NUCLEAR SAFETY REVIEW 2016

Nuclear Safety and Security Programme

IAEA 60 Years Atoms for Peace and Development

GC(60)/INF/5

Nuclear Safety Review 2016

GC(60)/INF/5

Nuclear Safety Review 2016

IAEA/NSR/2016

Printed in the IAEA in Austria
August 2016

Foreword

The *Nuclear Safety Review 2016* contains an analytical overview of the dominant trends and challenges worldwide in 2015 and the IAEA's efforts to strengthen the global nuclear safety framework in relation to those trends. The report also has an appendix describing developments in the area of the IAEA's safety standards during 2015.

A draft version of the *Nuclear Safety Review 2016* was submitted to the March 2016 session of the Board of Governors in document GOV/2016/2. The final version of the *Nuclear Safety Review 2016* was prepared in light of the discussions held during the Board of Governors and also of the comments received by Member States.

Executive Overview

The *Nuclear Safety Review 2016* focuses on the dominant safety trends in 2015. The Executive Overview provides general nuclear safety information along with a summary of the trends covered in this report: improving radiation, transport and waste safety; strengthening safety in nuclear installations; strengthening emergency preparedness and response (EPR); and strengthening civil liability for nuclear damage. In this year's Review, improving management of the safety and security interface has also been included. The Appendix provides details on the activities of the Commission on Safety Standards (CSS), and activities relevant to the Agency's safety standards.

The global nuclear community continues to make progress in strengthening and improving safety notwithstanding significant challenges. In general, the challenges faced by Member States in 2015 highlighted the need for continued and improved international collaboration, cooperation and capacity building. Over the course of 2015, the Agency continued its efforts in assisting Member States in building their capabilities and strengthening the global nuclear safety and security framework through various national and international programmes and activities.

In February 2015, the Contracting Parties to the Convention on Nuclear Safety (CNS) demonstrated their commitment to strengthening and improving the nuclear safety framework at the Diplomatic Conference held at the Agency's Headquarters in Vienna, Austria by unanimously adopting the Vienna Declaration on Nuclear Safety[1]. The Diplomatic Conference was convened pursuant to a decision taken by the Contracting Parties to the CNS during their Sixth Review Meeting held in March–April 2014, to consider a proposal by Switzerland to amend Article 18 of the Convention[2], addressing both new and existing nuclear power plants (NPPs). The Vienna Declaration on Nuclear Safety included the following principles for the implementation of the third objective of the Convention, which is "to prevent accidents with radiological consequences and to mitigate such consequences should they occur":

- "New nuclear power plants are to be designed, sited, and constructed, consistent with the objective of preventing accidents in the commissioning and operation and, should an accident occur, mitigating possible releases of radionuclides causing long-term off site contamination and avoiding early radioactive releases or radioactive releases large enough to require long term protective measures and actions.

- "Comprehensive and systematic safety assessments are to be carried out periodically and regularly for existing installations throughout their lifetime in order to identify safety improvements that are oriented to meet the above objective. Reasonably practicable or achievable safety improvements are to be implemented in a timely manner.

- "National requirements and regulations for addressing this objective throughout the lifetime of nuclear power plants are to take into account the relevant IAEA Safety Standards and, as appropriate, other good practices as identified inter alia in the Review Meetings of the CNS."

In November 2015, the Agency attended an informal meeting in Buenos Aires. The meeting was convened by the Nuclear Regulatory Authority of Argentina to discuss the implementation of the Vienna Declaration and was attended by experts from the majority of the Contracting Parties to the

---

[1] The text of the Declaration is available at: https://www.iaea.org/sites/default/files/cns_viennadeclaration090215.pdf.

[2] Further information on the Convention on Nuclear Safety, including links to the full text of the Convention, can be found at: https://www.iaea.org/Publications/Documents/Conventions/nuclearsafety.html.

Convention on Nuclear Safety and by the Organisation for Economic Co-operation and Development (OECD)/Nuclear Energy Agency (NEA).

The Director General's fourth and final annual report entitled Progress in the Implementation of *the IAEA Action Plan on Nuclear Safety*[3] and its supplement[4] were submitted to Member States in September 2015 as summarized below:

- The Agency completed the systematic review of the Safety Requirements applicable to NPPs, the storage of spent fuel, and EPR. Revised Safety Requirements, endorsed by the CSS, were submitted to the Board of Governors in March 2015; the Board of Governors approved these revisions.

- The Agency continued to analyse the relevant technical aspects of the Fukushima Daiichi accident and to share and disseminate lessons learned to the wider nuclear community. In 2015, the Agency organized, in cooperation with the Nuclear Energy Agency (OECD/NEA), the International Experts' Meeting on Strengthening Research and Development Effectiveness in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant (IEM-8), which was attended by 150 experts, representing 38 Member States and five international organizations. It also organized the International Experts' Meeting on Assessment and Prognosis in Response to a Nuclear or Radiological Emergency (IEM-9), which drew 200 experts from 70 countries and five international organizations.

- In 2015, the following reports were published, the *IAEA Report on Severe Accident Management in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant*[5]*; the IAEA Report on Strengthening Research and Development Effectiveness in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant*[6]*; the IAEA Report on Assessment and Prognosis in Response to a Nuclear or Radiological Emergency*[7]*; and the IAEA Report on Capacity Building for Nuclear Safety*[8].

- The Agency released the Director General's report on the Fukushima Daiichi accident along with five technical volumes[9] at the 59th regular session of the General Conference.[10] The report and accompanying technical volumes were the result of an extensive international collaborative effort, involving five working groups made up of some 180 experts from 42 Member States, with and without nuclear power programmes, and several international organizations. The report and technical volumes provide a description of the accident and its causes, evolution and consequences, based on the evaluation of data and information from many sources, including the results of the work carried out in implementing the IAEA Action Plan on Nuclear Safety. The Government of Japan and various Japanese organizations provided a significant amount of data.

- Continuous efforts are necessary to maintain and strengthen nuclear safety. The Agency will continue to implement dedicated projects related to the Action Plan. The Department of Nuclear

---

[3]This publication is available at: https://govatom.iaea.org/GovAtom%20Documents/2015/GOV-INF-2015-13-GC-59-INF-520150731111159/gov-inf-2015-13-gc-59-inf-5.pdf.

[4] See: https://www.iaea.org/About/Policy/GC/GC59/GC59InfDocuments/English/gc59inf-5-att1_en.pdf.

[5] This publication is available at: https://www.iaea.org/sites/default/files/iem7-severe-accident-management.pdf.

[6] This publication is available at: https://www.iaea.org/sites/default/files/iem8-report-on-research-and-development.pdf.

[7] This publication is available at: https://www.iaea.org/sites/default/files/iem9-assessment-and-prognosis.pdf.pdf.

[8] This publication is available at: https://www.iaea.org/sites/default/files/report-on-capacity-building.pdf.

[9] See: http://www-pub.iaea.org/books/IAEABooks/10962/The-Fukushima-Daiichi-Accident.

[10] This publication is available at: http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1710-ReportByTheDG-Web.pdf.

Safety and Security will be the focal point for supporting cross-departmental activities and aligning them with the various programmes and strategies for nuclear safety.

Significant progress has been made in reviewing and revising various Agency safety standards in areas for regulatory framework, site evaluation, design safety, safety assessment, radiation protection of the public, transport safety, waste safety and human factors.

In May 2015, the Board was informed of the establishment of a new Emergency Preparedness and Response Standards Committee (EPReSC) under the Commission on Safety Standards. EPReSC will review and approve Agency safety standards in the area of emergency preparedness and response. EPReSC will also contribute, inter alia, to the review of other Agency safety standards and publications in the Nuclear Security Series that include emergency preparedness and response.[11] The committee comprises senior experts nominated by Member States in the area of nuclear and radiological emergency preparedness and response.

The Agency continued to undertake activities to strengthen its comprehensive peer review services. Some improvements to peer reviews included: revision of the 2005 edition of the Operational Safety Review Team (OSART) guidelines and trial implementation of them during OSART missions in 2015; and, revision of the Emergency Preparedness Review (EPREV) mission guidelines, which will be available in 2016. Also requests for peer review missions by Member States continued to increase. In 2015, the Agency conducted:

- Six OSART missions in Canada, France, Japan, Pakistan, the Russian Federation and the United Kingdom; two follow-up OSART mission in France and the United States of America; and one follow-up Corporate OSART mission in the Czech Republic;

- Eight Integrated Regulatory Review Service (IRRS) missions in Member States with and without NPPs: Armenia, Croatia, Hungary, India, Indonesia, Ireland, Malta, and the United Republic of Tanzania; four IRRS follow-up missions in Member States with and without NPPs: Finland, Slovakia, Switzerland, and the United Arab Emirates; four IRRS preparatory missions in Member States with NPPs: Bulgaria, Finland, Japan, and Sweden; and four IRRS preparatory mission in Member States without operating NPPs: Belarus, Guatemala, Lithuania (the Ignalina NPP has been shut down), and the United Republic of Tanzania;

- Five EPREV missions in Ghana, Jamaica, Kenya, Nigeria and the United Arab Emirates; and two preparatory EPREV missions in Ghana and Hungary;

- One Integrated Safety Assessment of Research Reactors (INSARR) mission in Turkey; two follow-up INSARR missions in Italy and Slovenia; and one preparatory INSARR mission in Portugal;

- One Safety Evaluation of Fuel Cycle Facilities During Operation (SEDO) follow-up mission in Romania;

- Three Generic Reactor Safety Review (GRSR) services in China: for the ACP1000, ACP100 and CAP1400 reactor designs;

- One Safety Assessment Advisory Programme (SAAP) service in Malaysia;

- Four Site and External Events Design (SEED) missions in Bangladesh, Jordan, Thailand and Viet Nam;

---

[11] Establishment of Emergency Preparedness and Response Standards Committee (EPReSC) https://govatom.iaea.org/GovAtom%20Documents/2015/gov-inf-2015-09/gov-inf-2015-9_en.pdf.

- Four Safety Aspects of Long Term Operation (SALTO) missions in Belgium, China, Mexico and South Africa;

- Three Education and Training Appraisal (EduTA) missions in Greece, Israel and Lithuania; and two Education and Training Review Service (ETReS) missions in the Philippines and Thailand; and

- Four advisory missions to assist Member States in strengthening radiation safety regulatory infrastructure: Bosnia and Herzegovina, the Lao People's Democratic Republic and Papua New Guinea and Uruguay.

Knowledge networks continued to grow and played an integral part in assisting capacity building in Member States during 2015. Additionally, the Agency's Global Nuclear Safety and Security Network (GNSSN) gained a new international network — the Small Modular Reactor (SMR) Regulators' Forum. The SMR Regulators' Forum is the first forum of its kind specifically to address regulatory issues in the safety and licensing of SMRs. The GNSSN platform now links 20 international and regional networks. Moreover, the Secretariat began discussions with various international groups in Europe and Central Asia on the development of a new regional safety network under the GNSSN with a view to involving those countries that are currently not members of any safety network (e.g. in eastern and south-eastern Europe and in Central Asia). Some 17 Member States have expressed interest in the development of such a new network. During 2015, other developments in other GNSSN networks continued as noted the following:

- The Regulatory Cooperation Forum (RCF) has begun development of a new online database to map planned and completed capacity building activities for Member States receiving donor support. This tool will facilitate the systematic coordination and monitoring of support activities and their implementation across various support frameworks for both donor and receiving countries.

- The Asian Nuclear Safety Network (ANSN) implemented some 45 capacity building activities in 2015. The Arab Network of Nuclear regulators (ANNuR) and the Forum of Nuclear Regulatory Bodies in Africa (FNRBA) implemented altogether some 20 activities, including advisory and review missions, field visits, workshops and training courses conducted in line with the Agency's safety standards and nuclear security guidance documents.

- The Ibero-American Forum of Radiological and Nuclear Regulatory Agencies (FORO) completed a three-year joint project with the Agency intended to strengthen regional regulatory capacity building. This project was developed in line with the IAEA Safety Report on *Managing Regulatory Body Competence* (IAEA Safety Report Series No. 79)[12] and the IAEA Technical Document *Methodology for the Systematic Assessment of the Regulatory Competence Needs (SARCoN) for Regulatory Bodies of Nuclear Installations* (IAEA-TECDOC-1757)[13]. FORO regulators produced a report intended to guide the development of capacity building programmes.[14] The report includes several annexes with specific information on competence profiles and training resources in the region. An IAEA TECDOC based on this work is also under preparation and will be published in Spanish. FORO also concluded a three-year joint project with the Agency to develop guidelines for safety culture in practices involving activities with sources of ionizing radiation; a final report is due to be published in 2016.

---

[12] The publication is available at: http://www-pub.iaea.org/MTCD/publications/PDF/Pub1635_web.pdf.

[13] The publication is available at: http://www-pub.iaea.org/MTCD/publications/PDF/TE-1757_web.pdf.

[14] The publication is available at: http://www.foroiberam.org/web/guest/crean1.

In reviewing developments in radiation protection, transport and waste safety in 2015, the Agency noted the following:

- The activities undertaken by the Agency in 2015 in radiation protection of patients, workers, the public and the environment, included publishing safety guides, conducting workshops, and developing and implementing databases designed to enable Member States to improve their national programmes.

- An inter-regional technical cooperation project on the control of radioactive sources, with a strong focus on the management of sources at the end of their life cycle, ended in 2015, with the participating Member States having achieved significant progress in the safe management of disused sources at the policy, regulatory and operational levels. Two follow-on technical cooperation projects in this area have been proposed for the coming cycle.

- The fifth Review Meeting of the Contracting Parties to the Joint Convention took place in May 2015 in Vienna, Austria and was attended by 61 Contracting Parties. This meeting highlighted progress made since the fourth Review Meeting with regard to the management of disused sealed sources and discussed means to encourage adherence to the Joint Convention, to improve the active participation in the peer review process, and to increase the effectiveness of the review process for Contracting Parties without a nuclear power programme.

- Member States continue to request Agency assistance in developing and implementing guidance and building capacity for the regulatory oversight of transporting radioactive material within and across national borders. Over 80 Member States participated in Agency-sponsored regional transport programmes in 2015 to strengthen their collaboration and harmonize their regulatory approaches.

- The Agency's assistance in relation to the safe implementation of long term radioactive waste management solutions continues to be requested, and a number of Member States have encouraged the Secretariat to establish and implement harmonized strategies and approaches for use in national programmes worldwide.

- Member States have identified the need to enhance capacities for strategic planning and regulation during decommissioning of legacy nuclear facilities. In January 2015, the Agency launched a new International Project on Managing the Decommissioning and Remediation of Damaged Nuclear Facilities within the framework of the IAEA Action Plan on Nuclear Safety. The project is meant to provide a forum to facilitate discussion and share knowledge and experiences related to key aspects of decommissioning.

- There is an on-going demand for assessment and remedial action for legacies of past uranium mining and milling activities. In 2015, the Agency established the Coordination Group for Uranium Legacy Sites to support multilateral efforts to remediate such sites in the Central Asia region, and several Member States have provided bilateral assistance to other countries to assist national and regional remediation projects.

- Member States continued to give high priority to the adoption of sustainable approaches to build competence in radiation, transport and waste safety. The Agency sponsored several train the trainers' workshops in various countries and also ran regional programmes based on the syllabus of its Postgraduate Educational Course in Radiation Protection and the Safety of Radiation Sources.

- Many Member States are building national radiation safety infrastructures and continued to request Agency assistance in developing them. In 2015, the Agency conducted several advisory missions as well as several full and preparatory IRRS missions in various Member States to provide assistance in this area.

In reviewing developments in nuclear installation safety in 2015, the Agency noted the following:

- With over 16 000 cumulative reactor-years of commercial operation in some 35 countries, operational safety around the world remains high, as indicated by safety data collected by the Agency's Power Reactor Information System database and by the World Association of Nuclear Operators. A review of the OSART peer review missions has identified the following topics that need improvement in several Member States: severe accident management programmes; EPR at NPPs; reporting, screening, trending and analysis of incidents at NPPs; fire protection and control of combustible materials. In addition, OSART missions have identified good practices in operational safety, including substantial design modifications to address design extension conditions and effective corporate support.

- The Agency revised its OSART guidelines in 2015 to take into consideration the lessons learned from the Fukushima Daiichi accident as well as experience gained with the application of Agency safety standards.

- At the end of 2015, 41% of the 441 operating nuclear power reactors in the world had been in operation for 30 to 40 years, and another 15% for more than 40 years. Over the past several years, results from the Agency's SALTO peer review missions have identified areas for improvement associated with plant life management and extension such as the need to strengthen ageing management programmes and to develop appropriate regulations to govern life extensions in some Member States.

- The Agency hosted the International Conference on Research Reactors: Safe Management and Effective Utilization held in Vienna, Austria, in November 2015; some 300 participants attended it from 56 countries and three international organizations. The main conclusions of the conference were that the operators should ensure full utilization of research reactors through proper strategic planning, work to integrate IAEA guidance on safety and security into their operations and make increased use of networking to learn from their peers.

- The INSARR peer review missions identified the need for improvement on the implementation of lessons learned from the Fukushima Daiichi accident ascribed to lack of competent resources and funding.

- The Agency conducted three SEED missions, one pre-SEED mission, and four capacity building and training activities for embarking Member States in 2015.

- The Agency assisted countries embarking on NPP and/or research reactor construction through the implementation of a variety of capacity building activities aimed at providing essential knowledge and practical training in key safety areas, including establishing and implementing a proper regulatory framework.

- The Agency produced publications and conducted several workshops and technical meetings throughout 2015 to assist regulatory bodies to establish effective regulatory control in relation to managerial, human and organizational factors.

In reviewing developments in emergency preparedness and response in 2015, the Agency noted the following:

- The International Conference on Global Emergency Preparedness and Response was hosted at Headquarters in Vienna, Austria, in October 2015; some 420 people attended it from 82 Member States and 18 international organizations. The conference discussed public communication challenges that include disproportionate risk perceptions, lack of public knowledge and the awareness of contradictory analyses. The conference confirmed that provision of timely, concise, factually correct

and easily understandable information by relevant authorities and organizations to the public is a key element for effective emergency response.

- There has been an increased demand for Agency assistance to strengthen regional EPR and an increased number of requests for the Agency to participate with Member States conducting national exercises during 2015.

- The Secretariat and Member States intensified their efforts in preparing and testing arrangements for effective implementation of the assessment and prognosis function in accordance with the IAEA Action Plan on Nuclear Safety.

- Participation in the ConvEx-2b exercise, held in August 2015, involved 14 Member States registering as requesting States and 28 Member States registering as assisting States. Of the 28 assisting States, 19 were registered in the IAEA Response and Assistance Network (RANET), representing an 11% increase in the participation of RANET counterparts over the 2014 ConvEx-2b exercise. Enhancements to the guidance and mechanism for generating offers of assistance significantly contributed to the higher quality of the offers made during the exercise.

- The EPR module of the IRRS missions, which is used to review the regulatory effectiveness of Member States in emergency preparedness and response, was revised to be consistent with Preparedness and Response for a Nuclear or Radiological Emergency (IAEA Safety Standards Series No. GSR Part 7), and to simplify the self-assessment questionnaire on this subject.

Member States continue to seek Agency services and guidance in improving the management of the safety and security interface. The Nuclear Safety Review 2016 includes a new section that covers trends and activities in this area. This report covers the following topics.

- Progress has been made on two safety and security resolutions that were adopted to enhance the coordination of the safety and security interface (GC(52)/RES/9 and GC(52)/RES/10)[15]. Highlights in this section provide the results achieved to date in reviewing and improving interfaces between nuclear safety standards and nuclear security guidance publications.

