Advancing the Global Implementation of Decommissioning and Environmental Remediation Programmes

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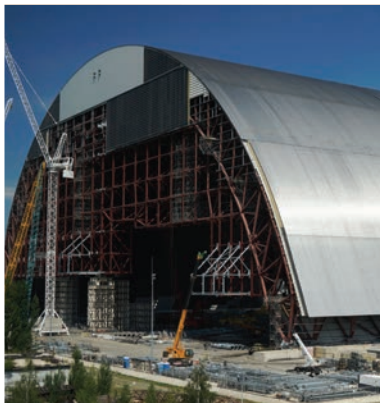

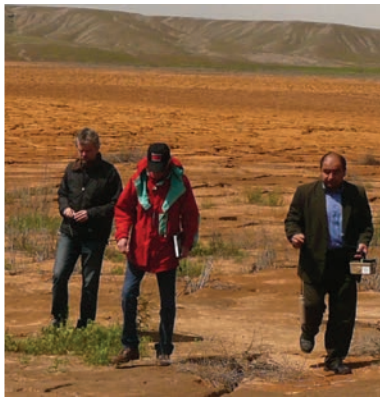


IAEA International Atomic Energy Agency
European Commission
OECD BETTER POLICIES FOR BETTER LIVES
NEA NUCLEAR ENERGY AGENCY
European Bank for Reconstruction and Development

ADVANCING THE GLOBAL IMPLEMENTATION OF DECOMMISSIONING AND ENVIRONMENTAL REMEDIATION PROGRAMMES

The Agency's Statute was approved on 23 October 1956 by the Conference on the Statute of the IAEA held at United Nations Headquarters, New York; it entered into force on 29 July 1957. The Headquarters of the Agency are situated in Vienna. Its principal objective is "to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world".

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FOREWORD

Both decommissioning and environmental remediation (D&ER) concern the management of liabilities resulting from activities involving radioactivity. They each share the common objective to reduce radiation exposure to people and the environment at sites where radioactivity levels restrict access. Decommissioning is the administrative and technical actions taken to allow the removal of some or all of the regulatory controls from a facility, thus releasing the site for other uses. Environmental remediation is any measures to reduce the radiation exposure from existing contamination of land areas.

The International Conference on Advancing the Global Implementation of Decommissioning and Environmental Remediation Programmes was organized by the IAEA and held in Madrid, Spain, on 23–27 May 2016. The last major conferences organized by the IAEA on this topic were on decommissioning (Athens, 2006) and environmental remediation (Astana, 2009). Since then, significant developments in the field have taken place. Therefore, it was considered timely for the IAEA to organize this conference, which was cosponsored by the European Commission, and in cooperation with the OECD Nuclear Energy Agency and the European Bank for Reconstruction and Development. The conference was hosted by the Government of Spain through Empresa Nacional de Residuos Radiactivos, S.A. (ENRESA), the Nuclear Safety Council (CSN) and the Spanish Electricity Industry Association (UNESA). The conference was attended by 540 participants from 54 States and 4 organizations. The large attendance is a testament to the current levels of awareness and interest of Member States and relevant organizations of the need to provide safe, environmentally sound and cost effective solutions for implementing D&ER programmes worldwide.

The conference was organized to share and review challenges, achievements and lessons learned from the D&ER programmes since 2006. The decision to combine D&ER in one conference is recognition of the significant synergies between the two activities. The conference explored these interactions to foster and optimize the global implementation of D&ER. The key goals were to raise awareness of the importance of addressing the legacies from past activities, identify current priorities and recommend strategies and approaches that can enable and enhance safe, secure and cost effective implementation of national and international programmes.

This publication provides the Conference President's report as well as a description and summary of the outcomes from each session, and main current challenges, including what the conference participants identified as the main approaches to further advance D&ER, and it concludes with the contributed abstracts and the posters presented at the conference. The accompanying CD-ROM contains the presentations given.

The IAEA gratefully acknowledges the support and hospitality of the Government of Spain through ENRESA. The IAEA officers responsible for this publication were P.J. O'Sullivan and H. Monken-Fernandes of the Division of Nuclear Fuel Cycle and Waste Technology, and V. Ljubenov of the Division of Radiation, Transport and Waste Safety.

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INTRODUCTION

BACKGROUND

There have been significant advances over the last decade in D&ER, especially in those countries with large nuclear programmes and from lessons learned in ER programmes worldwide. However, much remains to address the legacies from the early development of nuclear energy. Activities from which experience has been gained include: the dismantling of redundant research and fuel cycle facilities, research reactors and nuclear power plants, the remediation of former nuclear test sites, and remediation of those sites affected by past uranium mining and processing operations, by other activities involving the use of naturally occurring radioactive material (NORM), or by major nuclear or radiological accidents. Long term solutions often still need to be found for management of the resulting waste, including the development of disposal facilities that meet public acceptance and safety requirements. Some countries are moving forward with dealing with these legacies, and accordingly have built up appropriate technical resources and expertise, but many national programmes still face very significant challenges.

The IAEA has organized five major international events on D&ER over the past two decades[1]:

- The Symposium on Restoration of Environments with Radioactive Residues, hosted by the US Government, through the Department of Energy (DOE), the Environmental Protection Agency (EPA) and the Nuclear Regulatory Commission (NRC), and held in Arlington, Virginia, USA, from 29 November to 3 December 1999 (the Arlington Symposium) [1];
- The International Conference on Safe Decommissioning for Nuclear Activities, hosted by the Government of Germany through the Federal Office for Radiation Protection and held in Berlin, Germany, from 14 to 18 October 2002 (the Berlin Conference) [2];
- The International Conference on Lessons Learned from the Decommissioning of Nuclear Facilities and the Safe Termination of Nuclear Activities, in co-sponsorship with the European Commission and in cooperation with the OECD Nuclear Energy Agency and the World Nuclear Association, hosted by the Government of Greece through the Ministry of Foreign Affairs of the Hellenic Republic and the Greek Atomic Energy Commission and held in Athens, Greece, from 11 to 15 December, 2006 (the Athens Conference) [3];
- The International Conference on the Remediation of Land Affected by Radioactive Residues, which was hosted by the Government of Kazakhstan through the Kazakhstan Atomic Energy Committee and held in Astana, Kazakhstan, from 18 to 22 May 2009 (the Astana Conference) [4].
- The International Experts Meeting on Decommissioning and Remediation after a Nuclear Accident, organized in conjunction with the implementation of the IAEA Action Plan on Nuclear Safety, and held in Vienna, Austria, 28 January – 1 February, 2013 [5].

A further significant event aimed at fostering exchanges on a relevant decommissioning issue was:

- The International Conference on Control and Management of Radioactive Material Inadvertently Incorporated into Scrap Metal, organized by the Spanish Nuclear Safety Council in cooperation with the IAEA, and held in the Tarragona, Spain, 23–27 February 2009 (the Tarragona Conference) [6].

Since the 2006 decommissioning conference and the 2009 environmental remediation conference, significant advances have occurred in the implementation of D&ER programmes, and therefore it was

[1] For further information on these conferences, refer to the paper contributed by Abel J. Gonzalez, "Advancing the Global Implementation of Decommissioning and Environmental Remediation Programmes", on the attached CD-ROM.

considered timely to exchange recent experiences on these topics and discuss what is needed for further advancement. The proposal to combine the two subjects in one conference is a recognition that significant synergies exist between the two activities, which should be explored to foster and optimize the implementation of both D&ER worldwide.

SCOPE AND OBJECTIVES OF THE MADRID CONFERENCE

The objective of the conference was to share and review challenges, achievements and lessons learned related to the D&ER programmes that have been implemented during the past decade. A further objective was to identify mechanisms that can facilitate the implementation of these activities, especially wherever they are moving at a slow pace or are virtually stagnant. Key goals included raising awareness of the importance of addressing the legacies from past activities, identifying current priority needs and providing recommendations on the strategies and approaches that can enable and enhance safe, secure and cost effective implementation of national and international programmes during the next one to two decades. The conference scope covered the full breadth of D&ER, including but not limited to licensed nuclear facilities, NORM activities, uranium mining and milling, post-accident situations and legacy sites and associated facilities.

The objective and scope reflected the outcome of a recent IAEA study [7] which suggests that the major factors that can advance the implementation of D&ER programmes include: visible government commitment, having in place adequate legal and regulatory frameworks with clear allocations of responsibilities for funding and implementation of projects, arrangements for decision making which provide for stakeholder engagement, and ensuring the availability of appropriate human, technical and financial resources for the implementation and oversight of programmes now and in the future.

The conference was organized around the following seven themes, plus a special session to allow an opportunity for young professionals to present their projects, achievements, and discuss career opportunities in the D&ER fields. The conference themes were:

- National policies and strategies to enable and enhance D&ER;
- Regulatory framework and standards;
- Decision making process: societal and stakeholder involvement during the lifecycle of programmes;
- Technical and technological aspects (including technology and innovation needs);
- Waste management in D&ER ;
- Project management, skills and supply chain considerations;
- International cooperation.

While each individual theme was discussed most thoroughly during the specific thematic session, there was also cross-over between themes, which allowed a discussion of, for example, regulatory framework within the specific context of decommissioning waste management. This emphasized the importance of a holistic approach to D&ER and the synergies that exist.

OBJECTIVES AND STRUCTURE OF THIS REPORT

The objective of this report is to highlight the outcomes and main challenges identified during the conference. Main ideas and messages expressed and discussed at the conference are presented in the Conference President's Report. The central components of the report are derived from the insights gained from presentations by speakers, panellists and poster presentations and discussions and contributions by participants during the conference.

The report structure follows the thematic organization of the conference, as described above. The Conference President's Report is included in Appendix A. Appendix B contains the welcome address to the conference on behalf of the IAEA. An outline of the contents of the attached CD-ROM is given in Annex A.

ESTABLISHING NATIONAL POLICIES AND STRATEGIES TO ENABLE AND ENHANCE D&ER (OPENING SESSION AND SESSION 1)

The conference opened with remarks from the leadership of the host organization, the sponsoring and the cooperating organizations. Each speaker emphasized the importance of planning, especially the benefit of planning for decommissioning during design of new facilities and advance planning for ER, including for recovery from potential post-accident scenarios. They highlighted the importance of addressing the legacy associated with residual radioactive materials and nuclear fuel production, and the social responsibility of the industry to demonstrate the ability to complete D&ER in a timely manner so as not to pass the burden to future generations. Opportunities for further advancing D&ER included taking advantage of the synergies between D&ER, mechanisms for international funding, motivating young professionals to choose the D&ER field for their career path, and continued engagement with stakeholders.

