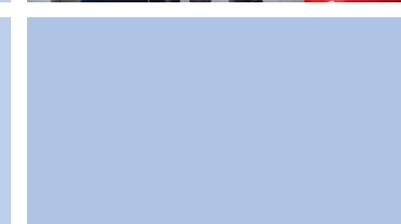
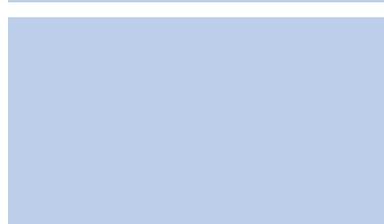
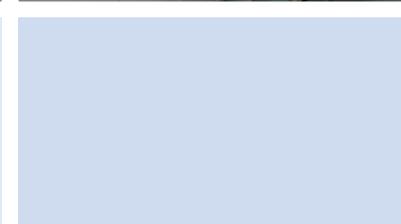
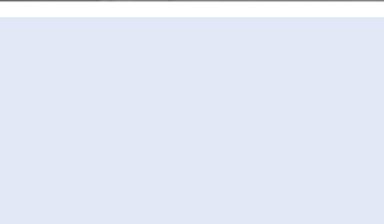
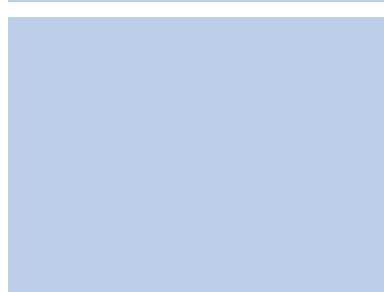
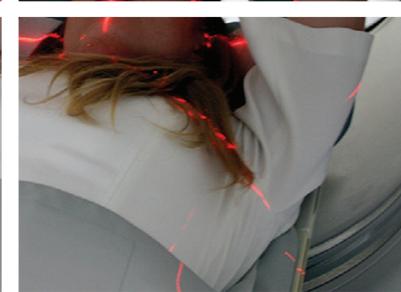
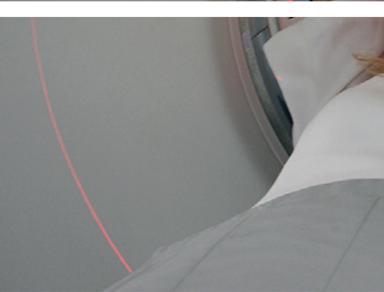


Nuclear Safety Review 2022



IAEA

International Atomic Energy Agency
Atoms for Peace and Development

GC(66)/INF/3

NUCLEAR SAFETY REVIEW 2022

GC(66)/INF/3

Nuclear Safety Review 2022
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Foreword

The *Nuclear Safety Review 2022* includes the global trends and the Agency's activities undertaken in 2021 and thereby demonstrates the progress made regarding the priorities for 2021. It also presents priorities for 2022 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 2022* was submitted to the March 2022 session of the Board of Governors in document GOV/2022/3. The final version of the *Nuclear Safety Review 2022* 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 2022

Executive Overview

1. The *Nuclear Safety Review 2022* reflects the global trends in 2021. It shows that the nuclear community continued to make steady progress in improving nuclear safety throughout the world. It also presents planned Agency activities for 2022 and priorities, as identified by the Agency, for strengthening nuclear, radiation, transport and waste safety, and emergency preparedness and response (EPR). Agency activities undertaken in 2021 can be found in Appendix A.



Nuclear Safety Priorities

- Assisting Member States in ensuring continuing safety of operating nuclear installations, such as power reactors (including those that are entering LTO), research reactors and fuel cycle facilities;
- Providing consistent support and guidance to embarking countries with regard to ensuring proper site selection, establishing an independent regulatory body, using Agency safety standards, and leveraging international experience and cooperation;
- Providing proactive support to Member States in the safe and secure development and deployment of small modular reactors and non-light water reactors, including hosting the International Conference on Topical Issues in Nuclear Installation Safety: Strengthening Safety of Evolutionary and Innovative Reactor Designs;
- Assisting Member States in developing and implementing national policies and strategies for the safe management of radioactive waste and spent fuel, for the promotion of disposal as the end state for waste, the development of decommissioning safety strategies and plans, and releases to the environment;
- Encouraging political commitment to the Code of Conduct on the Safety and Security of Radioactive Sources and its supplementary Guidance. The Agency will actively interact with Member States to encourage political and practical commitment to the Code and the Guidance. The objective is to get all Member States to participate in it, promote it and observe its recommendations;
- Continuing to assist Member States in strengthening their EPR capabilities through the implementation of IAEA Safety Standards Series No. GSR Part 7 and the delivery of capacity building activities, including consideration of the outcomes of the International Conference on the Development of Preparedness for National and International Emergency Response (EPR2021);
- Continuing the activities of the task force to conduct a review that will assess the Government of Japan's plan to discharge ALPS treated water at the Fukushima Daiichi NPP against relevant Agency safety standards. As proposed by the Director General, the Agency's work on the plan will take place before, during and after its implementation;
- Continuing to support Member States in managing the interface between nuclear safety and security for nuclear installations, radioactive sources and transport, including through guidance and capacity building activities; and
- Continuing to assist Member States in building and sustaining their technical and scientific capabilities supporting regulatory functions, based on IAEA TECDOC No. 1835 and the corresponding technical support organization self-assessment methodology.

2. During 2021, the Agency continued to carry out its mandate despite the challenges posed by the COVID-19 pandemic. The Agency published *The Operation, Safety and Security of Nuclear and Radiation Facilities and Activities during the COVID-19 Pandemic* (document GC(65)/INF/9) to report on the experiences of the Agency and experiences of Member States reported to the Agency regarding COVID-19. An update of this report will be provided to the Board of Governors at its meeting in March 2022.
3. The Executive Overview provides a summary of significant nuclear safety issues and trends covered in this period of reporting.
4. The work on the Agency's safety standards continued to focus on the revision of existing standards rather than the establishment of new ones. Seven Specific Safety Guides were published in 2021.
5. Analysis of Agency activities shows a continued commitment of Member States to strengthening national legal and governmental infrastructure despite the circumstances of the COVID-19 pandemic.
6. Broader analysis of peer review and advisory service mission reports shows that these continue to include recommendations relating to leadership, safety management, occupational radiation protection and safety culture.
7. Member States continue to express a need for Agency support as they develop and strengthen their national provisions for education, training, qualification and competence in radiation protection and safety. Member States also continue to request support regarding their knowledge management programmes for nuclear safety. Many Member States that are considering embarking on a nuclear power programme or on a first research reactor project face difficulties in allocating resources for regulatory capacity building.
8. Member States continue to show high interest in research related to EPR, including in the effective use of dose projection tools.



The Agency will:

- Strengthen its safety standards and assist with their application;
- Promote adherence to Conventions under its auspices and support their implementation;
- Assist Member States in strengthening their regulatory effectiveness;
- Assist Member States in strengthening leadership and management for safety;
- Assist Member States in strengthening their processes for communicating radiation risks;
- Assist Member States in their capacity building programmes; and
- Assist Member States' efforts in the field of research and development for safety.

General Safety

9. There is an increasing awareness among Member States of the need to protect workers and properly manage residues in industries involving naturally occurring radioactive material. There is also a need for revised guidance regarding the application of regulatory flexibility in exemption and clearance.
10. 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. Furthermore, the magnitude of recurrent radiological imaging of patients and the associated higher cumulated individual exposure has been shown to be more extensive than previously known.

11. There is a growing need for Member States that have not yet done so to put in place appropriate arrangements for the control of sources and the safe and secure management of disused¹ sealed radioactive sources, including national strategies for managing disused radioactive sources and establishing national programmes and regulatory requirements. In addition, Member States require further guidance on the application of the Code of Conduct on the Safety and Security of Radioactive Sources on ensuring financial provisions for the safe management and secure protection of disused radioactive sources. The number of Member States committed to acting harmoniously with the supplementary Guidance on the Import and Export of Radioactive Sources is 123, and the number of Member States who have committed to implementing the supplementary Guidance on the Management of Disused Radioactive Sources grew to 44 in 2021.

12. The need for more flexible provisions in Member States for the release of material and waste from regulatory control has increased. Requests continue for Agency support on interim safe long term management solutions for radioactive waste. Disposal is the safe long term management solution for waste. The Agency's Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS) continues to be in demand.

13. There is growing Member State interest in the identification and characterization of contaminated areas, knowledge for the development of remediation plans and conduct of supporting safety assessments, and guidance on how to plan and implement institutional control over a remediated area where free release does not apply.

14. Agency missions have shown that there is a growing need to analyse and evaluate the radiological implications of radionuclides being released to the environment. Member States continue to request Agency assistance in remediation activities.

15. There has been increased international attention regarding the handling of Advanced Liquid Processing System (ALPS) treated water at the Fukushima Daiichi nuclear power plant (NPP). In response to Japan's request, the Agency has formed a task force to conduct a review that will assess the Government of Japan's plan to discharge ALPS treated water against relevant Agency safety standards. The review started in September 2021. As proposed by the Director General, the Agency's work on the plan will take place before, during and after its implementation.



FOCUS AREAS

Strengthening Radiation, Transport and Waste Safety

The Agency will:

- Assist Member States in the management of radioactive sources;
- Promote the application of the Code of Conduct on the Safety and Security of Radioactive Sources and the supplementary Guidance on the Import and Export of Radioactive Sources and Guidance on the Management of Disused Radioactive Sources;
- Assist Member States in developing and implementing national policies and strategies for the safe management of radioactive waste and spent fuel, including disposal, and the development of decommissioning strategies and plans;
- Promote and facilitate the sharing of experience regarding the remediation of contaminated areas and;
- Conduct technical reviews, upon request, of Member State activities.

16. Operational Safety Review Team (OSART) mission reports continue to identify recommendations and suggestions regarding strengthening the conduct of safe operations; enhancing continuous improvement; optimizing maintenance activities; strengthening accident management and on-site EPR; and setting, communicating and implementing management expectations.

17. Safety Aspects of Long Term Operation (SALTO) missions continue to identify the need for improving the preparedness of NPPs for long term operation (LTO), specifically in the areas of safety

¹ Radioactive sources are defined as 'disused' when they are no longer used for the practice for which they were authorized.

assessment, including ageing, knowledge and competence management. Member States increasingly use periodic safety reviews for justifying LTO of NPPs and have an interest in sharing current challenges, good practices, and examples of corrective actions and resultant safety improvements.

18. Analysis of data from reports in the International Reporting System for Operating Experience (IRS) indicated a continuing need to learn from events related to human performance, improve operation and maintenance fundamentals, and improve leadership, management and oversight of processes and practices.

19. Member States continue to express an interest in the lessons arising from the Fukushima Daiichi accident with regard to site and design safety. They are also interested in sharing experiences of the safety reassessment of existing NPPs, performing reasonably practicable safety improvements for preventing accidents as needed, and, should an accident occur, mitigating its consequences and avoiding significant radioactive releases.

20. The number of requests from Member States for Site and External Events Design (SEED) missions, as well as other capacity building services related to this subject, continues to be high.

21. Member States continue to revise severe accident management guidance for existing NPPs to include safety upgrades and non-permanent equipment as well as to address multi-unit considerations.

22. The application of Agency safety standards to innovative designs of NPPs, including small and medium sized or modular reactors (SMRs), is a matter of great interest to Member States. The Agency developed the Platform on Small Modular Reactors and their Applications.

23. The regulatory bodies in the Small Modular Reactor Regulators' Forum acknowledge the need to enhance their international cooperation on SMR regulation. Furthermore, Member States expressed an interest in applying a holistic approach to safety–security–safeguards by design for nuclear installations, in particular for SMRs in the early stage of the design process.

24. 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.

25. Analysis of reports provided to the Fuel Incident Notification and Analysis System in 2021 showed the importance of establishing effective ageing management programmes, continued training of personnel, and effective use of operating procedures.

26. The Integrated Regulatory Review Service (IRRS), Integrated Nuclear Infrastructure Review² (INIR) and other peer review and advisory services undertaken in embarking countries continue to identify the need to strengthen regulatory body independence, build regulatory capacity and competence, and establish safety regulations and licensing processes as part of effective legislative and regulatory oversight programmes.

² The Integrated Nuclear Infrastructure Review is a service provided by the Agency's Department of Nuclear Energy regarding nuclear power programmes. It is reported here due to its coordinated delivery with many safety related elements.



FOCUS AREAS

Strengthening Safety in Nuclear Installations

The Agency will:

- Assist Member States in implementing programmes for ageing management and the long term operation;
- Facilitate the exchange of operating experience;
- Provide assistance to Member States to support their preparation for implementation of safety upgrades;
- Assist Member State activities related to small and medium sized or modular reactors;
- Strengthen the application of the Code of Conduct on the Safety of Research Reactors; and
- Assist Member States in the development of safety infrastructures for new nuclear power and research reactor programmes.

27. In 2021, two further Member States became Parties to the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency. The number of Member States using the International Radiation Monitoring Information System for the regular sharing of simulated emergency radiation monitoring data decreased in 2021.

28. Member States are increasingly requesting support in strengthening national and regional EPR arrangements. Many requests relate to the need for support and advice in implementing the requirements established in IAEA Safety Standards Series No. GSR Part 7, requests for the development of new Safety Guides, for the revision of existing Safety Guides, and for training and exercises.

29. The number of published Emergency Preparedness and Response Information Management System (EPRIMS) self-assessment modules increased from 1790 in 2020 to 1815 in 2021. The analysis of new information uploaded to EPRIMS allowed the Agency to assess progress made in technical cooperation projects and to identify global trends in national EPR arrangements based on Agency safety standards. The lowest level of implementation is shown for Requirement 17 (international assistance) followed by Requirements 15 (radioactive waste management), 16 (mitigating non-radiological consequences) and 18 (terminating a nuclear or radiological emergency). In this light, the Agency developed new guidance to further support Member States' implementation of these requirements.

30. Member States continue to seek Agency support in improving the preparation, conduct and evaluation of national emergency exercises.



FOCUS AREAS

Strengthening Emergency Preparedness and Response

The Agency will:

- Further develop and support the implementation of the operational arrangements for notification, reporting and assistance;
- Assist Member States in the implementation of IAEA Safety Standards Series No. GSR Part 7 and develop associated Safety Guides; and
- Continue to implement an active exercise programme at the international level to test EPR and support national EPR exercise programmes.

31. Member States continue to attach importance to having in place effective and coherent nuclear liability mechanisms at the national and international levels. Member States continue to request Agency assistance in their efforts to adhere to and implement the international nuclear liability conventions.

32. The number of contracting parties to the Convention on Nuclear Safety increased by two, and to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management by three, during 2021.



FOCUS AREAS

**Improving
Management
of the Safety and
Security Interface
And
Strengthening
Civil Liability for
Nuclear Damage**

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; 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.

33. The Agency's priorities for 2022 regarding strengthening nuclear, radiation, transport and waste safety, and EPR are as follows:

- Assisting Member States in ensuring continuing safety of operating nuclear installations, such as power reactors (including those that are entering LTO), research reactors and fuel cycle facilities;
- Providing consistent support and guidance to embarking countries with regard to ensuring proper site selection, establishing an independent regulatory body, using Agency safety standards, and leveraging international experience and cooperation;
- Providing proactive support to Member States in the safe and secure development and deployment of small modular reactors and non-light water reactors, including hosting the International Conference on Topical Issues in Nuclear Installation Safety: Strengthening Safety of Evolutionary and Innovative Reactor Designs;
- Assisting Member States in developing and implementing national policies and strategies for the safe management of radioactive waste and spent fuel, for the promotion of disposal as the end state for waste, the development of decommissioning safety strategies and plans, and releases to the environment;
- Encouraging political commitment to the Code of Conduct on the Safety and Security of Radioactive Sources and its supplementary Guidance. The Agency will actively interact with Member States to encourage political and practical commitment to the Code and the Guidance. The objective is to get all Member States to participate in it, promote it and observe its recommendations;
- Continuing to assist Member States in strengthening their EPR capabilities through the implementation of IAEA Safety Standards Series No. GSR Part 7 and the delivery of capacity building activities, including consideration of the outcomes of the International Conference on the Development of Preparedness for National and International Emergency Response (EPR2021);
- Continuing the activities of the task force to conduct a review that will assess the Government of Japan's plan to discharge ALPS treated water at the Fukushima Daiichi NPP against relevant Agency safety standards. As proposed by the Director General, the Agency's work on the plan will take place before, during and after its implementation;
- Continuing to support Member States in managing the interface between nuclear safety and security for nuclear installations, radioactive sources and transport, including through guidance and capacity building activities; and

- Continuing to assist Member States in building and sustaining their technical and scientific capabilities supporting regulatory functions, based on IAEA TECDOC No. 1835 and the corresponding technical support organization self-assessment methodology.

