International Conference on

Effective Nuclear Regulatory Systems: Sustaining Improvements Globally

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INTERNATIONAL CONFERENCE ON EFFECTIVE NUCLEAR REGULATORY SYSTEMS: SUSTAINING IMPROVEMENTS GLOBALLY

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FOREWORD

The International Conference on Effective Nuclear Regulatory Systems: Sustaining Improvements Globally, organized by the IAEA and held in Vienna on 11–15 April 2016, is the fourth in a series of conferences on the topic. The first was held in Moscow, Russian Federation, in 2006 and discussed the safety and security challenges of effective nuclear regulatory systems; the second was in Cape Town, South Africa, in 2009 and focused on further enhancing the global nuclear safety and security regime; and the third was in Ottawa, Canada, in 2013 and explored transforming experience into regulatory improvements. The 2016 conference drew on the conclusions and deliberations of the first three conferences to review issues and recent developments that are important to the global nuclear regulatory community and to focus on, in particular, their role in ensuring safety and security.

Since the 2013 conference, there have been a number of significant events. In 2014, the Contracting Parties to the Convention on Nuclear Safety, at the Sixth Review Meeting, discussed a proposal by Switzerland to amend the convention. A diplomatic conference to consider the proposal was convened in Vienna in 2015 at which principles were unanimously adopted to guide Contracting Parties in the implementation of the convention's objective of preventing accidents with radiological consequences and mitigating such consequences should they occur.

A further milestone was the adoption of the ministerial declaration at the International Conference on Nuclear Security held in Vienna in 2013. The declaration affirmed the central role of the IAEA in strengthening the nuclear security framework globally and in leading the coordination of international activities in the field of nuclear security. It also highlighted the importance of IAEA guidance in improving and strengthening regulatory effectiveness, which was reinforced at the International Conference on the Safety and Security of Radioactive Sources held in Abu Dhabi in 2013.

This fourth conference on effective nuclear regulatory systems coincided with the tenth anniversary of the launch of the Integrated Regulatory Review Service (IRRS) and provided an opportunity to focus on the experience of Member States and the IAEA in the implementation of lessons learned from IRRS missions.

Over 200 participants from 62 Member States and 8 international organizations attended the conference. A total of three keynote presentations and 42 invited papers were given in the opening session, five technical sessions and the special panel. Each session was accompanied by a panel discussion, which allowed additional speakers to give statements. This publication includes the opening addresses, summaries of the sessions, and the President's summary and conclusions of the conference. The attached CD-ROM contains all the papers from the conference made available for publication.

The IAEA gratefully acknowledges the cooperation and support of the organizations and individuals involved in this conference. The IAEA officers responsible for this publication were S. Mallick and L. Guo of the Department of Nuclear Safety and Security.

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OPENING SESSION

WELCOME ADDRESS

Y. AMANO
Director General,
International Atomic Energy Agency,
Vienna

Good afternoon, Ladies and Gentlemen.

I am very pleased to welcome you all to this IAEA International Conference on Effective Nuclear Regulatory Systems. The sub-title of the conference is Sustaining Improvements Globally. This implies that improvements have been made, both in establishing effective regulatory systems throughout the world, and in improving nuclear safety generally. And that is indeed the case. The accident at the Fukushima Daiichi nuclear power plant in March 2011 cast a shadow over the work of everyone involved in the sector – plant operators, regulators, governments and the IAEA. However, in the five years since then, all countries with nuclear power programmes have taken vigorous steps to reassess all aspects of safety and to make improvements, where necessary. I have seen this for myself when visiting facilities throughout the world. Additional measures have been put in place to protect against extreme natural events such as major earthquakes and tsunamis. Some countries have reformed their regulatory systems.

The IAEA Action Plan on Nuclear Safety made a valuable contribution to improving safety globally. Many activities were undertaken by the Agency, Member States and other organizations. Continuing Agency activities under the Action Plan are now being addressed through our regular work. I encourage all countries with nuclear power programmes, or which are considering introducing nuclear power, to become parties to the Convention on Nuclear Safety. The Convention is a very important mechanism which has contributed a lot to strengthening nuclear safety in the countries which are party to it.

Ladies and Gentlemen,

This conference provides a valuable opportunity for you to discuss major regulatory, policy and technical issues in nuclear safety and security. While nuclear safety and security are primarily the responsibility of individual countries, the Agency has a vital role to play in ensuring international cooperation. The IAEA provides the international forum through which national regulatory bodies share information and experience. Strong and independent regulators, operating under a robust legal framework, are vital for ensuring a high level of nuclear safety and nuclear security.

As I have said many times, there can be no grounds for complacency about nuclear safety in any country. Some of the factors that contributed to the Fukushima Daiichi accident were not unique to Japan. Continuous questioning and openness to learning from experience are essential for everyone involved in the nuclear sector.

Ladies and Gentlemen,

In 2016, we will mark a number of important anniversaries. The IAEA will begin celebrating its 60th birthday. And one of the most important IAEA peer review services – the Integrated Regulatory Review Service, or IRRS – will have its 10th anniversary.

