

Working to Protect People,  
Society and the Environment

# Nuclear Safety Review 2014



Nuclear Safety and Security Programme



**IAEA**  
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# Nuclear Safety Review 2014

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Nuclear Safety Review 2014

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# Foreword

The *Nuclear Safety Review 2014* contains an analytical overview of the dominant trends, issues and challenges worldwide in 2013 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 2013.

A draft version of the Nuclear Safety Review 2014 was submitted to the March 2014 session of the Board of Governors in document GOV/2014/6. The final version of the *Nuclear Safety Review 2014* was prepared in light of the discussions held during the Board of Governors and also of the comments received.



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# Executive Summary

The *Nuclear Safety Review 2014* focuses on the dominant nuclear safety trends, issues and challenges in 2013. The Executive Overview provides general nuclear safety information along with a summary of the major issues covered in this report: strengthening safety in nuclear installations; improving radiation, transport and waste safety; enhancing emergency preparedness and response (EPR); improving regulatory infrastructure and effectiveness; and strengthening civil liability for nuclear damage. The Appendix provides details on the activities of the Commission on Safety Standards, and activities relevant to the Agency's safety standards.

The global nuclear community has made steady and continuous progress in strengthening nuclear safety in 2013, as promoted by the IAEA Action Plan on Nuclear Safety (hereinafter referred to as "the Action Plan") and reported in *Progress in the Implementation of the IAEA Action Plan on Nuclear Safety* (document GOV/INF/2013/8-GC(57)/INF/5)<sup>1</sup>, and the Supplementary Information<sup>2</sup> to that report and *Progress in the Implementation of the IAEA Action Plan on Nuclear Safety* (document GOV/INF/2014/2).

- Significant progress continues to be made in several key areas, such as assessments of safety vulnerabilities of nuclear power plants (NPPs), strengthening of the Agency's peer review services, improvements in EPR capabilities, strengthening and maintaining capacity building, and protecting people and the environment from ionizing radiation. The progress that has been made in these and other areas has contributed to the enhancement of the global nuclear safety framework.
- Significant progress has also been made in reviewing the Agency's safety standards, which continue to be widely applied by regulators, operators and the nuclear industry in general, with increased attention and focus on vitally important areas such as design and operation of NPPs, protection of NPPs against severe accidents, and EPR.
- The Agency continued to share and disseminate the lessons learned from the Fukushima Daiichi accident through the analysis of relevant technical aspects. In 2013, the Agency organized two international experts' meetings (IEMs), one on decommissioning and remediation after a nuclear accident and one on human and organizational factors in nuclear safety in light of the accident at the Fukushima Daiichi NPP. The Agency also organized the International Conference on Effective Nuclear Regulatory Systems: Transforming Experience into Regulatory Improvements, held in Ottawa, Canada, in April 2013.

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<sup>1</sup> The document is available at: [http://www.iaea.org/About/Policy/GC/GC57/GC57InfDocuments/English/gc57inf-5\\_en.pdf](http://www.iaea.org/About/Policy/GC/GC57/GC57InfDocuments/English/gc57inf-5_en.pdf)

<sup>2</sup> The document is available at: [http://www-govatom.iaea.org/DocumentDetails.aspx?Language=English&Path=f:\websites\govatom\govatomdocs\govinf\2013\gov-inf-2013-08-gc\(57\)-inf-051\gov-inf-2013-8-gc-inf-57-5-supplement.doc](http://www-govatom.iaea.org/DocumentDetails.aspx?Language=English&Path=f:\websites\govatom\govatomdocs\govinf\2013\gov-inf-2013-08-gc(57)-inf-051\gov-inf-2013-8-gc-inf-57-5-supplement.doc)

- The Agency published a) the IAEA Report on Preparedness and Response for a Nuclear or Radiological Emergency in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant<sup>3</sup>; b) the IAEA Report on Decommissioning and Remediation after a Nuclear Accident<sup>4</sup>; and c) the IAEA Report on Strengthening Nuclear Regulatory Effectiveness in Light of Accident at Fukushima Daiichi Nuclear Power Plant<sup>5</sup>.

The operational safety of NPPs remains high, as shown by safety performance indicators collected by the Agency and the World Association of Nuclear Operators. Figure 1 shows the number of unplanned shutdowns ('scrams') per 7000 hours (approximately one year) of operation. This is commonly used as an indication of success in improving plant safety by reducing the number of undesirable and unplanned scrams. As shown, steady improvements, although not as dramatic as those attained in the 1990s, have been achieved in recent years. The increase from 2010 to 2011 is related to the high number of scrams triggered by the March 2011 earthquake in Japan.

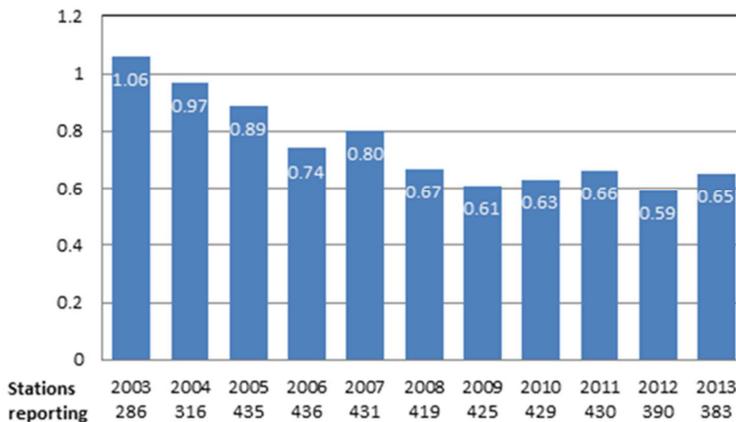


Fig. 1. Mean rate of scrams: the number of automatic and manual scrams that occur per 7000 hours of operation. (Source: IAEA Power Reactor Information System <http://www.iaea.org/pris>)

The annual technical meeting of National Coordinators of the International Reporting System was held in September 2013 in France.<sup>6</sup> The International Reporting System for Operating Experience (IRS) is a feedback system jointly operated by the IAEA and the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development, which provides information on NPP events and promotes a systematic approach to feedback from operating experience and lessons learned. In a

<sup>3</sup> The publication is available at <http://www.iaea.org/newscenter/focus/actionplan/reports/preparedness0913.pdf>.

<sup>4</sup> The publication is available at <http://www.iaea.org/newscenter/focus/actionplan/reports/decommissioning0913.pdf>.

<sup>5</sup> The publication is available at <http://www.iaea.org/newscenter/focus/actionplan/reports/regeffectiveness0913.pdf>

<sup>6</sup> IRS is a web based application that provides information access to 1400 users from the international nuclear community; it now contains more than 3900 reports.

plenary discussion, the National Coordinators exchanged experience and reviewed actions taken and lessons learned in response to 30 recent events in the countries that participate in the IRS. The meeting covered topics ranging from improving quality control and maintaining operating knowledge to human performance and safety management issues.<sup>7</sup>

There is an increased recognition by Member States operating research reactors of the importance of exchanging operating experience and feedback in order to improve safety. This trend is evident from the increased participation in the Agency's Incident Reporting System for Research Reactors (IRSRR) to more than 90% of Member States operating research reactors. This was confirmed during the biennial Technical Meeting of national and local IRSRR coordinators, held in April 2013 in Vienna with 38 Member States participating. This meeting identified a continued need to ensure dissemination of feedback from the IRSRR to research reactor operators.

Despite the increase in the number of Member States participating in the Fuel Incident Notification and Analysis System (FINAS) to 28 and the fact that these Member States are operating more than 80% of the fuel cycle facilities covered by FINAS, effective use of FINAS by Member States remains limited as a result of the commercial and sensitive nature of these facilities.

Additionally, the specificity, diverse nature and types of research reactors and fuel cycle facilities make it difficult to transpose the corrective actions taken following an incident from one facility to another, and this continues to hamper effective sharing of operating experience feedback.

As of 2013, over thirty countries are considering or embarking on nuclear power programmes. For example, in 2013, the United Arab Emirates started construction on its second unit; Belarus poured the foundation slab for its first unit at the Ostrovets site; Turkey signed an intergovernmental agreement with a vendor for the Sinop NPP (the final stage before a commercial contract); and Bangladesh signed an initial contract with a vendor country for two units at the Rooppur site. Additionally, Jordan has selected a vendor as the preferred bidder for its first NPP, and Nigeria, Poland, Saudi Arabia and Viet Nam have taken significant steps towards establishing their first power reactors.

Almost all embarking countries have been working to overcome difficulties in establishing a sound, well-functioning regulatory framework, and a competent, effective and independent regulatory body with sufficient competent staff to carry out its regulatory responsibilities. As in previous years, the Agency continued to provide assistance to regulatory bodies in newcomer countries, focusing on areas such as capacity building and human resource development as well as development of safety regulations and establishment of management systems. The Agency developed training materials which were used in many workshops at the national and regional levels, with a particular focus on strengthening core regulatory functions for new nuclear power reactor projects. Furthermore, the Agency developed the Integrated Review of Infrastructure for Safety (IRIS) self-assessment tool, which enables embarking countries to identify improvements based on recommendations contained in *Establishing the Safety Infrastructure for a Nuclear Power Programme* (IAEA Safety Standards Series No. SSG-16)<sup>8</sup>. The Agency also organized several national or regional activities to introduce the IRIS self-assessment methodology.

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<sup>7</sup> *Nuclear Power Plant Operating Experience from the IAEA/NEA International Reporting System for Operating Experience 2009–2011* is available at: <http://www-ns.iaea.org/downloads/ni/irs/npp-op-ex-2009-2011.pdf>.

<sup>8</sup> The publication is available at [http://www-pub.iaea.org/MTCD/publications/PDF/Pub1507\\_Web.pdf](http://www-pub.iaea.org/MTCD/publications/PDF/Pub1507_Web.pdf).

Knowledge networks for nuclear safety and security have been an integral element of the nuclear safety capacity building initiatives provided by the Agency. The Agency's Global Nuclear Safety and Security Network (GNSSN) provides a robust and comprehensive framework for enhancing global nuclear safety and security, by sharing knowledge, expertise and results at regional as well as national levels. The GNSSN has also been instrumental in harmonizing approaches and best practices to achieve sustainable nuclear safety infrastructure, by coordinating activities among global safety and security networks/forums, regional safety networks and National Nuclear Regulatory Portals (NNRPs).

On the regional front, safety networks such as the Arab Network of Nuclear Regulators (ANNuR), the Asian Nuclear Safety Network (ANSN), the European Nuclear Safety Regulators Group (ENSREG) the Forum of Nuclear Regulatory Bodies in Africa (FNRBA), the Ibero-American Forum of Radiological and Nuclear Regulatory Agencies (FORO), the Regulatory Cooperation Forum (RCF), Technical and Scientific Organizations Forum (TSOF) and the Western European Nuclear Regulators' Association (WENRA) work as effective and efficient platforms for establishing regional capacity building systems, through activities that include advisory and review missions, field visits, workshops and training courses, conducted in line with the Agency's safety standards and guidance documents. To date, the Agency has held over 100 workshops and missions within the GNSSN framework, involving participants from 94 Member States, representing nuclear regulatory authorities, governmental organizations and technical support organizations.

National safety and security infrastructure, national capacity building plans, good practices and lessons learned are reflected in the NNRPs. The NNRPs are interfaces between national stakeholders and the international nuclear safety community at large; but they are also harmonization mechanisms for national, regional and global nuclear safety and security knowledge management. To date, 32 Member States have developed an NNRP.

In reviewing developments in the area of nuclear installation during 2013, the Agency noted the following:

- Safety culture and leadership commitment to safety continue to be of major interest to the international nuclear community and to constitute a major challenge with regard to integrating improvements and lessons learned into a more systemic approach to safety. This was discussed during the International Experts' Meeting on Human and Organizational Factors in Nuclear Safety in Light of the Accident at the Fukushima Daiichi Nuclear Power Plant in May 2013.<sup>9</sup> Additionally, in October 2013, the Agency conducted a safety culture workshop for the senior management of Tokyo Electric Power Company (TEPCO) in Tokyo, Japan, where these topics and others were discussed.
- Site evaluation, installation design and external hazard assessment activities continue to strengthen safety infrastructures for countries with existing nuclear power programmes as well as for newcomer countries, especially for those who have used the Site and External Events Design (SEED) review service to address issues in the early stages of their nuclear power programme development. However, many newcomer countries still require much assistance in these areas and early utilization of SEED services can help Member States avoid situations needing correction that could occur during later stages of development.

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<sup>9</sup> The IEM Summary Report is currently in the publication process.

- Work continued on enhancing safety review services, such as the Design and Safety Assessment Review Service, the International Probabilistic Safety Assessment Review Team Service and the Generic Reactor Safety Review Service, and focused on the Safety Assessment Education and Training Programme. Under the Integrated Regulatory Review Service (IRRS), a new module was developed in 2013 for newcomer countries, which has been added to the IRRS Guidelines.
- In 2013, 42% of the world's nuclear power reactors had been in operation for more than 30 years, and another 7% for more than 40 years. Managing these reactors in the long term continues to pose challenges that need to be addressed and integrated into all operational aspects relevant to safety. Furthermore, in 2013, 70% of the world's research reactors have been in operation for more than 30 years with over half of them in operation for more than 40 years. The safety and availability of research reactors continues to be challenged by ageing-related failures. As reported to the IRSRR, prolonged shutdown of these reactors has led to and could lead to shortages of radioisotopes used for medical applications.<sup>10</sup>

In reviewing developments in radiation protection, waste and transport safety during 2013, the Agency noted the following:

- The medical diagnostic and therapeutic use of radiation continues to increase, with many associated benefits to patients. However, there is clearly widespread overuse and the number of patients who receive unnecessary radiation exposures is high. Balancing the potential risks against the known benefits of a given medical radiation procedure remains an ongoing challenge with regard to safety and patient radiation protection.
- Rising exposure to ionizing radiation in many occupations, stemming from both artificial and natural sources requires the existing protection of workers in all situations to be strengthened. Radon accounts for half the human exposure to radiation from natural sources, according to an assessment by the United Nations Scientific Committee on the Effects of Atomic Radiation<sup>11</sup>, with about one-fifth of the affected people working in shops, offices, schools and other premises in radon prone areas.<sup>12</sup>
- The Agency is preparing for the International Experts' Meeting on Radiation Protection after the Fukushima Daiichi Accident: Promoting Confidence and Understanding, which will focus on the complex technical, societal, environmental and economic issues in radiation protection. It will be held at the Agency's Headquarters in Vienna from 17 to 21 February 2014.
- More than 300 participants from nearly 90 Member States and six international organizations attended the IAEA International Conference on the Safety and Security of Radioactive Sources: Maintaining the Continuous Global Control of Sources throughout their Life Cycle, held in Abu

<sup>10</sup> For example, the National Research Universal reactor, located in Ontario, Canada, shut down from May 2009 to August 2010; this reactor generates isotopes used to treat or diagnose over 20 million people in 80 countries every year. The 2009 shutdown occurred at a time when only one of the other four worldwide regular medical isotope sourcing reactors was producing, resulting in a worldwide shortage.

<sup>11</sup> This publication is available at [http://www.unscear.org/docs/reports/2006/09-81160\\_Report\\_Annex\\_E\\_2006\\_Web.pdf](http://www.unscear.org/docs/reports/2006/09-81160_Report_Annex_E_2006_Web.pdf).

<sup>12</sup> See *Radiation Protection against Radon in Workplaces other than Mines* (Safety Reports Series No.33), available at: [http://www-pub.iaea.org/MTCD/publications/PDF/Pub1168\\_web.pdf](http://www-pub.iaea.org/MTCD/publications/PDF/Pub1168_web.pdf).

Dhabi, United Arab Emirates, in October 2013. Its purpose was to review current successes and challenges in ensuring the safety and security of radioactive sources and to identify means of maintaining the highest possible levels of safety and security from manufacture to disposal.

- Member States continue to strongly support the Code of Conduct on the Safety and Security of Radioactive Sources. 119 Member States have committed to follow the Code provisions in the development of their policies, laws and regulations, 85 Member States have expressed their intention to act in accordance with the related Guidance on the Import and Export of Radioactive Sources, 125 States have designated a point of contact to facilitate the import/export of sources in accordance with the Code and 68 Member States have submitted national reports for the previously-mentioned Abu Dhabi conference detailing their level of implementation of the Code and the Guidance.
- As requested by Member States in resolution GC(57)/RES/9, the results of the discussion conducted during the initial development of a code of conduct on the transboundary movement of radioactive material inadvertently incorporated into scrap metal and semi-finished products of the metal recycling industries will be made available in a technical document.<sup>13</sup>
- Denials of shipment for radioactive material remain an issue. The Denials Working Group was formed following the final meeting of the International Steering Committee, which was disbanded in 2013, to continue working towards resolving this important issue.
- The disposal of high level radioactive waste remains a challenge. The demonstration of the long term safety of geological disposal facilities through the development of safety cases is progressing and some Member States are moving towards the licensing process. Due to the lack of implementation of disposal solutions for high level radioactive waste and spent fuel, longer periods of storage have to be considered, and will continue to pose safety challenges as well as concern for the public. The decommissioning of nuclear facilities damaged by severe accidents remains a difficult and long-standing challenge. In August 2013, Japan launched the International Research Institute for Nuclear Decommissioning to address the challenges in decommissioning the Fukushima Daiichi NPP.
- The Agency's Modelling and Data for Radiological Impact Assessments (MODARIA) programme, aimed at addressing remediation of contaminated land, continues to investigate different aspects of remediation and to identify situation-specific remedial actions for nuclear legacies and sites with enhanced levels of natural radionuclides due to mining activities. The MODARIA programme will conclude in 2015.

In 2013, emergency preparedness and response issues and activities at both the national and international levels included the following:

- Embarking countries have increased their demand for assistance in the development of national EPR capabilities and arrangements. Additionally, there has been an increase in the number of Member States requesting targeted Emergency Preparedness Review missions; one review mission and three preparatory missions were conducted in 2013.

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<sup>13</sup> In May 2013, a batch of metal-studded belts sold by online retailer ASOS.com were confiscated and held in a US radioactive storage facility after testing positive for cobalt-60. This news article is available at: <http://news.sky.com/story/1096486/asos-belts-seized-over-radioactive-studs>

- The Agency continues to revise and harmonize the application of the EPR methodology within the framework of the IRRS missions, enhancing its focus on EPR regulations and regulatory effectiveness.
- The Agency is modernizing its training, e-training and train the trainer materials, and is developing a modern learning management system for EPR training.
- A publication on the effective use of the International Nuclear Event Scale (INES) for event communication was finalized in 2013 and will be published in 2014; it includes an annex on lessons learnt on the Fukushima Daiichi accident. The INES Rating Interactive Learning Tool was developed and will be available on the Agency's website in the first quarter of 2014.
- At the international level, many States Parties to the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (Assistance Convention)<sup>14</sup> failed to fulfil their obligations in identifying and notifying the Agency of their national assistance capabilities. Furthermore, no State Party has registered its capabilities in the new functional area of nuclear installation assessment and advice; this is especially critical should a severe nuclear emergency occur again.
- Referred to as a Convention Exercise (ConvEx), a ConvEx-1 tests communication; a ConvEx-2 tests response times; and a ConvEx-3 tests the full operation of the information exchange mechanism worldwide. This year, the Agency conducted four ConvEx-1 exercises, two ConvEx-2 exercises and one ConvEx-3 exercise.<sup>15</sup>
- Pursuant to the Action Plan that expanded the IAEA Secretariat's response role in an emergency at a nuclear power plant, the assessment and prognosis process was developed; constraints and limitations identified; tools for assessment and prognosis set up and trained; and discussion with Member States on minimum required set of data/parameters needed for assessment and prognosis initiated.