Abbreviations

ALPS	Advanced Liquid Processing System
AMRAS	Advisory Mission on Regulatory Infrastructure for Radiation Safety
ARTEMIS	Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation
CGULS	Coordination Group for Uranium Legacy Sites
CNS	Convention on Nuclear Safety
CRP	coordinated research project
CSC	Convention on Supplementary Compensation for Nuclear Damage
CSS	Commission on Safety Standards
EduTA	Education and Training Appraisal
EPR	emergency preparedness and response
EPREV	Emergency Preparedness Review
EPRIMS	Emergency Preparedness and Response Information Management System
GNSSN	Global Nuclear Safety and Security Network
IES	Incident and Emergency System
IEC	Incident and Emergency Centre
iNET-EPR	International Network for Education and Training for Emergency Preparedness and Response
INIR	Integrated Nuclear Infrastructure Review
INLEX	International Expert Group on Nuclear Liability
INSAG	International Nuclear Safety Group
IRMIS	International Radiation Monitoring Information System
IRRS	Integrated Regulatory Review Service
ISCA	Independent Safety Culture Assessment
LTO	long term operation
NORM	naturally occurring radioactive material
NPP	nuclear power plant
NSS-OUI	Nuclear Safety and Security Online User Interface
ORPAS	Occupational Radiation Protection Appraisal Service
OSART	Operational Safety Review Team
PGEC	postgraduate educational course

PROSPER	Peer Review of Operational Safety Performance Experience
PSR	periodic safety review
RANET	Response and Assistance Network
RASIMS	Radiation Safety Information Management System
RCF	Regulatory Cooperation Forum
RPO	radiation protection officer
SALTO	Safety Aspects of Long Term Operation
SAMG-D	Severe Accident Management Guideline Development
SARIS	Self-Assessment of Regulatory Infrastructure for Safety
SCCIP	Safety Culture Continuous Improvement Process
SEED	Site and External Events Design
SMR	small and medium sized or modular reactor
TECDOC	IAEA Technical Document
TNPP	transportable nuclear power plant
TSR	Technical Safety Review
USIE	Unified System for Information Exchange in Incidents and Emergencies

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 March 2011 Fukushima Daiichi nuclear accident has been completed. The revision of the related Safety Guides also continues to be a focus.



2. The impact of COVID-19 on nuclear and radiation safety has been discussed at several meetings, including of the International Nuclear Safety Group (INSAG) and the Commission on Safety Standards. The Commission on Safety Standards strategic planning meeting concluded that reviewing the safety standards in light of the COVID-19 pandemic was not a priority.

3. The Agency's peer review and advisory services continued to be provided to Member States upon request, and Member State requests for these services remains high (see Figure 1). Many reviews were conducted face-to-face with site visits, but some others were postponed until 2022 or later owing to the COVID-19 pandemic travel restrictions. Some missions were implemented as virtual events.

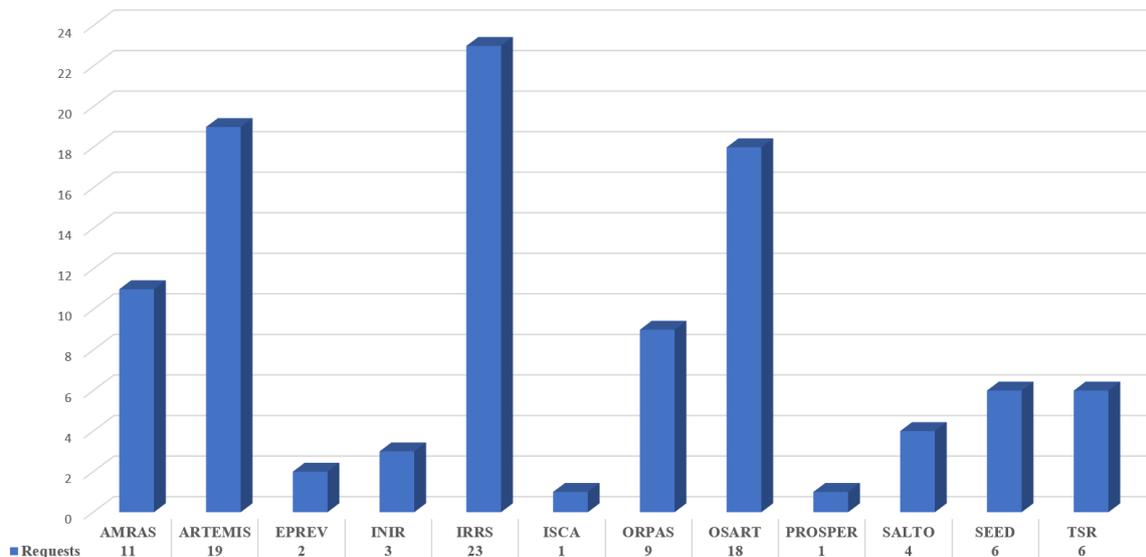


Fig. 1. Number of Member State requests for Agency peer review and advisory services to be conducted over the next two years.

Related Activities

4. 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 is planning to undertake the following related activities:

- Continue to encourage Member States to request Agency peer review and advisory services to strengthen their operational safety performance and leadership and management for safety;
- Organize a Technical Meeting on the work of the Peer Review and Advisory Services Committee;
- Continue activities on the pilot application of the Technical Safety Review (TSR) service for novel advanced reactors, including small and medium sized or modular reactors (SMRs);
- Continue assisting Member States in strengthening radioactive waste and spent fuel management through the implementation of the Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS); and continue the improvement of the service, including the exploration of the development of an online tool for the ARTEMIS self-assessment questionnaire, and the development of guidance to conduct Integrated Regulatory Review Service (IRRS) and ARTEMIS missions in a back-to-back manner;
- Continue strengthening Emergency Preparedness Review (EPREV) missions by extending the pool of experts serving as reviewers, facilitating the self-assessment process using the Emergency Preparedness and Response Information Management System (EPRIMS), increasing transparency of findings, and using performance indicators to assess the effectiveness and efficiency of each mission; and
- Follow up on the outcomes of the International Conference on a Decade of Progress After Fukushima-Daiichi: Building on the Lessons Learned to Further Strengthen Nuclear Safety.

A.2. International Safety Conventions

Trends

5. The Convention on Nuclear Safety (CNS) was adopted on 17 June 1994 and entered into force on 24 October 1996. As of December 2021, there were 91 Contracting Parties to the CNS, an increase of two compared to the end of 2020 (see Figure 2).

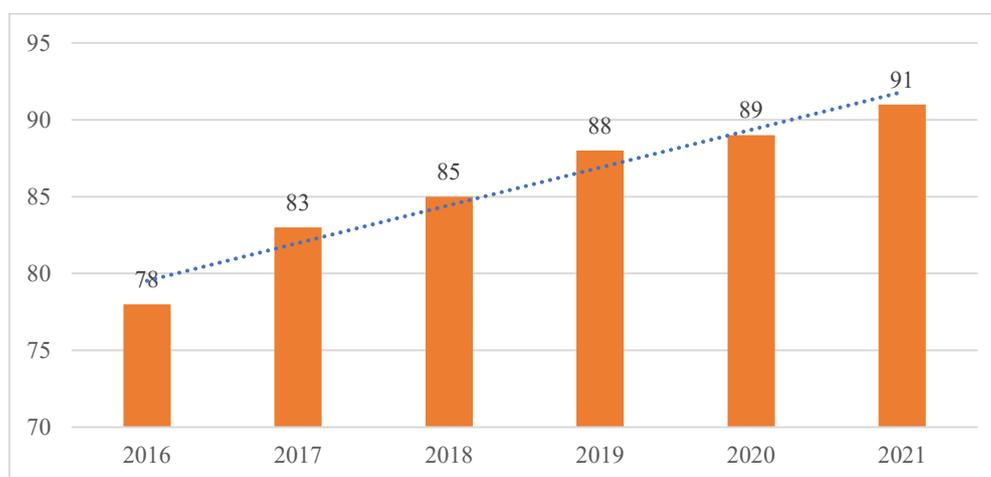


Fig. 2: Number of Contracting Parties to the CNS between 2016 and 2021.

6. The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (Joint Convention) was adopted on 5 September 1997 and entered into force on 18 June 2001. As of December 2021, there were 86 Contracting Parties to the Joint Convention, an increase of 3 compared to the end of 2020 (see Figure 3).

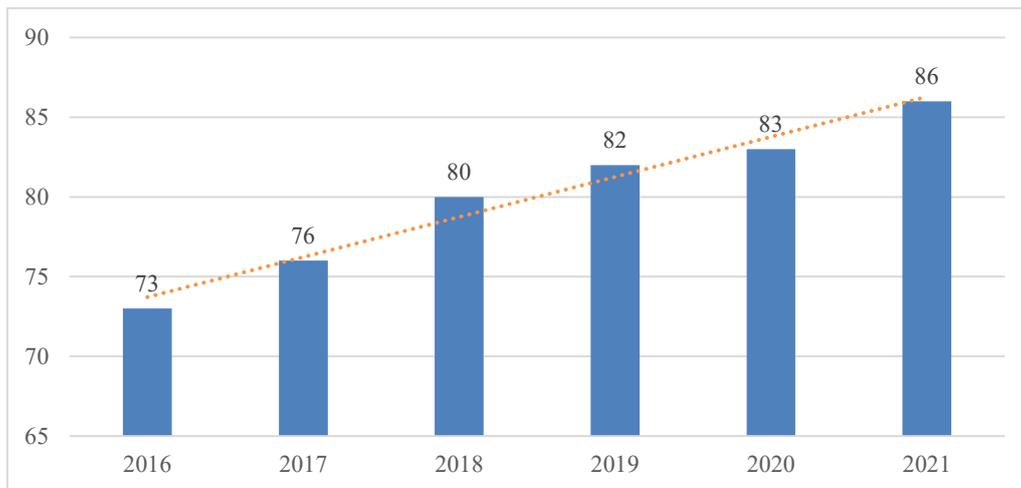


Fig. 3: Number of Contracting Parties to the Joint Convention between 2016 and 2021.

Related Activities

7. *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 is planning to undertake the following related activities:*

- Organize the Seventh Review Meeting, and hold the Fourth Extraordinary Meeting, of the Contracting Parties to the Joint Convention;
- Continue to promote the adherence of Member States to international safety conventions; and
- Organize educational workshops for Contracting Parties to ensure effective implementation of the CNS.

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

Trends

8. Information provided in the Agency's Radiation Safety Information Management System (RASIMS)³ indicates that 70%⁴ of Member States whose information in the system has been evaluated have a regulatory infrastructure for radiation safety with a 'satisfactory' or 'good' level of compliance with Agency safety standards.

9. The four IRRS missions conducted in 2021 highlighted the continued commitment of the Member States concerned to strengthening national legal and governmental infrastructure despite the pandemic-related circumstances. The Agency's ongoing analysis of IRRS missions conducted since 2015 shows that many regulatory bodies still experience issues in relation to long term human resource planning,

³ RASIMS can be found at <https://rasims.iaea.org/>.

⁴ This percentage is based on verified data in the new version of RASIMS. It is slightly lower than last year, as Member States are still in the process of entering their data into the new system.

management systems, and the implementation of a graded approach to regulatory processes, including authorization and inspection.

10. There is increasing interest from Member States in the assessment of their radioactive waste and spent fuel management, decommissioning and remediation programmes, as demonstrated by the number of requests for ARTEMIS missions.

11. The Agency surveyed 124 radiation safety regulatory bodies to identify the impacts of the COVID-19 pandemic on the safety of facilities using radiation sources and their regulatory oversight. Analysis suggests that many regulatory functions have been diminished and some companies may have to close as a result of the economic impact of the pandemic, and there could be an increased risk of radioactive sources becoming orphaned. This information, and other information relevant to the COVID-19 pandemic, was provided in *The IAEA and the COVID-19 Pandemic* (document GC(65)/INF/9).

12. The Agency noted continued interest among many Member States in updating national emergency preparedness and response (EPR) frameworks, including EPR regulations, and harmonizing national arrangements with *Preparedness and Response for a Nuclear or Radiological Emergency* (IAEA Safety Standards Series No. GSR Part 7). EPRIMS continued to help Member States and the Secretariat learn about the key needs and efforts in this field. Data indicate that 4% of Member States conducted or updated one of their self-assessments against GSR Part 7 during 2021.

13. The number of requests for Occupational Radiation Protection Appraisal Service (ORPAS) missions remains high, and consultation with several Member States continued concerning the future of ORPAS missions. This consultation indicates a continual need for guidance and training for radiation protection officers (RPOs) and qualified experts, as well as an extension of the monitoring scope of technical service providers to strengthen occupational radiation protection.



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

There is ...

- Continued commitment to strengthening national legal and governmental infrastructure;
- Continued interest among many Member States in updating national EPR frameworks, including EPR regulations, and harmonizing national arrangements;
- Increasing interest in ARTEMIS missions.

There are ...

- Issues in relation to long term human resource plans, the management system and the implementation of the graded approach within regulatory processes.

Need for ...

- Training for RPOs and qualified experts, and extension of the monitoring scope of technical service providers to strengthen occupational radiation protection.

Related Activities

14. 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 is planning to undertake the following related activities:

- Organize workshops to assist RASIMS national coordinators in providing information on their national radiation safety infrastructures; and
- Prepare a virtual workshop on regulatory infrastructure for radiation safety.

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

Trends

15. Agency peer review and advisory service mission reports continue to include recommendations relating to leadership, safety management, occupational radiation protection and safety culture.

16. The number of requests from Member States for assistance in conducting safety culture self-assessments for regulatory bodies remains high. The number of requests for the International School of Nuclear and Radiological Leadership for Safety also remains high.

17. Thematic working groups and Technical Meetings have highlighted the need for the Secretariat to further support Member States in developing communication strategies and plans.



- Review and advisory service mission reports continue to include recommendations relating to leadership, safety management, occupational radiation protection and safety culture;
- Member States continue to request assistance in developing their programmes on leadership and safety management.

Leadership and Management for Safety, Safety Culture and Communication on Safety

Need for ...

- The Secretariat to further support Members States in developing communication strategies and plans.

Related Activities

18. The Agency will assist Member States in strengthening leadership and management for the safety of nuclear and radiation 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 is planning to undertake the following related activities:

- Implement the International School of Nuclear and Radiological Leadership for Safety in the Africa, Asia and the Pacific, and Latin America and the Caribbean regions, including the development of new case studies for regulatory bodies; and
- Hold a Technical Meeting to discuss the draft text of a Safety Guide on leadership, management and culture for safety.

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

Trends

19. Member States continue to express a need for Agency support as they develop and strengthen their national provisions for education, training, qualification and competence in radiation protection and safety, in order to achieve closer alignment with Agency safety standards. Member States have provided information on the current status of their national provisions in order to identify areas where these should be strengthened and have evaluated the education and training needs at the national level, particularly for personnel with responsibilities for radiation protection and safety (RPOs and qualified experts).

20. The Postgraduate Education Course (PGEC) in Radiation Protection and the Safety of Radiation Sources continued to be an effective programme through which Member States can train personnel with regulatory or advisory functions in radiation safety. Member States showing an increasing interest in hosting the course, under the auspices of the Agency, for the benefit of other Member States at the regional level.

21. The demand for training of RPOs continued to be high with a ‘train the trainers’ approach effectively addressing this demand. There is an increasing interest in running these events in an online format in light of the COVID-19-related travel restrictions. In general, there is a growing interest in online and web-based training on radiation protection, including radiation protection in medical uses of ionizing radiation, occupational radiation protection and radon.

