the availability of information that will impact the approach the next generation takes to nuclear security. This is more than just a technological advance; it is a change in expectation regarding information exchange and what delay is acceptable for receiving information. As an attorney for the largest US public utility, Tennessee Valley Authority, I suspect that this change in attitude will have long term impacts on nuclear verification activities that we have not even considered.

Again, I welcome you and invite you to enjoy the symposium.

OPENING STATEMENT

E. Martikka

President,
European Safeguards Research and Development Association

It is my honour and great pleasure to give the opening statement on behalf of the European Safeguards Research and Development Association (ESARDA). The name of the eleventh international safeguards symposium, "Preparing for Future Verification Challenges", is promising. It is worth recognizing how much and how quickly the world is changing. These are crucial times in terms of both concern and of hope. We remember the Chernobyl nuclear power plant accident 24 years ago. We can say that there was nuclear safety before the Chernobyl accident, and nuclear safety after the Chernobyl accident. The same can be said about nuclear security. After the terrorist attack of 11 September 2001, we became aware of the risk of a terrorist attack using nuclear or radioactive materials. Traditional safeguards, which means that nuclear materials are being used as declared, have been implemented successfully for many decades. But during that time, it was still possible to have a clandestine or secret nuclear weapons programme. Big changes in the world of safeguards had to be made. The additional protocol to safeguards agreements and the implementation of integrated safeguards were some of these changes. It seems that very often an accident, an attack or some other clandestine activity has to occur before a change takes place. Today, nuclear safety, security and safeguards are better in balance with the risks — but for how long?

ESARDA is also the result of change. The world was not the same after the Second World War. In the light of the knowledge that there is an effective way to destroy a large part of our planet in a split second, many actions were taken to ensure that our world would remain a safe place, even with nuclear energy being used. In 1957, the IAEA was set up as the world's "Atoms for Peace" organization within the United Nations family. Also in 1957, the European Atomic Energy Community (Euratom) was established under the Treaty of Rome. The 1960s were a period of intense R&D activity in safeguards, and ESARDA was created in 1969 with the purpose of facilitating collaboration in safeguards R&D.

The main task of ESARDA is to advance and harmonize R&D in the area of safeguards. It is also a forum for the exchange of information and ideas between nuclear facility operators, safeguards authorities, and organizations and people engaged in R&D. ESARDA aims to bring together all those involved in safeguards, so that progress and continuous improvement in international

safeguards can be achieved efficiently and to professional standards. The principal issues are coordination of research, exchange of information and joint execution of R&D programmes.

The heart of ESARDA activities are its Working Groups, which were established to promote and undertake collaborative R&D and information exchange in particular fields. ESARDA has nine Working Groups covering:

— Destructive analysis, non-destructive analysis, containment and surveillance, safeguards implementation, integrated safeguards, and nuclear material accounting and control;
— Training and knowledge — we note that over the past six years, ESARDA has educated more than 250 students, and that in 2011, ESARDA will run three courses — in Ispra (Italy), France and Sweden;
— Verification technologies and methodologies, and the latest in novel technologies and approaches.

The Editorial Committee, which takes care of all external communications, publishes the ESARDA Bulletin, and organizes biennial meetings and symposia.

During its 40 year history, ESARDA has been active in building an effective European safeguards world and has reached a remarkable position in the international safeguards community. Success has followed from responding to the needs of our customers.

To be successful in the future, we must be sensitive to changes and challenges in our operational environment, and understand how our customers and their needs are developing and changing. During the past year, the ESARDA Steering Committee set up a new Reflection Group, with the task of assessing the international and European context, and the trends in nuclear non-proliferation and safeguards, security and disarmament verification areas, and their impact on ESARDA's R&D activities. The Reflection Group is analysing whether further actions and activities are needed in order to meet our members' needs. It seems that the extent of ESARDA activities will grow in the future; we see nuclear safety, security, export control, border control, new technologies, nuclear networking and training ahead of us when we envision safeguards R&D activities for the future. The Group will report its results at the beginning of next year, and a presentation of ESARDA's new vision will be given at the ESARDA symposium.

I have to add that occasionally ESARDA meetings have been rather too well timed. Last year, just a day before the ESARDA symposium in Vilnius, the Democratic People's Republic of Korea carried out its second nuclear test. The nuclear test and matters relating to it belong to ESARDA's field of activities; this nuclear test was one of the most discussed topics at the meeting. During ESARDA's meeting in Helsinki in 1998, India and Pakistan carried out nuclear

tests. It is our hope that, in the future, a habit will not be made out of carrying out nuclear testing at the same time as ESARDA's meetings.

Now I am sure that you are interested in participating in ESARDA's meetings. The next ESARDA symposium will take place in Budapest 16–20 May 2011. Also, ESARDA and the INMM will organize their next joint meeting in Aix-en-Provence, France, 16–20 October 2011. You will find more information about ESARDA in the "ESARDA corner" during the poster session.

I started with change, and I would like to conclude by saying that the world is changing, and also safeguards need to change. After the additional protocol, safeguards are no longer only about accounting and control of nuclear materials, but also about verifying that there are no undeclared nuclear materials and activities. It is important to remember that, for the Member States, safeguards and verification are a prerequisite for the peaceful use of nuclear energy. Safeguards are and will remain of growing importance in the future when new nuclear power plants and facilities are constructed. It is very important to have a good vision of what safeguards are expected to be and of what the needs of safeguards customers are. What safeguards will there be for the next generation of nuclear power plants and nuclear fuel cycle facilities, and for geological repositories of spent nuclear fuel? We have to determine these things now because these facilities will be under construction very soon. It should, indeed it must be possible, in the near future, to order a nuclear facility as a package on a turnkey basis, including safety, security and safeguards. Our common goal has to be to ensure that development of the safeguards concept will meet the new challenges in the field.

I hope that we will remember in these interesting days that this is not only a meeting with presentations but also a forum for meeting colleagues and friends, and exchanging some new ideas or means of action for our own work. I wish you a very challenging meeting!

NUCLEAR NON-PROLIFERATION AND DISARMAMENT: WHERE NEXT?

G. Evans

Co-Chair,
International Commission on
Nuclear Non-Proliferation and Disarmament

Let me come straight to the point: We are still at a real watershed with respect to the whole nuclear non-proliferation and disarmament project, about which hopes have been so high for most of the last two years, especially following the political breakthrough of the election of a US president totally committed to the ultimate achievement of a nuclear weapon-free world. Unless the key players in the international community, and there are many that matter in this context, not just the United States of America and the Russian Federation, get really serious about moving forward on the multiple critical agenda issues that face us — not just safeguards, the subject of this symposium, but right across the whole spectrum of non-proliferation, disarmament and peaceful-uses challenges — there is a very real danger that such remaining momentum for change as there is will stall, that the whole project will fall apart, and that we will be condemned to live for the indefinitely foreseeable future in a nuclear world that is very dangerous indeed.

The prevailing sentiment after the May Nuclear Non-Proliferation Treaty (NPT) Review Conference was one of relief — that the conference had not broken down as it did in 2005 and that catastrophe had been avoided; in effect, that this particular watershed point had been passed. But the positive gains from that conference, when objectively assessed, were negligible on crucial NPT regime strengthening issues, and, with the possible exception of the agreement to hold a Middle East conference in 2012, very slight indeed elsewhere.

And, weighing in the negative balance, there have been some serious disappointments on other key benchmark issues spelled out in US President Obama's April 2009 Prague Speech and on which real movement had been hoped for this year. Nothing has moved on Comprehensive Test Ban Treaty (CTBT) ratification by the USA or any other major nuclear power; negotiations on a fissile material cut-off treaty (FMCT) remain completely stalled; there is now real uncertainty about US ratification of the New START treaty with the Russian Federation, and with it any major new round of arms reduction negotiations; there has been less movement than hoped for in reducing the role and salience of nuclear weapons in national security doctrine; there has been no movement

on the file of the Democratic People's Republic of Korea (DPRK); and concern about the intentions of the Islamic Republic of Iran (Iran) remain as strong as ever. About the only ray of real light for the year has been the substantial measure of agreement achieved at the Washington Summit on nuclear security issues and cooperative implementation of the global anti-terrorism agenda.

In my own approach to difficult international policy issues, I usually err on the side of congenital optimism, and it *is* possible to see the glass as half full rather than half empty on most of the specific issues I have mentioned — and others as well, such as the question of multilateralization of sensitive stages of the fuel cycle on which the IAEA Board of Governors has already expended so much time and energy. The road ahead — as mapped in detail, for example, in the report last year by the International Commission on Nuclear Non-proliferation and Disarmament (ICNND), with which I hope you are familiar — was always going to be long and slow. But everything depends on some real momentum being sustained. If that momentum is lost, as it was during the fifteen years or so of sleepwalking that followed the initial flurry of disarmament activity in the early post–Cold War years, and looks in real danger right now of being completely lost again, it is not easy to see how it will ever be regained. And that is very bad news indeed for this planet.

It is worth reminding ourselves on these occasions, although the facts and arguments are familiar enough to this audience, *why* such an outcome would be such bad news, and why it is that the work that is done at symposiums and conferences like this matters so much. The truth of the matter is that the threats we face are not remote or trivial, but real, immediate and immense. Confronting them now is not a matter of choice but necessity. Complacency is not an option.

