

**Board of Governors
General Conference**

GOV/2020/28-GC(64)/5*

Date: 13 August 2020

General Distribution

Original: English

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Item 17 of the Conference's provisional agenda
(GC(64)/1 and Add.1)

**STRENGTHENING THE AGENCY'S
ACTIVITIES RELATED TO
NUCLEAR SCIENCE, TECHNOLOGY
AND APPLICATIONS**

Report by the Director General

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Strengthening the Agency's Activities related to Nuclear Science, Technology and Applications

Report by the Director General

Summary

In response to General Conference resolutions GC(63)/RES/10 and GC(62)/RES/9, this document contains progress reports on:

- Part A.: Non-Power Nuclear Applications
 - General (Annex 1)
 - Support to the African Union's Pan African Tsetse and Trypanosomosis Eradication Campaign (AU-PATTEC) (Annex 2)
 - Renovation of the Agency's Nuclear Applications Laboratories at Seibersdorf (Annex 3)
 - Development of the Sterile Insect Technique Package for the Management of Disease-Transmitting Mosquitoes (Annex 4)
 - Strengthening the Support to Member States in Food and Agriculture (Annex 5)
 - Plan for Producing Potable Water Economically Using Small and Medium Sized Nuclear Reactors (Annex 6)

- Part B: Nuclear Power Applications
 - Introduction (Annex 7)
 - IAEA Communication, Cooperation with Other Agencies and Stakeholder Involvement (Annex 8)
 - Nuclear Fuel Cycle and Waste Management (Annex 9)
 - Research Reactors (Annex 10)
 - Operating Nuclear Power Plants (Annex 11)

- Agency Activities in the Development of Innovative Nuclear Power Technology (Annex 12)
- Approaches to Supporting Nuclear Power Infrastructure Development (Annex 13)
- Small and Medium Sized or Modular Reactors — Development and Deployment (Annex 14)

- Part C: Nuclear Knowledge Management
 - Nuclear Knowledge Management (Annex 15)

Further information on the Agency's activities related to nuclear science, technology and applications can be found in the *Nuclear Technology Review 2020* (document GC(64)/INF/2); the *IAEA Annual Report 2019* (GC(64)/3), in particular the section on nuclear technology; and the *Technical Cooperation Report for 2019* (GC(64)/INF/9).

Recommended Action

- It is recommended that the Board take note of Annexes 1–15 of this report and authorize the Director General to submit the report to the General Conference at its 64th regular session.

General

A. Background

1. In resolution GC(63)/RES/10.A.1, the General Conference requested the Director General, in conformity with the Statute, to continue to pursue, in consultation with Member States, the Agency's activities in the areas of nuclear science, technology and applications, with special emphasis on supporting the development of nuclear applications in Member States with a view to strengthening infrastructures and fostering science, technology and engineering for meeting sustainable growth and development needs of Member States in a safe manner.
2. The General Conference recommended that the Secretariat report to the Board of Governors and to the General Conference at its 64th regular session on the progress made in the areas of nuclear science, technology and applications. This report has been prepared in response to that recommendation.

B. Progress since the 63rd Regular Session of the General Conference

3. Due to the COVID-19 outbreak, the Agency transitioned to a remote working environment, allowing it to continue programmatic activities. Several planned events required postponement, however where possible, the Agency continued activities using digital technology that included inter alia organizing virtual meetings.
4. In response to the current pandemic, the Agency, as a member of the United Nations Crisis Management Team on COVID-19 and in coordination with the WHO, provided assistance to Member States, to fight COVID-19 through the provision of equipment and training.¹
 - i. The Agency responded to requests from 123 countries and territories. Besides supplying related equipment such as RT-PCR, the Agency, through various webinars, assisted health care providers around the world to adjust their standard operating procedures to cope with the pandemic in order to continue delivering their services.
 - ii. Thirteen webinars were conducted related to the COVID-19 pandemic in subjects related to human health, radioisotope production and radiation technology reaching more than 7000 participants from all over the world. Topics covered inter alia the production of medical radioisotopes and radiopharmaceuticals as well as their supply for clinical use during the pandemic. One of the main topics of discussion was the transport of molybdenum 99 (Mo 99) and Mo99/technetium 99m (Tc 99m) generators. Furthermore, a webinar was held on radiation sterilization of personal protective equipment.

¹ Please see GOV/INF/2020/6, for the latest status of the Agency's assistance rendered to its Member States in their efforts to address the current COVID-19 pandemic and indicated future steps.

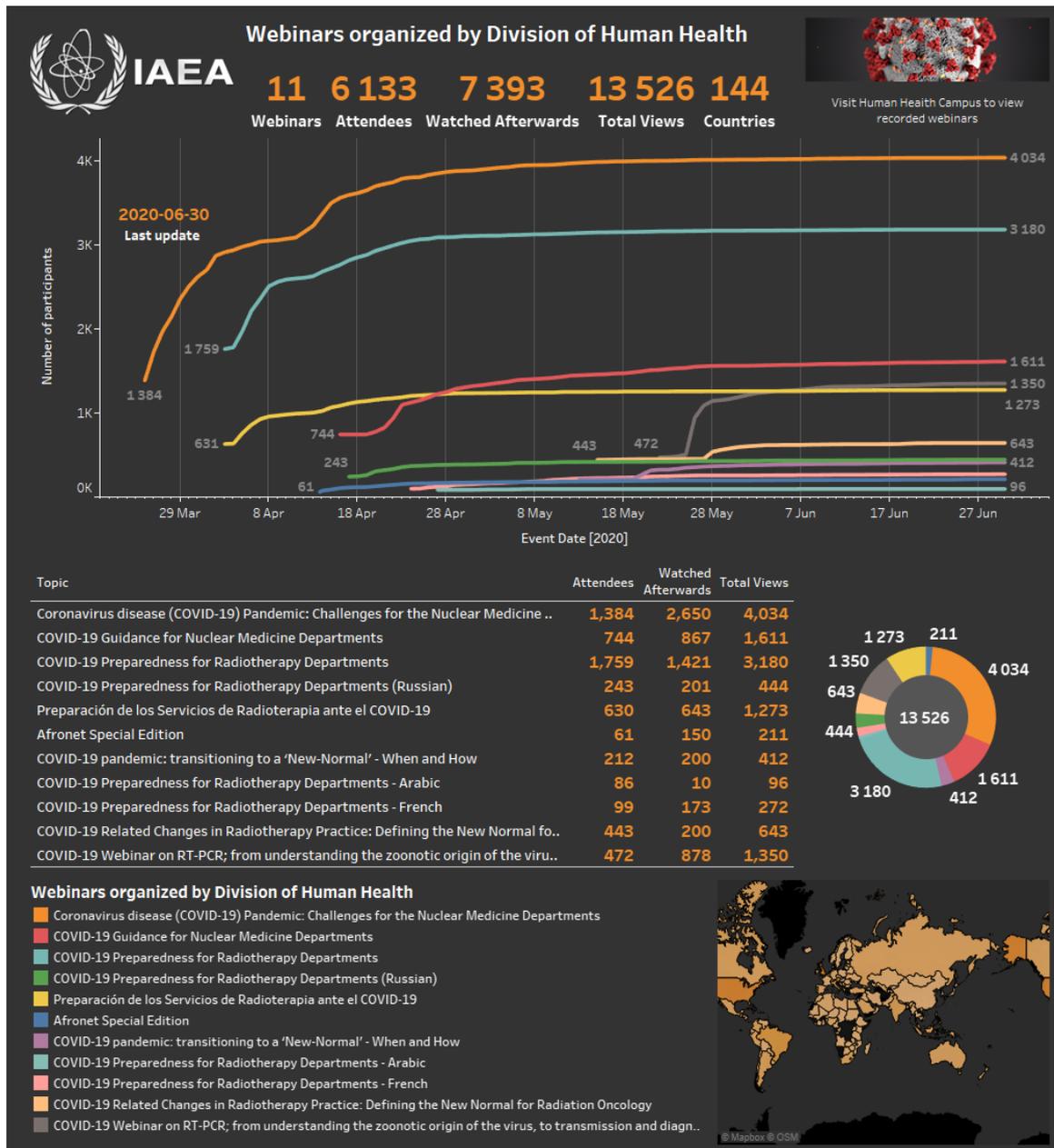


FIG. B.1. Covid-19 webinars organized by the IAEA in support of Member States. (Source: IAEA)

- iii. The Agency’s Animal Production and Health Laboratory (APHL) verified and confirmed the technical performance of the immunological and molecular detection kits included in the emergency detection package and put together a set of standard operating procedures for detecting the virus in accordance with WHO recommendations. The APHL continues to validate the most promising COVID-19 detection kits to determine their sensitivity and specificity performance as they become available on the market.



FIG. B.2. IAEA Director General Rafael Mariano Grossi and Mr Alexander Schallenberg, Federal Minister for European and International Affairs of the Republic of Austria visit the Animal Production and Health Laboratory, Seibersdorf, Austria, to view COVID-19 detection package ready for shipment to Member States. (Source: IAEA)

5. The Agency continued to collaborate with designated Member State institutions to implement the Agency's programmatic activities and promote the practical use of nuclear techniques. At the end of 2019, the Agency had 43 active Collaborating Centres, representing an increase of 10 compared to the end of 2018. The Agency organized a side event during the 63rd regular session of the General Conference to promote, inter alia, the Collaborating Centre mechanism. The Agency also organized the first Technical Meeting on IAEA Collaborating Centres in Nuclear Science and Applications, attended by Liaison Officers from 33 Collaborating Centres, to discuss resource mobilization, capacity building, communication, policy, synergies and network opportunities.

6. In response to Member States' request to commence consultations towards convening a follow-up to the IAEA Ministerial Conference on Nuclear Science and Technology: Addressing Current and Emerging Development Challenges, held in 2018, the Secretariat intends to initiate consultations with Member States in 2021 with a view to holding a follow-up event in 2023.