This important service, in which leading practitioners share their experience and offer expert advice to the country that invited them, has resulted in regulatory

improvements that have benefited countries throughout the world. The IAEA's expert peer review services are among the most valuable services which we offer. I encourage all countries to make use of our full range of peer reviews.

Ladies and Gentlemen,

Last Friday was an important day for nuclear security. Uruguay and Nicaragua deposited their instruments of ratification of the Amendment to the Convention on the Physical Protection of Nuclear Material. This brought to 102 the number of countries which have adhered to the Amendment. It means that the Amendment will finally enter into force on 8 May, nearly 11 years after it was first adopted. The Amendment makes it legally binding for countries to protect nuclear facilities, as well as nuclear material in domestic use, storage and transport. It will reduce the risk of a terrorist attack involving nuclear material, which could have catastrophic consequences. I urge all countries to adhere to this important legal instrument. Universal implementation of the amended Convention will ensure that nuclear and other radioactive material throughout the world is properly protected against malicious acts by terrorists.

Ladies and Gentlemen,

Improving nuclear safety is an issue that will never cease to require our attention. Regulators play an essential role. In the next few days, you will consider the achievements since the last conference in this series in Ottawa in 2013, and reflect on how best to maintain the momentum in improving nuclear safety.

I wish you every success with your meeting and I look forward to learning about the outcome.

Thank you.

WELCOME ADDRESS

H. LIU
Conference President
National Nuclear Safety Administration (NNSA)
P. R. China

Distinguished Delegates, Ladies and Gentlemen,

Good afternoon.

It is my honour to welcome you to this International Conference on Effective Nuclear Regulatory Systems as the President of the Conference. I would like to thank the IAEA, especially Director General Yukiya Amano and his staff, for organizing this event. It's a pleasure indeed to see old friends as well as new faces coming from different countries. Your presence here today indicates a growing interest in effective nuclear regulation.

Effective regulatory systems are very important in maintaining and improving global nuclear safety. Looking back to our beginning ten years ago, we still remember the first conference which created this valuable platform. In the past decade, from Moscow, Cape Town, Ottawa to Vienna today, step by step, we have developed a better understanding of the importance of effective regulation and identified the key elements including independence, transparency, openness, competence, and wider international cooperation. We have proposed specific actions for governments, regulatory bodies and stakeholders to take, and we are glad to see that many of the actions have already achieved fruitful outcomes. Today as senior regulators from worldwide we gather here in Vienna again to share our views and make our work plans for the future.

Ladies and Gentlemen,

Nuclear energy plays a key role in international energy mixture. Up to now there are 442 nuclear power reactors in operation with 384 GWe sharing over 11% of the global electricity capacity and 66 reactors under construction. Meanwhile some new nuclear power projects have been planned in some national development programs. To combat the climate change and to reach the aim of limiting global warming agreed on the UN Climate Change Conference in Paris last year, nuclear energy should continuously make its contribution in the future.

Last month we just had the fifth year of the Fukushima Daiichi accident. Within these five years many efforts have been made to learn lessons from this disaster both nationally and internationally. All the countries having operational NPPs have taken "Stress Tests" and many safety improvements have been carried out or underway. With five years' implementation of IAEA Action Plan on Nuclear Safety, 12 important areas in the plan have been strengthened and 9 International Expert Meetings have been convened. Last year IAEA published the Director General's report and the technical annexes, which provides comprehensive and authoritative information under joint efforts by global experts.

In February 2015, the Vienna Declaration on Nuclear Safety was reached by contract parties of Convention on Nuclear Safety. It requests that new NPPs are to be built with the objectives of preventing accidents and, should an accident occur, avoiding possible large releases of radionuclides to the environment. It also requests that safety of existing Nuclear Power Plants is to be assessed and improved as

appropriate. The international peer review has been further enhanced, with 37 IRRS missions carried out since Fukushima accident.

On April 1 this year, the fourth Nuclear Security Summit was hold in Washington DC. The world leaders called on strengthening international cooperation on nuclear security and safety as well.

Ladies and Gentlemen,

After Fukushima accident, many have been learnt and many have been done. I have highlighted some above and I will not try to list all. Looking back to the effective work we have done in the last five years, I feel that, only by knowing safety deeper, can we know nuclear energy better; only by making nuclear energy safer, can we make nuclear energy stronger. I am very much convinced that, with more lessons learned and more actions taken, we will make the Fukushima accident not the winter of the nuclear power, but the spring of the safer nuclear power, and we will make a safer nuclear world.

In addition to nuclear power safety, I would like to remind that the exposure of the world's population received from radiation sources is much more than from nuclear power plants. According to the report of UNSCEAR, medical exposure is by far the largest type of exposure from man-made radiation sources. It has been estimated that the number of medical procedures using ionizing radiations has more than doubled over the past two decades. This message requests us to pay great attention to radiation safety, radioactive sources and radioactive waste management.

Ladies and Gentlemen,

Nuclear safety is achieved by concerted efforts of various stakeholders, among those; nuclear regulators play a vital role. However, nothing is one hundred percent perfect and the effectiveness of our work needs to be continuously improved as well. I understand this is exactly the reason why we have our conference every three years and why we are here this week.