Threat number one comes from the existing stockpile. Despite the big reductions which occurred immediately after the end of the Cold War, there are at least 23 000 nuclear warheads still in existence, with a combined destructive capability of 150 000 Hiroshima-sized bombs. Over 9000 of them are in the hands of the USA, around 13 000 with the Russian Federation and around 1000 with the other nuclear-armed States combined (China, France, the United Kingdom, India, Pakistan, Israel and, at the margin, the DPRK). More than a third of all these weapons, over 7000, remain operationally deployed. And, most extraordinarily of all, over 2000 of the US and Russian weapons remain on dangerously high alert, ready to be launched on warning in the event of a perceived attack, within a decision window for each President of four to eight minutes.

Given what we now know about how many times the very sophisticated command and control systems of the Cold War years were strained by mistakes and false alarms; given what we know about how much less sophisticated are the command and control systems of some of the newer nuclear-armed States; and given what we both know and can guess about how much more sophisticated and

capable cyber offence will be of overcoming cyber defence in the years ahead, it is sheer dumb luck — not a matter of good political leadership or the inherent stability of the weapons systems that have evolved — that there has not to date been a nuclear weapons catastrophe, and utterly wishful thinking to believe that luck can continue in perpetuity. As the Canberra Commission put it starkly and succinctly in 1996: so long as any nuclear weapons remain anywhere, they are bound one day to be used, if not by design, then by mistake or miscalculation.

We have been even closer to catastrophe in the past than most people know. Communications satellite launches have been mistaken for nuclear missile launches; demonstration tapes of incoming missiles have been confused for the real thing; technical glitches have triggered real time alerts; live nuclear weapons have been flown by mistake around the USA without anyone noticing until the plane returned to base. About the only consolation to be derived from this comedy of errors, if anything so serious can be called a comedy, is the very recent revelation that for several months of his presidency, Bill Clinton completely mislaid the nuclear codes he was supposed to carry in his pocket at all times, which means that a US retaliatory nuclear strike could not in fact have been authorized even had anyone wanted to.

Threat number two is proliferation — new States adding new stockpiles, with all the risks of deliberate or inadvertent use that come with them. So long as any State retains nuclear weapons, others will want them, for reasons that may be wrongheaded but have their own force: maybe to buy perceived equivalent prestige in the case of relatively strong powers; or to try to buy immunity from attack in the case of weak ones. India, Pakistan and Israel have already joined the five original nuclear powers. The DPRK has thumbed its nose at the NPT and now has five or six nuclear explosive devices. Iran may or may not be preparing to follow suit; if it does, others in the region are bound to join in. The 'cascade' of proliferation which has been feared since the 1960s may not now be far away, at least in the wider Middle East.

Add to all that now risk number three: terrorist actors getting their hands on a nuclear weapon or the makings of one. We can no longer be under any illusions about the *intent* of certain messianic groups to cause destruction on a massive scale. And — although the probability is small, and probably lower than some alarmist accounts have suggested — their *capacity* should not be underestimated to put together a Hiroshima-sized nuclear device, using manageable technology long in the public domain and backchannel sourcing of the kind the A.Q. Khan network taught us to be alarmed about, and to explode it from the inside of a delivery truck in Trafalgar Square, or Times Square, or a small boat in New York harbour or on the Thames, causing in each case hundreds of thousands of deaths and injuries.

The fourth risk is associated with the likely significant expansion of civil nuclear energy in the decades ahead, in response not least to the need for non-fossil fuel contributions to baseload electricity generation — maybe a less dramatic expansion than the 'doubling plus' within twenty years that was originally widely predicted, but significant nonetheless, and with a number of new countries still likely to take up this option. The problem, as an audience of safeguards specialists will be well aware, is not so much with the power generating plants themselves, but with the new uranium enrichment or plutonium reprocessing facilities such countries may be tempted to build: so-called bomb starter kits of the kind that have caused so much anxiety in the DPRK and Iran.

The bottom line is this: Nuclear weapons are not only the most indiscriminately inhumane weapons ever invented, and for that reason alone worth every possible effort to eliminate, but they are also the only weapons ever invented that have the capacity to wholly destroy life on this planet as we know it. And the arsenals we now possess — taking into account the technical refinement of current weapons and their combination of blast, radiation and 'nuclear winter' effects — are able to do so many times over. The only remotely comparable existential threat is from global warming — and nuclear bombs will kill us much faster than CO_2. There is only one way we can be confident that this will never occur: stopping the further spread of nuclear weapons and reducing the existing stockpiles to zero.

So how do we get there? What needs to be done, and how well are we doing it? It is now generally accepted that, as the ICNND and others have framed the current debate, there are three big, interrelated objectives about which we have to get serious and, moreover, get serious simultaneously because they are closely interrelated:

First, *disarmament*, dramatically reducing the existing stockpile nuclear weapons and ultimately eliminating them;

Second, *non-proliferation*, holding a very tight line against new players coming into the weapons game and taking action to reduce the proliferation risks associated with any major expansion of civil nuclear energy;

Third, putting in place the *building blocks* for both disarmament and non-proliferation, three in particular — a comprehensive test ban treaty, a global ban on the production of any new material for fissile purposes, and effective measures of nuclear security to guard existing weapon and fissile material stocks against theft or diversion.

So, taking them in reverse order, let me take you through, in a little more detail, what getting serious means in each of these areas, how far have we come to date and what remains to be done.

It is difficult to overstate the importance of the CTBT as the first crucial building block for both non-proliferation and disarmament, setting as it does a

qualitative cap on the capacity of both existing weapons possessors and potential new ones to develop new nuclear weapons. But, although concluded in 1996, the treaty is still not in force, and the only thing stopping testing is a fragile voluntary moratorium. Entry into force specifically depends on ratification by nine States that have not done so — six that have at least signed it (USA, China, Indonesia, Egypt, Iran and Israel) and three that have not (India, Pakistan and the DPRK), despite constant, strong urging by the rest of the international community, including at the NPT Review Conference. Indonesia has announced that it will now move to ratification, but the crucial holdout is the USA: if Washington moves, this would be a real circuit breaker, certainly with China and India in the first instance (although there is no practical reason for either of these States to wait for the USA, and both would enhance their nuclear credentials if they were to pre-empt it). President Obama announced in Prague last year that he was determined to "immediately and aggressively pursue US ratification" but has so far been unable to deliver on that promise, with ever more aggressive partisan politics placing the necessary 67 Senate votes, for the time being at least, out of reach. Tomorrow's mid-term elections do not appear likely to make his task any easier.

The quantitative counterpart to banning testing is verifiably banning the production of further quantities of fissile material, highly enriched uranium or plutonium, for weapons purposes. That would be achieved by negotiating to conclusion the FMCT now before the United Nations Conference on Disarmament in Geneva. But despite years of skirmishing — and renewed statements of determination by nearly all the key players over the past two years to get the process moving, and with reasonably strong language coming out of the NPT Review Conference — negotiations remain completely paralyzed as a result of Pakistan refusing the necessary consensus to even let them commence (in a way that one suspects has not been entirely to the discomfort of at least two other currently nuclear-armed States that also appear to be keen to further add to their nuclear arsenals). It was hoped that the ministerial meeting convened in late September by the United Nations Secretary General in the margins of the General Assembly would do something to break this logjam, but it appears, to put it gently, to have been totally ineffectual in this respect. It is time for the great majority of States, who do want progress on this, to now either seek a separate mandate from the UN General Assembly or negotiate informally a treaty text and open it for signature. And in the meantime, seek a voluntary moratorium on the production of fissile material for weapons purposes.

The only reasonably good news on the building blocks front is in the area of nuclear security, where President Obama's Washington Summit in April did secure agreement from all the key players to put maximum effort into the effective practical implementation of the multiple treaties, resolutions, arrangements and

cooperative threat reduction programmes already in place — many of them agreed after 11 September 2001 — designed to put so-called loose nukes (i.e. nuclear weapons and materials insufficiently guarded against theft or diversion) out of the reach of rogue States and non-State terrorist actors once and for all. It cannot be assumed that these measures are currently watertight, or will be for the foreseeable future, but as much is being done as can reasonably be expected.

Getting serious about non-proliferation means effectively remedying weaknesses in the NPT regime and strengthening the IAEA as the relevant watchdog organization. But even though those weaknesses have been clearly identified, not least in our Commission report, and widely acknowledged — and will be acutely clear to this audience — the news here is not especially encouraging. The agreed language on these issues at the NPT Review Conference was either limp or non-existent; the most that can be said following the NPT Review Conference is that all this is still work in progress.

Most States now acknowledge that the traditional safeguards system, which focuses essentially on accountancy — tracking the flow of materials inside civil reactors and ensuring there is no diversion to military purposes — has to be supplemented by a proper detection system, enabling the following up, with effective inspections, of intelligence received about a State engaging in unreported fuel cycle activity, or more seriously still, actual weapons design or engineering. The voluntary additional protocol, by which States can agree to these additional disciplines, has not been universally embraced, and there has been a reluctance by many NPT members — again unhappily in evidence at the NPT Review Conference — to put pressure on the foot-draggers by making its acceptance a condition of supply by others of nuclear technology or materials.

It is also very widely recognized that there needs to be some explicit pains and penalties attached to a State purporting to walk away from the NPT, as the DPRK has done, after spending years sheltering under it, building weapons capacity in the guise of a peaceful programme. But again, with a number of States claiming that this is at odds with the general right under international law to withdraw from any treaty, action has so far gone no further than rhetoric, without even any rhetoric on the subject in the agreed conclusions of the NPT Review Conference.

It is also widely recognized — and well documented in particular by the Zedillo Commission report on the *Role of the IAEA to 2020 and Beyond* — that the IAEA badly needs more personnel, expanded and updated laboratories and general budgetary support if it is to be able to do its monitoring and inspection job, and a hopefully expanded such job in the future, with maximum efficiency; but its Member States have again, so far anyway, shied away from delivering much more than purely rhetorical support, without even much of that evident in the NPT Review Conference outcome.

