NUCLEAR SAFETY REVIEW 2018

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Foreword

The *Nuclear Safety Review 2018* includes the global trends and the Agency's activities in 2017. It also presents priorities and related activities for 2018 and beyond, as identified by the Agency, for strengthening nuclear, radiation, transport and waste safety. The Appendix provides details on the activities of the Commission on Safety Standards and on other activities relevant to the Agency's safety standards.

A draft version of the *Nuclear Safety Review 2018* was submitted to the March 2018 session of the Board of Governors in document GOV/2018/4. The final version of the *Nuclear Safety Review 2018* was prepared in light of the discussions held during the Board of Governors and also of the comments received from the Member States.

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Executive Overview

1. The *Nuclear Safety Review 2018* includes the global trends and the Agency's activities in 2017. It also presents priorities for 2018 and beyond, as identified by the Agency, for strengthening nuclear, radiation, transport and waste safety.

2. The Executive Overview provides a summary of the trends, activities and priorities covered in this report. They include those related to: general safety areas; radiation, transport and waste safety; safety in nuclear installations; emergency preparedness and response (EPR); management of the safety and security interface; and strengthening civil liability for nuclear damage.

3. The Appendix provides details of the activities of the Commission on Safety Standards (CSS) and activities relevant to the Agency safety standards.

General Safety Areas

Trends

4. The main focus regarding the production of the Agency's safety standards continued to be the revision of existing standards rather than the establishment of new ones. The CSS Chair provided the Commission's conclusion in a letter to the Director General dated 20 August 2015. The letter emphasized that good progress had been achieved in the revision of the Safety Requirements, and confirmed that the technical elements of the Vienna Declaration on Nuclear Safety[1] are already well reflected in the relevant IAEA Safety Requirements.[2]

5. Member State requests for the Agency's peer review and advisory services continued to increase and a large number of missions were conducted across all safety areas.

6. The majority of Member States receiving Agency assistance report that they require support to further develop their national regulatory infrastructure, with many Member States facing difficulties in allocating resources for regulatory capacity building.

7. A considerable number of Member States report that they require support to further develop leadership and management for safety.

8. There is an increasing demand for Agency support to Member States' efforts for establishing a safety and licensing framework for innovative technologies, such as small and medium sized or modular reactors.

9. There is an increasing demand for Agency support for building radiation protection competence.

Activities

10. The Agency issued the Safety Requirements publication entitled *Safety of Nuclear Fuel Cycle Facilities* (IAEA Safety Standards Series No. SSR-4)[3]. The issuance of this publication completes the

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[1] The document is available at: https://www.iaea.org/sites/default/files/infcirc872.pdf.

[2] See para 10 of the appendix in Nuclear Safety Review 2016 (GC/(60)/INF/5) available at: https://www.iaea.org/About/Policy/GC/GC60/GC60InfDocuments/English/gc60inf-5_en.pdf.

[3] INTERNATIONAL ATOMIC ENERGY AGENCY, Safety of Nuclear Fuel Cycle Facilities, IAEA Safety Standards Series No. SSR-4, IAEA. Vienna (2017).

work to revise the Safety Requirements publications to take into account lessons from the Fukushima Daiichi accident. The Agency also issued the Safety Guide entitled *Communication and Consultation with Interested Parties by the Regulatory Body* (IAEA Safety Standards Series No. GSG-6)[4].

11. The Nuclear Safety and Security Online User Interface (NSS-OUI) platform was launched during the 61st regular session of the General Conference. NSS-OUI was used in 2017 to support several projects to revise the safety standards across topical areas.

12. A large number of peer review and advisory service missions were conducted across all safety areas. This included the first two Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS) missions in Italy and Poland. The Agency conducted six Integrated Regulatory Review Service (IRRS) missions, all to Member States without nuclear power plants (NPPs), and seven follow-up IRRS missions, three of which were in Member States without operating NPPs. The Agency conducted one Emergency Preparedness Review (EPREV) mission. The Agency conducted seven Operational Safety Review Team (OSART) missions, two of which were conducted at NPPs in the pre-operational phase prior to initial fuel load, and seven follow-up OSART missions. The Agency conducted three Safety Aspects of Long Term Operation (SALTO) missions, and one follow-up SALTO mission. The Agency conducted five Site and External Events Design (SEED) review missions and three preparatory missions for SEED reviews.

13. The Agency hosted and provided support to the Seventh Review Meeting of the Contracting Parties to the Convention on Nuclear Safety (CNS)[5] and to the Third Extraordinary Meeting of the Contracting Parties to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (Joint Convention) as well as to the Organizational Meeting for the Sixth Review Meeting of the Contracting Parties to the Joint Convention.

14. The Agency hosted several meetings of the Small Modular Reactor Regulators' Forum to facilitate collaboration and cooperation among Member States in order to identify, understand and address key regulatory matters associated with the deployment of small and medium sized or modular reactor (SMRs). The Agency also continued coordinating a study on the application of the design-related safety requirements to SMR designs.

15. The Agency held a pilot session of its International School of Nuclear and Radiological Leadership for Safety.

Priorities for strengthening general safety areas

16. The Agency will:

- Continue strengthening its safety standards using lessons from the Fukushima Daiichi accident and other relevant sources, and taking into account the Vienna Declaration on Nuclear Safety on Principles for the Implementation of the Objective of the CNS to Prevent Accidents and Mitigate Radiological Consequences;
- Strengthen the Agency's peer review and advisory services;
- Assist Member States in the application of its safety standards through, inter alia, its peer review and advisory services;

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[4] INTERNATIONAL ATOMIC ENERGY AGENCY, Communication and Consultation with Interested Parties by the Regulatory Body, IAEA Safety Standards Series No. GSG-6, IAEA, Vienna (2017).

[5] Summary Report of the 7th Review Meeting of the Contracting Parties to The Convention on Nuclear Safety, https://www-ns.iaea.org/downloads/ni/safety_convention/7th-review-meeting/17-08671e_cns7rm2017_08.pdf.

- Strengthen the Agency's activities to promote universal adherence to the international safety conventions and support their effective implementation;
- Assist Member States in strengthening: regulatory effectiveness; leadership and management for the safety of nuclear facilities and activities; efforts to foster and sustain a strong culture for safety; capacity building programmes; processes for communicating radiation risks to the public; and
- Support research and development for safety, and facilitate the exchange of the results.

Improving Radiation, Transport and Waste Safety

Trends

17. The increased use of sealed radioactive sources in medicine, industry, agriculture and research, has led to further demands for appropriate arrangements for the management of disused sealed sources.

18. The increased use of radioactive material is creating additional demand for regulatory oversight, including for transport within and across national borders.

19. Some Member States are increasingly interested in the construction and deployment of reactors transportable by sea.

20. The number of decommissioning projects worldwide has increased significantly leading to a corresponding increase in the need for education and training programmes.

21. There is a growing demand for Agency support from Member States that are developing and implementing plans and facilities for the near surface disposal of low and intermediate level radioactive waste.

22. Several Member States are showing increased interest in geological disposal of high level radioactive waste and spent fuel. In some Member States, licencing activities for geological disposal facilities are continuing.

23. The increasing use of nuclear techniques and applications has resulted in an increased demand for analysing and evaluating the radiological implications of releases to the environment.

Activities

24. The Agency organized the International Conference on Radiation Protection in Medicine — Achieving Change in Practice in Vienna, Austria, in December 2017. The conference participants discussed, inter alia, the implementation of the Bonn Call for Action to improve radiation protection in medicine.

25. The Agency finalized the Guidance on the Management of Disused Radioactive Sources, supplementary to the Code of Conduct on the Safety and Security of Radioactive Sources which was approved by the Board of Governors and endorsed by the General Conference in September 2017.

26. The Agency continued to support capacity building for the regulatory oversight of transport of radioactive material in over 80 Member States in Africa, Asia and the Pacific, Latin America and the Mediterranean regions through workshops.

27. The Agency, in collaboration with the European Commission, the European Bank for Reconstruction and Development and the Member States in Central Asia, developed the *Strategic Master Plan for Environmental Remediation of Uranium Legacy Sites in Central Asia*. This document provides the strategy and an implementation plan for remediating the uranium legacy sites in Central Asia.

Priorities for improving radiation, transport and waste safety

28. The Agency will assist Member States in:

- The effective implementation of the radiation protection principles of justification and optimization based on *Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards* (IAEA Safety Standards Series No. GSR Part 3),[6] with particular emphasis on medical exposures;
- The management of radioactive sources, particularly by promoting the application of the Code of Conduct on the Safety and Security of Radioactive Sources and the supplementary Guidance on the Import and Export of Radioactive Sources and Guidance on the Management of Disused Radioactive Sources;
- Building capacity for the safe transport of radioactive material;
- The safe management of radioactive waste, including geological disposal of high level waste, and the development of decommissioning strategies and plans; and
- The remediation of contaminated areas, including from post-accident situations and from uranium legacy sites.

Strengthening Safety in Nuclear Installations

Trends

29. At the end of 2017, around 30 Member States are actively considering or planning a new nuclear power programme. Many other Member States are planning or implementing projects for a new research reactor in support of capacity building.

30. The need to strengthen the implementation of organizational changes, the optimization of maintenance activities, and the assessment of major plant safety modification, are recurring lessons identified from Operational Safety Review (OSART) missions. These missions continue to highlight a need to further strengthen accident management and on-site emergency preparedness and response.

31. Programmes for long term operation (LTO) and ageing management are being implemented for an increasing number of nuclear power reactors around the world and the Agency continued to receive a high level of requests for the SALTO peer review service.

32. The number of Member States expressing an interest in SMRs has increased over the past few years.

Activities

33. The Agency held the Fourth International Conference on Nuclear Power Plant Life Management in Lyon, France, in October 2017. The conference was hosted by the Government of France in cooperation with the European Commission's Joint Research Centre and the Electric Power Research Institute. The meeting highlighted the importance of continuous safety improvements, a strong safety culture and operating experience.

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[6] EUROPEAN COMMISSION, FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR ORGANIZATION, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, UNITED NATIONS ENVIRONMENT PROGRAMME, WORLD HEALTH ORGANIZATION, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, IAEA Safety Standards Series No. GSR Part 3, IAEA, Vienna (2014).

34. The Agency convened an International Conference on Topical Issues in Nuclear Installation Safety: Safety Demonstration of Advanced Water Cooled Nuclear Power Plants in Vienna, Austria, in June 2017. The participants exchanged information on the latest approaches, advances and matters arising in demonstrating the safety of the nuclear power plants that are planned to be licensed and constructed in the near future, in particular those in which water cooled reactors are used.

35. The Agency continued coordinating a study on the application of the design-related safety requirements to SMR designs intended for near term deployment. The study included a review of current practices in Member States with regard to the application of the Agency's safety standards to SMR technologies. In addition, the Agency supported the Small Modular Reactor Regulators' Forum by facilitating discussions on matters of common interest and publishing the results of a pilot study conducted by the Forum.

36. The Agency held the fourth triennial International Meeting on Application of the Code of Conduct on the Safety of Research Reactors in Vienna, Austria, in May 2017. The meeting provided a forum for the participating countries to exchange information on the safety status of their research reactors and on their experience in applying the Code's provisions.

Priorities for strengthening safety in nuclear installations

37. The Agency will assist Member States in:

- Implementing and improving programmes for ageing management and the safe LTO of nuclear installations;
- Facilitating the exchange of operating experience of NPPs;
- The application of the Agency's safety standards relating to the evaluation of safety of nuclear installations, such as siting, design, commissioning and operating requirements, including long term operation;
- Sharing knowledge and experience in efforts to strengthen severe accident management guidelines and will further develop technical documentation in this area;
- Activities related to SMRs, particularly in efforts to develop safety requirements, build capacity for design and safety assessment, and share good practices;
- Performing safety assessments of research reactors, managing the ageing of research facilities, enhancing regulatory supervision and strengthening application of the Code of Conduct on the Safety of Research Reactors;
- Performing safety assessments and implementing safety upgrades for nuclear fuel cycle facilities; and
- Developing safety infrastructure for new nuclear power and research reactor programmes.

Strengthening Emergency Preparedness and Response

Trends

38. Member States are increasingly requesting technical assistance and advice in strengthening national and regional emergency preparedness and response (EPR) arrangements and interest is increasing in receiving comprehensive training through the Agency's Schools of Radiation Emergency Management.

39. Member States are showing increased interest in harmonization of EPR arrangements based on *Preparedness and Response for a Nuclear or Radiological Emergency* (IAEA Safety Standards Series No. GSR Part 7). In addition, there is noticeable interest from Member States in starting to address the EPR arrangements for the new generation of reactors.

40. Use of the Emergency Preparedness and Response Information Management System (EPRIMS) is increasing. Ninety-six Member States have appointed EPRIMS national coordinators.

41. Member States are increasingly interested in the development of protocols for exchange of information, coordinated assessment and decision-making at regional levels. They continue to seek the Agency's assistance in improving the preparation, conduct and evaluation of national emergency exercises.

42. Strengthening preparedness to communicate effectively with the public and the media in a nuclear or radiological emergency continues to be a priority for most Member States.

Activities

43. The Agency organized 53 training events and workshops at national, regional and interregional levels, focusing on assistance for implementing the requirements established in IAEA Safety Standards Series No. GSR Part 7[7]. This included eight workshops on effective communication with the public in an emergency, including one train-the-trainers workshop.

44. The Agency held its first Response and Assistance Network (RANET) Joint Assistance Team (JAT) exercise in October 2017 in the Agency's RANET Capacity Building Centre in Fukushima Prefecture, Japan. The exercise simulated an Agency assistance mission with a JAT that comprised field assistance teams and external-based support experts from different Member States registered in RANET, as well as representatives of the Secretariat.

45. Within the framework of the Inter-Agency Committee on Radiological and Nuclear Emergencies, the Agency conducted a ConvEx-3 exercise[8], which lasted for 36 hours and was based on the scenario of a severe accident at an NPP. With 83 Member States and 11 international organizations participating, this was the largest ConvEx-3 exercise conducted so far.

Priorities for strengthening emergency preparedness and response

46. The Agency will:

- Further develop operational arrangements for notification, for reporting and for requesting assistance in a nuclear or radiological incident or emergency;

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[7] FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL CIVIL AVIATION ORGANIZATION, INTERNATIONAL LABOUR ORGANIZATION, INTERNATIONAL MARITIME ORGANIZATION, INTERPOL, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, PREPARATORY COMMISSION FOR THE COMPREHENSIVE NUCLEAR-TEST-BAN TREATY ORGANIZATION, UNITED NATIONS ENVIRONMENT PROGRAMME, UNITED NATIONS OFFICE FOR THE COORDINATION OF HUMANITARIAN AFFAIRS, WORLD HEALTH ORGANIZATION, WORLD METEOROLOGICAL ORGANIZATION, Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSR Part 7, IAEA, Vienna (2015).

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

- Assist Member States in the implementation of IAEA Safety Standards Series No. GSR Part 7 and develop associated Safety Guides; and
- Implement an active exercise programme to test EPR at the international level and support national EPR exercise programmes.

Improving Management of the Safety and Security Interface

Trends

47. Member States continue to encourage the Secretariat to facilitate coordination of the safety–security interface. The Agency's activities highlight a continuing need to strengthen the management of the interface between safety and security for research reactors.

Activities

48. The Interface Group, comprising representatives of the Safety Standards Committees and the Nuclear Security Guidance Committee, reviewed 12 proposed Agency safety standards and nuclear security guidance publications to identify any safety and security interfaces.

49. The Agency completed the development of four guidance publications related to aspects of security that have significant interfaces with safety.

50. The Agency conducted two international workshops addressing the interface between nuclear security measures and emergency response arrangements for Member States planning major public events and establishing appropriate arrangements at ports.

Priorities for improving management of the safety and security interface

51. The Agency will ensure that safety standards and nuclear security guidance take into account the implications for both safety and security whenever appropriate, recognizing that the activities that address nuclear safety and security are different.

Strengthening Civil Liability for Nuclear Damage

Trends

52. Member States continue to attach importance to having effective and coherent nuclear liability mechanisms in place at the national and global level to ensure prompt, adequate and non-discriminatory compensation for damage caused by a nuclear accident or incident.

Activities

53. The Agency's International Expert Group on Nuclear Liability (INLEX) held its 17th regular meeting in Vienna, Austria, in May 2017. The meeting was preceded by a Workshop on Civil Liability for Nuclear Damage. Other activities included an IAEA-INLEX follow-up mission in Kuala Lumpur, Malaysia, in February 2017, a Sub-regional Workshop on Civil Liability for Nuclear Damage for Latin American Countries, in Montevideo, Uruguay, in June 2017, and a Workshop on Civil Liability for Nuclear Damage in Accra, Ghana, in November 2017.

54. The Agency issued *The 1997 Vienna Convention on Civil Liability for Nuclear Damage and the 1997 Convention on Supplementary Compensation for Nuclear Damage — Explanatory Texts* (IAEA International Law Series No. 3 (Revised))[9] in May 2017.

Priorities for strengthening civil liability for nuclear damage

55. The Agency will continue to facilitate the establishment of a global nuclear liability regime and, upon request, assist Member States in their efforts to adhere to and implement the international nuclear liability instruments, taking into account the recommendations adopted by INLEX in 2012.

[9] INTERNATIONAL ATOMIC ENERGY AGENCY, The 1997 Vienna Convention on Civil Liability for Nuclear Damage and the 1997 Convention on Supplementary Compensation for Nuclear Damage – Explanatory Texts, IAEA International Law Series No. 3 (Revised), IAEA, Vienna (2017).

Analytical Overview

A. General Safety Areas

A.1. Agency Safety Standards and Peer Review and Advisory Services

Trends

1. The main focus regarding the production of the Agency's safety standards continued to be the revision of existing standards rather than the establishment of new ones. The CSS Chair provided the Commission's conclusion in a letter to the Director General dated 20 August 2015. The letter emphasized that good progress had been achieved in the revision of the Safety Requirements, and confirmed that the technical elements of the Vienna Declaration on Nuclear Safety[10] are already well reflected in the relevant IAEA Safety Requirements.[11]

2. Member State requests for the Agency's peer review and advisory services continued to increase and a large number of missions were conducted across all safety areas. The Agency received the following requests for peer review missions to be conducted over the next two years: 2 requests for Emergency Preparedness Review (EPREV) missions; 18 requests for Integrated Regulatory Review Service (IRRS) missions; 6 requests for Technical Safety Review (TSR) services; 14 requests for Operational Safety Review Team (OSART) missions; 7 requests for Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS) missions; 11 requests for Site and External Events Design (SEED) review missions; and 12 requests for Safety Aspects of Long Term Operation (SALTO) missions. The Agency continues to receive many requests for TSR services related to site and design safety, safety requirements developed by regulatory authorities, and the application of probabilistic safety assessments.

