



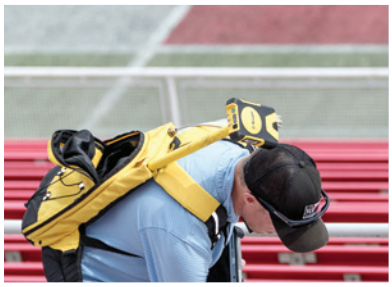





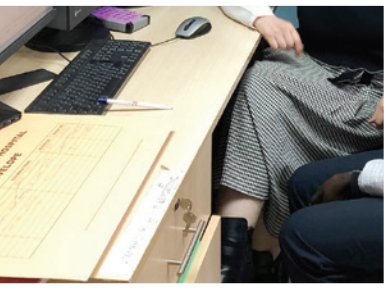

Nuclear Safety Review 2020

IAEA
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NUCLEAR SAFETY REVIEW 2020

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Foreword

The *Nuclear Safety Review 2020* includes the global trends and the Agency's activities undertaken in 2019 and thereby demonstrates the progress made regarding the priorities for 2019. It also presents priorities for 2020 and beyond, as identified by the Agency, for strengthening nuclear, radiation, transport and waste safety. The majority of priorities remain unchanged from the previous year due to their long term nature but some have evolved to take into account changing global trends and in response to activities performed.

A draft version of the *Nuclear Safety Review 2020* was submitted to the March 2020 session of the Board of Governors in document GOV/2020/2. The final version of the *Nuclear Safety Review 2020* 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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Nuclear Safety Review 2020

Report by the Director General

Executive Overview

1. The *Nuclear Safety Review 2020* reflects the global trends and the Agency's activities undertaken in 2019. It shows that the global nuclear community continued to make steady progress in improving nuclear safety throughout the world in 2019. It also presents priorities for 2020 and beyond, as identified by the Agency, for strengthening nuclear, radiation, transport and waste safety, and emergency preparedness and response.

2. The Executive Overview provides a summary of selected significant nuclear safety issues and trends covered in this period of reporting. A list of the Agency's priorities is also provided at the end of this Executive Overview.

3. The work on the Agency's safety standards continued to focus on the revision of existing standards rather than the establishment of new ones. The revision of the Safety Requirements publications to include lessons from the Fukushima Daiichi accident has been completed. The revision of the related Safety Guides continues to be a focus.

4. The number of Contracting Parties to the Convention on Nuclear Safety (CNS) and to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (Joint Convention) continued to grow. Preparations for the Eighth Review Meeting of the Convention on Nuclear Safety and the Fourth Extraordinary Meeting of the Joint Convention are under way. The International Conference on Effective Nuclear and Radiation Regulatory Systems: Working Together to Enhance Cooperation, in The Hague, Netherlands, in November 2019, highlighted the importance of capacity building for regulatory bodies to enable them to respond to emerging and innovative technologies in nuclear power, medical, research and development and other applications of nuclear and radiation technologies.

5. Member State requests for Agency peer review and advisory services remain high and 60 missions were conducted across all safety areas. Integrated Regulatory Review Service (IRRS) follow-up missions undertaken in 2019 highlighted Member States' continued commitment to strengthening national legal and governmental infrastructure. Agency peer review mission reports continue to include recommendations relating to leadership and management for safety and safety culture. An increasing number of Member States are requesting assistance in developing their programmes on leadership and management for safety, as well as for conducting safety culture self-assessments for regulatory bodies.

6. In the area of capacity building, Member States continue to make progress towards the establishment of national strategies for education and training in nuclear, radiation, transport and waste safety. Member States continue to express a need for Agency support in capacity building that takes into

account the establishment and development of national strategies on education and training as set out in *A Methodology for Establishing a National Strategy on Education and Training in Radiation, Transport and Waste Safety* (Safety Reports Series No. 93).[1] Member States embarking on new nuclear power programmes continue to request Agency support for education and training in many safety related fields. Although continuous progress is being made in Member States towards establishing and strengthening nuclear and radiation safety infrastructure in line with the IAEA safety standards, there is still room for improvement.

7. The increased use of sealed radioactive sources in medicine, industry, agriculture and research has resulted in a growing need to have appropriate arrangements for the control of sources and the safe management of disused sealed radioactive sources. Also, the increased use of radioactive sources in Member States is creating a growing need for regulatory oversight, including for domestic and international transport. An increasing number of Member State expressed their political commitment to the Code of Conduct on the Safety and Security of Radioactive Sources and its supplementary Guidance on the Import and Export of Radioactive Sources and Guidance on the Management of Disused Radioactive Sources.

8. New and advanced cancer control applications, including radiotherapy technology and procedures, are increasingly used for the treatment of cancer. Accidental radiation exposures continue to occur during the medical use of ionizing radiation, and safety measures need to be further enhanced. The Safety in Radiation Oncology reporting and learning system (SAFRON) includes a training module for health professionals with the objective of reducing accidental radiation exposures. Improved access to diagnostic imaging procedures utilizing ionizing radiation is creating a need for greater awareness of the importance of justification of medical exposures and optimization of protection and safety to protect patients from risks associated with ionizing radiation.

9. Significant growth in the number of nuclear decommissioning projects worldwide has increased the need for the Agency's assistance in establishing and enhancing capacity in decommissioning planning and implementation. Requests for comprehensive and advanced education and training programmes are growing. As such, Member States have requested that the Agency develop training materials and support training on specific safety aspects of decommissioning of facilities.

10. Regulatory infrastructure development for uranium production projects remains an important topic in some Member States. Many Member States are facing challenges in managing activities involving naturally occurring radioactive material (NORM). Requests for Agency assistance in establishing regulatory and safety infrastructure for uranium production and management of NORM residues are increasing. Member States are now more aware of the effects of exposure to radon in homes and workplaces, as well as of radiation doses from the consumption of food and drinking water in non-emergency situations.

11. Member States continue to develop and implement disposal facilities as a safe long term management solution for radioactive waste. As far as high level radioactive waste and spent fuel when considered as waste are concerned, several Member States are progressing in their geological disposal activities. The Agency continues to provide support to Member States through the development of safety standards and guidance and the organization of international projects relating to the safe disposal of radioactive waste as a long term management solution. Recognizing the importance of the issue of disposal, in July 2019, the Chair of the International Nuclear Safety Group (INSAG) in his annual letter to the Director General urged action by policy makers in Member States on "the need to deal permanently with the accumulation of spent fuel and high level radioactive waste".

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[1] INTERNATIONAL ATOMIC ENERGY AGENCY, A Methodology for Establishing a National Strategy for Education and Training in Radiation, Transport and Waste Safety, Safety Reports Series No. 93, IAEA, Vienna (2018).

12. Several Member States worked to develop borehole disposal solutions for the long term management of disused sealed radioactive sources, regulatory and infrastructure support systems, hardware and equipment, and processes and procedures. Many other Member States are interested in exploring the concept, for example as expressed through their proposals submitted to a CRP to develop a framework for the borehole disposal of disused sealed radioactive sources and small quantities of low level and intermediate level waste.

13. In the area of protection of the environment, there is growing interest in methodologies for the prospective and retrospective assessment of radiological impacts to members of the public and non-human biota. There is also growing interest in the remediation of sites and areas with radiological contamination arising from past unregulated practices and events. Requests of assistance for identification of contaminated sites and in supporting remediation are growing.

14. Many nuclear power plant (NPP) operating organizations continued to show good safety performance in 2019 and the Agency makes examples available to all Member States of good practices noted during Operational Safety Review Team (OSART) missions. However, the Agency also continued to identify recommendations regarding the strengthening of leadership and management for safety, the conduct of safe operations, enhancing continuous improvement, optimizing maintenance activities, improving assessment of major plant safety modifications, strengthening accident management and on-site emergency preparedness and response, and setting, communicating and implementing management expectations. To assist operating organizations to improve performance, the Agency offers workshops and tailored training activities to Member States and confirms progress in resolving issues during review mission follow-up visits.

15. The Agency's safety standards provide principles, requirements and guidance to support the implementation of reasonably practicable safety improvements, such as periodic safety reviews of existing NPPs against current safety standards to determine ways to further enhance NPP safety, and thus the Agency will continue to facilitate the exchange of information and will prepare relevant publications, focusing on consolidating shared experiences and summarizing practical examples. Moreover, the Agency developed a practical methodology addressing the safety of multi-unit sites in an integrated manner.

16. An increasing number of nuclear power reactors around the world have programmes to address ageing management and long term operation (LTO). Member States use different strategies and methods to ensure operational safety. Safety reviews focus primarily on physical aging management and may not systematically consider other elements, such as those considered in a periodic safety review, to conclusively demonstrate that the arrangements to maintain and strengthen plant safety remain adequate. There is room for improvement in the performance of ageing management reviews and in the coordination of existing work with ageing management programmes. Also, human resource policies and strategies to support LTO could benefit from further development, including enhanced knowledge management and transfer of knowledge between generations.

17. Member States continue to express an interest in the lessons arising from the Fukushima Daiichi accident with regard to site and design safety and severe accident prevention and mitigation. Member States highlighted the importance of clear, comprehensive, well-designed accident management provisions capable of helping to address the difficulties that operators and decision-makers may face when dealing with a severe accident. Much recent research and development work undertaken in Member States has focused on providing a demonstration of the safety of NPPs in respect of severe accident phenomena and novel design features.

18. An increasing number of Member States have expressed interest in small and medium sized or modular reactors (SMRs), with a corresponding increase in requests for workshops and expert missions on licensing and safety matters from Member States embarking on SMR technology. More than 50 SMR designs are currently in various stages of design and development and a few concepts are close to

deployment. One vessel for a transportable NPP has completed manufacture, with its two reactors operational and connected to the grid. To provide for better coordination of international efforts on key relevant safety aspects, the Agency continued supporting the Small Modular Reactor Regulators' Forum to identify and enhance understanding of key regulatory challenges that may emerge in future SMR regulatory and licensing discussions.

19. 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 implemented at many facilities. Member States have shown increased awareness and have improved their management of the interface between safety and nuclear security when planning and implementing these projects. Also, many Member States are planning or implementing projects to establish their first or a new research reactor with the goal of building capacity for embarking on a nuclear power programme and/or conducting research and development to support industry and national programmes, such as those for medical radioisotope production.

20. Twenty-eight Member States are considering or planning a new nuclear power programme. Four of these Member States have commenced the construction of their first nuclear power plant, and two of these expect the commissioning of their first unit in 2020. Developing an effective legal and governmental framework for safety including an independent regulatory body is a priority during the early stages of the NPP programme and the Agency conducted five missions to newcomer Member States to coordinate support activity plans through the Regulatory Cooperation Forum.

21. The International Conference on Climate Change and the Role of Nuclear Power, held in Vienna in October 2019, highlighted the utmost importance of the implementation of high levels of safety and security consistent with Agency safety standards and nuclear security guidance, throughout the life of NPPs as essential for all countries pursuing nuclear power for peaceful purposes. Avoidance of complacency is key to maintaining high levels of safety and nuclear security.

22. Effective information exchange and emergency communication remain a priority for Member States. In 2019, the Agency was informed by competent authorities, or became aware through earthquake alerts or media reports, of 245 events involving or suspected to involve nuclear or radiological facilities or activities. This number remains significant in line with the trend of recent years. The sustained effort by the Secretariat and the Member States in regard to workshops and training on notification, reporting and requesting assistance contributed to the increase of the number of recorded events in the last years. In 2019, Agency received 5 requests for information about events from official contact points. An increasing interest in research relating to emergency preparedness and response (EPR) is expressed by an ongoing Coordinated Research Project (CRP) on determination of emergency planning zones for SMRs and two new CRPs: one relating to dose projections launched in 2019; and another one relating to public communication for emergency preparedness and response to be launched in 2020.

23. Member States' support is increasing for the continuous review and update of the arrangements for notification, reporting and assistance through the provision of feedback on the content of the operational manuals and the latest developments of the Agency's web systems and tools used in the implementation of the arrangements.

24. Member States are increasingly requesting technical assistance and advice in strengthening national and regional emergency preparedness arrangements. Many requests relate to the need for assistance and advice in implementing the requirements established in IAEA Safety Standards Series No. GSR Part 7, including requests for the development of new Safety Guides, for the revision of existing Safety Guides, and for training and exercises. The number of Member States using GSR Part 7 and the Safety Guide *Arrangements for the Termination of a Nuclear or Radiological Emergency* (IAEA Safety Standards Series No. GSG-11) in developing their national emergency response

arrangements is increasing. Member States are showing increased interest in harmonizing their emergency preparedness and response arrangements based on the requirements in GSR Part 7.

25. The Agency held 40 emergency preparedness and response training events at the regional and interregional levels, and 15 at the national level with a total of 1368 participants from 133 Member States. A total of ten ConvEx2a-f exercises were held, and the first ConvEx-2g exercise was piloted in October 2019. Use of the Unified System for Information Exchange in Incidents and Emergencies (USIE) Exercise website for exercises in Member States remains at a high level.

26. Member States have highlighted the importance of the safety and security interface and its coordination, recognizing that the activities that address nuclear safety and security are different, and have encouraged the Secretariat to facilitate a coordination process to address safety and security interfaces in all facilities and activities. The Interface Group, comprising representatives of the Safety Standards Committees and the Nuclear Security Guidance Committee (NSGC), reviewed seven of the Agency's proposed safety standards to identify 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 15 safety standards identified as having interfaces with security, and the relevant Safety Standards Committees reviewed one draft IAEA Nuclear Security Series publication having interfaces with safety. INSAG and the Advisory Group on Nuclear Security (AdSec) also highlighted the importance of the safety and security interface. Currently, they are working on a joint publication.

27. Member States continue to attach importance to 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. Member States continue to request the Agency to assist them 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 that were adopted by the Agency's International Expert Group on Nuclear Liability (INLEX) in response to the IAEA Action Plan on Nuclear Safety.

28. The Agency's priorities for 2020 and beyond for strengthening nuclear, radiation, transport and waste safety, and emergency preparedness and response are to:

- continue strengthening its safety standards using lessons from the Fukushima Daiichi accident and other relevant sources;
- assist with the application of its safety standards by, inter alia, strengthening its peer review and advisory services and related self-assessment tools;
- 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;
- assist Member States in strengthening their regulatory effectiveness by identifying lessons from international conferences, peer reviews, advisory missions, knowledge networks and relevant meetings and workshops;
- assist Member States in strengthening leadership and management for the safety of nuclear facilities and activities;
- assist Member States in their efforts to foster and sustain a strong safety culture;
- assist Member States in strengthening their processes for communicating radiation risks to the public in planned and existing exposure situations and during an emergency;

- assist Member States in their capacity building programmes, including education and training in nuclear, radiation, transport and waste safety as well as EPR;
- assist Member States in developing their expertise in the relevant technical areas;
- assist Member States' efforts in the field of research and development for safety where the need for further work has been identified and facilitate the exchange of the results;
- assist Member States in the application of the Agency's safety standards, in particular, the International Basic Safety Standards (GSR Part 3), in radiation protection of the people and the environment for applications such as energy production, research, and medical and industrial uses of radionuclides;
- assist Member States in the management of radioactive sources from cradle to grave through guidance documents, peer reviews, advisory services, training courses and workshops;
- promote the effective 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, and facilitate the sharing of experience;
- assist Member States in building capacity for the safe transport of radioactive material;
- assist Member States in developing and implementing national policies and strategies for the safe management of radioactive waste and spent fuel, including disposal of waste, sealed radioactive sources, geological disposal of high level waste and spent fuel when considered as waste, and the development of decommissioning strategies and plans;
- promote and facilitate the sharing of experience gained in dealing with the remediation of contaminated areas, including post-accident situations and uranium legacy sites;
- assist Member States in implementing and improving programmes for ageing management and the safe LTO of nuclear installations;
- facilitate the exchange of operating experience of NPPs and provide assistance to Member States to support their preparation for implementation of safety upgrades in existing NPPs;
- 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;
- provide forums for Member States to share knowledge and experience in their efforts to strengthen severe accident management guidelines, and further develop technical documentation in this area;
- assist Member State activities related to small and medium sized or modular reactors, particularly their efforts to develop safety requirements, build capacity for design safety and safety assessment, and share good practices;
- provide assistance to Member States to support their preparation for implementation of safety upgrades resulting from 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, and continue to facilitate the exchange of operating experience;

- provide assistance to Member States to support their preparation for implementation of safety upgrades identified by safety reassessments of nuclear fuel cycle facilities, and continue to support Member States to enhance regulatory supervision;
- assist Member States in the development of safety infrastructures for new nuclear power programmes;
- assist Member States in developing safety infrastructure for new research reactor programmes;
- further develop and support the implementation by the Member States of the operational arrangements for notification, reporting and assistance in a nuclear or radiological incident or emergency;
- assist Member States in the implementation of IAEA Safety Standards Series No. GSR Part 7 and develop associated Safety Guides as a main reference for harmonization of EPR arrangements;
- continue to implement an active exercise programme at the international level to test EPR and support national EPR exercise programmes;
- 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; and
- continue to facilitate the establishment of a global nuclear liability regime and 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.

Analytical Overview

A. General Safety Areas

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

Trends

1. The work on the Agency's safety standards continued to focus on the revision of existing standards rather than the establishment of new ones, noting that the revision of the Safety Requirements publications to include lessons from the Fukushima Daiichi accident has been completed. The revision of the related Safety Guides continues to be a focus.

2. The Agency's peer review and advisory services continued to be provided to Member States upon request. Member State requests for these services remain high (see Figure 1).

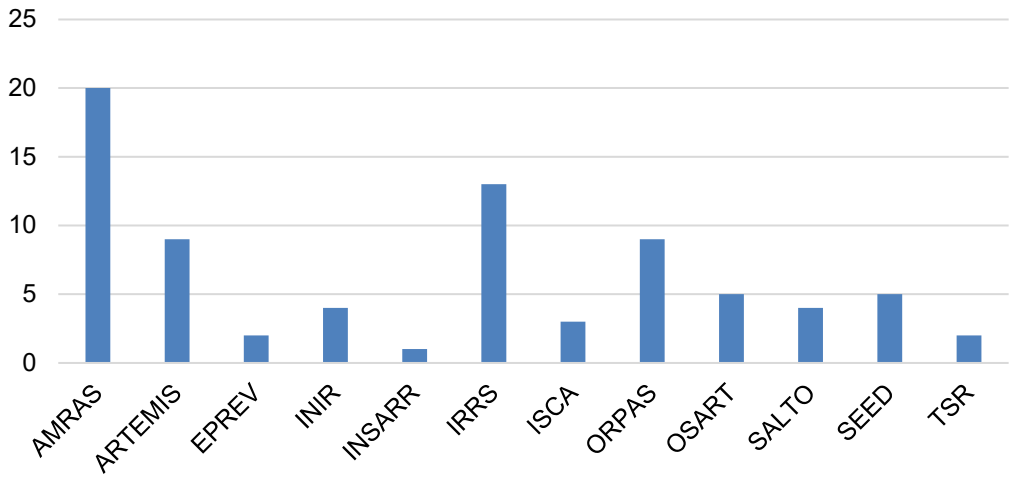

Fig. 1. Number of Member States requests for the Agency's peer review and advisory services to be conducted over the next two years.