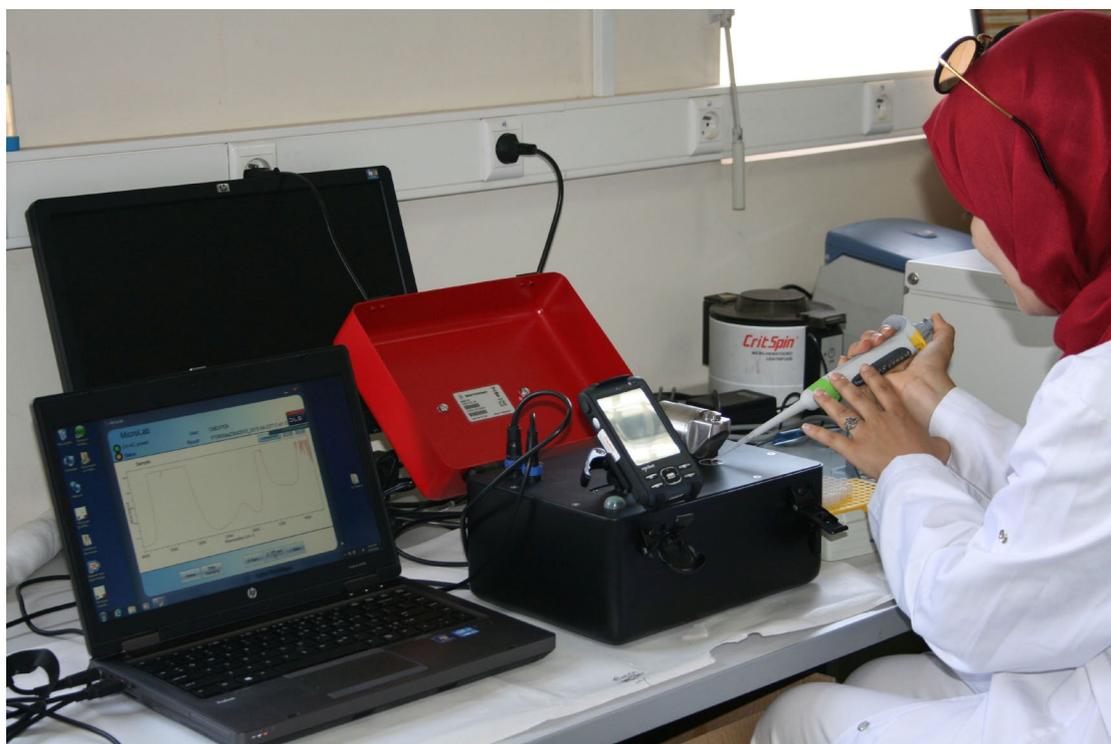
7. The Agency continued its outreach activities in seeking extrabudgetary resources for coordinated research projects (CRPs) to support research and development in Member States, including a side event during the 63rd regular session of the General Conference, attended by representatives from more than 50 Member States. The Agency continued updating information on newly initiated CRPs, and the publishing of CRP success stories. At the end of 2019, the Agency operated 1,620 active research contracts and agreements as part of 122 active CRPs.

8. The Agency has joined the United Nations Environment Programme Global Mercury Partnership, which is recognized for its expertise in the field of mercury analysis as a provider of independent quality control services for all 111 contracting parties of the Minamata Convention on Mercury. The collaboration will enhance partnerships and funding opportunities.

9. The Agency continued to strengthen its relationship with the World Health Organization (WHO) through cooperation in various areas and joint initiatives such as the IAEA/WHO Network of Secondary

Standards Dosimetry Laboratories (IAEA/WHO SSDL Network). Three new members, from the Republic of Korea, Nigeria and Turkey, have joined the SSDL Network since July 2019. This brings the total to 86 members from 73 Member States, as well as 18 affiliate members (primary standards dosimetry laboratories).

10. The proceedings of the International Symposium on Understanding the Double Burden of Malnutrition for Effective Interventions, which was organized jointly with the WHO in Vienna in December 2018, were prepared in close consultation with the WHO and published in November 2019. In addition, a brochure presenting an overview of opportunities to reduce the double burden of malnutrition was produced, jointly with the WHO, in 2019. The Agency also collaborates with the WHO under the CRP entitled 'Applying Nuclear Techniques to Understand the Link between Early Life Nutrition and Later Childhood Health', and discussions are ongoing to identify synergies for action at country level and to identify joint research projects.



*FIG. B.3. Using Fourier-transform infrared spectrometer (FTIR) to measure body composition.
(Source: Khalid El Kari/Morocco)*

11. To strengthen joint actions against human disease vector mosquitoes, the Agency, through the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, entered into a new strategic partnership with the WHO on vector borne diseases to intensify collaboration on the development and use of the sterile insect technique (SIT) against *Aedes* mosquitoes. This initiative seeks to further the development and application of SIT against major disease-transmitting mosquitoes, and a joint guidance framework for testing SIT against *Aedes*-borne diseases.

12. The comparisons, quality management system and procedures needed for the high dose rate brachytherapy calibration service were finalized, and the first calibration certificates were issued by the IAEA Secondary Standards Dosimetry Laboratory (SSDL) in February 2020. A new CRP entitled 'Applying Nuclear Nutrition Techniques to Improve Outcomes for Childhood Cancer in Low- and Middle-Income Countries', involving ten low- and middle-income countries (LMICs), was initiated in 2019. It will provide guidance to childhood cancer centres on implementing and monitoring nutritional support programmes to prevent premature deaths from childhood cancer in LMICs. A new CRP entitled

'Efficacy of Spatially Fractionated Radiation Therapy (SFRT) in Palliative Treatment of Lung and Cervical Cancer Patients' was initiated in 2020. The Agency continued to collaborate with the WHO and St. Jude Children's Research Hospital on childhood cancer care activities. The Agency also continues to collaborate with the WHO on the Joint Global Programme on Cervical Cancer Prevention and Control. The Agency is also part of the WHO's cervical cancer elimination initiative.

13. The Agency continues to support capacity building, emergency interventions and South–South cooperation through scientific and technical networks established and coordinated by the Agency. One such example is the Veterinary Diagnostic Laboratory (VETLAB) Network, a scientific and technical network of national veterinary laboratories from 45 African and 19 Asian countries, as well as recent initiated networks in Latin America and the Caribbean, and Eastern Europe. In addition to continuing to strengthen capacities for preparedness for and rapid response to infectious animal and zoonotic disease outbreaks (e.g., African swine fever, equine influenza, Ebola virus disease and Rift Valley fever), the VETLAB Network has been playing a crucial role in supporting the Agency's COVID-19 assistance to Member States in Africa, Asia, and Latin America and the Caribbean.

14. The Analytical Laboratories for the Measurement of Environmental Radioactivity network has further grown to encompass 187 laboratories in 89 Member States, all of which are endorsed by their national governments to provide rapid assistance in measuring radionuclides in the environment. Regular training activities for laboratories were performed, with 106 laboratories participating in the proficiency test that took place in October with the aim of demonstrating their technical competence.

15. The Agency continued to support, through the technical cooperation programme, more than 60 national and regional projects in Member States aimed at the production of medical radioisotopes and radiopharmaceuticals. In October 2019, the Agency held the International Symposium on Trends of Radiopharmaceuticals (ISTR-2019), with more than 400 participants from 72 Member States. ISTR-2019 provided scientists and professionals working in the production of medical radioisotopes and radiopharmaceuticals an international forum for discussing the most recent developments in the field, paving the way for future Agency activities aimed at supporting Member States.

16. The Third Research Coordination Meeting on Therapeutic Radiopharmaceuticals Labelled with New Emerging Radionuclides (Cu-67, Re-186, Sc-47) was held in Vienna in December 2019, attended by 20 participants from 14 Member States. The aim of the related CRP was to develop production methodologies for emerging beta minus emitters (copper-67 (Cu-67), rhenium-186 (Re-186) and scandium-47 (Sc-47)) for therapeutic application. An IAEA Technical Document (IAEA-TECDOC) is being prepared and will cover the main results of the project. Furthermore, the Agency held a Technical Meeting on the Production of Alpha Emitters and Radiopharmaceuticals (Ac-225, Bi-213) in Vienna in December 2019, attended by 21 participants from 8 Member States. The aim of the meeting was to begin developing an Agency publication on the production of alpha emitters and related radiopharmaceuticals.

17. The Agency and the WHO collaborated on producing guidelines on good practices for radiopharmaceutical manufacturing, which were made available to Member States in May 2020. Regulatory issues related to the production of radiopharmaceuticals are a major issue in Member States, in particular owing to the requirements for achieving good manufacturing practices, and many Member States will be able to draw on these guidelines to develop national regulations.



FIG. B.4. An IAEA supported radiopharmaceutical production facility, according to international guidelines and standards, to serve the Member States for the diagnosis and therapy of human diseases. (Source: IAEA)

18. The CRP entitled ‘Evaluation and Optimization of Paediatric Imaging’ was successfully concluded, and spreadsheets have been developed that will facilitate the adoption of techniques to improve dose optimization in common procedures used to image paediatric patients.

19. Furthermore, the CRP entitled ‘Enhancing Capacity for Early Detection and Diagnosis of Breast Cancer Through Imaging’ was successfully concluded in 2019 as a joint project involving radiologists and medical physicists. The main result was the implementation of best practices in mammography, including screening programmes, by improving image quality and interpretation of studies. The International Virtual Conference on Theranostics evaluated how the combination of diagnostic molecular imaging with radionuclide therapies is key to individualized management of the disease. The conference was also the first to be organized virtually by the Agency. Over 1000 participants from 104 Member States participated remotely, and 393 participants from 79 Member States met the requirements necessary to be awarded continuing medical education credits. This was the first time that the European Union of Medical Specialists awarded credits to participants of a virtual initiative.

20. The Agency continued to provide support to Member States, through the technical cooperation programme, in the production of Mo-99 through neutron activation of Mo targets using research reactors.

21. The Agency supported five CRPs on research and applications related to accelerators. In the framework of a new Partnership Agreement with Elettra Sincrotrone Trieste, Italy, 23 experiments

Elettra Sincrotrone Trieste was designated as an IAEA Collaborating Centre in May 2020. Areas of collaboration are focused on advanced light sources and their applications, and the collaboration will support countries in research, development and capacity building in the application of advanced and innovative radiation technologies.

involving participants from 11 Member States, were successfully performed using the X-Ray Fluorescence beamline in 2019. In addition, the first joint Agency–Elettra Sincrotrone Trieste training workshop was organized in October 2019, allowing seven scientists from seven Member States to become familiarized with the state-of-the-art Elettra facilities and to draft experimental proposals for future research to be performed at the facilities.

22. Through an existing Partnership Agreement, with the Ruder Bošković Institute (RBI), Croatia, which facilitates access to the ion beam facilities located in Zagreb, 17 beam time slots were granted to multiple users from five Member States in 2019. Furthermore, eight participants from eight Member States attended a hands-on-training workshop aimed at assisting specialists from accelerator facilities in their efforts towards self-sustainability through more efficient operation and maintenance tasks. A Joint ICTP–IAEA Workshop on Electrostatic Accelerator Technologies, Basic Instruments and Analytical Techniques was organized in Trieste, Italy, in October 2019. The participants were trained in electrostatic accelerator technologies, as well as associated analytical techniques and detectors.

23. A robotic calibration arm was delivered to the Dosimetry Laboratory in December 2019 and will enhance the calibration and comparison services of the IAEA Secondary Standards Dosimetry Laboratory (SSDL).



FIG.B.5 Performing LINAC calibration using the robotic bench at the IAEA Dosimetry Laboratory in Seibersdorf. (Source: IAEA)

24. The Agency continued to support, through the technical cooperation programme, more than 100 national and regional projects on the application of radiation technologies. New databases on irradiation facilities, on both gamma and electron-beam installations, are currently being developed by the Agency.

25. The Agency made arrangements with nine well-established accelerator facilities in different geographical areas within the framework of a new CRP entitled ‘Facilitating Experiments with Ion Beam Accelerators’. These facilities have agreed to provide their infrastructure to scientists from Member States that do not have such infrastructure.

26. The Agency, upon the request of Member States, provided targeted support through three expert missions to small accelerator facilities in Bangladesh, Croatia and Greece regarding technical aspects

and troubleshooting related to operation and maintenance of accelerators and associated experimental equipment.