SESSION DESCRIPTION

The objective of Session 1 was to consider how specific national policies and strategies may enable and enhance D&ER, and to stimulate all Member States to develop and maintain such national frameworks to enable immediate decommissioning of shutdown facilities and timely remediation where needed, thereby avoiding passing risks and obligations to future generations and freeing resources (land) for other beneficial purposes. The leadership and experts of D&ER programmes from 10 countries discussed their national policies and frameworks, successes and opportunities. The session also included two panel discussions and a film presentation on Fukushima.

SESSION OUTCOME

An important prerequisite for the implementation of D&ER programmes is the existence of relevant national policies based on an adequate understanding of the liabilities that exist and clear definition of responsibilities together with mechanisms to support the decision making processes; this is particularly the case in Member States where multiple legacy sites exist. The linkage of such policies with those for management of radioactive waste is crucial and, given this linkage, extensive reference is made below to precedents in the fields of radioactive waste management and spent fuel management.

It is generally accepted as being good practice that Member States establish and maintain and enforce national policies and strategies on spent fuel and radioactive waste management. Such policies should typically be based on the internationally recognized principles [8, 9]. Associated with such polices [10, 11, 12] is the need to establish national programmes for D&ER that align with the national policy and strategy for spent fuel and radioactive waste management, including for example:

- Milestones and associated timeframes;
- Current and future inventories of spent fuel and radioactive waste;
- Consideration of on-site disposal of radioactive waste in certain circumstances where appropriate;
- Availability of the concept of ‘conditional clearance’;
- Research, development and demonstration activities needed to implement the envisaged technical solutions;
- An assessment of costs and implementation of an appropriate financing scheme.

During the Conference, participants expressed their preference for early implementation of decommissioning of nuclear installations, with the main factors preventing this strategy being lack of waste disposal routes and, in some cases, insufficient availability of funds. In the case of the latter it has been argued that delay will enable existing funds to build up through investment in appropriate securities, with investment returns expected to be greater than any expected escalation in the eventual decommissioning cost. Lack of sufficient funds may also be observed particularly in the case of non-

power installations including obsolete research reactors and where small licensed companies are involved.

It was noted that there have been enhancements in project management and knowledge transfer from lessons learned and experience gained which may lead to cost and scheduling benefits in both decommissioning and remediation projects.

The need to develop national policy, strategies and means of national dialogue for remediation of legacy and post-accident sites containing residual radioactivity was emphasized. This should be done prior to any radiological or nuclear accident or incident occurring. This would include dialogue with stakeholders on the development of reasonable reference levels which, for post-accident situations, would apply in the existing exposure situation after the emergency phase had ended. In order to avoid inaction in individual countries due to fear of stigmatization by raising the possibility of accidents, it was suggested that international guidance and recommendations should be developed for all countries to adopt.

MAIN CHALLENGES

Radioactive waste and spent fuel policies, strategies and implementation structures tend to vary widely in different Member States, reflecting different customs, value systems and legal frameworks. Similar issues apply in the case of management of decommissioning liabilities and the remediation of contaminated land areas. As in the case of spent fuel and radioactive waste management, national policies for D&ER should be based on appropriate principles such as having a strong presumption against passing the burdens to future generations where technologies and resources (financial and human) are currently available to address these issues. It is important that national programmes are established and funded to implement the national policies, incorporating milestones and other similar elements to those being applied for the management of spent fuel and radioactive waste. Issues to be addressed in developing national policies include:

Establishing and maintaining national inventories of D&ER liabilities;
Prioritization of hazard reduction measures based on risk and societal factors;
Ensuring availability of adequate waste recycling/storage and disposal routes;
Ensuring adequacy of financing arrangements and related responsibilities;
Assuring safety, security and environmental protection assurance with relevant rules and regulations;
Encouraging both innovation and standardization of approaches, depending on circumstances;
Considering sustainability aspects in terms of the plausibility of achieving desired outcomes;
Assuring transparency of the process and active stakeholder participation.

Strong encouragement needs to be given to Member States to develop an accurate base of information that describes the quantities and characteristics of waste streams already existing and those that will be generated from D&ER programmes, supported by waste forecasting tools to be built around a set of appropriate assumptions. These assumptions should be re-evaluated and replaced over time by actual observed waste generation rates and waste characteristics. This information is essential to planning and optimizing the treatment, storage, and disposal system components for waste arising from D&ER programmes. The adoption of a ‘lifecycle management thinking’ culture should therefore also be encouraged.

Contracting Parties to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management should pay particular attention to their national policies for D&ER in their reports to the Review Meetings of the Convention, focussing on how they are integrating these fundamental activities in the national waste management programmes. Specific consideration needs to be given by the international community to reassess regularly and provide international best practice advice on whether deferred dismantling represents an optimized strategy for decommissioning in view of financing considerations, societal expectations and industry sustainability.

The assumption of high expected rates of return on financial investments intended to cover future decommissioning costs, when applied over long timeframes, may encourage delay and, if proven wrong, be in conflict with the principle of intergenerational equity. These arguments should therefore be reconsidered, not just in regards to funding issues but also taking into consideration societal expectations for reuse of land and difficulties such as knowledge retention when decommissioning liabilities are passed to future generations.

The importance of the option of on-site disposal of very low level and low level radioactive waste, to be considered in specific situations, in the scope of decommissioning and remediation activities was raised. International guidance for on-site disposal that addresses issues of intrusion and maintaining very long term institutional controls is needed.

Member States were encouraged to develop the necessary policy, strategy, reference levels and means of national dialogue for remediation of legacy and post-accident contamination, before any radiation or nuclear accident or incident occurs.

REGULATORY FRAMEWORK AND STANDARDS FOR D&ER (SESSION 2)

SESSION DESCRIPTION

The objective of this session was to review international experience concerning regulatory frameworks for implementing D&ER programmes, and to identify best practices, common challenges, and areas for improvement taking into account the different hazards/risks presented.

The session featured introductory remarks from the chairpersons. Presentations, both oral and posters, and a panel discussion provided the attendees an opportunity to hear experts from fourteen countries and the International Commission on Radiological Protection (ICRP).

SESSION OUTCOME

Effective implementation of D&ER programmes is strongly dependent on the establishment of appropriate regulatory regimes and associated standards to protect the safety of the workforce, the general public and the long term safety of the environment, and ability of the regulatory bodies to enforce the related regulatory requirements. The IAEA Safety Standards (such as [9, 13] and associated Safety Guides) provide the basis for the necessary regulatory framework and for implementing guides.

The session began with a comprehensive overview focused on international standards and how they could be effectively used to strengthen national regulatory instruments for different decommissioning and remediation cases. It was followed by presentations which reflected the regulatory experience concerning a wide variety of D&ER cases under different national, legal and regulatory frameworks. A separate presentation explained the application of the ICRP recommendations on exposures resulting from contaminated sites from past industrial, military and nuclear activities. Also the integrated European experience in use of Western European Nuclear Regulators Association (WENRA) Safety Reference Levels for decommissioning was presented. The session was completed with the panel discussion on key elements needed in a national regulatory framework to encourage progress in decommissioning and remediation. The following common issues were identified:

> Regulatory decision making for remediation needs to be risk informed and flexible enough to not obstruct implementation of remediation activities. An example of this concerns situations, for example in decommissioning, where a safety system needs to be removed to enable decommissioning to proceed. In such instances the regulator should have the means and flexibility to work with implementing organizations to acknowledge the necessity of the action and take a risk informed approach;

Consideration should be given to advanced land use planning for existing nuclear facility sites. An early dialogue with stakeholders on how such an area may be used in the future could make it easier to decommission a facility to an end state other than residential reuse, if such a land use decision is made at an early stage;
An appropriate framework to regulate radioactive materials and waste arising from remedial actions is needed, one that clearly defines the roles and responsibilities of the various institutions involved and highlights the need for an optimized approach which considers the waste management risks;
Particular attention to regulatory activities during the transition period from operation to decommissioning is needed, as well as to the early development of decommissioning plans as provided by the relevant IAEA Safety Requirements.

Some gaps in existing international safety standards and associated guidance when applied to D&ER situations were identified. Participants suggested further development of internationally recognized guidance, preferably as IAEA safety standards, on the following issues would be beneficial:

Regulatory approaches for decommissioning of accident damaged nuclear facilities and related remediation activities, including licensing considerations in accident recovery and management of resulting waste;
Selection and implementation of reference levels for existing exposure situations i.e. in remediation programmes;
Establishing and implementing criteria for the determination of end states of sites after D&ER, as well as on planning and implementation of long term institutional controls.

Conference participants stressed the value of regulatory collaboration, including such instruments as IAEA-supported networking — such as the International Decommissioning Network (IDN) and the International Working Forum on Regulatory Supervision of Legacy Sites (RSLS) — and relevant regional initiatives (like WENRA Working Group). Also it was recognized that the regulatory framework for D&ER should get more consideration under the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management review process and while applying IAEA Integrated Regulatory Review Service (IRRS) reviews.

It was suggested that IAEA should give consideration to the development of a set of coordinated activities at international level, reflecting the identified issues and taking account of the conference outcomes.

MAIN CHALLENGES

The expected significant increase in the number of nuclear installations being retired from service during the 20-year period from the time of this conference, together with the D&ER associated with the Fukushima accident, suggest a possible need for additional standards and/or guidance at the international level in relation to the following issues:

Workforce protection. Current standards on workforce protection from radiation were developed primarily for application at operating nuclear installations, based on the concept of an occupationally exposed person (radiation worker). An increased number of decommissioning and remediation projects in the future will necessarily increase the numbers of “non-radiation workers” being involved in some conventional activities related to D&ER. Such workers are treated in an analogous way to members of the public; however, there may be a need for them to work for a limited time in areas of slightly increased radiation exposure, which should be considered in their radiation safety arrangements. There may be a need for a new category to address this situation;
Reference levels. One of main challenges is selection and application of reference levels for remediation of contaminated sites. The process for selecting the reference level, and importantly, how to communicate what the reference level means, remains a significant challenge. The existing standards recommend selection of reference levels for remediation of

contaminated sites within a wide range of exposure levels (1-20 mSv/year), on the basis of consultation with regulators and other stakeholders, and taking into account ethical and socioeconomic considerations including the cost of proposed remediation measures [9]. Recent experience, including that from areas affected by the 2011 accident at the Fukushima Daiichi power plant, suggests that the general public tends to expect that reference levels at the lower end of the range should be selected and applied regardless of other considerations [14]. Such expectation leads to a good deal of confusion on this issue;

Restricted release of sites. There is a lack of consensus at the international level on what the criteria are for restricted release of a site after decommissioning or remediation and how they are derived and applied;

Waste management. Guidance is needed on how to better integrate D&ER with waste management, especially when very large quantities of low level waste are involved;

Conditional clearance. While standards for unconditional clearance levels are harmonized, there are a wide variety of approaches to conditional clearance levels. For harmonization of practices, international guidance for conditional clearance of materials and waste from D&ER is needed.