Getting serious about non-proliferation also means addressing the proliferation risks potentially associated with the likely dramatic expansion of civil nuclear energy in the years ahead. Proliferation resistant technology, involving mainly new reactor designs that do not require or produce sensitive material, may be part of the answer in the longer run, but the most immediate need is to ensure that no new 'bomb starter kits' are built by new countries. That means in turn being able to offer them assurances of supply of the fuel they need, the creation of an internationally managed fuel bank, or some other multilateral arrangement that would pose less risk. While all these options are under active discussion by the IAEA Board of Governors, agreement on any of them, in a way that would put this concern to rest still seems some distance away, and the NPT Review Conference did nothing much to bring it closer. It is to be hoped that countries like Brazil and South Africa will exercise their growing global influence to find a solution to this problem rather than continuing to focus on difficulties.

The most immediately pressing of all non-proliferation needs is, of course, to deal effectively with the specific problems of the DPRK and Iran, getting Pyongyang back into the NPT box and ensuring that Tehran does not jump out of it. The NPT Review Conference was vociferous on the DPRK in its absence, but — understandably but disappointingly — completely silent on Iran, which was very much present.

Although the DPRK problem on the face of it is more immediately serious, given that it has already tested nuclear explosive devices and possesses a half-dozen or so of them, it is in a sense more manageable. Neither of the countries most threatened by this development, Japan or the Republic of Korea, have shown any signs of wanting to join the race; there is no reason to fear — unless one accepts a 'madman' theory, never usually a good idea in international relations despite its popularity in the world's tabloids — that the DPRK would ever commit national suicide by actually using its devices aggressively; and with the succession issue now apparently resolved for the time being, there are some signs that it is again getting serious about restarting denuclearization negotiations. Do not hold your breath for a result — nothing in this country is ever beyond doubt — but the old 'contain and deter but keep the door open for negotiations' formula seems to be working.

The Iran case is more troubling, not only because just one or two nuclear bombs in its possession would be seen, understandably, as an immediate existential threat by Israel, but also because it is also reasonable to assume that a number of its neighbours, of whom Egypt has been the most explicit, would almost certainly want to respond with weapon programmes of their own. Tehran's secretive and unresponsive behaviour has certainly justified the international sanctions that have been imposed so far, but it has always been quixotic to

think that pressure of this kind alone would be enough to stop Iran's uranium enrichment programme dead in its tracks.

I believe that we have to try harder than we have done so far as an international community to understand Iran's thinking. One does not have to look hard for reasons for Tehran pushing the limits of international tolerance as far as it has to date, including making up for the humiliations of the Mossadeq era and beyond; demonstrating its technological prowess; and making clear its distaste for those Western powers whose perceived double standards abandoned Iran to the 'chemical weapons mercy' of Saddam Hussein in the war of the late 1980s.

But there are, equally, a number of reasons for thinking that Iran will actually stop well short of actually making the nuclear weapons it may sooner or later have the capability to produce. In my own many off-the-record discussions with senior officials, including key arms negotiators, in Tehran, New York, Vienna and elsewhere over the past few years, wearing my various hats as former Foreign Minister, President of the International Crisis Group and Co-Chair of the ICNND. In those discussions, I have regularly heard five such reasons, which I think deserve to be taken seriously, though I am well aware that others will disagree.

The first is that Israel will indeed perceive the existence of one or two Iranian bombs as an intolerable existential threat, demanding a pre-emptive military attack with or without US support, with resources Tehran knows it cannot match. But Iranians consider such an attack very unlikely provided they do not cross the red line of actual weaponization. Second, it is well understood that there is zero tolerance in Moscow and Beijing for an Iranian bomb, and all the rope that the Russian Federation and China have allowed Iran in the Security Council so far will completely run out if Iran weaponizes. The writing on this wall is seen more clearly still after the most recent round of sanctions decisions. Third, following from this, there is a clear perception that if Iran acquires an actual bomb, the globally enforced economic sanctions regime will become impossibly stringent. Financial sanctions, direct and indirect, are biting already — including on the significant economic interests of the Revolutionary Guard — and more heavily than in the past, but have so far been tolerable. Once it were to be in unarguable breach of the NPT, Iran sees as inevitable a comprehensive global buy-in to a much-tougher-still sanctions regime.

Fourth, it is acknowledged that any regional hegemony Iran is likely to buy with nuclear weapons is likely to be fairly short lived. There is certainly some scepticism about the capacity of Egypt, Saudi Arabia or Turkey to move quickly to build bombs of their own, and a belief that they would be under much international pressure, especially from the USA, not to do so; but equally there is a clear view that Arab-Persian, Sunni-Shiite or more straightforward regional power anxieties would make such moves inevitable.

A fifth reason, invariably put with great passion, is religious: weapons of mass destruction are simply against every precept of Islam. This is not a factor to which Western cynics will give much credence, but it has echoed very strongly in every private conversation I have ever had with Iranian officials, great or minor, as it does in all their public statements. And it is not without plausibility: Iran did not, after all, respond in kind when it was bombarded with chemical weapons by Iraq.

I hope my Iranian colleagues will forgive me if I say that none of this is to suggest that Iranian intentions can be taken absolutely on trust. There is too much history, too much disconcerting, ongoing leadership rhetoric, and too many ongoing grounds for suspicion for that. Any agreement involving the lifting of sanctions and Iran's diplomatic isolation would need to be accompanied by Iran accepting very intrusive monitoring, inspection and verification arrangements, going not only to all its nuclear power facilities but also to any suspected weapons design or engineering facilities, and giving others in the international community real confidence that they would have some twelve months lead time in which to respond to any evidence of real intent to move to weaponization.

But it does suggest that there is a solid foundation of rationality on which to build in keeping the door well ajar for negotiations. Iran is an extraordinarily complex country and often perplexing to outsiders. But just as we cannot afford to misread the forces of extremism that undoubtedly persist, we also fail at our peril to read those currents of restraint and good sense that are running within the country, not just in the wider community but at high policy making levels.

Holding the line against new proliferation breakouts is of course only part of the story. The nuclear threat will continue to hang over us until the last nuclear-armed State destroys its last weapon, and we have to get serious, now, about disarmament. That means the five original nuclear weapons Member States of the NPT getting serious, in a way that they have never been in the past, about their explicit commitment under Article VI of that Treaty to go down that path. And it also means the three nuclear-armed elephants outside the NPT — India, Pakistan and Israel — also being prepared to ultimately eliminate their own respective arsenals.

The realistic way forward, as our Commission argued and has been very widely accepted (though not, unfortunately, in the NPT Review Conference's agreed conclusions, which are wholly silent on anything resembling timelines, however indicative), is to treat the enterprise as involving two very distinct phases — minimization and elimination — setting a specific target date for the first, but recognizing that identifying a credible target date for getting to zero is much more difficult. For achieving the 'minimization point', we argued that 2025 can and should be set as the target date. Getting there would involve three things. First, the reduction of overall nuclear weapons numbers by over 90 per cent,

from 23 000 down to less than 2000: with the USA and the Russian Federation coming down to 500 each, and all the other nuclear-armed States retaining no more than 1000 between them (which would require none of them to give up, if that is what they are concerned about, minimum deterrent capability); second, all nuclear-armed States signing up to a doctrine of no first use; and third, all of them giving credibility to that commitment by limiting their actual deployments to an absolute minimum, and certainly (hopefully long before 2025) taking all their weapons off high alert launch status. Getting to this point will be tough, but doable, and it will make the world much safer than it is now.

But getting from there to zero will, we have to acknowledge, be much tougher. It will be perceived by all the relevant players as not just further steps in the same game, but a different game, and one for which it is not possible at this stage to set a credible concluding date. Geopolitical and psychological factors will be very much in play. States in dangerous neighbourhoods, such as South Asia and the Middle East, are going to be very hard to persuade to give up their nuclear weapons unless and until the underlying tensions in those regions are basically resolved, however unusable those weapons might be by any rational calculation. And States like France, for whom nuclear weapons have always been more a matter of national status and prestige than anything very evidently advancing their security, will have to be persuaded that their standing will not decline.

Moreover, every nuclear-armed State is going to have to be persuaded that verification and enforcement arrangements are in place that will ensure absolutely that no State will be able to re-arm without being detected in ample time, and that it will be able to be stopped from going further, without the kind of inhibition created by present Security Council veto rights. The point is not to be spooked by these realities but to regard them as challenges that can and will, over time, be overcome. States like the UK and Norway are working hard now on shaping a verification regime that will work in a global zero world. What seems unthinkable now is likely to seem much more achievable ten years from now: just as pessimism can feed on itself and produce pessimism, so too are positive developments self-reinforcing.

The objective *now* must be to focus single-mindedly on the minimization strategy: to bed down the New START treaty between the USA and the Russian Federation (much easier said than done in the current US political climate), and to start almost immediately on the next round of serious bilateral arms reduction negotiations. There are plenty of obstacles ahead in this respect, not least the stated Russian concerns about the USA's perceived massive current conventional weapons superiority and the problems posed by its ballistic missile defence programmes, but they are not insuperable. At the same time, the foundations have to be laid for eventual multilateral negotiations with the other key players, not

least China (which has concerns about US capability very similar to the Russian Federation's), India and Pakistan, in respect to all of whom the first priority must be to try to reach agreement on a freeze on additions to their present arsenals.