- Disused radioactive sources require regulatory oversight of safety and security to ensure against both accidents and malicious acts occurring. The Code of Conduct on the Safety and Security of Radioactive Sources addresses measures related to the management of disused sources. The Agency has begun development of a guidance document that addresses managing safety and security in an integrated manner.

- Emergency response procedures require the management and coordination of both safety and security response priorities. Experts discussed the need to integrate the safety and security aspects of EPR during IEM-9 in April 2015.

The IAEA Action Plan on Nuclear Safety specifically called on Member States to work towards establishing a global nuclear liability regime and to give due consideration to the possibility of joining the international nuclear liability instruments as a step towards achieving such a regime. In 2015, the Agency noted the following activities in this area:

- In April 2015, the Convention on Supplementary Compensation for Nuclear Damage entered into force.

---

[15] These resolutions are available at: https://www.iaea.org/About/Policy/GC/GC52/GC52Resolutions/English/gc52res-9_en.pdf and https://www.iaea.org/About/Policy/GC/GC52/GC52Resolutions/English/gc52res-10_en.pdf.

- The Agency held its Fourth Workshop on Civil Liability for Nuclear Damage at headquarters, where 65 participants from 38 Member States were introduced to topics on civil liability and compensation in case of nuclear damage.

- Joint Agency–INLEX missions were conducted in Mexico and Jordan to raise awareness of the international legal instruments relevant for achieving a global nuclear liability regime.

Table of Contents

Analytical Overview

A. Improving Radiation, Transport and Waste Safety

A.1. Radiation Protection of Patients, Workers, the Public and the Environment

A.1.1. Radiation Protection of Patients

Trends

1. Complex radiotherapeutic technologies and procedures are increasingly being introduced into regions where they have not been previously employed, resulting in the need to establish safety measures. While there is broad agreement among experts that radiotherapy is an effective form of treatment, with more than five million treatments delivered annually in the world[16], it is also recognized that safety measures need to be further enhanced for this rapidly developing medical application.

2. Access to diagnostic imaging is increasing globally. Medical use of radiation is the largest contributor to radiation exposure in the world's population from man-made sources and a significant percentage (20-50% in some areas) of individual medical exposures are unnecessary and unjustified.[17] While the increase in computed tomography scanning over the past number of years indicates better access to this medical technology, unjustified exposures need to be reduced and patients need to be protected from unnecessary risks related to ionizing radiation.[18]

Activities

3. The Agency held the Technical Meeting on Justification of Medical Exposure and the Use of Appropriateness Criteria[19] in Vienna, Austria, in March 2015, where more than 70 participants from 41 Member States and seven international organizations attended. These criteria have been developed by several radiological professional societies, helping to reduce unnecessary and unjustified medical exposures, but need increased use in practice. At this meeting, the factors behind successful implementation were explored. In view of the increased global access to radiotherapeutic technologies and diagnostic imaging, this conference provided the opportunity to discuss steps on how to overcome the barriers to implementation of the appropriateness criteria.

---

[16] UNITED NATIONS, Sources and Effects of Ionizing Radiation (2008 Report to the General Assembly), United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), UN, New York (2010) Annex A: Medical Radiation Exposures.

[17] MALONE, J., GULERIA, R., CRAVEN, C., et al. Justification of diagnostic medical exposures: some practical issues. Report of an International Atomic Energy Agency Consultation. Br J Radiol. 2012 May; 85(1013): 523-538.

[18] Ibid.

[19] Appropriateness criteria are an evidence-based approach intended to give information on the best clinical imaging procedure for a given clinical scenario, by taking into account the current medical scientific evidence on the diagnostic efficacy of the radiological procedure, the relative radiation level of the procedure, as well as alternative procedures that do not use ionizing radiation.

4. The technical meeting on Tracking the Radiation Exposure of Patients was held by the Agency in Vienna, Austria, in April 2015. The meeting was attended by 32 participants, from 22 Member States, including some that have already established a system for tracking individual radiological procedures and radiation doses and others that are actively considering establishing a system. The meeting concluded that tracking procedures is useful to avoid unnecessary repeated exams and to audit cases of questionable self-referral. The meeting further concluded that there is a need for the Agency to develop training material on this topic specifically oriented towards referring medical practitioners.

5. The Agency's Safety in Radiation Oncology (SAFRON) safety reporting and learning system currently contains more than 1300 registered events related to radiotherapy safety. This year it was updated to provide participating clinics and hospitals in Member States with the opportunity to perform statistical analysis and benchmarking using safety information from other SAFRON participants, in order to learn from events.

Future Challenges

6. The Bonn Call for Action, issued in 2013 as a joint position statement by the Agency and the World Health Organization (WHO), identified responsibilities and proposed priorities for stakeholders regarding radiation protection in medicine for the next decade, as well as the main actions considered to be essential for strengthening radiation protection in medicine. These stakeholders comprise international organizations, national organizations, professional bodies, health facilities, and health professionals. National and international programmes still need to be developed and implemented in many Member States in order to carry out the Bonn Call for Action. An international conference is planned for 2017 to address the success of implementation of these actions by all the relevant international and national stakeholders.

A.1.2. Radiation Protection of Workers

Trends

7. Workers are exposed to ionizing radiation in a wide range of occupational settings, including health care facilities, research institutions, nuclear reactors and their support facilities, and other various manufacturing facilities. Radiation exposure in these settings can pose a considerable health risk to workers if not properly controlled. Statistics over recent years have shown a continuous increase in the number of occupationally exposed workers in industry, medicine and research.[20] This increase, combined with the wider availability of new technologies and a shortage of trained staff in several industries outside of the nuclear sector, has resulted in an increased need for training and education on dose reduction techniques and on applying the optimization principle for protection of workers, especially in the health care sector.

Activities

8. In 2015, the Agency provided Radiation Protection training in the areas of occupational exposure, quality management, health services and naturally occurring radioactive materials to some 300 participants at six regional training courses in Botswana, China, Cuba, the Czech Republic, Egypt, and Lithuania; an additional four national training courses were held in Bahrain, China, Guatemala, and Honduras.

---

[20] UNITED NATIONS, Sources and Effects of Ionizing Radiation (2008 Report to the General Assembly), United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), UN, New York (2008) Annex B: Sources and Effects of Ionizing Radiation.

9. The Agency released the online database Information System on Occupational Exposure in Medicine, Industry and Research — Industrial Radiography (ISEMIR-IR)[21]. ISEMIR-IR is a web-based data collection and analysis tool that gathers occupational dose information for workers in industrial radiography. The system is for use by non-destructive testing companies carrying out industrial radiography to improve implementation of occupational radiation protection. ISEMIR-IR allows users to benchmark for comparison purposes and manage worker exposures, and hence promotes and implements optimization of protection.

Future Challenges

10. The continuing expansion of use of ionizing radiation in occupational settings suggests that Member States will continue to need guidance, training and education in occupational radiation protection in order to build their capacity to develop and strengthen knowledge, skills, and competencies and to accomplish worker protection in different areas (including in industries that involve naturally occurring radioactive material).

11. With the rapid increase in the number of individual monitoring service laboratories in Member States, national systems for the protection of health and safety of workers who are occupationally exposed to radiation need to be strengthened to be consistent with new requirements of the IAEA International Basic Safety Standards. This calls for increased staff training and better harmonization of quality management of monitoring practices in line with safety requirements.

12. Further optimization of radiation protection through ALARA (As Low As Reasonably Achievable) networks involving different stakeholders is needed. The current international occupational radiation protection ALARA network, Occupational Radiation Protection Network (ORPNET), and the Information System on Occupational Exposure in Medicine, Industry and Research (ISEMIR), will need to be further improved. Sustainable development of regional ALARA networks and creation of new regional ALARA networks are needed to harmonize the approaches for using occupational radiation protection tools.

A.1.3. Radiation Protection of the Public

Trends

13. In the immediate aftermath of the Chernobyl and the Fukushima accidents, world attention focused on the release of radionuclides into the environment and the resulting potential contamination of food and water supplies. Worldwide public concern regarding the safety of food and water continued after the end of the emergencies.

14. Communication deficiencies during the days directly following the accidents led to public uncertainty and an undue sense of risk regarding the existing exposure situation[22]/[23]. The International Experts' Meeting on Enhancing Transparency and Communication Effectiveness in the Event of a Nuclear or Radiological Emergency held in Vienna in June 2012 highlighted these issues and their

---

[21] The tool is available at: https://nucleus.iaea.org/isemir/IR/Home/LandingPage.

[22] *The Fukushima Daiichi Accident, Report by the Director General*. IAEA, Vienna, Austria (2015). This publication is available at: http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1710-ReportByTheDG-Web.pdf.

[23] *INSAG-7: The Chernobyl Accident: Updating of INSAG-1*, a Report by the International Nuclear Safety Advisory Group, IAEA, Vienna, Austria (1992). This publication is available at: http://www-pub.iaea.org/MTCD/publications/PDF/Pub913e_web.pdf.

impacts on public perceptions.[24] Member States continued to call upon the Agency in 2015 to assist them in the development of effective strategies for emergency and non-emergency communication with the public and other stakeholders.

Activities

15. In 2015, the Agency—together with the Food and Agricultural Organization of the United Nations (FAO) and WHO, prepared a TECDOC on levels for radionuclide activity concentrations for food and drinking water[25]. The TECDOC provides information on the current international standards that apply to radionuclides levels in food and drinking water, the radiation protection criteria on which they are based, and the circumstances in which they are used (summarized in Table 1 and 2). The TECDOC also discusses how to apply these international standards to special situations in which only a sub-group of the population may be affected. The Agency has started discussions with international organizations to identify improvements to the current system of protection against contamination in food and drinking water.

TABLE 1. CURRENT INTERNATIONAL STANDARDS THAT APPLY TO LEVELS FOR RADIONUCLIDES IN FOOD

Food	Individual Dose in a Year	Activity Concentrations (Bq/kg)	Responsible International Organization
Reference level	1 mSv	NO	IAEA
Intervention exemption level	1 mSv	YES — guideline levels	Joint FAO/WHO Codex Alimentarius Commission
Guideline levels	—	Developed separately for infants and non-infants	Joint FAO/WHO Codex Alimentarius Commission

TABLE 2. CURRENT INTERNATIONAL STANDARDS THAT APPLY TO LEVELS FOR RADIONUCLIDES IN DRINKING WATER

Drinking Water	Individual Dose in a Year	Activity Concentrations (Bq/l)	Responsible International Organization
Reference level	1 mSv	NO	IAEA
Indicative dose	0.1 mSv	YES — guidance levels	WHO
Guidance level	—	Developed primarily for radionuclides of natural origin	WHO

16. The Agency conducted several technical meetings and provided advisory services to Member States in Central Asia and Japan in 2015 to support them in enhancing their communication strategies for public and other stakeholder engagement regarding technical risk assessments, radiation monitoring results, key recovery and remediation initiatives.

[24] *International Experts' Meeting on Enhancing Transparency and Communication Effectiveness Report.* IAEA, Vienna, Austria (2012). This publication is available at: http://www-pub.iaea.org/books/iaeabooks/10442/IAEA-Report-on-Enhancing-Transparency-and-Communication-Effectiveness-in-the-Event-of-a-Nuclear-or-Radiological-Emergency.

[25] The Agency's Publications Committee is currently reviewing this TECDOC for publication. Final publication awaits decision on co-sponsorship by the WHO and FAO. The anticipated publication date of this TECDOC is therefore not yet available.

Future Challenges

17. Member States and international organizations recognize the need to improve communication of radiation risks by use of clearer language and enhanced communication strategies.

18. Multiple sponsors will need to continue harmonizing guideline levels for radionuclides contained in food and in water, using a consistent scientific basis to produce a single set of numbers. The international organizations involved (the FAO, the Agency and the WHO) need to widely disseminate existing information on the current international standards for radionuclides in food and drinking water and the circumstances to which they apply.

19. Member States need to ensure that a robust and harmonized system is in place for controlling radionuclides in food and drinking water. Since different national agencies and authorities share responsibilities for managing food and drinking water, Member States will need to inform them regarding the applicability of the international standards in different situations. Member States will also need to ensure that appropriate coordination mechanisms are established in advance for all relevant governmental bodies to ensure that national safety standards are effectively implemented when dealing with food and drinking water contaminated with radionuclides in the aftermath of a nuclear or radiological emergency.

A.1.4. Radiation Protection of the Environment

Trends

20. Many countries have used the oceans for disposing all sorts of industrial wastes for centuries; since the mid-1940s, this has included radioactive waste. In 1975, the entrance into force of the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972 (the London Convention)[26] banned the disposal at sea of high-level radioactive waste. Some countries continued to allow disposal at sea of low and intermediate level radioactive waste in a regulated manner, a practice considered legal until 1993, when international treaties[27] had banned ocean disposal. However, many countries are still dumping industrial wastes and other materials at sea that could also contain radioactive residue.

Activities

21. The Agency has developed a new radiological procedure to regulate the dumping at sea of industrial wastes and other materials that could have radioactive residue. This procedure was approved for incorporation into the International Maritime Organization (IMO) guidelines for the London Convention for use by national authorities and industrial operators of the 87 Contracting Parties. This procedure requires the preparation of a detailed assessment to demonstrate that the radiological impact of disposal at sea would be negligible. Contracting Parties to the London Convention are obliged to perform these assessments based upon the advice provided in the recently published TECDOC entitled *Determining the Suitability of Materials for Disposal at Sea under the London Convention 1972 and London Protocol 1996: A Radiological Assessment Procedure* (IAEA-TECDOC-1759).[28] The methodology used by the Agency to define de minimis explicitly considers the protection of workers, the public and the flora and fauna in the marine environment, in line with the most recent relevant

---

[26] The Agency acts in a Technical Advisory capacity in fulfilment of its obligations to the London Convention. The London Convention is available at: http://www.imo.org/en/OurWork/Environment/LCLP/Pages/default.aspx.

[27] London Convention, Basel Convention—Controlling Transboundary movement of Hazardous Wastes; International Convention for the Prevention of Pollution from Ships (MARPOL).

[28] The publication is available at: http://www-pub.iaea.org/MTCD/Publications/PDF/TE-1759_web.pdf.

recommendations by the International Commission on Radiological Protection (ICRP)[29] and in *Radiation Protection and Safety of Radiation Sources*: *International Basic Safety Standards* (IAEA Safety Standards Series No. GSR Part 3).

22. In 1989 and more recently in 2006, the Contracting Parties to the London Convention requested that the Agency undertake the preparation of an inventory of all materials that have entered the oceans as a result of disposal activities and from accidents and losses at sea. The Agency recently updated this inventory in consultation and cooperation with its Member States and the IMO, and in October 2015 published *Inventory of Radioactive Material Resulting from Historical Dumping, Accidents and Losses at Sea — For the Purposes of the London Convention 1972 and London Protocol 1996* (IAEA-TECDOC-1776).[30] This publication compiles past-recorded waste dumping, accidents and losses at sea involving radioactive material since the 1940s, and will serve as the official record for the London Convention, helping scientists worldwide evaluate the impact of radionuclide sources in the marine environment anywhere in the world.

23. The Agency is currently contributing to a comprehensive review of completed studies on dumping radioactive waste at sea being conducted by the Scientific Group of the London Convention. This review must be completed by 2019, as required every 25 years under the London Convention and Protocol in order to review the prohibition on dumping of such substances.

Future Challenges

24. Ensuring that the current London Convention is in alignment with the evolving IAEA Safety Standards will remain a challenge.

A.2. Control of Radiation Sources

Trends

25. Sealed radioactive sources are used worldwide in medicine, industry and research for a wide range of applications. The sources can contain a broad spectrum of radionuclides, and exhibit a wide range of activity levels and half-lives. Radioactive sources are defined as ‘disused’ when they are no longer used for the practice for which they were authorized. More and more accidents involving loss of control of sources occur every year, sometimes resulting in injury and death.[31] Member States continue to be interested in and supportive of the Code of Conduct on the Safety and Security of Radioactive Sources.[32]As of December 2015, 127 Member States have made a political commitment to implementing the Code, of which 98 Member States have also notified the Director General of their intention to act in a harmonized manner with the Code’s supplementary Guidance on the Import and Export of Radioactive Sources (Import and Export Guidance)[33]. Some 132 Member States have nominated points of contact for facilitating the export and import of radioactive sources.

---

[29] The recommendations of the ICRP are available at: http://www.icrp.org/publication.asp?id=ICRP%20Publication%20108.

[30] The publication is available at: http://www-pub.iaea.org/MTCD/Publications/PDF/TE-1776_web.pdf.

[31] *Lessons Learned from the Response to Radiation Emergencies* (1945 -2010), IAEA, Vienna, Austria. (2012). The publication is available at: http://www-pub.iaea.org/MTCD/Publications/PDF/EPR-Lessons%20learned%202012_web.pdf.

[32] The Code is available at: http://www-pub.iaea.org/MTCD/publications/PDF/Code-2004_web.pdf.

[33] The Guidance is available at: http://www-pub.iaea.org/MTCD/Publications/PDF/8901_web.pdf.

Activities

26. An Open-ended Meeting of Legal and Technical Experts to Develop Internationally Harmonized Guidance for Implementing the Recommendations of the Code of Conduct on the Safety and Security of Radioactive Sources in Relation to the Long Term Management of Disused Radioactive Sources was organized by the Agency in October 2014 to establish internationally harmonized guidance on the management of disused radioactive sources. Good progress was made in 2015 to revise the draft based on comments received during and after the open-ended meeting. A second open-ended meeting was held in December 2015 where more than 70 Member States participated to further review the draft guidance. The document under discussion is proposed as supplementary guidance to the Code.

27. An interregional technical cooperation (TC) project on the cradle to grave control of radioactive sources, with a strong focus on the management of sources at the end of their life cycle in the Mediterranean region, came to an end in 2015. This project achieved significant progress in the region at the policy, regulatory and operational levels for the safe management of disused sources. As a result of the success of this project, two similar projects are proposed for the next TC cycle, one international and one focusing on the Caribbean region.

28. The Agency organized two regional meetings — in March 2015 for the Mediterranean region and in November 2015 for Africa — on sharing experience in implementing the Import and Export Guidance. The Agency also organized an international meeting on facilitating States' political commitment to, and implementation of, the Code in November 2015. This meeting provided an opportunity for those Member States that have not yet expressed political commitment to the Code to learn from other Member States about their achievements and challenges associated with the implementation of the Code. The Agency has developed draft guidelines and a report template, to facilitate States' reporting on their implementation of the provisions of the Code, which is to be circulated to all Member States for comments.

Future Challenges

29. Return to the supplier through contractual arrangements made at the time of acquisition of the source is a well-established practice for new sources. However, the management of disused sources for which such agreements do not exist or where the original supplier is no longer in business remains an issue in many Member States, due to the lack of appropriate long-term management strategies and practical arrangements.

30. Many Member States need to secure sufficient resources and build the capacity to fully implement the provisions of the Code.

A.3. Safe Transport of Radioactive Material

Trends

31. Many Member States now use the dual-purpose cask (DPC) for both storage and transport of spent nuclear fuel, and the number of Member States who are considering using this approach has risen. A framework needs to be in place to ensure that DPCs can be transported safely both nationally and internationally which necessitates a revision of the Agency's Regulations for the Safe Transport of Radioactive Material.