The following trends related to improving regulatory infrastructure and effectiveness were noted in 2013:

- Some Member States continue to struggle to establish and maintain a national radiation safety regulatory infrastructure in line with the Agency's safety standards and adequate to the level of risks posed by the actual use of radiation sources; ensuring that Member States' radiation safety infrastructure, and in particular their regulatory framework, is adequate remains high on the Agency's as well as the international agenda.
- Some Member States, especially newcomer countries, continue to have difficulties in establishing priorities for the development or enhancement of their national regulatory infrastructures, often

<sup>14</sup> By the end of 2013, there were 107 States Parties to the Assistance Convention

<sup>15</sup> The Convention on Early Notification of a Nuclear Accident (Early Notification Convention) and the Assistance Convention are the prime legal instruments that establish an international framework to facilitate the exchange of information and the provision of assistance in the event of a nuclear accident or radiological emergency. The Agency has specific functions allocated to it under these Conventions and regularly conducts ConvEx exercises whereby it and other emergency response bodies work around the clock during the drill, as if a severe radiological emergency were actually occurring.

lacking in capacity building programmes to aid in adequately trained human resources, which as a result are also in short supply. The Agency is assisting an increasing number of States to develop national strategies for education and training in radiation, transport and waste safety as one of the key mechanisms that can contribute towards sustainable capacity building.

The Agency and the International Expert Group on Nuclear Liability (INLEX) continued to work towards facilitating the achievement of a global nuclear liability regime, as called for in the Action Plan, through meetings, workshops and missions to Member States. In addition, INLEX developed key messages on the benefits of joining the international nuclear liability regime, to be used during legislative assistance activities carried out by the Agency.

In 2011, the Agency started a review of Safety Requirements publications in the IAEA Safety Standards Series on the basis of information that was available on the Fukushima Daiichi accident. As a first priority, the Agency considered the Safety Requirements applicable to NPPs and to the storage of spent fuel. The comparative review consisted first of a comprehensive analysis of the findings of the reports. In light of the results of this analysis, the Safety Requirements publications were then examined in a systematic manner in order to decide whether amendments were desirable to reflect any of these findings.

The Appendix contains a summary of activities related to the Agency's safety standards during 2013. This Appendix highlights newly published standards and guidance as well as the activities of the CSS and the various safety standards committees. Of particular note were the activities covering the review prompted by the Action Plan and the proposed improvements to the standards identified. Additionally, the review provided by the Safety/Security Interface Group concluded that nearly 80% of the safety standards have some sort of interface with nuclear security guidance publications and more than 80% of the nuclear security guidance publications being developed have an interface with safety.

# Analytical Overview

## A. Strengthening Safety in Nuclear Installations

### A.1. Leadership and Management for Safety

#### *Trends and Issues*

1. Effective plant safety management is a key indicator of overall leadership commitment to and strength of a plant's safety culture. Effective management for safety is about ensuring protection of the workers, the public and the environment from harm that could arise from the organization's activity and installations. It is the duty of senior management staff to provide strategic direction to the entire organization as well as to motivate staff to engage effectively in adopting good practices, attitudes and behaviours to ensure safety.
2. In nuclear installations, managers at all levels have to develop their leadership capabilities by understanding the context in which they are operating the plants, and give sense to everyone's action, establishing a common understanding of goals, objectives and policies, creating the vision of the future and creating the means to make the vision a reality.
3. *OSART mission highlights 2010–2012*<sup>16</sup> provides analysis results on managing safety issues. In 19 Operational Safety Review Team (OSART) missions conducted over a three-year period (2010-2012), the following safety issues, directly related to leadership, human behaviour, awareness of risks and the management system, were commonly found at NPPs:
  - Deficiencies were not systematically identified and reported (50% of the sites);
  - Material conditions and housekeeping were not at the expected standards (60% of the sites);
  - Personal protective equipment was not used systematically (50% of the sites);
  - Contamination control practices and measures to prevent spreading of contamination were often insufficient (70% of the sites);
  - Management of fire loads and maintenance of firefighting equipment were lacking (80% of the sites).
4. Of the seven follow-up OSART missions conducted in 2013, insufficient progress was made in resolving some of the safety issues identified in four of the seven plants; this was an increase over follow-up mission results in previous years.
5. In 2013, both licensees and regulatory bodies demonstrated interest in performing safety culture assessments. The Agency has received multiple inquires about how to conduct these assessments; this

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<sup>16</sup> This publication is available at: <http://www-ns.iaea.org/downloads/ni/s-reviews/osart/osart-mission-highlights%202010-2012.pdf>

is an encouraging sign that nuclear organizations around the world are striving to understand and strengthen their safety culture. During the May 2013 International Experts' Meeting on Human and Organizational Factors in Nuclear Safety in Light of the Accident at the Fukushima Daiichi Nuclear Power Plant, one of the sessions highlighted the importance for the regulatory body to be aware of the influence of its own safety culture upon the safety culture of the licensee.

6. This IEM and the Technical Meeting on the Evolution of the Operational Safety Review Team (OSART) Service over the Last 30 Years, held in October 2013 in the Republic of Korea (where the first OSART mission was conducted in 1983), highlighted the fact that national factors can have both positive and negative impacts on safety culture. As this is a topic of growing concern, it was further recognized that safety culture assessments need to review key characteristics of the broader national factors when attempting to improve safety culture within a plant.

### ***Activities***

7. To address these issues, the Agency has conducted a number of activities in the area of leadership and management for safety and in the area of safety culture in 2013. For example, *The Management System for Facilities and Activities* (IAEA Safety Standards Series No. GS-R-3) is currently being revised and is in the final approval phase before publication. A draft publication on leadership and management for safety (to be published as IAEA Safety Standards Series No. GSR Part 2) will reinforce these aspects of leadership and management for safety and safety culture on the basis of feedback and lessons learned from OSART mission results and the Fukushima Daiichi accident.

8. At the previously-mentioned OSART Technical Meeting in the Republic of Korea, discussions were held on a proposal for improvements to the methodology for preparing and conducting OSART missions, as well as for the development of a safety culture enhancement toolbox (to include training, assessment, oversight tools and services) for use by both regulators and licensees.

9. During 2013, comprehensive safety culture self-assessment training was also developed and delivered to the Pakistan Nuclear Regulatory Authority. In conjunction with this training, a safety culture perception questionnaire for regulatory bodies was developed. Additionally, a regional workshop on the topic of safety culture for regulatory bodies took place in Slovenia in November.

10. In September 2013, the Agency conducted a training workshop on leadership and safety culture for senior management in Vienna which attracted 38 participants from 24 Member States. One of the outcomes of the workshop was new requests for the Agency to deliver similar workshops considering each Member State's context, inviting senior managers of the regulatory body, licensees, government agencies, technical support organizations and other stakeholders involved in the nuclear infrastructure.

11. In November 2013, at the request of Member States, a training workshop on safety culture assessment was conducted in Vienna and was attended by more than 45 participants from 30 Member States. Feedback from the participants indicated that the Agency's new safety culture assessment methodology and approach would help assessors to better understand the cultural dimension of the organization.

12. In October 2013, the Agency conducted a safety culture workshop for the senior management of Tokyo Electric Power Company (TEPCO) in Tokyo, Japan; more than 20 participants attended this workshop. The workshop covered the fundamentals of safety culture, self-assessment methodologies and the actions required to strengthen safety culture from corporate headquarters to nuclear power plants. Additionally, in June and August, two senior management workshops on proactive management for safety and safety culture were conducted at the Bushehr NPP in the Islamic Republic of Iran, where more than 25 senior managers and plant managers attended.

13. Finally, at the previously-referenced IEM on human and organizational factors, new perspectives on nuclear safety were presented and exchanged, such as the consideration of various national aspects, regulators' need for assessing their own safety culture, practical application of a systemic approach to safety, diversity of expertise with emphasis on behavioural science, preparedness for severe unexpected situations, and a new approach in developing resilience in high risk organization. The meeting engaged a high level of interaction on these topics. The IEM outcome addressed the need for participants and the Agency to review existing guidance and develop new ones to improve nuclear safety culture in the context of human and organizational factors.

### ***Future Challenges***

14. Despite the increased interest and engagement in safety culture improvement, safety culture remains a work in progress. The nuclear industry faces a challenge to integrate state-of-the-art research and experience in safety culture into its approach to nuclear safety. To do this effectively, specialized expertise is needed, both in Member States and in the Agency, to complement the technical and organizational approach to safety with competences and experience in applied behavioural sciences, ergonomics and social psychology, as required in the Agency's safety standards. It should be noted that some Member States e.g., Finland, France, South Africa, Sweden and the United States of America, have made significant progress in the use of behavioural science expertise in their nuclear safety programmes, serving as good examples for the international nuclear community.

## **A.2. Site Safety**

### ***Trends and Issues***

15. The site and environment of power reactors affect their safe operation. Site evaluation is, therefore, an essential component for assuring the safety of the public and the environment. Thorough site-specific external hazard assessments are essential for the development of a consistent and appropriate design basis for ensuring the safety of nuclear installations. The external hazard loads identified in the site hazard assessment are utilized in the design of the nuclear installation and provide a basis for the estimate of the loads to be considered in the beyond design basis safety assessment of the installation.

16. Adequate installation design is one of the primary defence in depth measures for ensuring the protection of the public and the environment against the harmful effects of ionizing radiation. Design adequacy is demonstrated by ensuring that the designed installation is capable of maintaining its intended function under the loads imposed by hazards that are identified in the site hazard characterization.

17. Therefore it is important to establish the site specific design parameters prior to the design of the installation. Countries embarking on nuclear power programmes continue to face challenges in establishing a national regulatory basis for site evaluation. The current trend in Member States is to rapidly develop a nuclear power programme without accounting for the resources needed to properly characterize the sites. Member States cannot adequately evaluate site safety without first having adequate regulatory requirements in place to ensure that the site is appropriate for the proposed power reactor design.

18. Newcomer countries that conduct a site hazard assessment after accepting a nuclear power plant design face the challenge of incorporating any modifications needed as a result of this assessment in the agreed design. This is especially difficult for newcomer countries that lack adequate knowledge of site hazards at the early stage of negotiations as they are often faced with the costs of retrofitting modifications based on site limitations to vendor designs at a later stage.

19. The Agency provides the Site and External Events Design (SEED) review service to assist Member States in the early stages of their nuclear power programme development. The use of the SEED review service at an early stage of vendor design negotiations will enable newcomer Member States to develop adequate regulations to harmonize the safety initiatives from the different Nuclear Steam Supply System vendors.
20. Those Member States that have utilized the SEED review services have benefited significantly by identifying site hazards in the early stages of the nuclear power programme.
21. The Fukushima Daiichi accident highlighted the importance of a proper site evaluation and subsequent 'stress tests' with the focus on assuring adequate safety margins for existing nuclear facilities. The Action Plan, endorsed by the General Conference, is geared towards strengthening safety globally, in part through the use of the Agency's safety documents and services designed to assure nuclear safety. Implementation of the Action Plan will continue to emphasize the importance of adequate site evaluations for Member States.
22. Most Member States have not systematically utilized the latest methodologies developed by the Agency to ensure a consistent design basis or to address issues that are beyond the design basis. When used in 'stress tests', these methodologies will provide a uniform basis for the determination of the safety vulnerabilities; an action proposed in the Action Plan.
23. Member States embarking on nuclear power programmes have the opportunity to gain significantly from these new methodologies as it allows them to establish a verifiable and consistent process in establishing the design basis for their proposed nuclear installations. In addition, the use of these methodologies allows Member States to validate the safety assessment of their proposed nuclear installations using a common framework.
24. For countries with existing NPPs, the SEED review service offer a series of methodologies for the assessment of all types of external hazards using a consistent framework.
25. In addition, the SEED review service provides for an international review of the Member State's own site evaluation. This peer review helps to provide a level of credibility to the site evaluation by aligning it with the Agency's safety standards. Furthermore, this peer review provides for a consistent baseline for use in the design and safety assessment of nuclear power reactors, providing a meaningful yardstick for establishing the plant safety margins and providing public assurance.

### ***Activities***

26. A significant body of methodologies has been developed by the Agency to estimate external hazard loads specific to the site.
27. In 2013, five newcomer countries (Bangladesh, Indonesia, Jordan, Turkey and Viet Nam) and the Czech Republic and Romania requested SEED services.
28. For Bangladesh, the Agency provided review and advisory services to assist in the development of their site acceptance criteria. This will form the basis for the further development of its site-related regulations.
29. Indonesia requested a mission to review the work done for Vanka Island. This mission will be conducted in 2014.
30. For Jordan, the Agency provided review and advisory services to assist in the development of their site selection process.

31. For Turkey, the Agency provided a two-week hands-on training course covering the review and development of site licensing applications, development of requests for additional information and the preparation of the safety evaluation report to be used in making a safety case for licence approval. This course used actual application data as part of the training material. In addition, several SEED missions were undertaken in Turkey to strengthen the technical knowledge of the regulatory staff in specialized areas.

32. In Viet Nam, the Agency provided reviews and recommendations for the development of site regulations and assisted the Vietnam Agency for Radiation and Nuclear Safety (VARANS) in the development of its guidance on site acceptance criteria. In addition, several SEED advisory missions were conducted to provide support to VARANS in the areas of seismic issues, human resources planning and development of technical review capabilities.

### ***Future Challenges***

33. Over the past three years, 19 SEED missions have been conducted leading to 337 recommendations, but few follow-up missions have been scheduled. Follow-up missions determine the progress the Member State has made to address the recommendations and demonstrate the Member State's commitment to improving nuclear safety.

34. Countries embarking on nuclear power programmes continue to face challenges in establishing a national regulatory basis for site evaluation and having the resources needed to properly characterize the sites. Member States cannot adequately evaluate site safety without first having adequate regulatory requirements in place to ensure that the site is appropriate for the proposed power reactor design. SEED missions, complemented by capacity building related to site safety topics, will continue to assist Member States as they develop a national regulatory basis and perform site evaluations for proposed nuclear power plants.

35. By using the SEED review service in the early stages of their nuclear power programme development, Member States can benefit from the use of a consistent set of methodologies in hazard assessment, which is an essential ingredient for establishing the safety of installations and sites. This can help to avoid subsequent challenges in the modification process if the site hazards assessment identifies additional issues that need to be addressed. In some cases, modifications that were intended to improve plant safety can actually result in degrading safety conditions because of unanticipated consequences. Such degraded conditions can remain undetected for long periods.

36. Implementation of SEED review recommendations can be challenging. However, it should be noted that all recommendations are established in consultation with each Member State concerned to ensure that the cost benefit of remedial actions can be reasonably achieved at the national level. Furthermore, by identifying remedial actions in their report to the Convention on Nuclear Safety, Member States will promote greater transparency and allow for the sharing of experience on remedial actions among Member States.

37. The Fukushima Daiichi accident showed that extreme external events can affect multiple units at a site. The SEED hazard assessment methodologies provide the flexibility to assess the safety of all units at a site in a holistic manner, a need that has not been addressed by the nuclear industry in the past. The SEED missions provide advisory and review services for establishing such a site level safety assessment.

### A.3. Reactor Design and Safety Assessment

#### *Trends and Issues*

38. Worldwide the nuclear industry is continually assessing the adequacy of the design of its facilities against new information including operating experience and the output of improved safety assessment. In light of the Fukushima Daiichi accident, this activity has taken on new importance and Member States have expended considerable resources conducting these reviews using the knowledge available to date from the accident. In some cases, these reviews have led to the imposition of new requirements or enhancements to requirements that existed prior to the accident. As the lessons from this accident continue to emerge, it is expected that these assessments will continue for the foreseeable future.

39. Safety assessment is used to assess the adequacy of designs against requirements, but the need to perform safety assessment is a requirement itself. As such, the capability and scope of safety assessments are continually improving and expanding. One such change has been the recent trend towards taking a holistic view of deterministic and probabilistic assessments and making decisions based on the combination of these two methods rather than looking at the results independently. Continuing these improvements to safety assessment will require a sustained commitment to methods development and training in the use of these state of the art approaches.

#### *Activities*

40. In 2013, the Agency began a pilot project to assess the adequacy of the Agency's safety standards in light of the Fukushima Daiichi accident. It was determined that the most effective approach would be to review certain Safety Requirements and Safety Guides with the following design-related safety standards being chosen: *Safety of Nuclear Power Plants: Design* (IAEA Safety Standards Series No. SSR-2/1)<sup>17</sup>; *Design of the Reactor Coolant System and Associated Systems in Nuclear Power Plants* (IAEA Safety Standards Series No. NS-G-1.9)<sup>18</sup>; and *Design of Reactor Containment Systems for Nuclear Power Plants* (IAEA Safety Standards Series NS-G-1.10).<sup>19</sup> Lessons learned from this review will also be incorporated into other Agency's safety standards.

41. Work to enhance safety review services was initiated in 2013 and efforts have primarily focused on the Design and Safety Assessment Review Service (DSARS); an integrated service that provides Member States with a safety assessment of their nuclear facilities using a methodology based on Agency safety standards. Work on DSARS was primarily focused on ensuring that the service was based on the latest available safety standards and was up to date regarding the most current developments in Probabilistic Safety Assessment. In 2013, Member States requested three International Probabilistic Safety Assessment Review Team missions and one Generic Reactor Safety Review.

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<sup>17</sup> The publication is available at: [http://www-pub.iaea.org/MTCD/publications/PDF/Pub1534\\_web.pdf](http://www-pub.iaea.org/MTCD/publications/PDF/Pub1534_web.pdf)

<sup>18</sup> The publication is available at: [http://www-pub.iaea.org/MTCD/publications/PDF/Pub1187\\_web.pdf](http://www-pub.iaea.org/MTCD/publications/PDF/Pub1187_web.pdf)

<sup>19</sup> The publication is available at: [http://www-pub.iaea.org/MTCD/publications/PDF/Pub1189\\_web.pdf](http://www-pub.iaea.org/MTCD/publications/PDF/Pub1189_web.pdf)

42. Safety assessment training continued to be a focus during 2013. The Agency conducted 30 Safety Assessment Education and Training (SAET) Programme in 2013 to provide training on the knowledge necessary for informed decision-making in the design, licensing and operation of nuclear facilities. SAET Programme courses offer the means to acquire sustainable safety assessment competency and support the development of specialized knowledge essential for the assessment and evaluation of safety through practical applications (see Figure 2). This year, the SAET Programme further increased the scope of its course content.