Activities

3. The Agency issued the Safety Requirements publication entitled *Safety of Nuclear Fuel Cycle Facilities* (IAEA Safety Standards Series No. SSR-4)[12]. The issuance of this publication completes the work to revise the Agency's Safety Requirements publications to take into account lessons arising from the Fukushima Daiichi accident. Accordingly, the main focus is now on revising the Safety Guides.

4. The Agency has issued the following Safety Guides:

- *Communication and Consultation with Interested Parties by the Regulatory Body* (IAEA Safety Standards Series No. GSG-6)[13], to provide recommendations on communication and consultation with

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[10] The document is available at: https://www.iaea.org/sites/default/files/infcirc872.pdf.

[11] See para 10 of the appendix in Nuclear Safety Review 2016 (GC/(60)/INF/5) available at: https://www.iaea.org/About/Policy/GC/GC60/GC60InfDocuments/English/gc60inf-5_en.pdf.

[12] INTERNATIONAL ATOMIC ENERGY AGENCY, Safety of Nuclear Fuel Cycle Facilities, IAEA Safety Standards Series No. SSR-4, IAEA. Vienna (2017).

[13] INTERNATIONAL ATOMIC ENERGY AGENCY, Communication and Consultation with Interested Parties by the Regulatory Body, IAEA Safety Standards Series No. GSG-6, IAEA, Vienna (2017).

the public and other interested parties about the possible radiation risks associated with facilities and activities, and about processes and decisions of the regulatory body; and

- *Safety of Nuclear Fuel Reprocessing Facilities* (IAEA Safety Standards Series No. SSG-42)[14], and *Safety of Nuclear Fuel Cycle Research and Development Facilities* (IAEA Safety Standards Series No. SSG-43)[15].

5. The CSS endorsed for submission for publication the safety standard *Arrangements for the Termination of a Nuclear or Radiological Emergency* (IAEA Safety Standards Series No. GSG-11), with joint sponsorship by ten international or intergovernmental organizations. This Safety Guide provides guidance and recommendations on how to prepare to terminate a nuclear or radiological emergency and to transition either to an existing exposure situation or to a planned exposure situation.

6. The Safety Standards Committees approved two draft Safety Guides that support the implementation of the General Safety Requirements publication entitled *Governmental, Legal and Regulatory Framework for Safety* (IAEA Safety Standards Series No. GSR Part 1 (Rev. 1))[16]: *Organization, Management and Staffing of a Regulatory Body for Safety* (DS472) and *Functions and Processes of the Regulatory Body for Safety* (DS473). Furthermore, they also approved a draft Safety Guide entitled *Decommissioning of Medical, Industrial and Research Facilities* (DS403) that supports the implementation of the General Safety Requirements publication entitled *Decommissioning of Facilities* (IAEA Safety Standards Series No. GSR Part 6)[17]. Further information about the Agency's activities regarding safety standards is provided in Appendix A.

7. The CSS approved the revision of *Arrangements for Preparedness for a Nuclear or Radiological Emergency* (IAEA Safety Standards Series No. GS-G-2.1) at its November 2017 meeting. The draft Safety Guides entitled *Arrangements for Public Communications in Preparedness and Response for a Nuclear or Radiological Emergency* (DS475) and *Preparedness and Response for an Emergency during the Transport of Radioactive Material* (DS469) have been prepared for their next stage of formal reviews and approvals by relevant Safety Standards Committees.

8. The Nuclear Safety and Security Online User Interface (NSS-OUI) platform was launched during the 61st regular session of the General Conference. NSS-OUI was used in 2017 to support several projects to revise the safety standards across topical areas. Moreover, the IAEA Safety Glossary[18] was integrated into the NSS-OUI platform, enabling future electronic versions of the safety standards to include user-friendly access to Glossary definitions.

9. The Agency continued to strengthen its peer review and advisory services, and self-assessment tools by incorporating lessons learned from their implementation. The Agency also shared relevant information with Member States. The Agency held the Technical Meeting to Assess the Overall Structure, Effectiveness and Efficiency of Peer Review and Advisory Services in the Areas of Nuclear Safety and Security in Vienna, Austria, in August 2017. The presentations and outcome of this meeting

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[14] INTERNATIONAL ATOMIC ENERGY AGENCY, Safety of Nuclear Fuel Reprocessing Facilities, IAEA Safety Standards Series No. SSG-42, IAEA, Vienna (2017).

[15] INTERNATIONAL ATOMIC ENERGY AGENCY, Safety of Nuclear Fuel Cycle Research and Development Facilities, IAEA Safety Standards Series No. SSG-43, IAEA, Vienna (2017).

[16] INTERNATIONAL ATOMIC ENERGY AGENCY, Governmental, Legal and Regulatory Framework for Safety, IAEA Safety Standards Series No. GSR Part 1 (Rev. 1), IAEA, Vienna (2016).

[17] INTERNATIONAL ATOMIC ENERGY AGENCY, Decommissioning of Facilities, IAEA Safety Standards Series No. GSR Part 6, IAEA, Vienna (2014).

[18] See https://www-ns.iaea.org/downloads/standards/glossary/iaea-safety-glossary-rev2016.pdf.

are available on the Global Nuclear Safety and Security Network (GNSSN) platform[19]. The meeting was attended by 47 participants from 38 Member States.

10. The Agency conducted six IRRS missions, all to Member States without nuclear power plants (NPPs), and seven follow-up IRRS missions, three of which were in Member States without operating NPPs. The Agency conducted one EPREV mission and two EPREV preparatory meetings. The Agency conducted seven OSART missions, two of which were conducted at NPPs in the pre-operational phase prior to initial fuel load, and seven follow-up OSART missions. The Agency conducted three SALTO missions, and one follow-up SALTO mission. The Agency conducted five SEED review missions and three preparatory missions for SEED reviews. The Agency conducted three INSARR missions and two follow-up INSARR missions.

11. The Agency conducted its first two Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS) missions in Italy and Poland.

12. The Agency conducted 12 Advisory Missions for Radiation Safety (AMRAS) to support Member States in establishing and strengthening national radiation safety regulatory infrastructures. The web-based Radiation Safety Advisory Mission Tool (RASAMT) aided the preparation and conduct of the missions.

13. ARTEMIS draft guidelines were made available through the GNSSN ARTEMIS platform[20]. The self-assessment associated with ARTEMIS implementation is available to those Member States who have requested the organization of an ARTEMIS review.

14. New Guidelines for EPREV missions, developed in 2017, improve the mission processes by taking into account experience, feedback from Member States, and recommendations from the Peer Review and Advisory Services Committee.

15. The Agency further revised the set of questions in the Self-Assessment of Regulatory Infrastructure for Safety (SARIS) methodology and tool, and made an updated version available to Member States in February 2017. The Agency also provided support to Member States in conducting self-assessment of the national regulatory frameworks in preparation for IRRS.

16. The Agency carried out analysis of the 2006–2016 IRRS missions to countries with operating NPPs and published it on the IRRS platform under GNSSN. A Training Course for Nuclear Safety Reviewers in Integrated Regulatory Review Service Missions took place in Vienna, Austria, in January 2017 and was attended by 32 participants from 19 Member States.

17. The CSS Working Group established to consider the implications for the Agency's safety standards of the 2012 United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) report on *Attributing Health Effects to Ionizing Radiation Exposure and Inferring Risks*[21], met in Vienna, Austria, in October 2017. The CSS endorsed the Working Group's recommendations to review the Safety Fundamentals to identify whether there is a need to refine certain parts of the text with respect to the dose and risk concepts set out in the UNSCEAR report, and to analyse the safety standards currently under development and already published to determine which could be strengthened in this respect.

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[19] See: https://gnssn.iaea.org/main/PRASC/Pages/default.aspx.

[20] See: http://gnssn.iaea.org/main/artemis.

[21] UNITED NATIONS, Sources, Effects and Risks of Ionizing Radiation (2012 Report to the General Assembly), United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), UN, New York (2015) Annex A: Attributing Health Effects to Ionizing Radiation Exposure and Inferring Risks.

18. At the request of the CSS, the Secretariat undertook an assessment of the implications for the Agency's safety standards and peer review and advisory services of the International Nuclear Safety Group (INSAG) publication entitled *Ensuring Robust National Nuclear Safety Systems: Institutional Strength in Depth* (INSAG-27)[22].

Priorities and Related Activities

19. ***The Agency will continue strengthening its safety standards using lessons arising from the Fukushima Daiichi accident and other relevant sources, and taking into account the Vienna Declaration on Nuclear Safety on Principles for the Implementation of the Objective of the CNS to Prevent Accidents and Mitigate Radiological Consequences. The Agency will assist the application of its safety standards by, inter alia, strengthening its peer review and advisory services and related self-assessment tools. The Agency will undertake the following activities in relation to these priorities:***

- The Agency will continue to review and revise Safety Guides to take account of lessons from the Fukushima Daiichi accident and other pertinent sources of existing or new information. When developing new standards, the Agency will continue to focus on areas such as post-emergency recovery procedures and criteria for food, drinking water, non-food commodities in existing exposure situations and the methodology for the development of such criteria;

- The Agency will further enhance the NSS-OUI platform and seek feedback from Member States to identify priorities for the revision of existing standards. Terms defined in published standards will be tagged with definitions and associated information notes from the IAEA Safety Glossary. The NSS-OUI platform will be used to support the drafting, review and approval process for safety standards;

- The Agency will initiate an analysis of the Safety Fundamentals to identify whether there is a need to refine certain parts of the text concerning retrospective attribution of radiation health effects to past radiation exposures, prospective inference of health risks from radiation exposures and prediction of notional health effects for comparative purposes (e.g. use of collective dose);

- The Agency will continue to provide peer review and advisory services upon request;

- The Agency will continue to strengthen its peer review and advisory services and self-assessment tools by incorporating lessons learned from their implementation and share, as appropriate, the relevant information with Member States;

- The Agency will implement the IRRS mission and programme performance indicators;

- The Agency will issue EPREV performance indicators; and

- The Agency will publish ARTEMIS guidelines and work with Member States to ensure the availability of sufficient internationally recognized experts to support the ARTEMIS review activities.

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[22] INTERNATIONAL NUCLEAR SAFETY ADVISORY GROUP, Ensuring Robust National Nuclear Safety Systems — Institutional Strength in Depth, INSAG-27, IAEA, Vienna (2017).

A.2. International Safety Conventions

Trends

20. The Convention on Nuclear Safety[23] (CNS) was adopted on 17 June 1994 and entered into force on 24 October 1996. As of December 2017, there were 83 Contracting Parties to the CNS, an increase of 5 compared to the end of 2016.

21. The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (Joint Convention)[24] was adopted on 5 September 1997 and entered into force on 18 June 2001. As of December 2017, there were 76 Contracting Parties to the Joint Convention, an increase of 3 compared to the end of 2016.

Activities

22. The Agency hosted and provided support for the Seventh Review Meeting of the Contracting Parties to the CNS, which was held in March–April 2017. More than 900 participants from 77 Contracting Parties took part. For the first time, countries that have signed, but not yet adhered to the Convention were invited to attend the opening plenary, the part of the final plenary where the summary report was adopted and the press conference. These sessions were also webcast for the first time. In another first, all National Reports were made publicly available after the meeting on the IAEA website.

23. The Third Extraordinary Meeting of the Contracting Parties to the Joint Convention was held in Vienna, Austria, in May 2017, with the participation of 57 Contracting Parties. The Contracting Parties agreed to amend the Joint Convention Guidelines regarding the Review Process to make publicly available each National Report for future Review Meetings, 90 days after the Review Meeting, unless the Contracting Party notifies the Secretariat otherwise. The Contracting Parties agreed that, similar to the approach used during the Seventh Review Meeting of Contracting Parties to the CNS, the concept of 'Areas of Good Performance' would be introduced on a trial basis at the Sixth Review Meeting of the Contracting Parties to the Joint Convention.

24. The Organizational Meeting for the Sixth Review Meeting of the Contracting Parties to the Joint Convention took place in Vienna, Austria, in May 2017 and was attended by 57 Contracting Parties. Meeting participants decided that the Sixth Review Meeting should have two sequential topical sessions, the first on disused sealed sources and the second on general safety matters and public acceptance aspects associated with the long term storage of higher level radioactive waste. The Contracting Parties agreed to invite the two States that have signed, but not yet ratified, accepted or approved the Joint Convention, to attend selected parts of the Sixth Review Meeting, namely the opening plenary session and the part of the closing plenary session where the Summary Report will be adopted.

25. The Agency undertook activities to further encourage adherence to the CNS and the Joint Convention and active participation in the peer review process. It also worked to increase the effectiveness of the review process for Contracting Parties without a nuclear power programme. The Agency held a Regional Workshop in Vienna, Austria, in November 2017 to promote the CNS and the Joint Convention for Latin American and Asian Countries. A Regional Workshop to promote the Joint Convention in African Countries was conducted in Rabat, Morocco, in December 2017.

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[23] The text of the CNS is available in document INFCIRC/449: https://www.iaea.org/sites/default/files/infcirc449.pdf.

[24] The text of the Joint Convention is available in document INFCIRC/546: https://www.iaea.org/sites/default/files/infcirc546.pdf.

26. The Agency organized a side event during the 61st regular session of the General Conference to celebrate the 20th anniversary of the adoption of the Joint Convention. Representatives from five Contracting Parties shared experiences and highlighted the role of the Convention as the only legally binding international instrument to address, on a global scale, the safe management of spent fuel and radioactive waste.

Priorities and Related Activities

27. ***The Agency will promote universal adherence to the CNS and the Joint Convention and support their effective implementation, inter alia, through the organization of workshops at the regional level and through bilateral activities with the Member States. The Agency will undertake the following activities in relation to this priority:***

- The Agency will provide support for the Sixth Review Meeting of the Contracting Parties to the Joint Convention, to be held in May–June 2018;
- The Agency will provide support for the preparation of the Eighth Review Meeting of the Contracting Parties to the CNS by hosting and preparing the CNS Organizational Meeting in October 2018;
- The Agency will organise regional educational workshops for countries with no nuclear power reactors to encourage participation and provide assistance and information on how to join and implement the CNS, in line with a request expressed by the CNS Contracting Parties in the Seventh Review Meeting Summary Report; and
- The Agency will continue to organise workshops at regional level and bilateral activities with the Member States, to raise awareness and promote adherence to the Joint Convention and to the CNS.

A.3. Regulatory Effectiveness in Nuclear, Radiation, Transport and Waste Safety, and in Emergency Preparedness and Response

Trends

28. The number of Member States making good progress in strengthening their radiation safety regulatory infrastructure increased in 2017 (see Figure 1). Nevertheless, based on the information provided by Member States in the Agency's Radiation Safety Information Management System (RASIMS)[25], the majority of Member States report that they require support to further develop their national regulatory infrastructure to bring it closer in line with the Agency's safety standards.

[25] The Agency's Radiation Safety Information Management System can be found at http://rasims.iaea.org/.

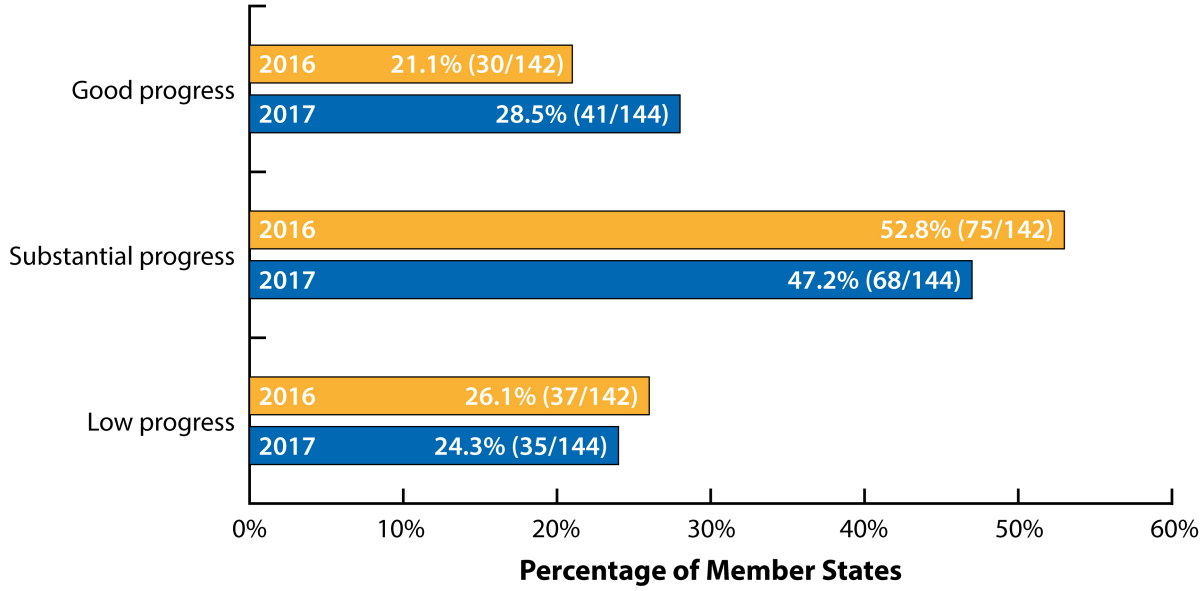

FIG. 1. Progress made in establishing a national radiation safety regulatory infrastructure (TSA 1) by Member States receiving Agency assistance.

29. Recent AMRAS missions show that there is a need in some Member States for continuous technical support for establishing and developing a sustainable regulatory framework for radiation safety.

30. The seven IRRS follow-up missions undertaken in 2017 indicate a high level of commitment among Member States to strengthening national legal and governmental infrastructure by completing the IRRS cycle.

31. The Agency noted an ongoing commitment by many Member States to update national EPR frameworks, including EPR regulations, in line with the latest safety requirements. Member States showed commitment to harmonizing arrangements based on IAEA Safety Standards Series No. GSR Part 7.

32. Review meetings, technical and steering committee meetings, as well as the new INSAG publication (INSAG-27), highlighted a need to further connect the different nuclear organizations, facilitate adherence to legal instruments, and promote the Agency's safety standards and services through communication, and information and knowledge sharing mechanisms.

Activities

33. The Agency conducted two regional training courses on organization and implementation of a national regulatory programme for control of radiation sources in Latin America and the Caribbean and in Africa; two regional workshops on regulatory enforcement and inspection for Europe and for Africa; and a regional training course on effective and sustainable regulatory control of radiation sources in Asia and the Pacific. Ninety-seven participants from 53 States participated in these workshops and training courses.

34. Based on feedback from Member States, the Agency significantly updated and restructured the International Regulatory Network (RegNet) to better facilitate knowledge and experience sharing among regulators.

35. The Agency continued operating RASIMS as a tool for assisting Member States that receive technical support from the Agency, so that they can evaluate their progress in applying the Agency's radiation safety standards. The Agency organized a workshop for RASIMS national coordinators from

Member States in the Asia and the Pacific region. Technical experts from 10 Member States also participated in two meetings that tested and evaluated a new version of the RASIMS platform.