32. As radioactive materials and their availability for use in medicine, industry, agriculture and pest control continues to grow, there is an increasing need to package them in proper containers and

transport them safely. Often times packaging that is used has not received regulatory approval owing to a lack of sufficient regulatory capacity.

Activities

33. Some 15 changes have been proposed to the *Regulations for the Safe Transport of Radioactive Material* (IAEA Safety Standards Series No. SSR-6)[34] that will incorporate regulatory requirements directly relating to the transport of packages after storage and will apply to all radioactive materials in all transport package types. The Transport of Radioactive Material Safety Committee (TRANSSC) reviewed and approved the proposed changes during the 2015 review cycle for SSR-6. Also approved for revision, was the *Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (2012 Edition)* (IAEA Safety Standards Series, No. SSG-26).[35]

34. Capacity building for transport regulatory oversight in Member States continued in 2015, with over 80 Member States participating in the Agency's regional transport programmes in Asia and the Pacific, Africa and the Mediterranean. Member States could benefit from using regional frameworks to collaborate and harmonize their approaches, ensuring that appropriate regulatory oversight can be achieved.

Future Challenges

35. In recognition of the increased use of radioactive material in Member States, particularly in medicine, industry, agriculture and pest control, there is an increasing need to have appropriate transport regulatory oversight. Many Member States do not have the capacity or necessary framework to regulate the transport of radioactive material within and across their borders. The Agency continues to foster collaboration among transport regulators within the regions as well as with Member States with more mature regulatory programmes.

36. Building collaborative regional networks in support of transport regulatory capacity building will extend beyond typical Agency project periods. If the Member States are to succeed in building sustainable regional networks, more investment will be needed over the next ten years. Currently, more than 80 Member States participate in these networks.

A.4. Waste Management and Decommissioning Safety

Trends

37. Radioactive waste is an inevitable residue from the use of radioactive materials in industry, research and medicine, as well as from the use of nuclear power to generate electricity. Long-term management solutions and safe implementation of those solutions is an issue necessary for almost all countries. Member States continue to seek Agency assistance in this area and have indicated that they would welcome harmonized strategies and approaches for use in national programmes.

38. Decommissioning a nuclear facility is a process involving activities such as radiological characterization, decontamination, dismantling and waste materials handling. Planning and execution of decommissioning projects involves factors such as developing work schedules, identifying resource needs, interfacing with regulators, handling public relations and can take several years to complete. The importance of developing and implementing decommissioning plans is growing as more nuclear facilities in Member States cease operation or approach the end of their operational life.

---

[34] The publication is available at: http://www-pub.iaea.org/MTCD/publications/PDF/Pub1570_web.pdf.

[35] The publication is available at: http://www-pub.iaea.org/MTCD/publications/PDF/Pub1586web-99435183.pdf.

Activities

39. In May 2015, the Agency held the fifth Review Meeting of the Contracting Parties to the Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management. The discussions identified some overarching issues and focused on the safety implications of very long storage periods and delayed disposal of spent fuel and radioactive waste as well as international cooperation in finding solutions for the long-term management and disposal of different types of radioactive waste and/or spent fuel. The Contracting Parties decided on a number of actions to, inter alia, encourage adherence to the Joint Convention, improve active participation in the peer review process, and increase the effectiveness of the review process for Contracting Parties without a nuclear power programme. A Topical Session on lessons learned from the Fukushima Daiichi Accident was also organised during the review meeting.

40. With a view to addressing the ongoing needs and anticipated demands by Member States for international peer reviews on the safe management of all types of radioactive waste, the Agency has established draft guidelines for the Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS). These guidelines will be further developed and finalized based on feedback gained during the first review—anticipated for the first half of 2016.

41. In January 2015, the Agency launched a new International Project on Managing the Decommissioning and Remediation of Damaged Nuclear Facilities (DAROD) as part of the IAEA Action Plan on Nuclear Safety, which was adopted following the Fukushima Daiichi accident. The aim of the project is to establish a forum for discussions and exchange of experiences on several key aspects of decommissioning of damaged facilities, such as: regulatory, technical and strategic planning aspects of post-accident decommissioning.

Future Challenges

42. The Agency expects the demand for international ARTEMIS peer reviews from Member States to increase in the near future as a result of the European Union Council Directive 2011/70/EURATOM of 19 July 2011.The Agency will work with Member States to ensure the availability of sufficient internationally recognized experts to support these activities.

43. In the next few years many legacy facilities, some of which are damaged or contaminated, will enter the decommissioning stage. This will involve planning of complex activities based on incomplete characterization data, using innovative technological solutions, and managing larger volumes of non-standard categories of radioactive waste. International meetings since the Fukushima Daiichi accident, such as the International Experts' Meeting on Decommissioning and Remediation after a Nuclear Accident, held in Vienna, Austria, in January 2013, pointed out that there is a general lack of experience with decommissioning such facilities, from both the operator and the regulator points of view. Member States will need to build capacities to handle the strategic planning, regulatory, technical and other challenges that will arise when decommissioning legacy and damaged nuclear facilities.

A.5. Remediation and Protection of the Environment

Trends

44. In the past decade, there has been a growing recognition of the need to remediate uranium legacy sites (ULS) as noted during the 2009 International Conference on Remediation of land

Contaminated by Radioactive Material Residues held in Astana, Kazakhstan.[36] Bringing such sites under regulatory control and providing for their remediation is a particular challenge for countries that do not have established regulatory infrastructures.

Activities

45. The Agency's programme on decommissioning and remediation safety continues to provide assistance in response to the growing needs for remediation of ULSs. In 2015, the Agency developed two new comprehensive training packages with regard to ULSs: one to enhance knowledge for application of short-term actions to mitigate hazards at ULSs — 29 participants from 11 countries were trained; and the second to provide regulators with knowledge and tools to review remediation plans for ULSs — 44 participants from 18 countries.

Future Challenges

46. Effective remediation of ULSs will involve: identifying and prioritizing sites for remediation; securing funding for remediation activities; and ensuring the sustainability of remediated sites by providing for their long-term care and maintenance. It will also be important to ensure that lessons learned from the management of ULSs have been disseminated to those responsible for operating or developing new uranium production sites.

A.6. Building Capacity in Radiation, Waste and Transport Safety

Trends

47. In 2015, Member States continued to give high priority to the adoption of sustainable approaches to build competencies in radiation, transport and waste safety. Member States continued their work toward establishing national policies and strategies for education and training (E&T) for these competency areas in line with the Agency's Strategic Approach to Education and Training in Nuclear Safety 2013–2020[37]. Figure 1 provides an overview of the actions taken by Member States to develop E&T policies, including steps taken to establish their national strategies[38].

---

[36] The conference website is available at: http://www-pub.iaea.org/mtcd/meetings/Announcements.asp?ConfID=35422.

[37] INTERNATIONAL ATOMIC ENERGY AGENCY, Strategic Approach to Education and Training in Nuclear Safety 2013–2020, Note by the Secretariat 2013/Note 9, IAEA, Vienna (2013). Available at: http://www-ns.iaea.org/downloads/ni/training/strategy2013-2020.pdf.

[38] INTERNATIONAL ATOMIC ENERGY AGENCY, Building Competence in Radiation Protection and the Safe Use of Radiation Sources, IAEA Safety Standards Series No. RS-G-1.4, IAEA, Vienna (2001).

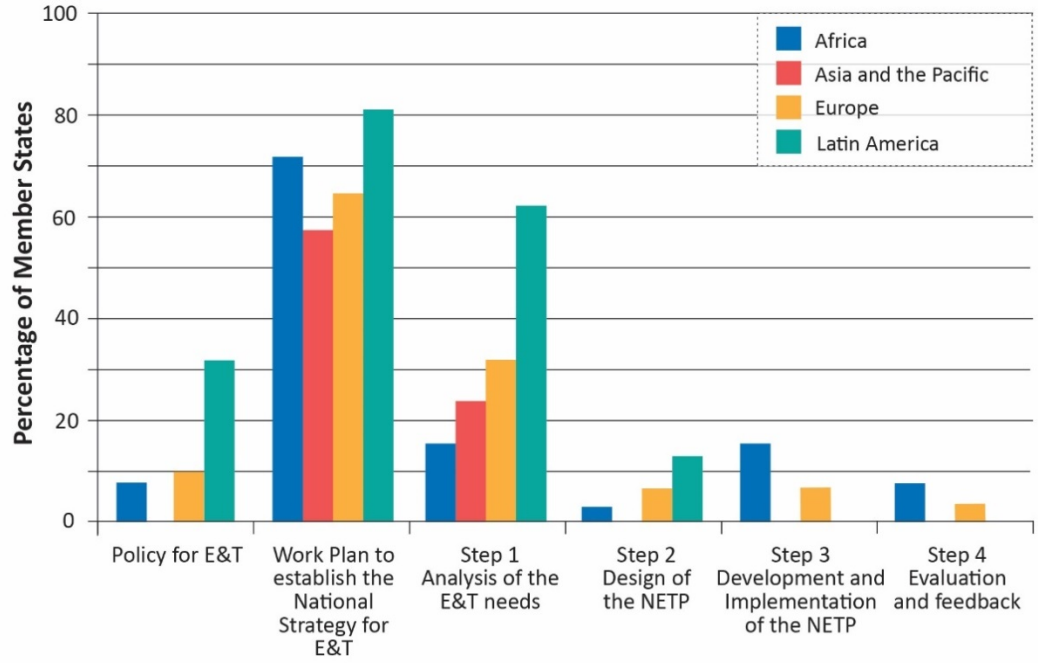


FIG. 1. Percentage of Member States in each region that completed the steps to establish a national strategy for education and training in radiation, transport and waste safety for their national education and training programme.

48. Preliminary analysis of E&T needs indicate the need for more competent people in the areas of radiation, transport and waste safety, with particular emphasis being placed on medical personnel and those with direct responsibilities in radiation protection and safety (e.g. radiation protection officers).

49. Throughout 2015 there continued to be high demand for training. Approximately 40 major training events were arranged in different areas of radiation, transport and waste safety, and some 70 requests for fellowships were received to enable attendance at courses aimed at training competent radiation protection officers and qualified experts.

50. Increasingly, Member States have recognized the importance of receiving Agency assistance in establishing and strengthening their national legal and regulatory framework for Education and Training in Radiation (Figure 2), Transport and Waste Safety (Thematic Safety Area (TSA) 6). In 2015, 55 Member States have assessed and reported on the status of their national infrastructure in this area as reported by Member States in Radiation Protection Information Management System (RASIMS)[39].

[39] For information on this database see: https://rasims.iaea.org/.

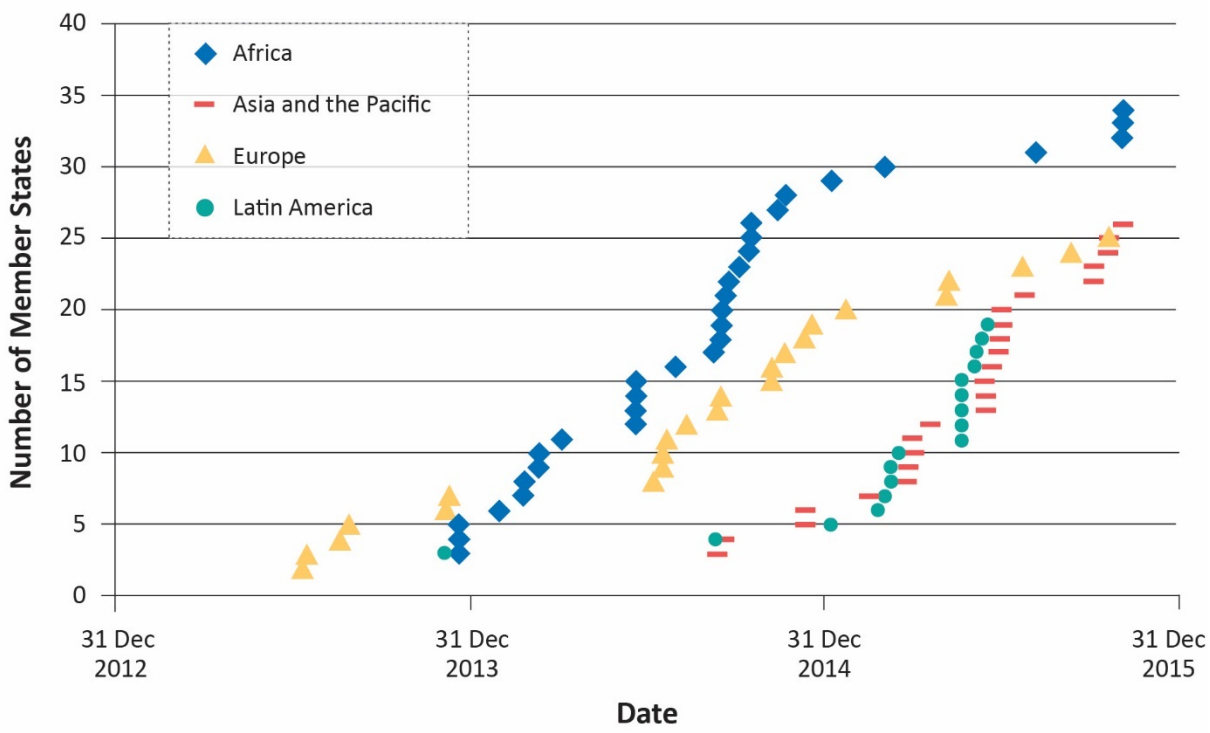


FIG. 2. Number of profiles for TSA 6 (Education and Training in Radiological Protection) in RASIMS that have been updated in the past four years by Member States.

Activities

51. In 2015, seven separate regional postgraduate educational courses in Radiation Protection and the Safety of Radiation Sources (PGEC) were held in Member States (Algeria, Argentina, Greece, Malaysia, and Morocco; two separate courses were held in Ghana) in the language of their choice, providing training to 138 participants. The course is hosted at the Agency's regional training centres for radiation protection and runs for approximately five months.

52. The need to build competencies for personnel with responsibilities in radiation protection and safety within facilities was addressed in 2015 via regional train the trainers courses for radiation protection officers; 76 attendees from Morocco and Namibia, Portugal and the United Arab Emirates participated in these events.

53. In December 2015, the Agency hosted an international consultative meeting at headquarters in Vienna, Austria, for policymakers and decision-makers on the establishment of a national strategy for E&T in radiation, transport and waste safety to raise awareness on the need to address sustainability when building competencies in radiation protection and safety. In addition, this meeting aimed at gaining experience from those Member States that had already taken significant initiatives and made outstanding achievements in developing and establishing their national strategies. More than 50 participants, mainly heads of regulatory bodies and officials at ministerial levels, attended the meeting.

54. The Agency conducted three Education and Training Appraisal (EduTA) missions in 2015 in Greece, Israel and Lithuania. The missions were aimed at carrying out a detailed appraisal of the status of the provisions for E&T in radiation protection and safety, identifying areas in E&T where the provisions should be improved to meet the Agency's safety standards, national E&T needs, and best practices. These missions provided key staff in the host Member State with an opportunity to discuss the legislative framework and the national policy and strategy in the field.

Future Challenges

55. Commitment of Member States towards the development of a policy and the establishment of a national strategy for E&T in radiation, transport and waste safety is key to ensuring that national training needs are addressed by optimizing national human resources and the Agency's support.

A.7. Regulatory Effectiveness of Radiation, Transport and Waste Safety

Trends

56. As reported in the *Nuclear Safety Review 2015,* some Member States have made good progress in establishing or strengthening their regulatory effectiveness in radiation, transport and waste safety, many other Member States are facing challenges in building their infrastructures.[40] The Agency collects and analyses information from Member States that receive technical assistance in order to help identify needs and to better plan future support for their national radiation safety infrastructure[41]. As shown in Figure 3, more than 75% of those Member States benefiting from technical assistance of the Agency still need additional support to have a national regulatory infrastructure that is consistent with the Agency's safety standards. Generally, Member States that have been receiving Agency assistance over longer periods have made better progress and new Member States and those Member States with very little to no radiation safety regulatory infrastructure need higher levels of assistance.

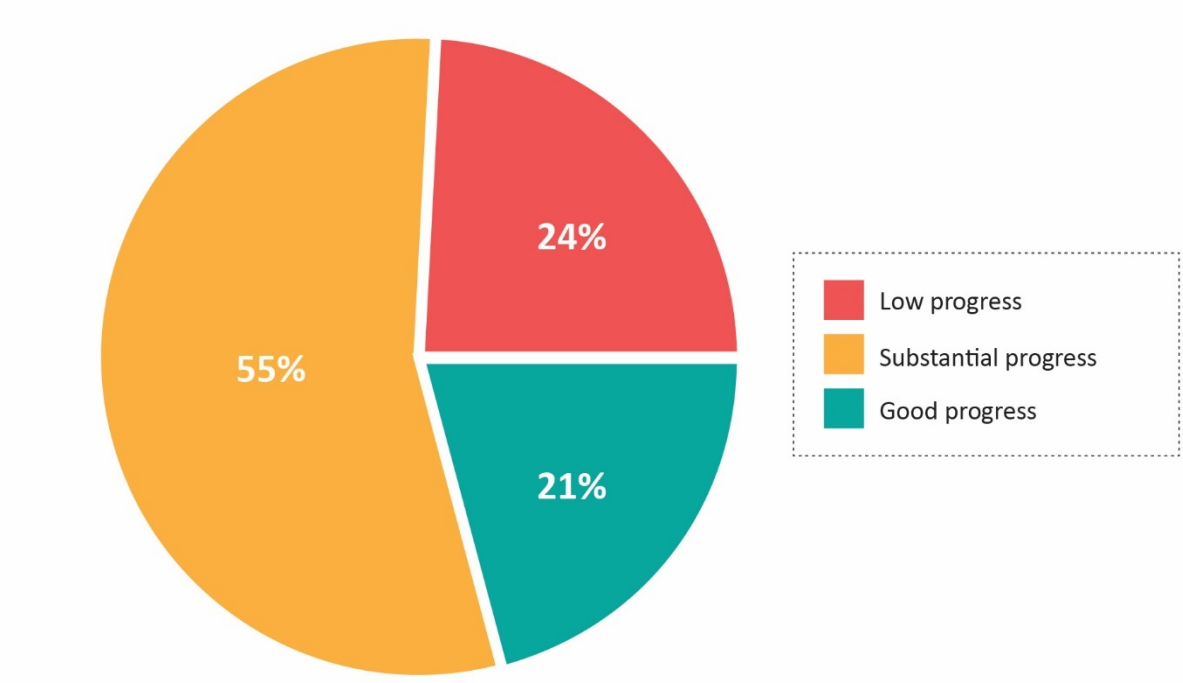


FIG. 3. Status of progress made in establishing a national radiation safety regulatory infrastructure in Member States receiving Agency assistance, data from November 2015.

57. In keeping with the findings reported in the *Nuclear Safety Review 2015,* data continue to indicate that the reasons for slow progress include: difficulties due to institutional instability; general infrastructural weaknesses; additional support needed at the decision-making level; changes in

[40] This publication is available at: https://www.iaea.org/About/Policy/GC/GC59/GC59InfDocuments/English/gc59inf-4_en.pdf.

[41] See the Radiation Safety Information Management System (RASIMS) website: https://rasims.iaea.org.

national programme priorities; and insufficient human and financial resources for the regulatory body. The data also indicate the important role played by Governments in ensuring that all individuals within the regulatory body, as well as other individuals with responsibilities for the safety of facilities and activities, receive the necessary professional training for building and maintaining the appropriate competencies.[42] The data reviewed during this analysis indicate that there is a need to ensure that governments have a clear understanding of these roles and are committed to fulfilling them.