Activities

3. The Agency issued the Safety Requirements publication Site Evaluation for Nuclear Installations (IAEA Safety Standards Series No. SSR-1)2, which completed the set of Safety Requirements. Additionally, seven Specific Safety Guides were issued. The Commission on Safety Standards (CSS) endorsed 13 Safety Guides for submission for publication (see Appendix).

4. The Agency addressed Member States' comments on the seven Safety Guides on operational safety for nuclear power plants (DS497).

5. The Agency included all new safety standards and nuclear security guidance publications in the Nuclear Safety and Security Online User Interface (NSS-OUI) platform. This platform was also used to develop a strategic plan for the revision of Safety Guides on the safety of nuclear fuel cycle facilities.

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[2] INTERNATIONAL ATOMIC ENERGY AGENCY, Site Evaluation for Nuclear Installations, IAEA Safety Standards Series No. SSR-1, IAEA, Vienna (2019).

6. The Secretariat continued its good coordination between the Departments of Nuclear Energy and of Nuclear Safety and Security through representation of staff from both Departments on the respective Departmental coordination committees for publications.

7. The Agency conducted 61 peer review and advisory services across all safety areas (Figure 2).

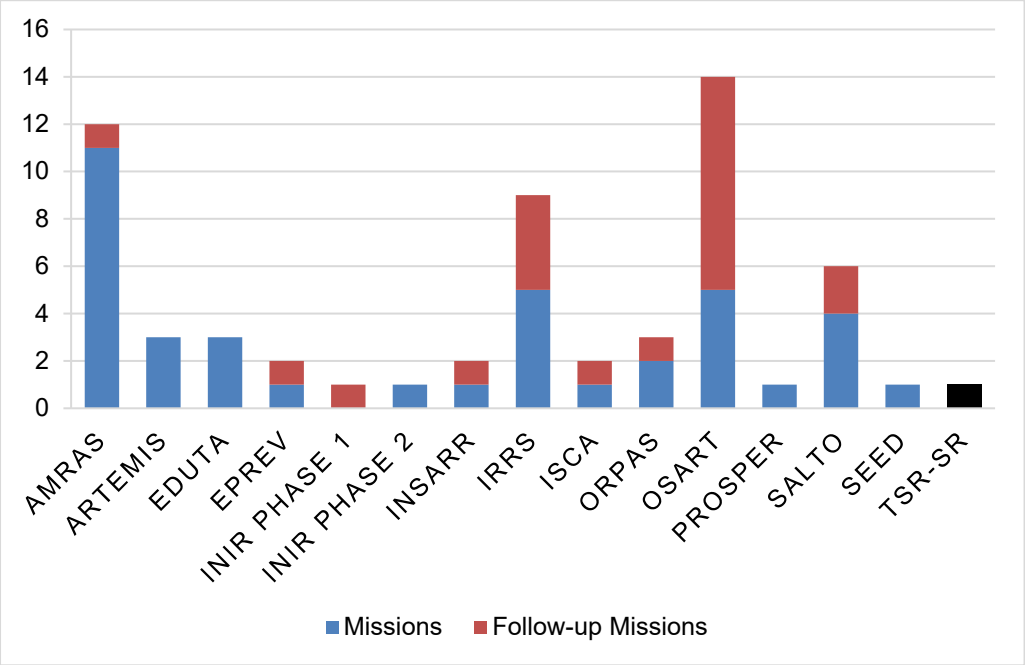

Fig. 2. Breakdown of the 61 peer review and advisory services conducted across all safety areas (note that the data for TSR services represent the number of such services, not missions).

8. The Agency established a working group to take forward the lessons learned from the first Integrated Regulatory Review Service (IRRS) – Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS) combined mission which took place in Spain in October 2018. During six meetings in 2019, the group carried out a preliminary analysis of experience feedback gained and identified ways to increase the efficiency of implementation of such combined missions, including in relation to scope to be covered by each component of a combined mission (either IRRS or ARTEMIS) and interaction between them during a mission. The group's findings contributed to the continuing development of guidance on combined missions.

9. The Agency issued revised Technical Safety Review (TSR) service guidelines that comprise all six technical subject areas and incorporate lessons learned from TSR service implementation. The Agency also updated the Global Safety Assessment Network (GSAN) to facilitate TSR peer reviews through provision of detailed information about TSR services.

10. The Agency held a Technical Meeting on "Twenty Years of EPREV: Building on Two Decades of Experience" in Vienna in October 2019, attended by 56 representatives from 45 Member States and one international organization. Participants shared their experiences from using the Emergency Preparedness Review (EPREV) service, and proposed improvements and coordination with the World Health Organization (WHO) Joint External Evaluation service's module on radiation emergencies.

Priorities and Related Activities

11. ***The Agency will continue strengthening its safety standards using lessons from the Fukushima Daiichi accident and other relevant sources. The Agency will assist with 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 incorporate lessons from the Fukushima Daiichi accident and other sources;
- The Agency will update the content of the NSS-OUI platform by importing newly published safety standards and nuclear security guidance and use the platform to continue collecting and analysing Members States' feedback;
- The Agency will continue to provide peer review and advisory services upon request and encourage Member States to participate in and request such services;
- The Agency will continue to strengthen its peer review and advisory services and self-assessment tools by incorporating lessons learned from their implementation and to share, as appropriate, the relevant information with Member States, including at a Technical Meeting. In particular, based on the lessons from the first IRRS–ARTEMIS combined mission, guidance will be finalized to support efficient implementation of future IRRS–ARTEMIS combined missions;
- The Agency will continue collecting and analysing lessons from the implementation of the ARTEMIS review service by organizing a feedback workshop in the second half of 2020. Using the outcomes of the feedback workshop on the ARTEMIS review service, a new version of the guidelines and the self-assessment will be made available by the end of 2020;
- The Agency will implement various activities to further increase EPREV's effectiveness: develop streamlined training materials for EPREV; develop an EPREV findings data base to identify trends; continue ongoing work with the WHO and the Pan American Health Organization for coordination between EPREV and the WHO Joint External Evaluation service's module on radiation emergencies; and
- The Agency will further enhance the GSAN to provide Member States with detailed information on safety assessment and design safety programmatic activities, such as peer reviews, workshops, technical meetings and trainings.

A.2. International Safety Conventions

Trends

12. The Convention on Nuclear Safety[3] (CNS) was adopted on 17 June 1994 and entered into force on 24 October 1996. As of December 2019, there were 88 Contracting Parties to the CNS, an increase of 3 compared to the end of 2018.

13. The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (Joint Convention)[4] was adopted on 5 September 1997 and entered into force on 18 June 2001. As of December 2019, there were 82 Contracting Parties to the Joint Convention, an increase of 2 compared to the end of 2018.

Activities

14. At the Agency-facilitated Officers' Turnover Meeting in Vienna in March 2019, the officers of the CNS Seventh Review Meeting shared experience and feedback on the preparation and conduct of the previous Review Meetings with the officers elected for the CNS Eighth Review Meeting. At the Officers' Turnover Meeting, incoming and outgoing officers also discussed the Review Meeting process

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

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

in detail, including key documents, thereby ensuring the transfer of knowledge on the CNS, its processes and the role of the officers. The Agency also organized the CNS Officers' Meeting in September 2019 where the 31 Officers discussed and approved templates to be used in preparation for and during the Eighth Review Meeting.

15. Following a request made by CNS Contracting Parties during the Seventh Review Meeting, multiple educational and promotional workshops were organized to enable the Secretariat to reach out to countries not yet party to the CNS and countries that have signed the CNS but not yet deposited their instrument of accession, as well as newcomer countries and non-nuclear power countries. The Eighth Review Meeting of the Contracting Parties to the CNS will for the first time include two topical sessions on ageing management and safety culture. The aim of such sessions is to focus on knowledge sharing through in-depth discussion of technical and safety issues of mutual interest.

16. In preparation for the Fourth Extraordinary Meeting of Contracting Parties to the Joint Convention, the Agency facilitated two working group meetings of Contracting Parties in Vienna in July and November 2019 at which participants discussed actions to improve the review process and amend Joint Convention guidance documents as appropriate.

17. Nine participants from seven Member States took part in an Agency Workshop to Promote the Convention on Nuclear Safety and the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management in Vienna in August 2019. The Agency held a regional workshop to promote the Joint Convention in Centurion, South Africa, in October 2019, with 21 participants from 18 African Member States.

18. The Agency held two educational workshops for non-nuclear power Contracting Parties to the CNS in Vienna in July 2019: one attended by ten participants from seven member countries of the Regulatory Cooperation Forum (RCF); and one attended by seven participants from seven Member States. The Agency held a third educational workshop in Rabat in July 2019 during which 21 Moroccan representatives from multiple stakeholders enhanced their understanding of the CNS obligations.

Priorities and Related Activities

19. ***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 activity in relation to this priority:***

- The Agency will continue to promote adherence to the CNS and Joint Convention and organize educational workshops at the international, regional and national levels to ensure effective implementation of the Conventions.

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

Trends

20. Information provided by Member States in the Agency's Radiation Safety Information Management System (RASIMS)[5] indicates that 81% of Member States (as compared with 76% the year before) are making good or substantial progress in strengthening their radiation safety regulatory infrastructure (see Figure 3). The 12 Advisory Missions on Regulatory Infrastructure for Radiation Safety (AMRAS) missions undertaken in 2019 showed that there is a need in some Member States for

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

continued technical support for establishing and developing a sustainable regulatory framework for radiation safety.

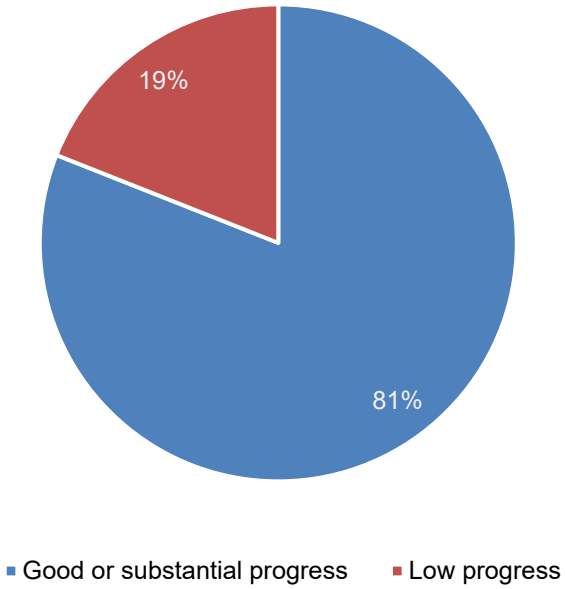

Fig. 3. Status of progress made in establishing a national radiation safety regulatory infrastructure in Member States receiving Agency assistance.

21. The four IRRS follow-up missions undertaken in 2019 highlighted the continued commitment of these Member States to strengthening national legal and governmental infrastructure by completing the IRRS cycle.

22. The Agency noted continued interest among many Member States in updating national emergency preparedness and response (EPR) frameworks, including EPR regulations, and harmonizing arrangements with *Preparedness and Response for a Nuclear or Radiological Emergency* (IAEA Safety Standards Series No. GSR Part 7)[6]. The Emergency Preparedness and Response Information Management System (EPRIMS) helps Member States and the Secretariat learn about the key needs and efforts in this field. Data indicate that 27% of Member States conducted or updated self-assessments against GSR Part 7 during 2019.

23. Outcomes from meetings, as well as the recent report of the International Nuclear Safety Group (INSAG) entitled *Ensuring Robust National Nuclear Safety Systems — Institutional Strength in Depth* (INSAG Series No. 27)[7], continue to highlight a need to further connect the operators, regulators and other stakeholders, facilitate adherence to legal instruments and promote the Agency's safety standards and services through communication as well as information and knowledge sharing mechanisms.

24. The annual number of Occupational Radiation Protection Appraisal Service (ORPAS) missions continues to be high. This indicates a continued need for guidance, training and technical services to strengthen occupational radiation protection.

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[6] INTERNATIONAL ATOMIC ENERGY AGENCY, Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSR Part 7, IAEA, Vienna (2015).

[7] INTERNATIONAL ATOMIC ENERGY AGENCY, Ensuring Robust National Nuclear Safety Systems — Institutional Strength in Depth, INSAG Series No. 27, IAEA, Vienna (2017).

Activities

25. The Agency supported Member States in the establishment, development, implementation and strengthening of regulatory infrastructure for radiation safety in line with *Governmental, Legal and Regulatory Framework for Safety* (IAEA Safety Standards Series No. GSR Part 1 (Rev. 1))[8] through 75 national and 15 regional technical cooperation projects and through the extrabudgetary Regulatory Infrastructure Development Project.

26. The Agency began developing a Safety Report on the licensing process for construction, commissioning and operation of NPPs to support the implementation of the Safety Guide *Licensing Process for Nuclear Installations* (IAEA Safety Standards Series No. SSG-12)[9].

27. The Agency held the International Conference on Effective Nuclear and Radiation Regulatory Systems: Working Together to Enhance Cooperation, in The Hague, Netherlands, in November 2019, with more than 200 participants from 75 Member States and five international organizations. The Conference participants highlighted the need to improve the management of cross-cutting regulatory areas and identified actions for consideration by governments and regulatory bodies.

28. The Agency organized the annual plenary meeting of the RCF in Vienna in September 2019, attended by 70 participants from RCF member countries and other IAEA Member States.

29. The Agency conducted five missions to review the current status of regulatory infrastructure development and to identify RCF support plans to Bangladesh in April, Morocco in July, Nigeria in October, Poland in November, and Belarus in December 2019.

30. The Agency updated the Control of Sources Network portal with new content such as newly developed training packages. The portal was used as a collaboration platform for the preparation and implementation of several regional workshops and training courses.

31. In January 2019, the Agency published a TECDOC entitled *Methodology for the Systematic Assessment of the Regulatory Competence Needs (SARCoN) for Regulatory Bodies of Radiation Facilities and Activities* (IAEA-TECDOC-1860).

32. The Agency held several regional activities to promote the use of the Safety Guides *Organization, Management and Staffing of the Regulatory Body for Safety* (IAEA Safety Standards Series No. GSG-12)[10] and *Functions and Processes of the Regulatory Body for Safety* (IAEA Safety Standards Series No. GSG-13)[11]:

- In June 2019, representatives from 21 Member States attended the Regional (AFRA) Training Course on Competence Management for the Regulatory Body in Abuja;
- In August 2019, representatives from 19 Member States attended the Regional Workshop on the Implementation of the Integrated Management System in ARASIA State Parties in Vienna;

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

[9] INTERNATIONAL ATOMIC ENERGY AGENCY, Licensing Process for Nuclear Installations, IAEA Safety Standards Series No. SSG-12, IAEA, Vienna (2010).

[10] INTERNATIONAL ATOMIC ENERGY AGENCY, Organization, Management and Staffing of the Regulatory Body for Safety, IAEA Safety Standards Series No. GSG-12, IAEA, Vienna (2018).

[11] INTERNATIONAL ATOMIC ENERGY AGENCY, Functions and Processes of the Regulatory Body for Safety, IAEA Safety Standards Series No. GSG-13, IAEA, Vienna (2018).

- In December 2019, representatives from 18 Member States attended the Regional Coordination Meeting in Montevideo.

33. The Agency held six interregional workshops in Vienna in 2019 to assist RASIMS national coordinators in using RASIMS 2.0: one in March, attended by 16 coordinators; two in May, attended by 11 and 9 coordinators, respectively; one in September, attended by 16 coordinators; one in October, attended by 17 coordinators; and one in November, attended by six coordinators. At the end of 2019, 70% of RASIMS national coordinators had been trained to use the new platform.

34. The Agency held two workshops for RASIMS 2.0 Thematic Safety Area 3 (medical exposure) counterparts in Vienna in July and December 2019.

35. The Agency continued to support the Forum of Nuclear Regulatory Bodies in Africa (FNRBA), which was recognized as an inter-governmental organization in Africa. The Agency also continued to support the Arab Network of Nuclear Regulators (ANNuR) to enhance the regulatory infrastructure in the Arab region, inter alia, through a project aimed at strengthening the regulatory supervision of research reactors. The Agency held a regional workshop for FNRBA and ANNuR member countries on review and assessment by the regulatory body in Centurion, South Africa, in October 2019, attended by 25 participants from 4 countries.

36. The Agency continued to support the implementation of the programme on nuclear and radiological safety of the Ibero-American Forum of Radiological and Nuclear Regulatory Agencies (FORO). The Agency participated in two FORO Steering Committee meetings: one in Santiago de Chile in June–July 2019 and one in Recife, Brazil, in December 2019. The Agency also participated in the annual meeting of FORO's Board of Directors in Santiago de Chile in July 2019. Six additional meetings were conducted under the FORO extrabudgetary programme on technical projects for enhancing radiological and nuclear safety in the Ibero-American region.

37. The Agency continued to support the implementation of GSR Part 7 requirements by developing technical guidance and conducting capacity building activities. In cooperation with the European Union (EU), the Agency continued to support non-EU, Mediterranean coastal Member States in harmonizing their EPR arrangements for maritime or at-port nuclear or radiological emergencies.

38. In 2019, the Agency conducted a tabletop exercise on harmonization of the implementation of protective actions in case of a nuclear or radiological emergency with transboundary or transnational consequences.

39. The Agency developed modules for the five thematic areas of the Schools for Drafting Regulations — nuclear safety, radiation safety, transport safety, waste safety, and emergency preparedness and response — and enhanced the Schools' online platform.

40. The Agency held two Regional Schools for Drafting Regulations on Radiation Safety and Nuclear Security in Vienna: one for the African region in January–February 2019, attended by 12 participants from six Member States; and one for the Asia and the Pacific region in July 2019, attended by 14 participants from six Member States. The Agency also held a School for Drafting Regulations for Countries Embarking on a Nuclear Power Programme in Moscow in July 2019 to provide guidance to countries embarking on a nuclear power programme in the preparation of regulations related to the safety of NPPs. Training materials for a School for Drafting Onsite EPR Regulations were developed and tested in a pilot School in Manila in October 2019, with ten participants from four Member States.

Priorities and Related Activities

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

- The Agency will continue assisting RASIMS Coordinators in the transition to the new version of RASIMS, which 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 continue to conduct Schools for Drafting Regulations and develop related training materials; and
- The Agency will organize a Technical Meeting on Next Generation Reactors and Emergency Preparedness and Response: Making Progress in Defining EPR Arrangements to discuss approaches for EPR regulations for new reactors.

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

Trends

42. Agency peer review mission reports continue to include recommendations relating to leadership and management for safety and safety culture.

43. An increasing number of Member States are requesting assistance, for example Agency workshops on management systems, in developing their programmes on leadership and management for safety, as well as for conducting safety culture self-assessments for regulatory bodies.

44. 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 practice to discuss and share experiences.

Activities

45. The Agency is developing training material to improve radiation safety culture in medicine to support safer uses of radiation in medical applications. The course material includes case studies, questions concerning ten different safety traits and a digital presentation provided by participants in an Agency-organized international competition “Towards a Strong Radiation Safety Culture in Medicine” in 2019.

46. The Agency held a regional workshop on the establishment of an integrated management system in regulatory bodies based on Agency safety standards in Jakarta in July 2019, attended by 17 participants from 8 Member States in the Asia and the Pacific region.

47. The Agency held a Technical Meeting on strengthening leadership and management for the safety of nuclear facilities and regulatory bodies in Vienna in August 2019, attended by 50 participants from 17 Member States.