In the context of nuclear energy development and the Fukushima accident lessons learnt, I would like to share with you the following lessons learnt in my thoughts which nuclear regulatory bodies are now faced with:

1. To further improve government infrastructure;
2. To further improve nuclear safety standards;
3. To further develop regulation capacity building and human resource;
4. To further enhance knowledge and experience management and transition,
5. To further foster and strengthen nuclear safety culture;
6. To further improve and rebuild public confidence.

Keeping these lessons learnt in mind, I would like to brief the five themes of this conference we will discuss in the following days:

Theme 1: Regulatory lessons learned and actions taken

Although the Fukushima accident occurred five years ago, it is still worthy to discuss the lessons and at the same time, maybe more important, to discuss how to take solid actions from regulators' perspective. Taking into account of the revision of the international legal document, IAEA safety standards, and publish of technical report, this kind of discussion is more necessary.

Theme 2: Challenges in regulating nuclear installations

Diversity of reactor technology brings challenge for regulators. New reactor designs are emerging quickly and the old reactors are aging simultaneously. Public concern is also a challenge. Another one is that the regulators should have agreed on technical standards to implement the principles of the Vienna Declaration as soon as possible.

Theme 3: Challenges in regulating radiation sources and radioactive waste

Radiation sources are widely used and easily to be illegally acquired. Radioactive wastes treatment and disposal are not merely technical but policy issues as well. As safety regulators, we should keep in mind these natures of radiation sources and radioactive waste, and to make sure they are managed safely and securely.

Theme 4: Strengthening international cooperation

In light of the no-boundary nature of nuclear accidents, international cooperation should be strengthened further. The cooperation should be widened and deepened. Regulators from different countries should help each other aiming at the common target of global nuclear safety.

Theme 5: Strengthening regulatory competence

Against the expansion of nuclear energy plan, development of new technology and increase of public concerns, adequate technical, managerial and human resources of regulatory body is needed to fulfil regulatory responsibilities.

Ladies and Gentlemen,

I am confident that by working together in the next five days, we will have a productive discussion and achieve insightful outcomes!

Thank you very much.

SESSION SUMMARIES

SESSION SUMMARIES

CONFERENCE OBJECTIVES

The objective of this conference was to review and assess ways of further improving the effectiveness of regulatory systems for nuclear facilities and activities for both nuclear safety and nuclear security. The action items in the summary presented by the President of the conference held in 2013 in Ottawa, the lessons of the Fukushima Daiichi accident, the discussions at other international conferences and at international experts' meetings conducted within the framework of the IAEA Action Plan on Nuclear Safety, as well as the Convention on Nuclear Safety (CNS) and the principles outlined in the Vienna Declaration on Nuclear Safety will continue to have a significant impact on regulatory systems. All the aforementioned need to be taken into account to sustain improvements to regulatory systems.

The expected outcomes of the conference were:

— Enhanced safety and security of nuclear installations worldwide;
— Challenges in regulating radiation sources and radioactive waste addressed;
— Enhanced international cooperation for sustaining regulatory effectiveness;
— Strengthened and sustained regulatory competence for nuclear safety and security; and
— Strategies and actions for the future identified, as well as issues for consideration by governments, regulatory bodies and international organizations.

The conference included an opening session, a keynote panel, five technical sessions and one topical panel.

OPENING SESSION

The conference was opened by IAEA Director General Yukiya Amano, who noted that improvements had been made throughout the world both in establishing effective regulatory systems and in improving nuclear safety generally. In the five years since the accident at the Fukushima Daiichi nuclear power plant, all countries with nuclear power programmes have taken vigorous steps to reassess all aspects of safety and to make improvements, where necessary. For its part, the IAEA, through its regular work, is continuing activities under the IAEA Action Plan on Nuclear Safety.

Mr. Amano noted that while nuclear safety and security are primarily the responsibility of individual countries, the IAEA has a vital role to play in ensuring international cooperation. The IAEA provides an international forum through which national regulatory bodies share information and experience. Strong and independent regulatory bodies, operating under a robust legal framework, are vital for ensuring a high level of nuclear safety and nuclear security. Mr. Amano stressed that there can be no grounds for complacency on nuclear safety in any country. Continuous questioning and openness to learning from experience are essential for everyone involved in the nuclear sector.

Mr. Amano pointed out that the IAEA will begin celebrating its 60th anniversary in 2016 and that one of the most important IAEA peer review services — the International Regulatory Review Service (IRRS) — will mark its tenth anniversary during that year. This important service, in which leading practitioners share their experience and offer expert advice to those countries that request a mission, has resulted in regulatory improvements that have benefited many countries throughout the world. He noted that the IAEA's expert peer review services are among the most valuable services offered by the organization and encouraged all countries to make use of the full range of peer reviews.