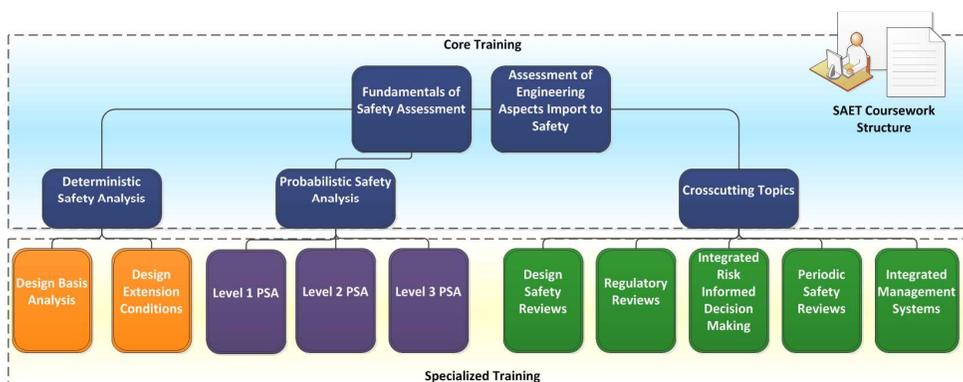


Fig 2. Core and specialized safety assessment training courses.

43. The Safety Assessment Advisory Programme (SAAP), based on the SAET Programme, was introduced in 2013 to assist Member States in assessing their development needs to perform and evaluate safety assessments for NPPs. SAAP has now been established in three Member States.

44. In Vienna, in October 2013, the Agency held the International Conference on Topical Issues in Nuclear Installation Safety, with a focus on advances and challenges in defence in depth. More than 130 participants from 40 countries and six regional and international organizations took part in the Conference. Defence in depth aims to provide layers of protection to workers, public and the environment. It is fundamental to the safety of nuclear installations and should be implemented during all stages of life cycles, from the design phase through operation and eventual decommissioning. Experts discussed international nuclear safety efforts, by reviewing current approaches and identifying future approaches in nuclear installations and their associated challenges. They focused on operating nuclear installations, including nuclear power plants, research reactors and fuel cycle facilities. The experts concluded that the implementation of the DID concept should be strengthened to maximize the safety of nuclear installation, and periodic safety reviews should be carried out across the entire life cycle of the installations. Experts also said there is a need to take full advantage of the Agency's review services, especially those related to siting, design and emergency preparedness.

### **Future Challenges**

45. Completing the review and update process for the Agency's safety standards, considering the complexity of the lessons learned from the Fukushima Daiichi accident, will be a very challenging task for both Member States and the Agency to maintain the necessary financial and staff resources to ensure that these efforts can continue for the years to come.

46. In 2013, Member States showed significant interest in the DSARS modules on probabilistic safety assessment reviews. However, other DSARS modules will require further development to address the emerging nuclear safety complexities stemming from the lessons learned from the Fukushima Daiichi accident. These additional DSARS modules will extend the capabilities of the review by providing a more comprehensive safety assessment. Increasing the utilization of these

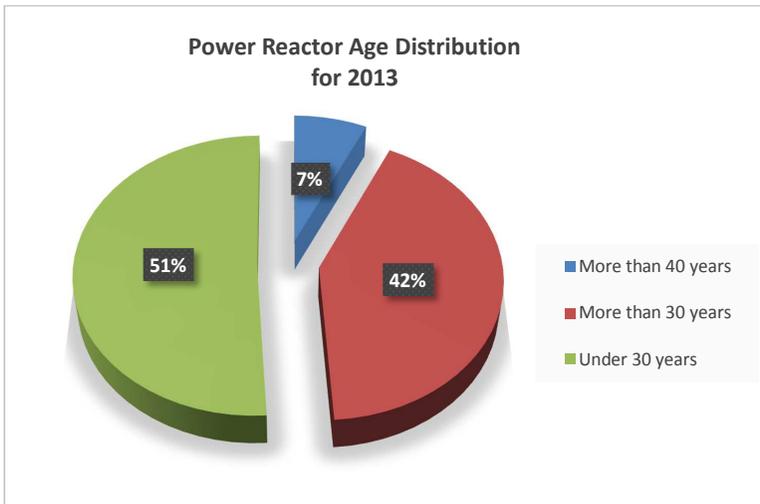
services will require sustained resources to allow the Agency to further develop the modules and carry out the reviews.

47. Expanding the access to and utilization of safety assessment training services is another future challenge. As reflected by the growing demand for the SAET Programme in 2013, there is a strong need for safety assessment training and the portions of the SAET Programme curriculum that are complete have been effectively utilized. Continued support from Member States will, therefore, be needed to complete the SAET Programme curriculum, update it to reflect changes introduced following the revisions to safety standards and to expand its implementation to Member States that have a capacity building programme.

## A.4. Long Term Operation of Power Reactors

### *Trends and Issues*

48. An area of increasing importance for many NPPs around the world is 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 NPP. As of the end of 2013, of the 434 NPPs operating in the world, 42% had been in operation for more than 30 years, and another 7% for more than 40 years (see Figure 3). The number of NPPs that are eligible for an extension of their operating life is growing and hence the LTO issue needs to be systematically addressed and integrated into all aspects relevant to safety.



*Fig. 3. Age distribution for all power reactors in 2013.*

49. In 2013, the Agency’s Safety Aspects of Long Term Operation of Water Moderated Reactors Peer Review Service (SALTO) generated interest among several Member States. Nevertheless, there are still many Member States with reactors approaching the end of their original design lifetimes that have yet to request a SALTO peer review mission.

50. On the other hand, a new trend appeared in 2013 where some Member States requested that their SALTO mission reports remain restricted either temporarily or permanently, possibly due to increased media attention and public opinion on operating NPPs.

51. The increasing number of participating Member States (26) in the Agency's International Generic Ageing Lessons Learned (IGALL) programme in 2013, shows the high significance of ageing for operating NPPs.

### ***Activities***

52. The Agency provided eight SALTO workshops/seminars to six Member States (Bulgaria, Canada, China, Japan, Mexico and Sweden) in 2013, in preparation for actual SALTO missions. These workshops/seminars resulted in an increased understanding of the SALTO peer review service and in an increased number of SALTO missions. Based on Member State requests, a new human resources, competence and knowledge management review area was introduced in the review programme. In addition, new SALTO guidelines were published. The scope, time schedule, terminology, reporting and procedures for SALTO peer review services were also standardized in this document.

53. The first phase of the IGALL programme was successfully completed at a Technical Meeting in September 2013, attended by 64 participants from 25 Member States and the European Commission. The IGALL safety report, which includes consolidated IGALL database information on 76 ageing management programmes, 27 time limited analyses and about 2 400 lines of data from the ageing management review tables was prepared for publication. A Technical Document on approaches to ageing management was also prepared for publication as a by-product of the programme. Further development of the IGALL ageing management programmes and time limited analyses is planned for 2014 and 2015.

### ***Future Challenges***

54. Insufficient national policies, processes and procedures that would ensure the required safety functions throughout the service life of an NPP and lack of peer review could result in the occurrence of safety issues during the LTO period. All Member States with NPPs approaching the end of their original design lifetimes are encouraged to request a SALTO safety review service to ensure that ageing management programmes and other programmes and processes are in line with the Agency's safety standards and guidelines for safe LTO.

55. The IGALL Technical Meeting held in September 2013 concluded that Member States should use the recently published IGALL safety report (which includes the IGALL database) as a guidance tool to address ageing management. Another outcome from this meeting highlighted that *Ageing Management for Nuclear Power Plant* (IAEA Safety Standards Series No. NS-G-2.12) needed to be revised to update parts on obsolescence management, scoping and screening, ageing management reviews, and revalidation of time limited ageing analysis, as well as some of the terminology used<sup>20</sup>.

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<sup>20</sup> The publication is available at: [http://www-pub.iaea.org/MTCD/publications/PDF/pub1373\\_web.pdf](http://www-pub.iaea.org/MTCD/publications/PDF/pub1373_web.pdf)

## A.5. Long Term Operation of Research Reactors

### *Trends and Issues*

56. The safe operation of ageing research reactors worldwide continues to be of concern for research reactor operators, regulators and the public. As indicated in Figure 4, 70% of the 247 operating research reactors have been in operation for more than 30 years — about 55% exceeding 40 years of operation. The safety and availability of these reactors continues to be affected by the negative impacts of ageing structures, systems and components (SSCs). Ageing-related SSC failures continue to be one of the primary root causes of incidents reported to the Agency’s Incident Reporting System for Research Reactors. Ageing-related failures are also one of the main causes of unanticipated shutdowns of many research reactors, including in particular, the major isotope-producing reactors, which have recently reported repeated ageing-related problems. The possibility of recurrence of these problems cannot be fully excluded and prolonged shutdown could lead to shortages of the radioisotopes used for medical applications and in turn lead to spikes in the price of isotopes.

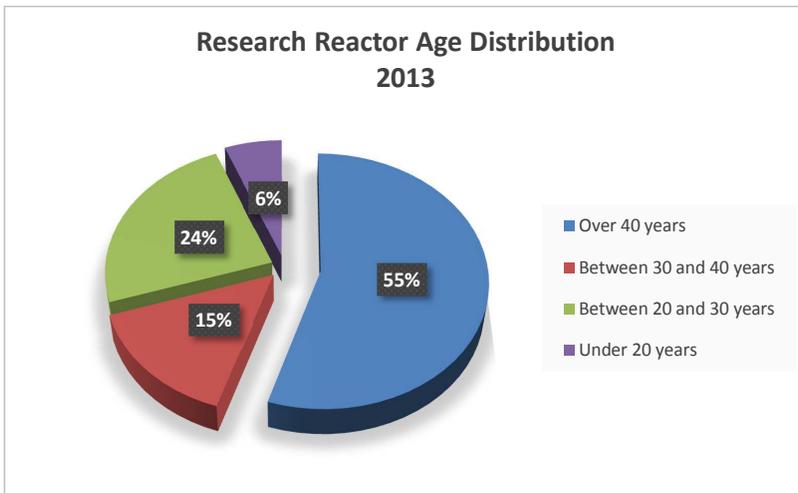


Fig 4. Age distribution for all research reactors in 2013.

57. Lessons learned from the Fukushima Daiichi accident have raised concerns about ageing research reactors as the majority of them were built to earlier safety standards that are not fully consistent with the current Agency’s safety standards and the Agency’s concept of defence in depth. Moreover, a formal process for periodic safety review similar to that for nuclear power reactors has not been established for research reactors, and the safety analyses for many of them have not been updated to incorporate modifications to the facilities and changes in the characteristics of their sites and site vicinity areas.

## *Activities*

58. Following the publication in 2010 of *Ageing Management for Research Reactors* (IAEA Safety Standards Series No. SSG-10),<sup>21</sup> the Agency developed a Safety Guide on the instrumentation and control and software important to safety for research reactors, which is in the last stage of approval for publication. This publication will provide guidance on the design and operation of the instrumentation and control systems, including computer-based systems, and on the safe replacement and modernization of obsolete instrumentation and control systems for research reactors.

59. The Agency continued to support Member States in the establishment of effective ageing management programmes through the organization of regular Technical Meetings and training activities. The International Workshop on Research Reactor Ageing, Modernization and Refurbishment, held in October 2013 in the Republic of Korea with the participation of 34 Member States, provided an excellent forum for sharing knowledge and exchanging experience on the safe and effective implementation of ageing management programmes. The biennial Technical Meeting on the Safety of Research Reactors under Project and Supply Agreements and Review of their Safety Performance Indicators, held in May 2013 in Vienna with the participation of 15 Member States, discussed good practices and defined practical actions to be taken by reactor operators to improve maintenance, periodic testing and in-service inspection programmes. A national workshop was conducted in Indonesia in December 2013 on the establishment and implementation of periodic safety reviews of research reactors; this contributed to developing national capabilities for carrying out such reviews.

60. The Agency also initiated a coordinated research project (CRP) on the establishment of a material properties database for irradiated core structural components for continued safe operation and lifetime extension of research reactors, with the participation of senior experts from research reactor organizations of 14 Member States. The first research coordination meeting of this CRP was held in November 2013 in Vienna where the individual work plans were developed and integrated. The CRP results will be published and are expected to provide valuable information for improving design provisions and operational practices for effective ageing management.

61. Additionally, the Agency continued to support technical cooperation projects addressing ageing management issues at facilities in Bangladesh, the Democratic Republic of the Congo, Egypt, Indonesia, the Islamic Republic of Iran and Uzbekistan. Expert missions conducted in 2013 under these projects contributed to improving ageing management at these facilities, including by safely replacing the instrumentation and control system of the research reactor in Uzbekistan, identifying specific actions to be taken to refurbish and modernize reactors in Egypt and in the Democratic Republic of the Congo, and establishing ageing management programmes for the research reactors in Bangladesh, Indonesia and the Islamic Republic of Iran.

62. In 2013, the Agency also conducted three Integrated Safety Assessment of Research Reactors (INSARR) missions at research reactors in Israel, Italy and South Africa. These missions provided recommendations and suggestions to further enhance the safety of the ageing research reactors in Israel and South Africa, and recommended actions to be implemented for the renewal of the operating licence of the research reactor in Italy. The follow-up INSARR mission conducted at the reactor in

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<sup>21</sup>The publication is available at: [http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1447\\_web.pdf](http://www-pub.iaea.org/MTCD/Publications/PDF/Pub1447_web.pdf).

Romania provided additional suggestions to improve the operational safety performance of the new instrumentation and control system that was installed following recommendations provided by previous Agency safety missions carried out in 2010 and 2011.

### ***Future Challenges***

63. Research reactor operating organizations are establishing systematic ageing management programmes based on the Agency's safety standards. These programmes include refurbishment and modernization projects to improve safety performance that has degraded over the reactors' lifetimes, requiring comprehensive safety analyses and safety assessments in the light of lessons learned from the Fukushima Daiichi accident. In addition, developing and implementing effective ageing management programmes for research reactors requires the establishment of a formal process of periodic safety reviews, using the experience acquired from the application of similar processes for nuclear power reactors.

64. It is a challenge for operators and regulators to implement these activities. Operating organizations are faced with limited human and financial resources and regulators have difficulty in developing their abilities to provide timely reviews and assessments of the relevant safety submissions and to establish criteria for ageing research reactors with due balance and care given to safety, public health and political implications. Another challenge is the need to make significant improvements in the availability and capabilities of research reactors that can potentially produce medical radioisotopes to supplement or replace the major isotope-producing reactors that are facing temporary or final shutdown due to repeated ageing problems.

## **A.6. Managing Severe Accidents at Nuclear Power Plants**

### ***Trends and Issues***

65. Based on the lessons emerging from the assessment of the Fukushima Daiichi accident, it can be concluded that there is a need to review existing severe accident management programmes. All Member States with nuclear power programmes have begun an evaluation of their severe accident management programmes and although all Member States with the exception of Japan have concluded that their nuclear power plants (NPPs) are safe to continue operating (the Japanese Nuclear Regulatory Authority is currently conducting restart reviews of Japanese NPPs), much work remains. This work falls into three broad categories: improvements to the technical basis of severe accident management guidance, training on severe accident response and proper regulatory treatment of severe accident programmes.

66. One specific issue that continues to be important is how to improve the integration of mobile, field deployable equipment for use as part of the on-site response to a severe accident. Proper consideration of this issue will lead to a better coordinated response to severe accidents by ensuring that resources are both available and effectively used. Given that this is an emerging issue the Agency's Safety Standards and training programmes do not address this issue and it will need to be considered as part of the Agency's normal process for the update and review of Safety Standards and the creation of associated training programmes.

## ***Activities***

67. *Severe Accident Management Programmes for Nuclear Power Plants* (IAEA Safety Standards Series No. NS-G-2.15) was issued in 2009 and therefore does not reflect knowledge from the Fukushima Daiichi accident<sup>22</sup>. In 2013, the Agency held two consultancy meetings to discuss proposals to revise this safety standard as approved by the Nuclear Safety Standards Committee. The revised version of this safety standard reflecting lessons learned from the Fukushima Daiichi accident is due to be completed in 2015; it will reflect input from both the IAEA Fukushima Report and the Seventh International Experts' Meeting on Severe Accident Management in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant to be held in March 2014.

68. In October 2013, the Agency hosted the Technical Meeting on Source Term Evaluation for Severe Accidents. The purpose of this meeting was to address source term evaluation for reactor design, the use of source terms for regulatory applications, the state-of-the-art in source term modelling in different power reactor types, and the use of source term methods for accident management and emergency response. A Technical Document will be issued as a result of this meeting.

## ***Future Challenges***

69. The nuclear industry needs to continue focusing resources on improving severe accident management capabilities because this capability is the key to the success of defence in depth level 4 — the last line of defence prior to the onset of significant off-site consequences. The Agency will continue its efforts to support Member States in this area and to develop the means of sustaining these improvements through such activities as the Seventh International Experts' Meeting on Severe Accident Management in the Light of the Accident at the Fukushima Daiichi Nuclear Power Plant to be held in March 2014 in Vienna and through updates to safety standards as appropriate.

70. There is a diversity of opinion amongst worldwide regulators on the regulation of severe accident management provisions. Reaching an international consensus regarding the regulatory treatment of severe accident management provisions will be difficult. Some of the challenges foreseen revolve around issues arising from the lessons learned from the Fukushima Daiichi accident, the recently proposed enhancements to defence in depth, and whether severe accident management provisions should be voluntary or compulsory, as well as the factors that flow from this decision, such as how to determine the applicable safety classification of structures, systems and components deemed to be of the highest importance in maintaining safe operation.

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<sup>22</sup> The publication is available at: [http://www-pub.iaea.org/MTCD/publications/PDF/Pub1376\\_web.pdf](http://www-pub.iaea.org/MTCD/publications/PDF/Pub1376_web.pdf)

## **B. Improving Radiation, Transport and Waste Safety**

### **B.1. Radiation Protection of Patients, Workers and the Public**

#### *Trends and Issues*

71. Radiation in diagnostic, interventional and therapeutic procedures in medicine provides benefits to hundreds of millions of people each year. However, physicians must carefully balance the potential benefits and the risks related to radiation exposure of people when using these medical procedures. The Agency continues its work to support the reduction of unnecessary exposures of ionizing radiation in medicine, as a substantial percentage of individual medical exposures are unjustified.

72. Applications of nuclear and radiation technologies have been contributing to industrial efficiency, energy conservation and environmental protection for many years. However, given the increase in use of these technologies, the number of workers exposed to ionizing radiation is also increasing worldwide. Occupational exposure in some sectors, such as in interventional cardiology and industrial radiography, need to be highlighted. Furthermore, radiation protection in industries involving exposure to naturally occurring radioactive material (NORM) should be strengthened by identifying specific activities that give rise to radiation exposure and the application of a graded regulatory approach to control the exposure. This is directly linked to the increase in the dose coefficient for radon and may have important implications for the regulation of NORM industries. An additional important issue to be addressed is related to reducing the dose limits for the lens of the eye and monitoring this reduction.