Of course it is the case that no progress will be made on the nuclear front without serious efforts to remove other sources of tension both globally and in the different regions. That is true of South Asia and Northeast Asia, and nowhere are regional tensions more acute at the moment than in the Middle East. But the nuclear dynamic at work there is by no means hopeless. It is clear, talking to Israeli officials, that they are no longer obsessed, as they were in decades past, with the prospect of being overrun by their vastly bigger Arab neighbours; they know, as does everyone else, that their formidable military is totally capable of dealing with any non-nuclear threat contingency. Their real concern these days is with a possible nuclear-armed Iran. This combination, in turn, makes the idea of a Middle East nuclear weapon-free zone, which they could join with their Arab neighbours in supporting, much less unattractive than it was in the past, and the prospect of their cooperation in the 2012 Middle East Conference on such a zone, as agreed by the NPT Review Conference, much stronger in fact than their initial public reaction would suggest. And I have already argued that Iran might in fact not prove as big a problem as is currently widely assumed.

Achieving a nuclear weapons free world is not an impossible dream, but it will certainly be an incredibly hard slog. To get there, the critical need is to build and sustain the necessary political will. That has many ingredients, as the Commission spelled out in its report, but the most critical of them will be the right leadership. And that has to come at three different levels: top-down, sideways from peers, and bottom-up.

The crucial top-down leadership is going to have to come from the USA and the Russian Federation: holding between them 95 per cent of the world's nuclear weapons, disarmament is inconceivable unless they lead the way bilaterally. Presidents Obama and Medvedev have made a flying start, but the next two years will be absolutely crucial in determining whether that momentum can be maintained.

When it comes to peer group leverage, like-minded countries around the world have to be mobilized to maintain the pressure on all the relevant players to do everything that is necessary to advance the disarmament, non-proliferation and building block agendas I have described**.** Australia and Japan, building on their joint sponsorship of the ICNND, have initiated a cross-regional grouping of ministers — who met first recently in the margins of the UNGA — which may prove useful in this respect. Another way of keeping political attention focused would be for like-minded countries to support financially the ICNND's proposal to establish, as an ongoing vehicle for analysis, advocacy and pressure, a high-profile, independent Global Centre for Nuclear Non-Proliferation and

Disarmament. That centre would have two distinctive missions: first, to produce an annual scorecard that would spell out clear benchmarks for progress, critically monitor how they are being met and be effective advocates for change; and second, to be the international body coordinating worldwide work on crafting a new nuclear weapons convention that would provide a workable framework for ultimate multilateral negotiations. Australia, Austria and Switzerland have expressed interest in supporting such a centre, though not yet on a scale to make it viable, and I hope other countries represented here might help make this work.

When it comes to bottom-up pressure, the critical need is to engage and energize influential civil society figures, key non-governmental organizations around the world, and the publics on whose support they depend, to focus on what needs to be done, year by year, step by step, and to hold governments relentlessly to account if they fall short. One way of doing that — on which I am also presently working with others, with the support in particular of the Nuclear Threat Initiative — is to create a worldwide set of leadership networks, comprising former heads of government, senior ministers and others who may be capable of influencing their own and other governments to take these issues seriously. The really crucial need, of course, is to somehow capture the imagination of publics around the world in the same way that it has been by that other great threat to our global survival, man-made climate change. Maybe the vehicle for that is now at hand with the new film "Countdown to Zero", premiered recently in the USA and scheduled for worldwide distribution in coming months, by exactly the same documentary team that produced Al Gore's "An Inconvenient Truth". I certainly hope so.

My very last word is this: If we are going to generate effective action to avoid the horror of nuclear obliteration, it will mean a continuing determined effort from all those passionately committed to holding the line on proliferation and making disarmament happen. That means not just from national and international leaders but from everyone, ordinary citizens in every country across every corner of the globe who are capable of influencing them. And it certainly means from you, the world's safeguards specialists, who know more about all these issues than anyone and are better placed than most to take a large part of this the agenda forward. Thank you for your attention, and good luck with your deliberations this week.

SYMPOSIUM SUMMARY

SYMPOSIUM SUMMARY[1]

INTRODUCTION AND BACKGROUND

The aim of this symposium was to foster dialogue and information exchange among the IAEA Secretariat, Member States, the nuclear industry and members of the broader safeguards and non-proliferation community in topical areas defined in the Long-Term Strategic Plan (2012–2023) of the IAEA's Department of Safeguards, in order to better prepare for future safeguards challenges. The symposium was designed to increase exchange among speakers and participants, and allow participants to discuss developments in IAEA safeguards concepts, approaches, technologies and implementation.

This 11th Symposium on International Safeguards, titled Preparing for Future Verification Challenges, was held in Vienna from 1 to 5 November 2010. 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 IAEA organizes a safeguards symposium once every four years.

OBJECTIVES

The objectives of the IAEA safeguards symposium include:

— To share information about IAEA safeguards implementation with a broad audience;
— To facilitate exchange and dialogue among IAEA staff and external stakeholders;
— To provide a forum for exchange among experts on timely technical issues of priority to the IAEA;
— To promote exchange among State safeguards regulatory authorities, and between State representatives and IAEA staff, to improve cooperation and understanding.

The theme chosen for this symposium was Preparation for Future Challenges to Nuclear Verification. The programme for the symposium was

[1] 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.

arranged around strategic topical areas highlighted in the Department of Safeguards' Long Term Strategic Plan, which itself was presented and discussed. This enabled the symposium discussions to include conceptual considerations ranging from safeguards approaches, safeguards implementation and performance evaluation, through to issues of organizational culture, knowledge management and professional development.

ORGANIZATION OF THE SYMPOSIUM

The symposium featured four kinds of sessions:

(1) Plenary sessions;
(2) Technical sessions;
(3) Panels and forums;
(4) Poster sessions.

Plenaries were attended by all symposium participants and were held only at the beginning and end of the symposium. The three plenary sessions included the opening plenary and the technical plenary on the first day of the symposium, and the closing plenary on the final day. The technical sessions, panels, forums and poster sessions were held throughout the remainder of the symposium and were conducted in parallel, with three events occurring at any one time — one technical session, one panel or forum, and one poster session.

These sessions were each aligned with one of the eight symposium topics adapted from the Long Term Strategic Plan. The summary of the topical themes provided in these proceedings is organized along these themes, which are listed below:

— Supporting the global nuclear non-proliferation regime;
— Building collaboration and partnerships;
— Improving cooperation between the IAEA and States for safeguards implementation;
— Addressing safeguards challenges in a changing and transnational world;
— Preparing for the global nuclear expansion and increasing safeguards workload;
— Safeguarding advanced nuclear facilities and innovative fuel cycles;
— Developing advanced technologies and methodologies;
— Enhancing the development and use of safeguards resources.

Awards were given for the best poster in each of nine topical poster sessions. The winners of the poster awards were announced during the closing plenary session.

SYMPOSIUM OVERVIEW

This was the 11th IAEA safeguards symposium and the largest ever in terms of the number of registered participants. Some 670 participants from 64 States and 17 international organizations attended the event. There were 213 papers presented, 71 orally and 142 in poster sessions. The symposium had 37 sessions, including the opening, technical and closing plenary sessions. New in 2010 were the 12 forum and panel sessions, a format designed to encourage interaction between participants. Nine sessions were devoted to poster presentations. For the first time, video coverage of the three plenary sessions was streamed live worldwide on the symposium web site.

ORGANIZATION OF THE PUBLICATION

This publication provides a summary of the opening, technical and closing plenary sessions, as well as a summary of each of the topical sessions for the eight topics listed above. The topics were addressed in a mix of technical sessions, panels, forums and poster sessions. The summaries bring together the presentations and discussions from all of the sessions to highlight the main themes, conclusions and insights. In addition, the content of the three keynote addresses, two opening statements, and the opening and closing remarks given during the plenary sessions are provided.

The plenary, technical and poster sessions all produced papers, which have been published on the symposium's web site. Summaries of the discussions held during each panel and forum are also published on the web site. The contents of the web site are described and a link to it is provided at the end of this publication.

SUMMARY OF THE OPENING PLENARY SESSION

The symposium was opened in session 1 with a keynote address by D. Waller, IAEA Deputy Director General and Head of the Department of Management. Opening statements were also made on behalf of the INMM and ESARDA. S. Vance, President of the INMM, and E. Martikka, President of ESARDA, described the work of their organizations and their interaction with the IAEA. H. Nackaerts, IAEA Deputy Director General and Head of the

Department Safeguards, gave an opening statement, followed by a keynote address by G. Evans, Co-Chair of the International Commission on Nuclear Non-Proliferation and Disarmament (ICNND). These addresses are summarized below.

D. Waller welcomed the participants and gave an update on senior IAEA appointments, including that of the Director General last year and the recent appointment of the Deputy Director General and Head of the Department of Safeguards. He went on to discuss the new Safeguards Analytical Laboratory developments at Seibersdorf, the way IAEA safeguards are evolving worldwide, and a series of recent events in the disarmament and non-proliferation areas. He referred to the IAEA's funding situation, recognizing the need for innovative and constructive solutions to ensure that the IAEA prioritizes its limited resources so as to provide maximum confidence that nuclear material worldwide is being used exclusively for peaceful purposes.

H. Nackaerts described the challenges and opportunities for the IAEA and its Member States due to increased expectations and new activities, the increasing interest in nuclear energy and the consequent expansion in nuclear trade, as well as actions to resolve certain safeguards cases. He identified the main safeguards challenge as the further enhancement of the IAEA's capability for early detection of undeclared nuclear material and activities in a State.