Mr. Amano noted that the number of countries that have adhered to the Amendment to the Convention on the Physical Protection of Nuclear Material (CPPNM) has now reached the number required to allow the Amendment to enter into force. The Amendment makes it legally binding for countries to protect nuclear facilities, as well as nuclear material in domestic use, storage and transport. The implementation of its provisions will reduce the risk of a terrorist attack involving nuclear material, which could have catastrophic consequences.

In his opening remarks, Mr. Liu Hua, the President of the conference, noted that the presence of so many attendees at the conference indicated a high level of interest in effective nuclear regulation. He added that effective regulatory systems are very important in maintaining and improving global nuclear safety, and that the first conference on this topic, held ten years ago, created a valuable platform for achieving that goal. In the intervening decade, through the conferences held in Moscow, Cape Town, Ottawa and Vienna, the importance of effective regulation has become more widely recognized and key elements, including independence, transparency, openness, competence and wider international cooperation, have been identified. Mr. Liu Hua pointed to specific actions proposed for governments, regulatory bodies and stakeholders, and highlighted that many of the actions had already achieved fruitful outcomes.

He also noted that many lessons had been learned and many improvements had been made in the light of the Fukushima Daiichi accident. He stressed that only by gaining a deeper knowledge of safety could nuclear energy be better understood, and that only by making nuclear energy safer could it be made stronger.

Mr. Liu Hua also reminded conference participants that doses received by the world's population from radiation sources are much greater than those from nuclear power plants, with by far the largest contributor being medical exposures, which have doubled in number in recent decades. This indicates the need to pay great attention to radiation safety, radioactive sources and radioactive waste management.

Mr. Ramzi Jammal, Vice President of the conference, noted that progress had been made since the Ottawa conference in 2013, whose theme had been 'Transforming Experience into Regulatory Improvements' and whose President had identified six key action items. Mr Jammal stated that although the IAEA and its Member States had reported on the follow-up activities undertaken as a result of the actions identified at that conference, there was a need to develop a formal reporting mechanism to enable both Member States and the IAEA to systematically report on follow-up activities. Mr. Jammal gave brief status updates on the six action items identified at the Ottawa conference and challenged the participants at the present conference to provide a comprehensive report on what had been accomplished since 2013.

Mr. Jammal noted the difficulty of obtaining political acceptance of the view that nuclear safety is as important as nuclear security and safeguards, remarking that heads of state do not meet to discuss nuclear safety in the same way they do nuclear security, and that many may have the perception that the IAEA is the international watchdog for safety.

Mr. Gustavo Caruso, in his keynote speech, noted that the IAEA Action Plan on Nuclear Safety had concluded in 2015, but that a number of ongoing activities continue under the IAEA's regular programme of work. He pointed to the more than 350 lessons that can be found in the IAEA report on the accident at the Fukushima Daiichi nuclear power plant, which are distilled into 45 key observations and lessons in the Director General's report.

Mr. Caruso noted that it can be helpful for embarking countries to adopt the IAEA safety standards in their regulatory systems. He also noted that the technical elements of the Vienna Declaration on Nuclear Safety are reflected in the revised Safety Requirements, and that Safety Guides are under review so as to incorporate these technical elements.

Mr. Shridhar Chande, in his keynote speech, noted that the accident at the Fukushima Daiichi nuclear power plant led to an evacuation of the local population, and that the lesson drawn was that the displacement of a large number of people for a long period is not acceptable to society and that, therefore, there is a need for off-site actions to be limited or even eliminated. This, in turn, leads to the requirement that accidents involving early or large releases be 'practically eliminated'.

KEYNOTE PANEL – A GLOBAL VISION

The Keynote Panel was chaired by Mr. Ramzi Jammal of Canada and it noted that in the three years since the Ottawa conference, many reports had been issued on the accident at the Fukushima Daiichi nuclear power plant, and the Vienna Declaration on Nuclear Safety had been unanimously adopted at a diplomatic conference. The panellists then presented and discussed their thoughts and ideas with respect to a global vision for the future of nuclear regulation.

The Keynote Panel noted that the observations and lessons from the IAEA report on the accident at the Fukushima Daiichi nuclear power plant are not ends in themselves but are steps that can help strengthen nuclear regulatory systems. Just as the accident at Three Mile Island changed how operating experience and severe accident management are dealt with, and the Chernobyl accident changed how safety culture is viewed, there are still long term lessons to be learned from the Fukushima Daiichi accident. Some potential long term lessons to be learned from the accident include the need to:

— Address the uncertainty and the magnitude of the consequences of extreme natural hazards in order to maintain the safety of nuclear installations.
— Improve the safety of existing installations (as per the Vienna Declaration on Nuclear Safety and the European Union's Nuclear Safety Directive) as far as reasonably practicable. Eliminating the off-site impacts of accidents will be challenging, as some plants may not be able to make the necessary

improvements, and difficult judgements may have to be made as to whether to continue operation or to shut the plant down.

— Improve emergency preparedness and response capabilities to anticipate and deal with the consequences of a severe accident anywhere in the world.