58. Over the past few years, the number of requests for Integrated Regulatory Review Service (IRRS) missions by Member States without nuclear power programmes has increased: from one conducted in 2013 to six conducted in 2015, with an additional ten missions that have been requested for 2016.

Activities

59. In 2015, the Agency organized advisory missions in Bosnia and Herzegovina, the Lao People's Democratic Republic, Papua New Guinea and Uruguay to assess and provide expert guidance on strengthening national regulatory infrastructures for radiation safety and the control of radiation sources. The Agency also developed a web-based Radiation Safety Advisory Mission Tool (RASAMT) to facilitate the preparation and implementation of these advisory missions by all parties involved, including the host country's regulatory body, Agency staff, and external experts. Internal guidelines for conducting these missions were revised in 2015 and will be tested during missions.

60. During 2015, IRRS missions to review the status of the national regulatory infrastructure for radiation, transport and waste safety in Member States without operating nuclear power plants were conducted in Croatia, Indonesia, Ireland, Malta, the United Arab Emirates (follow-up) and the United Republic of Tanzania. Preparatory work for upcoming missions began for Belarus, Botswana, Chile, Estonia, Ethiopia, Guatemala, Kenya, Lithuania and Malaysia.

61. IRRS experts also reviewed the effectiveness of the regulatory infrastructure for radiation, transport and waste safety in IRRS missions conducted at the invitation of the following Member States that have nuclear power programmes: Armenia, Finland, Hungary, Slovakia and Switzerland (follow-up missions).

62. The Agency conducted a course for radiation safety reviewers in IRRS missions for 40 experts at the US Nuclear Regulatory Commission to extend the pool of experts needed for the IRRS programme. In addition, the Agency organized two international workshops for radiation safety reviewers in Vienna, Austria, attended by more than 80 staff of regulatory bodies in all regions.

63. The Agency is revising and streamlining the question sets of the Self-Assessment of Regulatory Infrastructure for Safety (SARIS) methodology and tools to increase the effectiveness and efficiency of the self-assessment process. The Agency developed a new variant of the tool to assess the level of compliance of national regulations with GSR Part 3. The Agency conducted several national and regional workshops on self-assessment in 2015[43].

64. In 2015, two Schools for Drafting Regulations on Radiation Safety were organized by the Agency for Member States in Europe and in the Asia and the Pacific region, in which 20 regulatory

---

[42] Information presented to Member States at workshops on lessons learned as gathered from over 50 IRRS mission reports. See presentation at: https://gnssn.iaea.org/NSNI/Shared%20Documents/OPEN%20Shared%20Files/IRRS%20Lessons%20Learned%20Workshop%202014%20Documents/Moscow%20001%20-%20IRRS%20Missions%202006-2013%20-%20Overview%20from%20Radiation%20Safety%20Perspective.pptx.

[43] See: http://www-ns.iaea.org/tech-areas/regulatory-infrastructure/sat-tool.asp.

staff from 18 Member States participated. Additionally, the Agency is developing a new training course on management systems for radiation safety regulatory bodies to address a common shortcoming identified in IRRS missions; it will be offered to Member States as of 2016. The Control of Sources Network platform was used for the preparation and implementation of these activities.[44]

65. The Agency implemented the Regulatory Infrastructure Development Project to strengthen national regulatory infrastructure for the safe use of radiation sources in States in North Africa and the Middle East (Afghanistan, Algeria, Egypt, Iraq, Jordan, Libya, Mauritania, Oman, Tunisia and Yemen) through several activities conducted throughout 2015. These activities included national workshops and group training courses for regulatory staff on the system of authorization and inspection of radiation sources in medical and industrial practices, storage of disused sources, transport and import and export of radioactive sources.

66. To further promote the integration of radiation safety infrastructure into national cancer control programmes, the Agency continued to address radiation safety infrastructure through the imPACT Review[45] missions conducted in Algeria, El Salvador and Myanmar.

67. Based on feedback from users, the Agency has developed technical specifications for the next version of the Regulatory Authority Information System (RAIS). The RAIS assists Member State regulators to maintain their national registers of radiation sources and manage the information related to their regulatory functions[46]. The Agency continued to support Member States in the system's use by carrying out expert missions and providing equipment in Algeria, Chad, Colombia, Cuba, Egypt, Jordan, Latvia, Oman and the United Republic of Tanzania to enable use of the latest released version (RAIS Web 3.3).

68. The Agency has developed a safety guide on establishing a national radiation safety infrastructure (DS455); it is expected to be published in 2016. This safety guide will provide advice for Member States to assess the level of their national radiation safety infrastructure in line with the Agency's safety standards, and to enable them to effectively implement a set of actions to fully meet safety requirements progressively in an integrated manner, while taking full account of their specific national circumstances. Additionally, two safety guides are being developed — DS472 on the organization, management and staffing of a regulatory body, and DS473 on the functions and processes of regulatory bodies. These safety guides will help Member State regulatory bodies to implement the requirements of *Governmental, Legal and Regulatory Framework for Safety* (IAEA Safety Standards Series No. GSR Part 1[47]) in an effective manner, considering the extent of the national applications of radiation sources. These new safety standards are expected to be published in 2017.

Future Challenges

69. The growing use and diversity of radiation technologies (especially in medicine) and the associated increase in the transport of radioactive materials continue to create demands for strengthening national regulatory infrastructures for radiation safety.

---

[44] See: https://gnssn.iaea.org/CSN/default.aspx.

[45] The imPACT Review missions, where imPACT stands for 'integrated missions of PACT', are conducted through the Agency's Programme of Action for Cancer Therapy (PACT).

[46] See: http://www-ns.iaea.org/tech-areas/regulatory-infrastructure/rais.asp.

[47] The publication is available at: http://www-pub.iaea.org/MTCD/publications/PDF/Pub1465_web.pdf.

70. With the increasing demand for IRRS missions in the near future, coupled with the increasing number of Member States developing national cancer control programmes, the Agency will face challenges in mobilizing additional resources at the required levels to meet this demand.

B. Strengthening Safety in Nuclear Installations

B.1. Nuclear Power Plant Safety

B.1.1. Operational Safety

B.1.1.1 Operational Safety Review

Trends

71. The Operational Safety Review Team (OSART) missions have continued to identify safety improvements carried out at nuclear power plants (NPPs) in response to the Fukushima Daiichi accident but additional work remains necessary to re-evaluate the scope and validity of severe accident management programmes. OSART mission results also indicate that plant emergency preparedness and response plans need to be further enhanced and the scopes of drills and exercises reassessed.

72. OSART missions have revealed a need to improve the management of low level events and near misses, and the use of operational experience from international events. Weaknesses in reporting, screening, trending and analysis of problems persist, giving rise to the possibility of repeating mistakes. OSART missions continue to identify the need for a more proactive management approach to support continuous safety improvements and for sites to further improve their fire protection and control of combustible materials.

73. OSART missions have identified good practices in operational safety that can benefit other NPP operators. These include: effective processes to promote safety culture amongst NPP contractors; substantial design modifications to address design extension conditions; and effective corporate support of operating plants.

Activities

74. *The OSART guidelines: 2005 Edition* (IAEA Services Series No.12)[48] were revised to take into consideration the lessons learned from the Fukushima Daiichi accident and experience gained with the application of the Agency's safety standards. Detailed question banks were developed for OSART reviewers in all review areas.

75. The Agency conducted six OSART missions, three follow-up OSART missions and seven preparatory meetings for OSART missions in 2015. The Member States that hosted these activities were Canada, China, the Czech Republic, France, Japan, Pakistan, the Russian Federation, the United Kingdom, and the United States of America. During the review missions, the draft revised OSART guidelines were used and emphasis was placed on the review of conduct of operations, improvements implemented after the Fukushima Daiichi accident, leadership and management for safety, severe accident management, emergency preparedness and response, and safety culture.

---

[48]The publication is available at: http://www-ns.iaea.org/downloads/ni/s-reviews/osart/OSART%20GLN.pdf.

76. The Agency held an International Conference on Operational Safety, from 23 to 26 June 2015 in Vienna, Austria, to seek further opportunities for the improvement of operational safety worldwide. The conference, attended by 180 participants, identified challenges and actions in the following areas: Agency safety standards and OSART missions, corporate management of safety, leadership and safety culture, operational experience and long-term operation.

Future Challenges

77. Several countries are still to complete their commitment under the IAEA Action Plan on Nuclear Safety to host an OSART mission and some regulators have not yet taken the opportunity to benefit from having an international operational safety assessment for the NPPs they regulate.

78. OSART missions and World Association of Nuclear Operators (WANO) peer reviews are complementary and recognized as important tools for operational safety improvements and the exchange of operational experience at the international level. The Agency will continue to improve the coordination of its activities with WANO to ensure effective and efficient international peer review of operational safety.

B.1.1.2. Leadership and Management for Safety

Trends

79. One of the lessons learned in the Director General's report on the Fukushima Daiichi accident was that individuals and organizations need to continuously challenge or re-examine the prevailing assumptions about nuclear safety and the implications of decisions and actions that could affect nuclear safety. OSART missions have identified the need for senior managers at nuclear installations to take account of the complex interactions between people, organizations and technology to promote safe behaviours and the safe conduct of operations.

80. Many Member States have requested support in understanding how they can develop their leadership for safety, assess their safety culture, and implement a continuous improvement programme. Embarking countries, in particular, have requested assistance from the Agency in this area, and were actively engaged in taking part in Agency meetings on leadership and safety culture during 2015.

Activities

81. The Secretariat is currently revising the Agency's Safety Requirements and guidance associated with leadership, management and safety culture, and working towards publication of the updated version of *The Management System for Facilities and Activities* (IAEA Safety Standards Series No. GS-R-3[49]). By November 2015, the revised document had been approved by all safety standards committees for submission to the Commission on Safety Standards.

82. In September 2015, the Agency sponsored the fourth annual IAEA Workshop for Senior Managers on Leadership and Safety culture, in France. It provided an international forum for 23 senior managers from 16 Member States to share experience and learn more about how safety culture and leadership can be continuously improved. In addition, tailored senior management workshops on safety leadership and safety culture were held in several Member States' organizations, including in Armenia, Belgium, Brazil, Canada, Chile, Egypt, France, the Islamic Republic of Iran, Mexico, Romania, Spain, Sweden, Thailand, Viet Nam, the United Kingdom and the USA.

---

[49] The publication is available at: http://www-pub.iaea.org/MTCD/publications/PDF/Pub1252_web.pdf.

83. The Agency continues to work towards the international harmonization of approaches in leadership, management and safety culture to assist Member States with the application of safety standards and the use of assessment methods. Further work on the assessment of human, technological and organizational interfaces was carried out with a view to enhancing the OSART service.

Future Challenges

84. The need to take a systemic approach to safety — analysing and working with the safety outcomes of the interactions among human, technical and organizational factors — has proved challenging to implement. To respond to this challenge, the Agency is developing a dedicated training workshop on the practical implementation of the systemic approach to safety.

85. The Ibero-American Forum of Radiological and Nuclear Regulatory Agencies (FORO) concluded a three-year joint project with the Agency to develop guidelines for safety culture in practices involving activities with sources of ionizing radiation. The FORO regulators are drafting a report on this project for publication in 2016, which includes practical tools for safety culture assessment and impact analysis of safety culture on radiological accidents.

86. Member States are recognizing the importance of NPP operational safety self-assessment and the need for continuous safety improvement. There is an ongoing need for operational self-assessment and the establishment of strong leadership for safety.

B.1.1.3. Operating Experience

Trends

87. Preventing the recurrence of safety significant events in NPPs is one of the most efficient ways to improve operational safety performance. Roughly half of the recurring safety significant events that were analysed could have been prevented or consequences better mitigated if operating experience had been efficiently evaluated and corrective actions implemented in a timely manner.[50]

88. The results of the OSART missions indicate that analysis of events did not always result in identification of the actual root causes. In these cases, the appropriate corrective actions were not completed in a timely and comprehensive manner allowing the repetition of events. OSART Missions have identified that in some Member States there is a need to improve self-assessment programmes and the performance of corrective action programmes.

89. The Joint IAEA–OECD/NEA (Nuclear Energy Agency) International Reporting System for Operating Experience (IRS) is a powerful tool to exchange information on events at NPPs and increase awareness of actual and potential safety problems. The IRS indicated deficiencies with the use of operating experience, vulnerabilities in the design or operating practices during some external hazard situations, and continuing challenges with plant modifications. The data also indicate that inadequate contractor surveillance continues to be a relatively common issue and that incidents related to component degradation due to ageing have become more common over the past few years.

Activities

90. In October 2015, a Technical Meeting of IRS coordinators was held in Paris, France, to exchange experiences on the most significant events in NPPs, with 52 participants from 28 Member States attending. Also, in October 2015, a joint IAEA and WANO meeting was held in Vienna, Austria, to discuss how to improve the effectiveness of operating experience programmes and to

[50] International Reporting System for Operating Experience (IRS).

compare how different Member States deal with the lessons learned from other utilities. The meeting was attended by 15 participants from 12 Member States. In addition, a regional workshop on the management of low level events and near misses was held from 29 June until 3 July 2015 in Vienna, Austria, with 35 participants from nine Member States. A new Technical Document entitled *Root Cause Analysis Following an Event at a Nuclear Installation: Reference Manual* (IAEA-TECDOC-1756[51]) was published in January 2015. In September 2015, a Regional Workshop on Root Cause Analysis for Nuclear Power Plants with 35 participants from nine Member States was held in Hungary.

91. A regional workshop in Slovakia on effective solutions for human performance improvement was held in May 2015 with 35 participants from eight Member States.

Future Challenges

92. OSART mission reports and lessons learned from events reported in the IRS highlight weaknesses in overall continuous performance improvement (operating experience management, self-assessment, observation and coaching, etc.). Further efforts are needed to ensure the effective evaluation of operating experience and the completion of effective and comprehensive event root cause analysis.

93. In some Member States, challenges still exist in the management of operating experience. Weaknesses in reporting, screening, trending and analysis of events and near misses at their own plants and international events persist.

94. The sharing and use of operating experience in Member States continues to be a challenge. Despite the fact that the number of event reports shared though the IRS has increased (from a historical average of 80 per year to 99 in 2015), some of the events entered in 2015 occurred several years ago and some significant events have not been entered yet. Furthermore, there are no effective mechanisms to review and share the experience on implementing feedback based on the lessons learned from the events reported in the IRS.

B.1.1.4 Long Term Operation

Trends

95. An increasing number of nuclear power reactors around the world require implementation of long-term operation (LTO) and ageing management programmes that cover policies, processes and procedures to ensure the required safety functions throughout the service life of the nuclear power reactor. At the end of 2015, 41% of the 441 nuclear power reactors operating in the world had been in operation for 30 to 40 years, and another 15% for more than 40 years (see Figure 4).

[51] The publication is available at: http://www-pub.iaea.org/MTCD/Publications/PDF/TE-1756_web.pdf.

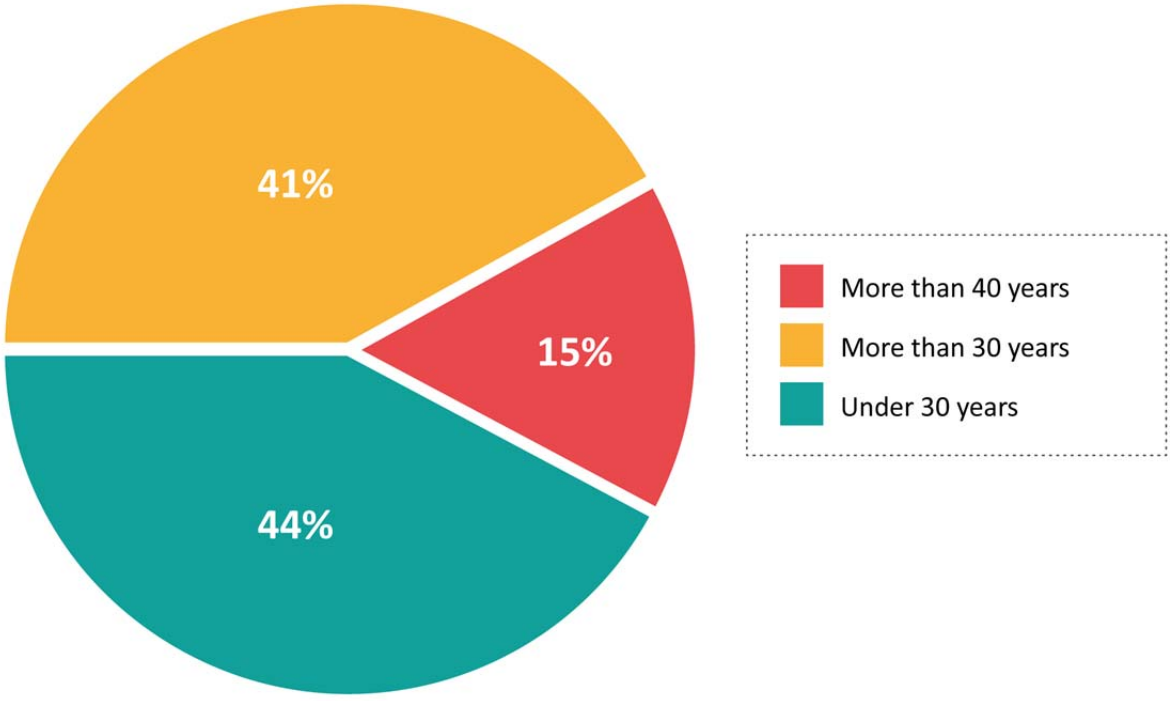


FIG. 4. Age distribution for all power reactors in 2015.

96. In 2015, the Agency noted an increase in requests for the Safety Aspects of Long Term Operation (SALTO) peer review service.

Activities

97. The draft of a new safety guide on ageing management and development of an LTO programme for NPPs, to replace *Ageing Management for Nuclear Power Plants* (IAEA Safety Standards Series No. NS-G-2.12) was prepared and approved by the Nuclear Safety Standards Committee and the Waste Safety Standards Committee. The objective of this revision is: to provide guidance to implement the requirements related to ageing management and LTO contained in the Safety Requirements publications *Safety of Nuclear Power Plants: Design* (IAEA Safety Standards Series No. SSR-2/1) and *Safety of Nuclear Power Plants: Commissioning and Operation* (IAEA Safety Standards Series No. SSR-2/2); to assure consistency and harmonize the document with all updated Agency safety standards and Safety Reports Series publications in the area of ageing management and LTO; and to update the content of some sections of the current safety guide.

98. In 2015, the Agency conducted four SALTO missions to Belgium (Tihange 1 NPP), China (Qinshan 1 NPP), Mexico (Laguna Verde NPP) and South Africa (Koeberg NPP). A large amount of experience was collected and, upon request of some Member States, the Agency has analysed the experience gained from SALTO missions for discussion during a Technical Meeting in June 2016.

99. The Agency conducted SALTO workshops/seminars and LTO/ageing management workshops and expert missions in eight Member States (Argentina, Armenia, Brazil, Bulgaria, China, Mexico, the Russian Federation and South Africa) in preparation for SALTO missions.[52] The second phase of the International Generic Ageing Lessons Learned (IGALL) programme was successfully completed

[52] Six SALTO missions to Argentina (Atucha 1 NPP), Armenia (Armenian 2 NPP), Bulgaria (Kozloduy 5&6 NPP), China (Qinshan 1 NPP), and Sweden (Forsmark 1 and Oskarshamn 1 NPPs), three follow-up missions to Belgium (Tihange 1 NPP), the Czech Republic (Dukovany NPP) and Sweden (Ringhals NPP) and one expert mission based on the SALTO guidelines to Belgium (Doel 1&2 NPP) were confirmed for 2016.

in 2015. Four working groups[53] developed eight new ageing management programmes, one time limited analysis and a technological obsolescence programme, and updated many original ageing management programmes, and time limited analyses and ageing management review tables. In 2015, the Agency's IGALL programme published *Ageing Management for Nuclear Power Plants: International Generic Ageing Lessons Learned (IGALL)* (Safety Reports Series No. 82), which is complemented by the IGALL knowledge base on the Agency's website.