22. Information provided by Member States to the Steering Committee on Regulatory Capacity Building and Knowledge Management shows that the implementation of the strategic approach to education and training in nuclear safety and the work of the Steering Committee and the Secretariat were on track. Building and sustaining capacity in nuclear safety remains important, and the Agency will continue to support Member States in this priority area.

23. 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 and safety assessment, protection against external events, design extension conditions, severe accident management, long term operation (LTO) 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 in training on safety assessment computational tools, probabilistic safety assessment, severe accident management guidelines, drafting regulations, inspector training, and senior manager leadership and safety culture from Member States embarking on new nuclear power programmes.

24. 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.

25. Member State interest in EPR capacity building activities has grown. In 2021, the Agency signed Practical Arrangements for cooperation in the area of EPR, including capacity building with the Institute for Radiological Protection and Nuclear Safety, France; and extended its cooperation with two existing Capacity Building Centres (CBCs), the Civil Protection School of the Federal Ministry of the Interior, Austria, and the Korea Institute of Radiological and Medical Sciences, Republic of Korea.

26. As the number of in-person events was reduced, the use of virtual methods increased, and there was a great deal of interest in such events, as evidenced by the high number of participants. In 2021, the Agency implemented the following training events in the area of EPR: 13 virtual training events at the national level, with a total of 506 participants; 14 training events (3 in person and 11 virtual) at the regional level, with a total of 455 participants from 82 Member States; and 50 webinars, with a total of over 6100 attendees.



27. Young graduates have shown interest in the opportunity to build their qualifications in EPR by applying for the master's degree programme in EPR.

28. International Network for Education and Training for Emergency Preparedness and Response (iNET-EPR) membership grew to 179 in 2021 from 172 in 2020, allowing for the exchange of information and resources and enhancing education and training in EPR through CBCs.

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



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

- Member States continue to request Agency support as they develop and strengthen their national provisions for education, training, qualification and competence in radiation protection and safety, in order to achieve closer alignment with Agency safety standards.

There is ...

- 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;
- 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 manager leadership and safety culture from Member States embarking on new nuclear power programmes;
- A growing interest in online and web-based training on radiation protection.

Need for ...

- Support in developing or strengthening national and organizational knowledge management programmes for nuclear safety, in developing or strengthening national capacity building programmes based on Agency guidance, and support in developing or strengthening technical and scientific capacity including technical and scientific support organizations.

Related Activities

30. 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 is planning to undertake the following related activities:

- Support Member States in the development and strengthening of provisions for education, training, qualification and competence in radiation protection and safety, and on the establishment of national strategies in this area;
- Continue enhancing, including by virtual methods, education and training programmes and implementing capacity building activities in the areas of safety assessment and design safety;
- Continue to provide the PGEC in Radiation Protection and the Safety of Radiation Sources and organize train the trainer events for trainers of RPOs;
- Develop a training course on the methodology of the Systematic Assessment of Regulatory Competence Needs for regulatory bodies of radiation facilities and activities; and
- Continue delivering EPR capacity building activities, including through remote participation through iNET-EPR; and continue the dialogue with universities on the possibility of launching the master's degree programme on EPR as a standalone programme, or including an EPR component as an additional module to their existing programmes.

A.6. Research and Development for Safety

Trends

31. Much of the recent research and development work undertaken in Member States focused on severe accident phenomena and safety features for design extension conditions to ensure the practical elimination of conditions that can lead to early or large radioactive release should an accident occur.

32. Member States continue to show high interest in research related to EPR, including in the effective use of dose projection tools, as demonstrated by their participation and contribution in a coordinated research project (CRP) on this topic. In addition, Member States expressed interest in documenting and sharing the outcomes of the CRP “Development of Approaches, Methodologies and Criteria for Determining the Technical Basis for Emergency Planning Zone for Small Modular Reactor Deployment”, which concluded in 2021.

Related Activities

33. The Agency will assist Member State 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 is planning to undertake the following related activities:

- Finalize the report of the CRP “Radioactive Release from the Prototype Fast Breeder Reactor Under Severe Accident Conditions”;
- Hold a Technical Meeting on Advanced Technologies and Systems for Containment Preservation in Design Basis Accidents and Design Extension Conditions with Core Melting, and a Technical Meeting on Ex-Vessel Molten Corium Behaviour and Coolability;
- Continue to carry out research and development activities in support of the safety of advanced/innovative reactors, including carrying out the study on the applicability of Agency safety standards to accident tolerant fuels;

- Continue to encourage research and development based on needs identified, particularly regarding advanced approaches in safety assessment, analysis of design extension conditions, new design features, and equipment qualification in severe accident conditions;
- Continue to carry out CRPs, including “Developing a Phenomena Identification and Ranking Table (PIRT) and a Validation Matrix, and Performing a Benchmark for In-Vessel Melt Retention”, and the Coordination Meeting of the CRP “Effective Use of Dose Projection Tools in the Preparedness and Response to Nuclear and Radiological Emergencies”; and
- Prepare an IAEA Technical Document on the development of approaches and methodologies for determining emergency planning zones for small modular reactors.

B. Strengthening Radiation, Transport and Waste Safety

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

Trends

34. There is an increasing awareness among Member States, including through Agency activities regarding naturally occurring radioactive material (NORM), of the need to protect workers and properly manage residues in industries involving NORM, and to apply a graded approach to the use of regulatory and operator resources for these tasks in line with the International Basic Safety Standards (IAEA Safety Standards Series No. GSR Part 3). The Agency is aware through national and regional projects that several Member States have already established regulatory requirements, and many are in the process of establishing such requirements for the safe management of NORM.

35. Member States are increasingly requesting Agency support for regulatory flexibility in exemption of practices or sources, as well as in the clearance of material from authorized practices, and there is a need for revised guidance. The application of a graded approach has been challenging especially in dealing with those cases related to existing exposure situations, such as international trade of commodities, criteria for exemption of surface contaminated non-food commodities and conditional clearance of materials.

36. High participation in Agency webinars and feedback from Member States both indicate a growing awareness among Member States of the effects of exposure to radon in homes and workplaces. High interest in the Technical Meeting on Radionuclides in Food and Drinking Water in Non-Emergency Situations confirms that the subject is an important concern. Non-medical human imaging is also a topic of increasing interest that raises new challenges, including ethical considerations, for regulatory bodies.

37. 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. 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. Furthermore, the magnitude of recurrent radiological imaging of patients and the associated higher cumulated individual exposure have been shown to be more extensive than previously known.



Radiation Protection of Patients, Workers and the Public

- Magnitude of recurrent radiological imaging and the associated higher exposure are more extensive than previously known;
- 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;
- Growing awareness among Member States of the effects of exposure to radon in homes and workplaces.

Need for ...

- Revised guidance regarding the application of regulatory flexibility in exemption and clearance.

Related Activities

38. 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 people and the environment for applications such as energy production, research, and medical and industrial uses of radionuclides. The Agency is planning to undertake the following related activities:

- Organize, in cooperation with the International Labour Organization, the International Conference on Occupational Radiation Protection: Strengthening Radiation Protection of Workers — Twenty Years of Progress and the Way Forward;
- Co-sponsor the Tenth International Symposium on Naturally Occurring Radioactive Material;
- Hold the annual meeting of the Regulatory Forum for Safety of Uranium Production and NORM;
- Organize national workshops on GSR Part 3 in response to requests from Member States; and
- Hold a Technical Meeting on radiation protection in fluoroscopy guided interventional procedures.

B.2. Control of Radiation Sources

Trends

39. The increased use of sealed radioactive sources in medicine, industry, agriculture and research has resulted in a need to establish and, if already established, maintain appropriate arrangements for the control of sources and the safe and secure management of disused sealed radioactive sources, including national strategies for managing disused radioactive sources and establishing national programmes and regulatory requirements.

40. Member States request further guidance on the application of paragraph 22(b) of the Code of Conduct on the Safety and Security of Radioactive Sources on ensuring financial provisions for the safe management and secure protection of radioactive sources once they have become disused, as well as on regulatory requirements for the different options in the management of disused sources.

41. In 2021, no additional Member States made a political commitment to implementing the Code of Conduct on the Safety and Security of Radioactive Sources, and the total number remains at 140. Since the issuance of the *Nuclear Safety Review 2021*, no 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, so the total number of Member States that have done so remains at 123. No additional Member States nominated points of contact for facilitating the import and export of radioactive sources, for which the total number of Member States remains at 145, and 5 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 44 (see Figure 4).



TRENDS

Control of
Radiation Sources

Need for ...

- Appropriate arrangements for the control of sources and the safe and secure management of disused sealed radioactive sources, including having national strategies.

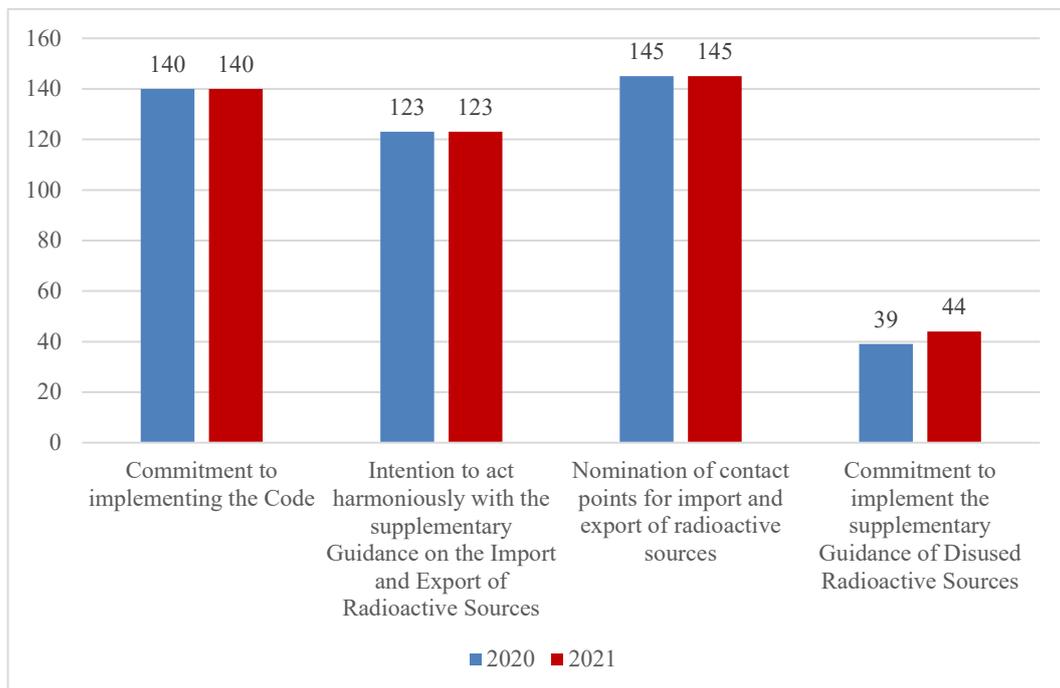


Fig. 4: Member State support for the Code of Conduct on the Safety and Security of Radioactive Sources and its supplementary Guidance documents.

Related Activities

42. 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 is planning to undertake the following related activities:

- Organize the International Conference on the Safety and Security of Radioactive Sources;
- The Agency will actively interact with Member States to encourage political and practical commitment to the Code and the Guidance. The objective is to get all Member States to participate in it, promote it and observe its recommendations;

- Continue organizing regional workshops to raise awareness of, provide information on, and encourage political commitment to, the Code of Conduct on the Safety and Security of Radioactive Sources and its supplementary Guidance; and
- Complete the template on best practice regarding the implementation of the Code of Conduct on the Safety and Security of Radioactive Sources.

B.3. Safe Transport of Radioactive Material

Trends

43. The increased use of radioactive material in Member States is creating a growing need to establish and, if already established, maintain regulatory oversight, including for domestic and international transport.
44. Denials and delays of international shipments of radioactive material continue to be a problem for Member States.
45. Some Member States are increasingly interested in the construction and deployment of transportable nuclear power plants (TNPPs).
46. There is a need to provide training in languages other than English to complement the Arabic, Chinese, French, Russian and Spanish versions of *Regulations for the Safe Transport of Radioactive Material* (IAEA Safety Standards Series No. SSR-6 (Rev. 1)).



- Denial and delays for international shipments of radioactive material continues to be a problem for Member States;
- An increased interest in the construction and deployment of TNPPs.

Need for ...

- Regulatory oversight, including for domestic and international transport;
- To provide training in the UN languages regarding the *Regulations for the Safe Transport of Radioactive Material* SSR-6 (Rev.1).

Safe Transport of Radioactive Material

Related Activities

47. The Agency will assist Member States in building capacity for the safe transport of radioactive material. The Agency is planning to undertake the following related activities:

- Establish the Denial of Shipment Working Group;
- Complete a formal review process for IAEA Safety Standards Series No. SSR-6 (Rev. 1); and
- Complete the Arabic, Chinese, French, Russian and Spanish versions of Modules 5–9 of the Transport Safety e-Learning platform.

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

Trends

48. Demand for the ARTEMIS service continues to increase, and the Agency has been requested to organize 19 ARTEMIS reviews in 2022 and 2023.



**Integrated
Review Service
for Radioactive
Waste and Spent
Fuel Management,
Decommissioning
and Remediation
(ARTEMIS)**

Planning for 2022–2023:

19

The Agency has been requested to organize 19 ARTEMIS reviews.

49. As the worldwide nuclear industry ages, significant global growth in the number of nuclear decommissioning projects has increased the need for more flexible provisions in Member States for release of material and waste from regulatory control. Member States are looking for new guidance on establishing clearance levels and granting unconditional, conditional and case-by-case clearance.

50. Member States continue to seek Agency assistance in developing and implementing safe interim and long term management solutions for radioactive waste, including the siting of radioactive waste management facilities. Disposal provides a safe and permanent long term management solution for waste. Assisting Member States in planning for and implementing national disposal programmes is an ongoing priority for the Agency. There is increasing interest in shared solutions for radioactive waste management.

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

52. Several Member States are increasingly interested in geological disposal of high level radioactive waste and spent fuel when considered as waste. Research, site investigations, licensing and construction activities for geological disposal facilities are progressing in many Member States.

53. Member States continue to request assistance in the safe long term management of disused sealed radioactive sources, including in the development of safe and secure storage facilities and borehole disposal facilities.

54. 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.



**Decommissioning,
Spent Fuel
Management
and Waste
Management**

There is an ...

- Increased interest in Agency support to develop and implement plans for near surface disposal of very low and low level radioactive waste;
- Increased interest in geological disposal of high level radioactive waste and spent fuel when considered as waste.

Need for ...

- More flexible provisions in Member States for release of material and waste from regulatory control;
- Agency support in establishing regulatory and safety infrastructure for regulating the management of residues containing NORM.

Related Activities

55. 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 is planning to undertake the following related activities:

- Continue activities related to the development and implementation of national policies and strategies for the safe management of radioactive waste and spent fuel;
- Organize the Third Plenary Meeting of the International Harmonization and Safety Demonstration Project for Predisposal Radioactive Waste Management;
- Complete the development of three training modules on safety of decommissioning, covering characterization, safety assessment and planning and project management; and conduct training events for the field-testing of specialized training modules on safety assessment for the decommissioning of facilities, and on decommissioning planning and project management;
- Hold Technical Meetings related to the safety of disposal and decommissioning; and
- Continue implementing activities under the Regulatory Forum for Safety of Uranium Production and NORM to promote application of Agency safety standards.

B.5. Radiation Protection of the Environment and Remediation

Trends

56. There is increased international attention on the handling of Advanced Liquid Processing System (ALPS) treated water at the Fukushima Daiichi nuclear power plant (NPP). In response to Japan's request, the Agency has formed a task force to conduct a review that will assess the Government of Japan's plan to discharge ALPS treated water against relevant Agency safety standards.