The Keynote Panel further noted that regulatory bodies need to improve safety without stifling innovation through finding the right balance between under- and over-regulation and avoiding becoming static or entrenched in their thinking (i.e. perfecting their 'regulatory craft'). In addition, there is a need for the regulatory bodies of States with established nuclear power programmes to harmonize their national requirements with the IAEA safety standards and for embarking countries to consider adopting these standards directly.

The Keynote Panel also discussed the fact that strong nuclear safety and nuclear security cultures need to be encouraged, bearing in mind that the interface between safety and security remains a challenge. While safety culture cannot be enforced, it needs to be promoted by the regulatory body. The challenge is in measuring and regulating it and the regulatory body needs to strive to harmonize its approaches with those of operators.

The Keynote Panel discussed the need to strengthen international collaboration between regulatory bodies. Areas for further collaboration include knowledge networking as well as joint research and development and bilateral cooperation in the import or export of nuclear power plants. IRRS missions can serve as a barometer of a good and improving organization, and their criteria embody the principles of good regulation. Implementation of recommendations and follow-up missions were seen by conference participants as being crucial for the success of IRRS missions. While international peer reviews are viewed as highly positive, ideally, they would challenge the host more and focus on weak points and implementation of recommendations and follow-up.

SESSION 1: REGULATORY LESSONS LEARNED AND ACTIONS TAKEN

This session, which was chaired by Mr. Ramzi Jammal of Canada and Mr. Hans Wanner of the Western European Nuclear Regulators Association, addressed the regulatory lessons learned and actions taken following the accident at the Fukushima Daiichi nuclear power plant. The presentations reviewed the actions taken by Member States in response to the accident, discussed the parallels between the Fukushima Daiichi accident and other major nuclear accidents (e.g. the accident at Three Mile Island), and discussed the impact of the accident on the IAEA safety standards. Participants also discussed the importance of the CNS as a tool for nuclear safety as well as measures to further strengthen it.

The session noted that there are parallels between some of the major nuclear accidents, including complacency in implementing lessons learned and feedback from operating experience; a lack of preparation for the unexpected; deficiencies in operator training and technical capabilities; and a poor safety culture. However, as a result of the accident at the Fukushima Daiichi nuclear power plant, Member States have undertaken specific actions to address the lessons learned. The actions taken have resulted in the significant improvement of the safety of nuclear power plants against severe accidents. In particular:

— ‘Stress tests’ were performed by all countries with nuclear power plants. The main conclusion from these assessments was that, while there was no need for the immediate shutdown of nuclear installations, there was a need to increase facility robustness to withstand extreme situations beyond existing safety margins.
— The accident highlighted the need for a clear separation of the regulatory body from promotional activities and the integration of all nuclear regulatory functions of the regulatory body.

The Fukushima Daiichi accident also highlighted the need to strengthen and harmonize approaches to emergency preparedness and response in the event of an accident, a radioactive release could affect neighbouring countries. The lack of a common approach to the implementation or execution of cross-border protective actions could lead to public confusion and concern. In addition, in preparing for an emergency, the national responses of impacted countries need to be coordinated, with the aim of achieving a coherent regional response to ensure proper decision making by operators, regulatory bodies and governments. Ultimately, nuclear accidents result in the loss of public trust in both the regulatory body and the operator. Therefore, regulators need to continually strive for openness and a transparent process.

During the session, the IAEA safety standards were discussed as a global reference for achieving a high level of safety. A review of these standards undertaken in the light of the Fukushima Daiichi accident indicated that there was no significant weakness in the existing safety standards. A further review confirmed that the technical elements of the Vienna Declaration on Nuclear Safety were captured by the relevant IAEA Safety Requirements. In this regard, implementation of the IAEA safety standards by Member States is a key to success.

The session noted that the Contracting Parties to the CNS, which include almost all Member States operating and/or planning to operate nuclear power plants, have obligations placed upon them by the CNS. Compliance with these obligations varies across countries, including those with and without nuclear power plants, and those embarking on a nuclear power programme. It was emphasized that Contracting Parties need to fully understand and respect these obligations. It was also noted that the procedures associated with the CNS review process had been strengthened and were agreed at the last review meeting.

SESSION 2: CHALLENGES IN REGULATING NUCLEAR INSTALLATIONS

This session, which was chaired by Mr. Victor McCree of the United States of America and Mr. Shiv Abhilash Bhardwaj of India, addressed numerous challenges,- some generally applicable and others specific to a set of individual countries, such as those embarking on a nuclear power programme. Such challenges include: ensuring an appropriate and current legal and regulatory framework; addressing ageing of the existing fleet of nuclear power plants, especially in the context of licence renewals; addressing challenges associated with the regulatory review of imported nuclear power plant designs; maintaining capacity building for continued regulatory competence; promoting safety culture; enhancing the safety and security interface; monitoring construction and start-up of operation; and ensuring openness and transparency in communication with the public.

The session noted that the lessons learned from the focused safety assessments that were completed worldwide following the accident at the Fukushima Daiichi nuclear power plant led to many additional protective features and mitigation measures. Furthermore, the session noted that harmonizing national standards with international standards would assist in the safe and efficient introduction of new nuclear power plants.