DECISION MAKING PROCESS: SOCIETAL AND STAKEHOLDER INVOLVEMENT DURING THE LIFECYCLE OF PROGRAMMES (SESSION 3)

SESSION DESCRIPTION

The objective of this session was to highlight how recent experience with stakeholder involvement for obtaining the necessary social acceptance for D&ER has informed decision making approaches and to identify areas where further improvements to decision making frameworks is needed.

The session featured introductory remarks from the chairpersons, presentations and a panel discussion, providing an opportunity for experts from seven countries to share their experiences.

SESSION OUTCOME

Overall, there was general recognition that there is a need for early consideration and alignment of thoughtful strategies for public communication and stakeholder involvement within the overarching national D&ER framework. Alignment at the beginning of the process will help establish effective mechanisms for dialogue, with clear allocation of roles and responsibilities. Since previous conferences held on this subject, there has been an evolution in stakeholder expectations and a revolution in information technology. Today, there is a greater expectation of integrated engagement of policy makers, regulatory authorities, industry and the public in the decision making process. These expectations are high and growing - both in terms of information needs and involvement in decision making.

Integrating public engagement into decision making concerning D&ER, particularly concerning desired end states, is extremely complex. The key areas constraining progress discussed during the conference included:

Limited technical knowledge and understanding of science leading to risk perception based predominantly on emotion and fear;

Groups and individuals opposed to projects because of waste disposal concerns and/or past negative experience with D&ER projects;

Insufficient government commitment or support to implement D&ER projects;

Limited budget or technical resources to meet stakeholder demands;

Changing procedures, legal frameworks or strategies relating to D&ER projects;

Lack of trust among the many stakeholders in the process, particularly between affected public and government authorities and/or industry.

Including communication strategies early in the development of national D&ER strategies will help bridge different risk perceptions. Building and maintaining trust was generally recognized as a best practice. This is best built early, through open, clear and agreed lines of communication with genuine listening to specific interests, respecting different viewpoints and understanding objectives and by maintaining openness and transparency. Risk communication was also seen as a potential bridge building process. This activity includes scientific and factual knowledge about ionizing radiation, as well as considerations based on emotions, values, trust, experiences, familiarity with risk and perceptions. Risk communication about D&ER should not be seen as a form of technical communication or education or as a marketing practice with the aim of 'persuading' people to adopt certain solutions. It should be a continuous process of engagement and not just a reaction to crises.

The session highlighted challenges that countries are facing with fostering societal engagement in D&ER projects. These challenges exist with legacy projects, decommissioning projects and in post-accident decision making. In regards to the latter, the presentation by Mayor Shoji Nishida, of Date City, Fukushima Prefecture, is worthy of specific mention. Mayor Nishida provided important perspectives as a decision maker. He described the need to make local decisions regarding protective measures and remediation decisions in that unprecedented emergency situation. This would have been easier if advanced planning was in place, integrating communications and D&ER policy strategies at a high level and communicating better in emergency and remediation situations.

While countries with mature nuclear programmes face particular challenges, newcomers embarking on nuclear programmes have important opportunities to learn lessons and to integrate public communication strategies into their D&ER national strategies early. Newcomer and embarking countries would greatly benefit from guidance and recommendations on best practices in developing D&ER national policies and strategies for public communication and engagement in their respective countries.

There are several other observations worth noting:

- Safety regulators, in particular, should consider proactive engagement in the process of stakeholder dialogue, while respecting the overall division of responsibilities for strategy formulation as determined by the government and safeguarding their ability to make independent judgments.
- D&ER projects could learn from best practices in societal engagement from other fields, e.g. health care, natural hazard emergency preparedness, etc.
- The possibility of successful implementation of remediation projects may be greatly improved if local communities are given a direct role in the implementation of those strategies, e.g. through cooperatively developing and implementing environmental monitoring programmes, defining end states and by keeping the community updated with project progress.
- Decisions on acceptable end states in cases where unrestricted release is impractical may involve issues of societal and intergenerational equity.
- Specific strategies may be necessary in some countries for engaging indigenous peoples in a meaningful way.

The session highlighted practical advice and tools on how to overcome constraints and to achieve greater societal satisfaction with these D&ER activities. Since the last conference, the need to adapt to social media was particularly highlighted.

MAIN CHALLENGES

Lack of information and lack of trust could result in stakeholders' opposition to implementation of D&ER projects, even well designed, economically sound ones. In order to reach a sustainable end state, government and implementers need to engage stakeholders in the decision making process and to respond to social perception challenges.

Decisions may require that a compromise be achieved between the desires of local communities, who may wish (for example) that waste is removed from the local area, and a lack of willingness of other communities to accept these materials, in particular whenever the site characteristics make the site of origin inappropriate for waste disposal.

Unrestricted reuse of sites is widely expected as the end state for D&ER projects. However, it is not the optimal decision in all situations. The ability to make decisions based on sustainability concepts in such instances remains a challenge.

While specific examples of successful stakeholder engagement were discussed, for example developing specific strategies for engaging indigenous people, the challenge is to determine the correct approach for each individual stakeholder community. Sharing of recent experiences, both positive and negative, within the wider international community was encouraged. It was emphasized that these experiences need to be adapted to the specific circumstances in each community.

TECHNICAL AND TECHNOLOGICAL ASPECTS OF IMPLEMENTING D&ER PROGRAMMES (SESSION 4)

Parallel sessions were conducted to discuss the technical aspects and technology needs for decommissioning and for environmental remediation. This section provides a description of each of the parallel sessions, its outcomes and main challenges.

SESSION DESCRIPTION

The objective of Session 4A, Technical and Technological Aspects of Implementing Decommissioning Programmes, was to review progress in decommissioning technologies, including those for damaged facilities, and cost estimations over the past decade and to identify challenges and needs for improvement in the future, including expectations for additional coordination and collaborative efforts.

The session featured introductory remarks from the chairpersons, presentations, a panel discussion, and poster oral presentations, providing an opportunity for experts from 15 countries to describe and discuss their decommissioning progress and challenges.

SESSION OUTCOME

The session began with a focus on the various aspects of radiological characterization throughout the duration of the entire decommissioning project, analysing related challenges and still-open issues. Other papers and posters addressed various additional aspects related to characterization, including in particular the characterization of graphite. Some important advances, for example in the field of instrumentation (laser scanning, gamma cameras, etc.) were presented. A poster presentation described the challenges of characterizing a damaged facility in preparation for decommissioning at the Fukushima nuclear power plant (NPP).

Concerning decommissioning of highly challenging legacy sites, it was emphasized that proven and standardized methodologies and technologies should normally be favoured, while using also special purpose solutions, as appropriate. The use of highly complex technologies should be limited to cases where there is an identified special need. In several cases the use of proven (and simple) technologies was highly recommended. In particular, small facilities, where a lack of adequate infrastructure exists, could be successfully decommissioned with easily accessible, but cost effective tools, assuring the necessary levels of safety to workers and population. The international community should contribute to the identification of these tools and should promote their deployment.

The main topic of discussion for NPP dismantling was the removal of the reactor vessels and its internal components. Safe and effective cutting technologies are needed for those situations when it is not possible to dispose of the reactor vessel as a single piece. The choice of the specific process should be carefully undertaken. However, these technologies are available and success stories were discussed.

The use of robotics in the monitoring and characterization process and in particular their envisioned role in the Fukushima decommissioning project was also discussed. Robotics may have several roles, from monitoring to dismantling. They are key tools in highly demanding and harsh environments, but they present operational and reliability challenges and are expensive. Therefore, their application should be carefully analysed.

Similar considerations apply to the implementation of virtual reality and 3-D modelling of areas and of specific dismantling activities. The use of these powerful tools can be justified in specific roles, for example task engineering and for operator training. However, it is still expensive to develop appropriate 3-D models, to use the necessary software, and provide the specialized "immersion" room. In the future, the availability of 3-D design tools, if kept updated during plant operational life, may facilitate the use of virtual reality in decommissioning and thereby greatly reduce the associated costs.

MAIN CHALLENGES

International cooperation is needed to foster technology evolution. While the sharing of new concepts and experiences in the commercial sector will be sometimes challenging as a consequence of market competition, platforms that are supported by international organizations and open to regulators and decommissioning implementers could be a powerful opportunity to compare, discuss and find common solutions. Some initiatives already exist, but a reinforced and more systematic approach could support safer and more cost effective projects. Such cooperation is particularly needed concerning irradiated graphite characterization. This is part of the unresolved issue concerning the treatment, conditioning and disposal of the about 250 000 tonnes of irradiated graphite which exists worldwide.

A challenge is to identify clearly the missions and develop a cost–benefit analysis for the use of robotics. It would be worthwhile to continue the exchange of information at the international level and possibly to develop some kind of standardization of their capability and qualification.

Decommissioning cost estimating is an exercise that should follow the entire life of a plant, through to its final decommissioning. It is important for effective decommissioning project management to have reliable cost estimates, to reduce uncertainties and to properly assess project risks. Project cost benchmarking at the national and international levels could provide the information necessary to improve project management in these areas. It was noted that the main relevant international organizations, including IAEA, OECD Nuclear Energy Agency, and the European Commission, have undertaken work in this area in recent years, but uncertainties are still generally too high and benchmarking remains very difficult to implement. There is a need to capture actual costs of decommissioning, at the lowest possible cost element level, to allow benchmarking against cost estimates.

There is a need for collecting, rationalizing, discussing and distributing the decommissioning lessons learned at the international level in a more systematic way. The need to transfer this information to the design process of new plants was also identified in the discussions as a point to be emphasized in the future. Doing so will make subsequent decommissioning projects safer, more cost effective and more efficient. It is important to develop a system where the cumulated experience is easily searchable and available when needed.

Decommissioning implementers, supply chain and R&D organizations should be encouraged to focus on innovations that may minimize the amount of resulting waste, operator doses and overall costs, while providing the highest level of assurance of safety to regulators and local communities. It is already well established that some existing and proven technologies from other industrial sectors may

be adapted to decommissioning. This tendency should be supported and encouraged. These observations apply to ER also.