48. The Agency launched LeaD — a nuclear leadership development web-based tool. The tool presents general themes dealing with nuclear leadership and provides assistance in developing leadership programmes. The first Agency expert mission using this tool to help in implementing a leadership programme in an organization took place in June 2019. The tool was developed in cooperation with the World Association of Nuclear Operators (WANO).

49. The Agency started to develop a Safety Guide on leadership and management for safety to provide more detailed guidance for the Safety Requirements *Leadership and Management for Safety* (IAEA Safety Standards Series No. GSR Part 2)[12].

50. The Agency held four Schools of Nuclear and Radiological Leadership for Safety in Brazil, Morocco, Pakistan and Turkey. The Agency also trained seven new experts on the School methodology and developed two new case studies for the School.

51. The Agency launched the Nuclear Communicator's Toolbox[13] in September 2019. The Toolbox aims at supporting effective communication on the benefits and risks associated with the use of nuclear technologies. It is intended for a variety of nuclear programmes and nuclear activities, including the use of radioactive sources in medicine or industry as well as more complex nuclear fuel cycle activities.

52. The Agency held a Technical Meeting on Stakeholder Involvement and Communication for New and Expanding Nuclear Power Programmes in Vienna in June 2019, attended by 47 participants from 29 Member States and one international organization. The meeting included a session on regulatory authority experience regarding engaging and communicating with interested parties.

53. The Agency developed material for a training package to complement *Communication and Consultation with Interested Parties by the Regulatory Body* (IAEA Safety Standards Series No. GSG-6)[14] and held two regional workshops on this topic: one for the Africa region in Addis Ababa in April 2019, attended by 43 participants from 25 countries; and one for the Asia and the Pacific region in Daejeon, Republic of Korea, in July 2019, attended by 19 participants from 11 countries.

54. The Agency held a Regional Meeting for Central Governments and Regulatory Bodies on the Development of Communication Strategy in Manila in December 2019.

55. In May 2019, the CSS approved for publication the Safety Guide *Arrangements for Public Communication in Preparedness and Response for a Nuclear or Radiological Emergency* (Safety Standards Series No. GSG-14).

Priorities and Related Activities

56. ***The Agency will assist Member States in strengthening leadership and management 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 continue organizing workshops on communication and consultation with interested parties by the regulatory body;
- The Agency will finalize a TECDOC on safety culture practices for the regulatory body;
- The Agency will continue to offer workshops and training in leadership, management and culture for safety for Member States. It will continue its work on continuously improving

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

[13] https://www.iaea.org/resources/nuclear-communicators-toolbox

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

safety culture and self-assessment of safety culture for regulatory bodies and nuclear facilities and activities;

- The Agency will encourage Member States to host Safety Culture Continuous Improvement Process (SCCIP) training workshops to build the capacity to conduct safety culture self-assessments and to strengthen safety culture;
- The Agency will encourage all Members States to contribute to the development of a Safety Guide on leadership and management for safety; and
- The Agency will continue to organize workshops and Technical Meetings to support Member States in sharing good practices in communication.

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

Trends

57. Information provided by Member States to the Steering Committee on Education and Training in Radiation, Transport and Waste Safety shows that Member States continue to make progress towards the establishment of national strategies on education and training in radiation, transport and waste safety. Member States have revised and strengthened the legal and regulatory framework for education and training in radiation protection and safety (with a particular view on the provisions for education, training, qualification and competence of personnel with responsibilities in radiation protection and safety, i.e. radiation protection officers (RPOs) and qualified experts (QEs)); analysed the training needs; and expanded the training programmes to address the training needs. Member States continue to express a need for Agency support in the establishment and development of national strategies on education and training in line with *A Methodology for Establishing a National Strategy on Education and Training in Radiation, Transport and Waste Safety* (Safety Reports Series No. 93)[15].

58. The Postgraduate Educational Course (PGEC) in Radiation Protection and the Safety of Radiation Sources[16] continued to be an effective programme to address Member States' needs to train personnel with regulatory or advisory functions. An analysis of the impact[17] of the PGEC, based on a detailed survey of participants over 35 years, indicated that the course significantly and positively influenced participants' professional development and the radiation safety infrastructure in their countries (see Figure 4).

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[15] INTERNATIONAL ATOMIC ENERGY AGENCY, A Methodology for Establishing a National Strategy on Education and Training in Radiation, Transport and Waste Safety, Safety Reports Series No. 93, IAEA, Vienna (2018).

[16] INTERNATIONAL ATOMIC ENERGY AGENCY, Postgraduate Educational Course in Radiation Protection and the Safety of Radiation Sources: Standard Syllabus, Training Course Series No. 18 (Rev. 1), IAEA, Vienna (2019).

[17] INTERNATIONAL ATOMIC ENERGY AGENCY, Impact of the IAEA Postgraduate Educational Course in Radiation Protection and the Safety of Radiation Sources (1981–2015), IAEA-TECDOC-1882, IAEA, Vienna (2019).

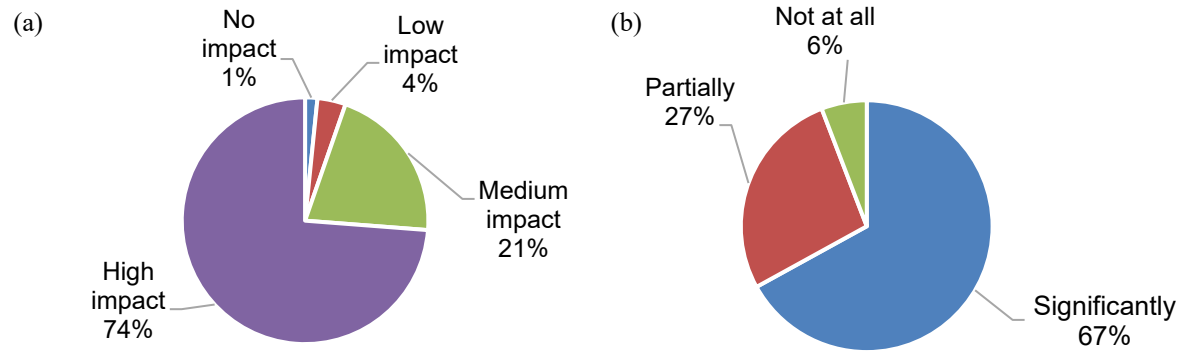

Fig. 4. Percentage of participants stating that the PGEC had a positive impact on: (a) their professional development (survey conducted more than five years after completion of the course); (b) their job performance (survey conducted one year after completion of the course).

59. Due to high demand in all regions, the number of train-the-trainers events for RPOs, which are now offered in Arabic, English, French, Russian and Spanish, and the number of participants continued increasing compared to the previous years: 133 participants attended seven such events in 2019. The 114 participants at six such events in 2018 had already represented a considerable increase regarding the previous years.

60. There was increased interest in online and web-based training on radiation protection, including radiation protection in medical uses of ionizing radiation, occupational radiation protection and radon.

61. There was an increase in the number of requests for 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 from Member States with existing nuclear installations and those considering embarking on nuclear power programmes. There was also an increase in the number of requests for support for training on safety assessment computational tools, probabilistic safety assessment, severe accident management guidelines, drafting regulations, inspector training, and senior managers leadership and culture for safety from Member States embarking on new nuclear power programmes.

62. 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 competence to perform its regulatory functions effectively.

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

64. The number of Member States that expressed interest in cooperation to strengthen EPR capacity building activities has grown. For example, the number of Member States that attended relevant workshops more than doubled in 2019 in comparison to 2018.

65. Member States continue to express a need for support in developing or strengthening their national and organizational knowledge management programmes for nuclear safety, in developing or strengthening national capacity building programmes, and in developing or strengthening technical and scientific capacity including technical and scientific support organizations (TSOs).

Activities

66. The Agency held a joint course with the International Centre for Theoretical Physics (ICTP) on scientific novelties in the phenomenology of severe accidents in Trieste, Italy, in June 2019, attended

by 22 experts from 16 countries. The course covered a range of topics directly related to physical, chemical and radiological phenomena specific to the progression of severe accidents in water cooled reactors, including current trends and recent developments.

67. The Agency held a Workshop on Advanced Probabilistic Safety Assessment (PSA) Approaches and Applications in Petten, Netherlands, in September 2019, attended by 35 experts from 21 countries. PSA practitioners exchanged information on current challenges in the application of advanced PSA approaches and discussed the path forward.

68. The Agency continued implementing the Strategic Approach to Education and Training in Nuclear Safety 2013–2020 and organized events in all of its four components: national strategies, capacity building mechanisms, regional knowledge networks, and knowledge management. The Agency continued its efforts in developing progress indicators and a methodology for assessing the status of implementation of the Approach. The set of indicators has been identified and an assessment methodology created. A trial of the progress indicators and the methodology by a limited number of Member States was successful.

69. The Agency together with the members of the Steering Committee on Regulatory Capacity Building and Knowledge Management reviewed achievements and events in education and training in nuclear safety over the period 2013–2020 and started developing a Strategic Approach to Building and Sustaining Capacity in Nuclear Safety for the period beyond 2020. The Approach will build on the refocused areas of human resource development, education and training, knowledge management, and knowledge networks. It aims to strengthen the Agency's support for building and sustaining capacity in Member States in the area of nuclear safety.

70. The Agency co-organized an industry workshop on human capital in Paris in May 2019 in collaboration with WANO and the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development (OECD/NEA).

71. The Agency developed, through coordination between the Department of Technical Cooperation and the Department of Nuclear Safety and Security, a Consolidated Plan for Safety process to streamline the Agency's assistance in radiation, nuclear, waste and transport safety, and emergency preparedness and response. During the first phase, 12 national plans are being developed.

72. The Agency developed a standardized approach to the delivery of Systematic Assessment of Regulatory Competence Needs (SARCoN): first, an introductory training package to SARCoN is provided to enable managers to clearly understand the principles and importance of competence management; this is followed by a training package that focuses on practical training in the SARCoN methodology and IT tool to enhance the knowledge and skills necessary for adopting and using SARCoN within the organization; and finally, an expert mission on SARCoN is carried out to review and assess the competence management system of the host organization.

73. Five PGECs in Radiation Protection and the Safety of Radiation Sources were conducted in English, French and Spanish at Agency-affiliated regional training centres in Africa, Asia, Europe, and Latin America and the Caribbean. The Agency held three train-the-trainers workshops for radiation protection officers in 2019: in Lebanon in March (in Arabic and English); in Peru in June (in Spanish); and in Estonia in October (in English and Russian).

74. A total of 48 regional and national training courses and workshops on radiation protection of patients, attended by 1450 participants, were organized under regional and national technical cooperation projects.

75. The Agency organized a Joint ICTP–IAEA Workshop on Establishment and Utilization of Diagnostic Reference Levels in Medical Imaging in Trieste, Italy, in November 2019.

76. The Agency's e-learning courses on the Radiation Protection of Patients website had 3330 new registrations during 2019. Two courses were also provided in Spanish. Four new e-learning courses are under development.

77. The Agency conducted three Education and Training Appraisal (EduTA) missions to assess education and training in radiation safety, in Zambia in May 2019, Kenya in June 2019, and Indonesia in November 2019.

78. Expert missions to provide guidance and support to strengthen regulatory requirements for education and training in radiation protection and safety (particularly for RPOs and QEs), and to support the establishment of national strategies for education and training in radiation, transport and waste safety, were conducted in 2019: in Morocco in April and October; in Myanmar in August; in Uruguay, Costa Rica and El Salvador in September; and in Chile in December.

79. A regional workshop was conducted in Mexico City in November 2019 on the progress made to establish national strategies for education and training in radiation, transport and waste safety.

80. The Agency conducted ten webinars on specialized topics in radiation protection in medicine in 2019, including one in cooperation with the European Society of Radiology and five with the International Organization for Medical Physics. Webinars were delivered in English, Russian and Spanish with 1500 participants from 100 countries.

81. The Agency held over 20 events in the framework of the Asian Nuclear Safety Network (ANSN), including two Steering Committee meetings in Vienna in June 2019 and in Singapore in November 2019, and a regional workshop on legal and regulatory frameworks for safety and regulatory independence in Manila in March 2019, attended by 15 participants from four ANSN member countries. The first ANSN technical report on self-assessment is under development.

82. The Agency organized the fourth Steering Committee meeting of the European and Central Asian Safety Network (EuCAS) in Vienna in May 2019. The Agency also held three regional events in the framework of EuCAS in 2019: one on the importance of information exchange with neighbouring countries in the event of a nuclear or radiological emergency, in Athens in September; one on identifying specific priority themes on education and training, in Moscow in October; and one on regulatory supervision of legacy sites and wastes from recognition to resolution, in Tromsø, Norway, in October-November.

83. At the Workshop on Capacity Building Centres on Emergency Preparedness and Response, which was conducted in Vienna in July 2019 and attended by 68 participants from 53 Member States, the Agency launched the International Network on Education and Training in Emergency Preparedness and Response (iNET-EPR). This network will support national and regional EPR capacity building activities and promote cooperation among interested entities at national and regional levels, including sharing of training materials and experience and the development of curricula for postgraduate courses in EPR.

84. The Agency continued to organize activities to provide guidance and support to universities in the development of education programmes in nuclear safety and security. Regional and national activities were implemented in Greece, Malaysia, Morocco and Tunisia to further develop the curriculum of a master's degree on nuclear safety and security.

85. The Agency finalized two TECDOCs to assist Member States in capacity building self-assessment and knowledge management for nuclear safety.

86. The Agency continued to develop a training course on regulatory control of NPPs as well as the Basic Professional Training Course on Nuclear Safety to an interactive e-learning format to enable individual study and support capacity building in Member States with enhanced flexibility and cost effectiveness.

Priorities and Related Activities

87. ***The Agency will assist Member States in their capacity building programmes, including education and training in nuclear, radiation, transport and waste safety as well as EPR, and will 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 continue to offer the PGEC in collaboration with the regional training centres affiliated to the Agency and organize train-the-trainers for RPOs; 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 and services such as EduTA. The Agency will also provide Member States with guidance and support to strengthen regulatory requirements for education, training, qualification and competence for all persons engaged in activities relevant to protection and safety, including RPOs and QEs;
- The Agency will continue implementing the Strategic Approach to Education and Training in Nuclear Safety 2013–2020, and will further develop and finalize progress indicators and a methodology for assessing the status of its implementation;
- The Agency together with the members of the Steering Committee on Regulatory Capacity Building and Knowledge Management will continue the development of a Strategic Approach to Building and Sustaining Capacity in Nuclear Safety for the period beyond 2020;
- The Agency will continue to support regional networks, such as ANNuR, ANSN, EuCAS and FNRBA, the initiatives of the TSO Forum, and associations, such as FORO, in the development and implementation of the joint programme of work;
- The Agency will continue enhancing education and training programmes and implementing capacity building activities in the areas of nuclear installation safety assessment and design safety; and
- The Agency will organize the first annual meeting of the iNET-EPR platform to discuss initiatives and share experiences, analyse the development of postgraduate EPR courses and enable knowledge networking.

A.6. Research and Development for Safety

Trends

88. Much of the recent research and development work undertaken in Member States has focused on severe accident phenomena and novel design features, such as design extension conditions, to ensure the practical elimination of consequences of accidents should an accident occur. This work is equally applicable to the safety demonstration for new and existing nuclear installations.

89. An increasing interest in research related to EPR is demonstrated by an ongoing coordinated research project (CRP) and two new CRPs: one relating to dose projections launched in 2019; and another one relating to public communication for EPR to be launched in 2020.

Activities

90. The Agency initiated a CRP on Developing a Phenomena Identification and Ranking Table (PIRT) and a Validation Matrix, and Performing a Benchmark for In-Vessel Melt Retention.

91. The Agency continued to develop detailed TECDOCs on advanced NPP designs, addressing design extension condition analysis, application of general requirements for the design of NPPs, equipment qualification for severe accident conditions and other topics.

92. The Agency held a Technical Meeting on Modelling of Fuel Behaviour in Design Basis Accidents and Design Extension Conditions in Shenzhen, China, in May 2019, attended by 31 experts from 14 Member States. The main results of the CRPs on Fuel Modelling in Accident Conditions (FUMAC) and on Analysis of Options and Experimental Examination of Fuels for Water Cooled Reactors with Increased Accident Tolerance (ACTOF) were presented and participants discussed the proposal of a new CRP on Testing and Simulation of Advanced Technology Fuels (ATF-TS) planned for 2020–2023.

93. The Agency continued its activities within the CRP on Development of Approaches, Methodologies and Criteria for Determining the Technical Basis for Emergency Planning Zone for Small Modular Reactor Deployment, which will form the basis for the planned Technical Meeting on the subject. At the 2nd Research Coordination Meeting of this CRP, which took place in Beijing in May 2019, participating entities shared the developments achieved in their research.

94. The Agency launched a new CRP on Effective Use of Dose Projection Tools in the Preparedness and Response to Nuclear and Radiological Emergencies, and approved another CRP on Emergency Public Communication in a Misinformation Environment to be launched in 2020.

95. The First Research Coordination Meeting on Fuel Materials for Fast Reactors was held in Vienna in October 2019. The ten participants from six countries and one international organization provided overviews of their planned research programmes, and discussed and agreed on a coordinated approach of their efforts for the first step of the CRP.

96. The Agency held the Eighth Joint IAEA–GIF Technical Meeting/Workshop on the Safety of Liquid Metal Cooled Fast Reactors in Vienna in March 2019. Participants discussed the development of the draft Generation IV International Forum (GIF) report provisionally entitled *Safety Design Guidelines on Key Structures, Systems and Components* as well as the development of the Safety Design Criteria and Safety Design Guidelines for lead and lead–bismuth cooled fast reactors.

Priorities and Related Activities

97. ***The Agency will assist 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 carry out the CRP on Developing a Phenomena Identification and Ranking Table (PIRT) and a Validation Matrix, and Performing a Benchmark for In-Vessel Melt Retention;
- The Agency will continue to organize meetings and conduct activities to encourage research and development based on identified needs, including on advanced approaches in safety assessment, analysis of design extension conditions, new design features, and equipment qualification in severe accident conditions;
- The Agency will continue to carry out research and development activities in support of the safety of advanced/innovative reactors;
- The Agency will initiate a study on the applicability of the Agency's safety standards to accident tolerant fuels;
- The Agency will finalize and publish the Final Reports of the CRPs on Fuel Modelling in Accident Conditions (FUMAC) and on Analysis of Options and Experimental Examination of Fuels for Water Cooled Reactors with Increased Accident Tolerance (ACTOF);

- The Agency will summarize the results of the CRP on Development of Approaches, Methodologies and Criteria for Determining the Technical Basis for Emergency Planning Zone for Small Modular Reactor Deployment in a CRP report; and
- The Agency will hold the first Research Coordination Meeting of the CRP on Effective Use of Dose Projection Tools in the Preparedness and Response to Nuclear and Radiological Emergencies, and the first Research Coordination Meeting of the CRP on Emergency Public Communication in a Misinformation Environment.

B. Strengthening Radiation, Transport and Waste Safety

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

Trends

98. There is an increasing awareness among Member States of the need to protect workers in industries involving naturally occurring radioactive material (NORM), and to apply a graded approach to the use of regulators' and operators' resources for management of worker protection, in line with the International Basic Safety Standards (IAEA Safety Standards Series No. GSR Part 3).[18] Many Member States have already established regulatory requirements or are in the process of establishing such requirements for the safe management of NORM as planned or existing exposure situations which require prior radiological characterization for realistic dose assessment.