He said the need was to determine how technology, science and innovation can help to meet these challenges, to help the IAEA remain a leader in verification and safeguards and to keep one step ahead of any who may want to defeat the safeguards system. He referred to the potential proliferation risks arising from the wider use of sensitive nuclear technology, and the likely emergence of new reactor types as well as further complex and large scale nuclear facilities. The IAEA needs verification technology that is state of the art, robust and reliable; it also needs to strengthen its capabilities in information analysis and environmental sampling. Although nothing can substitute for the presence of inspectors on the ground — on-site access is the main 'added value' provided by the IAEA — use of remotely acquired information will be increasingly important.

He noted that the safeguards concepts and approaches developed 20 or more years ago were focused at the facility level and were prescriptive and criteria driven. A new approach is now being adopted and further developed, focusing on the State level, guided by objectives, concerned with outcomes rather than procedures and driven by the 'integrated analysis' of all safeguards relevant information available for each State. This information is to be evaluated in a dynamic, collaborative process that identifies follow-up actions, both at IAEA Headquarters and in the field. He emphasized that this is not a different safeguards system — all States will remain subject to the same overall objectives

based on the agreements they have signed with the IAEA. The IAEA will ensure that it makes full use of the legal authority already available to it.

He also highlighted the need for enhancing the skill sets of safeguards staff and attracting staff of a high calibre. Modern safeguards require investigative and analytical as well as accountancy skills. He noted that if the situation of a static Regular Budget continues in the face of growing demands, the IAEA will be faced with the challenge of further optimizing its use of resources while ensuring that there is no compromise of its ability to draw independent and soundly based conclusions, and ensuring that safeguards continue to be applied without discrimination.

In his address, G. Evans focused on the status of the non-proliferation regime and disarmament as well as on ways to move to a world without nuclear weapons. He noted the major challenges, including the persistence of threats from existing nuclear weapons, new nuclear-armed States entering the scene, the risk of nuclear terrorism and the expansion of civil nuclear energy, which may bring about further proliferation risk.

He described steps needed to achieve a world free of nuclear weapons. Building blocks such as the Comprehensive Nuclear-Test-Ban Treaty (CTBT), a fissile material cut-off treaty (FMCT) and the agreements reached at the Nuclear Security Summit in April 2010 need to be implemented. The world needs to get serious about non-proliferation by remedying the weaknesses of the non-proliferation regime and by further strengthening the IAEA's detection capabilities. Mr. Evans said it was wrong to look at proliferation as a 'South' issue and disarmament as a 'North' issue. Rather, more commitment to both matters is deserved than was displayed at the 2010 Nuclear Non-Proliferation Treaty Review Conference. Mr. Evans spoke of the need to capture the public imagination with respect to non-proliferation and disarmament issues as has been done for climate change.

SUMMARY OF THE TECHNICAL PLENARY SESSION

The technical plenary session (session 2) began with a presentation by J. Cooley, Director of the Department of Safeguards Division of Concepts and Planning (SGCP), on the IAEA Department of Safeguards' Long Term Strategic Plan (2012–2023), followed by a panel discussion with all seven Safeguards Directors about moving towards a safeguards system that is fully information driven.

She described the strategic objectives of the Department of Safeguards as being to:

(1) Deter the proliferation of nuclear weapons by detecting early the misuse of nuclear material or technology and by providing credible assurances that States are honouring their safeguards obligations;
(2) Contribute to nuclear arms control and disarmament by responding to requests for verification and other technical assistance associated with related agreements and arrangements;
(3) Continually improve and optimize departmental operations and capabilities to effectively carry out the IAEA's verification mission.

Regarding the overall operating environment for safeguards, it was pointed out that Member State political support and adequate financial resources are required for the IAEA to support the global nuclear non-proliferation regime through the provision of credible assurances of non-diversion of declared nuclear material and the absence of undeclared nuclear material and activities, as well as to cope with nuclear expansion and the growing workload, and to accept potential new nuclear verification missions. Strategic issues also included preparedness to safeguard new and advanced nuclear facilities.

The Long Term Strategic Plan's underlying principles were described as to: continue to conduct robust nuclear material verification while seeking efficiencies; increasingly invest in strengthening IAEA capabilities to detect undeclared activities; capitalize on the IAEA's unique rights of access to information and locations; enhance preparedness to carry out further verification missions as requested by States; and continually improve the IAEA's delivery of high quality, cost effective services to its stakeholders.

Strategies and issues of great importance were described as being: strengthening the effectiveness and improving the efficiency of IAEA safeguards; making safeguards fully information driven; communicating with stakeholders and the public; exercising the IAEA's legal authority effectively; enhancing IAEA technical capabilities; managing the IAEA's two strategic assets (i.e. its workforce and its knowledge); strengthening cooperation and partnership with States and other stakeholders; improving communication and collaboration both within the Department of Safeguards and with other IAEA Departments; and managing the nuclear verification programme and financial resources.

The benefits of the Long Term Strategic Plan were outlined. The Plan complements existing planning activities while allowing more detailed and longer range planning at the departmental level. It supports the provision of Secretariat input to the nuclear verification section of the IAEA wide Medium Term Strategy and informs Departmental biennial planning, monitoring and evaluation

activities already carried out under the biennial Programme and Budget. More generally, the Plan plays a central role in the Department's planning, performance and self-improvement activities, and will support internal decision making on priorities and resource allocation. It will promote strategic thinking and help prepare the Department for future challenges.

All seven Directors of the Department of Safeguards participated in a panel discussion. The discussion was highly interactive, comprising introductory remarks by each Director followed by extensive questions and answers with the audience, lasting over two hours. The discussion covered such issues as: further development of the State level concept, taking into account all information available to the IAEA about a State; information collection from various sources, and its collaborative analysis and secure management; the Department's project to maintain and improve the safeguards analytical infrastructure, in particular for nuclear material and environmental sample analyses; traditional safeguards measures and techniques such as containment and surveillance, destructive and non-destructive assay, environmental sampling and remote monitoring; and strengthening of efforts to identify and effectively utilize new or novel technologies.

Attention was given to the issue of better utilizing State systems of accounting for and control of nuclear material (SSACs), including increasing understanding by States of the IAEA's verification processes and activities, and enhancements of SSACs in cooperation with the IAEA. It was pointed out that the introduction of 'safeguards by design' into facility design practices and the joint use of safeguards equipment have great potential for improving the effectiveness of IAEA safeguards and for reducing routine activities in the field while maintaining or increasing safeguards effectiveness.

SUMMARY OF THE TOPICAL SESSIONS

The programme of the symposium was organized thematically to address eight major topics, as described above. These themes were addressed from several aspects in oral presentations, panel and forum discussions, and poster presentations. There were overlaps in the various presentations, which did not all correspond exactly to a single topic, as is reflected in the following overview. Also, many of the issues were addressed in the opening plenary as well as in the topical sessions. The following sections summarize the key messages presented under each theme and include the session reference whenever possible.

SUPPORTING THE GLOBAL NUCLEAR NON-PROLIFERATION REGIME

This topic included: building support for strengthening international safeguards; enhancing confidence in compliance with safeguards obligations; using legal authority to enhance effectiveness and efficiency; and prospective verification roles in support of arms control and disarmament. These subjects were covered in the opening plenary, in oral presentations (sessions 3 and 33) and in panel session 17.

The panel in session 17 discussed building support for the safeguards mission. It is essential that States appreciate the benefits to their national security of an effective non-proliferation regime, which depends on effective safeguards. Issues identified included: the need to promote a safeguards culture shared between the IAEA and Member States through cooperation and partnership; the need for greater communication and outreach informing Member States on safeguards issues and activities; and the benefits of introducing greater transparency of information on safeguards implementation and costs. Also raised was the need to address ways of better funding safeguards, which could include innovative arrangements such as 'user pays' mechanisms.

On informing Member States of safeguards activities and issues, it was thought that more needed to be done by the IAEA and also by key safeguards supporters. It was suggested that the Standing Advisory Group on Safeguards Implementation (SAGSI) might contribute through briefings on its activities. An aspect of this issue is how to share expertise to better support diplomats, particularly in smaller missions, through briefings and workshops on technical aspects of safeguards issues.

On prospective future verification missions in support of arms control and disarmament, in oral session 33, it was noted there are synergies between safeguards and these new missions — technically, but also at a broader level (e.g. the relationship between confidence, detection capability and deterrence). While detection of undeclared nuclear materials and activities remains a fundamental safeguards priority, effectively addressing the broader objectives of confidence and deterrence is also essential, both for safeguards and for new verification missions.

In presentations on the potential role of the IAEA in nuclear disarmament verification (session 33), it was suggested that the IAEA's potential role be recognized and developed. The IAEA is well equipped to deal with this function, both from the legal perspective (the Statute anticipates that the IAEA could be asked to accept responsibilities under agreements dealing with disarmament) and because of the IAEA's extensive relevant expertise and experience. However, the importance of appropriate arrangements that will protect sensitive information was noted.

BUILDING COLLABORATION AND PARTNERSHIPS

This topic included other verification and non-proliferation regimes as well as synergies between the safety, security and safeguards regimes. These subjects were covered in oral presentations (session 33) and panel discussions (session 29).

It was noted (session 33) that as new technologies are developed for safeguards, physical protection and arms control, overlaps are being found. While requirements in each area may vary, there are similarities between technologies in terms of timeliness requirements, encryption, data authentication and remote monitoring. Some technologies developed for other purposes are potentially applicable in safeguards.