36. The Agency continued to assist Member States in further strengthening their national regulatory infrastructure for nuclear and radiation safety through the provision of peer review and advisory services. The six IRRS missions that took place in 2017 were hosted by Member States without operating NPPs, namely Botswana, Cyprus, Ethiopia, Guatemala, the former Yugoslav Republic of Macedonia and Nigeria. Seven follow-up IRRS missions were also conducted: four in Member States with operating NPPs, namely Belgium, the Czech Republic, France and Romania; and three in Member States without operating NPPs, namely Greece, Jordan and Poland.

37. The Agency continued to address radiation safety infrastructure in Member States that have a particular interest in establishing or enhancing their cancer control capacity through imPACT Review[26] missions, four of which were conducted in Burundi, in March 2017, Congo, in June 2017, Swaziland, in August 2017, and Togo, in September 2017.

38. The Agency initiated and implemented the Regulatory Infrastructure Development Project (RIDP) that was designed to support Member States in Africa in establishing and implementing a national radiation safety regulatory infrastructure in line with the Agency's safety standards. A meeting to launch the project was held in Nairobi, Kenya, in July 2017.

Priorities and Related Activities

39. ***The Agency will assist Member States in strengthening their regulatory effectiveness by identifying lessons from international conferences, peer reviews, advisory missions, appraisal services, knowledge networks and relevant meetings and workshops. The Agency will undertake the following activities in relation to this priority:***

- The Agency will continue to support Member States in establishing and further strengthening their national regulatory infrastructure for nuclear and radiation safety, through meetings and workshops, and the provision, upon request, of peer review and advisory services;

- The Agency will further develop the Control of Sources Network (CSN) to enhance regulatory cooperation and share experience, with particular focus on Member States that are in the early stages of establishing and implementing their national radiation safety regulatory infrastructure;

- The Agency will launch a revised RASIMS that will enable participating Member States to collect and evaluate information about their national radiation safety infrastructure in a more efficient and effective manner;

- The Agency will release a new version of the GNSSN RegNet platform to enhance knowledge and experience sharing among regulators. Information, analyses, results and lessons learned from peer review and advisory services will be shared on the RegNet platform;

- The Agency will continue to support the development, implementation and strengthening of regulatory infrastructure for nuclear safety through national and regional workshops, Technical Meetings and expert missions, and the development and improvement of guidance documents, in line with IAEA Safety Standards Series No. GSR Part 1 (Rev.1);

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

- The Agency will continue supporting Member States' implementation of the requirements established in IAEA Safety Standards Series No. GSR Part 7 for regulating EPR arrangements of operating organizations; and

- The Agency will assist Forum of Nuclear Regulatory Bodies in Africa (FNRBA) Member States in developing a project roadmap that addresses matters encountered by regulatory bodies in Africa. The Agency will develop a survey to prioritize project ideas and a collaborative platform to collect the needs of regulatory bodies in Africa on a regular basis.

A.4. Leadership and Management for Safety, Safety Culture and Communication on Safety

Trends

40. Agency peer review missions frequently provide recommendations relating to leadership and management for safety, and safety culture.

41. An increasing number of Member States are requesting assistance in developing their programmes for leadership and management for safety, as well as conducting safety culture self-assessment for regulatory bodies.

42. Thematic working groups and Technical Meetings have highlighted the need for the Secretariat to further support Member States in developing communication strategies and plans, as well as establishing a global community of practices to discuss and share experiences.

Activities

43. The Agency assisted Member States in the area of leadership and management for safety. This included arranging the fifth annual Workshop on Leadership and Culture for Safety for Senior Managers in Helsinki, Finland, in November 2017. This assistance also included assessing leadership and management processes and the interfaces between human, technology and organizational performance during OSART missions. The consideration of leadership and management for safety has been further strengthened in the relevant modules of the IRRS, including in the self-assessments. The Agency also assisted staff at nuclear facilities in the self-assessment of their safety culture, and encouraged continuous improvement and preparation of senior and middle managers for their roles as leaders of safety culture within their organizations.

44. The Agency developed a package of training materials and a syllabus that were tested during the first Pilot International School for Nuclear and Radiological Leadership for Safety, held in Nice, France, during late October to early November 2017. The pilot was aimed at junior and mid-career professionals and future leaders in the nuclear safety field, and was attended by 20 young and middle managers from operators and regulators in radiological and nuclear safety. The overarching objective of the School is to assist Member States in their application of the requirements established in IAEA Safety Standards Series No. GSR Part 2[27].

45. The Agency continued to promote safety and security culture, taking into account their various interfaces. A joint consultancy meeting was held in Vienna, Austria, in October 2017 to explore the interfaces between safety and security cultures, with the aim of developing a discussion document for the Agency.

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[27] INTERNATIONAL ATOMIC ENERGY AGENCY, Leadership and Management for Safety, IAEA Safety Standards Series No. GSR Part 2, IAEA, Vienna (2016).

46. The Agency conducted missions requested by Member States to assist them in their efforts to assess and improve safety culture at all levels, within nuclear regulatory bodies, at nuclear facilities and in other organizations. A safety culture perception survey was made available on the Agency website, and safety culture workshops were held in Abu Dhabi, the United Arab Emirates, in March 2017; Kola and Udomlya, the Russian Federation, in April 2017; Rio de Janeiro, Brazil, in May 2017; and Buenos Aires, Argentina, in November 2017. An Independent Safety Culture Assessment (ISCA) mission of an operating facility in Petten, the Netherlands, was carried out in June 2017, at the request of the regulator and operator. As part of a safety culture framework harmonization project involving the Agency and the World Association of Nuclear Operators (WANO), a workshop was held in Vienna, Austria, in October 2017, to further develop guidance on applying a harmonized safety culture framework.

47. The Agency is currently revising the Safety Guides supporting the Safety Requirements publication entitled *Leadership and Management for Safety* (IAEA Safety Standards Series No. GSR Part 2). Training material based on this publication was finalized and used in workshops and missions conducted for Member States in Africa, Latin America, Europe and Asia, and for those Member States that are party to the ARASIA Agreement[28].

48. The Agency drafted a Technical Document on regulatory oversight of human and organizational factors (HOF) to support the development and implementation of a regulatory oversight programme that adequately takes HOF into account in the oversight of safety throughout the lifetime of nuclear installations.

49. The Agency organized consultancy meetings and Technical Meetings under the auspices of the GNSSN to assist Member States in tackling their needs in ensuring effective and timely stakeholder involvement and in developing communication strategies. A Technical Meeting on Challenges and Good Practices in Safety and Security Communication was held in August 2017 in Vienna, Austria, to discuss experiences encountered by Member States in communicating with the public and other interested parties. The first GNSSCOM Steering Committee meeting took place in Vienna, Austria, in June 2017, to discuss and review the communication toolbox. Prior to this, the Agency held a consultancy meeting in Vienna, Austria, in April 2017, to review the first draft of the communication toolbox.

Priorities and Related Activities

50. ***The Agency will assist Member States in strengthening leadership and management activities for the safety of nuclear facilities and activities. The Agency will assist Member States in their efforts to foster and sustain a strong safety culture. The Agency will also assist Member States in strengthening their processes for communicating radiation risks to the public in planned and existing exposure situations and during an emergency. The Agency will undertake the following activities in relation to these priorities:***

- The Agency will deliver leadership and culture for safety workshops in a systemic approach to safety for senior leaders and managers;

- The Agency will assess and further develop the Pilot International School for Nuclear and Radiological Leadership for Safety. The Agency will tailor the School to regional needs and priorities and will conduct pilot editions of the school accordingly;

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[28] The Co-operative Agreement for Arab States in Asia for Research, Development and Training related to Nuclear Science and Technology (ARASIA).

- The Agency will continue to assist Member States in the area of leadership and management for safety, safety culture self-assessment for nuclear regulatory bodies, and communication on safety; and
- The Agency will further develop a communicator's toolkit for safety and security communicators.

A.5. Capacity Building in Nuclear, Radiation, Transport and Waste Safety, and in Emergency Preparedness and Response

Trends

51. There is increasing demand for the Agency's support in building the competence of personnel with radiation protection responsibilities in the use, transport, storage and disposal of radiation sources. Member States have, in particular, requested greater support to build the competence of radiation protection officers in a sustainable way by using a train-the-trainers approach. The number of training events for trainers of radiation protection officers in 2017 has increased, in terms of the number of both participants and courses in comparison to 2016 (see Figure 2).

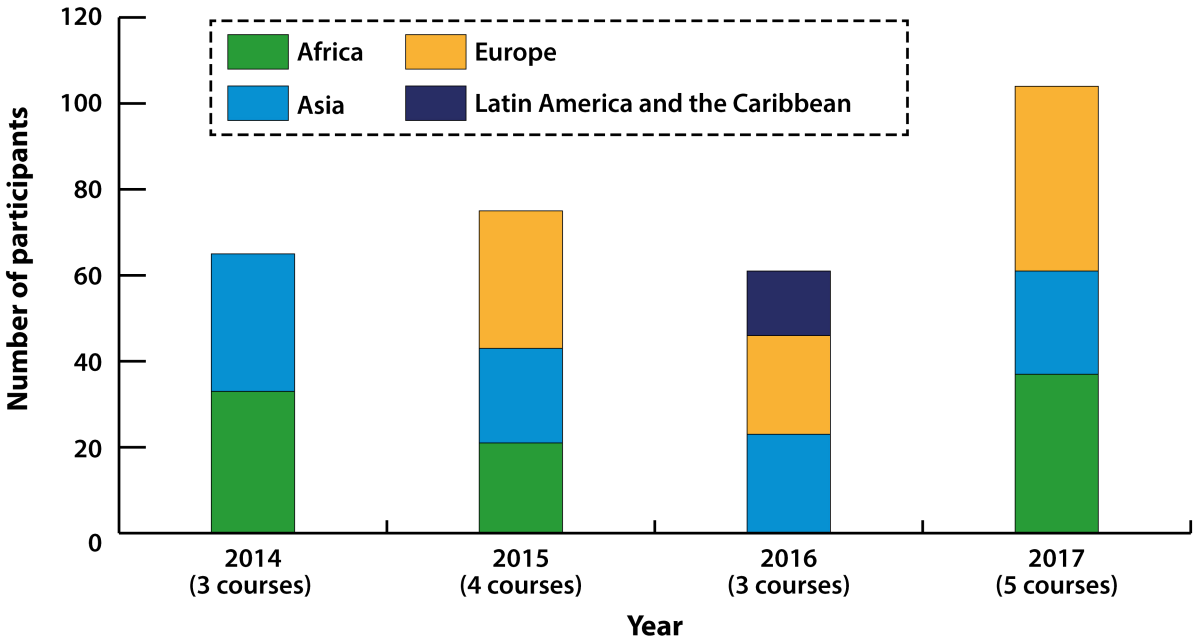

FIG. 2. Number of participants in courses to train the trainers of radiation protection officers.

52. The Postgraduate Educational Course (PGEC) in Radiation Protection and the Safety of Radiation Sources continued to be in high demand, with the number of applications consistently exceeding twice the number of available places.

53. There is increasing interest in the use of online and web-based training, particularly in the area of protection of patients from exposure to ionizing radiation.

54. There is increasing demand for Agency support for education and training activities related to site evaluation and operational safety of nuclear installations, design safety, protection against external events, design extension conditions, severe accident management, long term operation and safety culture. This demand comes from Member States with existing nuclear installations, as well as from those considering embarking on nuclear power programmes. Member States embarking on new nuclear power programmes have requested greater support for practical training on, for example, safety assessment computer software.

55. Many Member States considering embarking on a nuclear power programme, or on a first research reactor project, are facing difficulties in allocating resources for regulatory capacity building. In many of these Member States, the programme or project schedules allow only limited time for the regulatory body to establish its resources and competency in order to perform its regulatory functions effectively.

56. Some Member States also encounter difficulties in recruiting competent staff, which can be attributed to the absence of appropriate national infrastructure and/or coordination of national education and training resources.

57. Capacity Building Centres for Emergency Preparedness and Response (CBC-EPR) have contributed to an increase in regional EPR capacity building activities.

58. There is a need to support Member States in developing or strengthening their national and organizational nuclear safety knowledge management programmes (as noted in the conclusions of the 2016 Third International Conference on Nuclear Knowledge Management: Challenges and Approaches), in developing or strengthening their national capacity building programmes, and in developing or strengthening technical and scientific capacity and technical and scientific support organizations (TSOs).

Activities

59. The Agency organized a Technical Meeting on Managing Nuclear Safety Knowledge — Approaches and National Experiences in Vienna, Austria, in July 2017, attended by 51 participants from 33 Member States. A draft Technical Document on nuclear safety knowledge management, based on good practices and experiences exchanged at the Technical Meeting, provides guidance on developing such programmes.

60. Five PGECs were conducted in English, French, Russian and Spanish at the Agency-affiliated regional training centres in Africa, Asia, Europe, and Latin America and the Caribbean.

61. Five train-the-trainers events for radiation protection officers were organized for 73 Member States to develop sustainable national competencies in this topical area. The Agency also continued to organize a range of specialized training events in the field of radiation, transport and waste safety, including three Schools of Drafting Regulations on Radiation Safety held in Europe, the Caribbean and Asia and the Pacific. The Control of Sources Network (CSN), which is part of the International Regulatory Network and the GNSSN, was used in the preparation and implementation of the schools. In addition, more than 1500 participants benefited from e-learning activities such as interactive online seminars in English and Spanish offered on the Radiation Protection of Patients (RPOP) website.

62. The Agency conducted, upon request, two Education and Training Appraisal (EduTA) missions: in Argentina, in November 2017, and the United Arab Emirates, in February 2017, as well as two advisory missions in the Democratic Republic of the Congo, in January 2017, and in Uganda, in August 2017, to provide advice on the establishment of a national strategy and policy for education and training in radiation protection and safety.

63. The Agency strengthened its activities to support practical learning, experimental training and the assessment of training effectiveness. The Agency facilitated the acquisition of computer codes for safety assessment.

64. The Agency acquired a computer-based integral pressurized water reactor simulator and issued the following Training Course Series publications: *Integral Pressurized Water Reactor Simulator*

Manual (IAEA-TCS-65)[29], and *Integral Pressurized Water Reactor Simulator Manual: Exercise Handbook* (IAEA-TCS-65/Exercise Handbook)[30].

65. The Agency enhanced the Safety Assessment Education and Training (SAET) Programme, in support of the updated Safety Requirements publication, *Safety of Nuclear Power Plants: Design* (IAEA Safety Standards Series No. SSR-2/1 (Rev. 1))[31].

66. The Workshop on Considerations Related to the Interactions between Human, Technical and Organizational Factors in Research Reactor Safety was held in Vienna, Austria, in December 2017, with 30 participants from 22 Member States. Human, Technical and Organizational Factors (HTO) were included in the leadership and culture for safety training. Specific training in HTO has been given to OSART team members for the assessment during the peer review.

67. The Agency organized 53 workshops and training events in EPR: 41 at regional level and 12 at national level.

68. One new CBC-EPR was designated in Japan (National Institute of Radiological Sciences in Chiba).

69. The Secretariat developed a prototype for the Global Education and Training Resource (GETR) within the GNSSN, to assist Member States in strengthening their national education and training system. The GETR presents structured information about nuclear safety training and education resources organized by regulatory authorities, technical organizations, research institutions and universities. Two consultancy meetings were held to develop taxonomies of education and training, and to define the structure of GETR platform. Over 500 education and training resources, as well as 25 e-learning modules, are accessible through the platform.

70. The Agency renewed its Practical Arrangements with the Ibero-American Forum of Radiological and Nuclear Regulatory Agencies (FORO), on the 20th anniversary of its cooperation with FORO, in Buenos Aires, Argentina, in July 2017. The Agency increased its efforts to develop joint publications with the FORO and to disseminate its results inter-regionally.

71. The Agency held the 25th and 26th Steering Committee meetings of the Asian Nuclear Safety Network (ANSN) in May and October 2017, respectively. The Steering Committee approved the new ANSN Vision which is "a sustainable regional network for achieving a high level of nuclear safety in Asia"[32] and the revision of its terms of reference. The Steering Committee also agreed to organize the 3rd ANSN Plenary during the 62nd regular session of the IAEA General Conference and resume publishing the annual ANSN progress reports.

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[29] Integral Pressurized Water Reactor Simulator Manual, IAEA, Training Course Series No. 65, IAEA, Vienna (2017).

[30] Integral Pressurized Water Reactor Simulator Manual: Exercise Handbook. IAEA, Training Course Series No. 65/Exercise Handbook, IAEA, Vienna (2017).

[31] INTERNATIONAL ATOMIC ENERGY AGENCY, Safety of Nuclear Power Plants: Design, IAEA Safety Standards Series No. SSR-2/1 (Rev. 1), IAEA, Vienna (2016).

[32] Summary Report of the 26th Steering Committee of the Asian Nuclear Safety Network, 23–25 October 2017, Vienna, Austria.

Priorities and Related Activities

72. ***The Agency will assist Member States, upon request, in their capacity building programmes, including education and training in nuclear, radiation, transport and waste safety as well as EPR, and will also assist Member States in developing their expertise in the relevant technical areas. The Agency will undertake the following activities in relation to this priority:***

- The Agency will publish a Safety Report to assist Member States in the establishment of a national policy and strategy for education and training in radiation, transport and waste safety;

- The Agency will continue to offer the PGEC in collaboration with the regional training centres affiliated to the Agency, and organize specialized training events in the field of regulatory activities, occupational radiation protection, radiation protection of patients, transport safety and waste and environmental safety. The Agency will expand its e-learning activities in these areas, including those available on the Radiation Protection of Patients (RPOP) website[33];

- The Agency will support Member States in the development of national strategies for education and training in radiation, transport and waste safety through regional workshops, advisory missions such as EduTA, and the publication of a Safety Report on the establishment of such policies and strategies;

- The Agency will continue to support Member States' capacity building programmes through expert missions, capacity building and training workshops under the framework of SEED;

- The Agency will finalize the development of an IAEA Technical Document on knowledge management for regulatory bodies, drawing on experience gained through the use of the Systematic Assessment of Regulatory Competence Needs (SARCoN) methodology;

- The Agency will continue to implement the CBC-EPR concept. A network connecting existing centres will be developed to enable synergies and to facilitate the exchange of information and collection of feedback on EPR capacity building needs;

- The Agency will assist Member States in developing and strengthening TSO capability by, inter alia, organizing national and international workshops, and preparing several case studies and a modular TSO self-assessment;

- The Agency will assist European and Central Asian Safety (EuCAS) Network Member States in developing a strategic activity plan. The Agency will develop a survey designed to identify needs and existing cooperation activities between EuCAS members;

- The Agency will continue to develop and implement the FORO programme on nuclear and radiological safety. The Agency will further improve the coordination of the FORO programme with other efforts in Latin America, such as the technical cooperation programme in Latin America; and

- The Agency will continue to support ANSN activities. The Agency will assist with the organization of the 3rd ANSN Plenary as a side event of the 62nd regular session of the IAEA General Conference, including by inviting other regional network chairs, and the publication of the annual ANSN progress reports.