73. In the immediate aftermath of the Fukushima Daiichi accident, considerable attention was focused on the radioactive contamination of food and drinking water. There are several international standards relating to radionuclides in food and drinking water which are used in emergency exposure situations and in existing exposure situations. The activity concentrations contained in these standards differ due to a number of factors and assumptions underlying the common objective of protecting consumers under different circumstances. Therefore, there are several different sets of activity concentrations for radionuclides in food and also in drinking water that are in use around the world. The reasons for having these different activity concentration values, the criteria on which they are derived and the circumstances under which they are intended to be applied are not always clearly understood.

#### *Activities*

74. The Bonn Call for Action was an important outcome of the International Conference on Radiation Protection in Medicine — Setting the Scene for the Next Decade, held in December 2012 in Bonn, Germany. It 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 the strengthening of radiation protection in medicine<sup>23</sup>. The Bonn Call for Action was issued as a joint position statement by the Agency and the World Health Organization in July 2013.

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<sup>23</sup> The publication is available at: <https://rpop.iaea.org/RPOP/RPoP/Content/News/bonn-call-for-action-joint-position-statement.htm>.

75. The Agency held the Technical Meeting on Justification of Medical Exposure and the Use of Appropriateness Criteria in Vienna in March 2013. More than 60 medical professionals and regulators from 34 Member States attended to identify challenges and opportunities for strengthening justification in the use of radiological imaging. Some of the issues faced by the participants included the development and adoption of imaging guidelines specific to the needs of their country, how to support the use of these guidelines by the referring practitioners and how to evaluate the successful use of the guidelines.

76. Furthermore, the Technical Meeting on Patient Radiation Exposure Tracking: Progress Assessment and Development of Further Actions was held in September 2013. The technology in this area has now advanced to an extent where tracking of patient exposures and dose is a reality in many countries. The need to develop training material for patient exposure and dose tracking was highlighted at the meeting.

77. The Agency, together with the competent organs of the United Nations and, as an observer, the International Commission on Radiological Protection (ICRP), has developed a discussion paper on international standards for radionuclide contamination of food and drinking water and the circumstances in which they are intended to be used. Technical consultants with experience in this area from several Member States were also involved. The paper outlined steps that could be taken by international organizations and Member States to facilitate the recognition, understanding and implementation of international standards.

### ***Future Challenges***

78. Using radiation in medicine requires a careful balance between the benefits of enhancing human health and welfare, and the risks related to the radiation exposure of people. The aims of the Bonn Call for Action are to strengthen the radiation protection of patients and health workers overall; attain the highest benefit with the least possible risk to all patients by the safe and appropriate use of ionizing radiation in medicine; aid the full integration of radiation protection into health care systems; help improve the benefit/risk-dialogue with patients and the public; and enhance the safety and quality of radiological procedures in medicine.

79. The Agency will prepare a Technical Document utilizing, inter alia, the discussion paper mentioned above and addressing issues identified by international organizations on radioactive contamination of food and drinking water for existing post-emergency exposure situations. An overall framework and standards need to be established, covering dose criteria and operational levels in food and drinking water. This Technical Document will provide information on factors that should be considered in the framework, but the focus will be on the methodology for developing the operational levels or standards at national levels.

80. Member States are encouraged to ensure that appropriate coordination mechanisms for all relevant governmental bodies are established in advance to ensure that national safety standards will be effectively implemented when dealing with contaminated food and drinking water in the aftermath of a nuclear or radiological emergency.

## **B.2. Strengthening Control over Radiation Sources**

### ***Trends and Issues***

81. Recycling metal conserves raw materials and landfill space. Worldwide, over 400 million tonnes of metal are recycled each year from cans, cars and construction sites and shipped across the globe. However, lost radiation sources can end up in the scrap metal and expose workers, the public

and consumers to deadly levels of radiation. The best known example of this type of event was the Goiânia accident, in 1987 in Brazil. In accordance with resolutions GC(53)/RES/10, GC(54)/RES/7, GC(55)/RES/9, and GC(56)/RES/9, since 2010 the Agency has been developing a code of conduct on the transboundary movement of radioactive material inadvertently incorporated into scrap metal and semi-finished products of the metal recycling industries. In 2013, the General Conference, in resolution GC(57)/RES/9 did not address the future development of such a code of conduct, but instead encouraged the Secretariat to make the results of the discussions conducted on this issue available to Member States in a Technical Document.

82. Control of radioactive sources has significantly improved in the past ten years, since the publication of the Code of Conduct on the Safety and Security of Radioactive Sources. However, there remain some challenges and weaknesses in specific areas, such as the long term management of spent and legacy radioactive sources. In addition, international cooperation is still needed to establish or strengthen national infrastructures for the control of sources worldwide, especially in the development and use of radiation technologies in the health sector.

### *Activities*

83. The *International Conference on the Safety and Security of Radioactive Sources: Maintaining the Continuous Global Control of Sources throughout their Life Cycle*, held in Abu Dhabi in October 2013, was hosted by the Government of the United Arab Emirates through the Federal Authority for Nuclear Regulation, in cooperation with the International Criminal Police Organization (INTERPOL), the ICRP and the International Source Suppliers and Producers Association. It was attended by more than 300 participants from 90 Member States and six international organizations. Its purpose was to review successes and challenges in ensuring the safety and security of radioactive sources and to identify means to maintain the highest levels of safety and security throughout their lifecycle — from manufacture to disposal. The participants discussed approaches to strengthen the safety and security of radioactive sources, including during import, export, return and repatriation, recycling and disposal of sources; new and alternative technologies applied to radiation sources; long term safe and secure management of disused and legacy sources; emergency management of safety and security relevant events; control and protection within different facilities; and communicating with the general public.

84. States continue to be interested in and to support the Code of Conduct on the Safety and Security of Radioactive Sources. As of December 2013, 119 States had explicitly stated their commitment to using the Code as guidance in the development and harmonization of their policies, laws and regulations. As of December 2013, 85 States had explicitly expressed their intention to act in accordance with the related Guidance on the Import and Export of Radioactive Sources. Moreover, as of December 2013, 125 States had designated a point of contact for facilitating the import/export of sources in accordance with the Code and the Guidance. In addition, 68 States submitted national reports for the Abu Dhabi conference, as per the formalized process to share information and experience in implementation of the Code. Efforts should continue to ensure the full, harmonized implementation of the Code and the Guidance, as recognized at the Abu Dhabi conference. Actions were also initiated to improve the reporting guidelines for preparing national reports, to facilitate systematic self-assessment against all provisions of the Code and to facilitate more in-depth information sharing.

85. Recognizing the importance of the issues related to the transboundary movements of scrap metal or semi-finished products of the metal recycling industry inadvertently containing radioactive material, and in response to resolution GC(57)/RES/9 and the concerns stated during the Abu Dhabi conference, the Agency has already taken necessary actions to publish the results of the discussions conducted on this issue and will organize regional meetings to further address the issue upon request.

## ***Future Challenges***

86. As highlighted in the President's findings of the Abu Dhabi conference, challenges remain in strengthening the control of radioactive sources. Support for the Code of Conduct on the Safety and Security of Radioactive Sources should remain high. Such support would encourage more States to express their political support and encourage all States to move from political support to full implementation. Additional guidance is required to assist States in selecting the most relevant and sustainable approaches to ensure the long term safety of radioactive sources, taking into consideration technical and financial constraints.

## **B.3. Strengthening the Safe Transport of Radioactive Material**

### ***Trends and Issues***

87. Some 20 million packages of radioactive material are transported around the world each year with less than 5% associated with the nuclear industry. As cancer diagnosis and treatment procedures become more widely available and the need for other humanitarian applications in agriculture and drinking water sanitation increases in developing States, the ability to safely and securely deliver and return radioactive sources and other radioactive material is fundamentally important. In response to this growing demand, the Agency developed in 2013 with plans to initiate in 2014 a regional network approach to training relevant to transport regulatory infrastructure. This will provide a platform upon which Member States will be encouraged to improve their own regulatory infrastructure whilst collaborating on a regional basis to provide an effective transport regulatory infrastructure including regulatory oversight. Early feedback from a technical cooperation project in Africa which started in 2013 and was used as a pilot project for transport safety, indicates that this regional network approach is effective and provides measurable rates of progress.

### ***Activities***

88. The latest review cycle of *Regulations for the Safe Transport of Radioactive Material* (IAEA Safety Standards Series No. SSR-6)<sup>24</sup> was completed in 2013 by the Transport Safety Standards Committee with a decision not to begin a revision cycle. Several of the proposed changes to SSR6 made by Member States have been taken forward for further development in 2014 and the results will be submitted to Member States in the 2015 review cycle of SSR6.

89. The revision process for *Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material* (IAEA Safety Standards Series No. TS-G-1.1 (Rev.1))<sup>25</sup> reached its final stages in 2013 and publication of the revised standard is expected in 2014.

90. The revision process for *Planning and Preparing for Emergency Response to Transport Accidents Involving Radioactive Material* (IAEA Safety Standards Series No. TS-G-1.2 (ST-3))<sup>26</sup> has begun and is scheduled to continue in 2014.

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<sup>24</sup> The publication is available at: [http://www-pub.iaea.org/MTCD/publications/PDF/Pub1570\\_web.pdf](http://www-pub.iaea.org/MTCD/publications/PDF/Pub1570_web.pdf)

<sup>25</sup> The publication is available at: [http://www-pub.iaea.org/mtcd/publications/pdf/pub1325\\_web.pdf](http://www-pub.iaea.org/mtcd/publications/pdf/pub1325_web.pdf)

<sup>26</sup> The publication is available at: [http://www-pub.iaea.org/MTCD/publications/PDF/Pub1119\\_scr.pdf](http://www-pub.iaea.org/MTCD/publications/PDF/Pub1119_scr.pdf)

91. The revision process for *Schedules of Provisions of the IAEA Regulations for the Safe Transport of Radioactive Material (2005 Edition)* (IAEA Safety Standards Series No. TS-G-1.6)<sup>27</sup> has begun with the addendum relating to *Regulations for the Safe Transport of Radioactive Material: 2009 Edition* (IAEA Safety Standards Series No. TS-R-1) scheduled for publication in 2014, and the full revision relating to No. SSR-6 (2012 edition) continuing throughout 2014 with publication expected in 2015.

92. Transport training courses were held in China (Beijing), as part of a TC Project in the Asia Region and in Pakistan, in late 2013.

93. Denials of shipment of radioactive material remain an issue and a Denials Working Group was formed in 2013 following the final meeting of the Agency's International Steering Committee on Denials of Shipment of Radioactive Material in 2013. A work programme will be developed early in 2014 for the Group, which will require continued support from the Agency.

### ***Future Challenges***

94. The denial and delay of shipment of radioactive material continues to provide a fragile delivery network in some parts of the world and continues to present challenges and potentially inhibit Member States in developing their health care programmes and other uses of radioactive material. The denials of shipment issue also has the potential to significantly restrict the future capabilities of Member States to maintain their existing mature health care programmes if these rely upon the international transport of radioactive material. In response the Agency will continue its efforts to address this issue by its regional approach strategy for transport matters.

95. On a regional basis, training initiatives will be focused to provide a lasting and continuous programme of improvements in the area of transport regulatory infrastructure and oversight. The effectiveness of this approach will rely upon maintaining some level of Agency's involvement to encourage achievements of milestones over a period of several years. This longer term involvement will require some changes to the approach, resources and funding models currently in use and this will be further discussed in 2014.

## **B.4. Strengthening the Safety of Waste Management and Decommissioning**

### ***Trends and Issues***

96. Progress has been made on the implementation of safe solutions for the management and disposal of radioactive waste, in particular on the management of disused sealed sources, the safety implications of very long storage periods, the disposal of high level radioactive waste and spent fuel, and lessons learned from the Fukushima Daiichi accident.

97. However, despite the progress, disposal of high level radioactive waste remains a challenge. In particular, the demonstration of long term safety for disposal facilities needs to be considered holistically to address very long periods of time, integrating a broad range of assessments, arguments

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<sup>27</sup> These publications are available at: [http://www-pub.iaea.org/MTCD/publications/PDF/Pub1431\\_web.pdf](http://www-pub.iaea.org/MTCD/publications/PDF/Pub1431_web.pdf) and [http://www-pub.iaea.org/MTCD/publications/PDF/Pub1570\\_web.pdf](http://www-pub.iaea.org/MTCD/publications/PDF/Pub1570_web.pdf)

and activities in the development of a safety case. The safety case concept needs to be communicated as widely as possible.

98. In relation to the lack of implementation of disposal solutions for radioactive waste, in particular for high level radioactive waste and spent fuel, the issue of longer periods of storage has to be addressed, including the safety implications of considering longer periods of storage than initially planned as well as the acceptance by the public of longer periods of storage.

99. Over the past two years, there has been increased interest in the management of large amounts of very low level waste, in particular in relation to accident situations. It is of utmost importance to develop guidance for the appropriate and safe management of large amounts of low level radioactive waste, and to learn from existing and past situations.

100. Progress has been made in preparing decommissioning plans for facilities and in safely implementing decommissioning plans in many Member States. It has been demonstrated that successful decommissioning, and thus reducing radiological risks associated with the shutdown of facilities, is possible even without the presence of operating disposal facilities.

101. The decommissioning of nuclear facilities damaged by severe accidents has been a difficult and long-standing challenge — examples from the past include the Windscale pile (UK), Unit 2 of the Three Mile Island NPP (USA) and Unit 4 of the Chernobyl NPP (Ukraine). In August 2013, Japan launched the International Research Institute for Nuclear Decommissioning, a new research body to bring together international experience for decommissioning facilities damaged by nuclear accidents. This Institute will devote much of its energy to addressing the challenges in decommissioning the Fukushima Daiichi NPP.

### ***Activities***

102. The Agency continues to organize international projects and working groups for the development of approaches to harmonize the safety of predisposal management and radioactive waste disposal and to provide a forum for information exchange among Member States. These projects and groups have broad representation from Member States, providing an opportunity to compare national approaches to safety and licensing with Agency safety standards.

103. The International Project on Demonstration of the Operational and Long-Term Safety of Geological Disposal Facilities for Radioactive Waste works towards harmonizing approaches to the safety of geological disposal, in particular how to define the interface between the operational and post-closure safety phases of geological disposal facilities.

104. The Practical Illustration and Use of the Safety Case Concept in the Management of Near-Surface Disposal (PRISM) project was finalized in 2012. In 2013, a follow-up project, the *Application of the Practical Illustration and Use of the Safety Case Concept in the Management of Near-Surface Disposal Project* (PRISMA) was initiated with the objective of working on the design and preparation of a model safety case using the approach developed during the first project.

105. The International Project on Human Intrusion in the Context of Disposal of Radioactive Waste provides an opportunity to share experience and practical considerations for regulatory oversight of the impacts of human intrusion in the context of the safety case during a disposal facility's lifecycle.

106. The Joint Working Group on Guidance for an Integrated Transport and Storage Safety Case for Dual Purpose Casks for Spent Nuclear Fuel focuses on developing guidance for the structure and content of an integrated safety case for a dual purpose cask that would support applications for approval of the package design for transport and for the storage facility licence as part of the safety

case for the storage facility. The outcomes of the working group are being prepared for publication as a TECDOC.

107. The Chernobyl and Fukushima Daiichi accidents revealed the importance and difficulty of radioactive waste management following accidents, mainly due to the technical complexity caused by the huge variety and amount of waste, the time constraints involved, and the lack of an effective licensing procedure that could be applied to radioactive waste management in such situations. A project was established in 2012 to develop guidance on the management of large amounts of radioactive waste arising from emergency situations, including licensing aspects.

108. The Agency assisted several Member States in developing, finalizing and conducting regulatory reviews of decommissioning plans and supporting safety assessments for decommissioning. The issue of decommissioning of nuclear facilities damaged by severe accidents was a focus for discussions at the International Experts' Meeting on Decommissioning and Remediation after a Nuclear Accident, held in Vienna in February 2013.

109. The Agency finalized the revision of *Decommissioning of Facilities Using Radioactive Materials* (IAEA Safety Standards Series No. WS-R-5), incorporating the experiences of Member States since its publication in 2006.<sup>28</sup> The safety implications of poor management of project risks during planning and implementation of decommissioning have recently been recognized as a priority by many Member States. The Agency initiated the International Project on Decommissioning Risk Management to address this issue and to develop recommendations based on the experiences of Member States.

### ***Future Challenges***

110. The Agency has an essential role to play in supporting and assisting Member States upon request to develop and implement comprehensive radioactive waste and spent fuel management strategies. One challenge is the implementation of geological disposal for high level radioactive waste and spent fuel. The demonstration of the safety of such projects as well as the development, construction, operation and closure of geological disposal facilities is a long process. In relation to this issue and to meet the need for longer periods of storage for radioactive waste, activities related to the demonstration of safety of storage facilities have to be maintained and further developed.

111. In relation to post-accident situations, guidance and assistance is needed for the development and implementation of strategies for managing radioactive waste from remediation and decommissioning activities. In particular, the management of large quantities of radioactive waste and materials following accident situations remains a challenge that needs to be addressed.

112. Member States are facing increasing demands for the decommissioning of facilities. Providing guidance and assisting Member States in building capacities for decommissioning will continue to be the central part of the Agency's programme on decommissioning.

113. Decommissioning nuclear facilities damaged by severe accidents will remain a challenge for decades. Further exchange of experience related to the establishment of strategies and end points, as

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<sup>28</sup> The publication is available at: [http://www-pub.iaea.org/MTCD/publications/PDF/Pub1274\\_web.pdf](http://www-pub.iaea.org/MTCD/publications/PDF/Pub1274_web.pdf)

well as the development of technological and waste management solutions for safe decommissioning will be needed.

114. For the decommissioning of facilities after planned shutdown, one of the challenges for many Member States is to determine the radionuclide inventory produced by particle activation (neutron activation in the case of nuclear reactors), which is an important input for the proper consideration of safety, protection, waste, technology and cost aspects of decommissioning. Several Member States have experience that could be shared on this topic; it should be collected and disseminated to assist less experienced Member States. Further work is needed on the harmonization of approaches to clearance of decommissioning waste and release of sites after completion of decommissioning.

## **B.5. Remediation and Protection of the Environment**

### ***Trends and Issues***

115. The IAEA Action Plan on Nuclear Safety incorporated an action for guidance and advice in the remediation of areas affected by the accident. To better prepare for future remediation activities, it is essential to identify best practices and to explore the complexity of remediation processes, taking into account all interactions between radiological, technical, environmental and economic aspects, and most importantly, to share lessons learned from previous and ongoing remediation actions.