The panel (session 29) discussed how the three international verification organizations — the IAEA, the Organisation for the Prohibition of Chemical Weapons (OPCW) and the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) — complement each other in promoting international peace and security. It was suggested that Member States consider how collaboration between the organizations could be strengthened to avoid duplication of effort and reduce costs (e.g. by avoiding duplication by the IAEA in setting up a seismic monitoring capability for nuclear safety when the CTBTO already has a functioning global seismic monitoring system in place). While recognizing the different missions and mandates of these organizations, comparing and contrasting experience and practices between them could be beneficial to achieving efficiencies and cost effectiveness, as well as benefiting from best practices. Obvious areas cited were knowledge management, declarations management and information security. For the IAEA, such exchanges might contribute to the initiative to review safeguards processes and procedures. It was proposed that the next safeguards symposium give greater prominence to possible broader collaboration between the verification organizations and to enabling verification of disarmament.

IMPROVING COOPERATION BETWEEN THE IAEA AND STATES FOR SAFEGUARDS IMPLEMENTATION

This topic included: strengthening the capability of States and SSACs to meet their safeguards obligations; enhancing safeguards effectiveness and efficiency through greater cooperation; and recommendations for enhancing implementation of integrated safeguards based on lessons learned. These subjects were covered in oral presentations (session 14), panel discussions and forums (sessions 13, 23 and 25), and poster presentations (sessions 7 and 18).

In discussions on furthering IAEA–State safeguards cooperation (oral session 14 and forum session 25), it was noted that good cooperation between the IAEA, State and Regional authorities, and facility operators is essential for effective safeguards implementation. Discussion of SAGSI's consideration of this topic (in session 14) identified two primary objectives:

(1) To delineate a baseline for cooperation between a SSAC or regional system of accounting for and control of nuclear material (RSAC) and the IAEA, reflecting the obligations arising from safeguards agreements;
(2) To identify possible opportunities for enhanced cooperation with SSACs/RSACs that have competencies and capabilities beyond the baseline which could provide the basis for optimizing safeguards effectiveness and efficiency in the context of the State-level concept.

SAGSI recommendations included: completing the updated SSAC implementation guidelines; establishing a forum where information on best practices for SSACs could be exchanged; and reinforcing two-way consultations between the State and the IAEA. Other speakers in the session provided examples of the progression from a State receiving assistance to upgrade their State system, through fully-functional SSACs, through to States providing direct support to enhance the IAEA's technical capabilities.

In forum session 25, the European Atomic Energy Community (Euratom) and the Brazilian–Argentine Agency for Accounting and Control of Nuclear Materials (ABACC) outlined their activities for enhancing efficiency and cooperation with the IAEA. ABACC noted that the proficiency of the SSAC will be one of the State-specific factors in developing a State-level safeguards approach. The IAEA needs guidelines for assessing State capabilities as a starting point for considering 'enhanced' cooperation. While the IAEA's responsibility to draw independent conclusions must be maintained, an increased sharing of the verification activities could be considered.

Forum session 13 noted that changes in safeguards implementation have implications for the effort required from Member States, and that when States and the IAEA work closely together, the combined effort of the State and the IAEA can be optimized. Most participants considered there is not a one-to-one correspondence between IAEA efforts and the efforts of State or Regional authorities. Some participants commented that random inspections pose logistical challenges, particularly when national inspectors are required to attend all IAEA complementary access and inspections.

Session 23 was a forum discussing best practices for establishing, maintaining and improving the effectiveness of an SSAC. The main themes included:

— The importance of a legal and regulatory structure framework that ensures that the SSAC is independent and can enforce safeguards requirements;
— The challenges of information collection (both for comprehensive safeguards agreement and additional protocol obligations) and various approaches to improving collection, including more public outreach;
— The need for an accepted definition of SSAC effectiveness and a methodology for assessing the effectiveness of a system.

States undertaking the initial development of their regulatory authority and safeguards systems emphasized the need for training, particularly courses targeting their needs — such as the SSAC for Small Quantities Protocol States course — and assistance with legal and regulatory development, implementation of an accountancy system, the declaration development process, and reporting and hosting inspections.

In poster sessions 7 and 18, many presenters highlighted the need for close cooperation between the IAEA, State and Regional authorities, and facility operators to address implementation issues associated with the additional protocol, the modified small quantities protocol and integrated safeguards.

ADDRESSING SAFEGUARDS CHALLENGES IN A CHANGING AND TRANSNATIONAL WORLD

This topic covered non-State actors and covert trade networks. These subjects were covered in oral presentations (session 10) discussing how the IAEA would benefit from having more trade data to assist in unearthing indicators of undeclared material and activities. Increased IAEA resources are now dedicated to trade analysis, and this is providing important input to State evaluations. It was suggested that the present political climate is favourable to going beyond current reporting in this area, and that more companies and governments may be willing to share trade information with the IAEA. To encourage this, it was suggested that a culture of mutual trust is necessary.

PREPARING FOR THE GLOBAL NUCLEAR EXPANSION AND INCREASING SAFEGUARDS WORKLOAD

This topic included: furthering implementation of the State level concept and integrated safeguards; information driven safeguards; remote safeguards inspections; and safeguards in States without comprehensive safeguards agreements (i.e. States that are either under INFCIRC/66-type agreements or voluntary offer agreements, or that have no safeguards agreement at all). These subjects were covered in oral presentations (session 27), a panel discussion (session 16) and poster presentations (sessions 18 and 20).

In the panel discussion (session 16), it was noted that the global expansion in nuclear energy brings with it an increased volume of activity in the traditional area of verifying declared nuclear materials and activities. The growth in safeguards resources does not match the expansion in mission or the increased activity. Therefore, innovations are required, but it is important for these to be low-cost and reliable. Poster session 20 included displays on ways of involving the operator in safeguards planning, for example, in equipment installation and maintenance, as well as in cases where inspections do not need to be unannounced, which is increasingly important as the number of facilities increases.

It was seen in poster session 18 that drawing soundly based safeguards conclusions now requires the ability to integrate disparate and diverse sources of information, ranging from satellite and geospatial data to trade, scientific and other technical open source literature as well as nuclear material accounting data. Tools are being developed to support a more effective use of the varied information sources, for both an analyst and an inspector, and to enable their integration. In information analysis for detecting undeclared nuclear material and activities, emphasis is being placed on moving to more collaborative all-source analysis involving the development of a culture of collaboration within the Department of Safeguards. All of this work is being given high priority.

The use of remote safeguards inspections was covered in oral session 27 and poster session 18. Remote safeguards inspections are now being tested and will extend remote monitoring, helping to enhance and optimize safeguards implementation by shifting IAEA inspector resources from routine to non-routine activities, such as complementary access and unannounced inspections (sessions 18 and 27). This will also provide opportunities for enhanced cooperation with States, with some activities formerly performed by inspectors being performed by operators. Various aspects of the use of remote safeguards inspections are being studied, including: data authentication; how the approach fits into schemes such as short notice random inspections (SNRIs); information security; resources for implementation; and cost–benefit analysis. Implementation of remote safeguards inspections will require clear and regular

discussion between the IAEA, the State and Regional authorities, and the facility operators. Equipment reliability is especially important; it is essential to avoid a situation where savings from reducing inspectors in the field are negated by the need to have technicians in the field to carry out maintenance.

SAFEGUARDING ADVANCED NUCLEAR FACILITIES AND INNOVATIVE FUEL CYCLES

This topic included proliferation resistance, 'safeguards by design' and safeguards approaches for advanced nuclear facilities. These subjects were covered in oral presentations (particularly sessions 3 and 34) and poster presentations (session 19).

There was general consensus that taking safeguards requirements into consideration as early as possible in the design process for a new facility would provide benefits to all stakeholders: the IAEA, SSACs/RSACs, owners/operators, designers/contractors, and suppliers of safeguards equipment. This is being addressed through the development of 'safeguards by design', which will not only benefit safeguards implementation but can contribute to increasing proliferation resistance.

A 'new' safeguards culture highlighting safeguards by design needs to be promoted. The safeguards by design process requires early and regular interaction between stakeholders, and this may require fundamental changes in the way business is currently conducted. The IAEA is seeking to engage the nuclear industry to determine how features that would efficiently meet safeguards goals can be incorporated during the design stage of facilities, rather than retrofitting a facility after it has been licensed for operation.

It is essential that safeguards performance requirements be defined that reflect international safeguards for each facility type. A design guide for safeguards is being developed, consisting of recommendations based on best practices, and it was recommended that the 'Facility specific guidelines on safeguards by design requirements for designers and operators' elaborating the design guide be finalized as soon as possible. The Generation IV International Forum (GIF) Proliferation Resistance and Physical Protection methodology is being used for this exercise. The process is highlighting issues that must be resolved for effective implementation of safeguards by design. It was suggested that in due course safeguards by design requirements might be incorporated, with the safety and security requirements, in the IAEA Safety Standards Series. Finally, it was noted that safeguards by design is in its developmental stage, and dedicated resources are required to promote this valuable concept in order to fully realize the benefits.

ADVANCED TECHNOLOGIES AND METHODOLOGIES

This topic included: verifying nuclear materials and activities; detecting undeclared nuclear materials and activities; and information collection, analysis and integration. These subjects were covered in oral presentations (particularly sessions 4, 11, 15, 22 and 24), panel discussions (sessions 12, 16 and 28) and poster presentations (sessions 9, 20, 30–32).

The correctness of State declarations remains an important element of IAEA safeguards. The elements of correctness include nuclear material accountancy, material balance evaluation, trend analysis and environmental sampling data analysis. Future challenges include prioritization in the face of a growing volume of data, development of new statistical evaluation methodologies, and improved reference data and methodologies for environmental sampling.