Mechanisms should be established to ensure the development work currently taking place in Japan is shared with the global international decommissioning community. Technologies being applied to the accident damaged facilities might be successfully adapted and used in the decommissioning of plants which did not suffer from accident situations.

Consideration should be given to supporting the establishment of means to coordinate "pre-competitive" research and development activity for D&ER programmes. Guidance may also be provided on the use of reliable, but low cost and simplified solutions in appropriate situations.

SESSION DESCRIPTION

The objective of Session 4B, Technical and Technological Aspects of Implementing Environmental Remediation Programmes, was to review the available technologies for ER, identifying gaps in knowledge and improvements needed to facilitate its implementation.

The session featured introductory remarks from the chairpersons, presentations, poster presentations and a panel discussion, providing an opportunity for experts from 10 countries and two international organizations to describe and discuss their ER progress and challenges. The session also featured four presentations dedicated to lessons learned and progress in remediation of areas contaminated by the accident at the Fukushima Daiichi NPP.

SESSION OUTCOME

It was emphasized that the success of each remediation approach is typically case specific, e.g. the performance of remediation approaches can vary significantly in different environments and for different radionuclides. Nevertheless, case studies provide valuable information, including costs, to inform the selection of remediation technologies at other sites. Technology demonstrations were noted as being essential to gaining the confidence of stakeholders and regulators prior to full scale implementation.

A common theme in the presentations was the importance of considering economic and social factors in the selection of remediation technologies. The ability to jointly consider technical data with the societal/stakeholder views, values and perceptions, was recognized as important to successful completion of remediation projects.

Sustainable, low-tech, passive remediation approaches were discussed. Some of these approaches work with nature or work by enhancing natural processes. However, the conference participants acknowledged that stakeholders, and sometimes regulators, may prefer an active remedy, believing the remediation goal can be achieved more expeditiously. It was noted that overly prescriptive regulatory requirements can lead to suboptimal remediation approaches, such as use of pump and treat rather than monitored natural attenuation.

In several instances the presenters discussed technologies or analytical approaches that were transferred from other fields. For example, analysis techniques applied to natural disaster planning were demonstrated to be applicable to remediation planning, and some techniques from the field of metallurgy have been applied to long term water treatment at uranium mining sites.

Characterization is recognized as an essential, but often costly and time consuming step in the remediation process. Major developments in the use of in situ methods of site characterization coupled with the use of GIS and geostatistical analysis and software demonstrate the advances realized over the past decade. The merits of using geostatistics to manage the data and present it in terms that are more readily understood and which also express the level of uncertainty were discussed. In situ, real

time measurements to collect data have increased the representativeness of the data and reduced the costs and time spent. The use of mobile laboratories and drones also represent an opportunity to reduce costs and expedite the process.

The special session looking at the experience of off-site remediation in Fukushima prefecture described the key role of food monitoring in the remediation programme, and the development and demonstration of techniques for soil sorting to manage the volumes of contaminated residues.

MAIN CHALLENGES

Regulatory and societal acceptance of sustainable, passive remediation approaches that work with the forces of nature rather than against is a challenge that could benefit from support by the international community. This may take the form of guidance, information exchanges, and/or technical support, especially as concerns modelling. These solutions can only be applied if a common and solid understanding of the prevailing environmental mechanisms is gained by all involved parties.

An additional challenge is to identify the technical, economic and societal factors that play a role, along with the characterization data collected from the site, in the decision making process when selecting the ideal remediation strategy. Including stakeholder communities throughout the entire ER process was highlighted as a way to increase stakeholder confidence, especially in situations where passive remediation strategies are utilized.

While international mechanisms do exist and which provide information exchange among interested parties on the efficacy of remediation technologies, the need to further develop and improve such instruments to facilitate future remediation projects, taking advantage of international experience, was highlighted.

As remediation approaches are case specific, consideration needs to be given to specific site characteristics to select the optimal solution within the available resources. Technologies chosen should consider the scale of the project and other constraints in order to justify the required investments. The ability to identify, collect and analyse the appropriate information to make such decisions remains a challenge.

Throughout project implementation, an adaptive management approach where the process is continuously assessed and improved with the most recent data collected is encouraged, to ensure the remediation strategy aligns with the overall goals. Guidance on the indicators to be used that will demonstrate if change is required would be beneficial.

The panel discussion on technology transfer emphasized that without proper institutional and capacity building in the technology receiving country it is very difficult to achieve sustainable technology application.

WASTE MANAGEMENT IN D&ER (SESSION 5)

Parallel sessions were conducted to discuss waste management concerns in D&ER projects. This chapter provides a description of each of the parallel sessions, its outcomes and the main challenges.

SESSION DESCRIPTION

The objective of session 5A, Optimizing Waste and Materials Management in Decommissioning, was to review the developments and challenges of dealing with waste and materials resulting from decommissioning activities and to encourage integrated analysis of decommissioning options with the waste management system.

The session featured introductory remarks from the chairpersons, presentations, and a panel discussion, providing an opportunity for experts from nine countries to describe and discuss their approaches to waste management during the decommissioning process.

SESSION OUTCOME

A key topic for this session was the importance of optimizing decommissioning strategies and plans with those relating to waste management. The optimization of decommissioning and waste management encompasses the entire waste cycle, from waste generation to storage, transport and disposal and the decommissioning decisions that affect waste generation. Optimization needs to include consideration of regulatory requirements, waste and operator dose minimization objectives, enhancing the use of available technologies, costs, schedules and societal considerations. In many cases the requirements and the optimization of one phase do not support the optimization criteria for other phases. Optimization of the full waste cycle requires that all pre-disposal activities should be implemented with full consideration of the waste acceptance criteria for disposal.

Presentations were given on the application of waste cycle integration and optimization, highlighting the importance of these concepts. The value of early integration and coordination with the waste management system was evident in the case of potential issues related to transport and disposal of large components.

The issue of graphite management was further discussed. It is evident that, although research is ongoing, an industrial scale solution for management of irradiated graphite has yet to be established.

The timely availability of waste disposition routes is always an important determining factor in implementing decommissioning programmes. As large quantities of materials are generally involved, having in place options for recycling of metals and other material is an important consideration. Some programmes also need to manage waste for which no generally accepted disposition route has yet been established, as is the case with irradiated graphite from gas cooled power reactors and many types of research reactors. These issues can be important constraining factors, particularly in programmes which do not currently have access to repositories for the final disposal of some or all classes of radioactive waste.

MAIN CHALLENGES

The waste management life cycle, from generation of the waste during dismantling and decontamination to its disposal has to be considered as a key element of any decommissioning project. These aspects may influence strategies, technologies, schedules and costs. In order to achieve the required level of optimization it is important to have a disposal site available or at least to have regulatory agreement on some preliminary waste acceptance criteria. Proper planning should also be based on adequate and reliable evaluations of the amount of waste to be generated, which in turn is dependent on proper characterization, release limits, waste minimization techniques and so on.

Decommissioning strategies and plans are linked inevitably to the availability of disposal routes. Although decommissioning can proceed in the absence of a disposal facility, generic waste acceptance criteria are essential for the optimization of the waste management cycle. It would be beneficial if international guidance on the development of generic criteria could be provided.

SESSION DESCRIPTION

The objective of session 5B, Waste Management and Case Studies in Environmental Remediation, was to encourage optimization, based on available disposal pathways, of the production, management and categorization of waste from remediation. Presentations of experts from 11 countries provided an opportunity for participants to hear and discuss case studies and approaches to waste management during the environmental remediation process. Posters were also presented by experts from six countries.

SESSION OUTCOME

Participants acknowledged that the overall waste management process in remediation (especially waste disposal) tends to represent one of the highest cost components in this activity. The adoption of integrated approaches to environmental remediation and waste management was encouraged as a way to advance implementation of remediation projects. Waste management implications – waste quantities and disposal-related aspects – are key factors in the planning and selection of remediation strategies and technologies.

The key to systematic planning and design of remediation projects vis-à-vis the waste management system depends on an accurate base of information that describes the quantities and characteristics of the waste streams that have been generated (inventory) and that will be generated (forecast). Waste forecasts and the assumptions they are based upon need to be re-evaluated based on actual observed waste generation rates and waste characteristics. This information is essential to planning and optimizing the treatment, storage and disposal system components in remediation works.

Research and development (R&D) initiatives should be considered as providing important support to waste management and ER activities (waste forecasting tools, Monte Carlo analysis, modelling, proof of concept, demonstration of technologies, etc.). The information generated from the R&D will contribute to enhance ER project effectiveness and efficiency.

MAIN CHALLENGES

Waste forecasting tools associated with decontamination techniques are needed. Such tools would also be beneficial in the design and planning of remediation works. Further guidance is needed on ensuring that the selection of decontamination techniques is consistent with the required level of risk reduction. Such decision making guidance should include waste management in the optimization process.

Continuous improvement in site characterization technologies is needed and would be beneficial to improving project performance and reducing the amount of waste generated during remediation.

Further consideration of the impacts associated with the removal of large volumes of low level subsurface radioactivity is needed. The current approach of excavation and disposal at another location may not represent an optimal approach taking account of all the factors (risks, dose, etc.). International guidance is needed to address issues specific to on-site disposal of remediation waste, including issues of isolation and containment, intrusion risks and the need for long term institutional controls.

PROJECT MANAGEMENT, SKILLS AND SUPPLY CHAIN CONSIDERATIONS (SESSION 6)

SESSION DESCRIPTION

The objective of session 6 was to highlight how events and experience over the past 10 years have impacted the supply chain, to identify future trends and to ensure resources are available for present and future projects.

The session featured introductory remarks from the chairpersons, presentations and a panel discussion, providing an opportunity to learn from experiences of experts from nine countries.

SESSION OUTCOME

D&ER projects are usually implemented by a combination of existing staff of the implementing organization and contractors. This facilitates the involvement of specialist expertise and takes benefit from innovation. It was noted, however, that the acceptance of innovative approaches can be a challenge. Using contactors brings benefit in terms of expertise but also carries risk and brings

organizational challenges. In this situation it is important that project risks are understood and shared in a transparent way with contractors. It was also noted that it could be a good practice to foster long term relationships with contractors.

Skills requirements for the future were discussed, including the need to foster mobility. Continued efforts are needed in developing relationships with universities and training institutions to ensure that the necessary qualified personnel are available in future. The importance of project and contract management skills was highlighted. Staffing is a key factor for immediate dismantling because operators have essential knowledge required for decommissioning. In this context the age profile of current workforces in many programmes is a serious issue, together with the need for skills retraining among existing personnel. To this end, proper management of the transition from operation to decommissioning is important for a successful project.