116. In line with heightened public awareness of environmental issues, radiological impacts to flora and fauna need to be considered prospectively during the licensing of nuclear facilities and activities according to *Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards — Interim Edition* (IAEA Safety Standards Series No. GSR Part 3 (Interim)).<sup>29</sup> This requires the development of additional guidance to assist Member States in effectively implementing requirements on protection of flora and fauna in a manner commensurate with the underlying risks.

### ***Activities***

117. Within the Action Plan, a project has been set up to provide guidance on the development of situation-specific remediation strategies in urban and rural areas for a wide range of environmental conditions. The project integrates the experiences gained after the Chernobyl and Fukushima Daiichi accidents, as well as from other situations where environmental contamination has required the remediation of land. Relevant factors that have an impact on the exposure of the public following radioactive contamination of the environment are analysed. In particular, dose assessments for selected exposure scenarios will reflect the contributions of external and internal exposure and the impact of remedial actions on the exposure to the considered population groups, and will provide a ranking of protective and remedial actions that are most effective in terms of dose reduction. The results will also highlight the interaction of these factors with site-specific conditions, including technological, economic and societal aspects. The project will conclude in 2014.

118. The Agency's Modelling and Data for Radiological Impact Assessments (MODARIA) programme also addresses the remediation of contaminated land. The second MODARIA Technical

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<sup>29</sup> The publication is available at: [http://www-pub.iaea.org/MTCD/Publications/PDF/p1531interim\\_web.pdf](http://www-pub.iaea.org/MTCD/Publications/PDF/p1531interim_web.pdf)

Meeting was held in Vienna in November 2013, attended by over 150 participants from 43 Member States.

119. Three of the ten MODARIA working groups are investigating different aspects of remediation, covering areas such as the analysis of techniques to assist remediation decision making, the possibilities and limitations of remedial actions to reduce exposures in urban environments and the identification of situation-specific remedial actions for nuclear legacies and sites with enhanced levels of natural radionuclides due to mining activities. The MODARIA programme will be concluded in 2015.

120. Following the requirements of *Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards — Interim Edition* (IAEA Safety Standards Series No.GSR Part 3 (Interim)), the Agency provides guidance in related Safety Guides on how to address environmental radiological protection during facility licensing activities.<sup>30</sup> Within the MODARIA programme, two working groups are analysing data and testing models to assess radiological impacts to the environment in a simple and robust manner. The Agency also derived levels of activity concentrations for material that might be disposed of at sea providing a de minimis radiological impact, applying, in accordance with the International Basic Safety Standards, an integrated approach that explicitly includes potential impacts to both people and the environment. Meetings are held on a regular basis with international organizations such as the United Nations Scientific Committee on the Effects of Atomic Radiation, the United Nations Environment Programme, the ICRP and the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development to coordinate activities in this field.

### ***Future Challenges***

121. The experience gained since the Fukushima Daiichi accident in 2011 illustrates the complexity of the management of post-accident conditions. Public concerns related to radiological impacts are not limited to those population groups affected, but are often perceived as issues of global relevance, which may cause further public concern over land use, tourism, transport and trade. Observations made after the Fukushima Daiichi accident make it clear that the communication of the objectives, principles and methods applied in radiation protection is a key issue in achieving broad public consensus on the evaluation of radiation doses and the identification and implementation of the most appropriate remediation actions for mitigating exposures.

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<sup>30</sup> The publication is available at: [http://www-pub.iaea.org/MTCD/Publications/PDF/p1531interim\\_web.pdf](http://www-pub.iaea.org/MTCD/Publications/PDF/p1531interim_web.pdf)

## C. Strengthening Emergency Preparedness and Response

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

#### *Trends and Issues*

122. The Fukushima Daiichi accident continued to have an impact on interest in the Agency's safety standards and guidelines, including in areas that are not specifically addressed in depth by the existing suite of Agency documents on emergency preparedness and response (EPR). The need to develop additional guidelines and tools in specific EPR areas has become evident.

123. The training demand in the area of EPR is increasing, particularly in fields such as public communication, response management strategy and the management of consequences. This increased demand is creating a significant strain on the Agency's training resources. Consequently, there is a need to enhance the effectiveness and sustainability of training to establish a more efficient strategy, relying even more on a train-the-trainers approach, as well as on the creation of regional capacity building centres aimed at improving the training partnerships with competent organizations in each region.

124. Recent developments in some regions have shown the need for regional coordination in EPR. This has manifested itself through the creation of a regional response plan for radiation emergencies in the Gulf Cooperation Council and in a notable increase in the activity of EPR topical groups in regional networks such as the Arab Network of Nuclear Regulators (ANNuR), the Asian Nuclear Safety Network (ANSN) and its Topical Group on Emergency Preparedness and Response (EPRTG)<sup>31</sup>, the Forum of Nuclear Regulatory Bodies in Africa, the Ibero-American Forum of Radiological and Nuclear Regulatory Agencies and the International Regulatory Network (RegNet), all of which aim at enhancing regional knowledge sharing and complementing national EPR capabilities and arrangements through regional partnerships.

125. The number of countries that are planning to introduce nuclear power continues to increase, resulting in an increased demand for assistance in the development of national EPR capabilities and arrangements. The number of requests for targeted Emergency Preparedness Review (EPREV) missions has increased and has led to an effort to further enhance the EPREV process and approach in terms of the depth and thoroughness of the review; streamlining of the process; increased transparency in reporting findings; focusing and prioritizing the review areas based on country profiles; and introducing a graded approach to the scope of the review based on country priorities. With the increased demand in EPREV missions, there is also a need to further standardize the approach between different teams of experts through the introduction of enhanced guidelines, training and proficiency requirements for the reviewers.

126. Based on the lessons learned from previous Integrated Regulatory Review Service (IRRS) missions, there is a need to review the application of the EPR methodology in these missions to enhance the focus on regulations and regulatory effectiveness related to the cross-cutting area of EPR, thereby harmonizing the EPR methodology with the application of the methodology in other areas.

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<sup>31</sup> See [http://www.ansn.org/Common/Documents/Newsletter/ANSNewsletter\\_140.pdf](http://www.ansn.org/Common/Documents/Newsletter/ANSNewsletter_140.pdf)

127. Efforts to strengthen EPR at the national level showed the need to enhance reporting and information sharing using the International Radiation Information Exchange (IRIX) as an emergency communication standard and to develop and implement harmonized public communication strategies. Effective use of existing mechanisms for notification/information exchange and requests or provision of assistance requires adequate national EPR capabilities and arrangements.

### *Activities*

128. The Agency is actively identifying additional needs of the EPR community by consulting with partners, participating in workshops and conferences where various EPR issues are discussed and observing national exercises.

129. The Agency has initiated several projects to expand the EPR guidance to areas where a need has been expressed, such as, for example, the development of guidance on EPR for severe accidents at various reactor types, the development of a technical planning basis for radiation emergencies, the establishment of criteria for contamination of commodities other than food, and the management of non-radiological aspects of radiation emergencies.

130. The Agency intends to accelerate the development of state-of-the-art training techniques and strategies for capacity building. The training material is being modernized and standardized in trainer's packages and instructions are being developed. Train-the-trainers courses will be enhanced and made more widely available to qualified trainers in each region. E-training tools will be implemented where possible. The introduction of a computer-based system for the administration, tracking, management and delivery of its e-learning courses (also known as a Learning Management System) will become the pillar of future training courses. The Agency is also actively pursuing the identification of capacity building centres (CBCs) in all regions in specific areas of interest that build on existing expertise in those regions. CBCs will improve the Agency's ability to provide regional training focused on Member States' specific needs, and will also ensure the long-term sustainability of the regional training programmes.

131. To meet the increased demand for regional EPR planning, the Agency has initiated consultancies to develop a framework for regional EPR plans. The goal is to develop, in consultation with the experts from targeted regions, guidance on what should be included in a regional plan for radiation emergencies, on the application of the Agency's EPR requirements to regional planning, and on the mechanisms for developing and implementing such plans.

132. The Agency is also in the process of developing e-learning modules for embarking countries. The training is initially intended to help such countries through the introduction of the required infrastructure for nuclear emergency preparedness and response arrangements that build on the existing national structure and mechanisms, and aims at optimizing the effort required to establish EPR arrangements that are consistent with the Agency's safety standards.

133. To enhance the effectiveness of EPREV missions, the Agency has engaged in a process of consultation with experts from Member States experienced with EPREV missions to identify lessons from past missions. A consultancy on the enhancement of the EPREV process and tools took place in Vienna in December 2013. Follow up consultancies and one Technical Meeting will be held in 2014 to consolidate the lessons learned and revise the EPREV process and approach. A distance-learning package is also being developed to establish a baseline and harmonize the methodology and techniques used by various EPREV teams. In the future, all EPREV mission experts will be required to take this training and pass a basic test prior to each mission.

134. The Agency has enhanced the checklist and template for the EPR portion of IRRS missions. This revised tool was prototyped in IRRS missions in the last quarter of 2013. It will be evaluated after the completion of three IRRS missions, harmonized with the other facets of the IRRS and then

finalized. A new IRRS self-assessment questionnaire will be developed and incorporated in the global IRRS self-assessment tool in 2014.

135. The Agency further improved reporting and information sharing in three different ways: relevant guidance documents were developed and published in some of the official languages, providing experts in Member States with information on the strategy, the criteria and the practical steps for reporting incidents and emergencies and for providing further information in such situations; the Operations Manual for Incident and Emergency Communication was translated into Chinese, French and Russian and made available to contact points for incidents and emergencies; and the Agency conducted differently scaled exercises to test communication channels and to carry out exercises on parts or all of the international response procedures.

136. The Agency conducted training for emergency contact point staff and for International Nuclear and Radiological Event Scale (INES) National Officers. This training provides detailed knowledge on the procedures for notification, reporting and requesting assistance as well as on the use of INES and the reporting of INES ratings for nuclear and radiological events.

137. The Agency has enhanced the feature list and the usability of its secure website for reporting incidents and emergencies. In addition, the Agency has further enhanced the IRIX standard data set and data format for the exchange of information during incidents and emergencies. This standard allows machine to machine interfaces for importing and exporting information.

138. A publication on the use of INES for event communications was finalized in 2013 and will be published in the second quarter of 2014. It provides guidelines and good practices for a national framework on the effective use of INES for event communications. It is intended to assist Member States in establishing or improving their national framework for effectively using INES as an integral part of their communication strategy and includes an annex on lessons learned from application of INES during response to the Fukushima Daiichi accident.

139. The INES Rating Interactive Learning Tool was developed and will be published in the first quarter of 2014. It is an interactive learning tool developed to help Member States understand and apply the INES methodology for rating the safety significance of events. It will be made publicly available and used for initial training as well as for refreshing the knowledge of those who have already been trained in the INES methodology.

140. The INES methodology is being evaluated for the application in the medical area. A draft publication on the use of INES for unplanned events affecting patients undergoing a medical procedure is being reviewed to evaluate its usability and to enable changes to be made if needed. Six countries are applying the methodology to rate INES events involving individuals intentionally exposed as part of a medical procedure; this review will be completed in July 2014.

### ***Future Challenges***

141. The Agency needs to be prepared to implement more EPREV missions in the coming years, using a carefully revised approach and tools, expanding involvement of high-quality and trained professionals, and continuously improving the review process.

142. Member States and in particular decision-makers at the national level need to be encouraged to achieve worldwide adherence to the Agency's safety standards in the area of EPR. The implementation of regional plans and CBCs will be a challenge, but could greatly enhance the worldwide adherence to the Agency's safety standards in this area.

143. Effective and efficient response to nuclear or radiological emergencies depends mostly on human resources. Training, retraining, exercises and the establishment of sustainable mechanisms for

these activities at national and regional level for a wide range of responders, from planners and first responders to technical specialists and decision-makers, represent challenges, but they are also a key to success.

144. The development of regional EPR plans in harmony with national plans, coordination arrangements and harmonized EPR infrastructure will also be a challenging task.

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

### ***Trends and Issues***

145. Many States Parties to the Assistance Convention<sup>32</sup> have not fulfilled their obligations in identifying and notifying the Agency of their National Assistance Capabilities; this is a persistent issue. In 2013, Germany registered its capabilities in the Response and Assistance Network (RANET), raising the number to 23 registered States Parties to the Assistance Convention. Furthermore, none of the States Parties have registered their capabilities in the functional area “Nuclear Installation Assessment and Advice”. This may become critical if a severe nuclear emergency should occur again.

146. In 2013, the Agency conducted four ConvEx-1 exercises and two ConvEx-2 exercises.<sup>33</sup> In addition, a number of ConvEx-1 exercises were initiated by Member States. Some emergency contact points have persistently low participation in ConvEx-1 exercises and severe communication problems (unsuccessful fax deliveries and no attempts to resolve the issue) exist with roughly 15% of all emergency contact points. This problem should be addressed and resolved.

147. Preparing for a ConvEx-3 exercise requires inter-agency coordination and cooperation. The need to coordinate with relevant organizations such as INTERPOL and the European Police Office (EUROPOL) in the case of an emergency triggered by a nuclear security event became apparent.

### ***Activities***

148. The 23rd Regular Meeting of the Inter-Agency Committee on Radiological and Nuclear Emergencies (IACRNE) in May 2013 endorsed the *Joint Radiation Emergency Management Plan of the International Organizations* (JPLAN), which was then published as EPR-JPLAN with a 1 July 2013 effective date<sup>34</sup>.

149. The IACRNE web page was set up to keep international organizations informed of the activities, events and exercises relevant to the 17 international organizations that are members of the Committee.

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<sup>32</sup> Currently there are 111 States Parties to the Assistance Convention

<sup>33</sup> The Agency conducts regular exercises within the framework of the Early Notification and Assistance Conventions named ConvEx exercises at 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 as well as international level.

<sup>34</sup> The publication is available at: [http://www-pub.iaea.org/MTCD/Publications/PDF/EPRJplan2013\\_web.pdf](http://www-pub.iaea.org/MTCD/Publications/PDF/EPRJplan2013_web.pdf)

150. The Action Plan expanded the IAEA Secretariat's response role in an emergency at a nuclear power plant (NPP) to cover the need "to provide Member States, international organizations and the general public with timely, clear, factually correct, objective and easily understandable information during a nuclear emergency on its potential consequences, including analysis of available information and prognosis of possible scenarios based on evidence, scientific knowledge and the capabilities of Member States." The assessment and prognosis process was developed and reported to the Board of Governors<sup>35</sup> in November 2013; constraints and limitations identified; tools for assessment and prognosis set up and trained; and discussion with Member States on minimum required set of data/parameters needed for assessment and prognosis initiated.

151. *IAEA Response and Assistance Network* (EPR-RANET 2013) was published effective 1 September 2013. This new publication contains changes to reflect recent developments in RANET<sup>36</sup>. The changes include: the addition of a new functional area to address on-site assistance and advice following emergencies at nuclear installations; modifications to the concept of operations, which builds on and streamlines the version in EPR-RANET 2010; a description of the review of RANET national assistance capabilities, elaborating concepts introduced in EPR-RANET 2010; changes to the registration form to reflect the recent developments in RANET; and revision of Appendix G to include task lists to support Assistance Mission Leaders.

152. The RANET database containing information about the national assistance capabilities registered by Member States was created and published in January 2013 as an additional feature on the Unified System for Information Exchange in Incidents and Emergencies (USIE) website. The RANET database allows all official contact points to readily see the available national assistance capabilities of other Member States. RANET partners have requested further development of the database to incorporate additional details related to the specific capabilities registered by Member States, as well as the ability for Member States to update their capabilities directly through USIE. Additional improvements will be implemented in the future and include modifications to the Request for Assistance Form and the ability for Member States to submit offers for assistance through USIE.

153. Preparations for the seventh meeting of representatives of Competent Authorities identified under the Early Notification and Assistance Conventions are well under way. The meeting will take place in Vienna from 19 to 23 May 2014. To improve information exchange and facilitate the sharing of experience among Member States, the Competent Authorities are expected to prepare reports on national EPR issues, arrangements and capabilities.

154. The ConvEx-3 (2013) exercise, hosted by Morocco and codenamed Bab Al Maghrib, was prepared, conducted and evaluated within the framework of IACRNE. Fifty-nine Member States and 10 international organizations participated in the exercise. The exercise scenario was for the first time based on a radiological emergency triggered by a nuclear security event (dirty bomb scenario). The active participation of relevant international organizations (including INTERPOL and EUROPOL) and information sharing and public updates contributed to harmonized responses and consistent public information. For the first time, country specific inputs were prepared that required specific Member States response. The active role played by the Agency and Moroccan authorities helped to stress the importance of conducting such exercises. The exercise reached all of its objectives.

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<sup>35</sup> GOV/INF/2013/13.

<sup>36</sup> The publication is available at: [http://www-pub.iaea.org/MTCD/Publications/PDF/EPR-RANET\\_2013\\_web.pdf](http://www-pub.iaea.org/MTCD/Publications/PDF/EPR-RANET_2013_web.pdf)

## ***Future Challenges***

155. The Agency needs to actively encourage States Parties to the Assistance Convention that have developed response capabilities to register their national assistance capabilities in the RANET system, particularly in the functional area “Nuclear Installation Assessment and Advice”. At the same time there is a need to harmonize the assistance products produced by national assistance capabilities during assistance missions — this requires political will and effort on the part of Member States.

156. Coordination of information dissemination at national and international levels, communicating in plain language, and the effective use of social media in emergencies is a challenge for all Member States, as well as for international organizations. Further work is needed in this area of EPR.

157. Participation in the ConvEx exercises contributes to the implementing of operational arrangements enabling an effective emergency response. The Agency needs to follow up regular national participation in ConvEx exercises.

158. Common emergency assessment and harmonized and consistent communication of its results to the media and public in a nuclear or radiological emergency will require willingness and effort on the part of Member States, as well as on the part of relevant international organizations.

## **D. Improving Regulatory Infrastructure and Effectiveness**

### **D.1. Improving the Regulatory Infrastructure for Radiation Safety**

#### ***Trends and Issues***

159. While significant progress has been made in recent years, efforts are still needed to provide support to Member States that do not yet have a national regulatory infrastructure for radiation safety. While some Member States are making good progress in establishing or strengthening their national regulatory infrastructure for radiation safety, more work is needed to ensure the sustainability of such infrastructures. For some Member States, after the essential initial steps for establishing a national regulatory infrastructure have been taken, there have been delays and difficulties in developing the infrastructure further and in establishing an effective regulatory body with adequate resources to carry out its functions.

160. Governments have an essential role to play in the improvement of regulatory infrastructures, as well as in the implementation of a national safety policy and strategy, and they need to ensure 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 competences. An increasing number of Member States are, therefore, relying on guidance and technical assistance from the Agency to address these issues. As a result, the Agency has had to adjust its programmes and services to ensure harmonized implementation of its standards and has had to respond to specific national needs.

#### ***Activities***

161. The Agency has organized appraisal and advisory missions in Member States aimed at assessing and monitoring progress made in strengthening their national regulatory infrastructure for radiation safety and the control of radiation sources. In particular, the Agency’s Integrated Regulatory Review Service (IRRS), the use of which is standard practice by regulatory bodies of Member States with

nuclear installations, has also been promoted to Regulatory Bodies of States without nuclear installations, which also benefit from an international peer-review of their national regulatory framework, with due consideration of the limited national programme.