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[33] See the training section of the RPOP website: https://rpop.iaea.org/RPOP/RPoP/Content/AdditionalResources/Training/index.htm.

A.6. Research and Development for Safety

Trends

73. Much of the recent research and development work undertaken in Member States has been dedicated to gaining an increased understanding of severe accident phenomena and novel design features to provide a demonstration of the safety of nuclear installations.

74. Member States are interested in additional research activities in the EPR area, as was recognized at the Technical Meeting on Next Generation Reactors and Emergency Preparedness and Response, held in Vienna, Austria, in February 2017.

Activities

75. The Agency launched a new CRP on Development of Approaches, Methodologies and Criteria for Determining the Technical Basis for Emergency Planning Zone for Small Modular Reactor Deployment. The Secretariat is now selecting the organizations which have submitted proposals for research contracts/agreements.

76. The Agency held a Technical Meeting on Advanced Fuel Cycles to Improve the Sustainability of Nuclear Power through the Minimization of High Level Waste in Vienna, Austria, in October 2017. At this meeting, 18 participants from eight Member States discussed the technical perspectives of existing and future safe management of spent fuel, from direct disposal to the management of radionuclides that contribute to decay-heat generation, and the recycling of valuable nuclear materials, with an emphasis on final waste burden minimization.

77. The Agency continued to support coordinated research projects (CRPs) on:

- Radioactive Release from the Prototype Fast Breeder Reactor under Severe Accident Conditions to improve Member States' analytical capabilities in the field of sodium cooled fast reactor radiological releases in the case of severe accidents;

- Analysis of Options and Experimental Examination of Fuels for Water Cooled Reactors with Increased Accident Tolerance (ACTOF), to explore the potential to design and operate advanced fuel types. A second RCM-ACTOF was held in Vienna, Austria, in June 2017, gathering participating organizations from countries that explore the potential to design and operate advanced fuel types that are intended to be more tolerant of severe accident conditions; and

- Fuel Modelling in Accident Conditions (FUMAC), to share experimental data and good practices for a better understanding of the behaviour of water-cooled power reactor fuel in accident conditions. A third RCM-FUMAC was held in Vienna, Austria, in November 2017, gathering participating organizations from countries that share experimental data and best practices in the application of fuel modelling computer codes.

Priorities and Related Activities

78. ***The Agency will assist the Member States' efforts in the field of research and development for safety where the need for further work has been identified and will facilitate the exchange of the results. The Agency will undertake the following activities in relation to this priority:***

- The Agency will continue to organize meetings and activities to encourage research and development related to the practical implementation of the Agency's updated safety standards, such as IAEA Safety Standards Series No. SSR-2/1 (Rev. 1)[34], for novel NPP designs;

- With the support of interested Member States, the Agency will conduct the CRP on the Development of Approaches, Methodologies and Criteria for Determining the Technical Basis for Emergency Planning Zone for Small Modular Reactor Deployment, and launch new CRPs on: probabilistic safety analysis benchmark for multi-unit, multi-reactor sites addressing the radiation protection of patients and medical staff in fluoroscopy guided intervention procedures performed outside radiology departments; and radiation protection in the water treatment industry under the Agency's naturally occurring radioactive material (NORM) programme; and

- The Agency will conduct the seventh Joint IAEA-Generation IV International Forum Technical Meeting on the Safety of Liquid Metal Cooled Fast Reactors.

B. Improving Radiation, Transport and Waste Safety

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

Trends

79. There is an increasing awareness among Member States of the need for the protection of workers in different NORM industry sectors and the graded approach to optimize the use of regulatory and operators resources for proper management of worker protection elaborated in the *Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards* (IAEA Safety Standards Series No. GSR Part 3).[35]

Activities

80. The Agency held a Technical Meeting on Preventing Unintended and Accidental Medical Exposures in Radiology in Vienna, Austria, in March 2017. A total of 52 participants from 22 Member States and 12 international organizations exchanged information on methods for investigating, reporting and preventing unintended and accidental exposure in diagnostic radiology and interventional procedures. The Agency held a Technical Meeting on Strengthening of Safety Culture in Radiotherapy through the Use of Incident Learning Systems in Vienna, Austria, in October 2017. More than 50 participants from 30 Member States and 10 international organizations encouraged the use of incident learning systems to strengthen safety culture in radiotherapy. The Agency organized the International Conference on Radiation Protection in Medicine: Achieving Change in Practice in Vienna, Austria, in December 2017, attended by 534 participants from 96 Member States and 16 international organizations. The participants discussed, inter alia, the implementation of the Bonn Call for Action to

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[34] INTERNATIONAL ATOMIC ENERGY AGENCY, Safety of Nuclear Power Plants: Design, IAEA Safety Standards Series No. SSR-2/1 (Rev. 1), IAEA, Vienna (2016).

[35] EUROPEAN COMMISSION, FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR ORGANIZATION, OECD NUCLEAR ENERGY AGENCY, PAN AMERICAN HEALTH ORGANIZATION, UNITED NATIONS ENVIRONMENT PROGRAMME, WORLD HEALTH ORGANIZATION, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, IAEA Safety Standards Series No. GSR Part 3, IAEA, Vienna (2014).

improve radiation protection in medicine, and specifically the development of the Bonn Call for Action Implementation Toolkit.

81. Within the framework of the Practical Arrangements with Argentina's Nuclear Regulatory Authority, the Agency supported the review and development of regulatory guidance on radiological protection in radiotherapy, addressing in particular the potential increase in the risk of secondary cancers.

82. The Agency conducted Occupational Radiation Protection Appraisal Service (ORPAS) missions to Chile, Malaysia, Morocco and Paraguay, and preparatory missions to Nicaragua and Panama. The missions encouraged national regulatory authorities to consider further improvement of the graded approach definitions to be used in areas such as licensing of radiation practices, safety assessment and inspection for facilities and activities, and review or development of radiation protection regulations for facilities and activities.

83. The Agency further developed the Safety in Radiation Oncology (SAFRON) and Safety in Radiological Procedures (SAFRAD) voluntary reporting and learning systems to include the capability to report on safety events related to brachytherapy and to link prospective risk analysis with retrospective reports of events.

84. The Information System on Occupational Exposure in Medicine, Industry and Research-Industrial Radiography (ISEMIR-IR), a forum to exchange experiences and optimize radiation protection for industrial radiography sectors, was updated and released online.

85. The Occupational Radiation Protection Networks (ORPNET), a GNSSN web-based network that promotes optimization of occupational radiation protection, continued to announce occupational radiation protection related meetings, publications, joint projects, posters and news. The Agency's activities to enhance ORPNET contributed, inter alia, to the establishment of the African ALARA ('as low as reasonably achievable') Network in 2017.

86. One new utility member from China joined the Information System of Occupational Exposure (ISOE), operated jointly by the IAEA and the Organisation for Economic Co-operation and Development/Nuclear Energy Agency (OECD/NEA). A project to transfer the ISOE's accumulated radiation protection experiences to countries embarking on nuclear power programmes was proposed.

87. The Agency's new Safety Report on occupational radiation protection in uranium mining and processing industry was finalized. The document shows how to apply a graded approach to the protection of workers in the uranium mining and processing industry.

88. The Agency and the ILO jointly co-sponsored a national workshop on occupational radiation protection in Beijing, China, in April 2017. The Agency and ILO jointly organized regional workshops in Ibaraki, Japan, in October 2017, and in Antananarivo, Madagascar, in December 2017. These activities promoted the application of GSR Part 3 and the Safety Guide on Occupational Radiation Protection[36].

89. The Agency has published requirements on the control of radionuclides in food and drinking water in existing exposure situations. Supporting documents have been published by the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO), but the referenced figures of activity concentrations continue to differ owing to the different scope of their application.

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[36] INTERNATIONAL ATOMIC ENERGY AGENCY, INTERNATIONAL LABOUR OFFICE, Occupational Radiation Protection, IAEA Safety Standards Series No. RS-G-1.1, IAEA, Vienna (1999).

90. The Agency, in cooperation with the FAO, the Pan American Health Organization (PAHO) and the WHO, organized a regional workshop in Buenos Aires, Argentina, in March 2017, on controlling radioactivity in food, drinking water and commodities in non-emergency exposure situations. Forty-six participants from 16 Member States and 2 non-Member States in Latin America and the Caribbean identified a number of areas where greater consistency and harmonization regarding controlling radioactivity would be beneficial.

91. The Agency, in cooperation with the FAO and the WHO, organized a consultancy meeting in Vienna, Austria, in October 2017 to review the state of knowledge on the levels of natural radionuclides in foods, including the identification of the specific radionuclides and foods likely to contribute the highest radiation doses. A second consultancy meeting held in Vienna, Austria, in December 2017 discussed the development of guidance on the control of both natural and man-made radionuclides in food and drinking water.

92. The Agency continued to assist Member States in evaluating the need for a national action plan to control exposure due to radon, including a regional training course in Ciudad Rodrigo, Spain, in November 2017, in cooperation with the University of Cantabria at their radon test facility. The training provided 20 architects and building professionals from 13 Member States in Europe with knowledge of and experience in using methods to reduce radon concentrations in existing buildings.

93. The Agency, in cooperation with the WHO, prepared a Safety Report on design and implementation of representative indoor radon surveys.

Priorities and Related Activities

94. ***The Agency will assist Member States in the application of the Agency's safety standards in radiation protection, in particular, the IAEA Safety Standards Series No. GSR Part 3 regarding the effective implementation of the principles of justification and optimization. The Agency will assist Member States in their efforts to justify the medical exposure of patients through the use of clinical guidelines and to optimize the radiation protection of patients and health workers from the use of radiation in medicine. The Agency will undertake the following activities in relation to these priorities:***

- The Agency will organize Technical Meetings to exchange information on strengthening radiation protection in medicine through the implementation of the Bonn Call for Action. These meetings should gather views on best practices in the prevention of unintended and accidental exposures in diagnostic and therapeutic nuclear medicine procedures, including the role of goals and tools for safety culture training in medical uses of radiation;

- The Agency will promote the use of the ISEMIR-IR. Working group meetings will evaluate the information collected through the system for distribution;

- The Agency will convert existing training packages for occupational radiation protection during high exposure operations, worker protection in NORM industries and occupational radiation protection into e-learning material;

- The Agency will continue working with the WHO and other relevant organizations to raise awareness of public exposure due to radon in homes and assist Member States in establishing and implementing national action plans to reduce such exposure. The Agency will assist Member States in developing building codes for new constructions that minimize the accumulation of radon indoors; and

- The Agency will continue working with the FAO, WHO and experts from Member States to develop guidance on the control of radioactivity in food and drinking water in existing (non-emergency)

exposure situations. The Agency will also continue to seek views from Member States on the improvement of framework for controlling radioactivity in food and drinking water in such situations.

B.2. Control of Radiation Sources

Trends

95. The increased use of sealed radioactive sources in medicine, industry, agriculture and research has resulted in further demands for appropriate arrangements for the management of disused sealed radioactive sources.[37]

96. Member States support for the Code of Conduct on the Safety and Security of Radioactive Sources continues to grow. In 2017, three new Member States made political commitment to implementing the Code and its associated Guidance on the Import and Export of Radioactive Sources, bringing the total that have done so to 136. Five Member States notified the Director General of their intention to act in a harmonized manner with the supplementary Guidance on the Import and Export of Radioactive Sources, bringing the total that have done so to 111. Three Member States nominated points of contact for facilitating the export and import of radioactive sources, bringing the total that have done so to 142.

Activities

97. The Agency finalized the development of the Guidance on the Management of Disused Radioactive Sources, supplementary to the Code of Conduct on the Safety and Security of Radioactive Sources. The Guidance was approved by the Board of Governors and endorsed by the General Conference in September 2017.

98. The Agency organized an Open-ended Meeting of Legal and Technical Experts on the Implementation of the Code of Conduct on the Safety and Security of Radioactive Sources in Vienna, Austria, in June 2017. At the meeting, 180 experts from 101 Member States exchanged information and shared experiences on the establishment and implementation of financial provisions to ensure safe management and secure protection of radioactive sources once they have become disused, including associated aspects encountered by regulatory bodies and other stakeholders.

99. The Agency implemented regional and international projects, including several meetings and workshops, on the cradle-to-grave control of radioactive sources with emphasis on the management of radioactive sources after the end of their useful life. This supported Member States' efforts to strengthen national regulatory frameworks and the safe management of disused sealed radioactive sources.

100. The Agency organized an international Workshop on Implementation of a National Cradle-to-Grave Control System for Radioactive Sources in Vienna, Austria, in March 2017 where 35 experts from 23 Member States exchanged experiences and shared good practices in implementing a system for cradle-to-grave control of radioactive sources.

101. The Agency organized an International Workshop on National Registers of Radiation Sources in Vienna, Austria, in March 2017. Sixty participants from 50 Member States exchanged information and shared experiences on progress and lessons learned in establishing, maintaining and updating national registers of radiation sources. Participants recognized the Agency's Regulatory Authority Information System (RAIS) as a useful guide in establishing and maintaining a national register and inventory.

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[37] Radioactive sources are defined as 'disused' when they are no longer used for the practice for which they were authorized.

Priorities and Related Activities

102. ***The Agency will assist Member States in the management of radioactive sources from cradle to grave through guidance documents, peer reviews, advisory services, training courses and workshops. The Agency will also promote the effective application of the Code of Conduct on the Safety and Security of Radioactive Sources and the supplementary Guidance on Import and Export of Radioactive Sources and on the Management of Disused Radioactive Sources and facilitate the sharing of experience. The Agency will undertake the following activities in relation to these priorities:***

- The Agency will assist Member States in establishing and implementing cradle-to-grave control of radioactive sources, including through national registers and inventories of radiation sources;

- The Agency will promote, and continue to assist Member States in their efforts to build capacity to implement at national level the provisions of the Code of Conduct on the Safety and Security of Radioactive Sources and supplementary Guidance on the Import and Export of Radioactive Sources, and Guidance on the Management of Disused Radioactive Sources; and

- The Agency will further develop the RAIS to address the needs of Member States for an enhanced, highly secure and easily customizable tool to manage regulatory processes in accordance with Member States' needs.

B.3. Safe Transport of Radioactive Material

Trends

103. The increased use of radioactive material in Member States is creating additional demands for regulatory oversight, including for transport within and across national borders.

104. Some Member States are increasingly interested in the construction and deployment of transportable reactors by sea. One vessel is at an advanced state of manufacture and another Member State declared its ambitions to manufacture a vessel in the near future.

Activities

105. The Agency continued to support capacity building for the regulatory oversight of safety during the transport of radioactive material. Dedicated workshops were held in Vienna, Austria, in January, August and September 2017; Bangkok, Thailand, in May 2017; Auckland, New Zealand, in June 2017; San Jose, Costa Rica, in August 2017; Madrid, Spain, in September 2017; Accra, Ghana in October 2017; Sliema, Malta, in October 2017; and Montevideo, Uruguay, in November 2017. These workshops were attended by participants from more than 80 Member States.

106. The Agency continued to develop its ability to assist Member States in capacity building for regulatory oversight of transport safety by the development of an e-learning platform for IAEA Safety Standards Series No. SSR-6. This platform will be piloted in the first half of 2018 and formally launched later in the year.

107. The Agency has begun developing an electronic document that will generate a complete set of SSR-6 requirements associated with user defined UN numbers. This will facilitate the direct adoption of SSR-6 requirements by Member States into their transport related laws and regulations relevant only to the radioactive material being transported in the country.

Priorities and Related Activities

108. ***The Agency will assist Member States in building capacity for the safe transport of radioactive material. The Agency will undertake the following activities in relation to this priority:***

- The Agency will prepare draft revisions of the *Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (2012 Edition)* (IAEA Safety Standards Series No. SSG-26)[38] and the *Schedules of Provisions of the IAEA Regulations for the Safe Transport of Radioactive Material (2012 Edition)* (IAEA Safety Standards Series No. SSG-33).[39] The Agency will also prepare a new Specific Safety Guide on format and content of the package design safety report for the safe transport of radioactive material;

- The Agency will assist Member States in building capacity for the safe transport of radioactive material through offering workshops, training courses, peer review and advisory services and the development of appropriate e-learning material. It also will continue to foster regional collaboration among transport regulatory bodies to make sure Member States developing such regulatory oversight benefit from experiences of States with established regulatory programmes; and

- The Agency will continue to discuss and prepare a strategic approach for the development and deployment of transportable reactors. In that sense, the Agency will support, as appropriate, the outcomes of the review and possible revision of the associated International Maritime Organization's (IMO's) transport regulations considered necessary by the IMO.

B.4. Decommissioning, Spent Fuel Management and Waste Management

Trends

109. A significant growth in the number of decommissioning projects worldwide has increased the need for related education and training programmes. Member States have requested, inter alia, that the Agency develops specific training materials on regulatory inspections of decommissioning.

110. Member States continue to seek the Agency's assistance in developing and safely implementing long term management solutions for radioactive waste, such as the siting of radioactive waste management facilities.

111. Member States are increasingly requesting Agency support to develop and implement plans for near surface disposal of low- and intermediate-level radioactive waste.

112. Several Member States are showing increased interest in geological disposal of high level radioactive waste and spent fuel. In some Member States, licencing activities for geological disposal facilities are continuing.

113. Progress has been made in the development of a borehole disposal system for disused sealed radioactive sources (DSRS). Several Member States worked on developing requisite borehole disposal techniques, regulatory and infrastructure support systems, hardware and equipment, and processes and procedures. Many other Member States are interested in further exploring the concept.

114. Member States with little relevant regulating experience concerning large concentrations of NORM in residues generated in, inter alia, rare earth processing, oil, gas and titanium processing, and

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[38] INTERNATIONAL ATOMIC ENERGY AGENCY, Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (2012 Edition), IAEA Safety Standards Series No. SSG-26, IAEA, Vienna (2014).

[39] INTERNATIONAL ATOMIC ENERGY AGENCY, Schedules of Provisions of the IAEA Regulations for the Safe Transport of Radioactive Material (2012 Edition), IAEA Safety Standards Series No. SSG-33, IAEA, Vienna (2015).

water treatment, have expressed a need for Agency support in establishing regulatory and safety infrastructure for NORM residues management.

Activities

115. Upon a request from the Government of Italy, the Agency implemented an international peer review of SOGIN's[40] decommissioning and waste management programme. The review was conducted in July 2017 through the Agency's Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS).

116. The Agency conducted an ARTEMIS review of Poland's *National Plan of Radioactive Waste and Spent Nuclear Fuel Management* in October 2017. The Government of Poland requested to review the fulfilment of its obligations under article 14(3) of the European Council Directive 2011/70/Euratom of 19 July 2011 that establishes a Community framework for responsible and safe management of spent fuel and radioactive waste (EC Waste Directive).