Future Challenges

100. The Agency has identified a number of areas where further efforts are necessary for long term operation, e.g. the need to improve some national policies, processes and procedures that determine the required safety functions throughout the service life of an NPP; the need for peer reviews that could help identify safety issues during the LTO period; and the need to develop arrangements for regulation of LTO preparations.

B.1.2. Severe Accident Prevention and Mitigation

Trends

101. The Vienna Declaration on Nuclear Safety, CNS/DC/2015/2/Rev.1 of 9 February 2015, adopted principles to guide the Contracting Parties in the implementation of the CNS objective to prevent accidents with radiological consequences and mitigate such consequences should they occur. Specifically, new NPPs should be designed, sited, and constructed consistent with the objective of avoiding early radioactive releases or radioactive releases large enough to require long-term protective measures and actions, and for existing NPPs, comprehensive safety assessments are to be carried out to identify reasonably practicable or achievable safety improvements to meet the overall objective.

102. The principles of the Vienna Declaration on Nuclear Safety are clearly reflected in the corresponding IAEA Safety Standards however, some Member States with NPPs in operation and particularly those planning for new build may need further guidance on its implementation.

103. Further, OSART missions have identified that even though several safety improvements have been carried out at NPPs since the Fukushima Daiichi accident; additional improvements are still required to re-evaluate the scope and validation of severe accident management programmes. OSART mission results also indicate that the robustness of plant emergency preparedness and response plans needs to be further enhanced and the scopes of drills and exercises reassessed.

Activities

104. In March 2015, the Board of Governors approved the revision of the Agency's Safety Requirements to take into account the lessons learned from the Fukushima Daiichi accident, including the IAEA Specific Safety Requirements Publication *Safety of Nuclear Power Plants: Design* (IAEA Safety Standards Series No. SSR-2/1[54]) and the General Safety Requirements publication *Safety Assessment for Facilities and Activities* (IAEA Safety Standards Series No. GSR Part 4[55]). A draft TECDOC provisionally titled: *Considerations for the Application of the IAEA Safety requirements for the Design of Nuclear Power Plants,* was finalized in 2015 after intensive

[53] The working groups: CANDU mechanical components, WWER mechanical components, electrical and instrumentation and control (I&C) components, and technological obsolescence were established in 2013.

[54] The publication is available at: http://www-pub.iaea.org/MTCD/publications/PDF/Pub1534_web.pdf.

[55] The publication is available at: http://www-pub.iaea.org/MTCD/publications/PDF/Pub1375_web.pdf.

consultation and discussion with Member States. This TECDOC considers approaches and practices in Member States in relation to some complex topics such as design extension conditions and the practical elimination of large or early radioactive releases for new plants.

105. In 2015, the Agency revised a number of safety standards closely related to the prevention and mitigation of severe accidents, including *Severe Accident Management Programmes for Nuclear Power Plants* (IAEA Safety Standards Series No. NS-G-2.15[56]), which has been submitted to Member States for comments, *Design of the Reactor Coolant System and Associated Systems in Nuclear Power Plants* (IAEA Safety Standards Series No. NS-G-1.9[57]), and *Design of Reactor Containment Systems for Nuclear Power Plants* (IAEA Safety Standards Series No. NS-G-1.10[58]). The latter two safety guides specifically address recommendations for the design of NPPs to prevent and mitigate severe accidents. The Agency also revised *Deterministic Safety Analysis for Nuclear Power Plants* (IAEA Safety Standards Series No. SSG-2[59]), which addresses the demonstration of adequate safety provisions for the prevention and mitigation of severe accidents.

106. The President of the 7th Review Meeting of the Convention on Nuclear Safety (CNS) issued a letter to the Contracting Parties reminding them to address the Vienna Declaration in the country reports for the next CNS Review Meeting in 2017.

107. The Contracting Parties of the CNS will further discuss the implementation of the Vienna Declaration during the 7th CNS Review Meeting scheduled to take place in March 2017. The Contracting Parties will identify national and international best practices or approaches and potential areas for improvement.

108. The Agency held two meetings in 2015 related to severe accidents. The first was a Technical Meeting on the design and construction of containment structures and systems for new NPPs attended by 30 participants from 15 Member States, and the second was a Technical Meeting on severe accident analysis and management attended by 65 participants from 12 Member States.

109. A technical safety review mission for the plant design safety documentation (Preliminary Safety Analysis Report) for an NPP is planned for 2016 to assist Hungary in its technical evaluations and in enhancing nuclear safety based on the Agency's safety standards.

Future Challenges

110. The demonstration of compliance with the updated IAEA design safety and safety assessment requirements, in particular regarding the new design principles with respect to design extension conditions, practical elimination of certain plant conditions and strengthening of defence-in-depth continues to be a challenge for Member States particularly planning for new build. Existing nuclear power plants reassessments requested to investigate how the overall objective can be met, are predominantly challenging due to the earlier construction basis.

111. In efforts to move on with the implications of the new design safety principles adopted in the Vienna Declaration, it is crucial to continue a constructive and open discussion among the different stakeholders and with the Agency, to be able to make progress and to identify the current technology approaches and best practices to be integrated in the IAEA safety standards.

---

[56] The publication is available at: http://www-pub.iaea.org/MTCD/publications/PDF/Pub1376_web.pdf.

[57] The publication is available at: http://www-pub.iaea.org/MTCD/publications/PDF/Pub1187_web.pdf.

[58] The publication is available at: http://www-pub.iaea.org/MTCD/publications/PDF/Pub1189_web.pdf.

[59] The publication is available at: http://www-pub.iaea.org/MTCD/publications/PDF/Pub1428_web.pdf.

112. Additionally, to increase Member States' interest in requesting further technical safety review services to benefit from support for an adequate implementation of the available IAEA safety standards remains a challenge.

B.1.3. Site and Design Safety

Trends

113. There is an increased interest, expressed by several Member States in addressing lessons learned from the Fukushima Daiichi accident related to: (a) consideration of uncertainties associated with the evaluation of extreme hazards, (b) the need for using both available historical and prehistoric data in the evaluation of external hazards, (c) consideration of external hazard combinations, (d) consideration of external hazards potential impact to multi-unit sites, (e) and the use of a probabilistic approach in the analysis of external events.

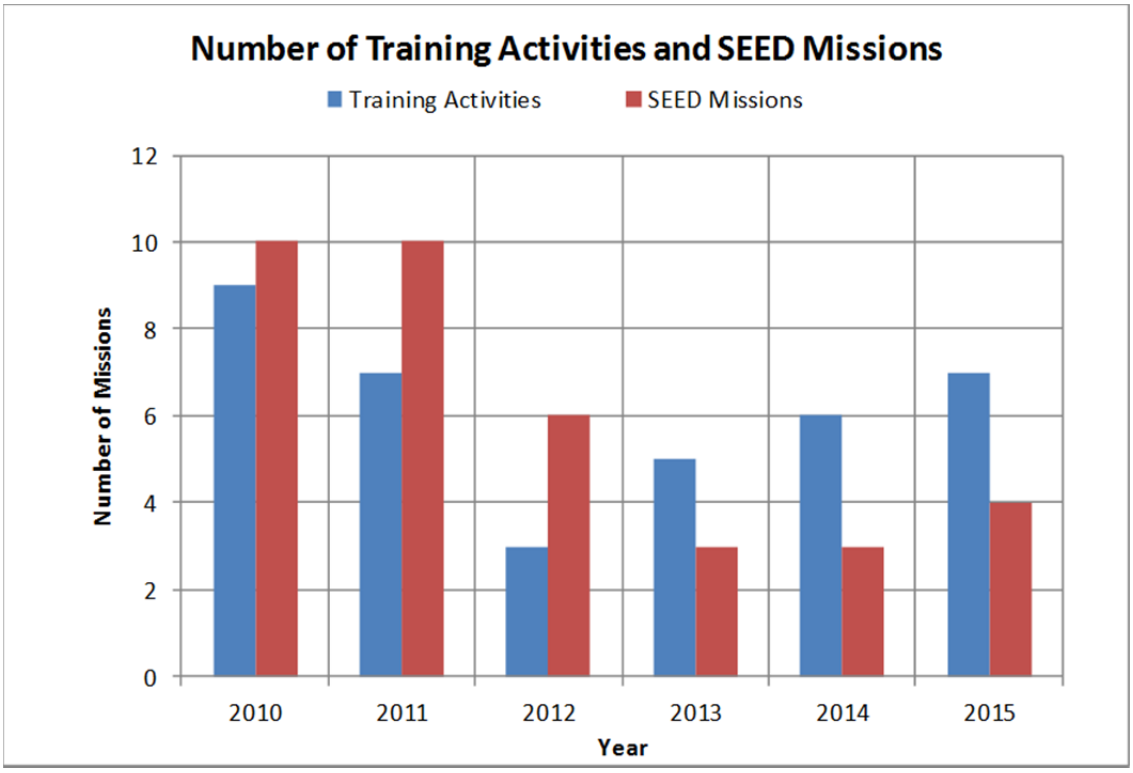


FIG. 5. Trends in SEED Missions and training over a five-year period.

114. The Agency provides the Site and External Events Design (SEED) review service to assist Member States throughout the different stages of site selection, site evaluation, design and safety assessment of structures, systems and components (SSCs) in the context of site-specific external hazards. The number of SEED review missions requested by the Member States is increasing but is still below Agency expectations (see FIG. 5). The number of capacity building and training workshops is also increasing. However, it is not consistent with the number of Member States currently embarking on nuclear power programmes and that have already started siting and site evaluation activities.

115. Despite the Agency's efforts in supporting embarking countries to develop modern regulations, a number of Member States initiated siting, site evaluation activities without having adequate regulatory requirements in place, and are now facing difficulties during site selection and site evaluation processes and during the review and licensing process.

Activities

116. The Agency continues to provide updated safety standards and detailed Technical Documents supporting the enhancement of site safety. A Technical Document entitled The Contribution of Palaeoseismology to Seismic Hazard Assessment in Site Evaluation for Nuclear Installation (IAEA-TECDOC-1767[60]) was published in June 2015. The safety guide Site Survey and Site Selection for Nuclear Installations (IAEA Safety Standards Series No. SSG-35[61]) was published in July 2015, the Safety Report Ground Motion Simulation Based on Fault Rupture Modelling for Seismic Hazard Assessment in Site Evaluation for Nuclear Installations was published in November 2015 (IAEA Safety Report Series No. 85[62]) and the Safety Requirements publication Site Evaluation for Nuclear Installations (IAEA Safety Standards Series No. NS-R-3[63]) is currently being revised and updated according to the Safety Standards review process.

117. A draft SEED guidelines document is currently being finalized related to site safety and design safety assessment of SSCs against external hazards. The SEED guidelines will streamline and clarify the roles, responsibilities, and expectations during the preparation, conduct and reporting of SEED missions. The guidelines document is due to be published in 2016.

118. In 2015, the Agency provided SEED review services and training workshops to Bangladesh, Jordan, Thailand to review their regulations on site evaluation for nuclear installations. Also a SEED mission was conducted in Indonesia to assist their regulatory authority BAPETEN during the licensing process to review the Site Permit Application for an experimental power reactor. Regulatory staff from Bangladesh and Jordan attended training workshops in Vienna, Austria, and discussed with Agency experts their current needs for finalizing the draft site evaluation guidelines and requirements.

119. In 2015, the Agency provided national workshops on site safety for Saudi Arabia, Sudan and Thailand, and a regional workshop in the Philippines for the member countries of the Asian Nuclear Safety Network's (ANSN's) Topical Group on Siting, which drew 32 participants from 10 Member States. Further, the Agency conducted a Workshop on Best Practices in Physics-Based Fault Rupture Models for Seismic Hazard Assessment of Nuclear Installations in Vienna, Austria; attended by 95 participants from 30 Member States.

Future Challenges

120. There is an ongoing need to address uncertainties related to the evaluation of external events for the protection of nuclear installations against external hazards and to address issues such as the impact of external hazards on multi-unit sites.

121. The need to develop a national regulatory basis for site evaluation remains an important challenge for countries embarking on a nuclear power programme.

122. There is an ongoing need, particularly in embarking countries, to train and develop a sufficient number of qualified staff in the implementing organization and the regulatory body for siting and site evaluation activities.

---

[60] The publication is available at: http://www-pub.iaea.org/MTCD/publications/PDF/TE-1767_web.pdf.

[61] The publication is available at: http://www-pub.iaea.org/MTCD/publications/PDF/Pub1690Web-41934783.pdf.

[62] The publication is available at: http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1689Web-30327813.pdf.

[63] The publication is available at: http://www-pub.iaea.org/MTCD/publications/PDF/Pub1177_web.pdf.

123. The implementation of SEED review recommendations to ensure site safety from the very start of nuclear projects, continues to pose challenges, mainly due to a lack of adequate human and financial resources.

B.2. Research Reactor Safety

Trends

124. Feedback from Agency activities, including international meetings and safety review missions, has shown an increased trend to apply the provisions of the Code of Conduct on the Safety of Research Reactors. However, there remains a need for further improvements in several areas, including regulatory effectiveness, operational radiation protection, emergency planning, and decommissioning planning.

125. Member States increasingly recognize the importance of exchanging operating experience. This is evident from the increased membership of the Agency's Incident Reporting System for Research Reactors (IRSRR) to more than 95% of the countries that operate research reactors, and from the increased voluntary reporting to the IRSRR of events of safety significance.

Activities

126. In November 2015, the Agency held the International Conference on Research Reactors: Safe Management and Effective Utilization, in Vienna, Austria with the participation of 314 experts from 57 Member States. The conference provided a forum for the participating countries to exchange information and experience on the safety of research reactors and provided recommendations for further safety enhancements in the areas of safety reassessment following the lessons learned from the accident at the Fukushima Daiichi NPP, ageing management, periodic safety reviews, the interface between safety and security, and infrastructure for new research reactor projects.

127. The Agency also conducted three regional meetings in Africa, Asia and the Pacific, and Europe, which provided practical information and forums for the exchange of experiences related to safety reassessments for research reactors in the light of the lessons learned from the Fukushima Daiichi accident. A Technical Meeting on the Safety of Research Reactors under Project and Supply Agreements and Review of their Safety Performance Indicators was also held in June 2015, in Vienna, Austria, with the participation of 24 experts from 16 Member States. The meeting discussed the safety performance indicators of these facilities and the actions taken (or planned) in performing safety reassessments to evaluate the robustness of these reactors against extreme external hazards.

128. A mission to support the safety of experiments and the utilization programme of the recently commissioned research reactor in China was conducted in January 2015. Additionally, safety analysis methods and results were reviewed during the safety mission conducted at the RP-10 reactor (Peru, February 2015), the Integrated Safety Assessment of Research Reactors (INSARR) mission at the TR-2 reactor (Turkey, March 2015), and the follow-up INSARR missions at the TRIGA reactor (Slovenia, November 2015) and the LENA reactor (Italy, December 2015). These missions provided guidance and recommendations for further safety improvements.

129. The Agency published the Safety Guide *Instrumentation and Control Systems and Software Important to Safety for* Research *Reactors* (IAEA Safety Standards Series No. SSG-37[64]) in 2015. This Safety Guide provides guidance for safety improvements, including on planning and implementation of I&C modernization.

---

[64] The publication is available at: http://www-pub.iaea.org/MTCD/publications/PDF/Pub1692web-47317079.pdf.

130. In October 2015, the Agency conducted a Technical Meeting on Research Reactor Ageing Management, Refurbishment and Modernization in the USA, with the participation of 150 experts from 17 Member States. The meeting discussed the elements of an effective ageing management programme and experience gained from the implementation of modernization and refurbishment projects. In November 2015, the Agency also conducted a Regional Meeting on Application of the Code of Conduct on the Safety of Research Reactors in Portugal, with the participation of 29 experts from 15 Member States, which focused on establishing a periodic safety review process for research reactors in Europe.

131. The Annual Meeting of the Regional Advisory Safety Committee for Research Reactors in Asia and the Pacific was held in September 2015, in Indonesia, with the participation of 23 experts from 9 Member States. The meeting discussed the national practices on periodic safety reviews and application of this process to the G.A. Siwabessy Multipurpose Reactor in Indonesia. Additionally, three workshops were conducted in Egypt, the Islamic Republic of Iran and Pakistan on establishing such a process for their national research reactors.

132. In March 2015, the Agency conducted a Technical Meeting for the National Coordinators of the Incident Reporting System for Research Reactors in Bulgaria, with the participation of 43 experts from 33 Member States. The meeting provided training on event investigation techniques and discussed the root causes of events at research reactors and the associated lessons learned and actions to be taken to prevent their reoccurrence. The Agency also published the Technical Document *Operating Experience from Events Reported to the IAEA Incident Reporting System for Research Reactors* (IAEA-TECDOC-1762[65]), in 2015 which provides for further dissemination of operating experience.

Future Challenges

133. Several research reactor organizations have addressed the relevant lessons learned from the accident at the Fukushima Daiichi NPP. However, many research reactor operating organizations — particularly those in countries that don't operate NPPs — face difficulties in this regard.

134. The establishment of effective ageing management programmes, including the implementation of refurbishment and modernization projects and the establishment of a periodic safety review process, presents challenges for research reactor operating organizations with limited human and financial resources.

B.3. Fuel Cycle Facility Safety

Trends

135. Significant progress has been made in the development of international safety guidance covering nuclear fuel cycle facilities. The Agency's safety standards in this area have now reached maturity and cover a wide range of activities and facilities, including criticality safety, conversion and enrichment, fuel fabrication, interim spent fuel storage, reprocessing, waste monitoring, and research and development.

136. Feedback from the Agency's activities on the safety of nuclear fuel cycle facilities showed the need to give continued attention to the effectiveness of the regulatory body, including with regard to the establishment of inspection programmes addressing relevant lessons learned from the Fukushima Daiichi accident.

---

[65] The publication is available at: http://www-pub.iaea.org/MTCD/Publications/PDF/TE-1762_web.pdf.

Activities

137. In 2015, the Agency finalized the development of two Safety Guides on nuclear fuel reprocessing and on nuclear fuel cycle research and development facilities: *Safety of Nuclear Fuel Reprocessing Facilities; and Safety of Nuclear Fuel Cycle Research and Development Facilities*. Additionally, the Agency finalized a new Safety Report with the provisional title *Safety Reassessment of Fuel Cycle Facilities in the Light of the Feedback from the Accident at the Fukushima Daiichi Nuclear Power Plant*, to be published in 2016.

138. In May 2015, the Agency conducted a Technical Meeting on Safety Analysis and Safety Documents for Fuel Cycle Facilities in Vienna, Austria, with the participation of 30 experts from 23 Member States. The meeting provided a forum for the participating States to share knowledge and experience related to performing safety analysis of different types of fuel cycle facilities as well as regulatory review and assessment of safety documentation of these facilities. Practical guidance was also presented on the application of the Agency's safety standards in these areas.