57. With rising concern regarding radiologically contaminated areas by past practices and the need for remediation of such areas for protection of human health and the environment, there is growing interest in identification and characterization of contaminated areas. Where remediation is identified to be essential, there are needs for knowledge pertaining to the development of remediation plans and for the conduct of supporting safety assessments. For those remediation activities that are under way or completed, there is a need for guidance on how to plan and implement institutional control over a remediated area where free release does not apply.

58. As observed during Agency missions, the use of a wide range of nuclear techniques and applications worldwide, as well activities such as uranium mining and milling and NORM industries, has resulted in a growing need to analyse and evaluate the radiological implications of radionuclides being released into the environment. This includes Member State 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 and for protecting the public from exposure to radionuclides in the environment stemming from past and potential future practices.

59. There is also growing Member State interest in the assessment of past unregulated activities and events 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. The existence of areas of unregulated past activities undermines trust in both governance and industry and can result in the withdrawal of the social licence for various ongoing and future activities.



Radiation Protection of the Environment and Remediation

There is ...

- Increased international attention on the handling of ALPS treated water at the Fukushima Daiichi NPP;
- Growing interest in the assessment of past unregulated activities and events, and the control of their impact;
- Growing interest in identification and characterization of contaminated areas.

Need for ...

- Analysis and evaluation of the radiological implications of radionuclides being released to the environment;
- Guidance on how to plan and implement institutional control over a remediated area where free release does not apply.

Related Activities

60. 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 also conduct technical reviews, upon request, of Member State activities against the relevant Agency safety standards. The Agency is planning to undertake the following related activities:

- Continue the activities of the task force to conduct a review that will assess the Government of Japan's plan to discharge ALPS treated water at the Fukushima Daiichi NPP against relevant Agency safety standards. As proposed by the Director General, the Agency's work on the plan will take place before, during and after its implementation;
- Continue to implement the activities of the International Working Forum on Regulatory Supervision of Legacy Sites, including Technical Meetings and a regional workshop;
- Hold a Technical Meeting on providing international assistance to take protective actions at uranium legacy sites and a Technical Meeting on the management of remediated areas;
- Hold the annual meeting of the Coordination Group for Uranium Legacy Sites (CGULS), as well as a Technical Meeting on the technical support of CGULS on the remediation of uranium legacy sites in Central Asia;
- Continue to run and coordinate the activities of the Methods for Radiological and Environmental Impact Assessment programme on methods for the assessment of radiation doses to the public and the environment from radionuclide releases; and
- Update the Database on Discharges of Radionuclides to the Atmosphere and Aquatic Environment.

C. Strengthening Safety in Nuclear Installations

C.1. Nuclear Power Plant Safety

C.1.1. Operational Safety

Trends

61. Operational Safety Review Team (OSART) missions continue to identify recommendations and suggestions regarding strengthening the conduct of safe operations, enhancing continuous improvement,

optimizing maintenance activities, strengthening accident management and on-site EPR, and setting, communicating and implementing management expectations.



Operational Safety
Review Team
(OSART)
mission reports

Continue to identify recommendations and suggestions regarding:

- strengthening the conduct of safe operations;
- enhancing continuous improvement;
- optimizing maintenance activities;
- strengthening accident management and on-site EPR; and
- setting, communicating and implementing management expectations.

62. Analysis of data from 85 reports submitted in the International Reporting System for Operating Experience in the previous year indicated a continuing need to learn from events related to human performance; improve operation and maintenance fundamentals; and improve leadership, management and oversight of processes and practices.



International
Reporting System
for Operating
Experience (IRS)

85

Based on analysis of data from 85 reports, need to:

- learn from events related to human performance;
- improve operation and maintenance fundamentals; and
- improve leadership, management and oversight of processes and practices.

63. Nuclear power reactors around the world have programmes to address LTO and ageing management. In 2021, 77% of the 441 operating NPPs had been in operation for 30 years or more and 23% had been in operation for more than 40 years (see Figure 5).

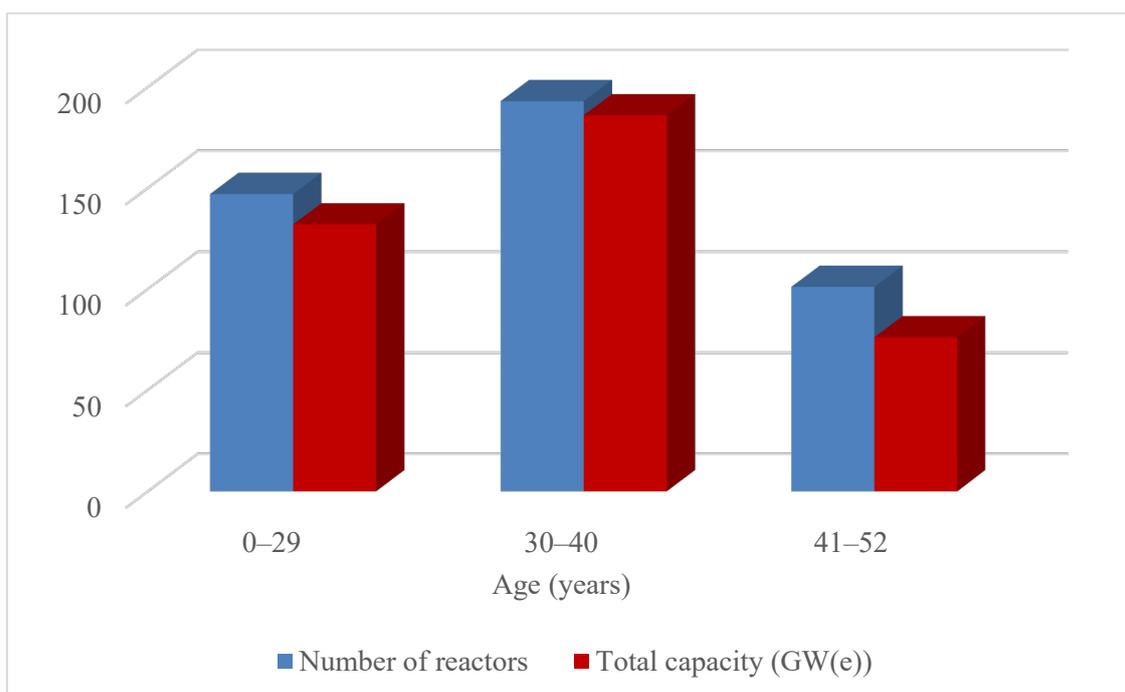


Fig. 5. Age distribution of all 441 operating reactors in 2021 based on information from the Power Reactor Information System on 14 December 2021.

64. Safety Aspects of Long Term Operation missions continue to identify the need to improve the preparedness of NPPs for LTO in the areas of safety assessments, including ageing as well as knowledge and competence management. This will be a priority for the Agency while, at the same time, supporting the safety of new advanced technologies.

Related Activities

65. *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 is planning to undertake the following related activities:*

- Issue a Technical Reports Series publication on Member State experiences and insights in ensuring safe, secure and reliable operation of nuclear and radiation facilities and activities during the COVID-19 pandemic; and
- Organize the Fifth International Conference on Nuclear Power Plant Life Management.

C.1.2. Site and Design Safety

Trends

66. Member States continue to request support for the application of Agency 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 2022, ten events to address these requests are foreseen.

67. The Agency continues to receive a high number of requests from Member States for Site and External Events Design (SEED) review missions (six review missions are currently planned for 2022), expert missions, and capacity building and training workshops (15 expert missions and workshops are currently planned for 2022). There is also an increased interest in the assessment of combinations of hazards as well as hazards at multi-unit sites.

68. Member States continue to express an interest in the lessons arising from the Fukushima Daiichi accident with regard to site and design safety. They are also interested in sharing experiences of the safety reassessment of existing NPPs, performing reasonably practicable safety improvements for preventing accidents as needed, and, should an accident occur, mitigating its consequences and avoiding significant radioactive releases.

69. Member States continue to show interest in the harmonization of safety requirements and licensing approaches, and in the sharing of knowledge, with respect to the design and safety evaluation of new NPPs, including innovative designs. The application of Agency safety standards to innovative designs of NPPs, including SMRs, is a matter of great interest for Member States. This will be a priority for the Agency while, at the same time, supporting the safety of operating reactors.

70. Member States continue to request assistance in the review of safety assessments of new reactor designs against Agency safety standards as well as TSR peer reviews in other technical subject areas and express interest in advanced safety assessment techniques in areas such as reliability of digital instrumentation and passive systems, human reliability assessment, use of safety analysis approaches for security purposes, and risk analysis in a multi-unit and multi-source context or multi-module interactions.



Site and Design
Safety

Member States ...

- Request assistance in the review of safety assessments of new reactor designs against Agency safety standards and;
- Express interest in advanced safety assessment techniques in areas such as reliability of digital instrumentation and passive systems, and human reliability assessment; and use of safety analysis approaches for security purposes;
- Express interest in risk analysis in multi-unit and multi-source context or multi-module interactions.

71. Member States increasingly use periodic safety reviews (PSRs) for justifying LTO of NPPs and have expressed interest in sharing current challenges, good practices, and examples of corrective actions and safety improvements related to the application of PSRs for justifying LTO.

Related Activities

72. *The Agency will assist Member States in the application of Agency safety standards relating to the evaluation of safety of nuclear installations, such as siting, design, commissioning and operating requirements, including LTO. The Agency is planning to undertake the following related activities:*

- Continue to organize meetings and TSR peer review services, and continue to develop technical documentation to assist Member States in the application of the Agency's safety assessment and design safety standards in support of safety improvements for existing NPPs and to address emerging topics in the design safety of new NPPs;
- Continue implementing capacity building activities based on Agency safety standards within the framework of SEED missions; and
- Conduct SEED review missions upon request by Member States.

C.1.3. Severe Accident Prevention and Mitigation

Trends

73. Member States continue to revise severe accident management guidance for existing NPPs to include safety upgrades and non-permanent equipment, and to address multi-unit considerations. For new NPPs, severe accident management guidance is acknowledged as an important contributor to the practical elimination of conditions leading to early radioactive releases or large radioactive releases.

74. Member States continue to express an interest in the lessons arising from the Fukushima Daiichi accident and request Agency support in developing clear, comprehensive and 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.

75. Member States express an interest in receiving peer reviews of accident management programmes as well as sharing experiences with the development of accident management programmes for advanced and innovative reactors.



Severe Accident Prevention and Mitigation

Member States ...

- Continue to revise severe accident management guidance for existing NPPs;
- Continue to express an interest in the lessons arising from the Fukushima Daiichi accident;
- Express an interest in receiving peer reviews of accident management programmes.

Related Activities

76. 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 is planning to undertake the following related activities:

- Continue to facilitate the exchange of experiences in the area of severe accident management and develop supporting technical documentation; and
- Promote and support capacity building and national human resource development in the area of severe accident management, including for newcomers.

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

Trends

77. The interest of Member States in SMRs has been reflected in their growing participation in Agency activities related to SMRs, particularly in the review of the applicability of Agency safety standards to SMR designs as well as an increase in requests for workshops and expert missions on licensing and safety matters from countries embarking on SMR technology. The applicability of Agency safety standards to SMRs will be a priority for the Agency while, at the same time, supporting the safety of operating reactors.

78. The Agency developed the Platform on Small Modular Reactors and their Applications to support countries worldwide in the development and deployment of this emerging nuclear power technology. The Platform will provide one-stop-shop access to the full array of Agency support and expertise on SMRs, including nuclear safety.

79. There is an increased interest in Member States regarding the review of the applicability of regulations to SMRs and building new technical capability for SMR safety. The final approval for the construction of the ACP100 SMR in China was obtained in June 2021, and the operating licence for the High Temperature Reactor–Pebble-Bed Module, a high temperature gas cooled reactor, was issued in China in August 2021. A construction licence for BREST-OD-300, a lead cooled fast reactor, was issued in the Russian Federation in February 2021.

80. The regulatory bodies in the Small Modular Reactors Regulators' Forum acknowledge the need to enhance their international cooperation on SMR regulation, with Agency safety standards and technical documentation being important for enhancing international collaboration on the regulatory assessment of SMR designs.

Related Activities

81. *The Agency will assist Member State activities related to SMRs, particularly their efforts to develop safety requirements, build capacity for design safety and safety assessment, and share good practices. The Agency is planning to undertake the following related activities:*

- Systematically review the applicability of Agency safety standards in support of the licensing and deployment of emerging SMR technologies and develop a road map for the application of Agency safety standards as part of a technology neutral safety and regulatory framework for SMRs;
- Continue the activities under the Agency-wide Platform on Small Modular Reactors and their Applications, and continue the preparation of a high-level SMR booklet; and
- Continue developing publications related to safety assessment and design safety of SMRs in the context of Agency safety standards and continue supporting Member States in strengthening their capabilities on safety assessment of SMRs.

C.3. Research Reactor Safety

Trends

82. 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.

83. 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. Member States have shown increased awareness and have improved their management of the interface between safety and security when planning and implementing these projects.

Related Activities

84. *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 is planning to undertake the following related activities:*

- Assist Member States in their efforts to strengthen the safety of research reactors through implementation of the provisions of the Code of Conduct on the Safety of Research Reactors and the Agency safety standards, as well as supporting Member States' capacity for self-assessment of safety; and
- Finalize the revision of the Agency safety standards related to research reactors and assist Member States in their application through peer reviews and capacity building activities in areas of common interest.

C.4. Fuel Cycle Facility Safety

Trends

85. In 2021, the total number of reports in the Fuel Incident Notification and Analysis System, a self-reporting system for sharing information on lessons learned from incidents at nuclear fuel cycle facilities, increased by 3 to 297. The main lessons learned were on the importance of establishing effective ageing management programmes, continuing training of personnel, and using operating

procedures effectively. More than 80% of the world's nuclear fuel facilities are currently part of the system.



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

Related Activities

87. The Agency will provide assistance to Member States to support their efforts to enhance regulatory supervision, manage ageing of facilities, and manage the interface between safety and security. The Agency will continue to facilitate the exchange of operating experience. The Agency is planning to undertake the following related activities:

- Finalize in 2022 the revision of the Agency safety standards for nuclear fuel cycle facilities and assist Member States to build capacity for application of these standards in areas of common interest such as regulatory inspection, ageing management, PSR, and the interface between nuclear safety and security; and
- Continue supporting Member States in the safety of nuclear fuel manufacturing for advanced reactors.

C.5. Safety Infrastructure for Embarking Countries

C.5.1. Nuclear Power Programmes

Trends

88. Twenty-nine Member States are considering or planning a new nuclear power programme.

89. The IRRS, Integrated Nuclear Infrastructure Review and other peer review and advisory services continued to identify the need to strengthen regulatory body independence, build regulatory capacity and competence, and establish safety regulations and licensing processes as part of effective legislative and regulatory oversight programmes.



90. It has been observed that there is a tendency to invite an IRRS mission only in Phase 3 when a regulatory body is expected to be almost fully functional at the end of Phase 2. The Specific Safety Guide *Establishing the Safety Infrastructure for a Nuclear Power Programme* (IAEA Safety Standards Series No. SSG-16 (Rev. 1)) states that countries embarking on a nuclear power programme are expected to host an IRRS mission in both Phase 2 and Phase 3. However, considering the numerous challenges for regulatory bodies in developing capacity and the regulatory framework required to effectively regulate an NPP, it is now proposed to offer embarking countries in Phase 2 an expert mission as an alternative to an IRRS mission. This alternative expert mission will cover only the relevant SSG-16 (Rev. 1) actions under the assumption that an IRRS mission will take place in Phase 3.

Related Activities

91. *The Agency will assist Member States in developing safety infrastructures for new nuclear power programmes. The Agency is planning to undertake the following related activities:*

- Continue to encourage Member States to host relevant nuclear safety review missions during the early stages of development of a nuclear power programme to support the evaluation of safety infrastructure aspects, including the promotion of the hosting of an expert mission in embarking countries in Phase 2 to review the establishment of the regulatory infrastructure;
- Continue to implement a generic roadmap for building nuclear safety infrastructure for licensing a first NPP, with the development of handbooks focusing on how to develop such infrastructure with suggested peer review services, sharing operating and regulatory experiences amongst embarking countries, and training programmes;
- Continue to organize meetings to assist Regulatory Cooperation Forum (RCF) active recipients in developing robust regulatory frameworks through international cooperation;
- Develop a guidance document on national policy and strategy for safety based on feedback from IRRS missions;
- Develop training material on regulatory oversight of the safety–security interface for the life cycle of NPPs; and
- Continue to assist newcomer Member States with the development of nuclear power programmes through enhancement of their technical capabilities in the areas of siting and site evaluation, safety review, design safety and safety assessment, and authorization. This will be a priority for the Agency.