27. The Agency continued to provide technical support for the use of research reactors in the production of radiopharmaceuticals and industrial radioisotopes by preparing a Technical Meeting on Reactor Based Radioisotope and Radiopharmaceutical Production in Warsaw, to share experience and know-how on the subject.

28. The Agency continued to develop instruments, and to make available, to requesting Member States, services for the rapid and economical mapping of radioactivity on the Earth's surface. In this regard, a cross-cutting Technical Meeting on Advanced Radiation Portal Monitor Testing and Configuration Techniques was organized in Seibersdorf, Austria, in October 2019. Twenty-two participants from 18 Member States and 5 international experts discussed test methods that are useful for evaluating the performance of radiation portal monitors and that are not currently addressed by international standards.

29. Furthermore, under the IAEA Action Plan on Nuclear Safety and within the framework of the project NA9/3 'Rapid Environmental Mapping with UAV, Phase II: Operational Support', substantial support was provided to the Fukushima Prefectural Centre for Environmental Creation in the calibration of nuclear instrumentation, data collection strategies and interpretation of results for radiological mapping of four different sites in Fukushima Prefecture, Japan.

30. In order to continue the activities on the demonstration fusion power plant (DEMO), the Sixth IAEA DEMO Programme Workshop was held in Moscow in September 2019. Approximately 60 experts from 14 countries, the European Union's Fusion for Energy and the ITER Organization participated in discussions on plasma stability, materials science and the impact of operational conditions of DEMO.

31. The 1st Costa Rica Training Workshop in Fusion for Latin-American Region 2019 was organized in cooperation with the Agency in Cartago, Costa Rica, in November 2019, attended by 60 participants.

32. The Agency issued two publications entitled *Pathways to Energy from Inertial Fusion: Structural Materials for Inertial Fusion Facilities* (IAEA-TECDOC-1911) and *Challenges for Coolants in Fast Neutron Spectrum Systems* (IAEA-TECDOC-1912) following the completion of the relevant CRPs. The 28th IAEA Fusion Energy Conference, initially planned to take place in October 2020, has been postponed to May 2021 owing to the COVID-19 pandemic. Nevertheless, its technical programme has been finalized, with more than 700 contributions, including close to 100 oral presentations.

33. The Agency, in collaboration with the ITER Organization, supported the organization of the sixth ASEAN School on Plasma and Nuclear Fusion and the SOKENDAI Winter School, held in January 2020 and attended by 80 students from across Southeast Asia.



FIG. B.6. Participants of the 6th ASEAN School on Plasma and Nuclear Fusion and SOKENDAI Winter School during one of the remote experiments conducted on the educational tokamak GOLEM located at the Czech Technical University, Prague. (Source: IAEA)

34. In December 2019, the Integrated Research Reactor Utilization Review (IRRUR) was approved as an official Agency peer review service following feedback from a pilot IRRUR mission, conducted in Pavia, Italy in April 2019. In 2020, two formal requests for IRRUR missions have been received from research reactors in the United States of America, but these missions had to be postponed owing to the COVID-19 pandemic.

Support to the African Union's Pan African Tsetse and Trypanosomosis Eradication Campaign (AU-PATTEC)

A. Background

1. In resolution GC(63)/RES/10.A.2, the General Conference recognized that tsetse flies and the trypanosomosis problem which they cause constitute one of the greatest constraints on the African continent's socio-economic development, affecting the health of humans and, in particular, of livestock, limiting sustainable rural development and thus causing increased poverty and food insecurity.
2. The General Conference requested the Agency and other partners to strengthen capacity building in Member States for informed decision-making regarding the choice of tsetse and trypanosomosis strategies and the cost-effective integration of sterile insect technique (SIT) operations into area-wide integrated pest management (AW-IPM) campaigns. The General Conference also requested the Secretariat, in cooperation with Member States and other partners, to maintain funding through the Regular Budget and the Technical Cooperation Fund for consistent assistance to selected operational SIT field projects and to strengthen its support for research and development and technology transfer to African Member States in order to complement their efforts to create and subsequently expand tsetse-free zone.
3. The General Conference requested the Director General to report on the progress made in the implementation of resolution GC (63)/RES/10. A. 2 to the Board of Governors and to the General Conference at its 64th regular session.

B. Progress since the 63rd Regular Session of the General Conference

B.1. Strengthening Collaboration with AU-PATTEC

4. The Agency was represented at the 18th meeting of coordinators/focal points for AU-PATTEC, at the 8th meeting of the AU-PATTEC Steering Committee and at the 35th General Conference of the International Scientific Council for Trypanosomosis Research and Control, which were held in Abuja in September 2019. A presentation was given to update AU-PATTEC members on the status of the activities of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture and the Agency's assistance provided under the technical cooperation programme in support of tsetse and trypanosomosis control. The Agency will continue its close collaboration with AU-PATTEC on its goal to eliminate tsetse flies and trypanosomosis through the creation of sustainable tsetse and trypanosomosis free areas.

B.2. Capacity Building through Applied Research and Technical Cooperation

5. The Agency continued to respond to Member States' requests for support in incorporating SIT into AW-IPM to eliminate or control tsetse-transmitted trypanosomosis. The disease has been recognized as a major constraint on both livestock and agricultural crop production in sub-Saharan Africa. The support included the provision of technical advice, procurement of equipment and materials, training courses and workshops, fellowships and scientific visits, as well as research conducted at the Insect Pest Control Laboratory (IPCL) at the FAO/IAEA Agriculture and Biotechnology Laboratories in Seibersdorf, Austria. In addition, experts from affected Member States continue to participate in the coordinated research project entitled 'Improvement of Colony Management in Insect Mass-rearing for SIT Applications', which includes a research group on tsetse flies.



FIG. B.1. Technical briefing by staff of the Insect Pest Control Laboratory, Seibersdorf, Austria, to the IAEA Director General Rafael Mariano Grossi. (Source: IAEA)

6. The Agency's support strengthened capacity in Member States, enabling them to obtain and analyse baseline data to support informed decision-making regarding the choice and feasibility of available tsetse and trypanosomosis suppression or eradication strategies, including the cost-effective integration of SIT operations into AW-IPM campaigns. Since the 63rd regular session of the General Conference, support in this area has been provided to Burkina Faso, Chad, Ethiopia, Mali, Senegal, South Africa, Uganda, the United Republic of Tanzania, Zambia and Zimbabwe.

7. Since September 2019, the Agency has supported six fellowships and scientific visits. The fellowships provided individual training at specialized institutions for a total duration of more than 700 days. The IPCL is currently hosting three graduate students (PhD and MSc) working under the supervision of senior Agency scientists on research topics pertaining to the tsetse microbiome and the release of chilled tsetse flies.

8. Research activities at the IPCL have focused on the improvement of the productivity and the performance of tsetse colonies through gaining a better understanding of the impact of pathogenic viruses and symbiotic bacteria.

9. Capacity building activities in this area included two regional training courses on tsetse dissections and on the use of the recently developed near infrared tsetse pupae sex sorter. The latter was hosted in December 2019 at the IPCL with the participation of professionals from the main tsetse insectaries in Africa.

B.3. Support for the Planning and Implementation of SIT Activities

10. Under technical cooperation project (RAF/5/080), the Agency has continued to supply equipment and consumables for field entomological surveillance, mass-rearing insectaries and molecular biology laboratories in Burkina Faso, Ethiopia, Mali, Uganda, the United Republic of Tanzania, Zambia and Zimbabwe. Irradiation capacities at the tsetse insectaries of the United Republic of Tanzania and of the International Centre of Research and Development for Livestock in Subhumid Zones have been strengthened through the provision of repair services and the replacement of a non-functional irradiator, respectively.

11. Expert missions, in collaboration with the Food and Agriculture Organization of the United Nations, were undertaken for the completion of a national atlas of tsetse and trypanosomosis in Mali, and for the mapping of the distribution of tsetse savannah species using cost-effective geo-referenced fly-rounds in Uganda, Zambia and Zimbabwe.

12. Through the technical cooperation programme, the Agency has continued to provide technical support to the Government of Senegal in its efforts to eradicate the tsetse fly *Glossina palpalis gambiensis* from the highly productive agricultural region of Niayes, to the north-east of Dakar, using an AW-IPM approach with a SIT component. Except for a few hot spots, tsetse fly populations have been reduced by approximately 97%. The prevalence of trypanosomosis is very low and the Government of Senegal continues to import more productive cattle into the area.

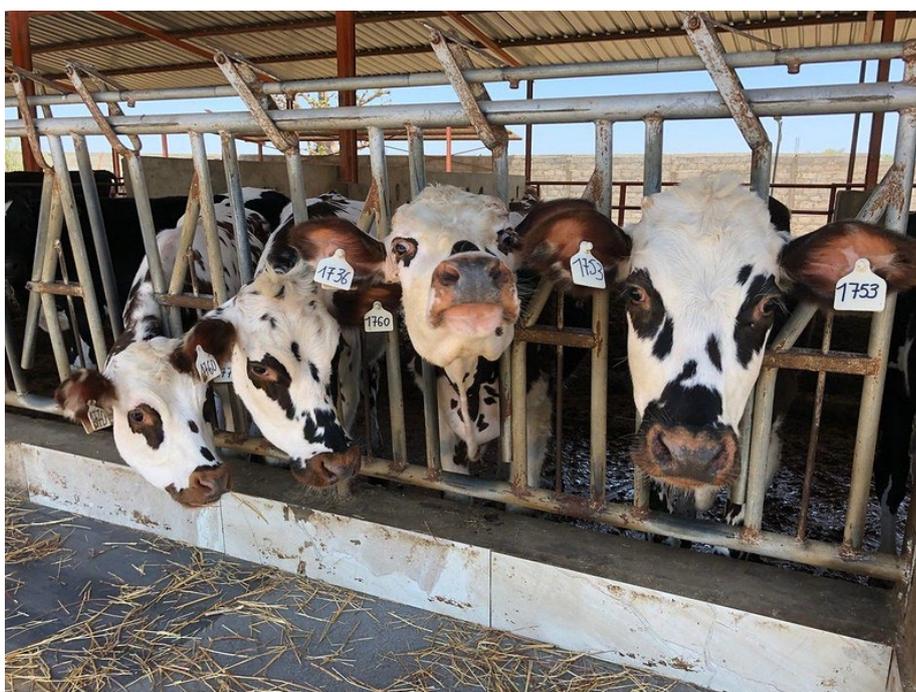


FIG. B.2. SIT used to suppress the tsetse fly in the Niayes region, enabling local farmers to significantly increase milk and meat production. (Source: USUNVIE)



FIG. B.3 Senegal's Nayas Region SIT implementation phase uses light aircraft to release sterile tsetse flies as part of tsetse population suppression and eradication campaign. (Source: IAEA)

13. In Burkina Faso, through the technical cooperation programme, capacity building activities on the use of molecular tools to identify tsetse fly and trypanosome species have been conducted, and a fully equipped molecular biology laboratory has been established. Efforts have been initiated to expand the *Glossina morsitans morsitans* colony and to establish a new colony of *Glossina tachinoides* from field-collected material. A mobile freezer is routinely used to transport blood collected at the abattoir in Ouagadougou to feed tsetse flies at the mass-rearing insectary in Bobo Dioulasso, Burkina Faso. Permission to use drones from the local authorities has been granted, and procurement procedures for long-range drones and associated training to release the sterile males in the field have been initiated.