With respect to embarking countries, the session noted that the regulatory bodies of those countries would benefit from studying the regulatory framework of the vendor country as well as other established nuclear regulatory bodies. Their regulatory bodies will need international support for building a sound regulatory framework and the competence of its staff.

With respect to long term operations, the sessions noted that safety oversight of ageing phenomena is needed throughout the lifetime of a nuclear power plant, starting from the early design and construction phases. In addition, the increasing trend for long term operation (including licence renewals) requires continuous research on ageing mechanisms and effects, including the development of detection technologies.

During the session it was also noted that an open and continuous dialogue between the regulatory body and the operator promotes safety. To the extent possible, this dialogue is to be open and transparent to the public. Furthermore, international peer reviews are to be used to assess a regulatory body's capabilities and performance against internationally recognized criteria, such as the IAEA safety standards.

SPECIAL PANEL: REGULATORY ASPECTS AND CHALLENGES OF HIGH LEVEL WASTE

This Special Panel, which was chaired by Mr. Lawrence Kokajko of the United States of America, presented approaches taken in, and the status of, the management of high level waste in a number of countries. It was noted that, while some countries have already decided on sites for the disposal of waste based on a voluntary process and work is progressing, other Member States are at much earlier stages in the process, namely searching for a host community.

The Special Panel noted that the entire process of selection, siting and design, application development, and construction and operation is very long and is complicated by numerous factors that may span many decades. A strong national policy commitment is important to support high level waste management over the lifetime of the project. Maintaining competence and resources over such long time periods is challenging. In addition, stakeholder involvement, particularly host community engagement, is crucial; it is important to have the early agreement of the selected host community.

Furthermore, the Special Panel noted that the selection process needs to be transparent. Communication with the host community and other appropriate stakeholders is important. Regular public meetings between the operator and the regulatory body are advisable. However, the independence of the regulatory body from the operator is crucial; this may include independent research and meetings with stakeholders and the general public.

During the Special Panel there was discussion concerning the fact that consideration needs to be given to the formation of an international working group to

develop criteria to determine when a safety case in support of a high level waste facility meets regulatory requirements.

SESSION 3: CHALLENGES IN REGULATING RADIATION SOURCES AND RADIOACTIVE WASTE

This session, which was chaired by Mr. Abel Gonzàlez of Argentina, covered a range of topical issues related to regulation of all types of radiation sources — namely apparatus generating ionizing radiation and radioactive sources — both in use and at the end of their life cycle, when they become disused or are declared as waste. The presentations dealt with a variety of challenges, including establishing and improving regulatory systems in Member States; regulating new medical technologies; dealing with disused sources; and addressing radiological accidents involving radiation sources.

This session was of key interest to a wide audience. The majority of IAEA Member States do not have nuclear power facilities, yet all States use radiation sources and have to deal with disused sources or radioactive waste. Moreover, patient exposures account for the highest radiation exposure of the population from human-made sources, and radiation sources have caused more accidents and have led to higher exposures to more people than accidents at nuclear power facilities.

The session noted that the IAEA safety standards, the Code of Conduct on the Safety and Security of Radioactive Sources and its supplementary Guidance on the Import and Export of Radioactive Sources are widely used by regulators and have been very effective in enhancing the safety and security of radioactive sources worldwide. However, while the safety of nuclear installations and of radioactive waste and spent fuel, the physical protection of nuclear materials, and the notification of accidents and the provision of assistance in the event of an accident or incident are covered by international conventions, no similar instruments exist for radioactive sources. A legally binding international instrument (or instruments) focused on radiation sources would in the longer term bring a higher level of commitment by States and therefore facilitate the necessary governmental support of national regulatory bodies.

The session also noted that establishing a new, independent and fully functioning regulatory body requires the support of high level policy makers for the provision of both funding and the availability of competent staff. Member States, especially those at the early or middle stages of developing their radiation safety infrastructure, would, in this regard, benefit from the wide dissemination of the model strategic approach to establishing and strengthening radiation safety infrastructure. The IAEA, through its technical cooperation activities and its review and advisory missions, assists Member States in establishing or enhancing their regulatory infrastructure in line with the IAEA safety standards.

The session noted that the management of spent or disused radioactive sources, including legacy sources and recovered orphan sources, continues to be a challenge in many countries. Noting that the long term storage of disused sources poses its own set of safety and security challenges, and that returning sources to the supplier is not always an option, disposal is being considered in some countries. Opinions differ concerning the safe lifetime for the use of radioactive sources and any extensions, and how this is to be regulated.

The session noted that the development and introduction of new medical radiation technologies would benefit from improved communication between regulatory bodies, manufacturers, professional bodies and end users. In addition, there are many national approaches to dealing with the import and export of both radiation generators and radioactive sources. While there may be no 'one size fits all' methodology, there may be scope for better harmonization of these approaches.

The session noted that reports of accidents involving patients, workers and the public highlighted that, although prevention is the best option, there is still an ongoing need to ensure that emergency preparedness and response continues to be a high priority. It was recognized that the International Nuclear Event Scale (INES) is only one of several communication tools and is not be used as a decision making tool.