99. Requests for Agency missions and workshops indicate a growing awareness among Member States of the effects of exposure to radon in homes and workplaces, as well as radiation doses from the consumption of food and drinking water in non-emergency situations.

100. New and advanced cancer control applications, including radiotherapy technology and procedures, are increasingly used for treatment of cancer in countries and regions that have previously had only limited access to such applications.

101. Improved access to and increasing use of diagnostic imaging procedures utilizing ionizing radiation are creating a need for greater awareness of the importance of justification of medical exposure, optimization of radiation protection, and safety of associated exposures to protect patients from risks related to ionizing radiation.

Activities

102. In cooperation with the Conference of Radiation Control Program Directors, the European Radon Association and the WHO, the Agency organized five webinars on reducing exposure to radon, attended by 717 participants from 71 Member States. In total during 2018–2019, eleven webinars were carried out, reaching almost 1500 live participants from 71 Member States. The Agency also held 15 workshops and training events on radon and published a Safety Report *Design and Conduct of Indoor Radon Surveys*[19].

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[18] INTERNATIONAL ATOMIC ENERGY AGENCY, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards, IAEA Safety Standards Series No. GSR Part 3, IAEA, Vienna (2014).

[19] INTERNATIONAL ATOMIC ENERGY AGENCY, Design and Conduct of Indoor Radon Surveys, Safety Reports Series No. 98, IAEA, Vienna (2019).

103. The Agency held a Technical Meeting on the Implications of the New Dose Conversion Factors for Radon in Vienna in October 2019 to discuss recent International Commission on Radiological Protection (ICRP) and United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) documents on exposure to radon and to consider if the recommendations from the two organizations should be incorporated into the Agency's safety standards. Participants concluded that no changes are needed in the International Basic Safety Standards (GSR Part 3) and recommended that the Agency and the organizations cosponsoring GSR Part 3 develop a position paper on the use of dose conversion factors for radiation protection.

104. The Agency held a consultancy meeting in Vienna in March 2019 to begin development of a Safety Report on the implications of the 2012 UNSCEAR report on attributability. The Safety Report will provide practical guidance on the application of the concept of attributability of health effects to radiation exposure and inference of risks with regard to the facilities and activities covered by the Agency's safety standards.

105. The Agency continued to develop a Safety Report provisionally entitled *Assessment of the Impact of Radioactive Discharges to the Environment* that will supersede the Safety Report *Generic Models for Use in Assessing the Impact of Discharges of Radioactive Substances to the Environment*[20]. The new Safety Report will include a methodology for assessing radiological impacts to animals and plants.

106. The Agency held a Technical Meeting on Radiation Exposure of Patients from Recurrent Radiological Imaging Procedures in Vienna in March 2019, attended by 53 experts from 26 Member States and nine international organizations. Participants agreed on several steps that can be taken to improve protection of patients and requested the Agency to coordinate further studies and hold a follow-up Technical Meeting in 2020.

107. The Agency held a Technical Meeting on Experience and Results in Implementing the Safety in Radiation Oncology Reporting and Learning System (SAFRON) in Vienna in September–October 2019, attended by 18 participants from 14 Member States and four international organizations. SAFRON users provided feedback and recommendations for improvements to the system. A SAFRON module for training of health professionals unfamiliar with safety reporting and learning was released.

108. The Agency concluded a review of individual doses from natural and artificial radionuclides in the total diet. The analysis of data from 45 countries published in the scientific literature indicates that, in general, individual doses from the diet are well below 0.5 mSv in a year and are dominated by the contribution from natural radionuclides. The review also noted that several different approaches are used by Member States to undertake dietary dose assessments.

109. The Agency organized the third meeting of the Steering Group for the project on developing guidance on radioactivity in food and drinking water in non-emergency situations in Vienna in September 2019. The Group prioritized the future activities, including the development of a technical report on the assessment of radiation doses from natural radionuclides in food.

110. Safe management of NORM was discussed during the Ninth International Symposium on Naturally Occurring Radioactive Material (NORM IX), organized in Denver, United States of America, in September 2019.

Priorities and Related Activities

111. ***The Agency will assist Member States in the application of the Agency's safety standards, in particular the International Basic Safety Standards (GSR Part 3), in radiation protection of the people***

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[20] INTERNATIONAL ATOMIC ENERGY AGENCY, Generic Models for Use in Assessing the Impact of Discharges of Radioactive Substances to the Environment, Safety Reports Series No. 19, IAEA, Vienna (2001).

and the environment for applications such as energy production, research, and medical and industrial uses of radionuclides. The Agency will undertake the following activities in relation to this priority:

- The Agency will produce guidance material, hold webinars and, upon request, national and regional workshops to support Member States in identifying situations involving exposure to high radon concentrations in homes and workplaces and in taking action to reduce exposures;
- The Agency will continue to support Member States, through capacity building activities and the development of guidance, in radiation protection and safety of patients and staff in medical uses of radiation;
- The Agency will continue to consult with Member States and the relevant international organizations on the development of guidance on the management of radionuclides in food and drinking water in non-emergency situations;
- The Agency will continue to support Member States in the field of occupational radiation protection;
- The Agency will continue to develop guidance on radiation protection in NORM industries; and
- The Agency will continue to support Member States in assessing the radiological impact to the public and the environment of radionuclide discharges.

B.2. Control of Radiation Sources

Trends

112. The increased use of sealed radioactive sources in medicine, industry, agriculture and research has resulted in a growing need to have appropriate arrangements for the control of sources and the safe management of disused sealed radioactive sources, including the building of national disposal facilities.[21]

113. Member State support for the Code of Conduct on the Safety and Security of Radioactive Sources continues to grow. In 2019, three further Member States made a political commitment to implementing the Code, bringing the total number to 140. Eight 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 number that have done so to 122. Two Member States nominated points of contact for facilitating the export and import of radioactive sources, bringing the total that have done so to 145, and 24 Member States made a political commitment to implementing the supplementary Guidance on the Management of Disused Radioactive Sources, bringing the total that have done so to 33 (Figure 5).

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

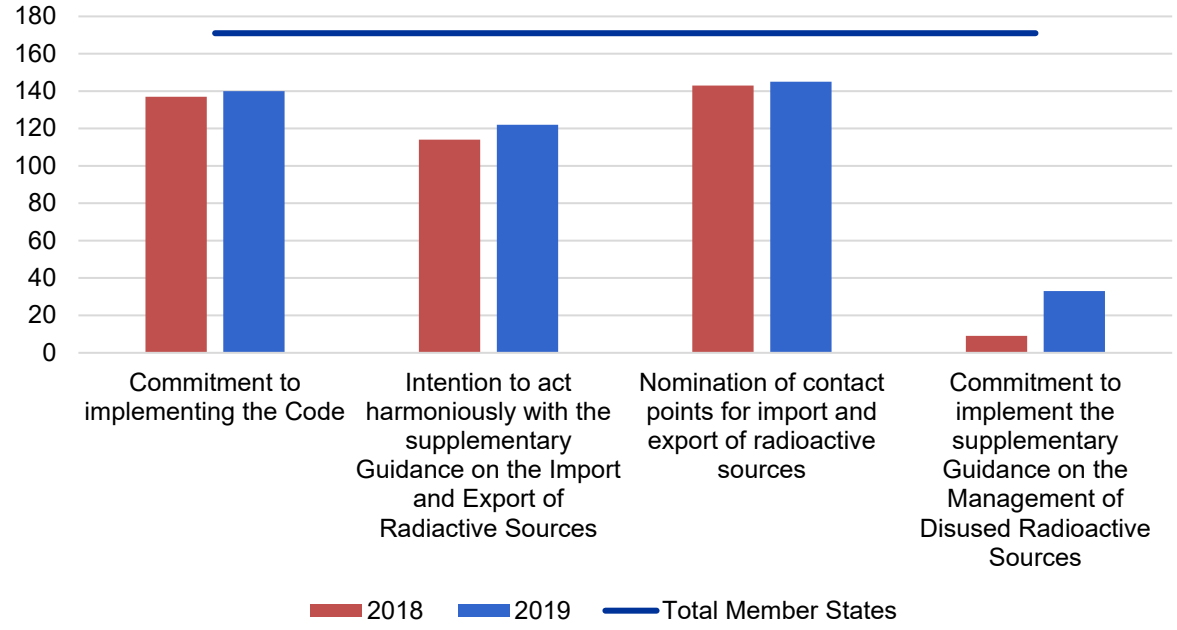

Fig. 5. Member State support for the Code of Conduct on the Safety and Security of Radioactive Sources and its supplementary Guidance documents.

Activities

114. The Agency promoted the Code of Conduct and supplementary Guidance documents and assisted Member States' efforts to build capacity to implement their provisions, including through the collection and dissemination of implementation practice papers.

115. The Agency held an Open-ended Meeting of Technical and Legal Experts to Share Information on States' Implementation of the Code of Conduct on the Safety and Security of Radioactive Sources and its Supplementary Guidance in Vienna in May 2019, attended by 191 participants from 102 Member States. Participants discussed, inter alia, transboundary movement of radioactive material inadvertently incorporated into scrap metal and semi-finished products of the metal recycling industries.

116. The Agency provided the Regulatory Authority Information System (RAIS) software and associated hardware to the Bahamas, Barbados, Belize, Curaçao, Guyana, Mozambique, Palestine, the Philippines, Qatar, and Saint Vincent and the Grenadines. It also provided training in the use and customization of the national register of sources to assist Member States in managing their regulatory control programmes.

117. The Agency conducted 14 expert missions that provided support and training for the use of RAIS 3.4 web. The Agency held two regional training courses on establishing a national registry of radiation sources using RAIS in 2019: one for the Latin America and the Caribbean region in San Salvador in April, attended by 14 participants from 4 Member States; and one for the Africa region in Rabat in November, attended by 27 participants from 11 Member States.

118. The Agency developed an interactive toolkit and e-learning module to facilitate the sharing of information on metal recycling for potential stakeholder groups in regulatory bodies, metal recycling industries and the radiation protection community.

Priorities and Related Activities

119. ***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 the Import and Export of Radioactive Sources and Guidance 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 continue to promote the Code of Conduct and supplementary Guidance documents and assist Member States in building capacity to implement their provisions, including by organizing meetings and identifying lessons learned from the implementation practice papers and reports from Member States;
- The Agency will continue to encourage States to express political commitment to 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;
- The Agency will continue to organize workshops for the establishment of national registers of sources and search for orphan sources; and
- The Agency will continue the development of RAIS+ to further support Member States in managing their regulatory processes and will continue to provide support and training for the use of RAIS 3.4 web as required.

B.3. Safe Transport of Radioactive Material

Trends

120. The increased use of radioactive material in Member States is creating a growing need for regulatory oversight, including for domestic and international transport.

121. Some Member States are increasingly interested in the construction and deployment of transportable nuclear power plants (TNPPs). One vessel for such a TNPP has completed manufacture, with its two reactors operational and connected to the grid in December 2019, and one Member State has declared its intent to manufacture a similar vessel in the near future.

Activities

122. The CSS endorsed revised drafts of *Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (2012 Edition)* (IAEA Safety Standards Series No. SSG-26)[22] and *Schedules of Provisions of the IAEA Regulations for the Safe Transport of Radioactive Material (2012 Edition)* (IAEA Safety Standards Series No. SSG-33)[23] for submission for publication.

123. The Transport Safety Standards Committee approved a new Safety Guide entitled *Format and Content of the Package Design Safety Report for the Transport of Radioactive Material* (DS493) for submission to the CSS.

124. In February 2019, the Agency launched phase 1 of the e-learning platform on *Regulations for the Safe Transport of Radioactive Material: 2012 Edition* (IAEA Safety Standards Series No. SSR-6).[24] Phase 2, which was developed for regulatory bodies, was launched in May 2019 and includes guidance

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[22] 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).

[23] 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 (2010).

[24] INTERNATIONAL ATOMIC ENERGY AGENCY, Regulations for the Safe Transport of Radioactive Material: 2012 Edition, IAEA Safety Standards Series No. SSR-6, IAEA, Vienna (2012).

on implementing the General Safety Requirements contained in *Governmental, Legal and Regulatory Framework for Safety* (IAEA Safety Standards Series No. GSR Part 1 (Rev. 1)) and the SSR-6 requirements.

125. The Secretariat established an inter-Departmental Coordination Group on Small and Medium Sized or Modular Reactors (SMRs) to enhance the coordination of Agency's activities on SMRs. This Group also addressed TNPPs. The Secretariat held an informal technical briefing in August 2019 to inform Member States on the Agency's activities related to TNPPs.

Priorities and Related Activities

126. ***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 update the e-learning platform to reflect the SSR-6 (Rev. 1)[25] requirements in preparation for the adoption of SSR-6 (Rev. 1) into the International Maritime Dangerous Goods Code in 2020 and into the International Civil Aviation Organization's Technical Instructions for the Safe Transport of Dangerous Goods by Air in 2021. In addition, the Agency will translate the e-learning platform into other languages; and
- The Agency will hold an International Conference on the Safe Transport of Radioactive Material in Vienna in June–July 2020 to support Member States in Africa, Latin America and the Caribbean, Asia and the Pacific, and the Mediterranean regions in developing their transport safety infrastructure.

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

Trends

127. ARTEMIS continues to increase in popularity and the Agency has received 18 requests for ARTEMIS reviews to be carried out between 2020 and 2023.

128. Significant global growth in the number of nuclear decommissioning projects has increased the need for related education and training programmes. Member States have requested, inter alia, that the Agency develop training materials on specific aspects of decommissioning of facilities.

129. Member States continue to seek the Agency's assistance in developing and implementing safe long term management solutions for radioactive waste, including on the siting of radioactive waste management facilities.

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

131. Several Member States are increasingly interested in geological disposal of high level radioactive waste and spent fuel when considered as waste. Licensing activities for geological disposal facilities are progressing in some Member States. Moreover, in July 2019 the Chair of INSAG in his annual letter to the Director General urged action by policymakers in Member States on "the need to deal permanently with the accumulation of spent fuel and high level radioactive waste".

132. The Agency made progress in the development of a borehole disposal system for disused sealed radioactive sources. Several Member States worked to develop borehole disposal techniques, regulatory and infrastructure support systems, hardware and equipment, and processes and procedures. Many other

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[25] INTERNATIONAL ATOMIC ENERGY AGENCY, Regulations for the Safe Transport of Radioactive Material: 2018 Edition, IAEA Safety Standards Series No. SSR-6 (Rev. 1), IAEA, Vienna (2018).

Member States are interested in exploring the concept, for example as expressed through their proposals submitted to the CRP to develop a framework for the borehole disposal of disused sealed radioactive sources and small quantities of low and intermediate level waste.

133. During the Sixth Review Meeting of the Contracting Parties to the Joint Convention, an increasing number of Member States reported ongoing measures to retain and acquire the appropriate human resources within their regulatory bodies as staff retire or leave the industry. There was also an increase in reporting of actions to preserve institutional knowledge and to attract new talent into the industry.

Activities

134. In 2019, the Agency carried out three ARTEMIS missions to Estonia in March; Germany in September; and Latvia in December. In January 2019, the Agency held a training course in Vienna for ten experts from ten countries taking part in ARTEMIS missions. In March 2019, the Agency held a feedback workshop in Vienna during which 66 participants from 38 Member States shared experiences of the ARTEMIS review service, and identified needs to develop the service further.

135. The Agency completed the revision of the Basic Training Course on the Safe Decommissioning of Facilities. The training materials were tested by 16 professionals from two Member States during the Training Event on the Safe Decommissioning of Facilities held in Athens in May 2019.

136. The Agency finalized the development of the Specialized Training Module on Regulatory Control of the Decommissioning of Facilities. The training material was tested at the Training Event on Regulatory Control for the Decommissioning of Facilities, held in Vilnius in May 2019, attended by 26 professionals from three Member States.

137. The Agency launched the Spent Fuel and Radioactive Waste Information System (SRIS) to support Member States in meeting national and international (Joint Convention and EU directive) reporting requirements. The system was developed in cooperation with the OECD/NEA and the European Commission and tested by 18 representatives of 17 Member States during a Technical Meeting on the Spent Fuel and Radioactive Waste Information System held in Vienna in June 2019.

138. The Agency continues to provide assistance to Member States in the development and implementation of borehole disposal facilities for disused sealed radioactive sources. The Agency launched a CRP to develop a framework for the borehole disposal of disused sealed radioactive sources and small quantities of low and intermediate level waste. The CRP is supported by 16 organizations from 11 Member States.

139. Member States with little experience in regulating the management of residues containing NORM, from industries such as oil and gas and rare earth processing, have expressed a need for Agency support in establishing regulatory and safety infrastructure for NORM residues management. The draft Safety Guide *Management of Residues Containing Naturally Occurring Radioactive Material from Uranium Production and Other Activities* (DS459), which has been approved for publication by the CSS, will assist Member States to establish such an infrastructure.

140. The Secretariat continued to maintain a range of international projects for waste and decommissioning safety, namely for the International Project on Demonstration of the Operational and Long-Term Safety of Geological Disposal Facilities for Radioactive Waste (GEOSAF Part III), the International Harmonization and Safety Demonstration Project for Predisposal Radioactive Waste Management (ECLiPSE), the Forum on the Safety of Near Surface Disposal, the International Project on Completion of Decommissioning (COMDEC), the International Project on Decommissioning of Small Facilities (MIRDEC) and the Regulatory Forum for Safety of Uranium Production and NORM (REGSUN).

Priorities and Related Activities

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

- The Agency will start developing a Safety Guide on policy and strategy for radioactive waste management, and finalize the drafting of a new Safety Guide on application of the concept of clearance developed in connection the revision of the Safety Guide RS-G-1.7[26];
- The Agency will complete the development of specialized training modules on safety of decommissioning;
- The Agency will continue international projects related to decommissioning, radioactive waste management, management of disused radioactive sources and environmental remediation; and
- The Agency will continue to promote the exchange of experience on the implementation of decommissioning strategies and plans.

B.5. Radiation Protection of the Environment and Remediation

Trends

142. As observed during Agency missions, the use of a wide range of nuclear techniques and applications worldwide has resulted in a growing need to analyse and evaluate the radiological implications of radionuclides being released to the environment.

143. There is growing interest in methodologies for the prospective and retrospective assessment of doses to members of the public and non-human biota in relation to the authorization and establishment of discharge limits for facilities and activities. Member States use source and environmental radiological monitoring programmes to complement such assessments and to demonstrate compliance with protection criteria. The number of Member States participating in the programme on Modelling and Data for Radiological Impact Assessment (MODARIA II) continues to increase, from 58 Member States at the end of 2018 to 61 at the end of 2019.

144. There is also growing interest in the assessment of past unregulated practices and accidents, and the control of their impact. Member States continue to request Agency assistance in remediation activities, particularly the remediation of legacy sites from past uranium production and other nuclear-related activities.

Activities

145. In October 2019, the Waste Safety Standards Committee approved the draft Safety Guide entitled *Remediation and Process for Areas Affected by Past Activities or Events* (DS468) for submission to the CSS.

146. The annual Technical Meeting of the Coordination Group for Uranium Legacy Sites (CGULS) was held in Issyk-Kul, Kyrgyzstan, in June 2019, with 36 participants from 10 Member States and 4 international organizations. A peer review of the environmental impact assessment for environmental remediation of the uranium legacy complex at Mailuu Suu, Kyrgyzstan, was conducted in September

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[26] INTERNATIONAL ATOMIC ENERGY AGENCY, Application of the Concepts of Exclusion, Exemption and Clearance, IAEA Safety Standards Series No. RS-G-1.7, IAEA, Vienna (2004).