C.5.2. Research Reactors Programme

Trends

92. Over 30 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.

Related Activities

93. *The Agency will assist Member States in developing safety infrastructure for new research reactor programmes. The Agency is planning to undertake the following related activity:*

- Continue to assist Member States in the establishment of safety and regulatory infrastructure for new research reactor programmes upon request and support capacity building activities through Technical Meetings and training activities.

D. Strengthening Emergency Preparedness and Response

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

Trends

94. Effective information exchange and emergency communication remain a priority for Member States. In 2021, the Agency was informed by competent authorities, or became aware through earthquake alerts or media reports, of 161 events involving or suspected to involve nuclear or radiological facilities or activities. This number of events remains significant in line with the trend of recent years (see Figure 6). The sustained effort by the Secretariat and Member States with regard to workshops and training on arrangements for notification, reporting and assistance contributed to the increase in the number of recorded events over the past years. In 2021, the Agency received two requests for information about the events from official contact points.

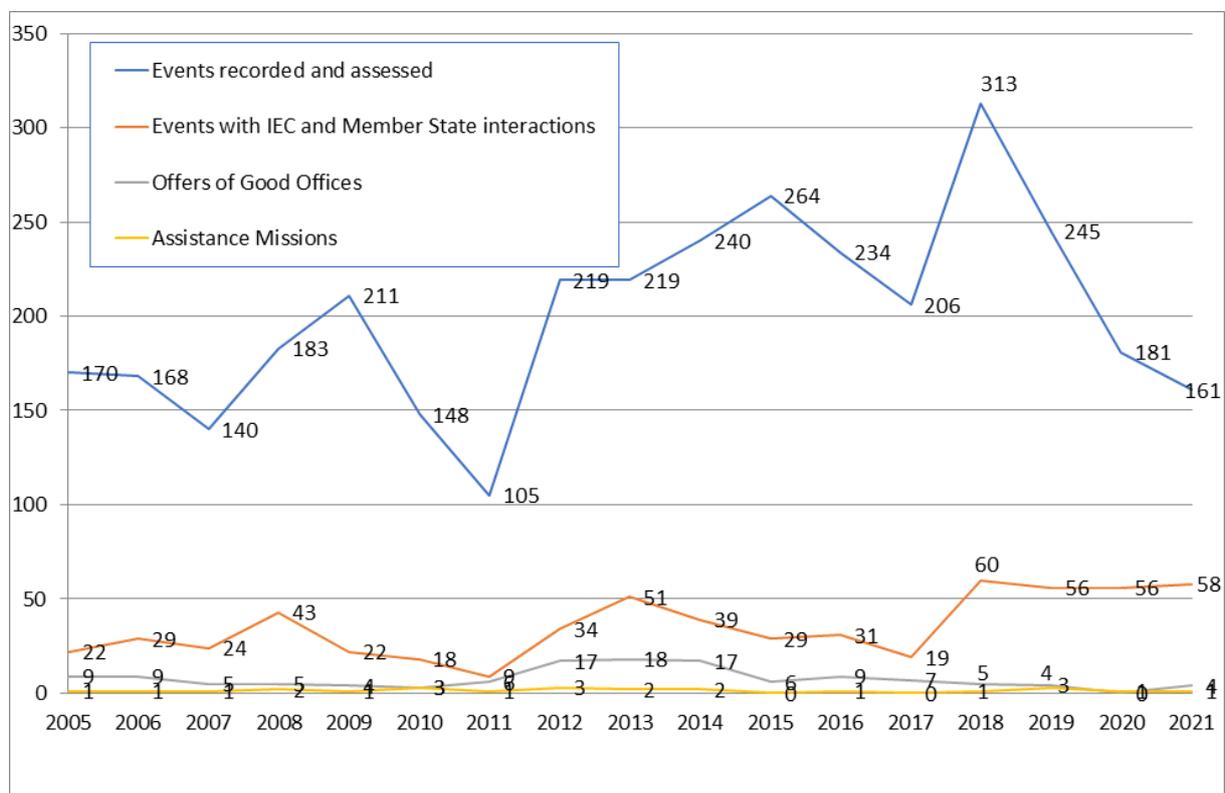
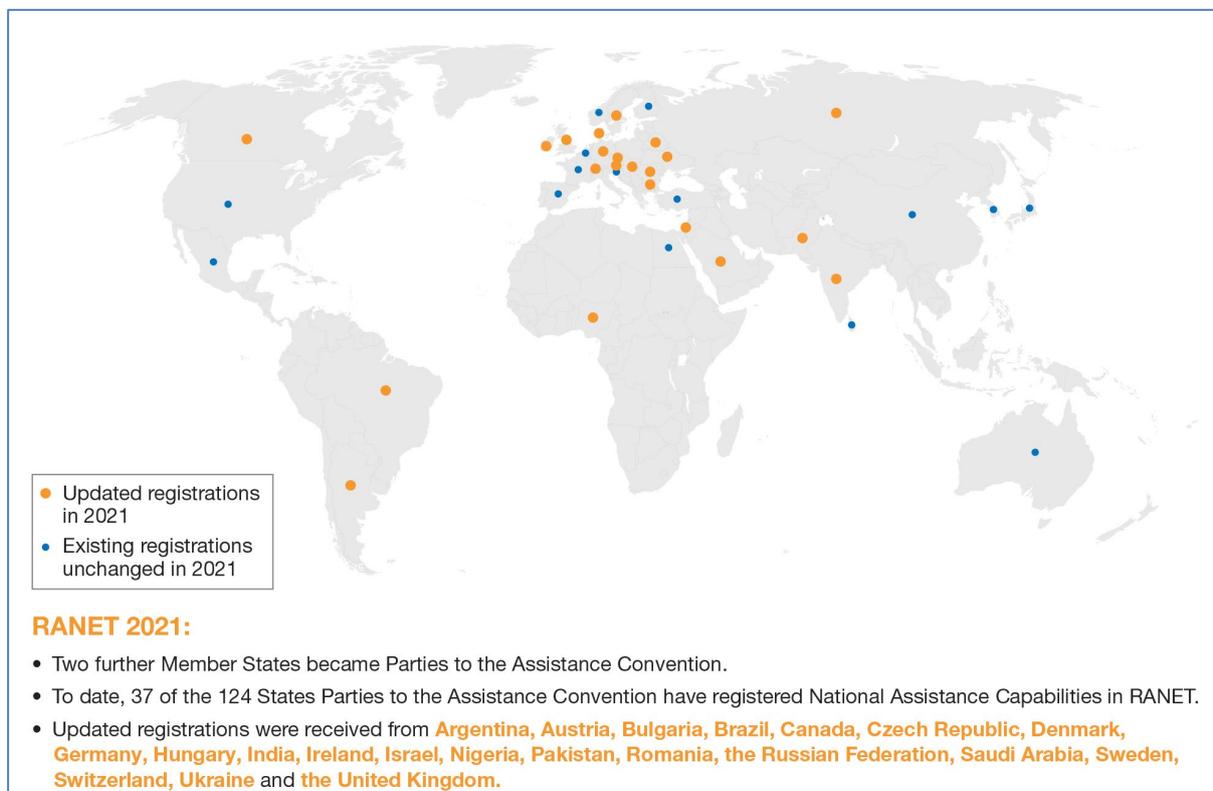


Fig. 6. Number of events involving or suspected to involve nuclear or radiological facilities or activities, about which the Agency was informed by competent authorities, or became aware through earthquake or media reports.

95. The percentage of new Unified System for Information Exchange in Incidents and Emergencies (USIE) users that requested two-factor authentication increased in 2021. Approximately 29% of all newly registered users of the USIE website in 2021 have registered for two-factor authentication.

96. The Agency continued to encourage Member States to ratify the Convention on Early Notification of a Nuclear Accident (Early Notification Convention) and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (Assistance Convention). In 2021, two further Member States became Parties to the Assistance Convention. To date, 37 of the 124 States Parties to the

Assistance Convention have registered National Assistance Capabilities⁵ in the Agency's Response and Assistance Network (RANET). New or updated registrations were received from Argentina, Austria, Bulgaria, Brazil, Canada, Czech Republic, Denmark, Germany, Hungary, India, Ireland, Israel, Nigeria, Pakistan, Romania, the Russian Federation, Saudi Arabia, Sweden, Switzerland, Ukraine and the United Kingdom.



97. During 2021, 29 additional Member States declared electronic mail as their preferred emergency communication channel, bringing the total number of Member States that have declared so to 129.

98. The number of nominated contact points for the coordination of activities related to the International Radiation Monitoring Information System (IRMIS) continues to grow. In 2021, 60 Member States nominated or updated their contact point. The number of Member States using IRMIS for the regular sharing of simulated emergency radiation monitoring data decreased in 2021 by three Member States.

99. In 2021, the number of Member States using the International Nuclear and Radiological Event Scale to communicate the safety significance of nuclear or radiological events remained unchanged at 78.

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

Related Activities

101. The Agency will further develop and support the implementation by Member States of the operational arrangements for notification, reporting and assistance in a nuclear or radiological incident or emergency. The Agency is planning to undertake the following related activities:

⁵ States Parties to the Assistance Convention are obliged to “within the limits of their capabilities, identify and notify the Agency of experts, equipment and materials which could be made available for the provision of assistance to other States Parties in the event of a nuclear accident or radiological emergency”.

- Conduct workshops on arrangements for notification, reporting and assistance in nuclear or radiological incidents and emergencies as well as webinars on specific details of the international arrangements to implement the Early Notification and Assistance Conventions; and
- 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

102. Requests from Member States for technical support and advice in strengthening national and regional EPR arrangements increased from 126 in 2020 to 220 in 2021. Many requests relate to the need for support 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. This will be a priority for the Agency.

103. The number of Member States using GSR Part 7 and the recently published Safety Guides *Arrangements for the Termination of a Nuclear or Radiological Emergency* (IAEA Safety Standards Series No. GSG-11) and *Arrangements for Public Communication in Preparedness and Response for a Nuclear or Radiological Emergency* (IAEA Safety Standards Series No. GSG-14) in developing their national emergency response arrangements is increasing.

104. In addition, the interest of Member States in the EPR Series publications *Preparedness and Response for a Nuclear or Radiological Emergency Combined with Other Incidents or Emergencies* (EPR-Combined Emergencies 2020) and *Considerations in the Development of a Protection Strategy for a Nuclear or Radiological Emergency* (EPR Protection Strategy 2020) has been high, which is evident from the requests for training events on these topics and the fact that EPR Protection Strategy 2020 appeared in the top ten most accessed publications on the Agency's website. The interest in the harmonization of national EPR arrangements in line with GSR Part 7 is growing, as evidenced by the audience reached by webinars organized on GSR Part 7 related topics.

105. Member States continued to increase their use of EPRIMS (see Figure 7). As of 2021, 127 Member States have appointed national EPRIMS coordinators, with a total of 513 users. The number of published modules also increased to 1815 in 2021 from 1790 in 2020. Regular analysis of the information uploaded to EPRIMS allowed the Agency to assess progress made in technical cooperation projects and identify global trends in national EPR arrangements based on Agency safety standards.

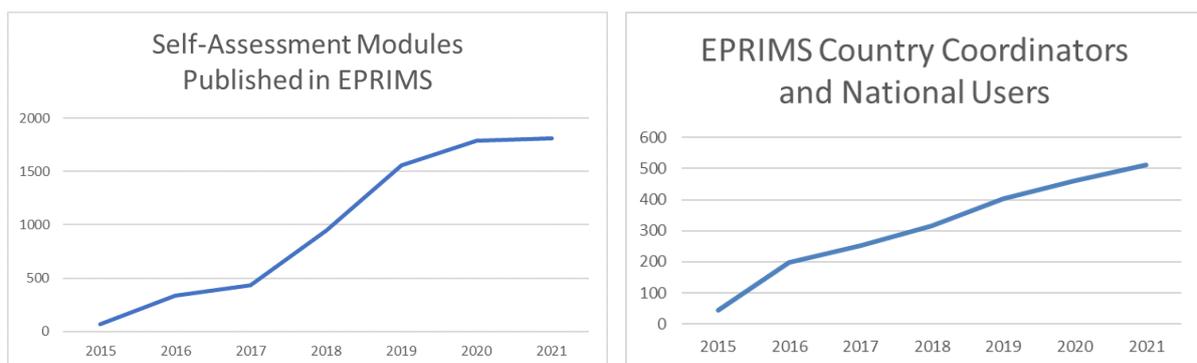


Fig. 7. The use of EPRIMS continued to increase in 2021.

106. An analysis of Member State EPRIMS self-assessments shows trends that are similar to previous years: the lowest level of implementation is shown for Requirement 17 (international assistance), followed by Requirements 15 (radioactive waste management), 16 (mitigating non-radiological consequences) and 18 (terminating a nuclear or radiological emergency). In this light, the Agency developed new guidance (IAEA Safety Standards Series No. GSG-11) to further support Member States' implementation of Requirements 15, 16 and 18 and is in the process of developing guidance for Requirement 17. Training in a virtual format based on this newly published guidance is being delivered to Member States at an increasing rate as a priority, in an effort to support the harmonization of national EPR arrangements. The requirements with the highest level of implementation are those related to EPR infrastructure (see Figure 8).

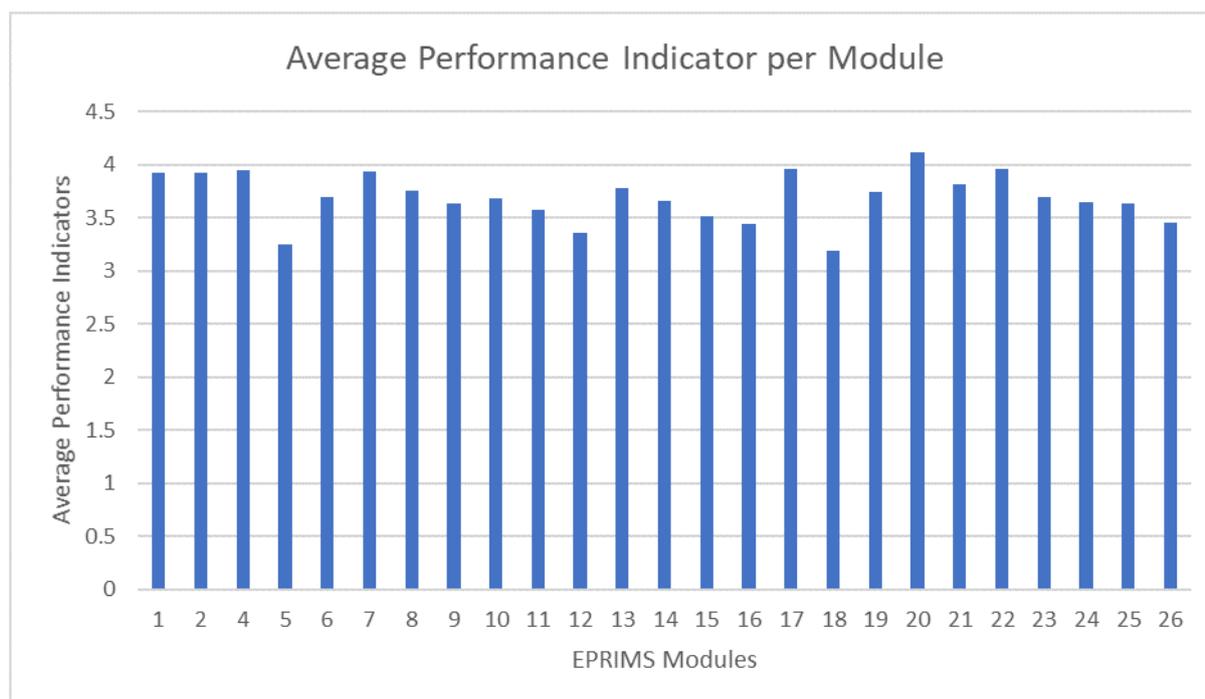


Fig. 8. GSR Part 7 requirements and their ratings according to self-assessment of countries.