139. In September 2015, the Agency also conducted a Workshop on Ageing Management for Fuel Cycle Facilities in Vienna, Austria, with the participation of 18 experts from 17 Member States. The workshop provided the participants with practical information and guidance on the elements of a systematic ageing management programme and served as a forum for sharing knowledge and experiences related to the establishment of such programmes for different types of fuel cycle facilities.

140. In November 2015, the Agency conducted a follow-up Safety Evaluation of Fuel Cycle Facilities during Operation (SEDO) mission at the fuel fabrication facility in Piteşti, Romania. The mission provided guidance and recommendations for further enhancement of operational safety at the facility.

Future Challenges

141. Applying safety standards in a graded manner commensurate with the potential hazards of the nuclear fuel cycle facilities remains a challenge in some Member States. Additionally, some regulatory bodies face difficulties developing or revising existing national regulations and regulatory inspection programmes to ensure that they are adequate to verify compliance of the operating organizations with current safety standards. Some regulatory bodies also face the challenge of verifying the robustness of the structures, systems and components, operating programmes and procedures, and emergency preparedness measures in the light of the relevant feedback from the Fukushima Daiichi accident.

142. Operating organizations need to establish effective ageing management programmes that address the diversity and specificities of nuclear fuel cycle facilities, taking into account the potential nuclear and chemical hazards that are often specific to a particular facility.

143. New commercial and innovative fuel cycle facilities will require adequate qualified human resources and adequate competencies in the areas of regulatory supervision, safety assessment, construction, commissioning, safe operation and decommissioning.

B.4. Safety Infrastructure for Embarking Countries

B.4.1. Nuclear Power Programmes

Trends

144. Agency peer reviews, expert missions, workshops and other assistance activities indicate that embarking Member States continue to experience challenges in establishing an adequate and effective regulatory framework and an independent regulatory body with a sufficient number of competent staff.

In particular, IRRS and Integrated Nuclear Infrastructure Review (INIR) missions continue to identify delays in the development of the regulatory framework, especially the establishment of the licensing process and regulatory inspection programmes.

145. Embarking Member States continue to face difficulties related to adopting or adapting vendor country regulatory requirements to their own circumstances and, in some cases, have difficulty in maintaining an awareness of ongoing or subsequent changes in the regulations of the vendor country.

146. Some Member States have not yet developed a national plan for human resource development, including competency and training framework for the regulatory body. The need to enhance capabilities for addressing leadership and management for safety aspects, especially with respect to safety culture, has been recognized.

147. Many embarking Member States continue to enhance their technical capabilities in the areas of review, assessment and authorization through Agency workshops, expert missions, scientific visits and fellowships.

Activities

148. The Agency conducted expert missions, workshops or training activities that provided guidance and information on all the elements of establishing an effective safety infrastructure as laid out in *Establishing the Safety Infrastructure for a Nuclear Power Programme* (IAEA Safety Standards Series No. SSG-16).[66] Expert missions on integrated work plans for the development of infrastructure for a nuclear power programme including the identification of gaps and areas for improvements were conducted in Belarus and Nigeria in January and June 2015. Other expert missions focused on areas such as the development of nuclear legislation, e.g., a national nuclear law and nuclear safety regulations; human resource development; establishment of a management system at the regulatory body; and planning of required actions to be implemented to remove the weaknesses in national infrastructure.

149. A Workshop on the Challenges Faced by Newcomer Countries Regarding the Establishment of an Effective National Safety Infrastructure was organized in May 2015 in Turkey. Fourteen high-level country representatives from 10 Member States exchanged information on possible challenges regarding the development of a national nuclear safety infrastructure. Recommendations to address those challenges and issues were identified.

150. The Agency developed and piloted the Hands-on Regulatory Inspector Training Workshop for embarking countries, to prepare them for the inspection of NPPs under construction. This workshop was conducted twice in 2015 for 32 participants from 9 Member States using the Zwentendorf NPP in Austria.

151. The Agency conducted IRRS missions to Belarus (IRRS preparatory mission, December 2015), Indonesia (full scope IRRS mission, including the tailored module for countries embarking on nuclear power based on SSG-16, August 2015) and the United Arab Emirates (extended IRRS follow-up mission, February 2015).

152. In August and September 2015, the Agency conducted Education and Training Review Service (ETRES) missions in the Philippines and Thailand, respectively. Through these ETRES missions, both countries identified national practices that were beneficial for sustaining their education and training infrastructure, such as cooperation with the universities and participation in regional and international knowledge networking. Additionally, challenges were identified with regard to achieving and

[66] The publication is available at: http://www-pub.iaea.org/MTCD/publications/PDF/Pub1507_Web.pdf.

sustaining the necessary level of nuclear safety knowledge in each country. During both ETRES missions, a joint evaluation and discussion took place with national universities and education institutions, operators, regulators and technical support organizations.

153. The Agency conducted three regional workshops in the Asia and the Pacific region on leadership and management for safety and safety culture. The workshops provided forums for 96 participants from all ANSN member countries to exchange information and experience on the implementation of requirements of the Agency's safety standards. The Agency also conducted national workshops in Africa and Europe, which provided practical information and forums for the exchange of experience on safety culture.

154. The Agency conducted 25 capacity and competency building activities for Member States embarking on a new nuclear power programme aimed at providing essential knowledge and practical training in deterministic and probabilistic safety assessment, engineering aspects important to safety and the review of safety case documentation to participants from regulatory bodies, future owner/operator organizations, and technical and scientific support organizations.

155. In April 2015, the Agency conducted a Safety Assessment Advisory Programme (SAAP) Phase 2 mission to Malaysia to support the nuclear power programme stakeholders in developing a national safety assessment capacity-building programme.

Future Challenges

156. In many embarking Member States, the defined project schedules allow limited time for the regulatory body to establish its resources and competency in order to perform its regulatory functions effectively.

157. Some embarking Member States have yet to establish a full understanding of the needs and priorities for the establishment or enhancement of the national safety infrastructure.

158. The national coordination of resources in education and training is still a challenge for many embarking Member States. Some embarking Member States continue to have difficulty in recruiting staff with the appropriate education and lack the appropriate national mechanisms or infrastructure to provide the necessary education and training.

B.4.2. Research Reactor Programmes

Trends

159. There is an increased trend in the number of Member States developing new research reactor programmes. The majority are establishing their first research reactor for utilization in the development of human resources, the development of applications in nuclear science and technology, or as a step towards embarking on a nuclear power programme. These Member States continue to face difficulties in developing the necessary safety, regulatory and technical infrastructure. In particular, the majority of these Member States still need to develop a clear strategy for human resource development and for building the competencies necessary for the safe implementation of new research reactor projects.

Activities

160. The Agency conducted a Workshop on Milestones and Infrastructure for New Research Reactor Projects in May 2015 in Egypt, with 32 participants from 10 Member States constructing or planning new research reactors in Africa and countries that are members of the Arab Network of Nuclear Regulators. A Training Workshop on Assessment of the National Nuclear Infrastructure to Support a

New Research Reactor Project was conducted in May 2015 in Vienna, Austria, with 20 participants from 18 Member States. These workshops provided the participating States with practical information on infrastructure development and on a methodology for national infrastructure assessment and identification of actions addressing the identified gaps. Additionally, the International Conference on Research Reactors: Safe Management and Effective Utilization (Vienna, Austria, November 2015) held a session on the experience from new research reactor projects that are currently under implementation.

161. The Agency conducted four expert missions on new research reactor projects in Sudan (January 2015), Tunisia (December 2015), the United Republic of Tanzania (July 2015), and Viet Nam (March 2015). These missions provided guidance and recommendations on infrastructure development and siting of new research reactor projects. Additionally, the Agency mission conducted in Jordan (September 2015) provided guidance and recommendations on enhancing the safety of construction and commissioning of the Jordan Research and Training Reactor.

Future Challenges

162. Establishment of safety and technical infrastructure continues to be a challenge for Member States embarking on new research reactor programmes. This includes the development of adequate human resources and national competencies, consistent with the project milestones, to fulfil the regulatory functions and to implement activities of safety importance, including site evaluation, design, safety assessment, authorization, construction, commissioning, and safe utilization of the reactor facilities. Of particular importance is the need to establish effectively independent regulatory bodies with the necessary authority and adequate resources to meet the national commitment and responsibility for safety. Additionally, effective coordination between research reactor and nuclear power development teams is needed in Member States where new research reactors are developed as a step towards embarking on a nuclear power programme.

B.5. Regulatory Effectiveness for Nuclear Installations

Trends

163. Member States with established nuclear power programmes continue to show strong interest in IRRS missions in 2015. Four IRRS missions were conducted in 2013, six in both 2014 and 2015 and seven requests are being processed for 2016, showing increased recognition of the benefits expert peer reviews. IRRS preparatory and follow up missions reflect this interest as well with four preparatory missions and three follow up missions being carried out in 2015.

164. Some Member States continued having difficulties in implementing IRRS mission recommendations and suggestions in areas such as the governmental and legal framework, management and systematic implementation of core regulatory processes and coordination of public and media information during emergencies.

165. Additionally, Member States continued having difficulty establishing effective regulatory oversight of managerial, human, and organizational factors (HOF). The need for improvement in the current regulatory oversight capabilities of licensees in these areas continues to be an ongoing trend in many Member States and have been noted at various regulatory forums. Further outcomes from the recent International Expert Meeting on Human and Organizational Factors highlighted that regulators and operators tend to take a technical-centred over people-centred approach with regard to the multiple

factors and complex interactions that affect safety.[67] This trend is even more noticeable for those Member States that have a research reactor programme, but no operating NPPs.

Activities

166. Inputs received from the analysis of IRRS missions have been incorporated into the revision of *Governmental, Legal and Regulatory Framework for Safety* (IAEA Safety Standards Series No. GSR Part 1[68]) and in the ongoing development of two new safety guides supporting GSR Part 1: *Organization, Management and Staffing of a Regulatory Body for Safety* and *Functions and Processes of the Regulatory Body for Safety*. Currently, the revised version of GSR Part 1 is in the publication process and the two safety guides are awaiting Member States' comments.

167. Based on the latest developments in the Agency's safety standards, in April 2015 the Agency revised the Self-Assessment of Regulatory Infrastructure for Safety (SARIS) tool question sets related to GSR Part 1. The SARIS tool is used by Member States during the IRRS mission preparatory phase to objectively document the degree of compliance with relevant Agency safety standards.

168. The Agency organized an IRRS reviewers training for staff of the US Nuclear Regulatory Commission in January 2015 attended by 40 participants. This training is provided nationally, regionally and internationally to ensure that a sufficient number of experts are available for the implementation of the IRRS programme.

169. A school on drafting nuclear safety regulations was held in Vienna, Austria, in October 2015, to provide participants with knowledge and expertise sufficient to develop regulations aligned with existing national legislative frameworks and compatible with the Agency's Safety Requirements; 11 participants from nine Member States attended. The participants were trained on drafting and revising regulations for NPPs in the areas of Management for Safety and Plant Operation, Care and Maintenance.

170. The Agency conducted a Regional Train the Trainers Course on Regulatory Oversight of Licensees' Human and Organizational Factors in Chisinau, Republic of Moldova, in June 2015; which was attended by 26 participants from 12 Member States. The basic principles of the development and implementation of regulatory oversight of licensees' integrated management systems and HOF were addressed in this course.

171. The Agency held a Technical Meeting on Regulatory Oversight of Human and Organizational Factors in Vienna, Austria, in December 2015, for 29 participants from 27 Member States, who shared and discussed national experiences related to the effective oversight of HOF, including regulatory inspection.

172. The Agency held two regional workshops in Asia and the Pacific, and in Africa on regulatory inspection programmes for research reactors. The workshops provided 44 participants from 13 Member States with information and practical knowledge on regulatory inspection programmes that included hands-on exercises on conducting regulatory inspections at research reactors and documenting the inspection results. Additionally, the International Conference on Research Reactors: Safe Management and Effective Utilization, held in November 2015 in Vienna, Austria, provided a forum for participating Member States to exchange information and experiences related to regulatory

[67] This publication is available at: http://www-pub.iaea.org/books/iaeabooks/10757/IAEA-Report-on-Human-and-Organizational-Factors-in-Nuclear-Safety-in-the-Light-of-the-Accident-at-the-Fukushima-Daiichi-Nuclear-Power-Plant

[68] The publication is available at: http://www-pub.iaea.org/MTCD/publications/PDF/Pub1465_web.pdf.

activities conducted at their national research reactors in order to address the relevant feedback from the Fukushima Daiichi accident.

173. The Agency conducted an expert mission in Jamaica (March 2015) that provided guidance and recommendations on regulatory review and assessment of the conversion of Jamaica's research reactor from high enriched uranium to low enriched uranium fuel. An expert mission in the Islamic Republic of Iran (July 2015) provided recommendations on the safety analysis report for the Tehran Research Reactor as part of the operating licence renewal for this facility.

174. The Agency also supported Nigeria, through a Technical Meeting held in August 2015 in Vienna, Austria, to finalize the national nuclear safety regulations for research reactors. Additionally, in April 2015, a meeting was held in Vienna, Austria, with four experts from the Arab Network of Nuclear Regulators to identify and address issues concerning the regulatory supervision of research reactors.

Future Challenges

175. There is an ongoing need to improve governmental and regulatory frameworks to support effective and independent regulatory bodies. A robust regulatory framework takes years to build and must be in place before a nuclear facility is built.

176. A number of regulatory bodies need to further consider human and organizational factors as part of their regulatory oversight programme.

C. Strengthening Emergency Preparedness and Response

C.1. Emergency Preparedness and Response at the National Level

Trends

177. The number of requests for assistance in strengthening national and regional emergency preparedness and response (EPR) is growing.[69] Member States requested assistance in harmonizing national emergency arrangements, particularly in the areas of hazard assessment, EPR framework, emergency notification, information sharing (including the exchange of radiation monitoring data), decision-making and public communication. Member States also continued to request training on the Agency's emergency communication tools. National exercises, which also address aspects of international communications during an emergency, revealed that corrective guidance was required regarding proper implementation of the communication arrangements described in the *Operations Manual for Incident and Emergency Communication (Emergency Preparedness and Response Series, EPR-IEComm 2012*) and, specifically, the use of the emergency communication channels.

178. Member States continue to focus on trends and issues in effectively communicating with the public during nuclear or radiological emergencies. Discussions during the International Conference on Global Emergency Preparedness and Response in October 2015, held by the Agency in Vienna, concluded that the use of social media has emerged as a trend and has forced a sharper delineation of the traditional principles of good crisis communication (i.e., timely, concise, factually correct and

[69] In 2015, requests for the Agency assistance in EPR (expert missions, training) have increased from nine in 2014 to 19 requests in 2015. Requests for regional assistance rose from one request in 2014 to four in 2015. In addition, the Agency was asked to be involved in over 30 national exercises.

easily understandable information to the public). Participants at the conference reinforced the need to develop methods and tools for communicating risks to the public during the preparedness phase as well as during a nuclear or radiological emergency.[70]

179. The International Nuclear and Radiological Event Scale (INES) is a self-reporting tool for Member States to rate the safety significance of a nuclear or radiological event[71]; 74 Member States use INES to report the occurrence and consequence of such events. The Agency along with the Organisation for Economic Co-operation and Development (OECD)/Nuclear Energy Agency (NEA) developed INES in an effort to facilitate the communication of the safety significance of an event associated with sources of radiation.

Activities

180. The Agency issued the revised General Safety Requirements publication *Preparedness and Response for a Nuclear or Radiological Emergency* (IAEA Safety Standards Series No. GSR Part 7)[72], and a new EPR Series publication, *Method for Developing a Communication Strategy and Plan for a Nuclear or Radiological Emergency* (EPR-Public Communication Plan 2015)[73].

181. Training was provided to 27 INES National Officers from 21 countries, with emphasis on the use of the INES methodology within the overall public communication strategy. In 2015, an elaborated draft publication on the use of INES for unplanned events affecting patients undergoing a medical procedure was evaluated by countries involved in its development with the view to ascertain its applicability and make recommendations on its potential wider use.

182. In 2015, the Agency conducted five EPREV missions (Ghana, Jamaica, Kenya, Nigeria and United Arab Emirates) and two preparatory EPREV missions (Ghana and Hungary).

183. In its efforts to enhance the effectiveness and usefulness of EPR self-assessment as well as of the EPR peer review service (EPREV), the Agency launched the Emergency Preparedness and Response Information Management System (EPRIMS) during the 59th regular session of the General Conference in September 2015. EPRIMS is a web-based tool that allows Member States to record information about their EPR arrangements, perform a self-assessment[74] of their status with reference to the recommendations outlined in the Agency safety standards on EPR and, at their discretion, share information and knowledge with the Agency and other Member States. EPRIMS features a database of NPPs in Member States and associated technical data; this is linked to the Agency's Power Reactor Information System and will be instrumental to the assessment and prognosis process in response to a nuclear or radiological emergency.

---

[70] INTERNATIONAL ATOMIC ENERGY AGENCY, International Conference on Global Emergency Preparedness and Response, Conference Report, Conference Report, IAEA, Vienna (2015).

[71] The INES rating ranges from 'Below Scale/Level 0', indicating a situation with no safety consequences, to Level 7, indicating a major emergency causing widespread contamination.

[72] This is sponsored by 13 international intergovernmental organizations and replaces IAEA Safety Standards Series No. GS-R-2.The publication is available at: http://www-pub.iaea.org/MTCD/publications/PDF/P_1708_web.pdf.

[73] The publication is available at: http://www-pub.iaea.org/MTCD/Publications/PDF/EPR-CommPlan2015_web.pdf.

[74] The 2015 General Conference resolution GC(59)/RES/9 encouraged "Member States to ensure regular self-assessments of their … emergency preparedness … taking into account relevant IAEA safety standards".

184. In 2015, the Agency initiated and conducted a number of activities that directly addressed the needs of Member States in capacity building, which included:

- Establishing the School of Radiation Emergency Management and delivering two pilot sessions in Italy (September 2015) and Brazil (November 2015). The School builds on enhanced training material on all aspects related to the Agency's safety standards in EPR and aims at imparting to the next generation of national emergency preparedness managers the fundamental knowledge and skills required to develop and enhance their respective countries' national EPR arrangements.

- Developing a workshop on the roles and responsibilities of operators, regulators and other stakeholders and on the coordination of emergency response activities. This workshop was conducted with regional audiences in Bangladesh (April 2015) and Indonesia (April 2015). The workshop addresses the basic issues and challenges in the establishment of a comprehensive national EPR framework and, in particular, the need for expansion of that framework while developing nuclear power programmes.

- Developing a workshop on hazard assessment and protection strategy, supported by the concurrent development of an EPR Series publication on the development of a protection strategy for emergency response. The workshop was piloted at the Agency's Headquarters in Vienna, Austria (August 2015) and subsequently held in Malaysia (October 2015). An expert mission on the subject was also conducted in Qatar (August 2015).

185. The Agency continued to conduct training for the emergency contact points identified under the Convention on Early Notification of a Nuclear Accident[75] (Early Notification Convention) and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (Assistance Convention). This included using new communication forms in the enhanced Response and Assistance Network (RANET) information area of the Agency's Unified System for Information Exchange in Incidents and Emergencies (USIE).

186. In 2015, the Agency established a new committee under the Commission on Safety Standards, the Emergency Preparedness and Response Standards Committee. This Committee will review and approve Agency safety standards in the area of EPR. It will also contribute, inter alia, to the review of other Agency safety standards and publications in the Nuclear Security Series that include EPR. The committee comprises senior experts nominated by Member States in the area of nuclear and radiological EPR.