There was a discussion on how young people can be attracted to the field of D&ER, prompted by a presentation by the EC regarding proposals for pooling of certain training programmes for decommissioning in European countries. As D&ER is a multidisciplinary task, the need was identified to facilitate cross-border and cross-sector mobility. Furthermore, the interest in D&ER at universities and training institutions should be stimulated, because it is an emerging activity which provides important service to society.

The improper use of non-nuclear conventional techniques in a NPP decommissioning project was presented. This illustrates the importance of ensuring the entire supply chain (technologies, workers and project management) has the requisite nuclear safety culture and experience. This paper highlighted the risk of underestimating the challenges of D&ER projects.

MAIN CHALLENGES

The very long timeframes relevant to the management of some D&ER liabilities is indicative of the importance of applying sound approaches to the management of relevant knowledge, especially in cases where management of long lived radioactivity is concerned. Ensuring the availability of skilled personnel, knowledge retention, and the necessary supply chain over very long periods represents a general challenge to many D&ER projects. It is essential that knowledge relating to facilities and sites under deferred dismantling regimes or long term institutional control is preserved in such a way that information necessary to ensure ongoing safety remains readily accessible.

It would be very useful to expand current training opportunities for professionals involved in D&ER. Relevant educational opportunities need to begin at universities, involving specific courses focused on basic academic training needs of persons entering this profession. Development and use of new technologies for D&ER is likely to be an important motivation in attracting young people to decide to devote their careers to working in an evolving and dynamic industrial sector.

The need for specialist engineers and plant operators will increase significantly in the coming years with a strong risk that there will not be sufficient qualified workers available to provide the required levels of safety and efficiency. Internationally recognized skill certificates would greatly assist the exchange and mobility of qualified experts across projects.

Availability of skills in the fields of decommissioning project management and contract management are likely to become increasingly important in future years, as more facilities enter the decommissioning phase and greater reliance is placed on specialist contractors for implementing technical tasks. Proper contract strategies will also be needed to support the development of a supply chain that will be conscious of the specificities of a nuclear/radiological project. The broadening of the D&ER market is encouraging many companies with no or limited nuclear and radiological experience to enter into the business. This may imply risks to be carefully managed.

It should be considered that changes are inevitable. Sometimes the people, skills and knowledge appropriate to steady state operations are not those required for project-based decommissioning

activities. Often decommissioning requires a different mind-set and has different knowledge requirements. Therefore "one size fits all" nuclear training may only have limited relevance for D&ER.

International organizations could promote and support the establishment of centre(s) (regional or inter-regional) to provide training and expert advice and capacity building for operators, contractors, and regulators (environmental modelling, protection of the environment, and other appropriate scientific skills) and minimum standards for skills and knowledge.

YOUNG PROFESSIONALS SESSION

SESSION DESCRIPTION

The objective of this session was to provide an opportunity for young professionals to present their work and discuss the opportunities and challenges associated with establishing a career in the D&ER field. The session included six technical presentations, representing projects in five countries, and three presentations detailing perspectives on D&ER career opportunities for young professionals and Science, Technology, Engineering and Mathematics (STEM) students in the fields of academics, regulation and implementation. Ten technical posters were also prepared by participants from four countries and presented by members of the young professionals group. The session concluded with a panel discussion.

SESSION OUTCOME

The presentations served as a demonstration of the diverse and ambitious nature of D&ER careers being developed by young professionals across IAEA Member States, and the valuable skills being introduced through their involvement. It is important to encourage young professionals to:

Encourage peers and colleagues in other industries (e.g. wider nuclear sector, energy, oil and gas etc.) to consider careers in D&ER;
Act as role models for those setting out on their academic/vocational journeys to enthuse them towards careers in D&ER.

The overall goal must be to sustain progress in D&ER by ensuring the availability of a sufficient number of qualified experts globally. This is important in the short and long term, as programmes in some Member States extend out many decades. The following suggestions were made during the panel discussion:

Continue and strengthen the support from international organizations for opportunities such as internships and fellowships for young professionals and students;
Organize young professional sessions as a part of future international meetings and conferences;
Use international networks to establish mentorship opportunities that allow young professionals to meet and network with the current generation of experts, leaders and decision makers;
Ensure D&ER is specifically considered as a part of nuclear energy training and education courses developed on an international basis.

MAIN CHALLENGES

Young professionals have proven skills and should be encouraged to take up the new challenges in the field of D&ER projects. However, international collaboration and cooperation is needed to promote opportunities for their involvement and to communicate that D&ER is not an end in itself, but rather a normal part of the nuclear life cycle, which brings new and diverse challenges and career opportunities.

There is a general concern that insufficient numbers of students, recent graduates and young professionals are currently entering nuclear decommissioning or environmental remediation careers. Hence there is a role for international action to improve this situation by seeking means to explain how the anticipated growth in D&ER provides long term career opportunities.

For the sector to become more attractive for young people, education and training programmes must be tailored to the present generation to ensure that there is effective knowledge transfer from more experienced professionals to the young generation to help them develop the technical and project management skills to advance D&ER in the future.

FUTURE NEEDS AND INTERNATIONAL COOPERATION (SESSION 7)

SESSION DESCRIPTION

This session included presentations from each of the session chairpersons and a panel discussion. The objective of this session was for each session chairperson to provide the key points and highlights from their session, based on the presentations, posters and panel discussions. From this, the panel focused on identifying and discussing the main priorities for action by the international community during the next decade.

MAIN CHALLENGES

All countries should have national policies and strategies for decommissioning and environmental remediation that are based upon the principles identified in international standards. These policies should minimize the transfer of D&ER liabilities to future generations. A holistic approach to waste management, ER, and decommissioning will facilitate better overall planning and improved programme implementation.

The importance of meaningful and sustained stakeholder involvement in D&ER decision making was emphasized throughout the conference. Countries should ensure that their legal and regulatory frameworks facilitate such involvement. The international community should develop guidance based on lessons learned in D&ER on how to engage stakeholders in decision making processes.

International peer review mechanisms should be more widely used to assess progress in D&ER implementation. Those countries who are Contracting Parties to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management were encouraged to pay particular attention to their national policies and programmes for D&ER in their reports to the Review Meetings of the Convention, focussing on how they are integrating these activities in national waste management programmes.

Member States should have in place policies and strategies for remediation and means of national dialogue to enable their implementation, including provisions that deal with remediation of sites after the occurrence of nuclear or radiological accidents. It was suggested that international guidance and recommendations for development of such policies and strategies, including on engagement with stakeholders during their formulation, i.e. prior to any accident, was necessary. Due to the specific circumstances of post-accident situations, dedicated guidance on stakeholder communication and engagement in decision making after the accident should also be provided.

Current safety standards and associated guidance for D&ER were discussed. Further development of internationally recognized guidance is needed on the following topics:

- Selection and implementation of reference levels for existing exposure situations including guidance on reasonable exposure levels for re-establishment of settlements;
- Determination of end states for decommissioning and environmental remediation;

Implementation and sustainability of long term institutional controls;
Criteria and use of the concept of conditional clearance of materials arising from decommissioning and environmental remediation;
Consideration of accident recovery in licensing;
Regulatory approaches for decommissioning of accident damaged nuclear facilities and related remediation activities;
Use of on-site disposal in certain circumstances where appropriate during remediation activities.

The value of networking in D&ER was highlighted throughout the conference. International organizations should continue to facilitate sharing of information, lessons learned from project implementation (including specific costs and their uncertainties, cost drivers and risks), and practical cooperation (for example technology pilot demonstrations and R&D). Decommissioning lessons learned should be considered in the design of new facilities in order to facilitate improved safety, reduced waste and cost effectiveness for the future decommissioning projects. Member States are encouraged to participate in and support such activities.

To realize continual improvements in D&ER, a joint international effort is needed to assure the advancement of technical innovation. International organizations should support and facilitate these efforts and Member States should promote their implementation.

In many cases, to ensure sustainable technology application, innovative approaches to capacity building (in the country where the technology will be deployed) are needed in order to address situations where technology deployment is constrained by a lack of suitably qualified local personnel.

In the absence of a disposal facility for decommissioning waste, interim generic waste acceptance criteria are essential for the optimization of the waste management cycle. International guidance on how to develop such generic waste acceptance criteria would be very beneficial.

The quantities of waste expected to be generated in ER projects need to be carefully considered in the selection of the decontamination techniques and the design of such projects. More accurate waste estimating tools are needed in this regard.

A need was identified for the international community to provide guidance on the identification and management of project risks in D&ER projects.

There is likely to be a shortage of qualified personnel for D&ER project implementation. International organizations should continue to promote and support the establishment of excellence centres for training of operators, contractors and regulators. Mapping the competencies required for each key position would allow training centres and universities to develop the necessary classes and programmes to prepare workers, students and young professionals for entering this field.

CLOSING SESSION

The main outcomes of the conference are summarized in the President's Report (Annex A), which was presented during this session. The highlighted issues included:

Considerable progress has been achieved in recent years with decommissioning of facilities and remediation of sites; nonetheless significant ongoing efforts will be needed in the coming decades in light of the projected increase in the number of facilities to be decommissioned due to the age profile of the existing nuclear fleet.
Adequately addressing these challenges requires, among other things, having in place an appropriate legal and regulatory framework and waste management infrastructure, with availability of suitably qualified personnel. In this regard actions and programmes aimed at

ensuring the availability of personnel to carry on future activities will be needed e.g. by launching dedicated initiatives to attract young professionals to these areas.

The responsibility of governments to put in place a clear framework for the decommissioning of nuclear facilities and for remediation of contaminated land was highlighted. It was also stressed that political commitment is generally a very strong driver for programme implementation. The importance of continued open and transparent interactions with stakeholders in decision making-processes was also emphasized.

Several requirements aimed at strengthening existing legal and regulatory frameworks were identified, particularly concerning the development of international standards for release of materials and sites for alternative uses following the completion of activities involving radioactive materials and remediation of sites.

The need to explore mechanisms to better assist countries where financial and technical resources are lacking for implementation of D&ER programmes was emphasized. The importance of promoting the adoption of measures, at national level, aimed at preventing similar situations occurring in future was also highlighted.

The early implementation of decommissioning, so as to avoid the transfer of risk and associated burdens to future generations, was stressed.

Although significant advances continue to be made in technological fields, there is a need to promote ongoing efforts in research and development work to support the cost effective implementation of D&ER projects, with results being shared among the international community.

The need to establish international guidelines for post-accident remediation (including policy and strategy and mechanisms to involve stakeholders in the development of policies and in the decision making process) received special attention.