117. The Agency organized a Technical Meeting on the Planning and Implementation of Long Term Institutional Controls and on the Release of Sites from Regulatory Control in Vienna, Austria, in November–December 2017. Twenty-three participants from 16 Member States discussed practices and experiences in dealing with regulatory, technical, societal and financial aspects related to the topic. The outcome of the meeting will be used to revise the Safety Guide entitled *Release of Sites from Regulatory Control on Termination of Practices* (IAEA Safety Standards Series No. WS-G-5.1)[41] and to develop related training material.

118. The Agency and the Joint Research Centre of the European Commission signed Practical Arrangements during the 61st regular session of the General Conference to formalize cooperation on training for decommissioning and environmental remediation. This cooperation will take place particularly in the context of the European Learning Initiatives for Nuclear Decommissioning and Environmental Remediation coordinated by the European Commission.

119. The Agency continued implementing the International Project on Managing the Decommissioning and Remediation of Damaged and Legacy Nuclear Facilities with meetings of the working groups on regulatory, technical and strategic planning aspects, and an international workshop held in Penrith, United Kingdom, in October 2017, that attracted 40 experts from 21 Member States.

120. The Agency issued a Technical Document entitled *Model Regulations for Decommissioning of Facilities* (IAEA-TECDOC-1816).[42] This publication covers all aspects of the planning, conduct and termination of the decommissioning of facilities and management of the associated waste in accordance with the Agency's safety standards.

121. The Agency issued a Technical Document entitled *Management of Large Volumes of Waste Arising in a Nuclear or Radiological Emergency* (IAEA-TECDOC-1826).[43] The publication focuses on waste management planning as part of overall emergency preparedness. It incorporates lessons learned

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[40] SOGIN is the Italian state-owned company responsible for the decommissioning of Italian nuclear plants and the management of radioactive wastes.

[41] INTERNATIONAL ATOMIC ENERGY AGENCY, Release of Sites from Regulatory Control on Termination of Practices, IAEA Safety Standards Series No. WS-G-5.1, IAEA, Vienna (2006).

[42] INTERNATIONAL ATOMIC ENERGY AGENCY, Model Regulations for Decommissioning of Facilities, IAEA-TECDOC-1816, IAEA, Vienna (2017).

[43] INTERNATIONAL ATOMIC ENERGY AGENCY, Management of Large Volumes of Waste Arising in a Nuclear or Radiological Emergency, IAEA-TECDOC-1826, IAEA, Vienna (2017).

from previous emergencies, considerations of the potential range of impacts of potential future emergencies, and experiences from legacy sites.

122. The Agency organized a workshop on the Responsible and Safe Management of Radioactive Waste and Spent Fuel in Vienna, Austria, in September 2017, attracting 37 participants from 30 Member States. A regional workshop on the Regulatory Requirements to Ensure Safe Management of Radioactive Waste for Operators and Regulators to promote the creation of a harmonized approach to the safe management of radioactive waste was also held in Vienna, Austria, in February 2017, with 16 participants from 16 countries. A technical cooperation project workshop on policy and strategy for radioactive waste management was held in Shanghai, China, in July 2017. The workshop was attended by 20 participants from China.

123. The Agency assisted Member States that are pursuing borehole configurations as an option for disposal of disused sealed radioactive sources. This assistance included an Interregional Workshop on Regulatory Review of Safety Case for Post-closure, held in Buenos Aires, Argentina, in June 2017, and the publication of a technical document entitled *Generic Post-closure Safety Assessment for Disposal of Disused Sealed Radioactive Sources in Narrow Diameter Boreholes*[44]. In addition, the Agency provided technology development, safety assessments, and peer reviews of national safety cases and plans for borehole-based disposal.

124. The Agency completed a project on Derivation of Specific Clearance Levels in Materials being Suitable for Disposal in Landfills, and initiated a project on Derivation of Activity Levels in Material with Residual Radioactivity for being Reused and Recycled for Civil Engineering Purposes.

125. The Agency also convened:

- Phase III of the International Project on Demonstration of the Operational and Long-Term Safety of Geological Disposal Facilities for Radioactive Waste (GEOSAF-III);
- Phase II of the International Project on Human Intrusion in the Context of Disposal of Radioactive Waste (HIDRA), on the safety of radioactive waste disposal;
- An International Project Forum on the Safety of Near Surface Disposal;
- An International Project on the Interaction and Roles of Regulators and Operators in the Licensing Process for the Development of Safe Geological Disposal Facilities; and
- An International Project on the Use of Monitoring Programmes in the Safe Development of Geological Disposal Facilities for Radioactive Waste.

126. The Agency is developing equipment required to implement operations needed for the borehole disposal of DSRS. A pilot test to demonstrate the complete operational cycle for DSRS borehole disposal was conducted in South Africa in September 2017.

Priorities and Related Activities

127. ***The Agency will assist Member States in developing and implementing national policies and strategies for the safe management of radioactive waste, including disposal of waste sealed radioactive sources, geological disposal of high level waste and spent fuel, and the development of decommissioning strategies and plans. The Agency will undertake the following activities in relation to this priority:***

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[44] INTERNATIONAL ATOMIC ENERGY AGENCY, Generic Post-closure Safety Assessment for Disposal of Disused Sealed Radioactive Sources in Narrow Diameter Boreholes, IAEA-TECDOC-1824, IAEA, Vienna (2017).

- The Agency will assist Member States in adopting a holistic approach to decommissioning, environmental remediation activities and management of the associated waste in order to avoid imposing an undue burden on future generations. To this end, the Agency will continue to update guidance in the areas of the application of the concepts of exclusion, exemption and clearance;

- The Agency will start new international projects on the completion of decommissioning, including the decommissioning of small medical, industrial and research facilities;

- The Agency will hold Technical Meetings on the management of radioactive residues from uranium production to develop safety assessment documents for long term management of radioactive residues from uranium production. The Agency also will launch a new international project to provide a regulatory forum for the safety management of uranium and naturally occurring radioactive materials residues;

- The Agency will issue two Safety Reports aimed at preventing legacy site situations from arising in the future. These reports will focus on the safety aspects of uranium production and on the development and management of uranium production by in situ leaching;

- The Agency will continue to assist Member States in areas related to fostering public awareness and communication, including stakeholder involvement in siting and developing for radioactive waste disposal facilities;

- The Agency will continue compiling and analysing information on the cost of decommissioning research reactors within the frame of the ongoing project on Data Analysis and Collection for Costing of Research Reactor Decommissioning;

- The Agency will continue to evaluate good practices, techniques, and implementing considerations for Member States' decommissioning preparedness planning in the event of a nuclear accident;

- The Agency will support strengthening the global capabilities for DSRS management through the development of Qualified Technical Centres in Member States;

- The Agency will assist Member States' efforts to develop comprehensive policies and strategies for the safe management of high level radioactive waste and spent fuel, including disposal; and

- The Agency will assist Member States in building and strengthening the capacities of regulatory bodies and operating organizations for the development of safe geological disposal facilities for high level radioactive waste and spent fuel, including disposal options for other radioactive waste classes and disused sealed radioactive sources. This includes assisting Member States in efforts to evaluate licence applications for the borehole disposal of disused sealed radioactive sources.

B.5. Radiation Protection of the Environment and Remediation

Trends

128. The increasing use of nuclear techniques and applications worldwide has resulted in an increased demand for analysing and evaluating the radiological implications of radionuclides being released to the environment.

129. There is an ongoing demand by Member States for Agency assistance in remediation activities, particularly the remediation of the legacy sites from past uranium production and other nuclear-related activities.

Activities

130. The Agency, in collaboration with the European Commission, European Bank for Reconstruction and Development, Kyrgyzstan, Tajikistan and Uzbekistan, developed the *Strategic Master Plan for Environmental Remediation of Uranium Legacy Sites in Central Asia* (the Strategic Master Plan). This document provides a strategy for remediating the uranium legacy sites in Central Asia and a master plan for implementing the strategy.

131. During the 61st regular session of the General Conference, parties collaborating on the development of the Strategic Master Plan signed a Preface to the document, stating their intention to support and contribute towards a coordinated approach to remediation of the uranium legacy sites in Central Asia.

132. The annual meeting of the Agency's Coordination Group for Uranium Legacy Sites (CGULS) was held in Almaty, Kazakhstan, in June 2017 and was attended by 37 representatives from 12 Central Asian and European Member States and from 6 international organisations. The CGULS continued to play a pivotal role in coordinating many different organizations working towards the goal of sustainable remediation of uranium legacy sites in Central Asia.

133. The Agency conducted training courses on the safety and regulatory aspects of uranium mining and production, with a focus on the remediation of legacy uranium sites and waste management. Training courses were held in Tehran, the Islamic Republic of Iran, in January 2017, in Buenos Aires, Argentina, in June 2017, in Dushanbe, Tajikistan, in September 2017 and in Bishkek, Kyrgyzstan, in November 2017.

134. The Agency held a workshop in Bessines-sur-Gartempe, France, in October 2017 as part of the International Forum for RSLS and in conjunction with the Technical Meeting of the Uranium Mining and Remediation Exchange Group. Twenty Member States were represented at the workshop focusing on preparing for remediation of uranium legacy sites.

135. The Agency initiated a coordinated research project entitled Integrating Perceived and Actual Risk in Stakeholder Communications (IPARSC). This project will support effective risk communication through the development of standardized methodology to assess risk perceptions among populations affected by existing exposure situations, such as uranium legacy sites or post-accidental situations. This project also takes into account situations where securing public acceptance by Government or implementing institutions is a prerequisite to implementing radiation protection measures.

136. The Agency held the second Technical Meeting of the second phase of the Modelling and Data for Radiological Impact Assessments (MODARIA II) programme in Vienna, Austria, in October–November 2017, attended by 150 participants from 47 Member States. The programme builds experience and transfers knowledge in the field of the assessment of radiation doses from radionuclides being released to or already present in the environment.

137. A Technical Meeting on the Development of Reference Assessment Tools to Support the Implementation of IAEA Safety Standards for Disposal Facilities, Nuclear Installations and Other Applications was held in Vienna, Austria, in December 2017. Thirty participants from 27 Member States discussed the development, testing, and dissemination of harmonized tools for the assessment of radiological impacts for the licensing of nuclear facilities and activities in industry, medicine and research, for the derivation of secondary radiological criteria, for the management of contaminated sites and for the safe operation of predisposal and disposal facilities.

138. The Agency held a workshop in Vienna, Austria, in November 2017 during which 47 participants from 41 Member States discussed the derivation of radionuclide levels in materials which allow the

disposal on municipal landfills, including materials resulting from decommissioning and remediation activities after nuclear accidents.

Priorities and Related Activities

139. ***The Agency will promote and facilitate the sharing of experience gained in dealing with the remediation of contaminated areas, including from post-accident situations and uranium legacy sites. The Agency will undertake the following activities in relation to this priority:***

- The Agency will publish reports on situation-specific remediation strategies for contaminated urban and rural areas for a wide range of environmental conditions, and on the remediation and decommissioning of an area or a site affected by a nuclear or radiological emergency;

- The Agency will publish a report providing a summary and analysis of experiences gained protecting local populations affected by the accidents at Chernobyl, Goiania and Fukushima, and of experience gained during the management of uranium legacy sites;

- The Agency will publish the *Strategic Master Plan for Environmental Remediation of Uranium Legacy Sites in Central Asia*. This document will support efforts of the European Commission, European Bank for Reconstruction and Development and the Central Asia Member States in awareness- and fund-raising activities to support the remediation works;

- The Agency will assist Member States in identifying and evaluating sites that have been contaminated with radionuclides by past practices so that such sites can be brought under appropriate regulatory control;

- The Agency will assist the efforts of Member States to be prepared for post-accident remediation activities, including the establishment of criteria for radiation doses to people and radionuclide contamination levels in soil, food and drinking water, and in planning for the implementation of remediation; and

- The Agency will progress a new project in Integrating Perceived and Actual Risks in Stakeholder Communication. This project aims to improve stakeholder communications by providing a method to bridge the gap between perceived and actual risks among populations affected by existing exposure situations.

C. Strengthening Safety in Nuclear Installations

C.1. Nuclear Power Plant Safety

C.1.1. Operational Safety: Operating Experience and Long Term Operation

Trends

140. The need to strengthen the implementation of organizational changes, the optimization of maintenance activities, and the assessment of major plant safety modification, are recurring lessons identified from Operational Safety Review (OSART) missions. These missions continue to highlight a need to further strengthen accident management and on-site emergency preparedness and response.

141. Analysis of data from the International Reporting System for Operating Experience (IRS) indicates a need to learn from events related to design modifications, ageing management, management

of internal hazards, contamination control, and use of operating experience. The data also continues to highlight a need to learn from events related to protection against external hazards and oversight of contractors.

142. Programmes are being implemented for an increasing number of nuclear power reactors around the world for long term operation (LTO) and ageing management. At the end of 2017, 47% of the 448 nuclear power reactors operating in the world had been in operation for 30–40 years, an increase from 45% of 450 reactors at the end of 2016, and another 17% for more than 40 years, an increase from 15% of 450 reactors at the end of 2016 (see Figure 3).

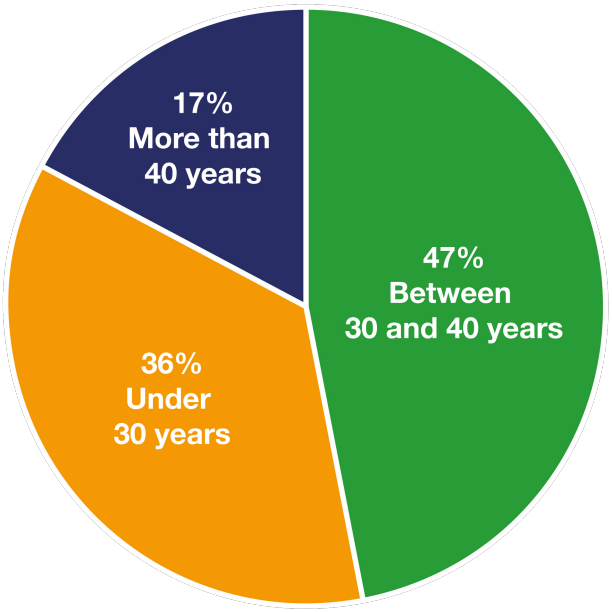

FIG.3. Age distribution of all nuclear power reactors in 2017 based on information from the IAEA PRIS system.[45]

143. The Agency noted a continuing higher-than-average number of requests by Member States for SALTO missions. The number of such missions increased from three to four per year in 2012–2015 to nine in 2016 and six in 2017.

Activities

144. The Agency finalized the development of a revised Safety Guide entitled *Ageing Management and Development of a Programme for Long Term Operation of Nuclear Power Plants* (DS485), which was endorsed by the CSS in April 2017.

145. The Agency conducted two peer review missions to assess the effectiveness of the Peer Review of Operational Safety Performance Experience Review (PROSPER) process in the Russian Federation and organized three Technical Meetings (including one in cooperation with WANO and one in cooperation with the CANDU Owners Group) and two workshops to share operating experience from events at NPPs and methods to improve prevention of events by effective use of operating experience. The Agency also conducted two national training courses for root cause analysis of events.

[45] The Power Reactor Information System (PRIS), developed and maintained by the IAEA, is a comprehensive database on nuclear power plants worldwide.

146. The Agency held two meetings, one in London, United Kingdom, in January 2017 and another in Vienna, Austria, in July 2017, to coordinate WANO's peer reviews with the Agency's OSART programme.

147. The Agency conducted seven OSART missions in 2017, in China, Finland, France, the Russian Federation, Slovenia, the United Arab Emirates and the United States of America, and seven follow-up OSART missions, in Canada, France, Japan, the Netherlands, Pakistan, the Russian Federation and the United Kingdom.

148. The Agency conducted three SALTO missions, in Belgium, China and Sweden, and one follow-up SALTO mission in Mexico. In addition, an expert mission based on the SALTO method was carried out in Mexico. The Agency analysed the large quantity of data collected during these missions and created a SALTO mission results database, named SALMIR. This database provides an overview of the results of SALTO and SALTO follow-up missions between 2005 and 2017. The SALMIR database has been made available to Member States.

149. The Agency organized the Fourth International Conference on Nuclear Power Plant Life Management in Lyon, France, in October 2017, hosted by France in cooperation with the European Commission's Joint Research Centre and the Electric Power Research Institute. Over 350 participants representing 32 Member States and 4 international organizations participated in the Conference. The outcomes of the meeting emphasized the importance of continuous safety improvements, strong safety culture and operating experience.

150. The Agency organized the Technical Meeting on Management and Leadership of Nuclear Power Projects from New Build to Decommissioning in Vienna, Austria, in August 2017, which was attended by 40 participants from 26 Member States. The purpose of the meeting was to provide an international forum for experts to exchange experiences in leading and managing major projects for new NPPs, for modifying operating NPPs and for decommissioning NPPs.

151. The Agency organized the Technical Meeting on Human Performance Reliability and Resilience in Nuclear Power Plant Operations, hosted by Oak Ridge National Laboratory in Oak Ridge, United States of America, in August 2017, which was attended by 60 participants from 18 Member States. The primary outcome of the meeting was the identification of good practices and working activities associated with a full 'worker cycle' of psychometric requirements, evaluations and assessments to support Member States with established and newly initiated nuclear power programmes.

Priorities and Related Activities

152. ***The Agency will assist Member States in implementing and improving programmes for ageing management and the safe LTO of nuclear installations. The Agency will facilitate the exchange of operating experience of NPPs. The Agency will undertake the following activities in relation to these priorities:***

- The Agency will further improve the coordination of its activities with WANO within their respective mandates, governing regulations, rules, policies and procedures to ensure effective and efficient international peer review of operational safety;

- The Agency will assist Member States in the implementation of NPP operational safety improvements. The Agency will support the exchange of lessons learned from OSART missions and from events reported through the International Reporting System for Operating Experience (IRS);

- The Agency will proceed with the revision of eight Safety Guides in the NPP operation domain and will publish highlights from OSART missions conducted between 2013 and 2015;

- The Agency will continue to assist Member States in strengthening effective management of operating experience. This will include the revision of the Safety Guide entitled *A System for the Feedback of Experience from Events in Nuclear Installations* (IAEA Safety Standards Series No. NS-G-2.11)[46];

- The Agency, in cooperation with the OECD/NEA, will extend the IRS database with construction experience database (ConEX), which will add experience from a further 100 events;

- The Agency will develop a new Safety Report on continuous improvement of operational safety performance and a new Safety Report on reviews of safety for LTO that covers data collection and record keeping; deciding the scope of structures, systems and components (SSC) to include in the review; and a review of plant programmes; and

- The Agency will organize Technical Meetings to assist Member States in ageing management and LTO.