162. Governments, including regulatory bodies, were provided with guidance on various aspects of their national regulatory infrastructure for radiation safety. Authorization and inspection of radiation sources are an essential prerequisite for an effective regulatory infrastructure. To further support Member State regulators, expert missions, fellowships and training courses were organized throughout the year under the Technical Cooperation programme and within the framework of various extrabudgetary projects. Schools for drafting regulations, previously organized for Member States in the European region, were also organized in 2013 for Member States in Asia and in Africa.

163. To ensure continuous improvement of the IRRS and to ensure its applicability to all regulatory bodies, the Agency organized a workshop on 28-31 January 2013 in Vienna, Austria for team leaders and deputy team leaders of past missions to collect their experience and suggestions. To extend the pool of experts needed for the ambitious and diverse IRRS schedule and programme, the first training course for future IRRS team members was organized in October 2013 in Vienna, Austria.

164. The Control of Sources Network is a dedicated platform within the Global Nuclear Safety and Security Network to help regulators promote the radiation safety of sources within their countries. The continuous improvement of CSN, together with its promotion, was discussed in several meetings in 2013 within the GNSSN and the Regulatory Network (RegNet) platform.

165. The web-based Radiation Safety Information Management System (RASIMS) was used by the Agency and Member States to monitor the status and progress of Member States' efforts to strengthen their national regulatory radiation safety infrastructures. A total of 90 Member States accessed RASIMS in 2013 to update their radiation safety infrastructure profiles. The updated information provided baseline data for the development of new Agency projects and aided the radiation safety clearance process prior to the procurement of radiation sources.

166. An updated version of the web-based Regulatory Authority Information System (RAIS), version 3.3, became available online in September 2013. This system helps Member State regulators to maintain their national register of radiation sources and manage the information related to their regulatory functions. The Agency supports Member States in its use by carrying out expert missions and national training courses. The system continues to evolve and the new extensions will improve the system's functionality.

167. RAIS 3.3 has been widely used in many national and regional workshops. A letter was sent to all heads of regulatory bodies to call their attention to the benefits of integrating these tools and the methodology into their management systems. In response to the Standing Advisory Group on Technical Assistance and Cooperation recommendation, an internal joint working group of staff from the Department of Nuclear Safety and Security and the Department of Technical Cooperation has been established in 2013, with the objective of identifying strategies for accelerating the establishment of an adequate radiation safety infrastructure in all Member States through the technical cooperation programme. It is expected that the results of the discussions of this group will be used in developing the next TC cycle, i.e., 2016-2017.

168. A Safety Guide on establishing a national radiation safety infrastructure has been prepared through several consultancy meetings in 2013 and is now ready for submission to relevant committees. This draft Safety Guide aims at providing advice for Member States to assess the level of their national radiation safety infrastructure in line with the Agency's safety standards, and to implement a set of actions to fully meet safety requirements progressively in an effective and integrated manner, while taking full account of the specific national circumstances.

## ***Future Challenges***

169. Continuous efforts and resources will be needed to address Member States' needs in establishing and maintaining a national radiation safety regulatory infrastructure that is in line with the Agency's safety standards and adequate to the level of risks posed by the actual use of radiation sources in each country. With priority being given to other aspects of safety at the international level, it might be difficult to mobilize resources at the required level both in the Agency and in Member States. The Agency will therefore need to ensure that radiation safety infrastructures, and in particular regulatory frameworks, remain high on the international agenda.

## **D.2. Embarking on Nuclear Power Programmes**

### ***Trends and Issues***

170. Over thirty countries are considering or embarking on nuclear power programmes. For example, the United Arab Emirates has continued the construction of Barakah Unit 1 and officially started the construction of Unit 2 in May 2013. These units are scheduled to go into operation in 2017 and 2020 respectively. Construction of two additional units is expected to start in subsequent years.

171. The concrete has been poured for the foundation slab of the first unit at the Ostrovets site, which marks the official start of the construction of Belarus's first NPP.

172. The detailed site investigation studies have already been completed and a report on the environmental impact of Turkey's first NPP project (four units at Akkuyu on Turkey's Mediterranean coast) has been submitted to the relevant national authorities. Turkey has also signed an agreement with Japan for construction of four units at Sinop on Turkey's Black Sea coast. All units of Akkuyu NPP Project are expected to be generating power by 2023 and of the Sinop NPP Project by 2028.

173. In June 2013, Bangladesh signed an initial contract with a vendor country for the construction of the country's first NPP with two units at the Rooppur site. In October 2013, Jordan has selected a vendor as the preferred bidder to supply its first NPP with two units planned to start operating in 2020. Nigeria, Poland, Saudi Arabia and Viet Nam have taken significant steps towards their first NPP. Almost all embarking countries have been working on improving their regulatory infrastructure since they began to consider embarking on nuclear power and have been getting various levels of assistance from outside sources, particularly from the Agency. However, peer reviews, expert missions and assistance activities conducted by the Agency in 2013 at the request of Member States embarking on nuclear power have indicated that those countries continue to experience common difficulties in establishing a well-functioning and effective regulatory framework and an independent regulatory body with sufficient staff who have the necessary competence to discharge the regulatory mandate. Considerable further work is needed to overcome these challenges in order to build the necessary human resources and technical competences, to establish an effective management system within the regulatory body, to develop safety regulations and regulatory requirements that will be used during the licensing process, and to establish national arrangements for obtaining the necessary technical support from national or foreign resources.

174. Some newcomer Member States continue to have difficulties in fully assessing their needs and in establishing priorities in order to develop or enhance their national regulatory infrastructures. Application of a sound decision-making process, where decisions are based on full information gathered from comprehensive feasibility and preparatory studies, continues to be a challenge for some newcomers. Therefore, the governments of these Member States may not be giving due consideration to allocating sufficient resources to their regulatory bodies, which are especially critical in the early stages of developing the safety infrastructure for a nuclear power programme. Building the necessary

regulatory workforce also continues to be a challenge due in part to pressing timeframes, lack of financial resources and lack of enough adequately trained and available staff. Indeed, most of the embarking countries' regulatory bodies have yet to prepare or finalize an appropriate workforce planning and relevant human resources development policy, strategy and programme, taking into consideration the exact scope and scale of their prospective nuclear power programmes.

175. As nuclear power programmes continue to develop, it will become important to monitor and continue to assist newcomer Member States in building their competences, as well as in the development of effective training programmes designed to promote and achieve overall regulatory effectiveness and evaluating their impact on safety.

### *Activities*

176. The Agency continued assisting newcomer Member States in establishing and strengthening their national nuclear safety infrastructures through the development of legal and regulatory frameworks and the establishment of effectively independent and competent regulatory bodies. The Agency also provided expert assistance to several newcomer countries, such as Bangladesh, Belarus, Egypt, Indonesia, Malaysia, Poland and Turkey to address their needs in human resource development, spent fuel and radioactive waste management policies, safety regulations, and management systems and regulatory safety culture. The Agency also provided guidance on planning the actions required to address the areas needing improvement.

177. Agency experts assisted Jordan, Malaysia and Nigeria in the development or updating of an integrated work plan that prioritizes identified needs and schedules relevant future actions to be implemented in an integrated manner to enhance existing infrastructures. In addition, the Agency provided specific guidance to a number of newcomer countries, such as Algeria, Bangladesh, Egypt, Indonesia and Poland, regarding the design of their national technical cooperation projects related to the establishment or enhancement of safety infrastructures for prospective nuclear power programmes.

178. To further assist newcomer countries, as well as those countries expanding their nuclear programmes, the Agency organized a workshop in October 2013 that focused on identifying issues and challenges in establishing an effective national safety infrastructure. This workshop provided a forum in which participants exchanged information on their relevant national experience and discussed possible challenges and topics of concern that their countries have experienced or may experience in the near future. They also discussed and shared opinions and recommendations for addressing these issues, including assistance services to be requested from the Agency. A summary report of this workshop and its recommendations was produced and distributed to the country representatives.

179. Various activities in the area of governmental and regulatory infrastructure were implemented in 2013 through national or regional TC projects, as well as extrabudgetary projects funded particularly by the ANSN, the European Commission and the USA. Most of these activities were expert missions, workshops or training activities that provided guidance and information either on all elements of establishing an effective safety infrastructure as described in *Establishing the Safety Infrastructure for a Nuclear Power Programme* (IAEA Safety Standards Series No. SSG-16)<sup>37</sup> or, in some cases, specifically focused only on the regulatory framework element of this publication.

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<sup>37</sup> The publication is available at [http://www-pub.iaea.org/MTCD/publications/PDF/Pub1507\\_Web.pdf](http://www-pub.iaea.org/MTCD/publications/PDF/Pub1507_Web.pdf)

180. In its continuing support of the development of infrastructure for nuclear power in newcomer Member States, the Agency has developed a series of professional training and education courses that assist in implementing the actions contained in *Establishing the Safety Infrastructure for a Nuclear Power Programme* (IAEA Safety Standards Series No. SSG-16). New courses have been added to this training series under training Module 1: Governmental, Legal and Regulatory Framework for Safety; this training module helps build awareness and knowledge of the regulatory implications when embarking on nuclear power and also assists regulatory bodies in building their capacity to full core regulatory functions. The regulatory bodies of the Republic of Korea, Pakistan and the USA have assisted in the development of the workshop materials, which were then used in several Agency workshops and expert missions conducted in 2013. Other workshop materials are expected to be ready for use in 2014.

181. A software self-assessment tool facilitating the implementation of the IRIS self-assessment methodology was developed and made available online for Member States in September 2013. IRIS self-assessment methodology provides guidance to newcomer Member States to assess the development level of their national safety infrastructure on the basis of the relevant IAEA Safety Standards, then to identify areas for improvement and to focus efforts to implement the actions listed in SSG-16 as well as to ensure a common understanding and coordination among all relevant national stakeholders. In 2013, workshops providing training on the use of this methodology and the IRIS software were held at the regional level for the ANNuR, the ANSN, the Forum of Nuclear Regulatory Bodies in Africa, and for European Region (RER) countries; workshops were also conducted at the national level for Indonesia, Jordan, Malaysia and Viet Nam.

182. Work was initiated in October 2013 on the development of an Annex for Safety Standards Series No. SSG-16 in the light of the lessons learned from the Fukushima Daiichi accident. The Annex will address changes to the Safety Requirements that were identified as a result of the accident and how SSG-16 actions are affected by these changes.

183. In 2013, the Agency continued strengthening and promoting the IRRS peer review missions for newcomer Member States. A specific chapter entitled Tailored Module for Countries Embarking on Nuclear Power Programmes was designed and included in the *Integrated Regulatory Review Service (IRRS) Guidelines for the Preparation and Conduct of IRRS Mission* (Services Series No. 23) that was published in 2013. In April 2013, the Agency conducted a full scope IRRS mission in Poland including this tailored module. Also, IRRS preparatory missions were conducted in Indonesia (August 2013) and Jordan (December 2013) in connection with the requested IRRS missions.

184. In 2013, the Agency issued *Use of External Experts by the Regulatory Body* (IAEA Safety Standards Series No. GSG-4)<sup>38</sup>, a Safety Guide for embarking country regulators who will rely extensively on external technical support while they build their own robust regulatory competences. This Safety Guide provides recommendations and guidance on determining the needs for use of external expert advice, as well as the relevant processes and procedures to be used by the regulatory body when taking the advice of external experts into account, while still retaining responsibility for its own decision making.

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<sup>38</sup> The publication is available at

[http://www-pub.iaea.org/MTCD/publications/PDF/Pub1583\\_web.pdf](http://www-pub.iaea.org/MTCD/publications/PDF/Pub1583_web.pdf)

185. In March 2013, the Secretariat informed the Board of Governors of *the IAEA Strategic Approach to Education and Training in Nuclear Installation Safety* for the period 2013-2020<sup>39</sup>. This strategic approach identifies roles, responsibilities, processes and mechanisms to build effective capacity through education and training in Member States. The strategic approach addresses education and training activities in order to develop safety infrastructure for nuclear power newcomers. Within this strategic approach, the Agency provides guidance on examining the national resources for education and training more broadly through the development of capacity building self-assessment. The capacity building approach is especially recommended for newcomer countries since it examines in an integrated way, education and training, human resource development, knowledge management and knowledge networks for regulators, operators, technical support organizations and other stakeholders.

186. In support of the strategic approach and the integrated capacity building self-assessment, new guidelines for an Education and Training Review Service (ETRES) were developed and implemented in Indonesia and Pakistan. ETRES permits an integrated and global evaluation of education and training and sets the basis for developing a national strategy and implementation plan on education and training. ETRES questionnaires, which are based on the IAEA safety standards, IAEA safety reports and IAEA technical documents as well as Member States' experience, provide specific guidance for assessing education and training gaps and assessing the national education and training strategy involving all stakeholders, such as education institutions, technical support organisations, regulators and operators. This analysis facilitated by ETRES is recommended for planning and developing safety competence in countries embarking on a nuclear power programme. Based on ETRES results, action plans can be developed to fulfil the education and training gaps identified through ETRES self-assessment questionnaires. Additionally, ETRES provides for a harmonised regional evaluation of education and training needs, based on the IAEA safety standards and facilitates regional sharing of training resources.

187. Also in 2013, the IAEA Steering Committee on Competence of Human Resources for Regulators which consists of regulators from newcomer countries' as well as regulators from expanding and/or mature nuclear power countries held its annual technical meeting in Vienna. The terms of reference and work programme of the steering committee include the specific objective of supporting regulators from newcomer countries in their training and human resources development activities. This has been achieved by addressing the newcomer regulators' challenges in the area of training within the discussions of the steering committee, by sharing experience in identifying regulatory competence needs through the IAEA tool SARCoN (Systematic Assessment of Regulatory Competence Needs), which has been used in more than ten newcomers Member States, and it has also been achieved by sharing information in a web dedicated space where regulators posts their training materials, and prospectus of training courses.

188. In 2013, the Agency finalised the IAEA Safety Report Series Number 79, entitled *Managing Regulatory Competence*. This safety report published early in 2014 identifies the specific competences that a regulatory body needs in order to perform the regulatory functions in an effective manner.<sup>40</sup> It

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<sup>39</sup> The publication is available at <http://www-ns.iaea.org/downloads/ni/training/strategy2013-2020.pdf>

<sup>40</sup> The publication is available at: <http://www-pub.iaea.org/books/IAEABooks/10474/Managing-Regulatory-Body-Competence>

also describes the main management processes for ensuring and maintaining the necessary competence of the regulatory staff. Furthermore, it addresses the particular challenges that might be encountered by newcomer regulators in developing and maintaining the necessary competence of their staff.

189. The Regulatory Cooperation Forum (RCF), a regulator-to-regulator forum to improve collaboration and coordination for regulatory capacity building among Member States with established nuclear power programmes and those considering the introduction or expansion of such a programme, has continued to assist Jordan and Viet Nam in the development of effectively independent and robust nuclear safety regulatory bodies. In 2013, the RCF expanded its membership to 25 members with Bangladesh and Kenya as its newest. The RCF will also begin to provide regulatory support for Belarus and Poland in 2014.

190. The Agency has taken a number of website related initiatives focused on sharing knowledge, good practices and information and fostering collaboration among newcomer regulators. The website for RegNet<sup>41</sup> continues to contribute to the enhancement of regulatory effectiveness by providing a forum for sharing and distributing regulatory information and knowledge among Member States. During a consultancy meeting held in March 2013, further development, improvement and collaboration within the RegNet portal was discussed. Progress was also made in standardizing a user friendly format for all web pages (such as, inter alia, those for the RCF, embarking countries and regulatory competence management) on the RegNet portal.

191. In June 2013, a Technical Meeting on RegNet usage by Member States was held specifically for those countries embarking on nuclear power programmes. Countries shared their experience in using the portal and made numerous recommendations to the Agency concerning the revision of the RegNet portal. It was proposed that consultancy meetings should be held regularly to ensure progress on the improvement process and that subsequent Technical Meetings should be held to discuss the achievements and outcomes from these consultancy meetings.

### ***Future Challenges***

192. The ambitious schedules of some embarking Member States committed to establishing a nuclear power programme mean that developing regulatory bodies have to conform to an externally driven time scale for regulatory reviews and approvals. This may adversely affect the ability of those regulatory bodies to perform their regulatory functions in an effective manner, because difficulties in finding sufficient competent resources within the country to perform the regulatory review and assessment of construction licence applications may not be taken into account.

193. In some embarking countries, the lack of coordination, as well as competition between the relevant national organizations, could hamper the effective planning and implementation of external assistance.

194. In embarking countries where the operators and the regulator report to the same government authority, the regulatory body may be faced with a problem if the operating organization has a higher level of reporting in the national hierarchy. When the level of the regulator's reporting line is lower than that of the operating organization, the regulatory body may not be able to enforce its decisions.

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<sup>41</sup> RegNet is available at <http://gnssn.iaea.org/regnet>

195. Embarking countries will continue to experience difficulty, in the short and long term, in finding experienced and knowledgeable experts and institutions that can provide direct or indirect assistance and guidance on the establishment of various elements of the nuclear safety infrastructure, and in finding appropriate host institutions/organizations for human resource development, particularly for on-the-job training. This challenge needs immediate global attention.

196. Although Master's degree programmes, training courses and workshops exist in all technical areas of nuclear power and nuclear safety, there is a lack of specific educational programmes devoted to regulatory approaches and practices<sup>42</sup>. The functions and challenges encountered by the regulator will require specific training in regulatory philosophy/approaches, functions (inspection, enforcement, review and assessment, licensing/authorization, management, etc), safety culture and ethics, implementation methodologies and performance monitoring as well as ongoing training to learn and integrate new regulatory knowledge.

197. Regulators will need to establish the necessary processes for identifying and managing needs, for creating action plans to fill the gaps, and for evaluating the results and effectiveness of competence building programmes. Regulators will need competent staff to carry out these tasks, as well as to make informed and strategic decisions on how to fill competence gaps in terms of outsourcing, reorganization and training.

198. Some governments of embarking countries are not prepared to provide sufficient resources or attention to strengthening the national regulatory framework, particularly in developing capabilities through human resource development programmes which may lead to deficiencies in regulatory competences. These governments need to make strong national commitments to providing appropriate funding for the development of the regulatory body and the relevant institutions that will provide it with technical support so that the required competences as outlined in the Agency's safety standards can be adequately developed and maintained. Some embarking countries also have difficulty in finding staff with the appropriate background education to assign them for further training programmes on the required subjects. Mechanisms and/or local infrastructures for the required basic training and education need to be developed.

### **D.3. Research Reactor Programmes**

#### ***Trends and Issues***

199. Regulatory effectiveness continues to be an important safety issue for Member States with existing research reactor programmes, particularly in the areas of establishing regulations specific to research reactors, reviewing and assessing safety documents for issuance of authorizations, and implementing inspection programmes. Regulatory bodies in many Member States, particularly those that do not operate NPPs, face difficulties in training staff with the necessary competencies to fulfil their regulatory functions. In addition, and in view of the lessons learned from the Fukushima Daiichi accident, appropriate attention needs to be given to ensuring regulatory effectiveness for evaluating the safety of potential off-site radiological consequences in extreme external events and for the emergency response to these events at research reactors.