2019. The Commonwealth of Independent States continued to implement remediation activities in Central Asia consistent with the CGULS Strategic Master Plan. A workshop with 33 participants from 20 countries was held in Portugal in September 2019 to elaborate on the concept of social licence for remediation of uranium legacy sites; the workshop was organized under the International Working Forum on Regulatory Supervision of Legacy Sites.

147. The Agency held its fourth Technical Meeting of the second phase of MODARIA II in Vienna in October 2019, attended by 126 participants from 41 Member States. The meeting focused on building experience, transferring knowledge and developing approaches to assist Member States in the assessment of radiation doses to the public and the environment from radionuclides that are being released to or exist in the environment.

148. The Agency continued to provide assistance to Fukushima Prefecture in the remediation of the environment in the Prefecture, management of radioactive waste from decontamination activities, and radiation monitoring including application of environmental mapping technology by using unmanned aerial vehicles, long term monitoring of radioactive material in forests and associated countermeasures.

Priorities and Related Activities

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

- The Agency will publish reports and develop underlying guidance on remediation strategies for contaminated areas for a wide range of environmental situations, including monitoring for the protection of the public and the environment;
- The Agency will update the Strategic Master Plan for Environmental Remediation of Uranium Legacy Sites in Central Asia to take account of recent developments with the implementation of projects in the field; and
- The Agency will plan and implement a new programme (replacement of MODARIA) on the assessment of radiation doses to the public and the environment from radionuclide releases, building experience, transferring knowledge and developing approaches to assist Member States implement the Agency's safety standards.

C. Strengthening Safety in Nuclear Installations

C.1. Nuclear Power Plant Safety

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

Trends

150. Operational Safety Review Team (OSART) mission reports continue to identify recommendations regarding strengthening the conduct of safe operations, enhancing continuous improvement, optimizing maintenance activities, improving assessment of major plant safety modifications, strengthening accident management and on-site EPR, and setting, communicating and implementing management expectations.

151. Analysis of data from 85 reports to the International Reporting System for Operating Experience (IRS) indicates a continuing need to learn from events related to design modifications, ageing

management, management of internal and external hazards, contamination control and use of operating experience. The analysis also continues to highlight a need to improve learning from events related to operating and maintenance practices, the adequacy of and adherence to procedures, and the oversight of contractors. The Agency continued to receive a significant number of requests for training workshops on the use of operating experience.

152. Nuclear power reactors around the world have programmes to address long term operation (LTO) and ageing management. At the end of 2019, 263.3 GW(e) or more than 66% of available nuclear power capacity (i.e. 300 nuclear power reactors, an increase from 294 at the end of 2018) had been in operation for 30 years or more. Of that, over 64.5 GW(e) or more than 16% of global capacity (i.e. 89 nuclear power reactors, a decrease from 93 at the end of 2018) had been in service for more than 40 years (see Figure 6).[27]

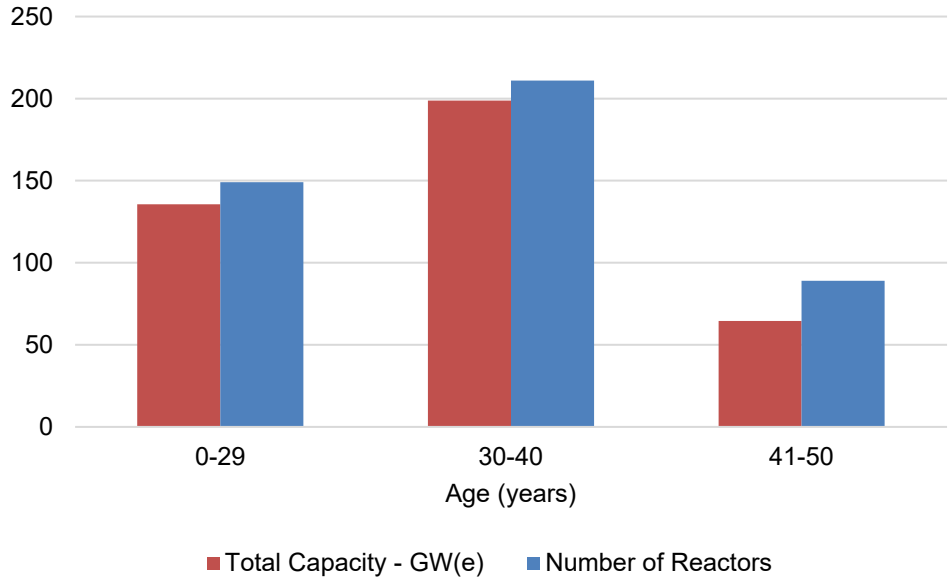

Fig. 6. Age distribution of all 449 operating nuclear power reactors in 2019 based on information from the Power Reactor Information System.

Activities

153. The Agency organized a CANDU Senior Regulators' Meeting 2019 in China in November 2019. The Agency progressed in the development of a Safety Report on continuous improvement of operational safety performance. The Agency held eight national workshops aimed at enhancing Member States' capacity to implement an effective operating experience programme. In cooperation with the OECD/NEA, the CANDU Owners Group and WANO, the Agency held a Technical Meeting on sharing operating experience and highlighting important lessons from events reported through the IRS, in Paris in October 2019, with 43 participants from 29 Member States.

154. The Safety Report entitled *Regulatory Oversight of Ageing Management and Preparedness for and Implementation of LTO Programme of NPPs* was developed, reviewed by Technical Meeting delegates in Vienna in October 2019, and approved for publication by the International Generic Ageing Lessons Learned (IGALL) Steering Committee in Vienna in December 2019.

[27] The Power Reactor Information System (PRIS), developed and maintained by the Agency, is an authoritative and comprehensive database on nuclear power plants worldwide.

155. The TECDOC summarizing the experience of Member States regarding ageing management during delayed construction, extended shutdown and post final shutdown periods was developed and approved for publication by the IGALL Steering Committee in Vienna in December 2019.

156. To support operators, regulators and other organizations in ageing management and LTO, the Agency held one Technical Meeting in Vienna in October 2019 with 36 participants, and two Technical Meetings in Vienna in December 2019 with the participation of representatives from 30 Member States operating NPPs and 3 international organizations (OECD/NEA, EU Joint Research Centre, Electric Power Research Institute), 22 workshops and support missions as well as eight meetings in the framework of IGALL.

157. To meet the need to collect and disseminate construction experience, the Agency, in cooperation with the OECD/NEA, extended the IRS database to incorporate data from the Construction Experience (ConEX) database.

158. The Agency held the International Conference on Climate Change and the Role of Nuclear Power in Vienna in October 2019. Conference participants highlighted the utmost importance of the implementation of high levels of safety and security consistent with Agency safety standards and nuclear security guidance, throughout the life of NPPs as essential for all countries pursuing nuclear power for peaceful purposes.

Priorities and Related Activities

159. ***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 and provide assistance to Member States to support their preparation for implementation of safety upgrades in existing NPPs. The Agency will undertake the following activities in relation to these priorities:***

- The Agency will continue to organize Technical Meetings, workshops and consultancy meetings to assist Member States in ageing management and LTO;
- The Agency will publish a new edition of the Safety Report *Ageing Management for Nuclear Power Plants: International Generic Ageing Lessons Learned (IGALL)*[28];
- The Agency will publish a new Safety Report entitled *Ageing Management for NPPs: Data Management, Scope Setting, and Review of Plant Programmes for LTO, Documentation of Ageing Management and LTO Assessment*; and
- The Agency will continue to hold Technical Meetings and workshops to assist Member States in enhancing their operating experience programmes.

C.1.2. Site and Design Safety

Trends

160. Member States continue to request support for the application of the Agency's safety standards for site and design safety against external hazards. Many of the requests for such support concern the evaluation of new sites, conservatism in hazard assessments and design, and use of the latest knowledge and techniques in assessing sites and designs.

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[28] INTERNATIONAL ATOMIC ENERGY AGENCY, Ageing Management for Nuclear Power Plants: International Generic Ageing Lessons Learned (IGALL), Safety Reports Series No. 82, IAEA, Vienna (2015).

161. Member States continue to express an interest in the lessons arising from the Fukushima Daiichi accident with regard to site and design safety. They also are interested in sharing experience of safety improvements in existing NPPs.

162. The Agency continues to receive a high number of requests from Member States for Site and External Events Design (SEED) review missions (six requests in 2018, and five requests in 2019, for missions in the subsequent two years), expert missions, and capacity building and training workshops.

163. Member States continue to show interest in addressing specific safety assessment and design safety aspects, including hazards at multi-unit sites, methods for aggregating various contributors to risk, human reliability assessment, and the use of a probabilistic approach to the analysis of internal and external events. Five Member States have recently expressed an interest in including combinations of hazards for the purpose of risk assessment.

164. Member States continue to design and retrofit measures to prevent accidents with radiological consequences and to mitigate consequences should they occur.

Activities

165. The Agency held a national workshop on site evaluation for nuclear installations in Tashkent in November 2019, attended by 20 participants, and an ANSN Regional Meeting on Seismic Hazard Analysis for Nuclear Installation Sites in Hanoi in November 2019, attended by 12 participants from 7 Member States.

166. The Agency published two Safety Reports: *Technical Approach to Probabilistic Safety Assessment for Multiple Reactor Units*[29] in May 2019; and *Approaches to Safety Evaluation of New and Existing Research Reactor Facilities in Relation to External Events*[30] in April 2019.

167. The CSS endorsed the revision by amendment of *Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants* (IAEA Safety Standards Series No. SSG-3).[31] The revised Safety Guide (DS523) will include multi-unit considerations.

168. The Agency initiated the revision of *Evaluation of Seismic Safety for Existing Nuclear Installations* (IAEA Safety Standards Series No. NS-G-2.13).[32]

169. The Agency continued to undertake activities relevant to the Vienna Declaration on Nuclear Safety. The Agency finalized a TECDOC summarizing the latest experiences of Member States in implementing safety improvements at existing nuclear power plants.

170. The Agency held a Technical Meeting on Multi-Unit Probabilistic Safety Assessment (MUPSA) in Vienna in October 2019, attended by 62 participants from 27 Member States. Participants exchanged information regarding current MUPSA practices and discussed the draft Safety Report on MUPSA.

171. The Agency held a Technical Meeting on External Human-Induced Events in Site Evaluation of Nuclear Installations in Vienna in April 2019, attended by 30 participants from 21 Member States.

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[29] INTERNATIONAL ATOMIC ENERGY AGENCY, Technical Approach to Probabilistic Safety Assessment for Multiple Reactor Units, Safety Reports Series No. 96, IAEA, Vienna (2019).

[30] INTERNATIONAL ATOMIC ENERGY AGENCY, Approaches to Safety Evaluation of New and Existing Research Reactor Facilities in Relation to External Events, Safety Reports Series No. 94, IAEA, Vienna (2019).

[31] INTERNATIONAL ATOMIC ENERGY AGENCY, Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants, IAEA Safety Standards Series No. SSG-3, IAEA, Vienna (2010).

[32] INTERNATIONAL ATOMIC ENERGY AGENCY, Evaluation of Seismic Safety for Existing Nuclear Installations, IAEA Safety Standards Series No. NS-G-2.13, IAEA, Vienna (2009).

Participants provided feedback for the revision of *External Human Induced Events in Site Evaluation for Nuclear Power Plants* (IAEA Safety Standard Series No. NS-G-3.1).[33]

172. The Agency held a Technical Meeting on Safety in Site Evaluation and Design to Protect Nuclear Installations against External Hazards in Vienna in June 2019, attended by 73 participants from 35 Member States. The Secretariat shared information on the progress of ongoing activities for the protection of nuclear installations against external events and the participants discussed plans and proposals for future activities in this area.

173. In October 2019, the Nuclear Safety Standards Committee approved three draft 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) for submission to the CSS.

174. The Agency continued work on a new Safety Guide entitled *Assessment of the Application of General Requirements for Design of Nuclear Power Plants* (DS508), in support of the practical implementation of the Agency's updated safety standards, particularly *Safety of Nuclear Power Plants: Design* (IAEA Safety Standards Series No. SSR-2/1 (Rev. 1)).[34]

175. The Agency continued the development of TECDOCs on human reliability analysis, risk aggregation, safety assessment of industrial digital devices in instrumentation and control, and analysis of design extension conditions.

176. The Agency held a Technical Meeting on the Safety Demonstration and Licensing of Passive Safety Features in Water Cooled Reactors in Vienna in May 2019, attended by 32 participants from 19 Member States. The meeting facilitated the exchange of knowledge and experience of Member States in several aspects of the safety of passive systems reflecting the view of various stakeholders.

177. The Agency held a Technical Meeting on the Management of Direct Current Power Systems and Application of New Devices in Safety Electrical Power Systems for Nuclear Power Plants in Vienna in December 2019, attended by 47 experts from 22 countries and one international organizations. Participants exchanged information on current approaches, challenges and experiences in the operation, maintenance and use of new digital devices in the direct current safety power systems of NPPs, including the necessary plant modifications.

178. The Agency held a Workshop on the Application of Latest IAEA Recommendations for the Design of the Reactor Coolant System and the Reactor Containment Structure Systems for Nuclear Power Plants in Vienna in September 2019, attended by 22 experts from 15 countries. Participants discussed current approaches, challenges and experiences in the practical application of the latest Specific Safety Guides on the design of the reactor coolant system and the reactor containment structure and systems for NPPs.

179. The Agency held a Workshop on the Applications of the New IAEA Safety Requirements for Nuclear Power Plant Design in Vienna in September–October 2019, attended by 29 experts from 20 countries. Participants discussed challenges and experiences in the practical application of the Safety Requirements for NPP design, in particular related to the design extension conditions.

180. The Agency held a Regional Workshop on Practical Experiences with the Application of Digital Instrumentation and Control Systems and Equipment at Nuclear Power Plants in Bucharest in

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[33] INTERNATIONAL ATOMIC ENERGY AGENCY, External Human Induced Events in Site Evaluation for Nuclear Power Plants, IAEA Safety Standards Series No. NS-G-3.1, IAEA, Vienna (2002).

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

November 2019, attended by 34 experts from 14 countries. Participants discussed the application of modern instrumentation and control systems and equipment at NPPs.

Priorities and Related Activities

181. ***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 meetings and to develop TECDOCs to assist Member States in the application of the Agency's safety assessment and design safety standards, including for existing NPPs, particularly related to the application of Safety Requirements No. SSR-2/1 (Rev. 1);
- The Agency will assist, upon request, Member States embarking on a nuclear power programme in developing a regulatory framework and qualified human resources for siting and site evaluation. Such assistance will be provided through peer review and advisory services, expert missions, capacity building and training services;
- The Agency will assist Member States, upon request, with operating nuclear installations in 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 revise and update its safety standards and will develop technical guidance to address 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 organize a Technical Meeting to share experience on site evaluation and design to protect nuclear installations against external hazards. It will also organize a Technical Meeting on evaluation of seismic safety for existing nuclear installations to compile feedback from Member States supporting a revision of the Safety Guide on this topic;
- The Agency will continue work on the forthcoming 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 initiate a project to address interest in combination of hazards for risk assessment of nuclear installations.

C.1.3. Severe Accident Prevention and Mitigation

Trends

182. Member States continue to express an interest in the lessons arising from the Fukushima Daiichi accident and request Agency's support in developing clear, comprehensive, well-designed accident management provisions capable of helping to address the difficulties that operators and decision-makers may face when dealing with a severe accident.

Activities

183. The Agency held a Technical Meeting on Current Practices in the Transition from Emergency Operating Procedures to Severe Accident Management Guidelines (SAMGs) in Vienna in August 2019,

attended by 38 experts from 24 countries and one international organization. Participants shared knowledge and experiences in the area of emergency operating procedures to SAMGs transition and provided the Agency with recommendations on future work.

184. The Agency used its technical cooperation implementation mechanism to promote and support capacity building and national human resource development in the area of simulation and modelling of severe accidents in water cooled reactors through the SAMG-D Toolkit.

Priorities and Related Activities

185. ***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 continue to facilitate exchange of experiences in the area of severe accident management and will develop supporting technical documentation; and
- The Agency will inter alia use technical cooperation implementation mechanisms to promote and support capacity building and national human resource development in the area of severe accident management in water cooled reactors.

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

Trends

186. Over ten Member States have expressed interest in small and medium sized or modular reactors (SMRs), with a corresponding increase in requests for workshops and expert missions on licensing and safety matters from countries embarking on SMR technology. The deployment of SMRs to address climate change was a major topic at the recent International Conference on Climate Change and the Role of Nuclear Power. More than 50 SMR designs are in various stages of development and a few concepts are close to deployment.

187. Feedback from Agency activities, including international meetings and TSR services, indicate increased interest in the application of the Agency's design-related Safety Requirements to SMR designs.

Activities

188. The Agency continued developing a publication related to the applicability of the Agency's design-related Safety Requirements to SMRs, safety assessment and analysis of SMRs, as well as the application of a logical framework to illustrate the development of regulatory safety requirements for SMRs.

189. The Agency held a Technical Meeting on Safety Assessment and Analysis of Small Modular Reactors in Vienna in November 2019, attended by 37 experts from 22 countries. Participants shared information on approaches, challenges and experiences related to safety assessment and safety analysis of such reactors planned for a near term deployment. They also provided feedback for the development of a Safety Report on safety assessment and analysis of such reactors.

190. The Agency held a workshop for the Europe region on design safety, safety assessment and site evaluation of SMRs in Vienna in October 2019, attended by ten experts from seven Member States. Participants exchanged information concerning the challenges and expectations in the area of siting and safety assessment of SMRs.

191. The Agency facilitated two meetings of the Small Modular Reactor Regulators' Forum in Vienna in March 2019 and November 2019. At the November meeting, the Forum approved the interim reports of the three working groups on licensing issues; design and safety analysis; and manufacturing, commissioning and operation. It is expected that the final reports on these topical issues will be published in 2020.

192. The Agency held the Third Research Coordination Meeting on Design and Performance Assessment of Passive Engineered Safety Features in Advanced Small Modular Reactors in the Republic of Korea in September 2019.

193. The Agency initiated the development of a TECDOC to document experience gained by some nuclear regulators in the licensing of SMRs in recent years. The first consultancy meeting was conducted in July 2019 with the participation of nine experts from six Members States.

194. The Agency held a workshop on regulatory frameworks and licensing issues for small modular reactor deployment in Ottawa in November 2019, attended by 11 experts from eight Member States intending to deploy such reactors in the medium term.

Priorities and Related Activities

195. ***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 safety and safety assessment, and share good practices. The Agency will undertake the following activities in relation to this priority:***

- The Agency will continue to develop publications related to safety assessment and design safety of SMRs in the context of the Agency's safety standards; and
- The Agency will continue to support Member States in strengthening their capabilities on safety assessment of SMRs, and continue to facilitate the Small Modular Reactor Regulators' Forum.

C.3. Research Reactor Safety

Trends

196. Feedback from Agency activities shows that most Member States with operating research reactors are applying the provisions of the Code of Conduct on the Safety of Research Reactors, including on regulatory supervision, ageing management, periodic safety reviews and preparation for decommissioning.