C.1.2. Site and Design Safety

Trends

153. There is continuing demand from Member States for support in application of the Agency's safety standards for site and design safety against external hazards. Many of the requests for such support concerned evaluation of a new site, conservatism in hazard assessments and design, and use of the latest knowledge and techniques in assessing sites and designs.

154. Member States continue to express an interest in the lessons arising from the Fukushima Daiichi accident with regard to site and design safety.

155. The Agency received 30 requests from Member States for SEED review missions, expert missions and capacity building and training workshops. A number of Member States initiated siting and site evaluation activities before they had the necessary regulatory framework in place for these activities. This results in difficulties during site selection and site evaluation, and during review and licensing.

156. Member States continue to show interest in addressing specific safety assessment and design safety aspects, such as: hazards on multi-unit sites, methods for aggregating various risk contributors, human reliability assessment and the use of a probabilistic approach to the analysis of internal and external events.

157. The Agency safety standards define design features to mitigate the consequences of accidents and to practically eliminate large or early radioactive releases. Work is ongoing by Member States to take further measures to prevent accidents with radiological consequences and to mitigate any consequences should they occur.

Activities

158. The Agency issued detailed Technical Documents and Safety Reports supporting the enhancement of site safety and the design of protection of nuclear installations against external events, including *Assessment of Vulnerabilities of Operating Nuclear Power Plants to Extreme External Events*

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[46] INTERNATIONAL ATOMIC ENERGY AGENCY, A System for the Feedback of Experience from Events in Nuclear Installations, IAEA Safety Standards Series No. NS-G-2.11, IAEA, Vienna (2006).

(IAEA-TECDOC-1834)[47], *Safety Aspects of Nuclear Power Plants in Human Induced External Events: General Considerations* (Safety Reports Series No. 86)[48] and *Safety Aspects of Nuclear Power Plants in Human Induced External Events: Margin Assessment* (Safety Reports Series No. 88)[49].

159. The Agency conducted three preparatory missions for SEED reviews, in the Republic of Korea, Thailand and Turkey. In addition, the Agency conducted five SEED review missions, in Belarus, Indonesia, the Republic of Korea, Turkey and Uganda; six expert missions in the framework of SEED, in Egypt, Ghana, Jordan, Nigeria and Pakistan; and seven capacity building and training workshops in the framework of SEED, in Egypt, Malaysia, the Russian Federation, Slovenia and Thailand.

160. The Agency convened an International Conference on Topical Issues in Nuclear Installation Safety: Safety Demonstration of Advanced Water Cooled Nuclear Power Plants in Vienna, Austria, in June 2017. The conference was attended by over 300 participants from 48 Member States and 5 international organizations. The participants exchanged information on the latest approaches, advances and other matters regarding demonstration of the safety of nuclear power plants that are planned to be licensed and constructed in the near future, in particular those in which water cooled reactors are used. During the conference, the Agency conducted a workshop on design extension conditions. The participants received an overview of the Agency design safety requirements for nuclear power plants, focused on design extension conditions.

Priorities and Related Activities

161. ***The Agency will assist Member States in the application of the Agency's safety standards relating to the evaluation of safety of nuclear installations, such as siting, design, commissioning and operating requirements, including long term operation. The Agency will undertake the following activities in relation to these priorities:***

- The Agency will continue to organize workshops on safety demonstration related to new safety features for the prevention and mitigation of severe accidents and the application of new technologies resulting in the practical elimination of early or large radioactive releases;

- The Agency will organize a Technical Meeting to share experience on implementing safety improvements at existing nuclear power plants. It will also organize Technical Meetings on current approaches in Member States to the analysis of design extension conditions for new nuclear power plants and on the development of a methodology for aggregation of various risk contributors for nuclear facilities;

- The Agency will revise and update its safety standards and will develop technical guidance for Member States to address the uncertainties related to the evaluation of external hazards at nuclear installations as well as the impact of external hazards on multi-unit sites;

- The Agency will assist, upon request, through its peer review and advisory services, expert missions, capacity building and training services, Member States embarking on a nuclear power programme in developing a regulatory framework and qualified human resources for siting and site evaluation. The Agency will also assist Member States with operating nuclear installations in

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[47] INTERNATIONAL ATOMIC ENERGY AGENCY, Assessment of Vulnerabilities of Operating Nuclear Power Plants to Extreme External Events, IAEA-TECDOC-1834, IAEA, Vienna (2017).

[48] INTERNATIONAL ATOMIC ENERGY AGENCY, Safety Aspects of Nuclear Power Plants in Human Induced External Events: General Considerations, Safety Reports Series No. 86, IAEA, Vienna (2017).

[49] INTERNATIONAL ATOMIC ENERGY AGENCY, Safety Aspects of Nuclear Power Plants in Human Induced External Events: Margin Assessment, Safety Reports Series No. 88, IAEA, Vienna (2017).

implementation of the recommendations of SEED reviews, application of safety standards and use of the latest knowledge and techniques in site assessments and in design against external hazards;

- The Agency will continue to develop the Safety Requirements publication entitled *Site Evaluation of Nuclear Installations* (DS484), as well as the Safety Guides entitled *External Events Excluding Earthquakes in the Design of Nuclear Installations* (DS498), *Seismic Design and Qualification for Nuclear Power Plants* (DS490) and *Seismic Hazards in Site Evaluation for Nuclear Installations* (DS507); and

- The Agency will organize the Second Workshop on Best Practices in Physics-based Fault Rupture Models for Seismic Hazard Assessment of Nuclear Installations and a Technical Meeting on the design and reassessment of nuclear installations for external hazards.

C.1.3. Severe Accident Prevention and Mitigation

Trends

162. The lessons arising from the Fukushima Daiichi accident highlighted the importance of clear, comprehensive, well-designed accident management provisions based on the difficulties that operators and decision-makers may face when dealing with a severe accident.

Activities

163. The Agency issued a Technical Document entitled *Severe Accident Mitigation through Improvements in Filtered Containment Vent Systems and Containment Cooling Strategies for Water Cooled Reactor*s (*IAEA-TECDOC-1812)*[50].

164. The Agency organized the Technical Meeting on the Implementation and Integration of Accident Management Guidelines and Interface with Emergency Preparedness and Response in Vienna, Austria, in September 2017. The Technical Meeting was attended by 39 participants from 23 Member States and 2 international organizations. The participants exchanged good practices and experiences on implementation of severe accident management guidelines and their interface with emergency preparedness and response arrangements.

165. The Agency organized a training workshop on the development of severe accident management guidelines on the basis of the Agency's Severe Accident Management Guideline Development Toolkit in Vienna, Austria, in December 2017. The workshop was attended by 66 participants from 32 Member States.

166. The Agency conducted the Technical Meeting on the Status and Evaluation of Severe Accident Simulation Codes for Water Cooled Reactors in Vienna, Austria, in October 2017. The meeting was attended by 37 participants from 19 Member States. The participants exchanged knowledge regarding the limitations of codes as well as code innovations.

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[50] INTERNATIONAL ATOMIC ENERGY AGENCY, Severe Accident Mitigation through Improvements in Filtered Containment Vent Systems and Containment Cooling Strategies for Water Cooled Reactors, IAEA-TECDOC-1812, IAEA, Vienna (2017).

Priorities and Related Activities

167. ***The Agency will provide forums for Member States to share knowledge and experience in their efforts to strengthen severe accident management guidelines. The Agency will further develop technical documentation in this area. The Agency will undertake the following activities in relation to these priorities:***

- The Agency will finalize the development of a revised Safety Guide on severe accident management. In addition, the Agency will prepare a Technical Document on the development and implementation of severe accident management programmes for nuclear power plants. The Agency will also conduct Technical Meetings on hydrogen management in severe accidents, and instrumentation for the management of severe accidents in heavy water reactors; and

- The Agency will publish Technical Documents on the status and evaluation of severe accident simulation codes for water cooled reactors and on in-vessel melt retention and ex-vessel corium cooling.

C.2. Safety of Small and Medium Sized or Modular Reactors

Trends

168. The number of Member States that have expressed interest in small and medium sized or modular reactors (SMRs) has increased over the past few years. Consequently, there has been an increasing number of requests for workshops and expert missions from embarking countries on SMR technology and associated licensing and safety matters. Currently, about 50 SMR designs are in development.

169. Feedback from Agency activities, including international meetings and Technical Safety Review services, has shown increased interest in the application of the Agency's design-related Safety Requirements to SMR designs, including to transportable nuclear power plants.

Activities

170. The Agency provided support to the Small Modular Reactor Regulators' Forum by facilitating discussions on matters of common interest during meetings in Vienna, Austria, in May and September 2017. The Agency organized two workshops for Member States embarking on a new nuclear power programme that includes SMRs, to share information and experience of nuclear regulation.

171. The Agency continued coordinating a study on the application of the design-related Safety Requirements to SMR designs intended for near term deployment. Fourteen design organizations and regulatory authorities in eight Member States participated in the study. This study included a review of current practices in Member States with regard to the application of the Agency's safety standards to SMR technologies. The main conclusion of the study to date is that the *Safety of Nuclear Power Plants: Design* (IAEA Safety Standards Series No. SSR-2/1 (Rev. 1)) is in principle applicable, with engineering judgement required for certain aspects, for water cooled SMR designs. The applicability of this safety standard to other SMR designs, e.g. gas cooled, needs further consideration and will be addressed in future Agency activities.

172. The Agency organized the Technical Meeting on Challenges in the Application of the Design Safety Requirements for Nuclear Power Plants to Small and Medium Sized Reactors in Vienna, Austria, in September 2017. The meeting was attended by over 50 participants from 36 Member States and 2 international organizations. The participants exchanged information on lessons learned in the application of design safety requirements to advanced reactor technology, such as SMRs.

Priorities and Related Activities

173. ***The Agency will assist Member State activities related to small and medium sized or modular reactors, particularly their efforts to develop safety requirements, build capacity for design and safety assessment, and share good practices. The Agency will undertake the following activities in relation to this priority:***

- The Agency will use the results of the study on application of the design-related Safety Requirements to SMR designs and of other relevant activities in this field to prepare a Technical Document;

- The Agency will continue to provide support to the Small Modular Reactor Regulators' Forum to facilitate discussions on matters of common interest. It will organize workshops for Member States embarking on a new nuclear power programme that includes SMRs, to share information and experience of nuclear regulation; and

- The Agency will complete the CRP on Modular High Temperature Gas Cooled Reactor Safety Design.

C.3. Research Reactor Safety

Trends

174. Feedback from Agency activities has shown that an increasing number of Member States are applying the provisions of the Code of Conduct on the Safety of Research Reactors.

175. Many Member States are planning or implementing modification and refurbishment projects to address ageing of the structures, systems and components of research reactors. Projects on physical protection systems are also planned or being implemented to strengthen the security measures at many facilities. Member States have shown increased awareness and have taken actions to improve effective management of the interface between safety and security when planning and implementing these projects.

Activities

176. The Agency held the fourth triennial International Meeting on Application of the Code of Conduct on the Safety of Research Reactors in Vienna, Austria, in May 2017, with the participation of 40 Member States. The meeting provided a forum for the participating countries to exchange information on the safety status of their research reactors and experience in application of the Code's provisions. Member States' self-assessments of application of the Code were reviewed to identify areas in which the Code was being applied satisfactorily and areas in which further improvements were necessary. The Agency conducted three Integrated Safety Assessment of Research Reactors (INSARR) missions, in Jamaica, Kazakhstan and Norway, and follow-up INSARR missions in Poland and Turkey. The aim of the missions was to review the operational safety of the facilities and provide guidance and recommendations for further safety improvements.

177. The Agency organized the Technical Meeting on Research Reactor Ageing Management, Refurbishment and Modernization in Vienna, Austria, in November 2017, which was attended by 34 participants from 28 Member States. The participants discussed the elements of effective ageing management programmes and experience in implementing modernization and refurbishment projects.

178. The Agency provided advisory services to Belgium and the Netherlands on managing ageing of their research reactors and conducted a national workshop in Romania on periodic safety review for research reactors.

179. The Agency conducted a safety review mission in Nigeria and made recommendations to ensure safety in converting a research reactor to use low enriched uranium fuel.

180. The Agency organized a workshop on Safety Reassessment of Research Reactors in the Light of the Lessons Learned from the Fukushima Daiichi Accident in Sydney, Australia, in December 2017, to share Member States' experiences performing safety reassessments and implementing related safety enhancements.

181. The Agency held the Technical Meeting on the Safety of Research Reactors under Project and Supply Agreements and Review of their Safety Performance Indicators in Vienna, Austria, in July 2017, with the participation of 15 experts from 14 Member States. The meeting discussed the safety performance indicators of these facilities, emergency planning and improvements resulting from safety reassessments following feedback from the Fukushima Daiichi accident.

182. The Agency conducted the Technical Meeting for the National Coordinators of the Incident Reporting System for Research Reactors in Vienna, Austria, in August 2017, with the participation of 41 experts from 34 Member States. Training on event investigation techniques was provided, and the meeting discussed the root causes and lessons learned to prevent the recurrence of events at research reactors, including those for which the root causes were attributed to interactions of human, technical and organizational factors.

183. The Agency conducted two expert missions to support the regulatory body in the Islamic Republic of Iran to establish safety requirements and the licensing process for research reactors, and two expert missions to Morocco to assist the regulatory body in enhancing its programmes for inspections, review and assessment of utilization activities.

184. The Agency held a workshop in Vienna, Austria, in June 2017 to support the regulatory body of the Philippines in developing national safety requirements for research reactors.

185. The Agency conducted a workshop in Centurion, South Africa, in November 2017, in which hands-on training was given for 28 participants from 11 Member States in planning, conducting and reporting on regulatory inspections of research reactors.

Priorities and Related Activities

186. ***The Agency will assist Member States in performing safety assessments of research reactors, managing ageing of research facilities, enhancing regulatory supervision, and strengthening application of the Code of Conduct on the Safety of Research Reactors through application of the relevant Agency safety requirements. The Agency will undertake the following activities in relation to these priorities:***

- The Agency will assist Member States in their efforts to build capacity to fully implement the provisions of the Code of Conduct on the Safety of Research Reactors through peer review services; regional meetings and training workshops on the Agency's safety standards for research reactors, including requirements for the safety of subcritical assemblies and planning decommissioning; and publication of guidelines for self-assessment of research reactor safety;

- The Agency will assist Member States in addressing ageing management and periodic safety reviews through the development of a Safety Report on periodic safety review for research reactors, by conducting peer review and advisory service missions to examine projects for the refurbishment and upgrading of research reactors and by organizing training activities, workshops and Technical Meetings on these topics; and

- The Agency will assist Member States' regulatory bodies in developing the programmes and competences necessary to ensure effective regulatory control of research reactors through meetings, training courses, workshops, and peer review and advisory services, and will develop a training package on regulatory inspection of research reactors.

C.4. Fuel Cycle Facility Safety

Trends

187. Member States increasingly recognize the importance of exchange of operating experience. This is evident by the increased participation of Member States in the Fuel Incident Notification and Analysis System (FINAS), which is a self-reporting and information sharing system on lessons learned from incidents at nuclear fuel cycle facilities.

Activities

188. The Agency conducted three workshops in Vienna, Austria, on the safety of nuclear fuel cycle facilities, covering: Operational Radiation Protection and Waste Management, in March 2017; Regulatory Supervision, in July 2017; and Safety Reassessment in the Light of the Accident at Fukushima Daiichi, in November 2017. These workshops provided practical information to over 72 participants from 29 Member States and provided forums to share information, experience and good practices on establishing and supervising safety and protection programmes for different types of facilities on the basis of the Agency's safety standards. The specific topics covered in these workshops included controls for worker safety and environmental protection in normal operations, implementation of safety upgrades identified by safety reassessments following the Fukushima Daiichi accident and the need for Member States to allocate sufficient resources to these programmes.

Priorities and Related Activities

189. ***The Agency will assist Member States in performing safety assessments and implementing safety upgrades for nuclear fuel cycle facilities. The Agency will undertake the following activities in relation to this priority:***

- The Agency will continue to assist Member States in developing capacity for performing and reviewing safety analyses for nuclear fuel cycle facilities through development and publication of a Safety Report on safety analysis and documentation and organization of a Technical Meeting on criticality safety in handling of fissile material;

- The Agency will continue to facilitate exchanges of operating experience for nuclear fuel cycle facilities between Member States by operating and maintaining FINAS, jointly with the OECD/NEA, and organizing and participating in regular meetings with national coordinators and the OECD/NEA; and

- The Agency will assist Member States in developing regulatory programmes and competence by organizing workshops on implementation of the Agency's safety standards for nuclear fuel cycle facilities, by updating related guidance publications and by producing a Safety Report on application of the graded approach to implementation of the safety requirements.

C.5. Safety Infrastructure for Embarking Countries

C.5.1. Nuclear Power Programmes

Trends

190. Currently, around 30 Member States are actively considering or planning a new nuclear power programme. This is similar to the position at the end of 2016.

191. The Agency's peer reviews, expert missions and other assistance activities continue to show that several Member States embarking on a nuclear power programme have not yet established an adequate, effective regulatory framework, including an independent regulatory body with a sufficient number of competent staff. In particular, IRRS and Integrated Nuclear Infrastructure Review (INIR) missions continue to identify late development of safety regulations and guides, establishment of the licensing process and preparation of regulatory oversight programmes.

Activities

192. Through national or regional technical cooperation and extrabudgetary projects, the Agency conducted various expert missions, workshops or training activities to provide guidance and information on all the elements of establishing an effective safety infrastructure, as laid out in particular in *Establishing the Safety Infrastructure for a Nuclear Power Programme* (IAEA Safety Standards Series No. SSG-16)[51]. Expert missions were conducted in areas such as: development of national nuclear legislation, e.g. nuclear law and nuclear safety regulations; human resource development; establishment of a management system at a regulatory body; and identification, planning and implementation of the actions required to eliminate weaknesses in the national safety infrastructure.

193. The Agency developed the Hands-on Regulatory Inspector Training Workshop for Member States embarking on a nuclear power programme to help them prepare for inspection of an NPP construction. The workshop was conducted twice in 2017 at the Zwentendorf NPP in Austria, a facility that was constructed but never commissioned.

194. The Agency conducted a two-week Basic Professional Training Course on Nuclear Safety in Khartoum, the Sudan, in January–February 2017.

195. The second International High Level Meeting on the Challenges Faced by Newcomer Countries Regarding the Establishment of an Effective Regulatory Framework and Infrastructure for Safety was held in Jakarta, Indonesia, in November 2017, to discuss aspects encountered by regulatory bodies of countries embarking on a nuclear power programme. The Meeting was attended by 15 high-level representatives of 9 countries.

196. The Regulatory Cooperation Forum (RCF) continued to coordinate support for activity plans for RCF active-recipient countries (Belarus, Jordan, Poland and Viet Nam) by organizing a meeting with each recipient country once a year. In June 2017, Ghana and Morocco became RCF active-recipient countries. In collaboration with other networks, such as the Arab Network of Nuclear Regulators and FNRBA, RCF organized a workshop on regulatory control for all recipient countries in Rabat, Morocco, in November 2017.