Future Challenges

187. Preparedness for effective public communication during an emergency and implementation of the emergency communication arrangements at the national level will continue to be a challenge for Member States. Stronger public communication strategies based on Agency guidance need to be developed and implemented at the national level. These strategies need to recognise current public communication trends such as the increased use of social media, and the use of specific tools, such as the INES methodology for rating the safety significance of nuclear and radiological emergencies.

---

[75] Adopted in 1986 following the Chernobyl NPP accident, the Convention on Early Notification of a Nuclear Accident establishes a notification system for nuclear accidents with the potential for international transboundary release that could be of radiological safety significance for another State. It requires States to report the accident's time, location, radiation releases, and other data essential for assessing the situation. Currently, there are 119 Parties to the Convention. The text of the Convention is available at: http://www.iaea.org/publications/documents/infcircs/convention-early-notification-nuclear-accident.

C.2. Emergency Preparedness and Response at the International Level

Trends

188. Contracting Parties to the Early Notification Convention[76] are obliged to make known their competent authorities and points of contact. The Agency has requested that all Member States designate their contact points in accordance with the *Operations Manual for Incident and Emergency Communication* (Emergency Preparedness and Response Series, EPR-IEComm 2012)[77]. In 2015, six more Member States designated contact points in compliance with EPR-IEComm 2012, increasing the number to 110 compliant Member States.[78]

189. Contracting Parties to the Assistance Convention[79] are obliged to "within the limits of their capabilities, identify and notify the Agency of experts, equipment and materials that could be made available for the provision of assistance to other States Parties in the event of a nuclear accident or radiological emergency" [80]. Contracting Parties can fulfil this obligation by registering their national assistance capabilities in RANET. Currently 25% of the 112 Contracting Parties to the Assistance Convention comply with this obligation.

190. Timely receipt of emergency messages is a vital aspect of emergency response; however, not all Member States participate in simple tests of their emergency communication channels. In 2015 around 15% of contact points did not responded to these tests, which is consistent with the previous year.

191. In 2015, the Republic of Korea added its capabilities in RANET and another three States Parties (Finland, Norway and the United States of America) added capabilities to their existing registrations. Three States Parties (Japan, the Republic of Korea and USA) have now registered capabilities in the functional area entitled "Nuclear Installation Assessment and Advice".

Activities

192. During 2015, the Agency conducted six workshops on notification, reporting and requesting assistance, which were attended by participants from 30 Member States. The workshops provided support to the contact points in Member States concerning the effective implementation of the arrangements for communicating with the Agency's Incident and Emergency Centre during emergencies as described in EPR-IEComm 2012 and *IAEA Response and Assistance Network* (Emergency Preparedness and Response Series, EPR-RANET 2013)[81]. The content of the workshops was revised in 2015 to include new processes (e.g. assessment and prognosis) and systems (e.g. the International Radiation Monitoring Information System) and to allow more practice in the use of the EPR-IEComm 2012 communication forms.

193. International cooperation in developing the International Radiation Monitoring Information System (IRMIS) resulted in a successful small-scale pilot test and subsequent release for use in Member States in December 2015. IRMIS provides Member States with a tool for reporting large volumes of radiological monitoring data during an emergency. The system allows for the visualization

---

[76] The convention is available at: https://www.iaea.org/sites/default/files/infcirc335.pdf.

[77] The publication is available at: http://www-pub.iaea.org/MTCD/publications/PDF/EPR_IEComm-2012_Web.pdf.

[78] Currently, 41 Member States have designated contact points, but not according to the definitions stated in the EPR-IEComm 2012; 16 Member States have not provided their emergency contact points to the Agency.

[79] The convention is available at: https://www.iaea.org/sites/default/files/infcirc336.pdf.

[80] This publication is available at: : https://www.iaea.org/sites/default/files/infcirc336.pdf.

[81] The publication is available at: http://www-pub.iaea.org/MTCD/Publications/PDF/EPR-RANET_2013_web.pdf.

and analysis of data, which will assist Member States and the Agency in assessing the radiological situation during an emergency involving the release of radioactive material. Currently, IRMIS is a stand-alone application; however, the system will be connected directly with USIE.

194. The Agency continued promoting and supporting the implementation and use of the International Radiological Information Exchange (IRIX) data standard for information exchange during nuclear or radiological emergencies. The IRIX data standard is currently in use in USIE and IRMIS, as well as in the European Commission's ECURIE (European Community Urgent Radiological Information Exchange) and EURDEP (European Union Radiological Data Exchange Platform) systems[82]. Several Member States currently implement IRIX in their domestic information exchange systems. The Agency is at present conducting a project to investigate the feasibility of extending the IRIX data standard to support more detailed reporting on plant status information during an NPP emergency. The Agency plans to make this data standard applicable for use in sharing data between reporting systems at NPPs and their off-site authorities.

195. A new version of the USIE website was released in November 2015, introducing several improved elements as well as additional features related to the request and provision of emergency assistance.

196. Draft *Guidelines for Response and Assistance Products during a Nuclear or Radiological Emergency* were finalized in consultation with experts from Member States and will be published as part of the EPR Series in 2016. The guidelines are intended to help harmonize different aspects of the national response arrangements of Member States and to facilitate the provision of international assistance 'products' so that the assistance may be received effectively by a requesting State. The guidelines were introduced at the Workshop on Monitoring during a Nuclear or Radiological Emergency that was conducted for RANET counterparts at the Agency's RANET Capacity Building Centre in Fukushima City, Japan, in November 2015, and they will be used in the RANET exercises to be conducted in 2016.

197. For the ConvEx-2b exercise held in August 2015, the Agency developed 11 exercise scenarios, while three participating Member States developed their own scenarios. The high number of scenarios allowed all requesting States to test thoroughly their capabilities to request the assistance needed and to engage in preparations for the receipt of assistance. The Agency continued the series of ConvEx-2e[83] exercises on the assessment and prognosis process based on national exercises in the Member States; three ConvEx-2e exercises were conducted.

198. At its 25th Regular Meeting in November 2015, the Inter-Agency Committee on Radiological and Nuclear Emergencies discussed the preparation of the ConvEx-3[84] exercise to be held in 2017, which will feature a scenario addressing a severe emergency at an NPP. It also deliberated on the proposals for the 2016 edition of the Joint Radiation Emergency Management Plan of the International Organizations (JPLAN). Operational protocols in the form of Practical Arrangements within the

---

[82] The Agency also developed a new set of IRIX based electronic reporting forms as a practical and readily useable means of implementing the IRIX data standard.

[83] ConvEx-2e exercises provide the Agency and its Member States with an opportunity to practise the development of harmonized messages that are appropriate for delivery to the public, technical audiences and the relevant authorities.

[84] The Agency conducts regular exercises within the framework of the Early Notification and Assistance Conventions, referred to as 'ConvEx exercises'. ConvEx exercises have three levels of complexity: at level 1 (ConvEx-1) only communication tests with emergency contact points are performed; at level 2 (ConvEx-2) emergency communications as well as different parts of emergency arrangements are tested; and at level 3 (ConvEx-3) the exercise aims to test full scale emergency arrangements and capabilities at national and international levels.

framework of the JPLAN continued to be developed. During 2015, the Practical Arrangement with the International Civil Aviation Organization was agreed and signed.

Future Challenges

199. Engaging Member States in ConvEx exercises will continue to be a challenge along with prompting them to use the new features in the USIE emergency communication platform.

200. Challenges remain in ensuring that national, regional and worldwide capabilities are available and sufficient to handle a nuclear emergency as not all contracting parties to the Assistance Convention have registered their national assistance capabilities in RANET.

C.3. Regulatory Effectiveness in Emergency Preparedness and Response

Trends

201. Recent peer review missions show that regulatory bodies and operating organizations are making efforts to better integrate severe accident management and EPR, particularly by consolidating command and control and training and exercises in realistic severe conditions.

Activities

202. The Agency has prepared a draft new EPR Series publication[85] that addresses the need for emergency arrangements in severe emergencies coincident with natural disasters. The new publication specifically considers the need for resilient severe accident management arrangements that are integral to emergency arrangements overall. Although intended for emergency management authorities, regulators will also be able to use it as input when developing regulatory guidelines on emergency arrangements for severe emergencies.

203. The EPR module of the IRRS missions, which is used to review the regulatory effectiveness of Member States in EPR, was revised to be consistent with GSR Part 7, to place greater emphasis on the effectiveness of the regulatory oversight process, and to simplify the self-assessment questionnaire on this subject.

204. The EPREV guidelines have also been revised to incorporate information on the resilience and robustness of emergency arrangements in severe emergencies.

Future Challenges

205. There is a need for regulators to ensure that robust, resilient and adequate emergency arrangements are in place and are effectively coordinated with severe accident management strategies and processes.

D. Improving Management of the Safety and Security Interface

206. Nuclear safety and nuclear security have a common purpose — the protection of people, society and the environment. Many of the principles to ensure protection are common to both safety and

---

[85] The draft publication is entitled *Preparedness for and Response to a Nuclear or Radiological Emergency Coincident with a Natural Disaster* and is expected to be issued in 2016.

security, although their implementation may differ. Likewise, many elements or actions serve to enhance both safety and security simultaneously. However, there are also circumstances in which actions to serve one objective can be antagonistic to the achievement of the other. For example, the introduction of delay barriers for security reasons can limit rapid access to respond to a safety significant event or can limit emergency egress by plant personnel. This has led to an increased focus on the safety and security interface.

D.1. Safety Standards and Nuclear Security Guidance

Trends

207. At the 52nd regular session of the General Conference in 2008, two resolutions were adopted to enhance the coordination of the safety and security interface: GC(52)/RES/9 on "Measures to strengthen international cooperation in nuclear, radiation, transport and waste safety"[86]; and GC(52)/RES/10 on "Measures to protect against nuclear terrorism"[87]. Since then, the Agency has developed and overseen a process whereby interfaces between nuclear safety standards and nuclear security guidance publications are identified and reviewed by experts in the areas that are relevant for both safety and security (e.g. defence in depth, safety and security culture, barriers). The objective of the process is to ensure that safety standards and nuclear security guidance publications promote interactions between safety and security where appropriate, and that required or recommended safety measures do not compromise security and recommended security measures do not compromise safety.

Activities

208. The Interface Group[88], conducted a review of all document preparation profiles for Agency safety standards and nuclear security guidance publications to identify whether there were any safety and security interfaces, then documented the nature of the interfaces and referred them to the appropriate Committee(s) for further review and approval. Approximately 80% of the draft IAEA Safety Standards Series publications under development have some sort of interface with nuclear security that needs to be reviewed by the NSGC, and approximately 80% of the draft IAEA Nuclear Security Series publications under development have an interface with safety that needs to be reviewed by at least one of the Safety Standards Committees.

Future Challenges

209. Member States rely on the timely provision of integrated safety requirements and security guidance so that they may continually achieve high levels of safety and security. While the interface review process notably improves the application of these standards and guidance, challenges in the timely development, approval and publication process remain.

D.2. Disused Sealed Radioactive Sources

Trends

210. The total inventory of sealed radioactive sources (SRSs) worldwide is estimated to be in the millions and many sources contain very high concentrations of radionuclides, which emit high levels

---

[86] The resolution is available at: https://www.iaea.org/About/Policy/GC/GC52/GC52Resolutions/English/gc52res-9_en.pdf.

[87] The resolution is available at: https://www.iaea.org/About/Policy/GC/GC52/GC52Resolutions/English/gc52res-10_en.pdf.

[88] This group was established in 2012 and comprises the chairs of the Nuclear Safety Standards Committee, the Radiation Safety Standards Committee, the Transport Safety Standards Committee, the Waste Safety Standards Committee and the Nuclear Security Guidance Committee (NSGC).

of radiation and require heavily shielded containers for their safe use, transport and storage. When sources become disused, and especially where regulatory infrastructure is ineffective, some of these sources have gone missing. As a result, serious injuries and deaths have occurred when a radioactive source is found inadvertently and the person handling the source is not aware of the risk.[89]

Activities

211. In 2015, the Agency started development of draft guidance for Member States on protection, control and management options of disused sources. This publication is based on the Agency's safety standards and nuclear security guidance and addresses safety and security in an integrated manner similar to that of the Code of Conduct on the Safety and Security of Radioactive Sources. It is due to be published in early 2017.

Future Challenges

212. Selecting and implementing the most appropriate national options for the safe and secure management of disused sources will continue to be a significant challenge for those Member States with limited capacities, restricted resources and with small inventories of disused sources.

213. Safe and secure management of disused sources beyond their actual useful life will require many decades of regulatory oversight — in some cases, even hundreds of years — and the necessary safety and security measures have to be put in place to cover these extended time frames.

D.3. Research Reactors

Trends

214. Research reactors fulfil diverse needs, including medical and industrial isotope production, elemental analysis, education and training, scientific research, and technology development. Their fuel generally requires uranium with much higher enrichment levels than that of power reactors. Many research reactors are situated within universities where in some cases poor safety and security measures have placed people and the environment at risk of radiation exposure through inadequate shielding or non-existent security barriers. Data collected from INSARR missions and from the Agency's Research Reactor Database highlight a continuing need to improve and strengthen the 'safety and security envelope' surrounding research reactors.

215. Many Member States are planning or implementing programmes to strengthen the security of their research reactors, including through upgrades to the physical protection systems.

Activities

216. The Agency began drafting a TECDOC in 2015 provisionally entitled *Management of the Interface between Safety and Security of Research Reactors*, to guide Member States in properly aligning the safety and security interface at research reactor sites. It is due to be published in the second quarter of 2016.

217. The preparations for a coordinated research project (CRP) entitled 'Nuclear Security for Research Reactors and Associated Facilities'[90] are currently being finalized and it is scheduled to begin in 2016, with four Member States (Ghana, Greece, Jamaica and Pakistan) and one organization

---

[89] *Lessons Learned from the Response to Radiation Emergencies (1945 -2010)*, IAEA, Vienna, Austria. (2012). The publication is available at: http://www-pub.iaea.org/MTCD/Publications/PDF/EPR-Lessons%20learned%202012_web.pdf.

[90] For more information on this project, see: http://cra.iaea.org/cra/stories/2014-12-05-J02006-NuclearSecurity-RRAFs.html.

signed up for participation so far. The CRP's objective, in addition to the interface with safety, is to simplify the process for developing nuclear security programmes to reduce the risk of theft of nuclear and/or other radioactive materials as well as of sabotage at research reactors and associated facilities, and to enhance the effectiveness of such programmes. This project is open to all Agency Member States and to institutes that are interested in undertaking scientific and technical work in support of achieving the CRP's objective.

Future Challenges

218. There is an on-going need for Member States to re-evaluate the safety and security of research reactor facilities, especially those located on university campuses where safety and security tends to be less rigorous than at commercial reactor sites. Specifically, Member States need to ensure that the safety and security interface is in line with Agency safety requirements and security guidance.

D.4. Emergency Preparedness and Response

Trends

219. Data collected from EPREV, OSART and IRRS missions indicate that Member States continue to face difficulties in integrating and managing the safety and security response priorities — both on-site and off-site — in the event of a nuclear or radiological emergency. This issue was highlighted during IEM-9 in April 2015, and was further emphasized at the International Conference on Global Emergency Preparedness and Response in October 2015. At both the international experts' meeting and the conference, it was concluded that there was a need for Member States to take proactive steps towards the effective integration of safety and security aspects in EPR, including by considering harmonized emergency arrangements and regulatory reviews that seek to identify and resolve potential conflicts that may exist between safety and security.

Activities

220. The Agency has developed a new Training Course on Response to a Radiation Emergency Resulting from a Nuclear Security Event in order to improve coordinated safety and security response to nuclear or radiological emergencies. The Agency delivered this course, in cooperation with the European Police Office (EUROPOL), in Warsaw, Poland in November 2015. It was attended by representatives of law enforcement agencies and response organizations from European countries.

221. Experts at the IEM 9 meeting held in April 2015, recommended that relevant actions should be taken at the international level to contribute to improving the safety and security interface at the national level.[91]

Future Challenges

222. Enhancing the integration of safety and security aspects in the response to emergencies will continue to be a challenge, requiring increased cooperation among emergency preparedness and security experts, both during the preparedness phase and in exercises to test response.

---

[91] The report is available at: http://www-pub.iaea.org/books/IAEABooks/10951/IAEA-Report-on-Assessment-and-Prognosis-in-Response-to-a-Nuclear-or-Radiological-Emergency.

D.5. Computer Security

Trends

223. Instrumentation and control (I&C) systems play a critical role in the safe operation of nuclear facilities. As digital technologies continue to evolve, they are increasingly incorporated into and integrated with I&C systems in nuclear facilities, which makes these systems vulnerable to cyberattacks.

Activities

224. In June 2015, the Agency hosted an International Conference on Computer Security in a Nuclear World: Expert Discussion and Exchange at its Headquarters in Vienna, Austria. It was the first conference on this topic and more than 700 experts from 92 Member States and 17 regional and international organizations participated. Organized in cooperation with the International Criminal Police Organization – INTERPOL, the International Telecommunication Union, the United Nations Interregional Crime and Justice Research Institute, and the International Electrotechnical Commission, the conference was attended by representatives of, inter alia, nuclear regulatory bodies and operating organizations, law enforcement agencies, and computer system and security vendors. The Agency also provides expert meetings and training courses to foster Member State awareness and facilitate information exchange.

225. The Agency has finalized Nuclear Security Series technical guidance that addresses the security of I&C systems as well as the management of the safety and security interface. Provisionally entitled *Computer Security of Instrumentation and Control Systems at Nuclear Facilities*, this new Technical Guidance publication will assist Member States in addressing the necessary security considerations to ensure security throughout the life cycle of an I&C system.

Future Challenges

226. Computer systems and their interconnectivity represent a field of ever-growing complexity. Coordinated research and information exchange are needed to prevent and respond to attacks on computer security.

E. Strengthening Civil Liability for Nuclear Damage

Trends

227. Member States continue to attach importance to having effective civil liability mechanisms in place to provide insurance against harm to human health, property and the environment, as well as consequential economic loss, caused by nuclear damage.

228. A number of international conventions have been adopted to ensure some degree of harmonization of national laws in this area, and the international legal regime created by these conventions was further enhanced after the Chernobyl accident. Although the Convention on Supplementary Compensation for Nuclear Damage (CSC) entered into force on 15 April 2015, the absence of treaty relations between States Parties to different conventions, as well as the comparatively low number of adherences to some of those conventions, have so far prevented the achievement of a global nuclear liability regime.

229. The IAEA Action Plan on Nuclear Safety specifically called on Member States to work towards establishing a global nuclear liability regime and to give due consideration to the possibility of joining the international nuclear liability instruments as a step towards achieving such a regime. Pursuant to the Action Plan, the International Expert Group on Nuclear Liability (INLEX) adopted, at its 12th regular meeting in 2012, a set of recommended actions to facilitate the achievement of a global nuclear liability regime.[92]

Activities

230. The 15th Meeting of INLEX took place in Vienna, Austria, from 28 to 30 April 2015. The Group discussed, inter alia, the issue of liability and insurance provisions covering radioactive sources; the implications of the entry into force of the CSC; a proposal to revise a paper issued by INLEX in 2013 on the benefits of joining the international nuclear liability regime and corresponding key messages; the revision of the model provisions on nuclear liability in the *Handbook on Nuclear Law: Implementing Legislation*; and outreach activities. As regards liability and insurance provisions covering radioactive sources, the Group recommended that licences for at least Category 1 and 2 sources include a requirement that the licensee take out insurance coverage or other financial security. However, in view of questions raised regarding the availability of such insurance in developing countries, the Group decided, at the same time, to keep the matter under review.