14. In Chad, pre-operational activities have continued in the Mandoul area, one of the country's few remaining active foci of sleeping sickness. Genetic population studies have confirmed the isolation of the population of the vector tsetse fly *Glossina fuscipes fuscipes*. Suppression activities have continued with the deployment of very small targets, resulting in an extremely low density of tsetse flies and the lowest number of cases of sleeping sickness in this focus, which consists of areas for which historical records of disease transmission were available in 2019. The upscaling of the colony to produce sterile males has begun at a mass-rearing facility, operated by Scientica, in Slovakia. Training activities on maintenance of tsetse colonies and long-distance shipment of sterile pupae have continued. Procurement procedures for the purchase of a long-range drone and training on its operation have been initiated with the aim of reducing the cost of the upcoming operational phase.

15. African trypanosomiasis affecting livestock continues to place a significant constraint on development in much of sub-Saharan Africa, especially in rural areas, where poverty and lack of infrastructure are most acute. Where technically feasible, SIT, as a component of area-wide integrated

pest control interventions, can be a significant tool for alleviating this constraint. It is an environmentally friendly option for eradicating tsetse fly vector populations, removing the risk not only of animal trypanosomosis but also of human trypanosomosis (sleeping sickness) where it occurs. The benefits achieved, such as the improved ability to rear livestock for milk, meat and animal traction for ploughing to grow crops, will substantially improve the livelihoods of rural populations. The Agency continues to assist in building capacity in this area for the benefit of Member States in sub-Saharan Africa.

16. The constraints on successful and more widespread application of SIT in suitable areas continue to be the shortage of mass-rearing capacity in Africa and the appropriate management and of management structures for mass-rearing and area-wide pest control operations.

Renovation of the Agency's Nuclear Applications Laboratories at Seibersdorf

A. Background

1. During the 56th regular session of the General Conference in September 2012, the Director General called for an initiative to modernize and renovate the eight laboratories of the Department of Nuclear Sciences and Applications in Seibersdorf, Austria, to enable them to meet the growing and evolving needs of Member States. The General Conference supported the initiative of the Director General in resolution GC(56)/RES/12.A.5, and the Renovation of the Nuclear Applications Laboratories (ReNuAL) project was officially launched on 1 January 2014. The strategy for the project was issued in May 2014 in document GOV/INF/2014/11 and Corr.1.
2. ReNuAL Plus (ReNuAL+) was delineated in an addendum to the strategy that was issued in September 2014 (document GOV/INF/2014/11/Add.1) to provide for improvements required by the laboratories that could not be accommodated within scope of the ReNuAL project. In February 2017, the Secretariat issued document GOV/INF/2017/1, *Renovation of the Nuclear Applications Laboratories (ReNuAL) Project*, which updated Member States on the status of ReNuAL and ReNuAL+ and provided details on the implementation of ReNuAL, the scoping and costing of ReNuAL+, and efforts on resource mobilization.
3. The combined ReNuAL/ReNuAL+ project has delivered new laboratory buildings to house four of the eight nuclear applications laboratories in Seibersdorf and has provided a new linear accelerator facility for the Agency's Dosimetry Laboratory. It was expected that the four remaining laboratories would be expanded, and core infrastructure enhanced in the existing buildings once the other laboratories currently sharing those facilities moved into their new space. However, in early March 2020, an assessment by external experts concluded that full renovation of the existing 60-year-old laboratory building, intended to make the laboratories 'fit for purpose' to support Member State requirements, would likely take longer, cost more and result in a lower-quality laboratory building than the construction of a new building to house three of the laboratories (the Terrestrial Environment Laboratory, the Plant Breeding and Genetics Laboratory, and the Nuclear Science and Instrumentation Laboratory). The ReNuAL project management team determined the conclusions of the experts to be appropriate and concurred that a new building was the most suitable option for enhancing the three laboratories.
4. In that context, the Director General announced during the March 2020 Board of Governors meeting plans to build a second new Flexible Modular Laboratory (FML-2) building, which will house the three above-mentioned laboratories. The Dosimetry Laboratory will remain co-located, with its new linear accelerator facility remaining in its current location following its refurbishment. Ageing greenhouses, on which the work of three laboratories heavily depends, will also be replaced. The successful conclusion of this final project phase will enable the nuclear applications laboratories to respond to growing and evolving Member State needs and assist their efforts to achieve the Sustainable Development Goals
5. The General Conference, in resolution GC (63)/RES/10. A .4, requested the Director General to report on the progress made in the implementation of this resolution to the General Conference at its 64th regular session.

B. Progress since the 63rd Regular Session of the General Conference

B.1. Implementation Status

6. Steady progress has been made in the construction of the laboratory buildings since building commenced in July 2016, and all new construction anticipated under the original project strategy and its addendum has now been completed. The Dosimetry Laboratory's new linear accelerator facility was officially opened on 6 June 2019 and is now fully operational. The new Insect Pest Control Laboratory (IPCL) building became fully operational in the fourth quarter of 2019.

7. The General Conference, at its 63rd regular session, unanimously decided to rename the new Flexible Modular Laboratory building, then under construction, as The Yukiya Amano Laboratories (YAL), in honour of the late Director General. The YAL building was completed in May 2020, and the facility was officially opened by the Director General at an event held on 5 June 2020. It is now operational.

8. The new Energy Centre became operational in the second quarter of 2019 and now provides heating and cooling for the new IPCL and YAL buildings. The remaining cogeneration feature will be incorporated into the Energy Centre's operations by the end of the third quarter of 2020 in order to reduce energy consumption and emissions.

B.2. Financial Status and Resource Mobilization

B.2.1. Financial Status

9. In 2019, the total target for funding of ReNuAL and ReNuAL+ was adjusted from €57 million to €57.8 million to align the planned to actual and projected expenditure. This reflected an adjustment of ReNuAL project funding from €31 million to €31.6 million, and an adjustment of the ReNuAL+ target budget from €26 million to €26.2 million. Full funding of the ReNuAL project's adjusted €31.6 million budget was achieved in September 2016. It comprises €0.6 million from the operational Regular Budget, €10.3 million from the Major Capital Investment Fund and €20.7 million of extrabudgetary funding, excluding funding related to enabling activities.

10. Over €39 million in extrabudgetary funds has been raised for ReNuAL and ReNuAL+ to date, with financial and in-kind contributions received from 42 Member States and additional financial and in-kind support received from non-traditional donors. Once all new pledged contributions are received, the current combined ReNuAL/ReNuAL+ project target budget of €57.8 million will have been exceeded by approximately €470 000. A total of €9.7 million of this project budget is available towards addressing the requirements of the four remaining laboratories in the next project phase, which will include the construction of a new building, greenhouses, and additional infrastructure work. Preliminary cost estimates for the final phase of ReNuAL are being developed and more detailed information will soon be made available to Member States.

B.2.2. Funding Priorities

11. The funding needed to complete all ongoing project activities has been mobilized. These activities include ongoing work with external experts to produce concept designs for the construction of FML-2, the Dosimetry Laboratory wing refurbishment and the replacement of greenhouses. The next objective will be to obtain additional funding urgently needed to procure and launch construction of FML-2. Funding for the refurbishment of the Dosimetry Laboratory wing and the replacement of greenhouses may be pursued separately or in tandem with funding for FML-2. A refined cost estimate range for these

project elements will become available later this year at the conclusion of the concept design work currently under way.

B.2.3. Resource Mobilization Strategy

12. The Secretariat has pursued an element-specific resource mobilization strategy that seeks resources from Member States and non-traditional donors based on existing funding requirements. In support of this strategy, new and targeted resource mobilization products have been developed for individual elements of ReNuAL+, including donor packages, that provide comprehensive information on the remaining elements of the project and their funding requirements. The updating of resource mobilization products to account for completed project elements and the adjusted scope of the next phase is under way.

13. Laboratory tours continue to play an essential role in fundraising efforts; the nuclear applications laboratories hosted more than 85 delegations with over 650 participants in 2019. The Secretariat continues to publish periodic news briefs and produce videos that report on the status of the project and promote awareness of its requirements. Special events organized by the Secretariat, including the June 2019 linear accelerator opening event, the June 2020 opening of the YAL building and side events at the General Conference, provide valuable additional support to resource mobilization efforts. A donor wall displaying a ‘national brick’ for each Member State contributor to the project was unveiled on the opening day of the 61st regular session of the General Conference. Since then, representatives of all first-time Member State contributors are invited to symbolically place their national brick in the donor wall during special events. Three additional Member States have announced first-time pledges to the project since the 63rd regular session of the General Conference.



FIG. B.2.3. IAEA Director General Rafael Mariano Grossi, together with Mr Alexander Schallenberg, Federal Minister for European and International Affairs of the Republic of Austria, unveil the dedication plaque at the official inauguration of the Yukiya Amano Laboratory (YAL) at the IAEA Laboratories in Seibersdorf, Austria. (Source: IAEA)

B.2.4. Resource Mobilization Efforts with Member States

14. The Secretariat has continued to engage in bilateral discussions with a wide number of Member States to support fundraising, resulting in 42 Member States providing financial contributions towards the ReNuAL and ReNuAL+ projects to date. The goal of these activities is to maximize both the amount of funds raised and the number of contributing Member States. In this context, the Friends of ReNuAL, an informal group open to all Member States and co-chaired by Germany and South Africa, has continued to play an important role.

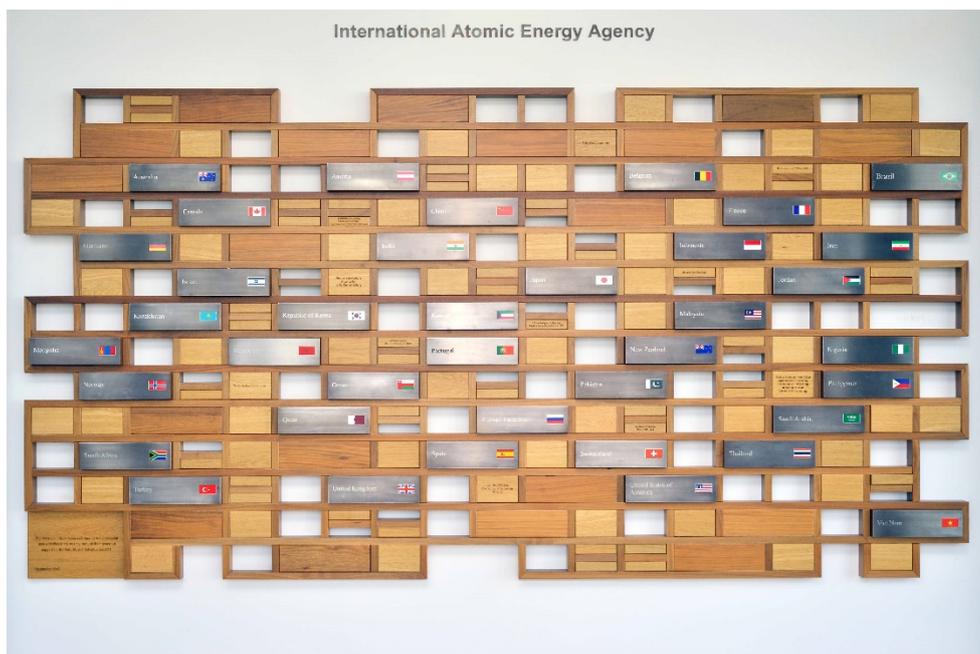


FIG. B.2.4. ReNuAL Donor Wall in Seibersdorf, Austria. (Source: IAEA)

15. Members of the Friends group, which meets on a regular basis, have been significant bilateral contributors to the project, and the group remains an important vehicle for maintaining and increasing awareness of ReNuAL/ReNuAL+ among Member States and for generating Member State support for the project.