In closing, it was suggested that the outcomes of the Conference should be considered by the Member States of the IAEA, with the intent that a set of coordinated activities should be developed to address the identified issues.

Appendix A

PRESIDENT'S REPORT[2]

J.J. Zaballa, President of Empresa Nacional de Residuos Radiactivos (ENRESA, SPAIN)

Nuclear activities have been undertaken on a significant scale since the Second Word War, initially associated with the production of atomic weapons, and then, from the 1950s, also involving facilities for the production of electricity and numerous other activities undertaken for civilian purposes. At that time little attention was paid to how these facilities should eventually be dismantled, nor how sites contaminated because of uranium mining, weapons testing, accidental releases and indeed due to practices involving substantial amounts of naturally occurring radioactive material, should be remediated.

The last two decades have witnessed growing efforts to deal with these liabilities, particularly in States with nuclear power programmes. It is now common practice that initial plans for the decommissioning of licensed nuclear facilities, and associated cost estimates, are developed as part of the initial licensing process, recognizing that this is normal step in the facility lifecycle. Similar considerations of the entire lifecycle of facilities are generally currently applied at the development stage for new uranium mines.

This evolution has occurred for several different reasons, including increasing interest and also pressure from society that principles of environmental sustainability are applied to all industrial activities, e.g. in line with the sustainable development agenda of the United Nations. This suggests, among other things, that sites hosting retired facilities should be made safe and be made available for other social and economic uses. This issue has strong ethical dimensions: the generations which gained benefit from the use of nuclear energy should, where reasonably practicable, not pass the burden of addressing the associated legacies to future generations.

The very large level of participation at this conference, which has been attended by 540 persons representing 54 countries and four international organizations, provides strong evidence of current levels of awareness and interest among Member States, relevant organizations and people on the need to provide safe, environmentally sound and cost effective solutions for implementing decommissioning and environmental remediation programmes worldwide.

The conference has shed light on areas where significant achievements have taken place in recent years — particularly since the impulse provided by the last IAEA conference on decommissioning in Athens in 2006 and the 2009 conference on environmental remediation in Astana. These achievements relate to decommissioning programmes and remediation of several legacy sites associated with uranium mining and to storage of radioactive waste, particularly in those Member States that have comprehensive and integrated national arrangements comprising: legal and regulatory framework, responsibility assignment including financing, access to technology and waste management routes.

The conference also served to highlight several areas where less progress than expected has been achieved, for example only about 17 of permanently-shutdown NPPs have been fully decommissioned though many are undergoing decommissioning or in a safe enclosure state. Large numbers of smaller facilities remain to be decommissioned, particularly in countries which do not have power programmes and there remain a very significant number of large contaminated sites where little remediation has been implemented. Issues constraining progress were discussed and ideas offered where a concerted effort by the international community could help in overcoming the main current barriers.

[2] The opinions expressed in this Summary – and any recommendations made – are those of the President and do not necessarily represent the views of the IAEA, its Member States or other cooperating organizations.

Delivering decommissioning and environmental remediation requires a complex interaction of several actors, including national governments, regulatory authorities, facility and site owners, national agencies responsible for liability and waste management (where these exist), industrial organizations involved in programme implementation (the supply chain), the university and vocational training sectors and the communities who would be affected by implementation of these decisions. Much of the discussion at the conference emphasized the importance of collaboration between the concerned agencies and organizations, and the importance of finding opportunities for motivating young professionals to work in this field.

These issues are discussed in the next section of my report.

THE ROLE OF GOVERNMENT

Elements consistently highlighted as important to the success of decommissioning and environmental remediation programmes were having in place an appropriate legal and regulatory framework that, among other things, establishes responsibilities among concerned actors for funding and implementation of projects, and ensuring safety of workers, the public and the environment, and requires engagement with affected communities in decisions affecting their livelihoods. Governments also need to ensure that that there are adequate facilities for management of waste, including its disposal. The existence of a law or a clearly stated national policy on radioactive waste management is important to provide direction and legitimacy.

The conference urged governments to establish national policies and related strategies for decommissioning and environmental remediation where these did not already exist, and urged that there should be a strong presumption against passing responsibilities to future generations where the means to address them currently existed.

The responsibility of governments to provide the necessary infrastructure to ensure that decommissioning and environmental remediation programmes are advanced at a satisfactory pace was emphasized. Governments are responsible for ensuring that environmental liabilities, including facilities which have been used for activities involving the use of radioactive materials and radioactively contaminated sites, are identified and evaluated and that responsibilities for managing these liabilities are clearly assigned.

States that are parties to Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management were suggested to consider to report on their arrangements for management of decommissioning and environmental liabilities as part of their reports to the Review Meetings of the Convention.

In general, the responsibility for managing liabilities concerned with radioactively contaminated facilities or sites will fall on the licensee, organization or government entity that undertook the activities that have led to radioactive contamination, except that there are important examples where this entity no longer exists and no adequate financial provisions have been set aside. In these cases the State needs to assume responsibility and the cost of decommissioning and/or remediation. These arrangements, including the relative priority given to allocating national resources to these issues, need to be addressed in national policy and strategy and, where appropriate, reflected in national legal frameworks.

Special efforts are needed to provide financing mechanisms to support the implementation of decommissioning and environmental programmes in States lacking necessary resources.

The conference participants emphasized the importance of establishing a decommissioning fund and a national strategy for decommissioning and environmental remediation at the onset of any new nuclear programme. Doing so would help ensure that such legacies are no longer passed forward to future

generations. The example set by the first nuclear countries should not be followed by the newcomers to nuclear.

The conference underlined that decommissioning and remediation programmes should normally be undertaken as the earliest reasonable opportunity, once the necessary prerequisites were in place. Advance planning was recognized as an essential element to achieving decommissioning and minimizing costs. The importance of making best use of limited financial resources was emphasized, requiring greater efforts to ensure the cost-effectiveness of proposed strategies.

It became clear from the discussions that have taken place during the Conference that one of the most important barriers to progress concerns a lack of appropriate management routes for materials, and especially radioactive waste, associated with decommissioning and environmental remediation programmes. Ensuring that such management routes are identified and developed is an important government responsibility that also should be reflected in national policy and associated planning. The waste management system in many countries often is not designed taking into account waste to be arisen from decommissioning and environmental remediation. Early coordination of these issues at national level is necessary to ensure an efficient and effective approach.

The conference recommended that States apply holistic approaches to the management of waste from decommissioning or environmental remediation, requiring an integrated approach to strategic decisions involving decommissioning and/or environmental/ remediation and the associated management of radioactive and other toxic waste and the development of waste disposal facilities.

Government involvement is important in ensuring that decision frameworks, for decisions such as desired end states from programmes, take adequate account of the different interest and views of concerned stakeholders, including communities whose livelihoods are affected by such decisions.

THE LEGAL AND REGULATORY FRAMEWORK FOR DECOMMISSIONING AND ENVIRONMENTAL REMEDIATION

A legal and regulatory framework that defines the responsibilities of all concerned parties was noted as important to the success of decommissioning programmes. It is especially important that the framework is adapted to the risks specific from decommissioning and remediation, and which establishes the standards that need to be achieved in in order to ensure the safety of people and the environment, now and in the future. The conference heard that, in the field of decommissioning, the necessary elements of this framework are generally well understood and appropriate regulations are in place in many countries facing decommissioning. There is a significant degree of harmonization of standards for unconditional clearance of materials from decommissioning, though this does not generally extend to conditional clearance, where a range of national approaches exists.

The conference recommended that international standards and associated guidance should be developed for conditional clearance of materials from decommissioning.

In the context of the standards applicable to the release of sites from regulatory control and making them available for alternative uses (whether as the final step of a decommissioning project or as a result of environmental remediation), the situation is significantly more complex and a wide range of different approaches is being applied in different countries.

The number of nuclear installations, especially NPPs, entering permanent shutdown and decommissioning is growing, increasing the need for continued improvements and enhancements in the standards and associated guidance for decommissioning. It was noted that pragmatic approaches to regulation of projects, recognizing their dynamic nature, were important to achieving progress.

Regarding remediation, the conference found the international standards to be less well developed than those for decommissioning. For example, there is insufficient guidance for addressing how to establish reference levels, how to conduct planning in advance of an accident, or how to communicate what is

safe. The need to establish the justification for interventions, together with rational and reasonable reference levels and to avoid reacting to public anxiety during a time of crisis or urgency was emphasized. These areas represent opportunities at the international level to develop specific guidance and or standards.

The conference recommended that the international community needed to do more to identify what levels of radioactive contamination could generally be regarded as being sufficiently low that they did not pose a threat to the safety of people and the environment. It was suggested this issue be included in any future IAEA Plan of Action addressing these issues.

The importance of planning in advance for dealing with the aftermath of nuclear or radiological accidents was discussed. Such planning would be analogous to the emergency response plans that are now routinely prepared for dealing with the accident situation itself. The plans, which need to be developed through a process of national dialogue, should include consideration of issues such as reference levels for remediation of large areas of contamination; end states and strategies for management of large quantities of waste, including its disposal.

The Conference further recommended that additional consideration be given to establishing international guidelines for post-accident recovery: in the aftermath of an accident it is too late to begin planning and establishing levels such as reference levels, end states and strategies, waste management and disposal strategies. The existence of guidance at international level would be particularly helpful in avoiding associations with any specific national facility but would provide guidelines that could reasonably be used in any post-accident recovery scenario.

THE DECISION PROCESS AND INVOLVEMENT OF STAKEHOLDERS

There was general recognition that there is a need for early consideration and alignment of thoughtful strategies for public communication and stakeholder involvement with the overarching national decommissioning and environmental remediation framework. Alignment at the beginning of the process helps to establish effective mechanisms for dialogue, with clear allocation of roles and responsibilities.

Early inclusion of communication strategies in the development of national decommissioning and environmental remediation strategies may help bridge different risk assessments by different actors. Building and maintaining trust was generally recognized as being very important to project success. This is best built early, through open, clear and agreed lines of communication and genuine listening to specific interests, respecting different viewpoints and understanding objectives and by maintaining openness and transparency. Risk communication was also seen as a potential bridge building process. This activity includes not only scientific and factual knowledge about ionizing radiation, but also need to consider emotions, values, trust, experiences and different perceptions of risk. This should be a continuous process of engagement, beginning from an early stage, and not just a reaction to crises.

Challenges being faced by countries with existing nuclear programmes in fostering societal engagement in decommissioning and environmental remediation projects were noted. While these countries face particular challenges, newcomers embarking on nuclear programmes have important opportunities to learn lessons and to integrate public communication strategies into their national strategies from the outset. It was highlighted that newcomers should enhance their stakeholder strategies in order to avoid some of the challenges being faced by countries with existing programmes. Newcomer and embarking countries would greatly benefit from guidance and recommendations on best practices in developing national policies and strategies for public communication and engagement in their respective countries.