107. Interest from Member States was identified to further improve EPRIMS and to include information in the platform from EPREV missions.

108. Interest from Member States in addressing EPR arrangements for new and emerging reactors types, mainly SMRs and TNPPs, continues to grow. Member States also continue to express interest in better understanding the applicability of EPR concepts from the Agency's safety standards to new reactor types.

109. Member States, particularly those embarking on a nuclear power programme, continue to express interest in performing self-assessments in EPRIMS and hosting EPREV missions.

Related Activities

110. 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 is planning to undertake the following related activities:

- Continue to develop EPRIMS to improve navigation, user experience, and the management of data stored and plotted;
- Continue to enhance the safety standards in EPR, including revisions of Arrangements for Preparedness for a Nuclear or Radiological Emergency (IAEA Safety Standards Series No. GSG-2.1) and Criteria for Use in Preparedness and Response for a Nuclear or Radiological

Emergency (IAEA Safety Standards Series No. GSG-2), initiating a new Safety Guide on protection strategies for a nuclear or radiological emergency, and implementing actions to address longer-term needs and priorities for Member States in relation to guidance that supports GSR Part 7 implementation; and

- Hold a Technical Meeting on Revision of the Safety Guide on Criteria for Use in Preparedness and Response for a Nuclear or Radiological Emergency.

D.3. Testing Readiness for Response

Trends

111. Member States continue to seek Agency support in improving the preparation, conduct and evaluation of national emergency exercises.

112. The Agency built a new website feature for USIE administrators to enable them to verify users within their organization or alert channels etc. once per year. If administrators do not verify users, the Agency follows up. To date, more than 79 USIE administrator accounts have been removed, and 63 new accounts have been created for administrators in different Member States.

113. The participation of Member States in Level 2 Convention Exercise (ConvEx-2) exercises continues to be high (see Figure 9).

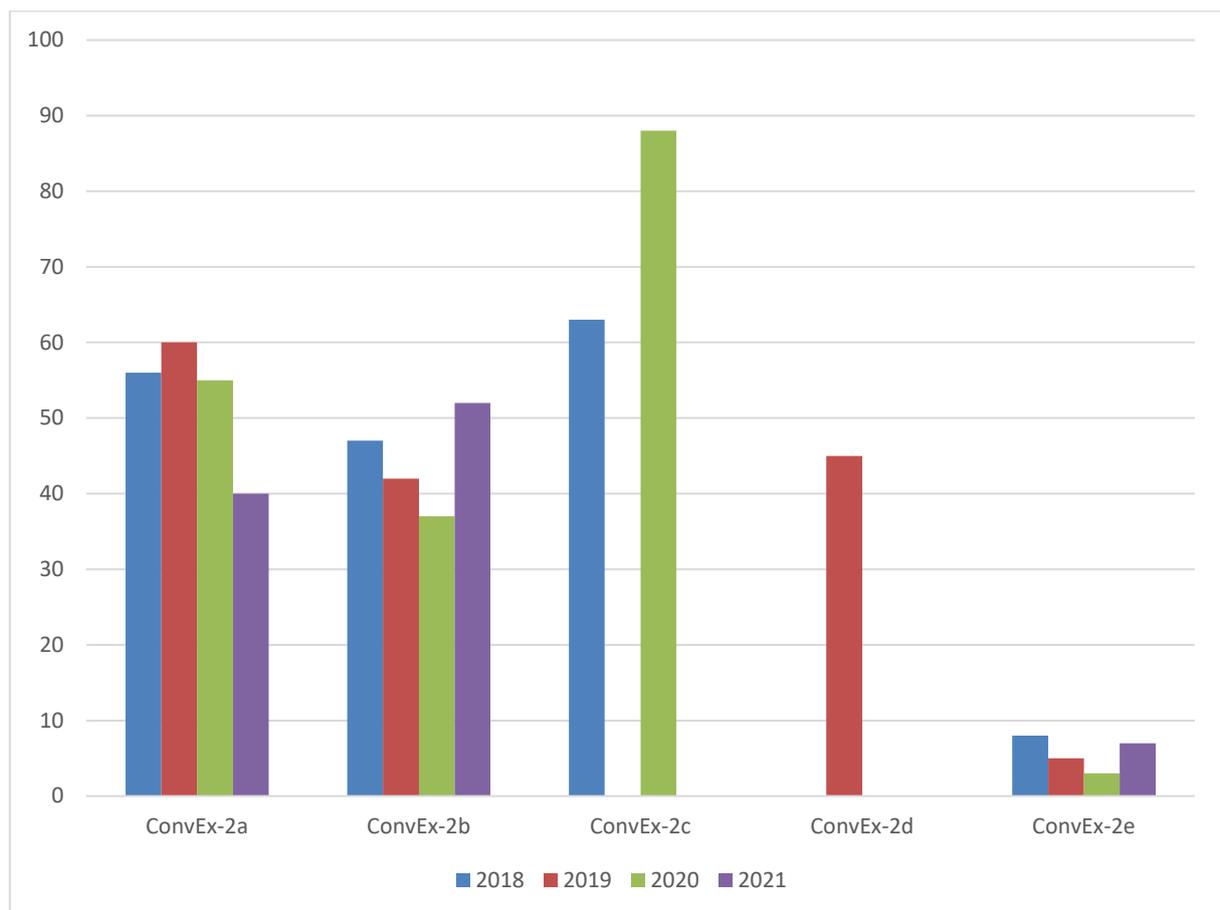


Fig 9. Participation of Member States and international organizations in ConvEx-2.

114. The percentage of emergency contact points that confirmed a test message via the USIE website during communication tests increased from 41% in 2019 to 42% in 2020 and increased to 49% in 2021.

Related Activities

115. 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 is planning to undertake the following related activity:

- Following the conduct of the ConvEx-3 exercise in 2021, conduct a Technical Meeting to evaluate the exercise and consolidate the lessons identified.

E. Improving Management of the Safety and Security Interface

Trends

116. 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 nuclear security are different.

117. As evident from the requests for consolidation or removal, and physical protection enhancements, of disused sealed radioactive sources that the Agency receives from Member States, 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.

118. INSAG and the Advisory Group on Nuclear Security also highlighted the importance of the safety and security interface. They are working on a joint publication on this topic.

119. Member States expressed an interest in applying a holistic approach to safety–security–safeguards by design for nuclear installations, in particular for SMRs, in the early stage of the design process, as well as in sharing experience in the development of technical publications and the organization of education and training activities.

 <p>Improving Management of the Safety and Security Interface</p>	<p>Member States ...</p> <ul style="list-style-type: none">• Continue to encourage the Secretariat to facilitate a coordination process to address safety and security interfaces and;• Have expressed an interest in applying a holistic approach to safety–security–safeguards by design for nuclear installations, in particular for SMRs.
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Related Activities

120. 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 nuclear security are different. The Agency is planning to undertake the following related activities:

- Continue to support Member States in managing the interface between nuclear safety and nuclear security for nuclear installations, radioactive sources and transport by developing new guidance, revising relevant safety standards and holding training activities;

- Continue to create synergies between nuclear safety and nuclear security for nuclear installations by facilitating the use of safety approaches for security purposes; and
- Continue to support Member States in integrating safety–security–safeguards by design for nuclear installations (in particular for SMRs) by developing technical publications and organizing education and training activities.

F. Strengthening Civil Liability for Nuclear Damage

Trends

121. Member States continue to attach importance to having in place effective and coherent nuclear liability mechanisms at the national and global levels to ensure prompt, adequate and non-discriminatory compensation for damage to people, property and the environment resulting from a nuclear accident or incident.⁶

122. 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 Safety⁷.



**Strengthening
Civil Liability for
Nuclear Damage**

Member States continue to ...

- Attach importance to having in place effective and coherent nuclear liability mechanisms at the national and global levels and;
- Request the Agency to assist them in their efforts to adhere to the international nuclear liability conventions.

Related Activities

123. 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 is planning to undertake the following related activities:

- Organize the annual meetings of INLEX;
- With the support of INLEX, undertake outreach activities that may be requested by Member States;
- Act as the Secretariat of the Contracting Parties and Signatories to the Convention on Supplementary Compensation for Nuclear Damage (CSC); and

⁶ See preambular paragraph (rr) of resolution GC(65)/RES/8 adopted by the General Conference in September 2021.

⁷ See operative paragraph 32 of part 2 of resolution GC(65)/RES/8. 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.

- Continue to support Member States, upon request, in their efforts to adhere to the international nuclear liability conventions and in adopting or revising national legislation on civil liability for nuclear damage, in the context of its legislative assistance programme.

Appendix A

Agency Activities in 2021

A. General Safety Areas

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

1. The Agency organized the International Conference on a Decade of Progress After Fukushima-Daiichi: Building on the Lessons Learned to Further Strengthen Nuclear Safety in Vienna in November 2021. The conference focused on lessons learned, experiences shared, results, and achievements from actions undertaken by national, regional and international communities following the accident, as well as identifying ways to further strengthen nuclear safety.
2. The Agency concluded a gap analysis study to consider whether the safety standards required strengthening following the experiences of COVID-19. The Commission on Safety Standards strategic planning meeting concluded that reviewing the safety standards in light of the COVID-19 pandemic was not a priority.
3. The Agency’s peer review and advisory services continued to be provided upon request. The Agency conducted 31 peer review and advisory services across all safety areas (Figure A). Thirty-three peer review and advisory services were postponed from 2021 due to the COVID-19 pandemic travel restrictions.

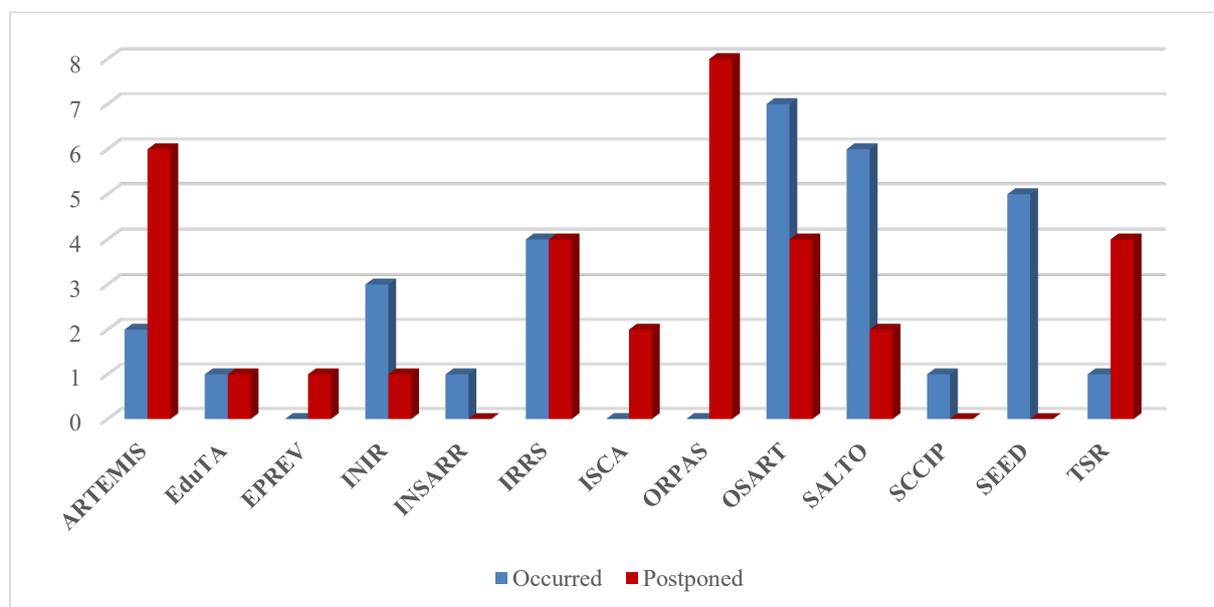


Fig. A. Number of peer review and advisory services conducted in 2021 and postponed from 2021.

4. At the request of Member States, the Agency has made provisions for the consideration of the regulatory implications of pandemic situations during Integrated Regulatory Review Service (IRRS)

missions. The IRRS mission conducted in Switzerland in October 2021 was the first to address the regulatory implications of the COVID-19 pandemic.

5. The Agency held a virtual Technical Meeting on the Assessment and Evaluation of the Occupational Radiation Protection Appraisal Service in September 2021, where participants discussed lessons learned and shared best practices and strategies used in the review.

6. The Agency launched an online database of good practices from IRRS missions in May 2021 to support Member States in enhancing their regulatory infrastructure and oversight activities.

7. The Agency continued developing guidance on the conduct of IRRS and Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS) missions in a back-to-back manner. To date, six countries have invited such back-to-back missions, and the guidance will be used for the first time in April 2022.

8. The Agency held a series of virtual national workshops on IRRS missions and self-assessments based on the Self-Assessment of Regulatory Infrastructure for Safety (SARIS) methodology and the new online version of SARIS (eSARIS).

9. The Agency held a virtual Technical Meeting on Experience in the Development and Application of Level 2 Probabilistic Safety Assessment for Nuclear Power Plants in May 2021, which provided the participants with an opportunity to contribute to the revision of the Safety Guide on this topic.

10. The Agency developed review guidelines for the Technical Safety Review (TSR) of conceptual reactor designs applicable to novel advanced reactors, including small and medium sized or modular reactor (SMRs).

11. The Agency launched e-learning courses for reviewers in Emergency Preparedness Review (EPREV) missions. The successful completion of the training became mandatory for all EPREV mission reviewers.

A.2. International Safety Conventions

12. The Agency held a virtual meeting for Officers of the Convention on Nuclear Safety (CNS) in March 2021 to discuss a framework for wrapping up the eighth review cycle, and merging the Eighth and Ninth Review Meetings, as well as to gather inputs and identify possible obstacles that may hamper the preparations for, and conduct of, such a meeting. The Agency facilitated the Organizational Meeting for the Joint Eighth and Ninth Review Meeting of the CNS in October 2021, where Contracting Parties *inter alia* confirmed the composition of Country Groups and the Officers for the Joint Review Meeting.

13. In March 2021, the Agency provided the Baltic Marine Environment Protection Commission with the technical basis for a methodology to assess radiological impact on the marine environment in the Baltic Sea region, based on *Prospective Radiological Environmental Impact Assessment for Facilities and Activities* (IAEA Safety Standards Series No. GSG-10).

14. The Agency held two virtual educational workshops, in September and November 2021, to provide information on the process for joining and meeting the obligations of the CNS and to provide guidelines on the preparation of National Reports.

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

15. In 2021, the Agency provided reports on the operation, safety and security of nuclear and radiation facilities and activities during the COVID-19 pandemic to the Board of Governors and the General Conference.

16. The Agency published *Application of a Graded Approach in Regulating the Safety of Radiation Sources* (IAEA TECDOC No. 1974) in September 2021 and *Application of a Graded Approach in Regulating Nuclear Installations* (IAEA TECDOC No. 1980) in November 2021.

17. The Agency held a virtual Technical Meeting to Share Approaches to and Experiences in the Management of Regulatory Oversight for the Operation of a First Nuclear Power Plant in June 2021 to gather Member States' experience in establishing an effective regulatory framework for safety and to develop guidance on good practices for newcomer countries. The outcome of this meeting has been incorporated in a draft TECDOC, provisionally entitled *Management of Regulatory Oversight for a First Nuclear Power Plant*.

18. The Agency published *Experiences of Member States in Building a Regulatory Framework for the Oversight of New Nuclear Power Plants: Country Case Studies* (IAEA TECDOC No. 1948) in March 2021.

19. The Agency continued to update the International Regulatory Network information technology (IT) platform to enhance knowledge and experience sharing among regulators. The work included development of new structure and content, as well as a new SharePoint-based IT platform, to address Member State feedback endorsed by the Steering Committee of the Global Nuclear Safety and Security Network (GNSSN).