Advances being made in safeguards approaches for existing fuel cycle facilities were outlined in oral sessions 11 and 22 and in poster sessions 9 and 20. For example, at gas centrifuge enrichment plants, modern safeguards approaches are currently being developed through further refinements in equipment and procedures. Short notice random inspections are now being used routinely at fuel fabrication plants, including under cooperative arrangements with RSACs. The application of integrated safeguards is being extended to more complex facilities, such as a large scale hot cell facility in Japan where the new safeguards approach will bring considerable savings in operator and inspector efforts. The implementation of site approaches under integrated safeguards in Japan is expected to reduce both operator and IAEA effort while maintaining effectiveness. As laser isotopic separation technology becomes more accessible, safeguarding laser enrichment facilities represents an emerging challenge, which the IAEA is now studying.

A recurring theme in session 11 was the need to develop appropriate non-traditional (i.e. novel) technologies. Subjects of particular interest were: the need for better spent fuel verification techniques; more effective tools for the monitoring of nuclear fuel cycle processes such as enrichment and reprocessing; the need for novel in-field analytical tools to provide the inspector with more information on a real time basis; better containment methodologies based on the intrinsic nature of the containment vessel; and the need to prepare for future challenges such as Generation IV reactors and geological repositories.

Regarding advances in measurements, it was noted in poster session 30 that the technology for verifying spent fuel continues to advance, including instruments to detect partial defects (e.g. fuel assemblies with a limited number of pins removed). Technological advances were also noted in poster sessions 31 and 32, in the areas of containment and surveillance as well as monitoring systems. Areas included anti-neutrino measurement for reactor power monitoring, on-line

process monitoring, 3-D laser scanning, aspects of remote monitoring, and the IAEA's XCAM next generation digital camera system.

All-sources information analysis for detecting undeclared nuclear material and activities (oral session 15 and panel session 6) has always been integral to the IAEA's work, but the volume of information and the number and types of sources, as well as the complexity of the tools being used to support the work, have increased. This has led to a new emphasis on a collaborative approach to analysis. The Department is reviewing the State evaluation process, implementing the necessary training, further developing the tools and technologies that are needed, and developing a culture of collaboration within the Department of Safeguards.

The requirement for detection of undeclared nuclear activities and materials, and technological gaps with respect to verification of declared activities and materials were discussed in panel session 16. It was suggested that the considerable challenges can be made into opportunities for technical creativity and process innovation. The challenges discussed included: accurately identifying which new technologies, or novel applications of existing technologies, are needed based on new inspection approaches; ensuring that new technology and concepts of deployment are cost effective, user friendly and easily deployable; and determining where the new technologies or methods fit within the existing framework of agreements. On the latter point, it was noted that the IAEA has broad legal authority to apply new technologies to meet its safeguards obligations.

New horizons for nuclear material and environmental sample analysis were discussed in oral session 4 and panel session 12. An overview was given of the IAEA's analytical capabilities and future development. Significant new work is being undertaken in this area with resources from the Regular Budget and extrabudgetary contributions. Presentations were given on nuclear material analysis techniques, the analysis of environmental samples and the Enhancing the Capabilities of the Safeguards Analytical Services (ECAS) project. New facilities that will be modular and easy to modify or expand are in hand — the new Nuclear Material Laboratory and the Safeguards Clean Laboratory Extension.

Future developments were also discussed, with a focus on new techniques that would improve the precision and accuracy of measurements. Promising new analytical techniques are in development by Member State Support Programmes, the Safeguards Office of Analytical Services and the IAEA Network of Analytical Laboratories (NWAL), which will improve the precision and accuracy of measurements, including improved sensitivity of bulk analysis for plutonium and age dating of high enriched uranium particles. An improvement in the timeliness of analysis is expected with the new facilities, achieving perhaps a two to three week process time. Environmental sampling has proved its usefulness, using bulk analysis and particle analysis techniques, not only for detecting the presence

of uranium and plutonium but increasingly for answering other questions related to completeness, including material origin, age and processing history. New technologies must be portable and user-friendly. There are opportunities in the areas of design information verification, sampling methods and on-line monitoring for giving more rapid results from the field. While there has been some innovation in the area of field-portable instruments (e.g. laser based spectrometric instruments), current discussions focus on remote systems for acquiring, integrating and analysing multiple sets of data.

A multinational study of wide-area environmental sampling for safeguards concluded that atmospheric sampling offered the greatest detection probability with the lowest false alarm rate. However, the projected cost was prohibitive and would need to decrease by a factor of ten in order to become practicable for IAEA use.

The challenges of using advanced information technologies for collection and evaluation produced a wide-ranging discussion in panel session 28. The main points were:

— Challenges for advanced information collection remain. Search engines do not always yield significant results; thus, searches must be refined and the results managed.
— Evaluation challenges include the complexity of the output of an analytical tool, which is analysed to identify connections and patterns. Tools such as cluster or network analysis provide clues as to what may be worth investigating further. They can be used to represent possibilities or hypotheses from which analysis can be developed, and to generate questions.
— Large data sets with duplicate, irrelevant or unstructured data, as well as structured data that require additional processing to fit into analytical tools, all make analysis more time consuming. High-powered tools have to be combined with the right information sets.

The development of forensic analysis methods and synergies with laboratories as well as methods used for safeguards purposes (oral session 24) hold promise. While forensics normally refers to a law enforcement situation where the authorities need to know immediately the relevance of a seizure and the possible radiological hazards, the use of forensics to determine material origin or route travelled can be relevant to nuclear safeguards.

ENHANCING THE DEVELOPMENT AND USE OF SAFEGUARDS RESOURCES

This topic included: strategic planning and specifically the current Department of Safeguards Long Term Strategic Plan (2012–2023)*;* safeguards professional development, and maintaining expertise and managing knowledge; optimizing technical support to the IAEA; and the safeguards organizational culture. These subjects were covered in oral presentations (in particular sessions 3, 21 and 26), panel and forum discussions (sessions 5, 6, 35 and 36), and poster presentations (session 8).

Following on from the presentation of the Department of Safeguards Long Term Strategic Plan (2012–2023) at the Technical Plenary (session 2), session 3 was devoted to discussion of strategic safeguards priorities and activities. The Department presented the rationale, methodology and departmental process for the development of the Plan. Strategic planning is now a regular and integral part of the Department's operations. Points made by other speakers included the following:

— The current safeguards system requires analysis to consider its relationship with future verification of nuclear disarmament, remembering the objectives and the challenges to achieving them, and the concepts of confidence, detection capability and deterrence.
— The US Department of Energy's Next Generation Safeguards Initiative (NGSI) is aimed at strengthening and sustaining the IAEA safeguards system as it evolves to meet new challenges. Its five priority areas are: development of concepts, approaches and technologies for the implementation of State level, information driven safeguards; promotion of safeguards by design; revitalization of human capital for safeguards; enhancement of SSACs; and development of effective approaches to process monitoring.
— Regional non-proliferation initiatives (e.g. nuclear-weapon-free zone treaties, which have had success in persuading States to sign on to international non-proliferation agreements) and the further pursuit of regional approaches in the negotiation and conclusion of additional protocols are warranted.

Panel sessions 5 and 6 dealt with the life of an inspector in the field and at IAEA Headquarters, and both were lively and well attended. Topics included: the current and anticipated roles for inspectors and analysts, and the relationship between them; collaborative analysis and the need for open and effective internal communication; and the tools required to achieve a truly collaborative approach.

The State evaluation working group approach was discussed, including how it facilitates the type of collaborative analysis needed.

Oral session 21 and forum session 36 discussed enhancing the IAEA's organizational culture to prepare for prospective future missions. To move to a safeguards system that is fully information driven, the culture will need to evolve to support full implementation of the State level approach to safeguards implementation. Some of the points from this discussion included the following:

— Clear processes and transparency at all levels encourage mutual collaboration;
— Allowing and encouraging those closest to the work to take decisions on how the work is performed leads to efficiencies;
— The multicultural aspects of the IAEA enrich the work environment and deserve recognition and respect.

A number of sessions, particularly oral session 26, forum session 35 and poster session 8, dealt with developing human resources for safeguards. In order to fill the gap between the number of competent nuclear safeguards experts and future human resource needs for the industry and international community, many entities are investing resources in this area. Coordination is required to meet the needs of the IAEA and newcomer nuclear power States, as well as to meet the expectations of individuals choosing this area of work. Forum session 35, on identifying, finding and retaining the right skills and expertise for the challenges of the 21st century, was well attended and resulted in extensive discussion. Some of the themes were:

— How to build on the knowledge and expertise already available within the IAEA;
— How to maintain the credibility of safeguards by keeping the IAEA objective, impartial and transparent, with a technically competent and independent Secretariat;
— The potential for cooperation between industry, governments and the IAEA in the exchange of expertise and development of human resources;
— The possibility of developing competency profiles required for safeguards in a manner that is understandable by education systems, trainers, employers and employees in areas other than safeguards;
— The possibility of developing a recognized safeguards qualification or certification, transferable between the IAEA and other verification organizations and SSACs/RSACs.

There was support for the idea of an international postgraduate school in safeguards, non-proliferation and nuclear security, funded by the private sector using mechanisms already in place in the international community. Another suggestion was to introduce training programmes at nuclear facilities to engage and attract young professionals to the field of non-proliferation and safeguards.

SUMMARY OF THE CLOSING PLENARY SESSION

The closing plenary began with J. Cooley presenting awards for the best poster for each of the nine poster sessions. The winners came from a variety of States as well as the IAEA, covering a broad range of topics in their presentations, and their names are posted on the symposium web site.