The Conference recommended that States develop and implement decommissioning and environmental remediation policies and related frameworks that clearly allow and facilitate stakeholder engagement in decision making, and that the legal and regulatory framework for decommissioning and environmental remediation specifically identify key points in the process for

stakeholder participation. It was suggested that the international community should develop guidance on how to engage stakeholders in such decisions.

TECHNOLOGY AND INNOVATION

The conference heard that significant advances have been made in the field of decommissioning over the last 10 years or so, particularly in the fields of characterization and segmentation. There is growing use of robotics and drone technology, and use of virtual reality, 3-D computer modelling is also becoming widespread. Many of these innovations have been taken from the automotive and transport industry as well as information technology and video gaming. It is evident that many organizations are working on similar issues, perhaps with significant duplication.

The conference recommended that greater efforts be made at international level to achieve coordination of research and development activities related to decommissioning and environmental remediation.

Technology advances and associated technical solutions, from passive to active, are being applied to remediation projects across a wide range of countries. Technological solutions continue to be 'transferred' from other areas, such as oil and gas exploration and metallurgy, and the continuation of this practice should be further encouraged. Once a new technology is developed and demonstrated, it is evident that successful technology transfer is dependent upon having an understanding of the new context in which the technology will be applied and through having assurance that the recipient country has the resources to implement and follow through with the operation of the technology for the long term.

The Conference encouraged the IAEA to proceed with (and eventually enhance) existing commitments to facilitate the sharing and exchanging of knowledge and experience and to explore additional mechanisms to build capacity in its Member States to allow them to use of technologies that will facilitate implementation of remediation projects in a sustainable manner.

Innovative approaches continue to be important to decommissioning and environmental remediation while they offer an opportunity to engage with universities and research laboratories. Doing so introduces engineers and scientists to the needs of the nuclear field, and has the added benefit of expanding the pool of talent to support decommissioning and environmental remediation. In the field of decommissioning, delaying projects while waiting for technology improvements is not a recommended approach as postponing action may increase the risk.

Practical demonstration of technologies is key to gaining the confidence of stakeholders (including regulators) prior to selection and implementation. In this respect the value of pilot projects to test the effectiveness of a remediation approach in a given situation was highlighted.

The Conference recognized that international cooperation is a fundamental tool to the application of technological evolution in decommissioning. While the sharing of ideas and experiences in the commercial sector will be sometimes challenging as a consequence of market competition, international platforms supported by international organizations, open to regulators and decommissioning implementers would provide potent opportunities to compare, discuss and find common solutions. Some initiatives already exist, but a reinforced and more systematic approach would foster this evolution, assuring safer and cheaper decommissioning projects. This issue will increase in importance in the near future, as increasing numbers of nuclear facilities are definitively shutdown.

The Conference recommended that decommissioning and remediation practitioners continue to exchange the results and experiences through forums such as this conference, and continue to look to other technical fields for relevant solutions. Publically accessible databases should be encouraged to promote lessons learned and to provide wide availability of experiences of technology application.

Successful implementation of decommissioning and environmental remediation requires the provision of facilities for management of the resulting waste and materials. In many countries the infrastructure for waste management has been dimensioned for operational needs and is not adequate for decommissioning and remediation needs. Integration of decommissioning and remediation waste into the national waste management strategies is of key importance for advancing implementation of decommissioning and remediation.

Early planning for decommissioning of facilities and national inventories of contaminated sites should facilitate the process of ensuring adequate provisions for management of waste, including its disposal, are available when needed.

THE SUPPLY CHAIN FOR PROJECT IMPLEMENTATION

The conference heard that, in general, decommissioning and environmental remediation programmes are implemented by a combination of in-house staff and contractors, to facilitate the involvement of specialist expertise in projects and to take benefit from innovation. Use of contactors brings benefit in terms of expertise but also brings organizational challenges and management needs.

In the decade since the last IAEA decommissioning conference, progress has been made, with an emphasis on prioritizing the implementation projects according to the risk they pose. In this situation it is important that project risks are understood and shared in a transparent way with contractors. It was also noted that it is beneficial to foster long term relationships with contractors. The importance of project and contract management skills was highlighted.

The conference recommended that the international community should develop guidance on the management of project risks in decommissioning and remediation programmes, including opportunities for sharing information on good practice on this issue.

The capability and skills to perform decommissioning and environmental remediation are different from those needed to operate a nuclear facility. Decommissioning and environmental remediation presents a work environment that is changing frequently, and so may not be fully dependent upon standardization of procedures or daily work plans. While this may not be the subject of policy, it should nonetheless be recognized that transition from operators to decommissioning workers will require retraining and a different motivational approach. Skills requirements for the future were discussed, including the need to foster mobility. Continued efforts are needed in developing relationships with universities and training institutions to ensure that the necessary qualified personnel are available in future.

The conference recommended that greater efforts be made at international level to develop training opportunities for young professionals working on decommissioning and remediation projects.

CONCLUDING REMARKS

The conference confirmed that the level of activity in both decommissioning and environmental fields is increasing a consequence of the ageing of existing nuclear facilities and sites ceasing operation, as well as the continued presence of a significant number of legacy facilities and sites.

Such activities attract wide interest from a wide diversity of stakeholders and which require dedicated attention. Experience in the last years has demonstrated the strong relevance of this aspect to successful implementation and execution of decommissioning and environmental remediation programmes.

The Conference recognized that in the last decade, since the last IAEA decommissioning conference, significant progress has been achieved in this field. A large number of facilities have been completely dismantled, including some nuclear power reactors. However, as it is foreseen that a large number of nuclear installations will shut down in the coming years, a reinforced commitment at national and

international level is needed to prevent the situation arising that existing numbers of legacy facilities are increased further.

Despite the results achieved, environmental remediation of contaminated sites remains an overarching issue for a large number of Member States. The Conference encouraged such Member States to adopt adequate dispositions to enhance these situations, taking account of risk, cost-effectiveness and environmental considerations. Unfortunately, a significant number of legacy sites remain in a similar situation over several decades due to lack of National capacity to address their remediation. As well as efforts being required at National level, the international organizations should explore how to better assist these Member States from a technical and financial point of view with the goal of improving existing conditions and preventing future undesirable impacts. The Conference underlined the shared need of the international community to promote the adoption of measures at National level aimed at preventing similar situations occurring in future.

The discussions suggested a broad consensus on the fundamental elements of a successful national programme: the existence of a regulatory and legal framework that guarantees safety, while establishing the necessary provisions with regard to the funding and effective availability of resources, access to technologies and qualified personnel in this field and the presence of logistic and management solutions for the resulting materials, particularly the spent nuclear fuel and the radioactive waste. In this regard, the Conference convened about the key roles played both by licensees and Government, involving the assumption of their respective responsibilities to support the early implementation of decommissioning and so avoid the passing of risk and associated burdens to future generations.

The conference offered an opportunity to highlight the continued efforts and successful results being achieved in the technological fields. While conventional industry remains the main source for the technology being used in decommissioning and environmental remediation activities, it is worth noting that dedicated developments have been necessary to address specific needs. The long term nature of these activities, and the continued demand for more efficient use of resources, from safety, programme ad cost perspectives, justify the need for a continued attention and activity focused on technological innovation.

Noting the global consequences of the accidents that affect nuclear installations, the Conference recommended that additional consideration should be given to establishing international guidelines for post-accident recovery.

As I mentioned earlier, the number of ongoing decommissioning and environmental remediation projects is large, and current estimates indicate further substantial increases in the coming years. The conference emphasized the need to promote actions and programmes aimed at ensuring the availability of personnel for future activities. In this regard the need to increase ongoing activities to attract young professional to make these activities sustainable over time was strongly emphasized.

The conference recommended that a report on its outcomes should be presented to the next General Conference of the IAEA and suggested that, subject to the views of its Member States, IAEA should formulate a Plan of Action, comprising activities that are specific and achievable, aimed at addressing the identified issues.

Appendix B

OPENING REMARKS ON BEHALF OF THE INTERNATIONAL ATOMIC ENERGY AGENCY

Juan Carlos Lentijo, Deputy Director General, International Atomic Energy Agency

Good morning Mr. President, Chairman, Esteemed Colleagues, Ladies and Gentlemen,

On behalf of the International Atomic Energy Agency, it gives me great pleasure to welcome you all to this 2016 International Conference on Advancing the Global Implementation of Decommissioning and Environmental Remediation Programmes. I would also like to extend my sincere appreciation to the co-sponsors of this conference: the European Commission and also those it is being held in cooperation with: the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development, and the European Bank for Reconstruction and Development. I would like to express our sincere gratitude to the Government of Spain for hosting the Conference and in particular to the Ministry of Industry, Energy and Tourism; the Consejo de Seguridad Nuclear and the Spanish Association of the Electricity Industry. Finally, I want to extend my sincere appreciation to the historically fascinating city of Madrid (my home) for hosting this important conference — a city which is also experiencing tremendous growth in research and development according to the latest figures from the EC.

I would like to take a brief moment to speak about the upcoming IAEA 60th anniversary. As you know, the IAEA began its "Atoms for Peace" mission all those years ago in an effort to enlarge the contribution of atomic energy to peace and prosperity throughout the world. Today, as we continue to help our Member States to ensure the benefits of the safe and secure use of peaceful nuclear technology, our mandate is better understood as Atoms for Peace and Development.

In the frame of this conference, it is important to bear in mind that decommissioning of nuclear facilities and environmental remediation of contaminated sites represent a considerable challenge for many countries around the world. Implementing these activities requires an integration of a variety of different aspects, including project management, use of appropriate technology, ensuring safety of people and the environment, management of waste and other residual material and facilitating societal engagement in decision making (the Conference will give special attention to this issue).

Decommissioning and environmental remediation are both concerned with ensuring that facilities and sites where nuclear and radioactive materials have been produced, used or stored do not present a future safety risk to humans or the environment, and generally are made available for alternative productive uses. Decommissioning is a normal part of the lifecycle of nuclear facilities, and needs to be considered from the design stage of the facility. Environmental remediation is concerned with existing exposure from past practices; but the ultimate objective is the same and advanced planning is also very important. It is important to recognize that, without showing an ability to take care of existing liabilities; it will be difficult to demonstrate the sustainability of nuclear technologies and thereby achieve public confidence and acceptance for new nuclear build.