197. At least 28 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 implemented to strengthen the security measures at many facilities. Member States have shown increased awareness and have improved their management of the interface between safety and security when planning and implementing these projects.

Activities

198. The Agency held a meeting on the application of the Code of Conduct on the Safety of Research Reactors for the Europe region in Brussels in March 2019, attended by 25 participants from 14 Member States. The participants exchanged information on the safety status of their research reactors and on their experience in applying the provisions of the Code.

199. The Agency conducted an Integrated Safety Assessment of Research Reactors (INSARR) mission to the NIRR-1 research reactor in Nigeria in August 2019, and a follow-up INSARR mission to the High

Flux Reactor in the Netherlands in April 2019. The Agency also conducted a preparatory INSARR mission to the LVR-15 research reactor in the Czech Republic in July 2019.

200. The Agency conducted a Technical Meeting on the Safety of Research Reactors under Project and Supply Agreements and Review of their Safety Performance Indicators (SPIs) in Vienna in July 2019, attended by 17 participants from 17 Member States. Participants exchanged information on the safety status of their research reactors, discussed their SPI reports and explored options to enhance the safety of their research reactors.

201. The Agency held a Technical Meeting on Digital Instrumentation and Control Systems for Upgrades and New Research Reactors in Vienna in July 2019, attended by 24 participants from 21 Member States. The participants exchanged experiences and lessons learned on digital instrumentation and control systems for upgrades and for new research reactors.

202. The Agency held a regional meeting on self-assessment of research reactor safety in Cairo in October 2019, attended by 15 participants from 7 Member States. Participants shared information, knowledge and experience related to self-assessments performed in line with Agency guidelines.

203. The Agency held a Training Workshop on Integrated Management Systems for Research Reactors and Good Practices in Vienna in June 2019, attended by 38 participants from 31 Member States.

204. The Agency held the annual meeting of the Regional Advisory Safety Committee for Research Reactors in the Asia and the Pacific region, in Sydney, Australia, in October 2019, and the annual meeting of the European Advisory Safety Committee for Research Reactors in Warsaw in November 2019.

205. The Agency conducted two expert missions on implementation of periodic safety reviews (PSRs) at the ETRR-2 research reactor in Egypt in February 2019, and at the TRIGA research reactor in Morocco in October 2019. These missions provided the counterparts with practical information on the establishment of PSRs for research reactors based on the Agency’s safety standards and helped the counterparts to develop PSR basis documents.

206. The Agency held an ANSN regional meeting on PSRs for research reactors in Chicago, United States of America, in August 2019, attended by eight participants from six Member States.

207. The Agency conducted a Workshop on Safety Evaluation of Research Reactors in Daejeon, Republic of Korea, in July 2019, attended by 18 participants from 11 Member States. The meeting, held in cooperation with the Korea Institute of Nuclear Safety (KINS), provided the participants with practical knowledge and information on regulatory review and assessment of safety submittals in the framework of the licensing process of research reactors.

208. The Agency conducted a Technical Meeting for the National Coordinators of the Incident Reporting System for Research Reactors in Vienna in June 2019, attended by 38 participants from 35 Member States. The participants discussed events that occurred at their research reactors and the corrective actions that were implemented. The meeting also included training on establishing an operating experience feedback programme.

209. The Agency held the International Conference on Research Reactors: Addressing Challenges and Opportunities to Ensure Effectiveness and Sustainability in Buenos Aires in November 2019, attended by 300 participants from 53 Member States. The Conference provided a forum to share information, and exchange knowledge and experience, on effectiveness and sustainability of operating and planned research reactors.

Priorities and Related Activities

210. ***The Agency will provide assistance to Member States to support their preparation for implementation of safety upgrades resulting from 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 continue to facilitate the exchange of operating experience. 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, and updates to Safety Guides for research reactors;
- The Agency will assist Member States in addressing ageing management and periodic safety reviews by conducting peer review and advisory service missions to examine projects for the refurbishment and upgrading of research reactors, and by organizing training activities and workshops;
- 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;
- The Agency will assist Member States in developing operating experience programmes and facilitate the sharing of safety information and dissemination of operating experience through operation of the Agency's Incident Reporting System for Research Reactors; and
- The Agency will organize an international meeting to assist Member States in implementing the Code of Conduct on the Safety of Research Reactors.

C.4. Fuel Cycle Facility Safety

Trends

211. In 2019, the number of reports submitted to the Fuel Incident Notification and Analysis System (FINAS), a self-reporting system for sharing information on lessons learned from incidents at nuclear fuel cycle facilities, increased by eight, bringing the total number of reports to 291. Since the number of participants in the system remained unchanged, the growing number of reports indicates greater Member States awareness of the importance of sharing operating experience. More than 80% of the world's nuclear fuel facilities are currently part of the system.

212. An increasing number of Member States are interested in establishing systematic ageing management programmes and processes for periodic safety reviews for fuel cycle facilities, including the development of corresponding regulatory competencies.

Activities

213. The Agency held a Technical Meeting on Ageing Management for Nuclear Fuel Cycle Facilities in Vienna in October–November 2019, attended by 30 participants from 19 Member States. Participants discussed safety aspects of ageing management of nuclear fuel cycle facilities, and shared national practices and experience on the development and implementation of systematic ageing management programmes.

214. The Agency continued to operate and maintain the FINAS database jointly with the OECD/NEA and held a consultancy meeting in Vienna in November 2019 to discuss and prepare a publication on experience feedback from the database.

Priorities and Related Activities

215. ***The Agency will provide assistance to Member States to support their preparation for implementation of safety upgrades identified by safety reassessments of nuclear fuel cycle facilities. The Agency will continue to support Member States to enhance regulatory supervision. The Agency will undertake the following activities in relation to this priority:***

- The Agency will assist Member States' regulatory bodies in developing the programmes and competences necessary to ensure effective regulatory control of nuclear fuel cycle facilities, through meetings, training courses, workshops, and peer review and advisory services;
- The Agency will assist Member States in developing operating experience programmes and facilitate the exchange of safety information and dissemination of operating experience through operation of the Agency's FINAS; and
- The Agency will continue to offer support to capacity building and strengthen implementation of its safety standards in fuel cycle operations through provision of its Safety Evaluation of Fuel Cycle Facilities During Operation (SEDO) peer review service.

C.5. Safety Infrastructure for Embarking Countries

C.5.1. Nuclear Power Programmes

Trends

216. Twenty-eight Member States are considering or planning a new nuclear power programme. Four of these Member States have commenced the construction of their first nuclear power plant, and two of these expect the commissioning of their first unit in 2020.

217. The IRRS, Integrated Nuclear Infrastructure Review (INIR)[35] and other peer review and advisory services continue to identify the need to strengthen regulatory body independence, to build regulatory capacity and competence, and to establish safety regulations and licensing processes as part of effective legislative and regulatory oversight programmes.

Activities

218. The Agency held a Workshop in Support of Establishing or Enhancing the Safety Infrastructure for a Nuclear Power Programme (IAEA Safety Standards Series No. SSG-16) in Vienna in May 2019, attended by 21 participants from 12 Member States embarking on or expanding their nuclear power programmes.

219. The Agency held a Technical Meeting on Topical Issues in the Development of Nuclear Power Infrastructure in Vienna in January–February 2019, attended by over 100 senior officials from national government organizations, regulatory bodies and owner/operator organizations from 41 Member States and two international organizations. Participants discussed considerations for regulatory bodies and strengthening the safety of nuclear power programmes for new entrants.

220. The Agency held a regional workshop on the Agency's Integrated Review of Infrastructure for Safety (IRIS) self-assessment methodology and software tool in Hanoi in September 2019.

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[35] INIR is a service provided by the IAEA Department of Nuclear Energy. It is reported here due to its coordinated delivery with many safety related elements.

221. The Agency organized workshops on level 2 PSA and deterministic safety assessment for representatives of embarking countries.

222. The Agency continued to support safety assessment capacity building in countries embarking on nuclear power programmes, particularly in the area of level 2 PSA and deterministic safety assessment.

223. The Agency held a joint workshop with KINS on safety review and assessment for licensing NPPs, in Daejeon, Republic of Korea, in May 2019, attended by 13 experts from nine Member States, including embarking countries. The workshop included an extensive introduction to safety assessment and related Agency safety standards on deterministic safety analysis, PSA, as well as SSR-2/1 (Rev. 1) and technical competences needed for safety analysis report development and review.

224. The Agency held a Technical Meeting on Case Studies: Experiences of Member States in Building a Regulatory Framework for the Oversight of New Nuclear Power Plants in Vienna in June 2019, attended by around 30 experts from 20 Member States, to collect additional information on Member States' experiences and practices and to discuss a draft TECDOC.

225. The Agency updated the materials for some standardized workshop packages developed for embarking countries concerning regulatory framework, infrastructure and main regulatory functions.

226. The Agency held an Interregional Training Course on Promoting Effective Interaction Among Nuclear Industry, Regulatory Body and Stakeholders in Countries Introducing or Expanding Nuclear Power Programmes in Tokyo and Tsuruga, Japan, in September–October 2019, attended by 14 participants from 11 Member States.

227. The Agency held a national workshop on site evaluation for nuclear installations in Tashkent in November 2019, which involved 20 participants and served to enhance the capabilities and knowledge of participants on site evaluation for NPPs.

228. The Agency initiated a review of *Considerations in Emergency Preparedness and Response for a State Embarking on a Nuclear Power Programme* (EPR-Embarking 2012).[36] The scope of the revision was presented at the Emergency Preparedness and Response Standards Committee's (EPReSC's) meeting in December 2019.

229. The Agency organized an expert mission to review Indonesian regulations regarding the licensing process for NPPs in Jakarta in February 2019. The Agency held a national workshop on regulatory oversight during construction in Dhaka in February 2019.

230. The Agency held a workshop on the TSR service, in Vienna in July 2019, with the participation of five experts from Poland. Participants received comprehensive information on the TSR service and manifested specific interest in TSR safety requirements and TSR design safety review services.

231. The Agency organized a national workshop on review and assessment of SMR design hosted by the regulatory body in Amman in September 2019. The Agency also organized a national workshop on regulatory oversight during construction of NPPs in Cairo in October 2019, and a workshop on transitioning from oversight of NPP construction and commissioning to the oversight of NPP operations for the Europe region in Minsk in August 2019. The Agency held a national workshop on actions to protect the public in case of severe accident in a light water reactor in Cairo in September 2019.

232. The Agency held two workshops for the Europe region: one on preparing for and conducting interviews during the inspection of nuclear and radiological facilities and activities in Skopje in

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[36] INTERNATIONAL ATOMIC ENERGY AGENCY, Considerations in Emergency Preparedness and Response for a State Embarking on a Nuclear Power Programme, Emergency Preparedness and Response Series, EPR-EMBARKING 2012, IAEA, Vienna (2012).

June 2019; and one to evaluate a project on enhancing inspection capabilities in nuclear safety and develop regulatory inspection workshops in Vienna in April 2019.

233. The Agency held a Workshop on Safety Review and Inspection Methodologies for Quality Assurance for Asia and the Pacific in Daejeon, Republic of Korea, in May 2019.

234. The Agency held a Workshop on Deterministic Safety Analysis and the Format and Content of the Safety Analysis Report in Hangzhou, China, in September 2019, attended by 56 experts from 18 countries. Participants exchanged information and experience and discussed the main aspects of *Deterministic Safety Analysis for Nuclear Power Plants* (IAEA Safety Standards Series No. SSG-2 (Rev. 1))[37] and the draft Safety Guide entitled *Format and Content of the Safety Analysis Report for Nuclear Power Plants* (DS449). The Agency also held a Workshop on Current Practices in the Preparation, Modification and Review of Safety Analysis Reports for Nuclear Power Plants in Shanghai, China, in September 2019, with the participation of 22 experts from 15 countries. Participants exchanged information on current approaches, challenges and experiences in preparing, modifying and reviewing safety analysis reports for NPPs.

235. The Agency also held an inspection walk-down on fundamentals of regulatory inspections of NPPs at the Zwentendorf facility in Austria in May 2019; interregional training courses on national responsibilities and infrastructure for new nuclear power programmes, in San José in May 2019, and on licensing and construction preparation and oversight, in Ulsan, Republic of Korea, in July 2019; a scientific group visit on the licensing process for NPPs in Moscow in September 2019; and an interregional workshop on the fundamentals of regulatory inspections of NPPs during construction and operation in Vienna in September–October 2019.

Priorities and Related Activities

236. ***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, through national or regional technical cooperation and extrabudgetary projects, to conduct various expert missions, workshops and training activities to provide guidance and information on all the elements of establishing an effective safety infrastructure in line with *Establishing the Safety Infrastructure for a Nuclear Power Programme* (IAEA Safety Standards Series No. SSG-16);[38]
- The Agency will continue to assist Member States in identifying their needs and establishing priorities to develop or enhance their national regulatory infrastructures in a timely manner, in using the IRIS self-assessment tool and in conducting national and regional self-assessment workshops;
- The Agency will continue to encourage Member States to host TSR services during the early stages of the development of a nuclear power programme in order to support the evaluation of the safety infrastructure aspects;
- The Agency will continue to assist Member States with the development of nuclear power programmes by new entrants and with safe implementation of new technologies through enhancement of their technical capabilities in the areas of safety review, assessment and

[37] INTERNATIONAL ATOMIC ENERGY AGENCY, Deterministic Safety Analysis for Nuclear Power Plants, IAEA Safety Standards Series No. SSG-2 (Rev. 1), IAEA, Vienna (2019).

[38] INTERNATIONAL ATOMIC ENERGY AGENCY, Establishing the Safety Infrastructure for a Nuclear Power Programme, IAEA Safety Standards Series No. SSG-16, IAEA, Vienna (2011).

authorization through Agency workshops, expert missions, scientific visits and fellowships;

- The Agency will continue to hold Technical Meetings and workshops and to assist Member States in developing operating experience programmes and to assist Member States to share operating experience in the design, construction and commissioning phase of the nuclear facilities;
- The Agency will conduct a second INIR Phase 3 pilot mission and finalize the INIR Phase 3 methodology upon incorporating the experience; and
- The Agency will proceed with the review and revision of *Considerations in Emergency Preparedness and Response for a State Embarking on a Nuclear Power Programme* (EPR-Embarking 2012).

C.5.2. Research Reactors Programme

Trends

237. Over 20 Member States are planning or implementing projects to establish their first or a new research reactor with the goal of building capacity for embarking on a nuclear power programme and/or to conduct research and development to support industry and national programmes such as those for medical radioisotope production.

Activities

238. The Agency held a Training Workshop on National Infrastructure Assessments to Support a New Research Reactor Project in Bahadurgarh, India, in October 2019, attended by 41 participants from 12 Member States.

239. The Agency held a national workshop on the Milestones approach for research reactors in Dakar in December 2019.

Priorities and Related Activities

240. ***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 conduct peer review missions on safety infrastructure for new research reactor programmes on request and support capacity building through Technical Meetings and training activities.

D. Strengthening Emergency Preparedness and Response

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

Trends

241. Effective information exchange and emergency communication remain a priority for Member States. In 2019, the Agency was informed by competent authorities, or became aware through earthquake alerts or media reports, of 245 events involving or suspected to involve nuclear or radiological facilities or activities. This number remains significant in line with the trend of recent years

(see Figure 7). The sustained effort by the Secretariat and Member States with regard to workshops and training on notification, reporting and requesting assistance contributed to the increase in the number of recorded events over the past years. In 2019, the Agency received 5 requests for information about the events from official contact points.

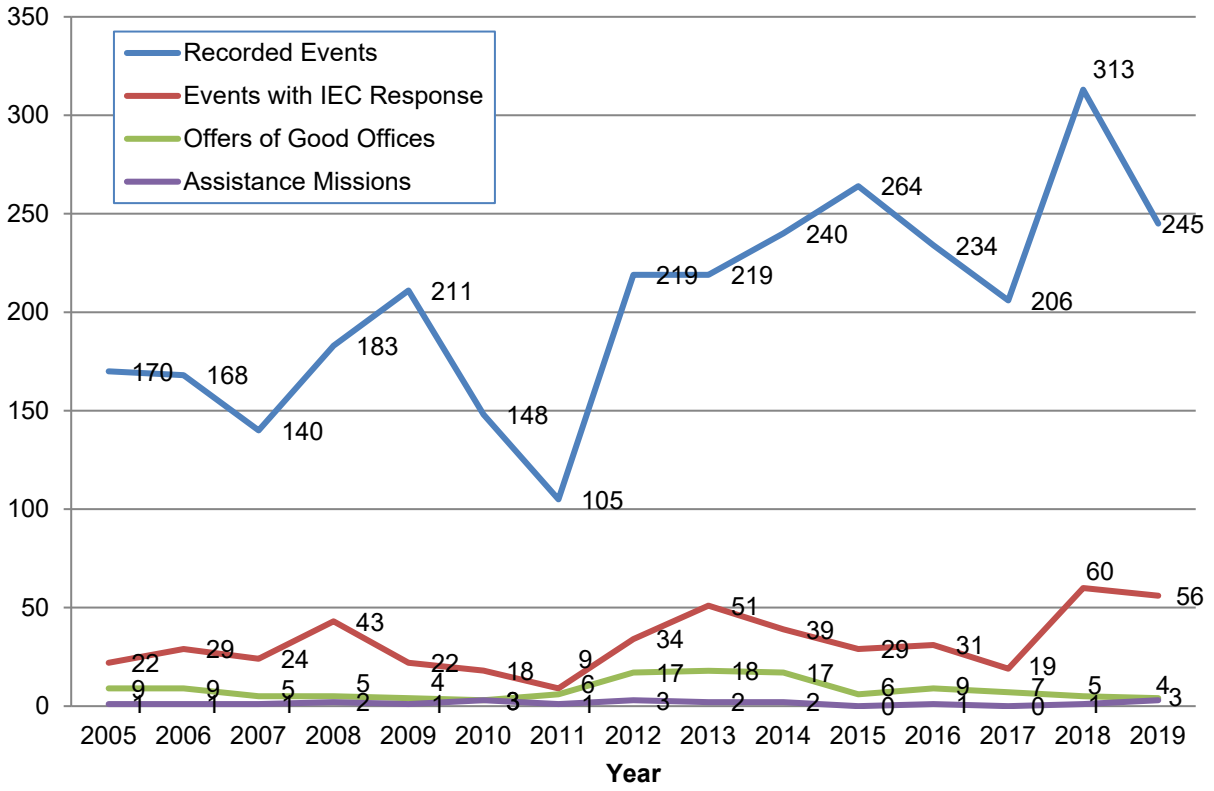

Fig. 7. Number of events involving or suspected to involve nuclear or radiological facilities or activities, about which the Agency was informed by competent authorities, or became aware through earthquake alerts or media reports.

242. Member State support is increasing for the continuous review and update of the arrangements for notification, reporting and assistance through the provision of feedback on the reviewed content of the operational manuals and the latest developments of the Agency web systems and tools used in the implementation of the arrangements. This support has resulted in the publication of the 2019 *Operations Manual for Incident and Emergency Communication* (EPR-IEComm 2019).

243. In 2019, there was no change in the number of Member States (125) with designated contact points[39] under the Convention on Early Notification of a Nuclear Accident (Early Notification Convention)[40] in accordance with the *Operations Manual for Incident and Emergency Communication* (EPR-IEComm 2012).[41]

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[39] States Parties to the Convention on Early Notification of a Nuclear Accident 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).