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<sup>42</sup> The regulatory approach as described in IAEA Safety Standards Series No. SSG-16 includes a robust framework of legislation and standards for safety, an effective independence in performing regulatory functions, a graded approach to risk assessment, a rigorous enforcement policy, a demonstration of transparency and active communication.

200. More than 20 Member States are currently in different stages of developing new research reactor programmes, with the majority building their first research reactor with a view to embarking on a nuclear power programme. They continue to have difficulties in developing the necessary safety, regulatory and technical infrastructures, primarily due to the lack of adequately qualified staff with sufficient competence in areas related to safety assessment, construction, commissioning, operation, safe utilization, and decommissioning. Most Member States do not have a clear national strategy for human resource development or for building the necessary competences. Weaknesses in the establishment of an effective regulatory body and in governmental support for its establishment have also been identified during some safety review missions.

### *Activities*

201. To assist Member States to better assess regulatory effectiveness, a publication on the safety reassessment for research reactors in the light of the accident at the Fukushima Daiichi NPP was approved in 2013 for publication in the Safety Reports Series. This publication provides practical information and suggested methods for performing safety reassessment for research reactors considering the feedback from the Fukushima Daiichi accident, including the relevant regulatory considerations.

202. The feedback from Member States on the use of this publication and the implications on regulatory activities were discussed in a workshop conducted in Vienna in June 2013, in which operating organizations and regulatory bodies from 26 Member States participated. A workshop conducted in the USA in December 2013 for the Asia and the Pacific region covered the same topic; 11 Member States participated. This workshop facilitated the sharing of regulatory review experience gathered from research reactor safety reassessments and the role of the regulatory body in off-site radiological emergencies.

203. In September 2013, a Regional Workshop on Application of the Code of Conduct on the Safety of Research Reactors: Core Management and Safety of Experiments was held in Indonesia for the Asia and the Pacific region with the participation of nine Member States. The participants identified actions to be implemented on the basis of the Code to improve regulatory supervision in the areas covered by the scope of the meeting<sup>43</sup>.

204. To further strengthen radiation safety of nuclear research reactors in the regions, a Workshop on Operational Radiation Protection Programmes for Research Reactors was held in Vienna in March 2013. Participants from 34 Member States were provided with practical information on regulatory review and assessment and regulatory inspection programmes, as well as guidance on the establishment of an effective operational radiation protection and radioactive waste management programme for research reactors.

205. The Agency conducted four safety missions dedicated to enhancing the regulatory programmes for research reactors in the Democratic Republic of the Congo, the Islamic Republic of Iran, the Netherlands and Thailand. These missions provided training and recommendations for developing regulatory inspection programmes for research reactors. The mission to the Netherlands provided further support to the regulatory body in revising the national regulations for research reactors and the

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<sup>43</sup> The summary report of this meeting is available at:  
<http://www.ansn.org/Common/Topics/OpenTopic.aspx?ID=13256>

one to Thailand assessed and provided recommendations on developing the competencies of the regulatory body.

206. To further support the efforts of Member States considering or actively building their first research reactor, the Agency developed and approved a publication that provides practical guidance on the preparation of the technical safety and utilization requirements for the bidding process of a new research reactor project. In September 2013, 26 Member States participated in a workshop on the application of this guidance. This workshop provided practical information to the participating regulatory bodies on the development of the safety requirements for the bidding process of a new research reactor.

207. In addition, the Agency conducted an expert mission in Tunisia, in February 2013, which provided advice, recommendations and suggestions on the licensing process and on establishing the necessary regulatory infrastructure for a new research reactor under consideration. Also in February 2013, the Agency conducted a safety mission assisting the Jordan Nuclear Regulatory Commission with the review and assessment of the safety analysis report submitted by the operating organization in support of its application for the construction permit for a research and training reactor; this is the first nuclear installation in the country.

### ***Future Challenges***

208. Feedback from the Agency's activities, including safety missions and meetings on the application of the Code of Conduct on the Safety of Research Reactors, showed that enhancing the effective independence of the regulatory body continues to be a challenge for Member States with existing research reactor programmes, as well as for those embarking on new research reactor programmes.

209. Member States need to make additional efforts to establish systematic regulatory inspection programmes. This is increasingly important in light of lessons learned from the Fukushima Daiichi accident, which has highlighted the need for specific inspections to be conducted to verify the robustness of the structures, systems and components that are important for safety and of the operating programmes and procedures and the emergency preparedness measures currently in place. Taking into account the limited resources available to regulatory bodies, another challenge will be to review and revise the existing national regulations and the existing regulatory supervision activities to ensure that they are adequate to verify compliance of the operating organizations with any new safety requirements established in light of the lessons learned from the Fukushima Daiichi accident.

210. For Member States embarking on new research reactor programmes, an important challenge that needs to be addressed is the development of an adequate regulatory infrastructure in parallel with the implementation activities of a new research reactor project. This will be especially challenging for Member States with limited qualified human resources to carry out regulatory functions and implementation activities for design, construction, commissioning and operation.

## **E. Civil Liability for Nuclear Damage**

### ***Trends and Issues***

211. The importance of 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,

continues to be a subject of increased attention among Member States, in particular after the Fukushima Daiichi accident.

212. 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. However, 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.

213. After the Fukushima Daiichi accident, the Action Plan 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. The Action Plan also called on the International Expert Group on Nuclear Liability (INLEX) to recommend actions to facilitate the achievement of a global nuclear liability regime. These recommendations were adopted by INLEX at its 12th regular meeting in 2012.<sup>44</sup>

### *Activities*

214. The 13th meeting of INLEX took place in Vienna from 15 to 17 May 2013. The Group discussed, inter alia, liability in the case of the transport of nuclear material, with special focus on the rights of non-nuclear transit States; liability issues in respect of transportable nuclear power plants; and the impact of the 2012 revision of the Agency's Transport Regulations on the Board of Governors' decision to exclude small quantities of nuclear material from the scope of the nuclear liability conventions. The Group also discussed a paper on the benefits of joining the nuclear liability regime and developed corresponding key messages to be used during legislative assistance activities carried out by the Agency.

215. The 2nd Workshop on Civil Liability for Nuclear Damage was held in Vienna on 14 May 2013 and was attended by 49 participants from 34 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. In addition, presentations on civil liability for nuclear damage were made at two Workshops for Diplomats on Nuclear Law held, respectively, in Geneva on 29 April 2013 and in Vienna on 15 July 2013.

216. As regards other outreach activities, presentations were made at a briefing for diplomats at the UN headquarters in New York on 1 May 2013. The Chairman of INLEX also made a presentation on nuclear liability at the IAEA Regional Workshop for Pacific Island States held in Nadi, Fiji, from 29 April to 1 May 2013.

217. A joint IAEA/INLEX mission was dispatched to Malaysia in August 2013. The mission aimed at raising awareness of the international nuclear liability regime and encouraging adherence to the relevant international legal instruments, and consisted of meetings with policy-makers and senior officials and of a workshop on civil liability for nuclear damage for other interested stakeholders in the Malaysia. Preparations are under way to organize similar missions in 2014.

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<sup>44</sup> The text is available at: <http://ola.iaea.org/ola/documents/ActionPlan.pdf>.

218. *The 1988 Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention — Explanatory Text*, developed by INLEX, was published in April 2013 as IAEA International Law Series No. 5.

### ***Future Challenges***

219. 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.

220. INLEX and the Agency will continue to facilitate the establishment of a global nuclear liability regime as called for by resolution GC(57)/RES/9, inter alia by carrying out further outreach activities. In so doing, account will be taken of the recommendations adopted by INLEX in 2012 and, in the context of the Agency's legislative assistance activities, of the key messages adopted by INLEX in 2013.

221. The Action Plan, including in particular, the call for establishing a global nuclear liability regime, was referred to in an important Joint Statement on Liability for Nuclear Damage, which was adopted by France and the United States of America in August 2013. In that Joint Statement, the two countries declared, inter alia, that they would coordinate their actions in encouraging adherence to the enhanced international nuclear liability instruments, including, as appropriate, the revised Paris Convention (together with the revised Brussels Convention) or the revised Vienna Convention, which may be linked by the Joint Protocol,<sup>45</sup> and the Convention on Supplementary Compensation for Nuclear Damage (CSC),<sup>46</sup> with an initial step being the entry into force of the CSC.

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<sup>45</sup> The Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention, which was adopted in 1988 in order to link the Vienna Convention and the Paris Convention, has currently 28 Contracting Parties.

<sup>46</sup> The CSC, which was adopted in 1997 and is not yet in force, has currently 18 Signatories and 5 Contracting States.



# Appendix

## The Agency's Safety Standards: Activities during 2013

### A. Summary

1. The Commission on Safety Standards (CSS) met twice in 2013 and endorsed the following draft Safety Standards for publication:

- Addendum to Safety Requirements on Safety of Nuclear Fuel Cycle Facilities: Appendices on Reprocessing Facilities and Fuel Cycle Research and Development Facilities (DS439)
- Safety Guide on Safety Classification of Structures, Systems and Components in Nuclear Power Plants (DS367)
- Safety Guide on Near Surface Disposal Facilities for Radioactive Waste (DS356)
- Safety Guide on Monitoring and Surveillance of Radioactive Waste Disposal Facilities (DS357)
- Safety Requirements on Decommissioning of Facilities (DS450)
- Safety Guide on Justification of Practices, including Non-Medical Human Imaging (DS401)
- Safety Guide on Protection of the Public against Exposure Indoors due to Radon and Other Natural Sources of Radiation (DS421)
- Safety Guide on Site Survey and Site Selection for Nuclear Installations (DS433)

2. The CSS also approved in 2013 the following Document Preparation Profiles (DPP):

- DPP for a new Safety Guide on Radiation Safety of Radiation Sources Used in Research and Education (DS470)
- DPP for a new Safety Guide on Radiation Safety of X-ray Generators and Radiation Sources Used for Inspection Purposes and for Non-Medical Imaging (DS471)
- DPP for a Safety Guide on Planning and Preparing for Response to Transport Events involving Radioactive Material, revision of TS-G-1.2 (DS469)
- DPP for a Safety Guide on Organization, Management and Staffing of a Regulatory Body (DS472)
- DPP for a Safety Guide on Regulatory Body Functions and Processes (DS473)
- DPP for a Safety Guide on Arrangements for the Termination of a Nuclear or Radiological Emergency (DS474)
- DPP for a Safety Guide on Arrangements for Public Communications in Preparedness and Response for a Nuclear or Radiological Emergency (DS475)
- DPP for a Safety Guide on The Management System for the Predisposal and Disposal of Radioactive Waste (DS477)

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

3. The Action Plan includes the following action on the Agency's safety standards<sup>47</sup>:

*“Review and strengthen IAEA 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 IAEA Safety Standards in an open, timely and transparent manner. The IAEA Secretariat to continue providing support and assistance in the implementation of IAEA Safety Standards.”

## **A.2. Review/Revision of Safety Requirements**

4. In 2011, the Secretariat started a review of Safety Requirements publications in the IAEA Safety Standards Series on the basis of information that was available from the Fukushima Daiichi accident. As a first priority, the Secretariat considered the Safety Requirements applicable to power reactors and to the storage of spent fuel. The comparative review consisted first of a comprehensive analysis of the findings of these reports. In light of the results of this analysis, the Safety Requirements publications were then examined in a systematic manner to decide whether amendments were needed to reflect these findings.

5. On that basis, the CSS approved, at its meeting in October 2012, a document outline (equivalent to a document preparation profile) DS462 to initiate a revision process to amend the following five Safety Requirements publications: *Governmental, Legal and Regulatory Framework for Safety* (IAEA Safety Standards Series No. GSR Part 1, Vienna, 2010), *Site Evaluation for Nuclear Installations* (IAEA Safety Standards Series No. NS-R-3, Vienna, 2003), *Safety of Nuclear Power Plants: Design* (IAEA Safety Standards Series No. SSR-2/1, Vienna, 2012), *Safety of Nuclear Power Plants: Commissioning and Operation* (IAEA Safety Standards Series No. SSR-2/2, Vienna, 2011), and *Safety Assessment for Facilities and Activities* (IAEA Safety Standards Series No. GSR Part 4, Vienna, 2009). The simultaneous revision of several publications is a new approach to improve the efficiency of the process, while maintaining the consistency of these five Safety Requirements.

6. Additional inputs were considered in preparing the draft text of the proposed amendments to these five safety standards in 2012 and 2013, including the findings of International Experts' Meetings and presentations made at the Second Extraordinary Meeting of the Contracting Parties to the Convention on Nuclear Safety in August 2012. Several national and regional reports were also analysed.

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<sup>47</sup> The IAEA Action Plan on Nuclear Safety was approved by the Board of Governors on 13 September 2011, and endorsed by the General Conference during its 55th regular session on 22 September 2011. This document is available online at <http://www.iaea.org/newscenter/focus/actionplan/reports/actionplanns130911.pdf>

7. The proposed draft amendments have been reviewed in consultants' meetings, as well as by all the Safety Standards Committees at their meetings in the first half of 2013 and were submitted to Member States for comments at the end of 2013.

8. For GSR Part 1, the proposed revisions relate to the following main areas:

- Independence of the regulatory body;
- Prime responsibility for safety;
- Emergency preparedness and response;
- International obligations and arrangements for international cooperation;
- Liaison between the regulatory body and authorized parties;
- Review and assessment of information relevant to safety;
- Communication and consultation with interested parties.

9. For NS-R-3, the proposed revisions relate to the general criteria for site evaluation and, in particular, to flood hazards.

10. For SSR-2/1, the proposed revisions relate to the following main areas:

- Preventing severe accidents by strengthening the plant design basis;
- Preventing unacceptable radiological consequences for the public and the environment;
- Mitigating the consequences of severe accidents to avoid long term contamination.

11. For SSR-2/2, the proposed revisions relate to the following main areas:

- Periodic safety review;
- Emergency preparedness;
- Accident management;
- Fire safety;
- Feedback from operating experience.

12. For GSR Part 4, the proposed revisions relate to the following main areas:

- Scope of the safety assessment;
- Scope of the safety analysis;
- Assessment of defence in depth;
- Maintaining the safety assessment.

13. This revision process is being carried out in conjunction with the revision of *Preparedness and Response for a Nuclear or Radiological Emergency* (IAEA Safety Standards Series No. GS-R-2, Vienna, 2002) (DS457) and of *The Management System for Facilities and Activities* (IAEA Safety Standards Series No. GS-R-3, Vienna, 2006) (DS456), for which consultation of Member States throughout 2013 was also organized in parallel to that for DS462.

14. With a view to also taking into account lessons learned from the Fukushima Daiichi accident for other facilities, and particularly for research reactors and fuel cycle facilities, two DPPs were initiated in 2012 for the revision of Safety Requirements *Safety of Research Reactors* (IAEA Safety Standards Series No. NS-R-4, Vienna, 2005) and *Safety of Nuclear Fuel Cycle Facilities* (IAEA Safety Standards Series No. NS-R-5, Vienna, 2008). The DPPs were submitted to the review committees for approval before submission to the CSS, which is expected to be done early in 2014. A DPP for the revision of *Site Evaluation for Nuclear Installations* (IAEA Safety Standards Series No. NS-R-3, Vienna, 2003) has also been initiated and will be submitted to the Committees for approval in 2014.

15. The review by the Safety Standards Committees of other Safety Requirements led to the conclusion that, at this stage, there is no need to revise *Predisposal Management of Radioactive Waste* (IAEA Safety Standards Series No. GSR Part 5, Vienna, 2009) and *Disposal of Radioactive Waste* (IAEA Safety Standards Series No. SSR-5, Vienna, 2011). The revision of *Preparedness and Response for a Nuclear or Radiological Emergency* (IAEA Safety Standard Series No. GS-R-2, Vienna, 2002) (DS457) and actual experience from the remediation activities after the Fukushima Daiichi accident will probably result in a future proposal to revise, only through specific amendments, *Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards — Interim Edition* (IAEA Safety Standards Series No. GSR Part 3 (Interim), Vienna, 2011). Finally, certain specific aspects related to transport safety are also being considered for *Regulations for the Safe Transport of Radioactive Material* (IAEA Safety Standards Series No. SSR-6, Vienna, 2012).

### **A.3. Review/Revision of Safety Guides**

16. With regard to the review/revision of Safety Guides, the first step was to analyse whether the methodology adopted for the Safety Requirements would also be appropriate for the Safety Guides and to prioritize the review of the Safety Guides based on the same list of lessons learned used for the previously-mentioned review of the Safety Requirements.

17. A pilot study was conducted in 2012 for the review of three Safety Guides applicable to nuclear power plants, namely *Design of the Reactor Coolant System and Associated Systems in Nuclear Power Plants* (IAEA Safety Standards Series No. NS-G-1.9, Vienna, 2004), *Design of Reactor Containment Systems for Nuclear Power Plants* (IAEA Safety Standards Series No. NS-G-1.10, Vienna 2004) and *Severe Accident Management Programmes for Nuclear Power Plants* (IAEA Safety Standards Series No. NS-G-2.15, Vienna, 2009).

18. It was concluded that the methodology was appropriate but that any revision would not be restricted to taking into account lessons learned from the Fukushima Daiichi accident, as other aspects also need to be addressed, particularly with the guidance on meeting the amendments proposed to SSR-2/1 and SSR-2/2 as part of the draft DS462 mentioned above. Three DPPs were prepared for the revision of these three Safety Guides and submitted to the Safety Standards Committees before their submission early in 2014 to the CSS.

19. A complementary pilot study was also performed in 2013 with the review of three additional Safety Guides: *External Events Excluding Earthquakes in the Design of Nuclear Power Plants* (IAEA Safety Standards Series No. NS-G-1.5, Vienna, 2003), *Seismic Design and Qualification for Nuclear Power Plants* (IAEA Safety Standards Series No. NS-G-1.6, Vienna, 2003), and *Deterministic Safety Analysis for Nuclear Power Plants* (IAEA Safety Standards Series No. SSG-2, Vienna, 2009), for which it was also concluded that revisions were needed. Two additional Safety Guides, *Storage of Spent Nuclear Fuel* (IAEA Safety Standards Series No. SSG-15, Vienna, 2012) and *Design of Fuel Handling and Storage Systems for Nuclear Power Plants* (IAEA Safety Standards Series No. NS-G-1.4, Vienna, 2003) are being reviewed.

20. Other Safety Guides were proposed for revision as a result of lessons learned from the Fukushima Daiichi accident, for example *Remediation Process for Areas Affected by Past Activities and Accidents* (IAEA Safety Standards Series No. WS-G-3.1, Vienna, 2007), and the DPP for this revision was approved at the CSS meeting in October 2012.