197. The Agency provided support for development of an adequate legislative and regulatory infrastructure for safety in Member States embarking on a nuclear power programme, including

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[51] INTERNATIONAL ATOMIC ENERGY AGENCY, Establishing the Safety Infrastructure for a Nuclear Power Programme, IAEA Safety Standards Series No. SSG-16, IAEA, Vienna (2012).

establishment of an independent nuclear regulatory body that would discharge its regulatory functions and responsibilities in an effective, adequate manner.

198. The Agency conducted a capacity building workshop for the Office of Atoms for Peace (regulatory body) in Bangkok, Thailand, in September 2017, under the framework of SEED. The workshop was attended by 18 participants from the regulatory body.

199. The Agency continued to promote and conduct IRRS missions to embarking countries. These included an IRRS follow-up mission to Poland in June 2017 and one to Jordan in October 2017. A full-scope IRRS mission including the Tailored Module for Countries Embarking on Nuclear Power, which is an additional module based on the guidance of IAEA Safety Standards Series No. SSG-16, was conducted in Nigeria in July 2017.

200. The Agency conducted an INIR mission to Ghana in January 2017.

201. The Agency continued to assist Member States in capacity building through the SAET Programme, which is designed to strengthen the capability of organizations to support a strong nuclear safety assessment infrastructure and to encourage strong national commitment of resources.

202. The Agency finalized the development of the INIR Phase 3 methodology.

Priorities and Related Activities

203. ***The Agency will assist Member States in the development of safety infrastructures for new nuclear power programmes. The Agency will undertake the following activities in relation to this priority:***

- The Agency will continue to assist Member States in capacity building programmes through the SAET programme, particularly on the revised Safety Requirements publication *Safety of Nuclear Power Plants: Design* (IAEA Safety Standards Series No. SSR-2/1 (Rev. 1)), with the aim of strengthening the capability of organizations to support a strong nuclear safety assessment infrastructure, as well as encouraging strong national commitment of resources;

- The Agency will continue to promote the development of an adequate and effective legislative and regulatory framework, including the establishment of an independent regulatory body with a sufficient number of qualified, competent staff;

- The Agency will continue to provide coordination and assistance to regulatory bodies of Member States embarking on a nuclear power programme to enhance their technical capabilities in developing safety regulations and guides, in safety review and assessment and in inspection and authorization through Agency workshops, expert missions, scientific visits and fellowships. The Agency will assist Member States in enhancing the regulatory competence of their staff and in establishing and implementing integrated management systems;

- The Agency will organize a Technical Meeting for embarking countries to systematically establish and strengthen the safety infrastructure for nuclear power programmes in line with IAEA Safety Standards Series No. SSG-16;

- The Agency will continue to assist Member States in identifying their needs and establishing their priorities in order to develop or enhance their national regulatory infrastructures in a timely manner. For this purpose, the Agency will continue to promote the use of the Integrated Review of Infrastructure for Safety self-assessment tool and will conduct self-assessment workshops at national and regional levels;

- The Agency will develop a guidance document on safety and security interfaces in the regulatory infrastructure for the oversight of NPPs and another on managing regulatory oversight for operation of first NPPs; and

- The Agency will expand the number of services for assisting capacity building of regulatory authorities of embarking countries under the framework of SEED. Upon request by Member States, the Agency will continuously monitor their needs and achievements in safety aspects of site selection, site evaluation and design of nuclear installations for safety against external events.

C.5.2. Research Reactor Programmes

Trends

204. Many Member States are planning or implementing projects to establish their first or a new research reactor to build capacity for embarking on a nuclear power programme and for research and development to support industry and national programmes such as those for radioisotope production for the medical sector. Many of these Member States face difficulty in developing the safety and regulatory infrastructure consistent with the project milestones, including the human resources and national competence necessary to implement activities that are important for safety during the project's lifetime, such as siting, construction, commissioning, operation and decommissioning.

Activities

205. The Agency conducted several meetings, workshops and advisory missions to assist Member States in safely establishing new research reactors and the related safety and regulatory infrastructure. These included a workshop on the Assessment of National Nuclear Infrastructure to support new Research Reactor Projects in Vienna, Austria, in September 2017, attended by 34 participants from 24 Member States. The Agency also organized expert missions and workshops on licensing, safety assessment, infrastructure assessment and developing safety regulations for research reactors.

Priorities and Related Activities

206. ***The Agency will assist Member States in developing safety infrastructure for new research reactor programmes. The Agency will undertake the following activity in relation to this priority:***

- The Agency will prepare a report within the IAEA Nuclear Energy Series to assist Member States in developing the infrastructure and human resources necessary to introduce a research reactor programme. The report will provide guidance on assessing national infrastructure and conducting Integrated Nuclear Infrastructure Review — Research Reactors missions along with training in the areas necessary to fulfil the regulatory functions and be consistent with the programme milestones. These areas include site evaluation, design, safety assessment, construction, commissioning, operation and utilization.

D. Strengthening Emergency Preparedness and Response

D.1. Arrangements for Information Exchange, Communication and Assistance

Trends

207. Member States continue to focus their attention on effective information exchange and emergency communication. Their feedback to the Agency has resulted in recommendations for improvements in several areas, such as: the Unified System for Information Exchange in Incidents and Emergencies (USIE); the International Radiation Monitoring Information System (IRMIS); processes and tools for assessment of emergencies; and the prognosis of a possible emergency progression.

208. In 2017, ten Member States designated contact points[52] in accordance with the *Operations Manual for Incident and Emergency Communication* (EPR-IEComm 2012)[53], thereby increasing the number of such Member States to 124.

209. A total of 31 of the 115 States Parties to the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (Assistance Convention)[54] have registered their National Assistance Capabilities[55] in the Agency's Response and Assistance Network (RANET). New or updated registrations were received from the Czech Republic, Egypt, Hungary, Republic of Korea, Pakistan, Slovenia, Spain, Switzerland, Turkey and Ukraine.

210. The number of nominated contact points for the coordination of IRMIS-related activities continues to grow. In 2017, 18 Member States nominated contact points, resulting in a total of 38.

211. The number of Member States using the International Nuclear and Radiological Event Scale (INES) to communicate the safety significance of nuclear or radiological events increased by two in 2017 to a total of 76.

212. Strengthening preparedness to communicate effectively with the public and the media in a nuclear or radiological emergency continues to be a priority for most Member States.

Activities

213. The Agency added new functions to the USIE website, enabling registered organizations to use short messages for updating information on an event, to easily identify the appropriate form for reporting events and to register public information officers of organizations. The upgraded USIE website supports the storage of encrypted information, which can be accessed only by the appropriate users. The interface for exchanging information from European Union member countries between the emergency websites

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[52] States Parties to the Convention on Early Notification of a Nuclear Accident (Early Notification Convention) are obliged to designate their competent authorities and points of contact that will be responsible for issuing and receiving the notifications and information referred to in the Convention. The Agency has requested that all Member States designate their emergency contact points in accordance with the Operations Manual for Incident and Emergency Communication (EPR-IEComm 2012).

[53] INTERNATIONAL ATOMIC ENERGY AGENCY, Operations Manual for Incident and Emergency Communication, Emergency Preparedness and Response Series, EPR-IEComm 2012, IAEA, Vienna (2012).

[54] Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, INFCIRC/336, IAEA, Vienna (1986).

[55] States Parties to the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (Assistance Convention) are obliged to "within the limits of their capabilities, identify and notify the Agency of experts, equipment and materials which could be made available for the provision of assistance to other States Parties in the event of a nuclear accident or radiological emergency".

of the Agency and the European Commission has been implemented and was tested during the international ConvEx-3 exercise in June 2017.

214. The Agency encouraged those Member States which had no contact points established for emergency communication to establish them. It also encouraged Member States to review the designation of their contact points, to be compliant with EPR-IEComm 2012.

215. Since 2010, the Agency has routinely conducted comprehensive training for emergency contact points, covering the operational arrangements for implementing the Early Notification and the Assistance Conventions. As of 2017, all Member States had been invited to participate annually in the workshops for notifying, reporting and requesting assistance. Three workshops, with 100 participants from 75 Member States, were conducted during 2017.

216. The Agency continued to develop and implement IRMIS. A draft manual on the use of IRMIS during a nuclear or radiological emergency was developed to assist Member States in implementing the system. IRMIS was used during emergency response exercises such as the ConvEx-2a and the ConvEx-3 and during a RANET Joint Assistance Team (JAT) field exercise organized at the IAEA RANET Capacity Building Centre in Fukushima Prefecture, Japan, in October 2017.

217. The Agency organized eight workshops at national, regional and interregional level, including one train-the-trainers workshop, which was held in Vienna, Austria, in August 2017, on communicating effectively with the public in an emergency. A total of 190 participants from 78 Member States attended these events.

218. The Agency tested and finalized the plain-language briefing package to support technical briefers and spokespersons with background materials within the Agency's Incident and Emergency System in 2017 for broader use in 2018.

219. The Agency conducted a train-the-trainers workshop on INES in Vienna, Austria, in October 2017. Thirty-two participants from 28 Member States were trained in the INES methodology and on how to effectively communicate the safety significance of an event to different audiences.

Priorities and Related Activities

220. ***The Agency will further develop operational arrangements for notification, reporting and requesting assistance in a nuclear or radiological incident or emergency. The Agency will undertake the following activities in relation to this priority:***

- The Agency will continue to encourage Member States to designate emergency contact points in accordance with EPR-IEComm 2012;

- The Agency will continue to look at supplementary methods to deliver training for Member State emergency contact points on the operational arrangements for notification, for reporting and for requesting assistance, using methods such as web-based training sessions;

- The Agency will make the updated USIE website with improved communication functions available to Member States in early 2018. Training on its application will be provided via webinars and workshops. The USIE website will be further enhanced to improve the secure authentication of user accounts;

- The Agency will promote the wider use and further implementation of the International Radiological Information Exchange data standard for information exchange during nuclear or radiological emergencies;

- The Agency will continue to work with Member States and relevant international organizations to increase the utilization of IRMIS, including through bilateral finalization of the necessary administrative and technical processes with Member States able to provide routine data to IRMIS;

- The Agency will hold the International Symposium on Communicating Nuclear and Radiological Emergencies to the Public in October 2018;

- The Agency will develop a social media simulator tool to integrate into its emergency exercise programme. This will simulate real-life social media to test the Agency's preparedness to cope with this aspect; and

- The Agency will complete the review and revision of *The International Nuclear and Radiological Event Scale User's Manual*.

D.2. Harmonization of Arrangements for Preparedness and Response

Trends

221. Member States are increasingly requesting technical assistance and advice in strengthening national and regional EPR arrangements. Many requests relate to the need for assistance and advice in implementing the requirements established in *Preparedness and Response for a Nuclear or Radiological Emergency* (IAEA Safety Standards Series No. GSR Part 7).

222. Member States are showing increased interest in harmonizing their EPR arrangements among themselves based on IAEA Safety Standards Series No. GSR Part 7. They are increasingly interested in the development of protocols for exchange of information, coordinated assessment and decision-making at regional level.

223. The use of the Emergency Preparedness and Response Information Management System (EPRIMS) is increasing: 96 Member States have appointed national coordinators, with a total of 339 users, (at the end of 2016, 78 Member States had appointed EPRIMS coordinators with a total of 181 users).

224. There is noticeable interest from Member States in starting to address the EPR arrangements for the new generation of reactors, including new designs that are close to deployment (e.g. SMRs) and designs still being developed, such as the Generation IV reactors, including different fast breeder reactor concepts and high temperature reactors.

Activities

225. The Agency conducted two Emergency Preparedness Review (EPREV) preparatory meetings, in Belarus and Slovenia, and one EPREV mission to Slovenia. It also received 11 requests for EPR technical assistance and advice, which were addressed by organizing specific expert missions.

226. The Agency organized a total of 53 training events and workshops, focusing on assistance for implementing the requirements established in IAEA Safety Standards Series No. GSR Part 7. Three regional and three national workshops were held to specifically discuss all the requirements and to identify and address their implementation. The workshops were attended by 314 participants, from 44 Member States.

227. The Agency conducted five Schools of Radiation Emergency Management: two in Austria and one each in Japan, the Republic of Korea and Mexico to address the need of Member States for comprehensive training on EPR topics. A total of 146 participants from 68 Member States attended these events.

228. The Agency, together with the WHO, conducted a webinar to raise awareness on the specific requirements set in IAEA Safety Standards Series No. GSR Part 7. The webinar covered medical preparedness and response for a nuclear or radiological emergency. It was held in February 2017, and attended by approximately 170 experts worldwide.

229. The Agency held two workshops for member countries of the Association of Southeast Asian Nations (ASEAN). The first was on communication with the public in a nuclear or radiological emergency, held in Singapore, in June 2017 and attended by 21 participants from 10 Member States. At this workshop, a plan was defined for a regional strategy for coordinating public communication in an emergency. The second workshop, held in Pattaya, Thailand, in August–September 2017, was attended by 22 participants from 10 Member States. The purpose of the workshop was to help ASEAN countries develop adequate and harmonized capabilities and arrangements for assessment and decision-making on protective and other response actions in the event of a nuclear or radiological emergency.

230. The Agency issued a new EPR Series publication entitled *Operational Intervention Levels for Reactor Emergencies and Methodology for Their Derivation*[56]. The publication provides selected default operational intervention level values for taking protective and other response action to protect the public in an emergency involving a severe release of radioactive materials from a light water reactor or its spent fuel, the methodological approach for their derivation, as well as practical tools and recommendations for their use.

231. The Agency held a Technical Meeting on Next Generation Reactors and Emergency Preparedness and Response in Vienna, Austria, in February 2017attended by 55 representatives from 35 Member States. It served as a first milestone in the discussion to reach a technical consensus on the appropriate EPR arrangements that need to be considered for these new reactors.

232. The Agency issued a new publication entitled *Guidelines on the Harmonization of Response and Assistance Capabilities for a Nuclear or Radiological Emergency*[57]. It developed training materials to support the implementation of the guidelines, and held a workshop in Vienna, Austria, in October 2017, to deliver this material to Member State users. Fourteen participants from 14 Member States attended the workshop.

233. The Agency organized three training webinars for new EPRIMS country coordinators and national users.

234. The Agency continued to prepare a draft EPR Series publication entitled *Considerations for Development of a Protection Strategy for a Nuclear or Radiological Emergency,* aimed at assisting Member States in developing, justifying and optimizing protection strategies at the preparedness stage in a coordinated and consistent manner, thus ensuring harmonized approaches to taking protective actions during an emergency. As part of the drafting process, a workshop was held in Vienna, Austria, in March 2017, to acquaint Member State representatives with this new concept and to provide feedback on the draft. The workshop was attended by 40 participants from 40 Member States.

235. During 2017, 240 healthcare professionals from 44 Member States participated in training activities related to medical preparedness and response to nuclear or radiological emergencies. The

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[56] INTERNATIONAL ATOMIC ENERGY AGENCY, Operational Intervention Levels for Reactor Emergencies and Methodology for Their Derivation, Emergency Preparedness and Response Series, EPR-NPP-OILs 2017, IAEA, Vienna (2017).

[57] INTERNATIONAL ATOMIC ENERGY AGENCY, Guidelines on the Harmonization of Response and Assistance Capabilities for a Nuclear or Radiological Emergency, Emergency Preparedness and Response Series, EPR-Harmonized Assistance Capabilities 2017, IAEA, Vienna (2017).

activities included four national and six regional events, covering medical response and dose assessment for individuals involved in emergencies.

236. The Agency's Assessment and Prognosis tool was launched on its website in April 2017 and is accessible to all USIE users. The website provides access to the specialized assessment and prognosis tools and procedures that have been developed for use during a nuclear or radiological emergency. Member States can use and review the same tools and procedures made available to Secretariat staff during emergencies, so that they can fully understand the Agency's assessment and prognosis process. Four webinars, attended by more than 50 experts from Member States were organized to assist in implementation of the tools. In addition, a draft *Operations Manual for IAEA Assessment and Prognosis during a Nuclear or Radiological Emergency* was prepared, which provides supporting information on the process and associated procedures.

237. The Agency held the first ever RANET JAT exercise at the Agency's RANET Capacity Building Centre in Fukushima Prefecture, Japan, in October 2017, with the participation of 30 experts from seven Member States registered in RANET. The primary purpose of the exercise was to conduct a simulated Agency Assistance Mission with a JAT, comprising field assistance teams and external support experts from various Member States registered in RANET, as well as representatives of the Secretariat. The exercise allowed participants to perform the management and resolution of administrative, logistical, technical, safety and security of personnel matters that might arise during an Assistance Mission. It also allowed participants to practise the coordination of JAT assistance operations with the simulated authority of the simulated Accident State and deliver data reports and briefing products requested by the simulated Accident State.

Priorities and Related Activities

238. ***The Agency will assist Member States in the implementation of IAEA Safety Standards Series No. GSR Part 7 and will develop associated Safety Guides, as a main reference for harmonization of EPR arrangements at the international level. The Agency will undertake the following activities in relation to this priority:***

- The Agency will, through various capacity building activities and missions, and in line with its related safety standards, continue to assist Member States in their efforts to: strengthen the consistency of national arrangements; improve preparedness and response; harmonize national criteria for protective and other response actions; and facilitate communication in an emergency;

- The Agency will further engage with Member States to populate the EPRIMS platform with relevant information, and build a common understanding of EPRIMS as a key tool for EPR information-sharing at the preparedness stage, and for tracking progress made by EPR-related technical cooperation projects. It will release a new version of EPRIMS, which, among other features, will include an improved user interface;

- The Agency will continue to develop the necessary guidance on the application of the requirements established in IAEA Safety Standards Series No. GSR Part 7 to facilitate harmonization of EPR arrangements among Member States; and

- The Agency will continue assisting Member States in harmonizing response and assistance capabilities and arrangements through specific training for those Member States registered in RANET, so that they are prepared to provide international assistance, upon request, which is compatible with the requirements of a requesting State and those of any other assisting States.

D.3. Testing Readiness for Response

Trends

239. Member States continue to seek the Agency's assistance in improving the preparation, conduct and evaluation of national emergency exercises.

240. The percentage of USIE administrators completing the requested tasks within the required time frame has fallen over the past few years (82%, 77% and 72% in 2015, 2016 and 2017, respectively). The Agency followed up USIE administrators who did not complete the requested tasks on time and, as a result, more than 30 USIE user accounts were removed, 48 new USIE user accounts were created, and 11 new USIE administrators were identified.

241. The participation of Member States in ConvEx-2 exercises continues to be high. In 2017, a total of 55 Member States participated in ConvEx-2a (51 in 2016); 36 Member States participated in ConvEx-2b (40 in 2016); eight ConvEx-2e exercises were conducted with six Member States (seven in 2016); and a total of 83 Member States participated in ConvEx-3.