20. Owing to the COVID-19 pandemic, no Advisory Missions on Regulatory Infrastructure for Radiation Safety were held in 2021. However, technical support for establishing and developing a sustainable regulatory framework for radiation safety was provided through virtual meetings.

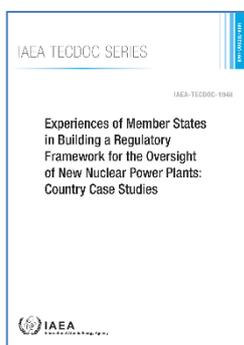
21. The Agency continued to support the implementation of the programme on nuclear and radiological safety of the Ibero-American Forum of Radiological and Nuclear Regulatory Agencies (FORO). At its annual meeting in July 2021, FORO's plenary approved its Action Plan for 2021–2023 and a new project on security during the transport of radioactive material.

22. In December 2021, the Agency held a virtual workshop on SARIS for Arab Network of Nuclear Regulators member countries.

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

23. The Agency held a series of webinars on the Global Nuclear Safety and Security Communication Network from March to September 2021. The webinars aimed to equip regulators with identified tools, best practice examples and lessons learned from experienced practitioners around the world.

24. The Agency held the 15th Meeting of the Steering Committee of the Global Nuclear Safety and Security Network virtually in January 2021 and the 16th Meeting virtually in June 2021, to revise and approve the documents guiding Secretariat activities for the GNSSN programme and to develop an action plan for the remainder of the current term of the Steering Committee.





25. The Agency held a pilot virtual IAEA School on Nuclear and Radiological Leadership for Safety in June 2021 and held the International School of Nuclear and Radiological Leadership for Safety in Athens in November–December 2021.

26. The Agency continued developing a Safety Guide on leadership, management and culture for safety.

27. The Agency published an educational handbook on safety culture in medical uses of radiation, entitled *Radiation Safety Culture Trait Talks*, in March 2021, which is structured around 10 principles, or traits, that contribute to a strong safety culture.

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

28. The Agency completed a project to reflect the priority area of building and sustaining capacity in nuclear safety across all Agency web pages, including a systematic approach to the four pillars of capacity building. In addition, the Agency developed an online tool containing indicators to monitor the progress made in capacity building in nuclear safety during the period 2021–2030.

29. The Agency developed the Strategic Approach to Education and Training in Radiation, Transport and Waste Safety 2021–2030, and established new terms of reference for the Steering Committee on Education and Training in Radiation, Transport and Waste Safety to monitor the implementation of the Strategic Approach.

30. The Agency launched a project on capacity building on site safety assessment in embarking countries, with the aim of enhancing the capacity of regulatory bodies for reviewing safety analysis reports related to site and design issues.

31. The Agency held a virtual Workshop on the Application of a Graded Approach to Regulating Nuclear Installations in Latin America in October 2021 to provide a platform for discussion and exchange of information, knowledge and lessons learned in applying a graded approach to all functions of regulatory programmes.

32. The Agency held five Postgraduate Educational Courses in Radiation Protection and the Safety of Radiation Sources, in Algeria, Argentina, Belarus, Ghana and Jordan, in a number of languages.

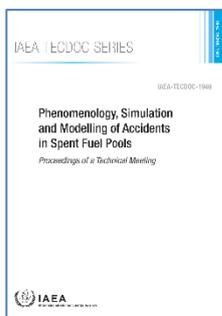
33. The Agency held a virtual Technical Meeting on Developing Effective Methods for Radiation Protection Education and Training of Health Professionals in March 2021 to share experiences in developing education and training and to identify potential gaps or issues in this area.

34. The Agency organized four virtual consultancy meetings for the working groups of the International Network for Education and Training for Emergency Preparedness and Response to enhance cooperation and collaboration between members of the Network, as well as outreach to Member States.

35. The Agency launched a pilot international master's degree programme in emergency preparedness and response (EPR) at Peter the Great St Petersburg Polytechnic University, in the Russian Federation in September 2021.

A.6. Research and Development for Safety

36. The Agency held a virtual Technical Meeting on the Evaluation of Defence in Depth in Periodic Safety Reviews in May 2021 to provide a platform for discussion on the approaches to reviewing the adequacy of defence in depth in periodic safety review global assessment for nuclear power plants (NPPs). The Agency also held a virtual Technical Meeting on the Licensing of Advanced Nuclear Fuels for Water Cooled Reactors in October 2021 to focus on the development and qualification of advanced nuclear fuels as well as national regulators' experience in the revision of national regulations.



37. The Agency published *Phenomenology, Simulation and Modelling of Accidents in Spent Fuel Pools* (IAEA TECDOC No. 1949) in April 2021.

38. The Agency held virtually the second Research Coordination Meeting of the coordinated research project (CRP) “Effective Use of Dose Projection Tools in the Preparedness and Response to Nuclear and Radiological Emergencies” in July 2021 to discuss the progress made and results from participation in the emergency response exercise and an emergency preparedness case study undertaken as part of the CRP.

39. The Agency conducted virtually the fourth and final Research Coordination Meeting for the CRP “Development of Approaches, Methodologies and Criteria for Determining the Technical Basis for Emergency Planning Zone for Small Modular Reactor Deployment” in July 2021, where participants provided updates on the work and conclusions of their institutes. In addition, a draft table of contents for a future IAEA Technical Document (TECDOC) on this topic was discussed.

B. Strengthening Radiation, Transport and Waste Safety

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

40. In February 2021, the Agency provided a report to the OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic, stressing the importance of a consistent approach to the practical implementation of the OSPAR Convention and the relevant Agency safety standards in order to protect people and the environment.

41. The Agency published an electronic handbook on radiation safety culture in health care settings in February 2021.

42. The Agency held a virtual Technical Meeting on Developing Effective Methods for Radiation Protection Education and Training of Health Professionals in March 2021.

43. The Agency held a virtual Technical Meeting on Radionuclides in Food and Drinking Water in Non-Emergency Situations in September 2021.

44. The Agency held a virtual Technical Meeting on Strengthening Safety in Radiotherapy in July 2021 to review the effectiveness and value of incident learning systems in radiotherapy and identify opportunities to improve these systems. A joint position statement was developed in collaboration with nine other international organizations on the topic of strengthening radiation protection of patients undergoing recurrent radiological imaging procedures. Additionally, the Safety Report *Radiation Protection and Safety in Veterinary Medicine* (Safety Reports Series No. 104) was published.

45. The Agency developed a system for managing dose information in dosimetry service laboratories in Member States, which was launched in March 2021.

46. The Agency held a virtual Technical Meeting on the Establishment of a Web-based Information Exchange Platform for Occupational Radiation Protection in Industries Involving Naturally Occurring Radioactive Material (ISEMIR-N) in November 2021.

47. The Agency held a virtual Technical Meeting on the Regulatory Forum for the Safety of Uranium Production and Naturally Occurring Radioactive Materials in August 2021 to review the progress made in activities identified as high priority at the 2020 Annual Meeting.

B.2. Control of Radiation Sources

48. The Agency held four virtual Regional Meetings on the Implementation of the Guidance on the Management of Disused Radioactive Sources in 2021 to enable Member States to exchange experiences in the safe management and secure protection of disused radioactive sources.

49. The Agency organized the virtual Open-ended Meeting of Legal and Technical Experts on the Implementation of the Guidance on the Management of Disused Radioactive Sources in August 2021.

50. The Agency finalized the draft of a document provisionally entitled “Financial Provisions to Ensure Safe Management and Secure Protection of Radioactive Sources Once they Become Disused”.

51. The Agency launched online tools for the control of radioactive material inadvertently incorporated into scrap metal in May 2021 to facilitate the exchange of information among Member States and encourage the participation of scrap metal industries. Furthermore, the Agency launched an e-learning training course entitled “Control of Radioactive Material Inadvertently Incorporated Into Scrap Metal” in June 2021.

B.3. Safe Transport of Radioactive Material

52. The Agency launched Version 2.0 of Modules 0–4 of the Transport Safety e-Learning platform, to reflect *Regulations for the Safe Transport of Radioactive Material* (IAEA Safety Standards Series No. SSR-6 (Rev. 1)), in Spanish and in Chinese.

53. The Agency held a virtual Regional Training Course on Safe Transport of Radioactive Material in January 2021 to provide training on IAEA Safety Standards Series No. SSR-6 (Rev. 1).

54. The Agency published the Spanish version of *Security of Nuclear Material in Transport* (IAEA Nuclear Security Series No. 26-G) in October 2021. The Agency also published an e-learning module on transport security in 2021.

55. The Agency held a virtual Technical Meeting on Denials of Shipment — Issues and Solutions in March 2021 to provide a forum to discuss the options for addressing denials of, and delays in, the shipment of radioactive material. The discussions held during the meeting, and the conclusions from the meeting, were summarized in the Chair’s report provided to Member States. Additionally, a second virtual Technical Meeting was held in August 2021 to discuss the draft Terms of Reference of the Denial of Shipment Working Group, which will begin meeting in 2022.

56. The Agency prepared a draft proposal to foster discussions on regulating TNPPs, with an intention to revise the IAEA Safety Standards Series No. SSR-6 (Rev. 1). This proposal was submitted to the Transport Safety Standards Committee’s Technical Expert Group on Package Performance and Assessment.

57. The Agency organized the virtual International Conference on the Safe and Secure Transport of Nuclear and Radioactive Materials in December 2021. The conference increased Member States’ awareness of the importance of effectively managing the interface between transport safety and transport security. The sessions and discussions during the conference informed the Agency of the potential needs

of Member States in this area, which will assist in the planning of future programmes. During a technical session on denials of shipment, it was decided that further consensus from Member States is needed on this issue.

B.4. Decommissioning, Spent Fuel and Waste Management

58. The Agency held the Annual Meeting of the Forum on the Safety of Near Surface Disposal virtually in October 2021, where participants discussed the draft technical notes developed by the Forum's Working Groups and topics related to the safety of near surface disposal facilities.

59. The Agency held the Fourth Plenary Meeting of the International Project on Demonstration of the Operational and Long-Term Safety of Geological Disposal Facilities for Radioactive Waste (GEOSAF Part III) virtually in October 2021 to discuss the results of the project and identify future project activities.

60. The Agency continued the development of a Safety Guide on national policies and strategies for the safety of radioactive waste and spent fuel management, decommissioning and remediation. This included developing a template for the Safety Guide and arranging a consultancy meeting.

61. The Agency held the Second Plenary Meeting of the International Harmonization and Safety Demonstration Project for Predisposal Radioactive Waste Management in September 2021 to discuss the Working Groups' activities, to review the structure and develop chapters of the project report, and to revise the work plan for the project.

62. The Agency held a virtual Interregional Training Course on Safety Assessment and Safety Cases for the Predisposal Management of Radioactive Waste in June 2021.

63. The Agency held a virtual Technical Meeting on the Development of a Model Road Map for Radioactive Waste Storage for the Countries with Small Inventories in July 2021 to discuss issues, practical needs and new developments related to radioactive waste storage in Member States with small inventories.

64. The Agency held two virtual Technical Meetings of the International Project on Completion of Decommissioning, in June and October 2021, to continue the collaboration and information exchange between Member States on the definition of end states and completion of decommissioning. The Agency also held two virtual Technical Meetings of the International Project on Decommissioning of Small Facilities, in May and November 2021, to provide a platform for collaborative work and exchange of experiences and lessons learned related to decommissioning of small medical, industrial and research facilities.

65. The Agency held a virtual Regional Workshop on Safety Assessment for Decommissioning of Small Facilities and Application of a Graded Approach in April 2021 to provide a platform for discussion and exchange of information, knowledge and lessons learned in performing safety assessments of decommissioning of small medical, industrial and research facilities, and the application of a graded approach to different aspects of decommissioning of small facilities.

66. The Agency held a virtual Technical Meeting on Decommissioning Planning for Uranium Production Facilities in December 2021.

B.5. Radiation Protection of the Environment and Remediation

67. In November and December 2021, the Agency conducted a series of on-site and virtual technical exchanges in preparation for the first mission of the Task Force's review that will assess the Government of Japan's plan to discharge ALPS treated water against relevant Agency safety standards. These

preparatory activities focused on reviewing the Government of Japan's self-assessment, and the radiological impact assessment that was published by TEPCO in November 2021.

68. The Agency held a virtual Technical Meeting of the International Working Forum on Regulatory Supervision of Legacy Sites on the Identification and Prioritization of Sites for Remediation in November 2021. As a result, the Agency organized a virtual Joint Regional Workshop of the International Working Forum on Regulatory Supervision of Legacy Sites and the Coordination Group for Uranium Legacy Sites (CGULS) on Licensing for Remediation Projects in December 2021, to support Central Asian Member States in the development of effective and efficient regulatory supervision of legacy sites.

69. The Agency continued to support Central Asian Member States in monitoring of uranium legacy sites before, during and after remediation. The Agency organized a virtual Workshop on the Use of Local Equipment for the Monitoring of Uranium Legacy Sites in Kyrgyzstan in September 2021. Joint field tests of the mapping technology with local experts took place in Kazakhstan and Kyrgyzstan in October 2021. The Agency also organized a virtual Training Workshop to Enhance the Capabilities of Experts from Central Asia for Environmental Monitoring of Surface, Ground and Seepage Waters at Uranium Legacy Sites in Kyrgyzstan, Tajikistan and Uzbekistan in September 2021.

70. The Agency held the virtual Annual Meeting of CGULS in May 2021 to continue information exchange and coordinate future activities of Member States and international organizations participating in CGULS.

71. The Agency developed the Methods for Radiological and Environmental Impact Assessment programme, and held the first Technical Meeting on this subject in October 2021 to focus on developing the topics and activities to be covered in the programme and launch a mentoring scheme and associated activities for young professionals and for professionals developing expertise in this area.

72. The Safety Guide *Remediation Strategy and Process for Areas Affected by Past Activities or Events* was approved in September 2021. In addition, a Safety Guide on source monitoring, environmental monitoring and individual monitoring for protection of the public and the environment is under development.

C. Strengthening Safety in Nuclear Installations

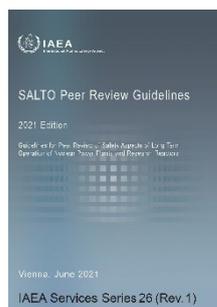
C.1. Nuclear Power Plant Safety

C.1.1. Operational Safety

73. The Agency published *Ageing Management of Nuclear Power Plants during Delayed Construction Periods, Extended Shutdown and Permanent Shutdown Prior to Decommissioning* (IAEA TECDOC No. 1957) in May 2021.

74. The Agency published the *SALTO Peer Review Guidelines: 2021 Edition* (IAEA Services Series No. 26 (Rev. 1)) in June 2021.

75. The Agency developed a draft publication of the *PROSPER Guidelines* (IAEA Services Series No. 10).



C.1.2. Site Design Safety

76. The Agency published *Level 1 Probabilistic Safety Assessment Practices for Nuclear Power Plants with CANDU-Type Reactors* (IAEA TECDOC No. 1977) in September 2021, and *Current Approaches to the Analysis of Design Extension Conditions with Core Melting for New Nuclear Power Plants* (IAEA TECDOC No. 1982) in October 2021.

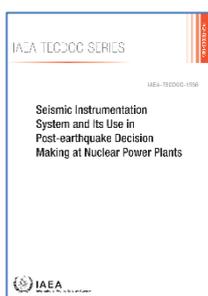
77. The Agency held a virtual Technical Meeting on CANDU Probabilistic Safety Assessment in October 2021 to facilitate cooperation and information exchange among the members of the CANDU Probabilistic Safety Assessment Working Group. The Agency also held a virtual Technical Meeting on the Licensing of Advanced Nuclear Fuels for Water Cooled Reactors in October 2021.

78. The Agency held a virtual Technical Meeting on the Use of Periodic Safety Review for Long Term Operation of Nuclear Power Plants in November 2021. The Agency completed a draft of a new Safety Report that aims at describing current challenges, synergies, good practices, and examples of corrective actions and safety improvements related to the application of PSRs for justifying long term operation for NPPs.