21. New Safety Guides were also proposed in this context such as DS474 on arrangements for the termination of a nuclear or radiological emergency and DS475 on arrangements for public communications in preparedness and response for a nuclear or radiological emergency, for which DPPs were approved at the CSS meeting in November 2013.

## **A.4. The IAEA Safety Standards Series and the IAEA Nuclear Security Series**

22. 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.

23. 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 for Technical Guidance — 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.

24. The Interface Group was consulted in 2013 essentially through electronic consultation (a dedicated web page was established and a consultation process by email put in place). 21 new or revised DPPs (for 12 safety standards and 9 nuclear security guidance publications) were submitted to the Interface Group with a recommendation from the Coordination Committee. All proposals from the Coordination Committee were accepted. Only one DPP was not considered as an interface document. From these consultations, it appears that almost 80% of the safety standards that are being developed have some sort of interface with nuclear security that need to be reviewed by NSGC and more than 80% of the nuclear security guidance publications being developed have an interface with safety that needs to be reviewed by at least one Safety Standards Committee.

## **A.5. Future Review, Revision and Publication Process**

25. After more than 50 years of history of the Agency's safety standards, and after having a nearly complete set of standards covering all main safety areas, the CSS discussed the Secretariat's proposal that a more efficient approach should be adopted for the future review, revision and publication of the safety standards, with the following key objectives:

- To ensure that the review and revision of published standards is based on a systematic feedback collection and analysis process;
- To ensure that any revision of the safety standards or part of the safety standards is justified by the previously-mentioned feedback process, therefore also ensuring stability of the parts of the standards that remain valid;
- To maintain technical consistency among the standards through a management of the standards as a complete collection rather than by individual management of individual standards;
- To enhance semantic consistency through systematic use of harmonized terminology;
- To ensure the completeness of the collection through a systematic top-down development approach complemented by topical gap analyses;
- To support harmonized use and application of the safety standards by enhancing their user-friendliness and by providing tools for users to navigate easily within the whole collection.

## **B. Current Agency Safety Standards**

### **B.1. Safety Fundamentals**

SF-1 Fundamental Safety Principles (2006), co-sponsorship: Euratom, FAO, ILO, IMO, OECD/NEA, PAHO, UNEP, WHO [ACEFRS]<sup>48</sup>

### **B.2. General Safety Standards (Applicable to All Facilities and Activities)**

GSR Part 1 Governmental, Legal and Regulatory Framework for Safety (2010) [ACEFRS]  
GS-R-3 The Management System for Facilities and Activities (2006) [ACEFRS]  
GSR Part 3 Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards — Interim Edition (2011) [ACEFRS]  
GSR Part 4 Safety Assessment for Facilities and Activities (2009) [ACEFRS]  
GSR Part 5 Predisposal Management of Radioactive Waste (2009) [ACEFRS]  
WS-R-5 Decommissioning of Facilities Using Radioactive Material (2006) [ACEFRS]  
GS-R-2 Preparedness and Response for a Nuclear or Radiological Emergency (2002), co-sponsorship: FAO, ILO, OECD/NEA, PAHO, OCHA, WHO [ACEFRS]  
GS-G-2.1 Arrangements for Preparedness for a Nuclear or Radiological Emergency (2007), co-sponsorship: FAO, ILO, PAHO, OCHA, WHO [ES]  
GS-G-3.1 Application of the Management System for Facilities and Activities (2006) [ER]  
GS-G-3.2 The Management System for Technical Services in Radiation Safety (2008) [EF]  
GS-G-3.3 The Management System for the Processing, Handling and Storage of Radioactive Waste (2008) [E]  
GSG-1 Classification of Radioactive Waste (2009) [E]  
GSG-3 The Safety Case and Safety Assessment for the Predisposal Management of Radioactive Waste (2013) [E]  
RS-G-1.1 Occupational Radiation Protection (1999), co-sponsorship: ILO [ACEFRS]  
RS-G-1.2 Assessment of Occupational Exposure Due to Intakes of Radionuclides (1999), co-sponsorship: ILO [ACEFRS]  
RS-G-1.3 Assessment of Occupational Exposure Due to External Sources of Radiation (1999), co-sponsorship: ILO [ACEFRS]

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<sup>48</sup> A = available in Arabic; C = available in Chinese; E = available in English; F = available in French; R = available in Russian; S = available in Spanish

RS-G-1.4	Building Competence in Radiation Protection and the Safe Use of Radiation Sources (2001), co-sponsorship: ILO, PAHO, WHO [ACEFRS]
RS-G-1.7	Application of the Concepts of Exclusion, Exemption and Clearance (2004) [CERS]
RS-G-1.8	Environmental and Source Monitoring for Purposes of Radiation Protection (2005) [ES]
RS-G-1.9	Categorization of Radioactive Sources (2005) [ACEFRS]
WS-G-2.3	Regulatory Control of Radioactive Discharges to the Environment (2000) (under revision) [ACEFRS]
WS-G-2.5	Predisposal Management of Low and Intermediate Level Radioactive Waste (2003) (under revision) [ERS]
WS-G-2.6	Predisposal Management of High Level Radioactive Waste (2003) (under revision) [ERS]
WS-G-3.1	Remediation Process for Areas Affected by Past Activities and Accidents (2007) [ES]
WS-G-5.1	Release of Sites from Regulatory Control on Termination of Practices (2006) [ERS]
WS-G-5.2	Safety Assessment for the Decommissioning of Facilities Using Radioactive Material (2008) [ES]
WS-G-6.1	Storage of Radioactive Waste (2006) [ERS]
GSG-2	Criteria for Use in Preparedness and Response for a Nuclear or Radiological Emergency (2011), co-sponsorship: FAO, ILO, PAHO, WHO [AEFRS]
GSG-4	Use of External Experts by the Regulatory Body (2013) [E]

### **B.3. Specific Safety Standards (Applicable to Specified Facilities and Activities)**

#### **B.3.1. Nuclear Power Plants**

SSR-2/1	Safety of Nuclear Power Plants: Design (2012) [ACEFRS]
SSR-2/2	Safety of Nuclear Power Plants: Commissioning and Operation (2011) [ACEFRS]
NS-R-3	Site Evaluation for Nuclear Installations (2003) [ACEFRS]
SSG-16	Establishing the Safety Infrastructure for a Nuclear Power Programme (2012) [E]
GS-G-1.1	Organization and Staffing of the Regulatory Body for Nuclear Facilities (2002) [CEFRS]
GS-G-1.2	Review and Assessment of Nuclear Facilities by the Regulatory Body (2002) [CEFR]
GS-G-1.3	Regulatory Inspection of Nuclear Facilities and Enforcement by the Regulatory Body (2002) [CEFRS]
GS-G-1.4	Documentation for Use in Regulating Nuclear Facilities (2002) [CEFRS]

GS-G-3.5	The Management System for Nuclear Installations (2009) [E]
SSG-12	Licensing Process for Nuclear Installations (2010) [ES]
GS-G-4.1	Format and Content of the Safety Analysis Report for Nuclear Power Plants (2004) [CE]
NS-G-1.1	Software for Computer Based Systems Important to Safety in Nuclear Power Plants (2000) (under revision) [CEF]
NS-G-1.3	Instrumentation and Control Systems Important to Safety in Nuclear Power Plants (2002) (under revision) [CEFR]
NS-G-1.4	Design of Fuel Handling and Storage Systems for Nuclear Power Plants (2003) [ERS]
NS-G-1.5	External Events Excluding Earthquakes in the Design of Nuclear Power Plants (2003) [ER]
NS-G-1.6	Seismic Design and Qualification for Nuclear Power Plants (2003) [ER]
NS-G-1.7	Protection against Internal Fires and Explosions in the Design of Nuclear Power Plants (2004) [ER]
NS-G-1.8	Design of Emergency Power Systems for Nuclear Power Plants (2004) (under revision) [ER]
NS-G-1.9	Design of the Reactor Coolant System and Associated Systems in Nuclear Power Plants (2004) [ERS]
NS-G-1.10	Design of Reactor Containment Systems for Nuclear Power Plants (2004) [ER]
NS-G-1.11	Protection against Internal Hazards other than Fires and Explosions in the Design of Nuclear Power Plants (2004) [E]
NS-G-1.12	Design of the Reactor Core for Nuclear Power Plants (2005) [CER]
NS-G-1.13	Radiation Protection Aspects of Design for Nuclear Power Plants (2005) [ER]
NS-G-2.1	Fire Safety in the Operation of Nuclear Power Plants (2000) [CEFR]
NS-G-2.2	Operational Limits and Conditions and Operating Procedures for Nuclear Power Plants (2000) [CEFRS]
NS-G-2.3	Modifications to Nuclear Power Plants (2001) [CEFRS]
NS-G-2.4	The Operating Organization for Nuclear Power Plants (2001) [CEFR]
NS-G-2.5	Core Management and Fuel Handling for Nuclear Power Plants (2002) [ER]
NS-G-2.6	Maintenance, Surveillance and In-service Inspection in Nuclear Power Plants (2002) [ER]
NS-G-2.7	Radiation Protection and Radioactive Waste Management in the Operation of Nuclear Power Plants (2002) [ERS]
NS-G-2.8	Recruitment, Qualification and Training of Personnel for Nuclear Power Plants (2002) [ER]
NS-G-2.9	Commissioning for Nuclear Power Plants (2003) (under revision) [E]
SSG-25	Periodic Safety Review for Nuclear Power Plants (2013) [E]

NS-G-2.11	A System for the Feedback of Experience from Events in Nuclear Installations (2006) [ERS]
NS-G-2.12	Ageing Management for Nuclear Power Plants (2009) [E]
NS-G-2.13	Evaluation of Seismic Safety for Existing Nuclear Installations (2009) [E]
NS-G-2.14	Conduct of Operations at Nuclear Power Plants (2008) [ERS]
NS-G-2.15	Severe Accident Management Programmes for Nuclear Power Plants (2009) [E]
SSG-13	Chemistry Programme for Water Cooled Nuclear Power Plants (2011) [E]
NS-G-3.1	External Human Induced Events in Site Evaluation for Nuclear Power Plants (2002) [CEFR]
NS-G-3.2	Dispersion of Radioactive Material in Air and Water and Consideration of Population Distribution in Site Evaluation for Nuclear Power Plants (2002) (under revision) [ER]
SSG-9	Seismic Hazards in Site Evaluation for Nuclear Installations (2010) [E]
SSG-18	Meteorological and Hydrological Hazards in Site Evaluation for Nuclear Installations (2011), co-sponsorship: WMO [E]
SSG-21	Volcanic Hazards in Site Evaluation for Nuclear Installations (2012) [E]
NS-G-3.6	Geotechnical Aspects of Site Evaluation and Foundations for Nuclear Power Plants (2004) [CER]
SSG-2	Deterministic Safety Analysis for Nuclear Power Plants (2009) [ES]
SSG-3	Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants (2010) [E]
SSG-4	Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants (2010) [E]
WS-G-2.1	Decommissioning of Nuclear Power Plants and Research Reactors (1999) (under revision) [ACEFR]

### **B.3.2. Research Reactors**

NS-R-3	Site Evaluation for Nuclear Installations (2003) [ACEFRS]
NS-R-4	Safety of Research Reactors (2005) [ACEFRS]
SSG-9	Seismic Hazards in Site Evaluation for Nuclear Installations (2010) [E]
SSG-18	Meteorological and Hydrological Hazards in Site Evaluation for Nuclear Installations (2011), co-sponsorship: WMO [E]
SSG-21	Volcanic Hazards in Site Evaluation for Nuclear Installations (2012) [E]
GS-G-1.1	Organization and Staffing of the Regulatory Body for Nuclear Facilities (2002) [CEFRS]
GS-G-1.2	Review and Assessment of Nuclear Facilities by the Regulatory Body (2002) [CEFR]

GS-G-1.3	Regulatory Inspection of Nuclear Facilities and Enforcement by the Regulatory Body (2002) [CEFRS]
GS-G-1.4	Documentation for Use in Regulating Nuclear Facilities (2002) [CEFRS]
GS-G-3.5	The Management System for Nuclear Installations (2009) [E]
SSG-12	Licensing Process for Nuclear Installations (2010) [ES]
NS-G-2.11	A System for the Feedback of Experience from Events in Nuclear Installations (2006) [ERS]
NS-G-2.13	Evaluation of Seismic Safety for Existing Nuclear Installations (2009) [E]
NS-G-4.1	Commissioning of Research Reactors (2006) [E]
NS-G-4.2	Maintenance, Periodic Testing and Inspection of Research Reactors (2006) [E]
NS-G-4.3	Core Management and Fuel Handling for Research Reactors (2008) [E]
NS-G-4.4	Operational Limits and Conditions and Operating Procedures for Research Reactors (2008) [E]
NS-G-4.5	The Operating Organization and the Recruitment, Training and Qualification of Personnel for Research Reactors (2008) [E]
NS-G-4.6	Radiation Protection and Radioactive Waste Management in the Design and Operation of Research Reactors (2008) [E]
WS-G-2.1	Decommissioning of Nuclear Power Plants and Research Reactors (1999) (under revision) [ACEFR]
SSG-10	Ageing Management for Research Reactors (2010) [E]
SSG-20	Safety Assessment for Research Reactors and Preparation of the Safety Analysis Report (2012) [E]
SSG-22	Use of a Graded Approach in the Application of the Safety Requirements for Research Reactors (2012) [E]
SSG-24	Safety in the Utilization and Modification of Research Reactors (2012) [E]

### **B.3.3. Fuel Cycle Facilities**

NS-R-3	Site Evaluation for Nuclear Installations (2003) [ACEFRS]
NS-R-5	Safety of Nuclear Fuel Cycle Facilities (2008) (under revision) [E]
SSG-9	Seismic Hazards in Site Evaluation for Nuclear Installations (2010) [E]
SSG-18	Meteorological and Hydrological Hazards in Site Evaluation for Nuclear Installations (2011), co-sponsorship: WMO [E]
SSG-21	Volcanic Hazards in Site Evaluation for Nuclear Installations (2012) [E]
GS-G-1.1	Organization and Staffing of the Regulatory Body for Nuclear Facilities (2002) [CEFRS]
GS-G-1.2	Review and Assessment of Nuclear Facilities by the Regulatory Body (2002) [CEFR]

GS-G-1.3	Regulatory Inspection of Nuclear Facilities and Enforcement by the Regulatory Body (2002) [CEFRS]
GS-G-1.4	Documentation for Use in Regulating Nuclear Facilities (2002) [CEFRS]
GS-G-3.5	The Management System for Nuclear Installations (2009) [E]
SSG-12	Licensing Process for Nuclear Installations (2010) [ES]
NS-G-2.11	A System for the Feedback of Experience from Events in Nuclear Installations (2006) [ERS]
NS-G-2.13	Evaluation of Seismic Safety for Existing Nuclear Installations (2009) [E]
SSG-5	Safety of Conversion Facilities and Uranium Enrichment Facilities (2010) [E]
SSG-6	Safety of Uranium Fuel Fabrication Facilities (2010) [E]
SSG-7	Safety of Uranium and Plutonium Mixed Oxide Fuel Fabrication Facilities (2010) [E]
WS-G-2.4	Decommissioning of Nuclear Fuel Cycle Facilities (2001) (under revision) [CEFRS]
SSG-15	Storage of Spent Nuclear Fuel (2012) [E]

#### **B.3.4. Radioactive Waste Disposal Facilities**

SSR-5	Disposal of Radioactive Waste (2011) [ACEFRS]
GS-G-1.1	Organization and Staffing of the Regulatory Body for Nuclear Facilities (2002) [CEFRS]
GS-G-1.2	Review and Assessment of Nuclear Facilities by the Regulatory Body (2002) [CEFR]
GS-G-1.3	Regulatory Inspection of Nuclear Facilities and Enforcement by the Regulatory Body (2002) [CEFRS]
GS-G-1.4	Documentation for Use in Regulating Nuclear Facilities (2002) [CEFRS]
GS-G-3.4	The Management System for the Disposal of Radioactive Waste (2008) [E]
SSG-1	Borehole Disposal Facilities for Radioactive Waste (2009) [E]
111-G-3.1	Siting of Near Surface Disposal Facilities (1994) (under revision) [E]
SSG-14	Geological Disposal Facilities for Radioactive Waste (2011) [E]
SSG-23	The Safety Case and Safety Assessment for the Disposal of Radioactive Waste (2012) [E]

#### **B.3.5. Mining and Milling**

RS-G-1.6	Occupational Radiation Protection in the Mining and Processing of Raw Materials (2004), co-sponsorship: ILO [ES]
WS-G-1.2	Management of Radioactive Waste from the Mining and Milling of Ores (2002) (under revision) [ERS]

### **B.3.6. Applications of Radiation Sources**

- GSR Part 3      Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards — Interim Edition (2011) [ACEFRS]
- GS-G-1.5      Regulatory Control of Radiation Sources (2004), co-sponsorship: FAO, ILO, PAHO, WHO [AEFS]
- RS-G-1.4      Building Competence in Radiation Protection and the Safe Use of Radiation Sources (2001), co-sponsorship: ILO, PAHO, WHO [ACEFRS]
- RS-G-1.5      Radiological Protection for Medical Exposure to Ionizing Radiation (2002), co-sponsorship: PAHO, WHO (under revision) [CEFRS]
- RS-G-1.9      Categorization of Radioactive Sources (2005) [ACEFRS]
- RS-G-1.10     Safety of Radiation Generators and Sealed Radioactive Sources (2006) [EFS]
- WS-G-2.2      Decommissioning of Medical, Industrial and Research Facilities (1999) (under revision) [ACEFRS]
- WS-G-2.7      Management of Waste from the Use of Radioactive Materials in Medicine, Industry, Agriculture, Research and Education (2005) [CERS]
- SSG-8          Radiation Safety of Gamma, Electron and X Ray Irradiation Facilities (2010) [E]
- SSG-11        Radiation Safety in Industrial Radiography (2011) [AEF]
- SSG-17        Control of Orphan Sources and Other Radioactive Material in the Metal Recycling and Production Industries (2012) [E]
- SSG-19        National Strategy for Regaining Control over Orphan Sources and Improving Control over Vulnerable Sources (2011) [AES]

### **B.3.7. Transport of Radioactive Material**

- SSR-6          Regulations for the Safe Transport of Radioactive Material: 2012 Edition (2012) [ACEFRS]
- TS-G-1.1 (Rev. 1) Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (2008) (under revision) [ES]
- TS-G-1.2 (ST-3) Planning and Preparing for Emergency Response to Transport Accidents Involving Radioactive Material (2002) [ERS]
- TS-G-1.3      Radiation Protection Programmes for the Transport of Radioactive Material (2007) [ES]
- TS-G-1.4      The Management System for the Safe Transport of Radioactive Material (2008) [E]
- TS-G-1.5      Compliance Assurance for the Safe Transport of Radioactive Material (2009) [E]
- TS-G-1.6      Schedules of Provisions of the IAEA Regulations for the Safe Transport of Radioactive Material (2005 Edition) (2010) [ES]