B.2.5. Resource Mobilization Efforts with Non-Traditional Donors

16. The Secretariat has continued its efforts to attract support from non-traditional donors, with the primary focus on equipment manufacturers to help meet the equipment needs of the laboratories. Successful partnerships enabled the use of the Dosimetry Laboratory's new linear accelerator and a memorandum of cooperation for a donation through the Peaceful Uses Initiative of a liquid chromatograph for use in activities to support Member States in research on food safety and training.

17. In light of significant remaining equipment requirements, since the 63rd regular session of the General Conference the Secretariat has continued an initiative to generate interest in private-sector partnerships by listing equipment needs under the ReNuAL/ReNuAL+ initiative on the United Nations Global Marketplace (UNGM). Together, the two UNGM listings have generated four offers for partnerships. Separate partnerships to supply the Dosimetry Laboratory with a gamma beam irradiator (valued at approximately €86 000) and to supply the Food and Environmental Protection Laboratory with an isotope ratio mass spectrometer (valued at approximately €220 000) were concluded in February 2020 and March 2020, respectively. The remaining potential partnerships are currently assessed.

C. Next Steps

18. With all the new facilities previously under construction now complete and fully operational, project focus has turned to working with external experts on planning for elements of the next project phase, including construction of the FML-2 building, refurbishment of the Dosimetry Laboratory wing and replacement of the greenhouses. The ongoing design phase will yield refined cost estimates that will further inform the project's resource mobilization strategy, including short-, medium- and longer-term funding targets.

19. Resource mobilization efforts will focus on raising, by early 2021, the additional funding urgently needed to procure and launch construction in 2021 of the FML-2 building. Funding to refurbish the Dosimetry Laboratory wing and replace existing greenhouses may be pursued separately or in tandem with funding for FML-2.

Development of the Sterile Insect Technique Package for the Management of Disease-Transmitting Mosquitoes

A. Background

1. In resolution GC(62)/RES/9.A.2, the General Conference noted with concern that “about 3.2 billion people remain at risk of malaria, transmitted by mosquitoes, and that in 2016 alone there were an estimated 216 million new cases of malaria and 445 000 deaths, mainly in Africa, thus constituting a major obstacle to poverty eradication in Africa.” It noted that “the malaria parasite has continued to develop resistance to available drugs and that mosquitoes had continued to develop resistance to insecticides.”
2. The General Conference noted with serious concern that “mosquito-transmitted dengue, now the world’s most common mosquito-borne disease, has become a major international public health concern with an incidence growing more than 30-fold during the last 50 years”, and that “dengue is estimated to infect around 400 million people per year, and over half of the world’s population is at risk of the disease.”
3. The General Conference noted that “the suppression of disease-transmitting mosquitoes using the sterile insect technique (SIT) will be suitable mostly in urban areas, where aerial spraying with insecticides is prohibited or not indicated, and an area-wide approach is required, which represents a novel and potentially powerful supplement to existing community-based programmes.”
4. The General Conference requested the Agency to continue and strengthen “the research, both in the laboratory and in the field, required to be able to refine and validate the use of the SIT for the integrated management of malaria-, dengue-, Zika- and other disease-transmitting mosquitoes.” It requested the Agency to “increasingly involve developing Member States’ scientific and research institutes in the research programme in order to secure their participation, leading to ownership by the affected countries.” The General Conference also requested the Agency to “increase efforts to develop and transfer more efficient sex separation systems, including genetic sexing strains, that allow complete removal of the female mosquitoes in production facilities and to develop cost-effective methods to release and monitor sterile males in the field.”
5. The General Conference also requested the Agency to “strengthen capacity building and networking in Latin America, Asia and the Pacific, and Africa through regional technical cooperation (TC) projects and to support field projects against *Aedes* and *Anopheles* mosquitoes through national TC projects for assessing the potential of the SIT as an efficient control tactic for disease-transmitting mosquitoes.”
6. The General Conference noted with appreciation “the interest shown by some donors in and their support for research and development (R&D) on the SIT for combating malaria-, dengue-, Zika- and other disease-transmitting mosquitoes,” and requested the Agency to “allocate adequate resources and to attract extrabudgetary funds so as to continue the currently expanded mosquito research programme, laboratory/office space and staffing.”
7. The General Conference invited the Agency to “act upon the recommendation made by the experts of the Thematic Plan for the Development and Application of the Sterile Insect Technique (SIT) and

Related Genetic and Biological Control Methods for Disease Transmitting Mosquitoes to invest in supporting the management of the mosquito vector species through continuous funding of the development of the SIT and related genetic and environment-friendly methods.”

8. The General Conference requested the Director General to report on the progress made in the implementation of resolution GC (62)/RES/9. A.2 to the General Conference at its 64th regular session.

B. Progress since the 62nd Regular Session of the General Conference

9. In response to resolution GC(62)/RES/9.A.2, the Agency, through the Insect Pest Control Laboratory (IPCL) in Seibersdorf, Austria, continued to work on the development of the SIT package for disease-transmitting mosquitoes, i.e. *Anopheles arabiensis*, which is a vector of malaria, and *Aedes aegypti* and *Aedes albopictus*, which are the main vectors of dengue, Zika virus disease, chikungunya and yellow fever. The IPCL is currently maintaining mosquito strains from 16 countries, including strains with morphological and other markers, which are currently being evaluated for their potential use in SIT-based approaches.



Fig. B.1 Sterile male mosquitoes, colour marked with a fluorescent dye, that are being prepared for release. (Source: IAEA)

10. The Agency continues its efforts to develop robust and efficient methods for sex separation, including genetic sexing. An *Ae. aegypti* red-eye genetic sexing strain (GSS) was developed and validated under laboratory conditions and can be used for field testing within the framework of the technical cooperation programme. An irradiation-induced chromosomal inversion was integrated into the red-eye GSS to enhance its genetic stability. Additional mutations (mainly body and eye-colour

mutations) have been isolated for *Ae. aegypti*, *Ae. albopictus* and *An. arabiensis* and are currently under evaluation as potential selectable markers for genetic sexing.

11. In terms of mosquito mass-rearing technology, the IPCL has developed and validated several tools, pieces of equipment and procedures with the aim of reducing production costs and increasing the quality of the biological material. For example, new cages for adult *Aedes* mosquitoes and larval racks have been validated on *Ae. Albopictus*, with a significant reduction in cost; an automated larval counter has been validated on three species; and a new larval diet based on inexpensive insect proteins (black soldier fly powder) has been validated in mass-rearing conditions.

12. Recognizing the increasing challenges associated with using isotopic irradiators for the sterilization of mosquitoes and the anticipated expansion of mosquito suppression projects, the Agency has assessed the relative efficiency of X-rays and gamma rays to induce sterility in pupae of *An. arabiensis*, *Ae. albopictus* and *Ae. Aegypti*. The Agency also assessed the major factors impacting the dose response curve and quality of insects, including the dose rate, anoxia, age and density of pupae. Furthermore, the potential for irradiating adult chilled mosquitoes on a large scale is being investigated. The Agency also initiated collaboration with the private sector for the development of X-ray irradiators adapted to the sterilization of mosquitoes.

13. A rapid quality control test that measures flight ability has been validated for *Ae. aegypti*, *Ae. albopictus* and *An. arabiensis* and transferred to Member States.

14. Molecular tools to diagnose mosquito-borne diseases and pathogens in mosquito colonies were validated in collaboration with 'Infravec 2', a research project funded by the European Commission. These molecular tools will prove crucial in maintaining pathogen-free colonies in SIT programmes.

15. Following the successful suppression of target populations of *Ae. albopictus* in Guangzhou, China, through a combination of SIT and the incompatible insect technique, similar results were obtained in Singapore against *Ae. Aegypti*, where the target population was suppressed by more than 90%.

16. The Centro Agricoltura Ambiente 'Giorgio Nicoli' in Italy and Moscamed in Brazil have been designated as Agency Collaborating Centres since September 2017 and March 2018, respectively. They have reported significant development of the SIT package, including a field estimation of the competitiveness of *Ae. albopictus* in Italy and *Ae. aegypti* in Brazil.

17. The Agency continued to implement the coordinated research project (CRP) entitled 'Mosquito Handling, Transport, Release and Male Trapping Methods' and developed a new CRP entitled 'Mosquito Irradiation, Sterilization and Quality Control', which has been approved and will commence in November 2020.

18. In response to Member States' needs for new sterile male mosquito release methods, the Agency, in collaboration with the European Research Council, is undertaking efforts to reduce the weight of a drone release system for sterile male mosquitoes to allow for the system's use over urban areas. Field tests are ongoing in some Member States.



FIG. B.2 Public information campaign in Mexico to educate the local people on the use of drones for the aerial release of sterile male mosquitoes. (Source: IAEA)

19. The Agency continued to provide Member States with support through three regional TC projects covering the European region (project RER5022, entitled ‘Establishing Genetic Control Programmes for *Aedes* Invasive Mosquitoes’); the Asia-Pacific region (project RAS5082, entitled ‘Managing and Controlling *Aedes* Vector Populations Using the Sterile Insect Technique’); and the Latin America and the Caribbean region (project RLA5074, entitled ‘Strengthening Regional Capacity in Latin America and the Caribbean for Integrated Vector Management Approaches with a Sterile Insect Technique Component, to Control *Aedes* Mosquitoes as Vectors of Human Pathogens, particularly Zika Virus’). It also provided support through an interregional TC project (project INT5155, entitled ‘Sharing Knowledge on the Sterile Insect and Related Techniques for the Integrated Area-Wide Management of Insect Pests and Human Disease Vectors’), which is a fundamental strategic platform for the exchange of knowledge and experiences worldwide.

20. The Agency continued to provide support to Member States through the technical cooperation programme in Brazil, Cuba, Mauritius, Mexico, the Philippines, South Africa, Sri Lanka, Sudan and Turkey. The Agency has also supported pilot trials for mosquito SIT application in Italy, Spain and the United States of America.

21. The Agency launched a phased conditional approach scheme, through which Member States can test and implement SIT for vector control where advancing to the next phase depends on completion of activities in the previous phase, with the objective of reaching large-scale deployment of SIT operational programmes.

22. . As part of the MOU between the Agency and the WHO, a Guidance Framework for Testing the Sterile Insect Technique as a Vector Control Tool against *Aedes*-Borne Diseases has been available to Agency Member States since April 2020. In addition, in August 2019, Agency and WHO experts assisted Bangladesh in assessing the country’s dengue outbreak and developing a plan to test a nuclear technique to suppress the mosquitoes that spread the disease.