242. The percentage of emergency contact points that confirm the test message via the USIE website during simple communication tests increased from 42% in 2016 to 46% in 2017.

Activities

243. The Agency participated in nine national emergency exercises and assisted Member States in organizing, conducting and evaluating these exercises. Through the ConvEx-1 exercises, the Agency conducted and analysed three tests of emergency communication channels, which should be available at all times and every day of the year. Problems with establishing communication were followed up with the relevant emergency contact points after each exercise.

244. At the request of the Dialogue of Coastal and Shipping States, the Agency facilitated a tabletop exercise in June 2017 to test the coordination between coastal and shipping States and international organizations when managing a transport event that did not have any radiological consequences but that triggered significant interest from the media and the public. Six Member States participated in the exercise, including two via video link.

245. The Agency held the ConvEx-2a exercise in February 2017, with an approximately 8% increase in participation from 2016. The participation of 65% of all Member States with operating NPPs is a measure of how important this exercise is perceived to be by Member States. All participating Member States used the correct communication channels.

246. The Agency conducted the ConvEx-2b exercise in December 2017, with 36 participating Member States and 2 international organizations: 16 Member States tested their capabilities to request assistance and prepare for its receipt, while 20 Member States and 2 international organizations participated as providers of assistance. For those assisting States, the response times were assessed as part of the exercise objectives.

247. The Agency continued the series of ConvEx-2e exercises to test the assessment and prognosis process, based on national exercises in Member States with operating NPPs. Eight ConvEx-2e exercises were conducted, and the assessment and prognosis process was tested in other exercises such as the ConvEx-3 exercise.

248. Within the framework of the Inter-Agency Committee on Radiological and Nuclear Emergencies (IACRNE), the Agency conducted the ConvEx-3 large-scale exercise in June 2017, which lasted for 36 hours and was based on the scenario of a severe accident at an NPP. A total of 83 Member States and

11 international organizations participated, making it the largest ConvEx-3 exercise conducted to date. Hungary offered its national exercise, hosted by the Paks NPP, as the basis for this ConvEx-3 event. The exercise evaluation report, which detailed many important achievements and lessons learned, was finalized at the Technical Meeting held in Vienna, Austria, in December 2017. The meeting was attended by 75 participants from 56 Member States and 4 international organizations.

249. The Agency has encouraged the emergency contact points to review the use of their emergency communications channels, especially when communication has failed during simple tests. It has implemented more than 100 changes to the communication channels of emergency contact points, such as telephone numbers, facsimile numbers, email addresses and video conference addresses.

250. Based on the results of analysis of the communication tests, the Agency has encouraged those emergency contact points that had no USIE website users to register new users. More than 300 changes of user accounts on the USIE system were implemented, and more than 200 new users were added to the website.

251. The 26th Regular Meeting of the IACRNE was held in Brussels, Belgium, in November 2017, to review EPR activities in each organization, discuss lessons identified in the ConvEx-3 (2017) exercise, consolidate the exercise report and agree on the IACRNE work programme for the next two years.

Priorities and Related Activities

252. ***The Agency will implement an active exercise programme to test EPR at the international level and support national EPR exercise programmes. The Agency will undertake the following activities in relation to this priority:***

- The Agency will continue to assist Member States in the preparation, conduct and evaluation of their emergency exercises;

- The Agency will continue to test and evaluate its international arrangements for information exchange, communication, assistance and assessment and prognosis; and continue to encourage Member States to engage in the ConvEx exercises and to test their arrangements for international information exchange in national exercises;

- The Agency will adapt its communication procedures to reflect the needs and capabilities of all Member States and follow up on all communication failures;

- The Agency will further develop and test the inter-agency EPR arrangements and bilateral protocols for response coordination and information exchange, and promote harmonization of the EPR arrangements among relevant international organizations within IACRNE; and

- The Agency will continue to test the international arrangements based on the JPLAN[58], including arrangements to coordinate public communications, to ensure an effective and harmonized international response.

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[58] INTERNATIONAL ATOMIC ENERGY AGENCY, Joint Radiation Management Plan of the International Organizations, Emergency Preparedness and Response Series, EPR-JPLAN 2017, IAEA, Vienna (2017).

E. Improving Management of the Safety and Security Interface

Trends

253. Member States continue to encourage the Secretariat to facilitate coordination of the safety–security interface. Feedback from the Agency's activities also highlighted a continuing need to strengthen the management of the interface between safety and security for research reactors.

254. An increasing number of radioactive sources are becoming disused and are no longer considered an asset. Ensuring continuous safe and secure management options for disused sealed radioactive sources remains an important priority for Member States.

Activities

255. The Interface Group, comprising representatives of the Safety Standards Committees and the Nuclear Security Guidance Committee (NSGC), conducted a review of 12 of the Agency's proposed safety standards and nuclear security guidance publications to identify whether there were any safety and security interfaces. The Interface Group documented the nature of the interfaces and referred them to the appropriate committee(s) for further review and approval. During the year, the NSGC reviewed drafts of 16 safety standards identified as having interfaces with security, and relevant Safety Standards Committees reviewed drafts of six Nuclear Security Series publications having interfaces with safety.

256. The Agency completed development of four guidance publications on aspects of security that have significant interfaces with safety, including maintaining security throughout the lifetime of nuclear facilities, security of radioactive material in use and storage, security of radioactive material in transport, and response to nuclear security events. These documents complement related safety standards and address the interfaces such that safety and security are mutually supportive where possible and do not adversely affect the functions of each other.

257. The Agency held an International Workshop on Nuclear Security Measures and Emergency Response Arrangements for Major Public Events, in Washington, DC, United States of America, in June 2017, and an International Workshop on Nuclear Security Measures and Emergency Response Arrangements for Ports, in Las Vegas, United States of America, in November 2017. Forty experts from 24 Member States attended these training events. The workshops addressed the interface between nuclear security measures and emergency response arrangements for Member States planning major public events and establishing appropriate arrangements at ports.

258. The Agency finalized the Guidance on the Management of Disused Radioactive Sources. It is based on the Agency's safety standards and nuclear security guidance, and addresses safety and security in an integrated manner similar to that of the Code of Conduct on the Safety and Security of Radioactive Sources. The Guidance was approved by the Board of Governors and endorsed by the General Conference in September 2017.

Priorities and Related Activities

259. ***The Agency will ensure that safety standards and nuclear security guidance take into account the implications for both safety and security whenever appropriate, recognising that the activities that address nuclear safety and security are different. The Agency will undertake the following activities in relation to this priority:***

- The Agency will continue to support Member States in managing the interface between nuclear safety and security for research reactors through developing new guidance, revising relevant safety standards and organizing training activities;

- The Agency will continue to support Member States, upon request, in applying the Guidance supplementary to the Code of Conduct to develop comprehensive national strategies for managing disused radioactive sources. It will conduct regional workshops and training courses to support the national regulatory bodies and other competent authorities responsible for managing disused radioactive sources; and

- The Agency will develop similar documents on managing safety–security interfaces in nuclear power plants and in the transport of radioactive material. The experiences reported in such documents could provide input to future consideration of possible consensus guidance on managing such interfaces.

F. Strengthening Civil Liability for Nuclear Damage

Trends

260. Member States continue to attach importance to having in place effective and coherent nuclear liability mechanisms at the national and global level to ensure prompt, adequate and non-discriminatory compensation for damage to people, property and the environment resulting from a nuclear accident or incident.

261. Member States continue to encourage the Agency to assist them, upon request, in their efforts to adhere to the international nuclear liability conventions, taking into account the recommendations on how to facilitate the achievement of a global nuclear liability regime, adopted by Agency's International Expert Group on Nuclear Liability (INLEX) in 2012[59].

Activities

262. INLEX held its 17th regular meeting in Vienna, Austria, in May 2017. The Group considered the possible exclusion of certain low-risk installations from the scope of application of the liability conventions, with specific reference to the case of installations being decommissioned and of installations for the disposal of certain types of low level radioactive waste. In this respect, the Group concluded that there was no need to exclude any such installations from the scope of application of the revised Vienna Convention on Civil Liability for Nuclear Damage and of the Convention on Supplementary Compensation for Nuclear Damage. The Group also discussed other liability matters relating to disposal facilities, to transportable nuclear power plants and to the transport of nuclear material, as well as the scope of application of the nuclear liability conventions regarding radioactive products or waste and agreed to consider them further at its next meeting.

263. *The 1997 Vienna Convention on Civil Liability for Nuclear Damage and the 1997 Convention on Supplementary Compensation for Nuclear Damage — Explanatory Texts* (IAEA International Law Series No. 3 (Revised)) was issued.[60] This revision was prepared in the light of the entry into force of the Convention on Supplementary Compensation for Nuclear Damage in 2015 and of the aforementioned recommendations adopted by INLEX in 2012.

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[59] The text of the recommendations is available at: https://ola.iaea.org/ola/documents/ActionPlan.pdf. These recommendations were adopted by INLEX following a request in the IAEA Action Plan on Nuclear Safety (document GOV/2011/59-GC(55)/14).

[60] INTERNATIONAL ATOMIC ENERGY AGENCY, The 1997 Vienna Convention on Civil Liability for Nuclear Damage and the 1997 Convention on Supplementary Compensation for Nuclear Damage – Explanatory Texts, IAEA International Law Series No. 3 (Revised), IAEA, Vienna (2017).

264. One IAEA-INLEX follow-up mission was conducted in Kuala Lumpur, Malaysia, in February 2017, to address matters relating to the implementation of the international nuclear liability regime. The Agency also organized a Sub-Regional Workshop on Civil Liability for Nuclear Damage for Latin American Countries, which was held in Montevideo, Uruguay, in June 2017 and was attended by 20 participants from 10 Member States, and a Workshop on Civil Liability for Nuclear Damage, which was held in Accra, Ghana, in November 2017 and was attended by 22 participants from 11 Member States in the Africa region. Both workshops provided the participants with an overview of the international nuclear liability regime and of related topics, and with an opportunity to discuss matters of concern.

265. In addition, the sixth Workshop on Civil Liability for Nuclear Damage was held in Vienna, Austria, in May 2017, and was attended by 32 diplomats and experts from 25 Member States. Participants were given an overview of the international nuclear liability regime and of related matters.

Priorities and Related Activities

266. ***The Agency will continue to facilitate the establishment of a global nuclear liability regime and assist Member States, upon request, in their efforts to adhere to and implement the international nuclear liability instruments, taking into account the recommendations adopted by INLEX in 2012. The Agency will undertake the following activities in relation to this priority:***

- The Agency will organize the next meeting of INLEX in May 2018;

- The Agency, with the support of INLEX, will undertake further activities, such as regional and subregional workshops, as well as IAEA-INLEX missions, that may be requested by individual Member States, to raise awareness of the international legal regime of civil liability for nuclear damage and facilitate its national implementation; and

- The Agency will also continue to support Member States, upon request, in adopting and revising national legislation on civil liability for nuclear damage, in the context of its legislative assistance programme.

Appendix

The IAEA Safety Standards Activities during 2017

A. Summary of the Agency's Safety Standards Activities during 2017

1. The Agency published the revised Safety Requirements entitled *Safety of Nuclear Fuel Cycle Facilities* (IAEA Safety Standards Series No. SSR-4) after Board of Governors approval in September 2017. This publication incorporates learning from the accident at the Fukushima Daiichi nuclear power plant in Japan as it relates to nuclear fuel cycle facilities. With the issuance of this Safety Requirements publication, all Safety Requirements have now been brought up to date to include feedback from the Fukushima Daiichi accident.

2. The Agency also published three Safety Guides after endorsement by the Commission on Safety Standards (CSS):

— SSG-42: *Safety of Nuclear Fuel Reprocessing Facilities*;

— SSG-43: *Safety of Nuclear Fuel Cycle Research and Development Facilities*; and

— GSG-6: *Communication and Consultation with Interested Parties by the Regulatory Body*.

3. The CSS met twice in 2017. A CSS Working Group was established to consider the implications of the 2012 UNSCEAR report entitled *Attributing Health Effects to Ionizing Radiation Exposure and Inferring Risks* for the safety standards. The CSS endorsed the Working Group's recommendations to review the Safety Fundamentals to identify whether there is a need to refine certain parts of the text with respect to the dose and risk concepts set out in the UNSCEAR report, and to analyse the safety standards currently under development and already published to determine which could be strengthened in this respect.

4. In 2017, the CSS endorsed the following draft safety standards for submission for publication:

— DS495: Draft Safety Requirements entitled *Regulations for the Safe Transport of Radioactive Material*, 2018 Edition (revision of SSR-6, 2012 Edition);

— DS478: Draft Safety Requirements entitled *Safety of Nuclear Fuel Cycle Facilities* (revision of NS-R-5 (Rev. 1));

— DS474: Draft Safety Guide entitled *Arrangements for the Termination of a Nuclear or Radiological Emergency*; and

— DS485: Draft Safety Guide entitled *Ageing Management and Development of a Programme for Long Term Operation of Nuclear Power Plants* (revision of NS-G-2.12).

5. In 2017, the CSS also approved the following document preparation profiles (DPPs) for Safety Guides:

— DS498: *External Events Excluding Earthquakes in the Design of Nuclear Installations* (revision of NS-G-1.5);

— DS499: *Application of the Concept of Exemption* (revision of RS-G-1.7);

— DS500: *Application of the Concept of Clearance* (revision of RS-G-1.7);

— DS503: *Protection Against Internal and External Hazards in the Operation of Nuclear Power Plants* (revision of NS-G-2.1);

— DS504: *Arrangements for Preparedness and Response for a Nuclear or Radiological Emergency* (revision of GS-G-2.1);

— DS505: *Source Monitoring, Environmental Monitoring and Individual Monitoring for Protection of the Public and the Environment* (revision of RS-G-1.8);

— DS506: *Schedules of Provision of the IAEA Regulations for the Safe Transport of Radioactive Material* (2018 Edition) (revision of SSG-33); and

— DS507: *Seismic Hazards in Site Evaluation for Nuclear Installations* (revision of SSG-9).

6. A number of drafts are being prepared to bring Safety Guides up to date in light of the Fukushima Daiichi accident:

— DS449: *Format and Content of the Safety Analysis Report for Nuclear Installations*;

— DS468: *Remediation Process for Areas Affected by Past Activities and Accidents*;

— DS475: *Arrangements for Public Communications in Preparedness and Response for a Nuclear or Radiological Emergency*;

— DS481: *Design of the Reactor Coolant System and Associated Systems in Nuclear Power Plants*;

— DS482: *Design of Reactor Containment Structure and Systems for Nuclear Power Plants*;

— DS483: *Severe Accident Management Programme for Nuclear Power Plants*;

— DS486: *Establishing the Safety Infrastructure for a Nuclear Power Programme*;

— DS487: *Design of Fuel Handling and Storage Systems for Nuclear Power Plants*;

— DS488: *Design of the Reactor Core for Nuclear Power Plants*;

— DS489: *Storage of Spent Nuclear Fuel*;

— DS490: *Seismic Design and Qualification for Nuclear Power Plants*;

— DS491: *Deterministic Safety Analysis for Nuclear Power Plants*;

— DS494: *Protection against Internal Hazards in the Design of Nuclear Power Plants*;

— DS497: revision of eight closely interrelated Safety Guides on operational safety for NPPs: NS-G-2.2 to 2.8 and NS-G-2.14;

— DS498: *External Events Excluding Earthquakes in the Design of Nuclear Installations*;

— DS503: *Protection Against Internal and External Hazards in the Operation of Nuclear Power Plant*s;

— DS504: *Arrangements for Preparedness and Response for a Nuclear or Radiological Emergency*; and

— DS507: *Seismic Hazards in Site Evaluation for Nuclear Installations*.

7. In addition, a completely revised draft of the Safety Requirements on site evaluation for nuclear installations was submitted to Member States for comment in 2017. This draft publication takes into account scientific knowledge and incorporates advances in technology relating to site evaluation for nuclear installations.

8. Similarly, several Safety Guides are being revised or newly prepared, including:

— DS419: *Radiation Protection and Safety in Well Logging*;

— DS420: *Radiation Protection and Safety in Nuclear Gauges*;

— DS434: *Radiation Safety of Radioisotope Production Facilities*;

— DS440: *Design of Auxiliary and Supporting Systems in NPPs*;

— DS459: *Management of Radioactive Residues from Mining, Mineral Processing, and other NORM related Activities*;

— DS469: *Preparedness and Response for an Emergency during the Transport of Radioactive Material*;

— DS470: *Radiation Safety of Radiation Sources used in Research and Education*;

— DS471: *Radiation Safety of X-ray Generators and Radiation Sources Used for Inspection Purposes and for Non-Medical Imaging*;

— DS477: *The Management System for the Predisposal and Disposal of Radioactive Waste*;

— DS492: *Human Factors Engineering in the Design of Nuclear Power Plants*;

— DS493: *Format and Content of the Package Design Safety Report for the Transport of Radioactive Material*; and

— DS496: *Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material* (2018 Edition).

9. The Nuclear Safety and Security Online User Interface (NSS-OUI)[61] was launched at the Senior Regulators' Meeting held during the 61st regular session of the General Conference. It provides users with an easier tool to access and browse the content of the IAEA Safety Standards Series and IAEA Nuclear Security Series with advanced search capabilities. It also constitutes a centralized platform to collect and retrieve feedback on the use of the current publications in both series. It provides information on the relationship between the publications and helps users to navigate from one publication to other relevant publications containing related recommendations.

10. The main objective of the NSS-OUI platform is to establish a knowledge and content management system to:

— ensure that the review and revision of published standards is based on a systematic feedback collection and analysis process;

— ensure that any revision of the safety standards or part of the safety standards is justified by the above mentioned feedback process, therefore also ensuring stability of the parts of the standards that remain valid;

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[61] https://nucleus-apps.iaea.org/nss-oui/.

— maintain the technical consistency among the standards through management of the standards as a complete collection rather than by management of individual standards;

— enhance semantic consistency through systematic use of harmonized terminology;

— ensure the completeness of the collection through a systematic top-down development approach complemented by topical gap analyses; and

— support harmonized use and application of the safety standards by enhancing their user-friendliness and by providing tools for the users to easily navigate within the whole collection.

11. All IAEA Safety Standards Series and IAEA Nuclear Security Series publications are available in full text on the NSS-OUI platform and have been tagged with metadata to enhance search capabilities. An advanced topical search functionality has been established (‘search the search criteria’), and the central feedback mechanism is fully operational for publications that are available in full text. An electronic version of the 2016 revision of the *IAEA Safety Glossary* has been established and issued in a dedicated ‘knowledge organization system’ server. A semi-automatic tagging mechanism has been developed to mark defined terms in the NSS-OUI publications with pop-up definitions.

12. This content management system enabled the development of a strategic plan for the revision of interrelated Safety Guides on the safety of research reactors. Based on the results of the analysis conducted, eleven Safety Guides will be revised and amended in the framework of an integrated project considering their technical interlinkages.

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