SESSION 4: STRENGTHENING INTERNATIONAL COOPERATION

This session, which was chaired by Mr. Liu Hua of China, addressed international cooperation among various stakeholders and regulatory networks for enhancing nuclear and radiation safety and security. The presentations highlighted that international cooperation covers numerous aspects in support of the enhancement of the capacity of regulatory bodies to deliver their mandates in an effective manner. IAEA peer review services were discussed as important tools available to Member States for enhancing nuclear safety and security.

The session noted that international cooperation in the regulatory area covers numerous topics, contributes to improving the competence, skills and knowledge of regulatory staff, and benefits from the active involvement of various organizations in the promotion of the acceptance of the IAEA safety standards. The IAEA is considered to be an advisor on nuclear safety, responding to invitations for support by Member States. However, international and regional support cannot serve as a substitute for the activities, responsibilities and commitment of national regulatory bodies.

The session noted that the IAEA's peer review services enhance the safety of nuclear installations by identifying opportunities for improvements and contribute to enhancing regulatory effectiveness and transparency through an increasing number of de-restricted reports. Self-assessment as part of the preparation for peer review missions was recognized as particularly valuable for a successful mission. Furthermore, peer review services play an essential role in the development and implementation of the safety infrastructure for a new nuclear power programme. However, while there has been an increase in the number of requests for peer reviews, requests for follow-up missions lag behind.

With respect to regulatory networks, the session noted that they face challenges including addressing differences in the level of development from country to country, coordinating with other networks, creating and maintaining awareness of the network in member countries, and developing a qualified and experienced workforce.

SESSION 5: STRENGTHENING REGULATORY COMPETENCE

This session, which was chaired by Mr Mohammad Anwar Habib of Pakistan and Mr Nader Mamish of the United States of America, addressed the issue of

strengthening regulatory competence together with various strategies for establishing and ensuring the sustainability of the competence of the regulatory body and its technical support organization. The session highlighted that staff of the regulatory body need to be competent in order to discharge their technical core regulatory functions, and they need to understand the nuclear safety and security concept in order to develop the nuclear safety and security culture within the organization.

The session noted that IAEA peer review services provide both a good independent review of regulatory competence and education and training programmes, especially those services geared specifically to education and training (e.g. Education and Training Appraisal (EduTA) and Education and Training Review Service (ETReS)). Furthermore, the IAEA's Guidelines for Systematic Assessment of Regulatory Competence Needs (SARCoN) methodology is useful for assessing the needed competence, identifying gaps in the existing competence, and bridging the gaps through the provision of education and training. However, it was acknowledged that finding the appropriate balance between academic training and professional training is sometimes difficult, especially for Member States where there are few professional training capabilities.

The session noted that there is an increased need for a strong regulatory competence building programme in cases where the regulatory body has to expand, for example in the case of countries embarking on a nuclear power programme. In addition, the presence of an integrated management system within the regulatory body is key, and efforts are needed to enhance the regulatory body's safety and security culture.

The session noted a number of areas in which specific focus should be given to competency development, such as human and organizational factors, which play an important role in ensuring safety and security and an adequate understanding of risk perception by the public as well as communication tools and technologies to ensure an effective radiation risk communication strategy.

CLOSING SESSION

PRESIDENT'S SUMMARY AND CONCLUSIONS OF THE CONFERENCE

H. LIU
Conference President

Following a presentation of the session summaries by the chairs, including a summary of the Special Panel, the President of the Conference presented his summary and conclusions of the conference. This included general observations since the accident at the Fukushima Daiichi nuclear power plant; ongoing challenges faced by regulatory bodies; issues for consideration by governments and regulatory bodies; issues for future international cooperation; and conclusions of the conference as a whole.

With respect to general observations since the accident at the Fukushima Daiichi nuclear power plant, the accident has not stopped the use of nuclear power internationally, but its continued use will require sustained improvements globally to maintain a high level of safety and security. Actions taken to address the lessons learned from the Fukushima Daiichi accident include the development and implementation of the IAEA Action Plan on Nuclear Safety, publication of The Fukushima Daiichi Accident – Report by the Director General, implementation of 'stress tests' (or equivalent) in most countries, and adoption of the Vienna Declaration on Nuclear Safety.

The IAEA Safety Requirements provide a good global reference and establish a good level of nuclear safety. A review of the IAEA safety standards revealed no significant areas of weakness and found that the requirements cover the lessons learned from the accident. A small set of amendments were proposed to strengthen the requirements and to facilitate their implementation.

Finally, while operators have the primary responsibility for safety, regulatory bodies play a vital role in sustaining nuclear safety, although some require, inter alia, additional authority, independence and transparency.

With respect to ongoing challenges faced by regulatory bodies, there is a need to establish and sustain strong regulatory systems in order to maintain nuclear safety and security, and public trust, regardless of the prevailing economic environment. This includes justifying to all stakeholders the safety improvements to existing plants, which will be required as countries implement the Vienna Declaration on Nuclear Safety. Furthermore, this leads to the need to revise IAEA Safety Guides to include descriptions of how to implement the revisions to the Safety Requirements made following the accident at the Fukushima Daiichi nuclear power plant and the Vienna Declaration on Nuclear Safety.