23. After a very successful reduction in the prevalence of malaria since the beginning of the 21st century, the number of cases has remained stable in the past five years.

24. The Agency is seeking further resources for the development of the SIT package against malaria-transmitting mosquitoes, particularly as it relates to the research and development component of the full SIT package, including its testing and validation, and transfer to Member States.

25. SIT is part of an area-wide integrated vector management approach. The Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture and the IPCL have continued with the development, validation and optimization of the SIT package as a complementary tool for the management of mosquito populations. Good progress has been made in collaboration with Member States on two of the main challenges: the development of efficient sex separation methods that would allow male-only releases, and the aerial release of mosquitoes. The development and validation of a mosquito release system mounted on remotely piloted aircraft is a significant achievement that paves the way for large-scale and cost-efficient releases over sparsely or densely populated areas.

26. The current developments in sexing and drone release will allow for the testing of the SIT approach in pilot trials to demonstrate that it is a safe, bio-secure and responsible approach to managing mosquito populations. A crucial aim is to demonstrate, in collaboration with the WHO, that the suppression of *Aedes* populations to below a certain threshold can limit or avoid the transmission of dengue, chikungunya, Zika virus disease and yellow fever, as well as new or re-emerging diseases.

Strengthening the Support to Member States in Food and Agriculture

A. Background

1. In resolution GC(62)/RES/9.A.5, the General Conference recognized the central role of agricultural development in accelerating progress towards several Sustainable Development Goals (SDGs), in particular to end hunger, achieve food security and improved nutrition and promote sustainable agriculture for the socioeconomic benefits of all Member States. It consequently urged the Secretariat, to further expand, in an integrated and holistic manner, its efforts to address, inter alia, food insecurity in Member States and to further increase its contribution to raising agricultural productivity and sustainability, reducing poverty and hunger, and improving farmers' incomes, through the development and integrated application of nuclear science and technology. It encouraged the Joint FAO/IAEA Division to continue responding to the major global trends framing agricultural development in order to ensure to the maximum extent possible an increased resilience of livelihoods to threats and crises in agriculture, including the adaptation to and mitigation of the effects of climate change.
2. The General Conference further recognized that the major global trends that will frame agricultural development over the medium term include rising food demand, lingering food insecurity, malnutrition, and the impact of climate change. It consequently urged the Secretariat to address the impacts of climate change on food and agriculture through the use of nuclear technologies, with priority on adaptation to and mitigation of the effects of climate change, including through the development of tools and technology packages. It invited the Secretariat to carry out activities for addressing climate change challenges under the thematic heading of 'climate-smart agriculture'.
3. The General Conference further invited the Secretariat, in view of the global trend in antimicrobial resistance (AMR) and its impact on human and animal health, to continue to follow international efforts to establish possible applications where nuclear/isotopic methods/tools may provide comparative advantages.
4. Welcoming the demand-driven research activities on the development of communication tools to improve decision-making in agricultural water management in Africa, and the new visualization platform for nuclear and radiological emergency preparedness and response for food and agriculture, the General Conference urged the Secretariat to further strengthen its effort to seek extrabudgetary funding for strengthening its research activities in the preparedness and response to nuclear and radiological emergencies affecting food and agriculture.
5. The General Conference requested the Director General to report on the progress made in the implementation of resolution GC (62)/RES/9. A .5 to the General Conference at its 64th regular session.

B. Progress since the 62nd Regular Session of the General Conference

6. The Joint FAO/IAEA Division currently oversees 30 coordinated research projects (CRPs) involving approximately 440 research institutions and experimental stations in Member States and is responsible for providing scientific and technical support to 301 national, regional and interregional technical cooperation (TC) projects. During the 2018–2019 biennium, 242 demand-driven workshops, seminars and training courses were held with the participation of 5839 trainees from developing countries, mainly supported through the Agency’s Technical cooperation programme. In addition, the Joint Division yielded 404 publications, including 103 technical documents, newsletters, guidelines and books, 165 articles in peer-reviewed scientific journals, 114 conference papers and 3 special editions in peer-reviewed scientific journals.

7. Demand-driven research and development activities continue at the FAO/IAEA Agriculture and Biotechnology Laboratories in Seibersdorf, Austria, in response to Member States’ requests, including the use of isotopes in climate-smart agriculture and climate change adaptation; the development of isotopic and analytical techniques for food traceability, authenticity and contaminant analysis; the investigation of irradiated animal vaccines; the development of radiation hybrid maps for animal breeding; the strengthening of animal disease diagnostic applications for early detection of animal and zoonotic diseases; the development of climate-adapted and higher-yielding crops; and the control of plant and livestock insect pests.

8. The development and further enhancement of laboratory networks with the participation of multiple stakeholders continued to be a primary focus, in particular to strengthen support for the timely diagnosis, control and eradication of transboundary animal and zoonotic diseases (e.g. the Veterinary Diagnostic Laboratory (VETLAB) Network); to enhance capabilities in food safety and food control systems (e.g. the Latin American and Caribbean Analytical Network (RALACA), the African Food Safety Network (AFoSaN) and the Food Safety Asia (FSA) Network); to foster crop improvement and adoption of modern biotechnologies (the Plant Mutation Breeding Network (MBN) for the Asia and the Pacific region); and to share knowledge on the sterile insect technique (SIT) for insect pest control (Tephritid Workers Database).



FIG. B.1 VETLAB Network scientists learn how to use multi-pathogen assay. (Source: IAEA)

- i. The Agency continued to support the VETLAB Network, through the provision of training, diagnostic kits, standard operating procedures, and equipment and material for the control and prevention of transboundary animal and zoonotic diseases. The Agency used the iVETNet information platform to provide timely guidance and validated procedures on COVID-19 detection to 124 veterinary laboratories in 46 Member States.
- ii. RALACA has expanded to include 56 institutions in 21 countries, as well as coordinating workshops and interlaboratory trials and training. AFoSaN continued to grow to 102 laboratories, and research and food control organizations have been established in 39 participating countries, fostering technical networking and capacity building. The FSA Network is facilitating collaboration among its member institutions in improving laboratory testing capabilities (e.g. Pakistan supported Papua New Guinea in food hazard testing; Lebanon assisted Jordan in testing pesticide residues; and Thailand supported Cambodia and Myanmar in testing contaminants) and enhancing regional capability and exchange of expertise.
- iii. The MBN for the Asia and the Pacific region was formally established by 13 signatory Member States which agreed on the ‘Jingzhou Proposal’ of July 2019. The proposal identified the MBN’s key roles: strengthening national and regional capacities; enhancing germplasm resources; enabling the use of speed-breeding technologies; establishing functional genomics platforms; establishing stress-screening locations; early detection of transboundary pests and diseases; conservation of mutant germplasm; and joint resource mobilization.
- iv. The Agency, through the APHL, has expanded its technical interactions with the Austrian Agency for Health and Food Safety for the use of a biosafety level 3 laboratory to strengthen research and development capacities for diagnostics of transboundary animal and zoonotic

diseases, for the evaluation and validation of COVID-19 detection kits and tests, and for the genetic characterization of highly pathogenic bacteria and viruses affecting livestock in Member States.

9. The Agency has stepped-up its assistance to several Asian Member States to fight the outbreak of African swine fever. The Agency assisted Member States in strengthening their technical diagnostic capabilities and provided guidance and advice to affected countries.



FIG. B.2 Sample processing for the diagnosis of transboundary animal diseases at the National Centre for Veterinary Diagnosis. (Source: IAEA)

10. The Agency has developed, in close collaboration with the Food and Agriculture Organization of the United Nations (FAO), guidelines on the use of nuclear/isotopic techniques for tracing antimicrobial movement from agricultural areas to the environment. Work is under way to produce a detailed guidance document for testing the methodology in Member States.

11. An Agency publication entitled *Strategies and Practices in the Remediation of Radioactive Contamination in Agriculture* was issued in February 2020 with a view to enhancing the preparedness and response planning of international organizations and Member States for nuclear emergencies and radiological incidents in relation to food and agriculture.

12. Applied research in parallel with capacity building on methodology for food authentication and detection of adulterants led to enhanced capacities for food safety and quality control in more than 30 Member States. This included various food products, such as milk, honey and tea in China; high-value edible bird's nests in Malaysia; vinegar in the Philippines; and imported pork and milk products in Singapore. A 'quality assured' mark was also developed for local milk and dairy products in Slovenia.

13. The Agency provided support to a Mediterranean fruit fly control scheme in Ecuador, as a component of the National Fruit Fly Management Project. As a result of the Agency's support, fruit and vegetable quality and quantity were increased, and international trade facilitated, with farmers being

able to start the export of golden berries, dragon fruit and tree tomatoes to markets in the United States of America, Latin America and Europe.



*FIG. B.3 With the help of the Sterile Insect Technique, Ecuador's tree tomato is now being exported to markets in the United States, Latin America and the Caribbean and the European Union.
(Source: AGROCALIDAD)*

14. The Agency's provided support to Argentina in the area of plant insect pest control which is now bearing fruit thanks to the successful application of SIT against the Mediterranean fruit fly. In early 2020, China recognized the fruit fly free status of Patagonia and parts of Mendoza Province. As a result, cherries and other stone and pome fruits from these regions of Argentina can be exported to the world's largest fresh food markets.

15. During the reporting period, the Agency published 23 standard operating procedures, manuals and guidelines on the topic of area-wide integrated pest management (AW-IPM) for the benefit of national plant protection and animal and human health organizations, covering fruit flies, mosquitoes and trypanosome species.

16. The Agency continued to provide technical support to the Government of Senegal in its efforts to create a tsetse-free zone in the highly productive agricultural region of Niayes in western Senegal, using an AW-IPM approach with a SIT component. The tsetse fly populations in the project area have been suppressed by approximately 97%, resulting in a very low prevalence of tsetse-borne trypanosomiasis, allowing Senegal to continue importing more productive cattle into the area.

17. The Agency worked with researchers from several Member States to fight Fusarium wilt tropical race 4 (TR4), which has been destroying banana plantations in Asia, Africa and Latin America. The concerted effort has led to the development and release by partners in China of a new mutant variety of Cavendish, a type of banana commonly used for export, with resistance to TR4. Other Member States have identified putative mutants with possible resistance or tolerance to the disease.



FIG. B.4 Chinese plant breeders at a banana plantation with the new Cavendish varieties grown in Guangdong, China. (Source: G Yi/Guangdong, China)

18. The Agency has been assisting Member States in tackling another major challenge to agriculture productivity and food security: Striga, a serious parasite for cereal and cowpea crops in sub-Saharan Africa. This parasitic weed causes yield reduction of staple crops such as maize, millet, rice and sorghum, resulting in enormous economic losses. Through the Agency's technical support, Burkina Faso, Madagascar and Sudan have developed maize, rice and sorghum mutant lines with resistance to Striga.



FIG. B.5 A researcher at Burkina Faso's Institute for the Environment and Agricultural Research explains his results on the new Sorghum lines resistant to Striga to fellow colleagues at the IAEA Plant Breeding and Genetics Laboratory in Seibersdorf, Austria. (Source: IAEA)

19. The Agency has strengthened its cooperation with, and its support for, small island developing States in the area of crop improvement for food security. Through the Technical cooperation programme, an interregional training course was held in October 2019 on mutation breeding and efficiency enhancing techniques for the benefit of 24 scientists from Fiji, the Marshall Islands, Palau, Papua New Guinea and Vanuatu, as well as from other small States in Africa and Latin America.