[40] The text of the Early Notification Convention is available in document INFCIRC/335: https://www.iaea.org/sites/default/files/infcirc335.pdf

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

244. To date, 35 of the 119 States Parties to the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (Assistance Convention)[42] have registered National Assistance Capabilities[43] in the Agency's Response and Assistance Network (RANET). New or updated registrations were received from Argentina, Austria, Belarus, Denmark, Finland, Germany, India, Israel, Republic of Korea, Norway, Spain, Sri Lanka and the United Kingdom.

245. During 2019, 88 additional Member States declared electronic mail as their preferred emergency communication channel, which is a significant increase bringing the total number of Member States that have declared electronic mail to be their preferred emergency communication channel to 110 Member States.

246. The number of nominated contact points for the coordination of activities related to the International Radiation Monitoring Information System (IRMIS) continues to grow. In 2019, three Member States nominated a contact point, bringing the total to 42. The number of Member States using IRMIS for the regular sharing of simulated emergency radiation monitoring data has risen from two in 2018 to nine Member States in 2019.

247. In 2019, the number of Member States using the International Nuclear and Radiological Event Scale (INES) to communicate the safety significance of nuclear or radiological events remained at 77.

248. Many Member States continue to prioritize strengthening preparedness to communicate effectively with the public and the media in a nuclear or radiological emergency.

Activities

249. The Agency held a Technical Meeting on Advances in Emergency Preparedness and Response Technology and Arrangements in Vienna in April 2019, attended by 178 participants from 85 Member States and 3 international organizations. Meeting participants shared advances in operational arrangements, developments of technology, and advances in accident simulations, atmospheric dispersion modelling and techniques for handling data for nuclear and radiological emergency response.

250. The Agency held a RANET Joint Assistance Team (JAT) exercise in Las Vegas, United States of America, in September 2019. Six Member States registered in RANET participated. As part of the exercise, participants managed and resolved administrative, logistical, technical, safety and security of personnel matters that might arise during an Assistance Mission.

251. Following the development of social media simulator software in 2019, pilot exercises were held both internally and with Member State public information officers.

252. The automatic interface for exchanging information from European Union member countries between the Agency's and the European Commission's emergency websites was made operational.

Priorities and Related Activities

253. ***The Agency will further develop and support the implementation by the Member States of the operational arrangements for notification, reporting and assistance in a nuclear or radiological incident or emergency. The Agency will undertake the following activities in relation to this priority:***

- The Agency will hold the Tenth Meeting of the Representatives of Competent Authorities identified under the Convention on Early Notification of a Nuclear Accident and the

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[42] The text of the Assistance Convention is available in document INFCIRC/336: https://www.iaea.org/sites/default/files/infcirc336.pdf

[43] States Parties to the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency 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".

Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency in June 2020. The meeting will discuss a range of issues including information exchange, international assistance, communication with the public and training and exercises;

- The Agency will continue to assist Member States in strengthening their capabilities for notification, reporting and assistance by conducting meetings and workshops on the operational arrangements for notification, reporting and assistance in a nuclear or radiological emergency. These will cover implementation of international arrangements described in the Agency's operational manuals; and
- The Agency will continue to assist Member States in building or strengthening their capabilities for public communication in a nuclear or radiological emergency by conducting training courses and exercises, using the social media simulator when appropriate.

D.2. Harmonization of Arrangements for Preparedness and Response

Trends

254. Member States are increasingly requesting technical assistance and advice in strengthening national and regional EPR arrangements through Technical Cooperation projects. Many requests relate to the need for assistance and advice in implementing the requirements established in IAEA Safety Standards Series No. GSR Part 7, including requests for the development of new Safety Guides, for the revision of existing Safety Guides, and for training and exercises. The number of Member States using GSR Part 7 and the Safety Guide *Arrangements for the Termination of a Nuclear or Radiological Emergency* (IAEA Safety Standards Series No. GSG-11)[44] in developing their national emergency response arrangements is increasing.

255. The information uploaded to EPRIMS shows that Member States are increasingly interested in harmonizing their EPR arrangements based on the requirements in GSR Part 7.

256. Member States are increasingly using EPRIMS (see Figure 8). In 2019, 120 Member States appointed national EPRIMS coordinators, with a total of 459 users, an increase from 103 Member States with national coordinators in 2018 and 96 in 2017, with a total of 394 and 339 users respectively. The number of published modules also increased to 1205 in 2019 from 382 in 2017 and 719 in 2018.

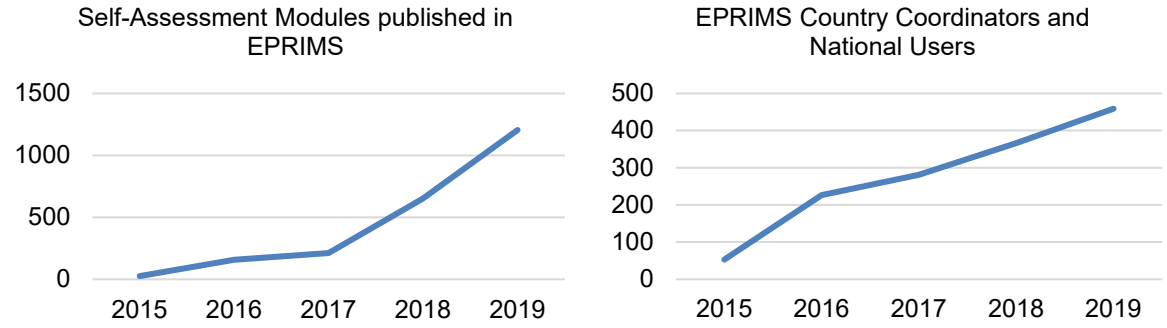

Fig. 8. The use of EPRIMS continued to increase in 2019.

257. An analysis of Member States' EPRIMS self-assessments shows the following trends: the lowest level of implementation is shown for Requirements 5 (protection strategy) and 18 (terminating a nuclear or radiological emergency), which were new in GSR Part 7. The Agency therefore developed new

[44] INTERNATIONAL ATOMIC ENERGY AGENCY, Arrangements for the Termination of a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSG-11, IAEA, Vienna (2018).

guidance to further support Member States' implementation of these requirements. The requirements with the highest level of implementation are those related to EPR infrastructure (see Figure 9).

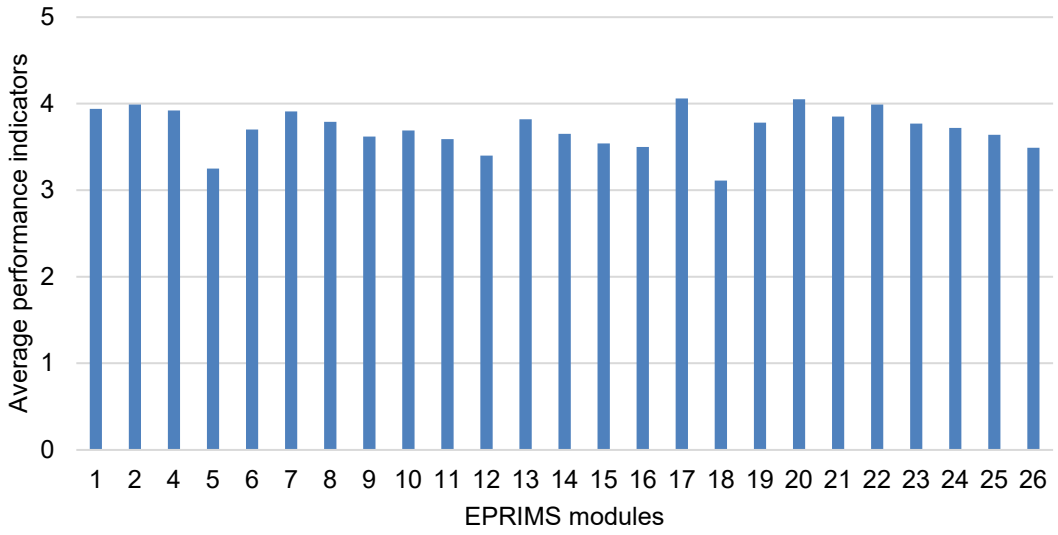

Fig. 9. GSR Part 7 requirements and their ratings according to self-assessment of countries.

258. Some Member States are interested in addressing EPR arrangements for new and emerging reactors types, including SMRs, TNPPs and Generation IV reactors.

Activities

259. The EPReSC completed the review of *Criteria for Use in Preparedness and Response for a Nuclear or Radiological Emergency* (IAEA Safety Standard Series No. GSG-2),[45] which will undergo revision. The Publications Committee approved six EPR Series publications for publication.

260. The drafting of two new EPR Series publications on medical follow-up of overexposed persons in nuclear or radiological emergencies, and on preparedness and response to a nuclear or radiological emergency combined with other incidents or emergencies are nearing completion. Work began on a third new EPR Series publication on dose assessment techniques in nuclear or radiological emergencies. The Agency is revising four EPR Series publications: *Preparation, Conduct and Evaluation of Exercises to Test Preparedness for a Nuclear or Radiological Emergency*[46]; *Method for Developing Arrangements for Response to a Nuclear or Radiological Emergency*[47]; *Manual for First Responders to a Radiological Emergency*[48]; and *Considerations in Emergency Preparedness and Response for a State Embarking on a Nuclear Power Programme*[49].

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[45] INTERNATIONAL ATOMIC ENERGY AGENCY, Criteria for Use in Preparedness and Response for a Nuclear or Radiological Emergency, IAEA Safety Standards Series No. GSG-2, IAEA, Vienna (2011).

[46] INTERNATIONAL ATOMIC ENERGY AGENCY, Preparation, Conduct and Evaluation of Exercises to Test Preparedness for a Nuclear or Radiological Emergency, Emergency Preparedness and Response Series, EPR-EXERCISE 2005, IAEA, Vienna (2005).

[47] INTERNATIONAL ATOMIC ENERGY AGENCY, Method for Developing Arrangements for Response to a Nuclear or Radiological Emergency, Emergency Preparedness and Response Series, EPR-METHOD 2003, IAEA, Vienna (2003).

[48] INTERNATIONAL ATOMIC ENERGY AGENCY, Manual for First Responders to a Radiological Emergency, Emergency Preparedness and Response Series, EPR-FIRST RESPONDERS, IAEA, Vienna (2006).

[49] INTERNATIONAL ATOMIC ENERGY AGENCY, Considerations in Emergency Preparedness and Response for a State Embarking on a Nuclear Power Programme, Emergency Preparedness and Response Series, EPR-EMBARKING 2012, IAEA, Vienna (2012).

261. The Agency held a workshop for the Africa region in Vienna in June 2019 to support Member States in performing their self-assessments against GSR Part 7 for uploading to EPRIMS. Four webinars have been delivered to support users in the operation of the system.

262. A total of 40 training events at the regional and interregional levels, and 15 training events at the national level were implemented, with a total of 1368 participants from 133 Member States. Overall, 46 200 person hours of training were delivered. More than 92% of participants of the training courses said they were satisfied or very satisfied with the provided training. The effectiveness of regional training events was measured by having students taking a test on the subject of the course before and after the training. The average increase of knowledge (measured by the % of correct answers) was 23% (from 63% of correct answers before the training to 86% after it).

Priorities and Related Activities

263. ***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. The Agency will undertake the following activities in relation to this priority:***

- The Agency will develop new Safety Guides on EPR and revise existing Safety Guides based on priorities identified by Members States. The Agency will continue developing new technical guidance to support GSR Part 7 implementation by Member States;
- The Agency will continue to deliver EPR capacity building activities and foster cooperation and synergies among Member State entities by conducting EPR training and educational activities; and
- The Agency will hold a RANET JAT exercise in the RANET Capacity Building Centre in Fukushima Prefecture, Japan, in August 2020.

D.3. Testing Readiness for Response

Trends

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

265. The percentage of Unified System for Information Exchange in Incidents and Emergencies (USIE) administrators completing the requested tasks within the required time frame did not change in comparison to 2018 but decreased in comparison with previous years (see Figure 10). The Agency followed up on USIE administrators who did not complete the requested tasks on time and, as a result, more than 30 USIE administrator accounts were removed, and 11 new accounts were created for administrators in different Member States.

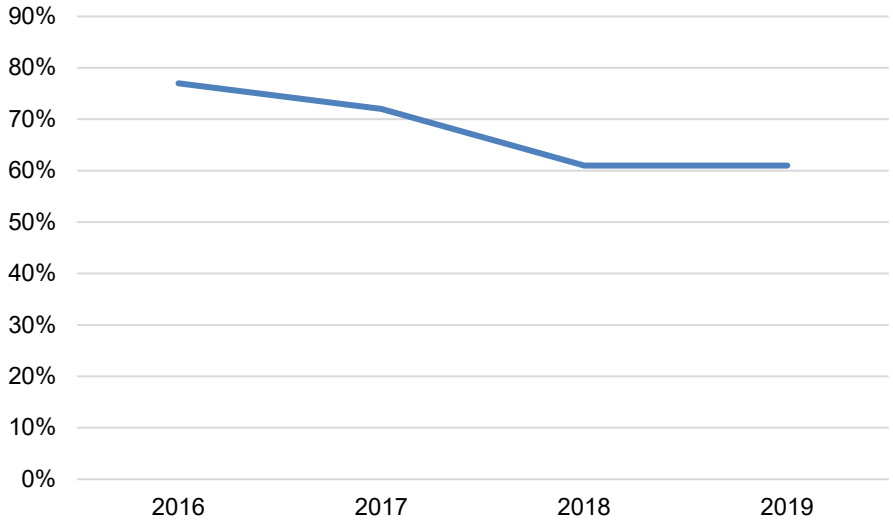

Fig. 10. The percentage of USIE administrators completing the requested tasks within the required time frame.

266. The participation of Member States in ConvEx-2 exercises continues to be high (see Figure 11).

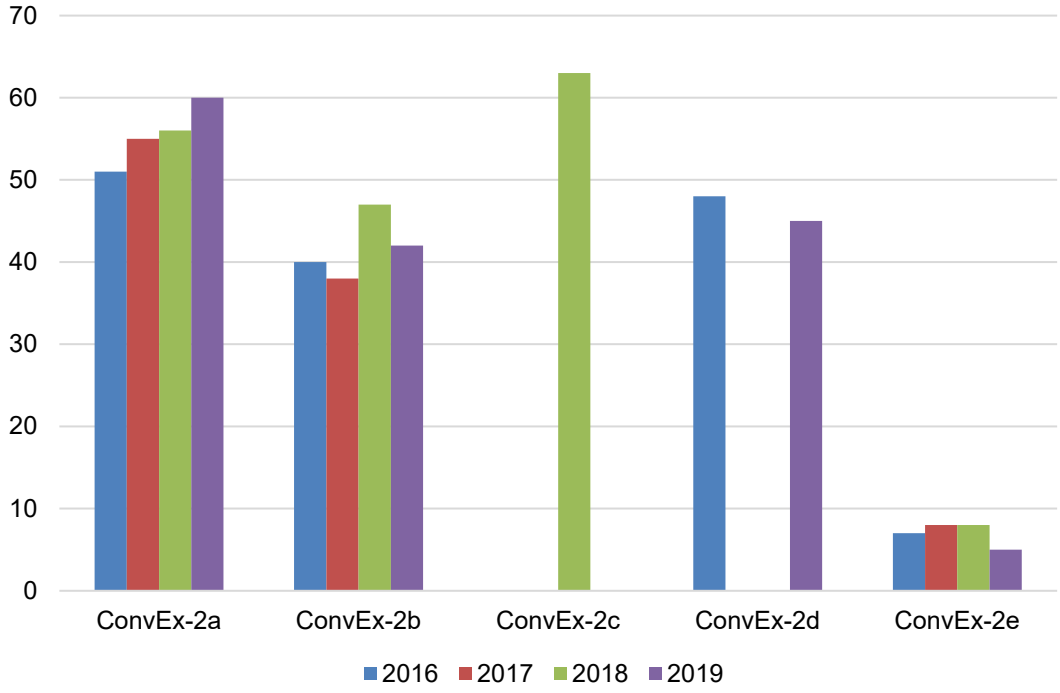

Fig. 11. Participation of Member States and international organizations in CovEx-2.

267. The percentage of emergency contact points that confirmed a test message via the USIE website during simple communication tests increased from 36% in 2018 to 41% in 2019.

Activities

268. The Agency convened the 27th regular meeting of the Inter-Agency Committee on Radiation and Nuclear Emergencies (IACRNE) in Geneva, Switzerland, in June 2019, hosted by the WHO and attended by 16 participants from 13 IACRNE organizations. The meeting reviewed IACRNE activities and discussed inter alia preparedness and response activities in all participating and corresponding organizations; lessons identified in the ConvEx-2f exercise; the status of the Practical Arrangements

with IACRNE participating organizations; other international exercises conducted since November 2017; and the IACRNE work programme for the next two-year period.

269. The Agency held a ConvEx-2a exercise in June 2019, with an increase in participation compared to 2018. The participation of 71% of Member States with operating NPPs indicates the importance attached by Member States to this exercise. All participating Member States used the correct communication channels.

270. The Agency conducted a ConvEx-2b exercise in March 2019, with 39 participating Member States and three international organizations; 17 Member States tested their capabilities to request assistance and prepare to receive it, while 22 Member States and three international organizations participated as providers of assistance. For the assisting States, the response times were assessed as part of the exercise objectives. Arrangements for the provision of privileges and immunities to an assistance mission team (in accordance with the *Agreement on the Privileges and Immunities of the International Atomic Energy Agency* (INFCIRC/9/Rev.2)) were also tested during the exercise.

271. The Agency conducted a ConvEx-2d exercise in October 2019, based on a full-scale national emergency exercise in Sweden. The exercise involved 42 Member States and three international organizations. Participating Member States reviewed the emergency information exchanged and determined appropriate actions to be taken to protect the public. The Agency merged this exercise with the conduct of one of its four annual large-scale Full Response Exercises during 2019 to test its internal emergency response procedures and interfaces. 54 Agency staff were involved to further strengthen their capacity.

272. 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. Five ConvEx-2e exercises were conducted in 2019. The assessment and prognosis process was tested and evaluated in four internal annual large-scale Full Response Exercises and drills in the Agency's ongoing internal training process.

273. The Agency held a ConvEx-2f exercise with six members of IACRNE in December 2019 to test the arrangements regarding public communication of international organizations, members of the IACRNE, during a nuclear or radiological emergency.

274. In October 2019, the Agency piloted the first ConvEx-2g exercise that tests the Secretariat's and Member States' emergency response arrangements to communicate effectively with the public during a nuclear or radiological emergency. Member State public information officers used the Agency's social media simulator as part of the exercise.

275. The ConvEx 2020 exercise schedule was shared with Member States to enable planning and broad participation. The Agency analysed all communication issues arising in ConvEx exercises and followed up with counterparts in Member States.

276. The Agency participated in 26 national emergency exercises and supported Member States in conducting and evaluating these exercises. All exercises included communications using the USIE Exercise website. Overall, in 2019, Member States used the USIE Exercise website for 100 of their exercises.

277. The Secretariat tested its operational arrangements with the World Meteorological Organization, regularly undertaking communications tests and sharing technical information.

278. In November 2019, the Agency held a first meeting to prepare ConvEx-3 (2021) — a full-scale exercise based on a scenario of an NPP severe accident. During the meeting, held in within the IACRNE framework, the United Arab Emirates offered the use of a national exercise hosted by the Barakah NPP as the basis for the ConvEx-3 (2021).