In addition to the technical and safety aspects of decommissioning and environmental remediation, there is also an important ethical dimension: generations taking benefit from the use of nuclear technologies have to do their best to solve the issues related to the back end (such as decommissioning, remediation and management of resulting waste), avoid the transfer of undue burdens to future generations.

This conference is the first IAEA conference presenting together both decommissioning and environmental remediation. In 2002 and 2006, Berlin and Athens hosted IAEA International Conferences on decommissioning; and in 1999 and 2009, Arlington and Astana hosted the IAEA International Symposium and Conference, respectively, on environmental remediation. IAEA hosted an International Experts Meeting on decommissioning and remediation after a nuclear accident in

Vienna in 2013. Over the course of this timespan, significant developments have taken place and therefore it is timely to discuss the implications for national programmes and to exchange recent experiences in the global implementation of decommissioning and environmental remediation and to propose actions on advancing the implementation of programmes and on how current challenges may best be addressed.

It is now 5 years since the accident at the Fukushima Daiichi nuclear power plant occurred, and significant lessons are being learned through the major work programmes currently being undertaken in Japan. Since the accident the international nuclear community has given increased attention to addressing aspects of decommissioning and environmental remediation in post-accident situations.

Over the last decade or so there has also been an increased focus on decommissioning nuclear facilities, as many of the older facilities are now reaching the end of their design lives and some Member States have begun the early shutdown of NPPs as part of a national decision to phase out from nuclear energy. Consequently, as one would expect, there is likely to be a significant increase in decommissioning activities in the coming years.

Regarding remediation, while some long-established uranium mining sites have already been remediated, many legacy sites still require remediation. In addition, some mines that were not operational or have finished operation are now being examined for their potential to be re-opened. It is important that the next generation of uranium production is done in accordance with established international safety standards to protect workers, people and the environment and that action be taken to prevent the need for extensive remediation following operation. The potential for creation of new legacy sites should be avoided by taking account of lessons and experience gained from past remediation work. My colleague, Christophe Xerri, will shortly provide an update on the global status of decommissioning and environmental remediation in his opening presentation.

Some of the outcomes that we hope to take away from this conference focus on clearer directions and priorities, both at national level and among the international community, to advance the implementation of decommissioning and environmental remediation programmes. The conference provides an opportunity for in-depth discussions into the roles played by national policies, and associated legal, regulatory and institutional frameworks. There is also the opportunity to gain a better understanding of issues concerned with the decision making processes; project management; skills and supply chain considerations; involvement of interested parties and international collaboration; and finally an overall review of the technical issues and technologies for decommissioning and environmental remediation, as well as approaches to waste management resulting from these operations.

My hope is that all of you will take the opportunity to discuss these topics at length with each other. The conference brings together a broad range of experts from governmental authorities, national agencies, regulatory bodies, nuclear operators, waste management organizations, as well as representatives from international organizations and stakeholders involved in implementing and supporting decommissioning and environmental remediation. This conference provides a valuable forum for you to discuss and put forward your recommendations and proposals for future actions on decommissioning and environmental remediation, in all the above areas.

We look forward to your recommendations, as they will assist in the formulation of the IAEA's activities in the fields of decommissioning and environmental remediation for the coming years.

In closing, I would like to reiterate the IAEA's commitment to serving as a focal point of international efforts in these areas and to continue facilitating the successful cooperation with other international organizations on decommissioning and environmental remediation.

Thank you again for your readiness to share your expertise and discuss challenges. I wish you a productive and successful conference.

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Annex

CONFERENCE MATERIALS (IN ATTACHED CD-ROM)

The following papers and presentations from the International Conference on Advancing the Global Implementation of Decommissioning and Environmental Remediation Programmes are available on the attached CD-ROM.

RELATED DOCUMENTS

Programme of the International Conference on Advancing the Global Implementation of Decommissioning and Environmental Remediation Programmes

President's Report
J. J. Zaballa
ENRESA, Spain

Book of abstracts of the International Conference on Advancing the Global Implementation of Decommissioning and Environmental Remediation Programmes:

Part 1 – Opening Session, Sessions 1, 2, 3, 4A;
Part 2 – Sessions 4B, 5A, 5B, 6, 7, Closing Session.

International Standards on Decommissioning and Environmental Remediation as a Basis for a National Regulatory Framework: Current Status and Looking Ahead
A. González
Argentina

List of Meeting Participants

PRESENTATIONS

Conference Opening Session (Monday, 23 May 2016)

Global status of decommissioning and environmental remediation programmes
C. Xerri
International Atomic Energy Agency (IAEA)

Session 1 (Monday, 23 May 2016): Establishing National Policies and Strategies to Enable and Enhance Decommissioning and Environmental Remediation

The U.S. Department of Energy's recent progress and future challenges with environmental cleanup
M. Regalbuto
U.S. Department of Energy, USA

Decommissioning and environmental remediation in the Russian Federation: main results and future plans
O. Kryukov
ROSATOM, Russian Federation

CEA dismantling programme and feedback experience
L. Piketty
CEA, France

National policy, institutional framework and programme for implementation of D&ER in Rep. of Korea – Overview of main current issues
L. Ok-heon
Ministry of Trade, Industry & Energy, Rep. of Korea

National policy, institutional framework and programme for implementation of D&ER in Kyrgyzstan – overview of main current issues
T. Taalaibek
Ministry of Emergency Situation, Kyrgyzstan

Establishing national policies and strategies to enable and enhance decommissioning
H. Yamana
Ministry of Economy, Trade & Industry (METI), Japan

The Current situation of off-Site cleanup activities in Japan
K. Yoshikawa
Ministry of Environment (MOE), Japan

Session 2 (Tuesday, 24 May 2016): Regulatory Framework and Standards for Decommissioning and Environmental Remediation

International standards as a basis for national regulatory framework – current status and look ahead
A. Gonzalez
Nuclear Regulatory Authority, Argentina

The Australian perspective: a national regulatory framework for environmental remediation
G. Williams
Australian Radiation Protection and Nuclear Safety Agency, Australia

Successful Implementation of WENRA Safety Reference Levels: the WENRA Decommissioning Report
S. Theis
Western European Nuclear Regulators Association (WENRA), Switzerland

Regulatory Requirements for Decommissioning of Nuclear Facilities in Germany
B. Rehs
Federal Office for Radiation Protection (BfS), Germany

Remediation of legacy low level radioactive waste: regulatory oversight for two major remediation projects in Canada
K. Lange
Canadian Nuclear Safety Commission, Canada

Innovative regulatory approaches to facilitate decommissioning and remediation at a multi-facility site
P. Hallington
Sellafield Ltd, United Kingdom

Session 3 (Tuesday, 24 May 2016): Decision Making Process: Societal and Stakeholder Involvement during the Lifecycle of Programmes

Societal constraints related to stakeholder involvement in environmental remediation and decommissioning processes
M. Martell
Merience, Spain

Aboriginal and Northern involvement and benefits from Gunnar Uranium Mine Environmental Remediation – Northern Saskatchewan
J. Muldoon
Saskatchewan Research Council, Canada

Case Study: Experience of Environmental Remediation in Date City (Fukushima Prefecture)
S. Nishida,
Mayor of Date City, Fukushima Prefecture, Japan

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Lessons learned from preparing decommissioning operations with virtual reality
C. Chabal
CEA, France

Robot challenges for nuclear decommissioning of Fukushima Daiichi Power Station
T. Kotoku
International Research Institute for Nuclear Decommissioning (IRID), Japan

Selection of strategy and technology for segmentation of pressure vessel and internals at Zorita NPP
M. Ondaro
ENRESA, Spain

Application of in situ measurement for site characterization for decommissioning the Korea Research Reactor (KRR) site
S. B. Hong
Korea Atomic Energy Research Institute (KAERI), Rep. of Korea

Experiences and challenges in the characterization of irradiated graphite in French first-generation gas-cooled reactors
F. Dumortier
EDF, France

Cost estimation for decommissioning including uncertainties and main cost drivers
T. LaGuardia
LaGuardia & Associates, USA

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M. Kazakov
Kozloduy Npp, Bulgaria

Benefits from R&D for decommissioning and remediation projects
C. Georges
CEA, FRANCE

Recent improvement and lessons learned using imaging tools for radiological characterization
C. Mahe
CEA, France

NDF strategic plan for decommissioning of the Fukushima Daiichi nuclear power station
T. Kanda
NDF, Japan

R&D outline for decommissioning of the Fukushima Daiichi Nuclear Power Station
H. Ohhashi
International Research Institute for Nuclear Decommissioning (IRID), Japan

Integrated 3-D support system for improving safety and cost efficiency of nuclear decommissioning projects
I. Szoke
Institute for Energy Technology, Norway

Immediate dismantling of a large fleet of light water reactors: consequences for spent fuel and waste management
D. Depauw
French Radiation Protection and Nuclear Safety Institute (IRSN), France

ISDC approach to probabilistic cost risk assessment
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Use of highly selective ion exchangers in different decommissioning projects
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Fortum Power and Heat Oy, Finland

Decommissioning and demolishing stacks from legacy fuel cycle facilities at Sellafield site
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Sellafield Ltd, United Kingdom

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Tuev Rheinland Industrie Service Gmbh, Germany

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Sellafield Ltd, United Kingdom

Applications of ecological engineering remedies for uranium processing sites, USA
W. Waugh
U.S. Department of Energy, USA

Assessment of speciation and mobility of uranium in abandoned tailing site in Ukraine
K. Korychenskyi
Ukrainian Hydrometeorological Institute, Ukraine

Long term water treatment at uranium mining sites
M. Paul
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Technological approaches to groundwater treatment in remediation projects
D. Wellman
Pacific Northwest National Laboratory, USA

The NEA Thermochemical Database Project: 30 Years of Accomplishments
M. E. Ragoussi
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Ministry of the Environment (MOE), Japan

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N. Hashimoto
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S. Yashio
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Reflection on lessons learned on Fukushima environmental remediation from the standpoint of governmental bodies and local residents
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CRIEPI, Emeritus Research Advisor to Fukushima Prefecture on Remediation, Japan

Demonstration of wide area radiological decontamination and mitigation technologies for building structures and vehicles
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U.S. Environmental Protection Agency (EPA), USA

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Contaminated land remediation on decommissioned nuclear facilities: an optimized approach
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Geostatistics for radiological characterization: Sampling optimization, data interpretation and risk analysis
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Geovariances, France

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Developments and challenges in graphite management,
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Consultant, United Kingdom

Research reactor BR-10: testing ground for conditioning of alkaline liquid-metal coolants under decommissioning
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IPPE, Obninsk, Russian Federation

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T. Payne
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