231. The Fourth Workshop on Civil Liability for Nuclear Damage was held in Vienna, Austria, on 27 April 2015 and was attended by 65 participants from 38 Member States. The purpose of the workshop was to provide diplomats and experts from Member States with an introduction to the international legal regime of civil liability for nuclear damage.

232. As regards other outreach activities in 2015, joint Agency–INLEX missions were conducted in Mexico and Jordan to raise awareness of the international legal instruments relevant for achieving a global nuclear liability regime. Preparations are under way to organize similar missions in 2016.

233. In addition, a Sub-regional Workshop for Caribbean Countries on Civil Liability for Nuclear Damage was held in Panama City, Panama, in June 2015 to provide participants with information on the existing international nuclear liability regime and to advise on the development of national implementing legislation. The event was attended by 31 participants from 14 Member States.

Future Challenges

234. The main challenge for the international legal regime of civil liability for nuclear damage remains the comparatively low number of contracting parties to the relevant international conventions, in particular those embodying the modernized regime adopted under the auspices of the Agency after the Chernobyl accident.

235. The Agency and INLEX will continue to facilitate the establishment of a global nuclear liability regime as called for by resolution GC(59)/RES/9, inter alia, by carrying out further outreach activities and taking into account the recommendations adopted by INLEX in 2012.

[92] The text of the recommendations is available at: http://ola.iaea.org/ola/documents/ActionPlan.pdf.

Appendix

The IAEA Safety Standards Activities during 2015

A. Summary

1. Five revised Safety Requirements publications were established by the Board in March 2015 as Agency safety standards and are in the process of publication in the IAEA Safety Standards Series; and one revised Safety Requirements publication was established by the Board as an Agency safety standard and was issued in the IAEA Safety Standards Series in November 2015. All incorporate lessons from the Fukushima Daiichi accident:

- GSR Part 1 (Rev. 1): Revision by amendment of the Safety Requirements GSR Part 1 on *Governmental, Legal and Regulatory Framework for Safety* (DS462);
- NS-R-3 (Rev. 1): Revision by amendment of the Safety Requirements NS-R-3 on *Site Evaluation for Nuclear Installations* (DS462);
- SSR-2/1 (Rev. 1): Revision by amendment of the Safety Requirements SSR-2/1 on *Safety of Nuclear Power Plants: Design* (DS462);
- SSR-2/2 (Rev. 1): Revision by amendment of the Safety Requirements SSR-2/2 on *Safety of Nuclear Power Plants: Commissioning and Operation* (DS462);
- GSR Part 4 (Rev. 1): Revision by amendment of the Safety Requirements GSR Part 4 on *Safety Assessment for Facilities and Activities* (DS462); and
- GSR Part 7: Revision of the Safety Requirements GS-R-2 on *Preparedness and Response for a Nuclear or Radiological Emergency* (DS457).

2. Five Safety Guides were also issued in 2015 after endorsement by the Commission on Safety Standards (CSS):

- SSG-32: *Protection of the Public against Exposure Indoors due to Radon and Other Natural Sources of Radiation*;
- SSG-33: *Schedules of Provisions of the IAEA Regulations for the Safe Transport of Radioactive Material (2012 Edition)* (revision of TS-G-1.6 (Rev. 1));
- SSG-35: *Site Survey and Site Selection for Nuclear Installations*;
- SSG-37: *Instrumentation and Control Systems and Software Important to Safety for Research Reactors*; and
- SSG-38: *Construction for Nuclear Installations*;

3. The CSS met twice in 2015 and endorsed the following draft safety standards for submission for publication:

- DS447: *Predisposal Management of Radioactive Waste from Nuclear Fuel Cycle Facilities* (revision of WS-G-2.6);
- DS448: *Predisposal Management of Radioactive Waste from Nuclear Power Plants and Research Reactors* (revision of WS-G-2.5);

- DS453: *Occupational Radiation Protection* (revision and combination of RS-G-1.1, RS-G-1.2, RS-G-1.3, RS-G-1.6 and GS-G-3.2);
- DS360: *Safety of Nuclear Fuel Reprocessing Facilities*;
- DS381: *Safety of Nuclear Fuel Cycle Research and Development Facilities*; and
- DS460: *Communication and Consultation with Interested Parties by the Regulatory Body.*

4. The CSS also approved the following document preparation profiles (DPPs) in 2015:

- DS489: *Storage of Spent Nuclear Fuel* (revision by amendment of SSG-15);
- DS490: *Seismic Design and Qualification for Nuclear Power Plants* (revision of NS-G-1.6);
- DS491: *Deterministic Safety Analysis for Nuclear Power Plants* (revision of SSG-2);
- DS492: *Human Factors Engineering in Nuclear Power Plants*;
- DS449: *Format and Content of the Safety Analysis Report for Nuclear Power Plants* (revision of GS-G-4.1); and
- DS493: *The Structure and Information to be Included in a Package Design Safety Report (PDSR) for the Transport of Radioactive Material.*

A.1. Review of the Agency's Safety Standards in the Light of the Fukushima Daiichi Accident

5. The IAEA Action Plan on Nuclear Safety includes the following action on the Agency's safety standards:

- "Review and strengthen Agency safety standards and improve their implementation:
    - The Commission on Safety Standards and the IAEA Secretariat to review, and revise as necessary using the existing process in a more efficient manner, the relevant IAEA Safety Standards in a prioritized sequence.
    - Member States to utilize as broadly and effectively as possible the Agency safety standards in an open, timely and transparent manner. The IAEA Secretariat to continue providing support and assistance in the implementation of Agency safety standards."

A.2. Review/Revision of Safety Requirements

6. The Secretariat undertook a review of the Safety Requirements applicable to research reactors and nuclear fuel cycle facilities to incorporate lessons from the Fukushima Daiichi accident. This provided the basis for preparation of a draft Safety Requirements document DS476, which was submitted for Member States' comment in January 2015. A draft Safety Requirements document DS478 was also prepared and submitted for Member States' comment in July 2015.

A.3. Implications of the Vienna Declaration on Nuclear Safety for the Safety Standards

7. At the Diplomatic Conference held in February 2015 to consider a proposal to amend the Convention on Nuclear Safety (CNS), the Contracting Parties to the CNS adopted by consensus the Vienna Declaration on Nuclear Safety, which includes principles for the implementation of the objective of the Convention to prevent accidents and mitigate radiological consequences:

8. The Contracting Parties also requested the transmission of the Vienna Declaration to the CSS "for its consideration with the four safety standards committees under its aegis, of the technical elements contained therein with a view to incorporating them as appropriate into the relevant Safety Standards".

9. In a letter dated 18 February 2015, the Director General accordingly asked for this to be included as an agenda item for the April 2015 CSS meeting, having previously consulted with the Chairs of the Committees, and requested to receive a report on what actions the Commission recommended so as to ensure that the technical elements contained in the Vienna Declaration were incorporated and further developed in a timely manner in the relevant Safety Guides.

10. After consideration of the Secretariat's proposal by the CSS, the Chairs of the Committees and by the entire Nuclear Safety Standards Committee (NUSSC), the CSS Chair provided the Commission's conclusions in a letter to the Director General dated 20 August 2015. The letter emphasized that good progress had been achieved in the revision of the Safety Requirements, and confirmed that the technical elements of the Vienna Declaration were already well reflected in the relevant Safety Requirements: GSR Part 1 (Rev. 1) on Governmental, Legal and Regulatory Framework for Safety, SSR-2/1 (Rev. 1) on Safety of Nuclear Power Plants: Design, and SSR-2/2 (Rev. 1) on Safety of Nuclear Power Plants: Commissioning and Operation.

11. The CSS therefore focused its efforts, as recommended in the Director General's letter, on consideration of the relevant Safety Guides. In doing so, the CSS also consulted NUSSC. A number of Safety Guides were already under revision at the time of the CSS meeting in April 2015 in connection with the main action in the IAEA Action Plan on Nuclear Safety, which called for strengthening the safety standards in the light of the Fukushima Daiichi accident. In response to the Director General's request, the CSS accepted the proposal from the Secretariat to consider six further Safety Guides in the list of priorities for review and possible revision which also directly or indirectly relate to the technical elements cited in the Vienna Declaration:

- SSG-25: *Periodic Safety Review for Nuclear Power Plants*;
- NS-G-1.5: *External Events Excluding Earthquakes in the Design of Nuclear Power Plants* (already identified by NUSSC in June 2013);
- NS-G-1.7: *Protection against Internal Fires and Explosions in the Design of Nuclear Power Plants*;
- NS-G-1.11: *Protection against Internal Hazards other than Fires and Explosions in the Design of Nuclear Power Plants*;
- NS-G-2.3: *Modifications to Nuclear Power Plants*; and
- NS-G-2.6: *Maintenance, Surveillance and In-service Inspection in Nuclear Power Plants.*

12. At its meeting in June 2015, NUSSC recommended that the first four Safety Guides on this list be considered priorities. The Secretariat has prepared a DPP for the revision of NS-G-1.7 and NS-G-1.11; a review of NS-G-1.5 has been performed and preparation of the DPP for a revision is under way. The review of SSG-25 is complete with the result that no changes are needed.

B. Interface between the IAEA Safety Standards Series and the IAEA Nuclear Security Series

13. The Nuclear Security Guidance Committee (NSGC) was established in March 2012 as a standing body of senior representatives in the area of nuclear security, open to all Member States, to make recommendations to the Deputy Director General, Head of the Department of Nuclear Safety and Security on the development and review of IAEA Nuclear Security Series publications.

14. An Interface Group was also established, immediately following the first meeting of the NSGC, to review all DPPs for IAEA Safety Standards Series and IAEA Nuclear Security Series publications — excluding those in the Technical Guidance category of the latter series — and, after considering the recommendations of the Coordination Committee on Safety Standards and Nuclear Security Series Publications, to identify whether there is a safety–security interface, to document the nature of the interface and to refer the DPP to the appropriate Committee(s) for review and approval.

15. The Interface Group was consulted in 2015 essentially through electronic consultation (a dedicated web page was established and a consultation process by email put in place). Three new or revised DPPs for draft IAEA Safety Standards Series publications were submitted to the Interface Group with a recommendation from the Coordination Committee.

C. Establishment of the Emergency Preparedness and Response Standards Committee

16. In 2007, the International Action Plan for Strengthening the International Preparedness and Response System for Nuclear and Radiological Emergencies recommended that the Secretariat consider, in close cooperation with the CSS, how to improve the involvement of emergency preparedness and response (EPR) experts in the preparation and review of relevant Agency safety standards.

17. This recommendation was presented to the Fourth Meeting of the Representatives of Competent Authorities identified under the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, which agreed with it.

18. The General Conference, in several resolutions (GC(51)/RES/11, GC(52)/RES/9, GC(53)/RES/10, GC(54)/RES/7 and GC(55)/RES/9), requested and urged the implementation of the International Action Plan for Strengthening the International Preparedness and Response System for Nuclear and Radiological Emergencies, as well as of the recommendations arising from it.

19. Furthermore, the IAEA Action Plan on Nuclear Safety called on the Secretariat, Member States and relevant international organizations to “review and strengthen the international emergency

preparedness and response framework, taking into account recommendations given in the final report of the International Action Plan for Strengthening the International Preparedness and Response System for Nuclear and Radiological Emergencies".

20. As a first step in the process of implementing the recommendations of the International Action Plan for Strengthening the International Preparedness and Response System for Nuclear and Radiological Emergencies, the relevant General Conference resolutions and the above-mentioned action arising from the IAEA Action Plan on Nuclear Safety, the Emergency Preparedness and Response Expert Group (EPREG) was established in 2013 as a standing advisory body comprising senior experts with high professional competencies and demonstrated leadership in the field of EPR who are appointed by the Deputy Director General, Head of the Department of Nuclear Safety and Security.

21. Since its establishment, EPREG has provided advice on various aspects of EPR, including assessment and prognosis in an emergency, self-assessment in EPR, the cross-cutting nature of EPR, and priority areas for capacity building. Despite the establishment of EPREG, the need to ensure the involvement of senior EPR experts in the process of establishing Agency safety standards has remained, as this function is excluded from the terms of reference of EPREG. Thus, EPREG, at its meeting in December 2014, recommended to the Deputy Director General, Head of the Department of Nuclear Safety and Security the establishment of the Emergency Preparedness and Response Standards Committee (EPReSC).

22. The Deputy Director General, Head of the Department of Nuclear Safety and Security presented information on the establishment of EPReSC to the members of the CSS in April 2015 and to the Board of Governors in June 2015. The new Committee was then established in July as a standing body of senior experts in the area of nuclear or radiological EPR with terms of reference similar to those of the four other Safety Standards Committees. All Member States were invited to nominate, as a member of EPReSC, a senior expert involved in EPR at the national level. Relevant international organizations, such as the Inter-Agency Committee on Radiological and Nuclear Emergencies, were also invited to attend EPReSC meetings as observers.

23. The Emergency Preparedness and Response Standards Committee held its first meeting in December 2015.

D. Future Review, Revision and Publication Process

24. After more than 50 years of history of the Agency's safety standards, which has resulted in a nearly complete set of standards covering all the main safety areas, the CSS further discussed in its meetings in 2015 the proposal from the Secretariat that a more efficient approach be adopted for the future review, revision and publication of the safety standards, with the following key objectives, reflected in a new Strategies and Processes for the Establishment of IAEA Safety Standards (SPESS) Version E document agreed by the CSS in November 2015:

- To ensure that the review and revision of published standards are based on a systematic feedback collection and analysis process;
- To ensure that any revision of the safety standards or part of a safety standard is justified by the above-mentioned feedback process, therefore also ensuring stability of the parts of the standard that remain valid;

- To maintain the technical consistency among the standards through management of the standards as a complete collection rather than by management of individual standards;
- To enhance semantic consistency through the systematic use of harmonized terminology;
- To ensure the completeness of the collection through a systematic top-down development approach complemented by topical gap analyses; and
- To support the harmonized use and application of the safety standards by enhancing their user-friendliness and by providing tools for users to easily navigate within the whole collection.

25. The approach of topical oriented review/revision of the Agency's safety standards was selected by the Safety Standards Committees and the CSS for the review and revision of the Safety Requirements in the light of the Fukushima Daiichi accident (DS462), as mentioned earlier in this report.

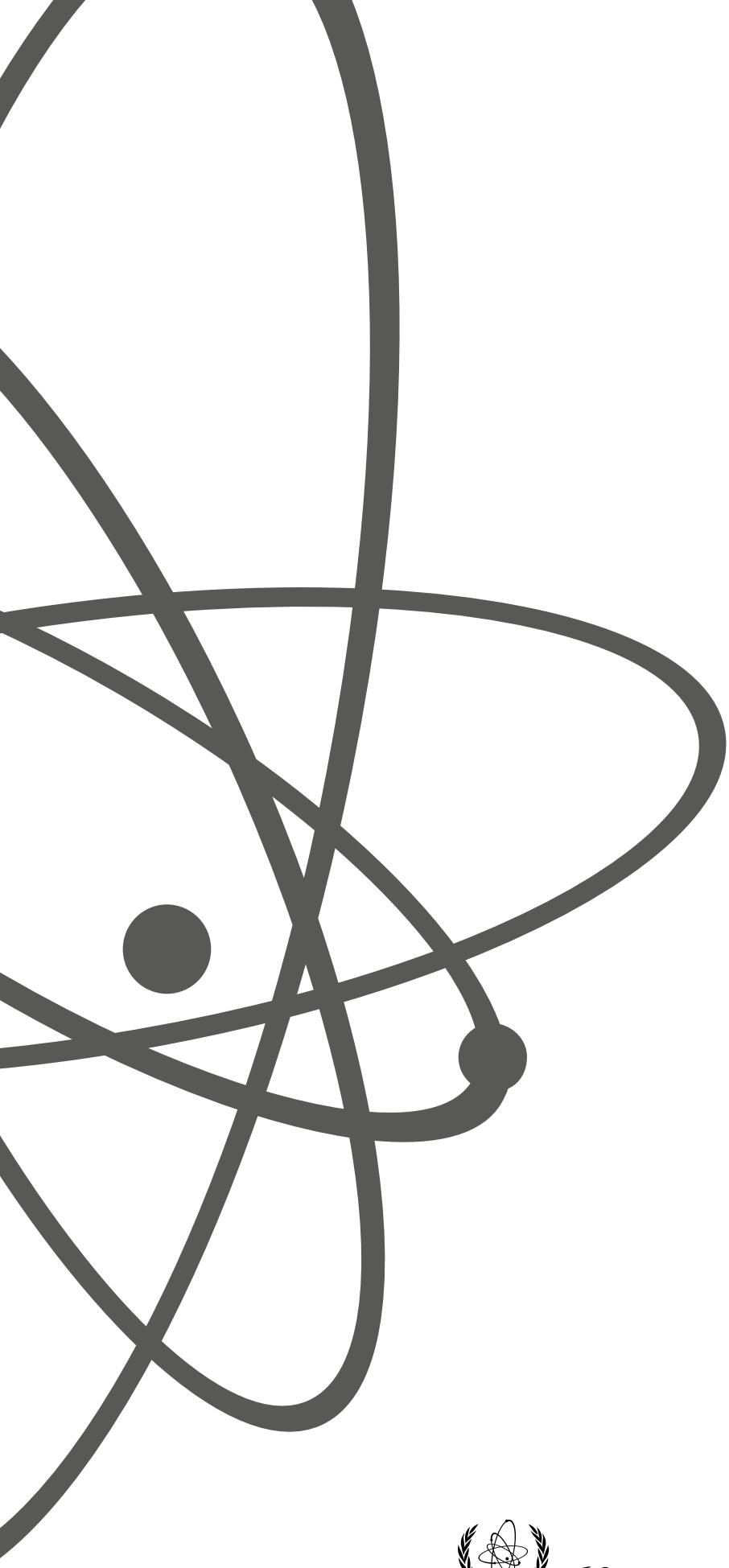
26. One particular advantage of this approach is that it addresses the second and third above-mentioned key objectives. The topical oriented review/revision process allows for focusing, during a revision, on those aspects that provide strong justification for amending a standard, thus ensuring at the same time both a rigorous justification process for their revision and the stability of those parts that remain valid. A second, no less important advantage is that such an approach enables the synchronous and coherent revision of several standards for the parts that relate to the selected topics, thus ensuring that consistency is maintained between the standards, which is impossible with a document-by-document, sequential revision process.

27. During its fifth term, the CSS also continued to discuss and expanded on the need for improved user friendliness of the electronic versions of the Agency's safety standards. The framework to achieve this received full support from all members of the CSS and went into initial operation in 2015. It is composed of the following key components:

- A content management system to manage the whole collection, the feedback mechanism, the content of the safety standards, and the relationships between the standards;
- An electronically supported review, revision and approval process management system; and
- A Nuclear Safety and Security Online User Interface that facilitates access to the content of the safety standards and greatly enhances in-depth navigation through the collection.

28. A report on the long-term status and a listing of all current IAEA safety standards can be accessed electronically[93].

[93] The report is available at: http://www-ns.iaea.org/committees/files/CSS/205/status.pdf.



IAEA 60 Years
Atoms for Peace and Development

Department of Nuclear Safety and Security
Vienna International Centre, PO Box 100, 1400 Vienna, Austria
http://www-ns.iaea.org | Official.Mail@iaea.org

16-22821