Priorities and Related Activities

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

- The Agency will continue to organize and conduct ConvEx-1, 2 and 3 exercises and share schedules in advance with Member States to support broad participation; and will continue to conduct regular internal exercises to test operational arrangements;
- The Secretariat will support Member States' requests for the Agency's participation in national and/or specific exercises organized by Member States; and
- The Agency will arrange meetings of the IACRNE Working Group on Coordinated International Exercises to continue preparations for ConvEx-3 (2021) which will be hosted in 2021 by the United Arab Emirates, based on a nuclear power plant accident scenario at Barakah NPP.

E. Improving Management of the Safety and Security Interface

Trends

280. Member States continue to encourage the Secretariat to facilitate a coordination process to address safety and security interfaces, recognizing that the activities that address nuclear safety and security are different.

281. 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.

282. INSAG and the Advisory Group on Nuclear Security (AdSec) also highlighted the importance of the safety and security interface. Currently they are working on a joint publication on this topic.

Activities

283. The Interface Group, comprising representatives of the Safety Standards Committees and the Nuclear Security Guidance Committee (NSGC), reviewed seven of the Agency's proposed safety standards to identify 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 15 safety standards identified as having interfaces with security, and the relevant Safety Standards Committees reviewed one draft IAEA Nuclear Security Series publication having interfaces with safety.

284. In 2019, the Agency issued two new nuclear security guidance publications having interfaces with safety, and for which relevant safety experts had been involved in their development and review, namely *Security during the Lifetime of a Nuclear Facility* (IAEA Nuclear Security Series No. 35-G)[50] and

[50] INTERNATIONAL ATOMIC ENERGY AGENCY, Security during the Lifetime of a Nuclear Facility, IAEA Nuclear Security Series No. 35-G, IAEA, Vienna (2019).

Preventive Measures for Nuclear and Other Radioactive Material out of Regulatory Control (IAEA Nuclear Security Series No. 36-G)[51].

285. The Agency held a Technical Meeting on Managing the Interface between Safety and Security for Nuclear Fuel Cycle Facilities in Vienna in October 2019, attended by 23 participants from 18 Member States. Participants discussed areas where safety and security aspects need to be managed at different phases in a nuclear fuel cycle facility's lifetime, and shared national practices and experience in regulatory capabilities in this area.

286. The Agency held a Technical Meeting in Vienna in December 2019 to develop case studies and country specific examples for a TECDOC on the safety and security interface for the oversight of NPPs.

287. The Agency held an International Workshop on Nuclear Security Measures and Emergency Response Arrangements for Ports in Las Vegas, United States of America, in November 2019, attended by 18 participants from nine Member States.

288. The Agency finalized *The Safety and Security Interface: Approaches and national Experiences* (Technical Reports Series No. TRS-1000). The report reflects the recommendations and the discussions from a Technical Meeting held in October 2018. The Agency also finalized *Managing the Interface between Safety and Security for Normal Commercial Shipments of Radioactive Material* (Technical Reports Series No. TRS-1001). The report provides technical advice to Member States, based on international good practices, to facilitate management of the interface between nuclear safety and security during shipments of radioactive material in an integrated and coordinated manner.

Priorities and Related Activities

289. ***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. 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 nuclear installations by developing new guidance, revising relevant safety standards and holding training activities;
- The Agency will continue the development of TECDOCs on interfaces, including one on the interface between transport safety and transport security. A module on this subject will also be developed and uploaded to the e-learning transport safety platform; and
- The Agency will finalize the TECDOC provisionally entitled *Notification, Authorization, Inspection and Regulatory Enforcement Procedures for the Safety and Security of Radioactive Sources in use and Storage and of Associated Facilities*.

F. Strengthening Civil Liability for Nuclear Damage

Trends

290. Member States continue to attach importance to effective and coherent nuclear liability mechanisms at the national and global level to ensure prompt, adequate and non-discriminatory

[51] INTERNATIONAL ATOMIC ENERGY AGENCY, Preventive Measures for Nuclear and Other Radioactive Material out of Regulatory Control, IAEA Nuclear Security Series No. 36-G, IAEA, Vienna (2019).

compensation for damage to people, property and the environment resulting from a nuclear accident or incident.[52]

291. Member States continue to request the Agency to assist them 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 that were adopted by the Agency's International Expert Group on Nuclear Liability (INLEX) in response to the IAEA Action Plan on Nuclear Safety[53].

Activities

292. INLEX held its 19th regular meeting in Vienna in May 2019. At this meeting, the Group reiterated its conclusions from previous meetings that a TNPP in a fixed position (i.e. in the case of a floating reactor, anchored to the seabed or the shore, and attached to the shore by power lines) would fall under the definition of 'nuclear installation' and therefore be covered by the nuclear liability regime, and that, in the case of transport of a factory-fuelled reactor, the TNPP would also be covered by the nuclear liability conventions in the same way as any other transport of nuclear material. INLEX, however, noted that these conclusions could not apply in circumstances where the reactor was used for the propulsion of the vessel.

293. INLEX also discussed the issue of factory-fuelled reactors transported and deployed in a host State either not party to a nuclear liability convention or not party to the same convention as the sending State and where no unloading of fuel from the vessel occurs before the operation of the TNPP in the State of destination. In this respect, INLEX recommended that the Vienna Convention on Civil Liability for Nuclear Damage (Vienna Convention) and the Convention on Supplementary Compensation for Nuclear Damage be interpreted to mean that the sending operator would cease to be liable when the TNPP is taken charge of by the authorized person in the State of destination. The Group added that, at some future point of time when the original sending operator took responsibility for the TNPP in order to return it to the sending State, that operator would again assume liability. It also decided that there was no need to discuss at this stage the potential further complications that may arise if the TNPP were to be deployed in a third State prior to its return to the State of origin. With these additional conclusions, INLEX considered the issues concerning TNPPs to be closed.

294. With respect to liability issues concerning cyberattacks, INLEX concluded that if a cyberattack triggered a nuclear incident, there was no basis for treating it differently from other acts of terrorism. On this basis, INLEX reaffirmed that, like other acts of terrorism, a cyberattack would not exonerate the operator from nuclear liability, unless that cyberattack amounted to "an act of armed conflict, hostilities, civil war or insurrection" and only if the nuclear incident were "directly due" to such an act. In this context, it was noted that the burden of proof would lie with the operator claiming such an exoneration before the competent court and that third-party liability insurance contracts generally do not contain an exoneration for cyberattacks.

295. The Group also discussed the differing amounts of compensation available under the various nuclear liability conventions and concluded that the higher liability amounts established by a State party to the 1997 Protocol to Amend the Vienna Convention are to be distributed without discrimination to victims in States party to the original 1963 Vienna Convention.

296. A Workshop on Civil Liability for Nuclear Damage for European countries was held in Bucharest in April 2019, and was attended by 74 participants from 25 Member States. Participants were given an

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[52] See preambular paragraph (qq) of resolution GC(63)/RES/7 adopted by the General Conference in September 2019.

[53] See operative paragraph 33 of part 2 of resolution GC(63)/RES/7. The text of the INLEX recommendations is available at: https://www.iaea.org/sites/default/files/17/11/actionplan-nuclear-liability.pdf. The IAEA Action Plan on Nuclear Safety is contained in document GOV/2011/59-GC(55)/14.

overview of the international nuclear liability regime and of its implementation in national laws. The Secretariat also conducted a follow-up Agency–INLEX mission to Saudi Arabia in August 2019.

297. Assistance was provided to seven Member States in the development of national legislation on civil liability for nuclear damage.

Priorities and Related Activities

298. ***The Agency will continue to facilitate the establishment of a global nuclear liability regime and 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. The Agency will undertake the following activities in relation to this priority:***

- The Agency will organize the next meeting of INLEX in 2020;
- The Agency, with the support of INLEX, will organize a workshop for newcomer countries and undertake further activities, such as Agency–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 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 2019

Summary of the Agency's Safety Standards Activities during 2019

1. The Agency issued the Safety Requirements *Site Evaluation for Nuclear Installations* (IAEA Safety Standards Series No. SSR-1). This Safety Requirements publication completes the long-term structure of the Safety Requirements with seven General Safety Requirements and seven Specific Safety Requirements.

2. The Agency issued seven Specific Safety Guides after endorsement by the Commission on Safety Standards (CSS):

- *Predisposal Management of Radioactive Waste from the Use of Radioactive Material in Medicine, Industry, Agriculture, Research and Education* (IAEA Safety Standards Series No. SSG-45);
- *Decommissioning of Medical, Industrial and Research Facilities* (IAEA Safety Standards Series No. SSG-49);
- *Human Factors Engineering in the Design of Nuclear Power Plants* (IAEA Safety Standards Series No. SSG-51);
- *Design of the Reactor Core for Nuclear Power Plants* (IAEA Safety Standards Series No. SSG-52);
- *Design of the Reactor Containment and Associated Systems for Nuclear Power Plants* (IAEA Safety Standards Series No. SSG-53);
- *Accident Management Programmes for Nuclear Power Plants* (IAEA Safety Standards Series No. SSG-54); and
- *Deterministic Safety Analysis for Nuclear Power Plants* (IAEA Safety Standards Series No. SSG-2 (Rev. 1)).

3. The Agency also issued the *IAEA Safety Glossary: Terminology Used in Nuclear Safety and Radiation Protection — 2018 Edition*. The previous edition of the IAEA Safety Glossary (2007 Edition) was revised and updated to take into account new terminology and usage in safety standards issued between 2007 and 2018, in particular IAEA Safety Standards Series Nos GSR Part 3 *(Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards*), GSR Part 7 (*Preparedness and Response for a Nuclear or Radiological Emergency*), SSR-2/1 (Rev. 1) (*Safety of Nuclear Power Plants: Design*), SSR-2/2 (Rev. 1) (*Safety of Nuclear Power Plants: Commissioning and Operation*), SSR-3 (*Safety of Research Reactors*), SSR-4 (*Safety of Nuclear Fuel Cycle Facilities*) and SSR-6 (Rev. 1) (*Regulations for the Safe Transport of Radioactive Material: 2018 Edition*).

4. The CSS met twice in 2019. It endorsed for submission for publication the following draft Safety Guides:

- *Radiation Safety in Well Logging* (IAEA Safety Standards Series No. SSG-57);
- *Radiation Safety in the Use of Nuclear Gauges* (IAEA Safety Standards Series No. SSG-58);
- *Radiation Safety of Accelerator Based Radioisotope Production Facilities* (IAEA Safety Standards Series No. SSG-59);
- *Management of Residues Containing Naturally Occurring Radioactive Material from Uranium Production and other Activities* (IAEA Safety Standards Series No. SSG-60);
- *Format and Content of the Safety Analysis Report for Nuclear Power Plants* (IAEA Safety Standards Series No. SSG-61);
- *Design of Auxiliary Systems and Supporting Systems for Nuclear Power Plants* (IAEA Safety Standards Series No. SSG-62);
- *Arrangements for Public Communication in Preparedness and Response for a Nuclear or Radiological Emergency* (IAEA Safety Standards Series No. GSG-14);
- *Design of Fuel Handling and Storage Systems for Nuclear Power Plants* (IAEA Safety Standards Series No. SSG-63);
- *Storage of Spent Nuclear Fuel* (IAEA Safety Standards Series No. SSG-15 (Rev. 1));
- *Preparedness and Response for a Nuclear or Radiological Emergency Involving the Transport of Radioactive Material* (DS469);
- *Protection against Internal Hazards in the Design of Nuclear Power Plants* (DS494);
- *Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (2018 Edition)* (DS496); and
- *Schedules of Provisions of the IAEA Regulations for the Safe Transport of Radioactive Material (2018 Edition)* (DS506).

5. In 2019, the CSS also approved the following document preparation profiles (DPPs) for Safety Guides:

- *Criticality Safety in the Handling of Fissile Material (revision of SSG-27)* (DS516);
- *Three draft Safety Guides for the revision of: SSG-5 on Safety of Conversion Facilities and Uranium Enrichment Facilities; SSG-6 on Safety of Uranium Fuel Fabrication Facilities; and SSG-7 on Safety of Uranium and Plutonium Mixed Oxide Fuel Fabrication Facilities* (DS517);
- *Two draft Safety Guides for the revision of: SSG-42 on Safety of Nuclear Fuel Reprocessing Facilities; and SSG-43 on Safety of Nuclear Fuel Cycle Research and Development Facilities* (DS518);
- *Leadership, Management and Culture for Safety* (DS513), revision of GS-G-3.1;
- *Protection of Workers against Exposure due to Radon* (DS519), new Safety Guide;
- *External Human Induced Hazards in Site Evaluation for Nuclear Installations* (DS520), revision of NS-G-3.1;

- *Evaluation of Seismic Safety for Existing Nuclear Installations* (DS522), revision of NS-G-2.13;
- *Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants* (DS523), revision of SSG-3; and
- *Radiation Protection Aspects of Design for Nuclear Power Plants* (DS524), revision of NS-G-1.13.

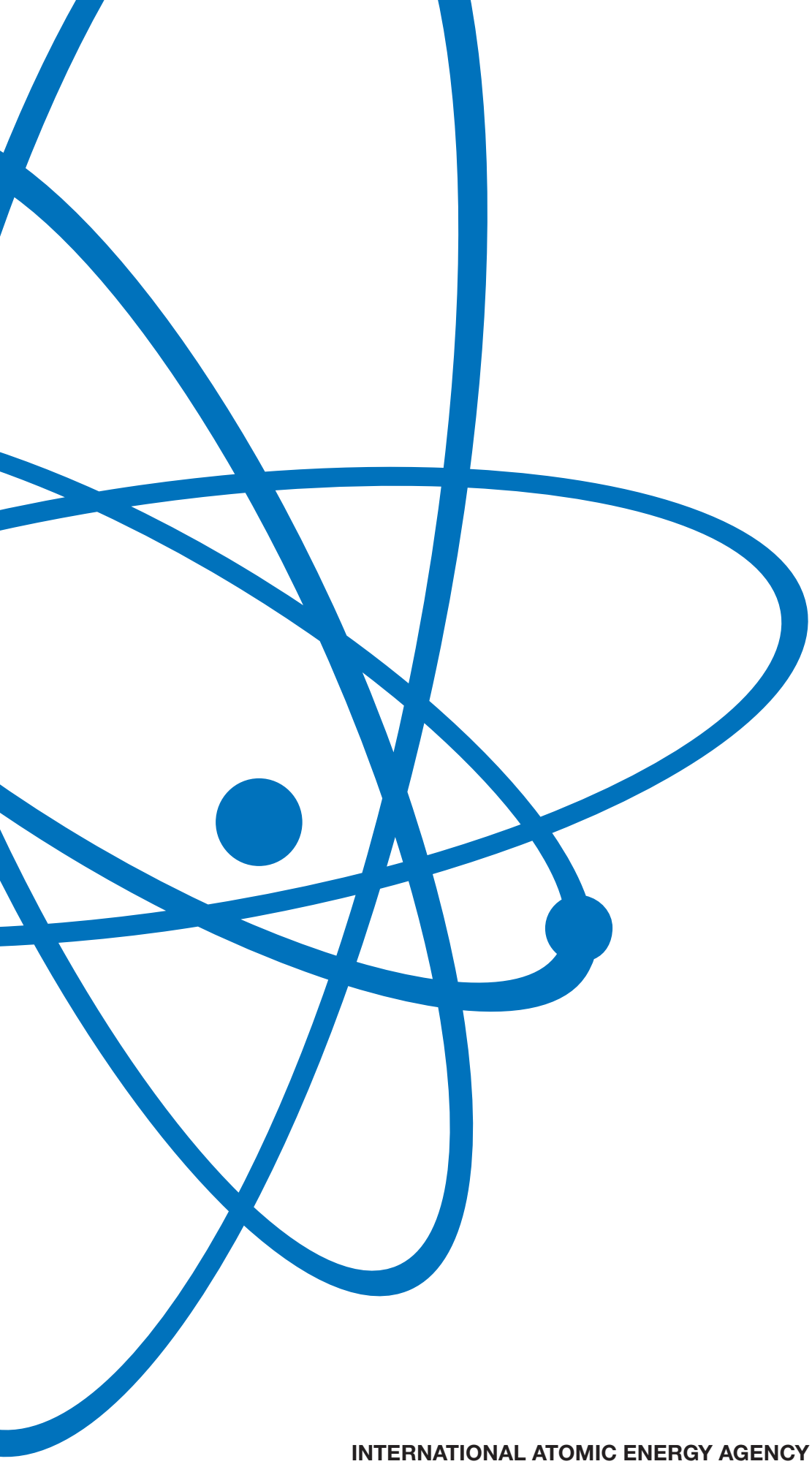
6. The second CSS meeting in 2019, held in December, was the last of its sixth term and the CSS Chairperson prepared an end of term report that is being finalized and will include recommendations for consideration during its seventh term.

7. In 2018, the CSS requested all Safety Standards Committees to undertake a review of the Safety Fundamentals publication SF-1. This review was performed by all Committees during 2018 and was finalized in early 2019. The results were discussed by all Chairpersons and an executive summary was prepared at a Chairs' meeting preceding the 45th CSS meeting in April 2019, where the summary was presented. All Committees identified several parts of SF-1 that could be improved, including parts that could be strengthened to improve consistency in the use of terminology or consistency with ICRP recommendations as well as with some of the General Safety Requirements. The possibility of introducing additional, new principles was also discussed. The Committees also commented that, overall, SF-1 remains valid, and that stability is important because it is widely used and supported by Member States. All Committees, and then the CSS, concluded that there was no justification for an immediate revision of SF-1, but recommended that, at some time in the future, a new review should be initiated with a dedicated framework to be established for the formal involvement of the current joint sponsoring organizations and possible additional joint sponsoring organizations.

8. The Agency included all newly issued safety standards and nuclear security guidance in the Nuclear Safety and Security Online User Interface (NSS-OUI) platform. All IAEA Safety Standards Series and IAEA Nuclear Security Series publications are available in full, are up-to-date and can be searched as a uniform knowledge base. The relationship search functionality of the platform was enhanced in 2019. The platform contains information on the relationship between the publications and helps users to navigate from one publication to other relevant guidance and recommendations from other publications.

9. The IAEA Safety Glossary: 2018 Edition was uploaded to a dedicated knowledge organization server and was used to tag the defined terms in the IAEA Safety Requirements with embedded links to the relevant glossary definitions. This web-based version of the IAEA Safety Glossary can also be used independently as an additional resource.

10. The NSS-OUI platform also enables the collection, storage and retrieval of feedback on the use of the current publications in both series. The functionality ensures that any revision of the safety standards or part of the safety standards is justified by the above-mentioned feedback, therefore also ensuring stability of the parts of the standards that remain valid. In 2019, the feedback mechanism was used by several Member State representatives and the Secretariat to document feedback on several safety standards publications, in particular the results of the review of the Safety Fundamentals publication SF-1. The NSS-OUI platform was used to develop a strategic plan for the revision of Safety Guides on the safety of nuclear fuel cycle facilities and will be further used for the systematic revision of other Safety Guides.



INTERNATIONAL ATOMIC ENERGY AGENCY
Department of Nuclear Safety and Security
Vienna International Centre, PO Box 100, 1400 Vienna, Austria
iaea.org/ns | Official.Mail@iaea.org

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