20. The International Symposium on Plant Mutation Breeding and Biotechnology, held in Vienna in August 2018, was attended by 350 delegates from 84 Member states, 2 non-Member States and 4 international organizations. The symposium focused on the latest developments, trends and challenges in the field of plant mutation breeding and biotechnology and fostered a broad exchange of information within the scientific community, as well as with the private sector.

21. The Agency continued its support to more than 75 African, Asian, European and Latin American Member States in the development of soil conservation strategies using fallout radionuclide techniques to ensure sustainable agricultural production and mitigate the impacts of climate change.

22. The Agency has furthered the development of the online Decision Support System for Nuclear Emergencies Affecting Food and Agriculture. The system is being customized for Member States such as Belgium and China to provide tailor-made solutions for improving nuclear emergency preparedness and response in food and agriculture. It includes the collection, management and visualization of appropriate data from affected areas in order to ensure timely dissemination and communication to stakeholders and the general public.

23. The Agency, through the technical cooperation programme, has assisted Mauritania and Sudan with drip irrigation and smart fertilization guided by nuclear technology-fostered subsistence agriculture, empowering 6,000 refugee women in Sudan and 400 women in Mauritania to produce food, improve nutrition and health, and generate additional income contributing to poverty alleviation. Similar outcomes were achieved in rural areas of Mali, where 500 small-holder farmers, mostly women, have turned low-yielding lands into fertile agricultural plots.



*FIG.B.6 Small-holder farmers harvesting tomatoes in the Sahel region of Segou in central Mali.
(Source: Daba Coulibaly)*

24. The Agency has also contributed to the use of digital agriculture as part of demand-driven research activities on communication tools to improve decision-making in agricultural water management in Africa. It has developed real-time digital technology for mapping soil properties and monitoring landscape water availability, along with a new visualization platform for nuclear and radiological emergency preparedness and response in food and agriculture.

25. The Agency has coordinated international research and development activities using isotopic techniques to identify greenhouse gas emission pathways and, in turn, devise effective mitigation techniques. Among the achievements were the development of a novel instrument for real-time measurement and analysis of carbon dioxide in agriculture and the development of a low-cost and robust method for methane measurement, in collaboration with the Agrobiological Centre of the Brazilian Agricultural Research Corporation and the Agronomic Institute of Paraná.

B.1. Strengthening the FAO–Agency Partnership

26. The Joint FAO/IAEA Division has continuously adjusted its programmatic activities to address the evolving needs of Member States and to help them improve productivity and address threats to food and agriculture production, livelihoods and health, as well as to accelerate the delivery of the SDGs.

27. In response to mounting food security and health challenges, the Director-General of the FAO and the Director General of the Agency agreed, during their bilateral meeting at the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP25) in Madrid in December 2019, to start a new era of collaboration for enhanced and effective support to Member States. They agreed that the renewed FAO–Agency strategic partnership will focus on applied research, innovative technology development and delivery capacity for technology transfer and emergency response.

28. The Joint Division maintains effective coordination with the relevant FAO organizational units through active participation in stocktaking workshops organized by FAO Strategic Programmes, continuous interactions with focal points on work planning and results reporting, consultation on the work planning for the biennium and briefings on activities in Member States. It also coordinates with FAO Country Offices during work planning, project implementation and reporting.

29. The Joint Division participates actively in the biennial FAO regional conferences for Africa, Asia and the Pacific, Europe and Central Asia, and Latin America and the Caribbean. Information materials illustrating nuclear and nuclear-related technologies and selected impacts of these in each region were well received by stakeholders during the respective conferences.

30. The Agency has enhanced its work with the FAO on important global initiatives, such as the Global Strategy for the Control and Eradication of Peste des Petits Ruminants; the collection and preservation of genetic material of livestock available locally in Member States for the identification of deoxyribonucleic acid markers associated with high productivity and disease resistance; the Global Soil Laboratory Network, within the Global Soil Partnership; and the Second Global Plan of Action for Plant Genetic Resources for Food and Agriculture through demand-based innovations that focus on the improvement and use of plant genetic diversity.

Plan for Producing Potable Water Economically Using Small and Medium Sized Nuclear Reactors

A. Background

1. In resolution GC(62)/RES/9.A.4, the General Conference requested the Director General to continue consultations and strengthen interactions with interested Member States, the competent organizations of the United Nations system, regional development bodies and other relevant intergovernmental and non-governmental organizations in activities relating to seawater desalination using nuclear energy.
2. The General Conference also stressed the need for continued strengthening of international cooperation in the planning and implementation of nuclear desalination demonstration programmes through national and regional projects open for the participation of any interested country. It also requested the Director General, subject to the availability of resources, to continue to increase the Secretariat's activities in capacity building (including training and education) on nuclear desalination projects to bridge the gap among users/vendors/operators/regulators.
3. The General Conference further requested the Director General to report on the progress made in the implementation of this resolution to the Board of Governors and to the General Conference at its sixty-fourth (2020) regular session.

B. Progress Made Since the 62nd Regular Session of the General Conference

4. Over the reporting period, the Agency participated in several major international activities and forums of information exchange on relevant topics, including the Water Sciences and Technology Association's 13th Gulf Water Conference in Kuwait, March 2019; the Sustainable Water Management Conference in the USA, March 2019; the American Nuclear Society Annual Meeting in the USA, June 2019; International Framework for Nuclear Energy Cooperation's Infrastructure Development Working Group meeting in Poland, September 2019; the International Desalination Association's (IDA's) World Congress in the United Arab Emirates, October 2019; and the Applications for SMRs and Advanced Reactors to Promote Clean Growth panel in the United Arab Emirates, February 2020.

The Technical Working Group on Nuclear Desalination (TWG-ND) continued its function as a forum for advice and review of nuclear desalination activities. The 7th meeting of the TWG-ND was held in Vienna in June 2019. The members of the TWG-ND recommended the Agency to initiate a coordinated research project on assessing the role of nuclear desalination within the context of climate change mitigation, and to organize technical meetings on coupling issues between desalination plants and nuclear power plants (NPPs); on the potential schemes and challenges for licensing a desalination plant integrated with an NPP; and on the merits of coupling desalination plants with NPPs.

5. In July 2019, the Technical Meeting on Specific Considerations for the Deployment of Nuclear Cogeneration Projects was conducted in Vienna with 18 participants from 17 Member States. Participants discussed the necessary considerations when deploying nuclear cogeneration projects, including lessons learned from existing projects and the steps to be considered to launch nuclear cogeneration projects.

6. The Agency conducted a Joint ICTP–IAEA Workshop on Physics and Technology of Innovative High Temperature Nuclear Energy Systems in Trieste, Italy, in October 2019 with 31 participants from 22 Member States. The lectures covered: SMRs of high temperature and molten salt technologies, aspects of sustainability, desalination and cogeneration using nuclear energy, and the role of the Agency in these areas. The participants were also trained and introduced to Agency tools and toolkits on nuclear desalination and nuclear hydrogen production. The Agency also conducted a workshop on non-electric applications including desalination in Prague in February 2019 with 20 participants from 15 Member States. Training was provided on the options and technology readiness for nuclear cogeneration and on the available Agency tools and toolkits on non-electric applications of nuclear energy.

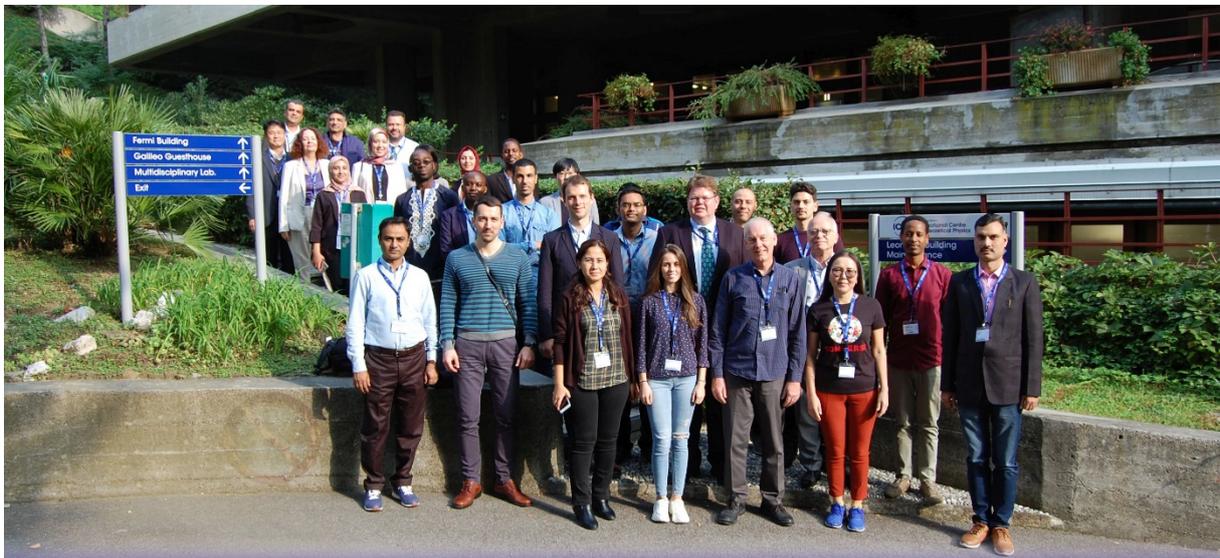


FIG. B.1 Joint ICTP-IAEA Workshop on Physics and Technology of Innovative High Temperature Nuclear Energy Systems in Trieste, Italy (Photo: ICTP)

7. The Agency continued its efforts to bridge the gap among users/vendors/operators/regulators involved in nuclear desalination and cogeneration projects. The publication *Guidance on Nuclear Energy Cogeneration* (IAEA Nuclear Energy Series No. NP-T-1.17) was issued in September 2019. This publication is aimed at users in academia and industry as well as government agencies and public institutions requiring basic information on various aspects of using nuclear power for cogeneration.

Introduction

A. Background

1. In resolution GC(63)/RES/10.B.1, the General Conference affirmed the importance of the role of the Agency in facilitating the development and use of nuclear energy for peaceful purposes, in fostering international cooperation among interested Member States, and in disseminating well-balanced information on nuclear energy to the public. It also encouraged the Agency to continue its support to interested Member States, including through peer review and advisory services, in building their national capacities in the operation of nuclear power plants and their nuclear power infrastructure when embarking on new nuclear power programmes.

2. The General Conference also encouraged Member States that are considering developing nuclear power to voluntarily use the support provided by the Agency on energy planning and assessment of energy systems in relation to environment, climate and economic factors and requested the Agency to continue its services to help interested Member States in this regard. It commended the Secretariat's efforts in providing comprehensive information on nuclear energy's potential as a low carbon energy source and its potential to contribute to mitigating climate change and encouraged the Secretariat to work directly with Member States upon request and to continue to extend its activities in these areas, including the Paris Agreement.