The rapporteur for the symposium, J. Carlson, outlined the highlights of the symposium. He recapped the themes from throughout the week and provided several take-away messages, including:

— The IAEA staff demonstrate outstanding professionalism and dynamism in tackling the challenges confronting safeguards, as was evident in the symposium sessions. The same could be said for the wider safeguards community contributing to the IAEA's efforts.
— Cultural change is of critical importance in safeguards. The evolution from a procedures oriented system to a focus on outcomes is vital for ensuring that the safeguards system meets the challenges before it. The development of a safeguards system that makes the most effective use of information is an essential part of this.
— All parties should view safeguards as a collaborative, shared responsibility that serves the common good. Member States should focus on outcomes and consider how safeguards can be used as a tool to serve their own national interest in ensuring an effective non-proliferation regime in which real progress towards the elimination of nuclear weapons is possible.
— Mechanisms are needed for providing technical expertise in support of the smaller missions in Vienna, to better inform them of safeguards activities and issues. In addition to further outreach and briefings by the IAEA, there could be a valuable role for informal mechanisms for sharing expertise (e.g. through the INMM).
— Member States should consider innovative ways of increasing funding for safeguards — ideas such as a 'user fee' from the nuclear power sector and the nuclear processing industry might be considered further.

— With regard to future nuclear verification missions, effective safeguards underpin future missions in two ways: an effective non-proliferation regime is essential for major progress in nuclear disarmament; and key elements in safeguards will also be fundamental to future missions (e.g. verification methodologies as well as issues of detection capability, confidence and deterrence).
— In addressing the challenges ahead, it is essential to maintain the engagement, energy and collective commitment shown at this symposium. All parties must ensure appropriate follow-up actions.

Following this summary, the keynote closing plenary speaker, M. Maybury of Mitre Corporation, spoke about a future vision for a safeguards system that is fully information driven. He emphasized the challenge posed by enormous volumes of low density data, exacerbated by the resource demands to cope with the necessary processing and analytical treatment to derive soundly based safeguards conclusions. He noted the progression from independent analysis to collaboration, requiring teamwork and intention, moving from awareness to sharing to interdependence and finally to a shared intent and co-dependence. The requirement of a culture supportive of collaboration was also highlighted. He presented a notional road map to accomplish the vision outlined in the Long Term Strategic Plan over the period 2010–2020. He also provided a technical paper for publication, which is available on the symposium web site. His remarks are therefore not reproduced in this book.

The session ended with closing remarks by H. Nackaerts, Deputy Director General for Safeguards, who deemed the symposium to have been a great success and to have achieved its objectives. He congratulated the coordinating committee, the Scientific Secretary M. Nicholas and Assistant Scientific Secretary M. Diaz Menendez, the key participants, exhibitors and the audience. He expressed his hope to see all participants at the 12th Safeguards Symposium in 2014.

CLOSING PLENARY

CLOSING STATEMENT

H. Nackaerts

Deputy Director General,
Head of the Department of Safeguards,
International Atomic Energy Agency

These past few days have been a tremendous success, and I am personally delighted with the outcome. When we placed an international call for papers earlier this year, we never expected that we would be presenting 213 of them here this week. Participants have come from 64 Member States as well as from 16 non-governmental organizations. We particularly want to continue to encourage developing countries to attend and contribute. The call for papers was to *all* States, and no submitted abstracts have been or will be rejected. A wealth of information and analysis arising from this week's deliberations is now available on the IAEA web site.

To remind you, the purpose of the symposium was to foster dialogue and information exchange involving Member States, the nuclear industry and members of the broader nuclear non-proliferation community, so as to prepare for future verification challenges. Clearly, a range of different ideas were expressed here this week, from across the spectrum of opinion. And that is a good thing, even if, as we have made very clear, not *all* views expressed are endorsed by the IAEA. This was a technical symposium but, as is the nature of such an event, some presenters have occasionally strayed into the political domain. Again, the IAEA does not associate itself with any such remarks.

Having listened to the debates myself, and having heard feedback from the sessions I could not attend, I know we have achieved our objectives. In my opening statement on Monday, I said that with your help we could overcome the challenges ahead and move forward as a modern, effective and efficient organization serving global security. As this symposium draws to an end, I am pleased to say that my conviction has been strengthened.

Organizing any large meeting is hard work, but a meeting with so many sessions and such a variety of sessions is a considerable challenge. In that regard, I would like to express my gratitude to those IAEA staff responsible for organizing the symposium — the scientific secretary, Malcolm Nicholas, and his team. Thank you also to session chairs, panel members and secretaries — to all of you who presented here this week as well as to those working behind the scenes. I'm sure you will join me in congratulating all of them. Thank you to our co-organizers, INMM and ESARDA. And to our sponsors, who, of course, come

here to promote their products, but who provide important financial support to enable this event to proceed. My gratitude also to all of you who have participated in this event with such enthusiasm and commitment — for the expertise that you brought to bear on the challenges we face, and the ideas and proposals that you have aired. We now need to digest what we have consumed!

Let me end by saying that I hope to see you in 2014 for what will be the 12th safeguards symposium. More immediately, I wish you a safe journey home. I hereby declare the 2010 safeguards symposium closed.

OVERVIEW OF THE PROGRAMME

TECHNICAL SESSIONS

Session	Title of Session	Session Chair/Technical Secretary
1	Opening plenary	H. NACKAERTS, IAEA E. GYANE, IAEA
2	Technical plenary	L. VINHAS, Brazil I. TSVETKOV, IAEA
3	Strategic safeguards priorities and activities	J. CASTERTON, Canada J. RISSANEN, IAEA
4	Nuclear material and environmental sample analysis: New horizons	D. SWINDLE, USA S. BAUDE, France
10	Addressing safeguards challenges in a changing and transnational world	S. A. VOROBIEV, Russian Federation A. EL GEBALY, IAEA
11	Emerging and future technologies for detecting undeclared activities and material	R. SCHENKEL, EU A. MONTEITH, IAEA
14	Furthering IAEA–State safeguards cooperation	M. ENNAMI, Libya P. MOITTA, IAEA
15	All sources information analysis for detecting undeclared activities and material	M. BURGESS, Australia C. ELDRIDGE, IAEA
21	Enhancing the organizational culture to prepare for future missions	R. HOWSLEY, WINS R. McCULLOUGH, IAEA
22	Advanced safeguards approaches for existing fuel cycle facilities	M. KIKUCHI, Japan F. MALUTA, IAEA
24	Application of forensic techniques to safeguards	A. PIDDUCK, United Kingdom D. DONOHUE, IAEA
26	Developing safeguards resources	D. DICKMAN, USA R. BARNES, IAEA
27	Remote safeguards inspections	M. BOELLA, EU T. JEFFREY, IAEA
33	Potential new verification roles in support of arms control and disarmament	K. MURAKAMI, Japan J. RISSANEN, IAEA

Session	Title of Session	Session Chair/Technical Secretary
34	Safeguards by design — safeguards for advanced and proliferation resistant nuclear fuel cycle facilities	C. JORANT, France S. SHAWKY, IAEA
37	Closing plenary	H. NACKAERTS, IAEA C. MATHEWS, IAEA

PANEL SESSIONS

Session	Title of Session	Panel Moderator/Technical Secretary
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6	Life of an inspector and analyst in Headquarters	R. WALLACE, USA C. ELDRIDGE, IAEA
12	The Network of Analytical Laboratories — Expansion and reform	F. GOUTELARD, France R. LAFOLIE, IAEA
16	Challenges relating to the implementation of technologies for detecting undeclared materials and activities	K. MAYER, Euratom E. MARK, IAEA
17	Building support for the safeguards mission	J. CARLSON, Australia S. PULLINGER, IAEA
28	Challenges using advanced information technologies for collection and evaluation	M. MAYBURY, USA Z. GASTELUM, IAEA
29	Sharing implementation experience and good practices with other verification organizations	T. RAUF, IAEA A. PETOE, IAEA

FORUM SESSIONS

Session	Title of Session	Forum Moderator/Technical Secretary
13	State experiences/views on implementation of integrated safeguards	E. MARTIKKA, Finland N. WILSON, IAEA
23	Best practices for establishing, maintaining and improving the effectiveness of an SSAC	A. VINCZE, Hungary R. STEVENS, IAEA
25	Furthering effectiveness and efficiency through enhanced IAEA–State cooperation	S. FERNANDEZ, Argentina S. MUNOZ, IAEA
35	Identifying the right skills and expertise for the challenges of the 21st century — Where to find them? How to retain them?	C. MONZEL, IAEA M. AKRAWY, IAEA
36	Changing organizational culture	J. PATTEN , IAEA R. McCULLOUGH, IAEA

POSTER SESSIONS

Session	Title of Session	Poster Technical Secretary
7	Safeguards implementation — State experiences	C. MATHEWS, IAEA
8	Safeguards capability development	S. PICKETT, IAEA
9	Indicators, forensics and environmental sampling	D. DONOHUE, IAEA
18	Information driven safeguards	Y. FELDMAN, IAEA
19	Safeguards by design	T. KILLEEN, IAEA
20	Safeguards concepts and approaches	A. HADFIELD, IAEA
30	Measurements	A. LEBRUN, IAEA A. BELIAN, IAEA
31	Monitoring techniques for safeguards	E. SMITH, IAEA
32	Advancements in containment and surveillance	C. MARTINEZ, IAEA

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CONTENTS OF THE SYMPOSIUM WEB SITE

Presentations, statements, remarks, abstracts, papers, a list of participants and exhibitors, and summaries of forums and panels from the 11th IAEA Safeguards Symposium can be found on the IAEA web site under the 'Safeguards Symposia' link at: http://www.iaea.org/safeguards/Symposium/2010/Home.htm.

The full programme can also be downloaded from this site. The web site features a search function to locate documents using, for example, abstract number, author name, session title, or a key word or phrase.

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