Regulatory bodies continue to be challenged by emerging radiation technologies, especially in the medical field. In addition, there is a need to increase Member State participation in the various nuclear international instruments (e.g. the CNS) and compliance with their obligations.

With respect to issues for consideration by governments, there is a need to ensure the independence of the regulatory body from agencies that promote the

nuclear and radiological sectors and to provide the regulatory body with adequate authority, resources and competent staff.

During the conference it was stated that developing a national policy to support high level radioactive waste management or disposition over the life of the programme is important. Also, governments need to give the same consideration and priority to nuclear safety as is given to nuclear security and safeguards as well as increase ratification of international legal instruments in support of safety and security.

Finally, governments need to endeavour to strengthen the management and control of the safety and security of radiation sources and the cross-border harmonization of actions to protect the public after a nuclear or radiological event.

With respect to issues for consideration by regulatory bodies, there is a need to, to the extent possible, harmonize national regulatory requirements with IAEA safety standards. Ideally, embarking countries will consider adopting the IAEA safety standards directly. In addition, regulatory bodies need to encourage research on ageing mechanisms and effects to support the licensing of long term operation and the sharing of results with the international community.

Regulatory bodies need to consider hosting peer review and advisory service missions, taking action in response to recommendations; hosting follow-up missions; and encouraging operating organizations to host peer reviews.

Furthermore, regulatory bodies need to build further capacity through outreach and knowledge transfer to future nuclear professionals. This may include the development of an integrated management system to promote safety culture within the regulatory body and to promote, assess and improve safety culture within authorized parties as well as anticipate and avoid future accidents by learning from international regulatory operating experience.

Throughout the conference, it was stated that regulatory bodies need to improve transparency and communication with the public and other stakeholders to build trust and that regulatory bodies should be encouraged to interact among themselves. As medical facilities, equipment and end users are likely to be regulated by several different authorities and in some cases in different jurisdictions (e.g. in countries with a federal system), such interaction is important radiation safety.

With respect to issues for future international cooperation Member States that are not Contracting Parties to the CNS or the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management need to be encouraged to join those instruments; Member States that have joined but not yet ratified need to do so; and those Member States that are Contracting Parties need to fully comply with their obligations. Furthermore, there is a need to explore the feasibility of developing a legally binding instrument covering radioactive sources.

Since all IAEA Member States use radiation sources, organizing a conference devoted to their regulation would be beneficial. Noting that the introduction of new medical technologies can be challenging for regulatory bodies, specific areas for support in this regard need to be identified.

Finally, consideration needs to be given to strengthening peer reviews such that they challenge the host more and focus on weak points, implementation of recommendations and follow-up.

Ultimately, since the previous conference, held in Ottawa, Canada, in 2013, many improvements have been made to nuclear regulatory systems. Sharing experience and lessons learned is key to sustaining improvements globally. This summary proposes issues for consideration by various bodies. The intention is for these bodies to develop actions to respond to these issues. Progress on these actions will be reported on and discussed at the next nuclear regulatory conference, to be held in three years' time. A willing Member State will be sought to host this fifth conference in the series.

Annex

CONTENTS OF THE ATTACHED CD-ROM

The following papers presented at this conference are available on the attached CD-ROM. Please note that the Special Panel was a panel discussion and therefore no papers were presented at them.

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Long Term Operation in the United States – Subsequent License Renewal for Plant Operation beyond 60 Years
M.R. Johnson, A.L. Hiser, C.G. Miller

Changes to Regulatory Systems for more Efficient Nuclear Energy Deployment an Industry Viewpoint
H. Pelin, B. Kaufer, G. Kaser

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K. Horvath, M. Lehota, G. Petofi

Regulatory Oversight for New Projects – Challenges and Improvements in Regulation
F. Lall

SESSION 3: CHALLENGES IN REGULATING RADIATION SOURCES AND RADIOACTIVE WASTE

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M.H. Marechal, A. Facure, R.F. Gutterres

U.S. Experiences and Regulatory Challenges with New Medical Technologies
J.G. Elee

A Strategic Approach to Establishing and Strengthening National Infrastructure for Radiation, Transport and Waste Safety
A. Mastauskas

Regulatory Oversight of Radioactive Sources Through the Integrated Management of Safety and Security
K. Horvath, Á. Vincze, S. Kapitány

Experience and Challenges in the Management of Disused Sources in Medical Application in Iran
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Challenges in Strengthening Regulatory Infrastructure in a Non-Nuclear Country: Example of Bosnia and Herzegovina
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SESSION 4: STRENGTHENING INTERNATIONAL COOPERATION

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Strengthening Regulatory Effectiveness in India – Lessons Learnt from Fukushima Accident
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Experience Transformed into Nuclear Regulatory Improvements in Russia
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More Effective Regulators through Improved Accountability
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Challenges in Regulating Disused Radioactive Sources and Radioactive Waste in Iraq
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