79. The Agency conducted five virtual Site and External Events Design missions — for Hungary, Türkiye and Uzbekistan, and two for Kenya — and held seven virtual workshops — for the Asian Nuclear Safety Network, Ghana, Poland, Uzbekistan and Viet Nam, and two for Sudan — on topics such as design, site selection and site characterization.



80. The Agency initiated the development of the External Event Notification System to support notification of external events potentially affecting nuclear sites as well as the analysis of the development of external events and damage caused to nuclear installations. The system will provide event notification reports to the Agency's Incident and Emergency Centre (IEC), as well as forecast and assessment of possible damage to nuclear installations and major population centres, and will provide support to the affected operators, regulators and communities.



81. The Agency published *Seismic Instrumentation System and its Use in Post-earthquake Decision Making at Nuclear Power Plants* (IAEA TECDOC No. 1956) in April 2021.

82. The Agency held four in-person Technical Meetings with the possibility of virtual participation in September, October and November 2021 to share experiences in site evaluation and design to protect nuclear installations against external hazards, and in the evaluation of seismic safety for existing nuclear installations and innovative reactors.

C.1.3. Severe Accident Prevention and Mitigation

83. The Agency held a virtual Training Workshop on the Development of Severe Accident Management Guidelines Using the IAEA's Severe Accident Management Guidelines Development Toolkit (SAMG-D Toolkit) in December 2021.

84. The Agency supported 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 and dedicated workshops.

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

85. The Agency held a Webinar on IAEA Applicability of IAEA Safety Standards to the Design of Novel Advanced Reactors including SMRs in December 2021.

86. The Agency developed a draft Safety Report on the applicability of Agency safety standards to novel advanced reactors, including SMRs. The Agency also developed review guidelines for the TSR of conceptual reactor designs applicable to novel advanced reactors, including SMRs.

87. The Small Modular Reactor Regulators' Forum published its phase 2 reports in June 2021, with Working Groups in the areas of licensing issues, design and safety analysis, and manufacturing, commissioning and operations. This was followed by a workshop in Amman in December 2021, where members presented the outputs of the Working Groups from first two phases and the work to be undertaken in phase 3. The workshop provided an opportunity to share the common positions of the Forum members in multiple topics and allowed for open discussion between the participants.

88. The Agency continued to work to produce a TECDOC on international experience in the regulation of small modular reactors and a TECDOC on optimization of protection against external hazards.

C.3. Research Reactor Safety

89. The Agency held a virtual Technical Meeting for the National Coordinators of the Incident Reporting System for Research Reactors in September 2021, where participants discussed lessons learned from events reported and shared their views on further enhancement of operating experience effectiveness through the system.

90. The Agency held four Technical Meetings to assist participating Member States to build capacity in several safety areas of research reactors: the Technical Meeting on Ageing Management, Refurbishment and Modernization in May–June 2021, the Technical Meeting on Upgrades to Digital Instrumentation and Control Systems for Research Reactors in August 2021, the Technical Meeting on Good Practices for the Operation and Maintenance of Research Reactors in August 2021, and the Technical Meeting on Safety of Research Reactors under Project and Supply Agreements and Review of their Safety Performance Indicators in November 2021.

91. The Agency held a virtual International Meeting on the Application of the Code of Conduct on the Safety of Research Reactors in July 2021, where participants discussed and exchanged experience in the safety status of their research reactors, as well as experience in the application of the provisions of the Code. The meeting concluded that continuous improvements in the application of many provisions of the Code, notably in the areas of regulatory supervision, leadership and management for safety, ageing management, and safety of research reactors, with regard to extended shutdown were made.

C.4. Fuel Cycle Facility Safety

92. The Agency held a virtual Technical Meeting on the Use of a Graded Approach in the Application of the Safety Requirements for Fuel Cycle Facilities in July 2021, where participants exchanged

experience in using a graded approach in the application of safety requirements, including Agency safety standards.

93. The Agency held a virtual Technical Meeting on Safety Analysis and Licensing Documentation for Fuel Cycle Facilities in November 2021.

94. The Agency made progress in the revision of the Safety Evaluation of Fuel Cycle Facilities During Operation mission guidelines.

C.5. Safety Infrastructure for Embarking Countries

C.5.1. Nuclear Power Programmes

95. The Agency held a virtual Workshop on Nuclear Power Plant Safety Assessment for Embarking Countries in June 2021.

96. The Agency has developed guidance for an expert mission to be offered to embarking countries in Phase 2 of safety infrastructure development, as set out in *Establishing the Safety Infrastructure for a Nuclear Power Programme* (IAEA Safety Standards Series No. SSG-16 (Rev. 1)), as an alternative to an IRRS mission, under the assumption that an IRRS mission will take place in Phase 3.

97. The Agency held a virtual Technical Meeting to Share Approaches to and Experiences in the Management of Regulatory Oversight for the Operation of a First Nuclear Power Plant in June 2021 to gather Member States' experience in establishing an effective regulatory framework for safety and to develop guidance on good practices for newcomer countries.

98. The Agency held four virtual meetings of the Regulatory Cooperation Forum, in March, June, September and November 2021, to assist its recipient members in developing robust regulatory frameworks.

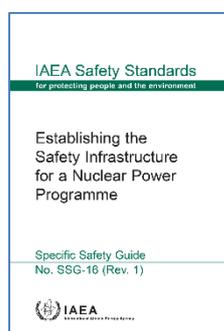
99. The Agency organized an interregional workshop on the roles and responsibilities of regulatory bodies during construction, commissioning and operation of NPPs in November 2021.

C.5.2. Research Reactors Programme

100. The Agency held two workshops to assist Member States in the preparation of a feasibility study and assessment of national nuclear infrastructure for new research reactor programmes.

101. The Agency conducted an Integrated Nuclear Infrastructure Review for Research Reactors mission to Thailand in December 2021 to assess the status of the development of national infrastructure to support the new research reactor project.

102. The Agency provided assistance in reviewing the commissioning programme for a research reactor in the Philippines and held virtual training for the Philippines via a live experimental demonstration on a subcritical assembly in the United States of America.



D. Strengthening Emergency Preparedness and Response

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

103. The Agency conducted three virtual workshops, in February, April and May 2021, on arrangements for notification, reporting and assistance in nuclear or radiological incidents and emergencies. In addition, the Agency conducted a ‘hybrid’ workshop on this topic in November 2021.

104. The Agency delivered two virtual International Workshops on Emergency Preparedness and Response Arrangements for Effective Communication with the Public, in September and November 2021.

105. The Agency issued a report entitled *Communicating on events including those with little or no impact on nuclear or radiation safety that may raise public or media interest* (document GOV/INF/2021/38) to the Board of Governors in August 2021. In the report, Member States were strongly encouraged to prioritize a prompt response to queries about relevant events of public or media concern and to consider addressing media queries with promptness and transparency.

106. The Agency held a workshop to promote the Early Notification and Assistance Conventions in September 2021, in which seven Member States not party to the Conventions participated.

D.2. Harmonization of Arrangements for Preparedness and Response

107. The Agency organized the International Conference on the Development of Preparedness for National and International Emergency Response (EPR2021) in October 2021, where participants discussed maintaining the preparedness to respond; the need to strengthen emergency operational arrangements aligned with the existing robust international emergency preparedness and response (EPR) framework; and the need to provide a clear, easily understandable answer to the key question in emergencies: “Am I safe?”. Among the conclusions of the conference was a call for a range of tools and capabilities to be utilized to inform emergency response, including quantitative and qualitative criteria and monitoring in emergency response to enable effective response, and the integration of systems/techniques for environmental monitoring and biodosimetry in the overall emergency management system to ensure that they are readily available and used effectively when needed.

108. The Agency organized a Technical Meeting on Next Generation Reactors and Emergency Preparedness and Response in October 2021, where participants discussed, inter alia, the graded approach to EPR for next generation reactors, the status of SMR design and deployment in Member States, non-reactor technical aspects of establishing off-site EPR arrangements, aspects of transportable SMRs, and the development of approaches, methodologies and criteria for determining the technical basis for emergency planning zones for SMRs.

109. Actions to further increase transparency, promote the exchange of information, and improve the Member State Emergency Preparedness and Response Information Management System (EPRIMS) user experience were developed in April 2021. These included refining the EPRIMS self-assessment function, and enhancing EPRIMS features to better support EPREV peer review service and include peer review reports.

D.3. Testing Readiness for Response

110. The Agency conducted a conducted a ConvEx-2b exercise in March 2021 with the largest number of participants to date, which involved 29 Member States and 5 international organizations acting as ‘Assisting Players’ and 18 Member States acting as ‘Requesting States’.



111. The Agency conducted six ConvEx-2e exercises with three Member States (Canada, the United Arab Emirates and the United States of America) to test the Agency's assessment and prognosis response role, including both the process and tools that support this role.

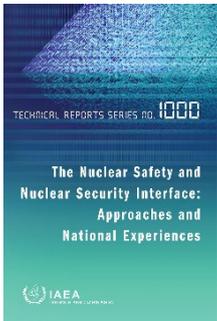
112. The Agency conducted two full response exercises, in March and June 2021 to test its ability to fulfil response roles under the Incident and Emergency System (IES) and to train IES responders. The Netherlands and Belgium were the respective hosts of the accident scenarios used in the exercises, which allowed for a thorough testing of information exchange with participating Member States.

113. The Agency conducted a ConvEx-2f exercise with public information officers and communication team leaders from the Agency and six international organizations in June 2021. The purpose of this exercise was to update the participants on the current standard operating procedures to be used during the ConvEx-3 exercise in October 2021.

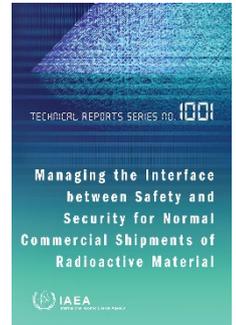
114. The Agency conducted a ConvEx-3 exercise, hosted by the United Arab Emirates, in October 2021 to test the international arrangements for response to a major nuclear emergency. The two-day emergency exercise tested the response to a simulated accident at Barakah NPP in the United Arab Emirates. The exercise also included several firsts: an Agency assistance mission, composed of experts from the Secretariat, as well as from France, the Republic of Korea and the United States of America, was deployed, integrated to the United Arab Emirates national response and provided radiation monitoring data from the area around Barakah NPP; 112 laboratories worldwide provided rapid gamma spectrum analysis results, thus testing not only the capability to measure but also the capability to operatively transmit results; and the Agency's social media simulator was used, allowing the participants to test responses to simulated crises on social media.

E. Improving Management of the Safety and Security Interface

115. At the October 2021 meetings of the International Nuclear Safety Group and the Advisory Group on Nuclear Security, the draft joint report *A System View of Nuclear Security and Nuclear Safety — Identifying Interfaces and Building Synergies* was approved. The report will now be prepared for publishing.



116. The Agency published *The Nuclear Safety and Nuclear Security Interface: Approaches and National Experiences* (IAEA Technical Reports Series No. 1000) in March 2021. The Agency also published *Managing the Interface between Safety and Security for Normal Commercial Shipments of Radioactive Material* (Technical Reports Series No. 1001) in September 2021.



117. The Agency developed a draft Technical Report on the safety–security–safeguards considerations by design of novel advanced reactors, including SMRs. The report elaborates on the gaps and challenges in this area and provides input for a draft Safety Report on the applicability of Agency safety standards to novel advanced reactors, which is currently under development. The Agency also held a virtual meeting to discuss the interfaces between safety–security–safeguards for novel advanced reactors in September 2021.

118. The Agency held a virtual Technical Meeting on the Use of Safety Analysis Approaches for Nuclear Security Purposes in October 2021 to discuss current approaches, with a focus on potential ways insights from safety analysis, both probabilistic and deterministic, could be used to support nuclear security considerations.

119. The Agency developed two training courses, one each on medical and industrial activities, to support the implementation of the Technical Reports Series publications on notification, authorization, inspection, and regulatory enforcement for the safety and security of radioactive sources.

120. The Agency prepared a draft document preparation profile, submitted to the Safety Standards Committees and the Nuclear Security Guidance Committee for their consideration, for a joint safety guide and implementing guide on Management of the Interfaces between Safety and Nuclear Security.

F. Strengthening Civil Liability for Nuclear Damage

121. The 21st regular meeting of the International Expert Group on Nuclear Liability (INLEX), which took place virtually in April 2021, provided a forum to present new developments in Member States and activities by the Secretariat in the field of civil liability for nuclear damage, as well as to discuss future outreach activities. In addition, INLEX discussed liability issues concerning nuclear fusion installations, operators' right of recourse under the nuclear liability conventions and the exclusion of operators' liability for on-site property damage.

122. With the support of INLEX and in cooperation with the Indonesian Nuclear Energy Regulatory Agency, the Agency held a virtual Workshop on Civil Liability for Nuclear Damage for ASEAN Plus Three in June–July 2021. In addition, a Workshop on Civil Liability for Nuclear Damage was held virtually with the assistance of members of INLEX in April 2021. The purpose of this workshop was to provide diplomats and experts from Member States with an overview of the international legal regime of civil liability for nuclear damage.

123. In the context of the Agency's legislative assistance programme, assistance was provided to seven Member States in the development of national legislation which also includes civil liability for nuclear damage.

Appendix B

The Agency's Safety Standards Activities in 2021

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

- *Schedules of Provisions of the IAEA Regulations for the Safe Transport of Radioactive Material (2018 Edition)* (IAEA Safety Standards Series No. SSG-33 (Rev. 1));
- *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);
- *Protection against Internal Hazards in the Design of Nuclear Power Plants* (IAEA Safety Standards Series No. SSG-64);
- *Seismic Design for Nuclear Installations* (IAEA Safety Standards Series No. SSG-67);
- *Design of Nuclear Installations Against External Events Excluding Earthquakes* (IAEA Safety Standards Series No. SSG-68); and
- *Equipment Qualification for Nuclear Installations* (IAEA Safety Standards Series No. SSG-69).

2. The CSS met twice in 2021. It endorsed for submission for publication the following draft Safety Guides:

- *Operational Limits and Conditions and Operating Procedures for Nuclear Power Plants* (DS497A);
- *Modifications to Nuclear Power Plants* (DS497B);
- *The Operating Organization for Nuclear Power Plants* (DS497C);
- *Core Management and Fuel Handling for Nuclear Power Plants* (DS497D);
- *Maintenance, Testing, Surveillance and Inspection in Nuclear Power Plants* (DS497E);
- *Recruitment, Qualification and Training of Personnel for Nuclear Power Plants* (DS497F);
- *Conduct of Operations at Nuclear Power Plants* (DS497G);
- *Protection Against Internal and External Hazards in the Operation of Nuclear Power Plants* (DS503);
- *Compliance Assurance for the Safe Transport of Radioactive Material* (DS515); and
- *Criticality Safety in the Handling of Fissile Material* (DS516).

3. In 2021, the CSS also approved the following document preparation profiles for Safety Guides:

- *Investigation of Site Characteristics and Evaluation of Radiation Risks to the Public and the Environment in Site Evaluation for Nuclear Installations* (DS529), revision of NS-G-3.2;
- *The Management System for the Safe Transport of Radioactive Material* (DS530), revision of TS-G-1.4; and

- *Site Geotechnical Aspects for Design Basis of Nuclear Installations* (DS531), revision of NS-G-3.6.
4. The CSS meetings in 2021, held virtually in June and in person with the possibility for virtual participation in November, were the third and fourth of its seventh term, and the CSS discussed a working plan for the implementation of its recommendations for that four-year term.
 5. The CSS also discussed the result of the review by the Safety Standards Committees of a draft medium-term plan for the safety standards.
 6. The CSS considered experiences from Member States in addressing challenges resulting from the COVID-19 pandemic and discussed the result of the review by the Safety Standards Committees of the preliminary gap analysis to determine any necessary strengthening of safety standards in the light of the pandemic. The Agency will continue collecting feedback from Member States, using NSS-OUI, that will then be considered when individual safety standards are reviewed and revised in future.
 7. 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 further enhanced in 2021. 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.
 8. The IAEA Safety Glossary is available in 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.
 9. 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 Agency 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. The NSS-OUI platform will be further used for the systematic revision of Agency safety standards.



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