3. The General Conference also stressed the importance, when planning, deploying, or decommissioning nuclear energy facilities, including nuclear power plants and related fuel cycle activities, of ensuring the highest standards of safety and emergency preparedness and response, security, non-proliferation, and environmental protection, of being informed of the best available technologies and practices, of continuously exchanging information on R&D addressing safety issues, of strengthening long-term research programmes to learn about severe accidents and related decommissioning activities, and of enabling continuous improvement in this regard; and valued the role of the Agency in fostering exchange of expertise and discussions within the international nuclear community on such issues.

4. The General Conference requested the Director General to report on progress made in the implementation of this resolution to the Board of Governors as appropriate and to the General Conference at its sixty-fourth (2020) regular session.

B. Progress Made Since the 63rd Regular Session of the General Conference

5. The Agency's programmatic delivery has been impacted by the COVID-19 outbreak. As a result of travel restrictions and lockdowns, as of March 2020, some of the planned activities could not be implemented, including physical meetings, training courses and missions. However, for mainly consultancy meetings, the Agency was able to convert several planned physical meetings into virtual

events, where the focus and number of participants were suitable for this new way of working (collaborative work and a series of web meeting spanned over one to six weeks). Other, larger and more complex meetings (such as Research Coordination Meetings, Technical Meetings, Training Workshops and Technical Working Group meetings) have been thoroughly assessed on a case-by-case basis and implemented as virtual events whenever delivery of planned outputs could be ensured.

6. The Agency also rapidly developed and piloted an international peer-to-peer network, the NPP COVID-19 Operating Experience Network (COVID-19 OPEX Network). The Network was established for information and experience sharing between operating organisations, technical support organisations, relevant international organisations and other stakeholders, and has proven to be very valuable with 26 reports from 9 Member States and 4 international organizations.²



FIG. B.1 The COVID-19 NPP OPEX Network provides a limited access platform for peer-to-peer sharing of COVID-19 related mitigating measures and impact on nuclear power plant performance

7. The annual Technical Meeting on Topical Issues in the Development of Nuclear Power Infrastructure, held in January 2020 with around 100 participants from 41 Member States and 3 international organizations, continued to be the main forum for newcomer and experienced Member States to share good practices and lessons learned in establishing the infrastructure required for a safe and successful nuclear power programme. The Agency continued to support participation from newcomer Member States and lectured at thirteen interregional nuclear infrastructure training (INIT) courses hosted by Japan, the Republic of Korea, the Russian Federation, the United Arab Emirates and the United States of America between September and December 2019. Fifteen INIT courses scheduled for the period from March to August 2020 were postponed due to the restrictions linked to the outbreak of COVID-19. One workshop was held on human resource modelling and workforce planning for new nuclear power programmes with the support of the Nuclear Power Human Resources workforce modelling tool.

² Please see GOV/INF/2020/8, on the Agency's actions undertaken to facilitate information exchange among stakeholders, collect feedback, and gather support for requesting Member States in mitigating the impact of COVID-19 on the operation, safety and security of nuclear and radiation facilities and activities.

The Agency continued to maintain and strengthen its assistance to Member States embarking on or expanding a nuclear power programme through self-evaluation support and Integrated Nuclear Infrastructure Review (INIR) missions to assess the status of nuclear power infrastructure development, including an INIR Phase 2 mission to Egypt in October 2019, an INIR Phase 3 mission to Belarus in February 2020, and an INIR Phase 1 Follow-Up mission to Ghana in October 2019. An INIR Phase 1 Follow-Up mission to Kenya, planned for March 2020, was rescheduled to December 2020 due to the outbreak of COVID-19. The coordination and sequencing of Agency services for Member States embarking on a nuclear power programme or expanding such programmes is typically addressed in Integrated Work Plan meetings between the Member States and the Agency's cross-Departmental core teams.

8. In the area of stakeholder involvement, the Agency conducted workshops and expert missions at the national level in November 2019 (Saudi Arabia) and September 2020 (Belarus), moving to online support in the second half of the reporting period. The Agency also participated as an observer in the FORATOM Communications Advisory Group meetings in October 2019 and March and June 2020, and supported Member States in their national nuclear power expansion projects through site visits and discussions on specific stakeholder engagement challenges and efforts in September 2019 (United States of America) and January 2020 (Sweden).

9. With regard to quality and management system aspects of nuclear procurement engineering and supply chains, the Agency has, with financial support from the Peaceful Uses Initiative, issued and upgraded a toolkit on supply chain management in June 2020, developed and implemented a pilot training course in October 2019, issued a publication on quality assurance, quality control and quality management (IAEA-TECDOC-1910) and organized a webinar on COVID-19 and the nuclear supply chain. Several activities on stakeholder involvement in nuclear power programmes were conducted in 2019, including launching a webinar series reaching hundreds of participants on a quarterly basis.



FIG. B.2 The IAEA webinar discussed the impact the global COVID-19 pandemic has had on the supply chains of products and services related to nuclear power plants and ongoing nuclear construction projects

10. The Agency has also started a webinar series on systematic approach to training and training effectiveness, standards and conditions, with the first session on building the blocks of nuclear facility training implemented online with 340 participants from 46 countries in June 2020. Moreover, the Agency developed a safety culture assessment methodology in nuclear power organizations in a meeting held in Vienna in October 2019.

11. The Secretariat continued its efforts to enhance Member States' understanding of funding requirements for nuclear power infrastructure development and potential approaches to financing nuclear power programmes through the initiation of the revision of the publication *Alternative Contracting and Ownership Approaches for New Nuclear Power Plants* (IAEA-TECDOC-1750) as well as the continued development of a new publication on resource requirements for infrastructure development. A Technical Meeting on Resource Requirements for Infrastructure Development was organized in Vienna in October 2019 with 19 participants from 15 Member States to review the draft publication and share interim results and gather further input. Two national workshops in Poland and Uzbekistan under the respective Integrated Work Plans to support Member States in reviewing financing options for a nuclear power programme were also provided, and three have been delayed to the end of 2020 due to the outbreak of COVID-19.

12. To analyse the technical and economic cost drivers for economic sustainability of nuclear power operation as well as to determine the value of nuclear power in the energy mix considering environmental conditions, the Agency developed and deployed the Global Forum for Nuclear Innovation Network, an international peer network hosted on the CONNECT platform. The Agency also organized a Workshop on the Cost Estimation and Cost Analysis of Nuclear Projects and Programmes in Idaho Falls, USA, in October 2020, with 50 participants from 24 Member States. A Technical Meeting on Cost Estimation Methodologies for Spent Fuel Management in Vienna, in November 2019, was attended by 46 participants from 28 Member States.

13. The Agency continued its services to help interested Member States on their energy planning and assessment of energy systems in relation to environment, climate and economic factors. In this regard, in 2019, the Agency conducted 81 capacity building events, providing training in energy planning to over 730 professionals from over 80 Member States in Africa, Asia, Eastern Europe, and Latin America and the Caribbean. National energy studies, as well as sub-regional integrated studies, were developed identifying opportunities to increase efficiencies and to promote sustainable energy sources through greater integration. In addition, Member States developed a common methodology for elaborating energy policies, thereby facilitating collaboration and information sharing on synergies and trade-offs, and the formulation of integrated energy development plans in the region. The Agency also updated and enhanced its energy planning tools — now in use by 150 Member States and over 20 international organizations — as well as the related multilingual training materials, including e-learning packages. At the United Nations Workshop on SDG7 Implementation in Asia and the Pacific, held in Bangkok in March 2019, the Agency hosted an event where the Agency's experience, role and programme to support capacity building for sustainable energy development was shared and discussed with international stakeholders. The event was an opportunity to further strengthen relations between the Agency and the United Nations Economic and Social Commission for Asia and the Pacific, and to explore areas of mutual interest in work, such as capacity building, energy modelling, data and integrated assessments.



FIG. B.3 The IAEA's Energy Planning tools, recently updated and enhanced, are in use by 150 Member States and over 20 international organizations

The Agency organized the International Conference on Climate Change and the Role of Nuclear Power in October 2019 in Vienna, with over 500 participants from 79 Member States and 17 international organizations. High level keynote speakers from international organizations included the Director General of the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development (OECD/NEA), the Under-Secretary-General for Economic and Social Affairs at the United Nations Department of Economic and Social Affairs, the Director General of the United Nations Industrial Development Organization, the Director General of the World Nuclear Association; the Executive Secretary of the United Nations Framework Convention on Climate Change and the Executive Director of the OECD International Energy Agency sent messages to contribute to the event. This first-of-a-kind topical conference on the nexus of climate change and nuclear power in the Agency's history served as a unique forum for exchanging science-based information on the role of nuclear power in supporting the low carbon energy transformation needed to achieve the climate change goals and conducting objective discussions on the opportunities and challenges of safe, secure and safeguarded nuclear technology development. A brochure entitled *Climate Change and the Role of Nuclear Power*, targeted at a broader audience, was issued on the occasion of this Conference. Finally, the Secretariat has started preparations to establish a new Technical Working Group on nuclear power in energy systems, which will address in particular the topics of climate, the environment and economics.



FIG. B.4 During the #Atoms4Climate conference, participants discussed, among other topics, the prospects for synergies between nuclear power and other low-carbon energy sources (IAEA)

14. The Agency published two TECDOCs addressing various aspects of severe accidents in nuclear power plants: *Status and Evaluation of Severe Accident Simulation Codes for Water Cooled Reactors* (IAEA-TECDOC-1872) was published in June 2019 and *In-vessel Melt Retention and Ex-vessel Corium Cooling* (IAEA-TECDOC-1906) in May 2020. A Technical Meeting on the Phenomenology, Simulation and Modelling of Accidents in Spent Fuel Pools was held in Vienna in September 2019 and attended by 34 participants from 23 Member States. In July 2019, the Agency published in the peer-reviewed journal *Progress in Nuclear Energy* a paper entitled *Review and Categorization of Existing Studies on The Estimation of Probabilistic Failure Metrics for Reactor Coolant Pressure Boundary Piping and Steam Generator Tubes in Nuclear Power Plants* as the first results of a coordinated research project launched in 2018.

15. A Technical Meeting on Global Status of Decommissioning was organized in Vienna in August 2019, attended by 35 participants from 22 Member States. The meeting served as the formal launch of an international collaborative project on the topic which is scheduled to run for two years. A workshop on decommissioning of nuclear facilities and spent fuel management was organized by the Agency in Taiyuan, China, in September 2019 and was attended by 25 participants from nine Member States. Aspects such as safety, environmental protection, decommissioning technologies and practices, and lessons learned from accidents were addressed. The Annual Forum of the Agency's International Decommissioning Network (IDN) was held in Vienna in November 2019 and was attended by 54 participants from 22 Member States.

16. Following the successful young professionals session at the IDN Annual Forum, the Agency initiated a young generation challenge on decommissioning and environmental remediation in April 2020. Young professionals from around the world were invited to propose an original concept or project outline for advancing the decommissioning of nuclear facilities or environmental remediation of radiologically contaminated sites. Twelve of the 26 submissions from 11 Member States were shortlisted

to provide enhanced presentations of the projects. The final evaluation of proposals was done in July 2020.



FIG. B.5 The IAEA invited young professionals from around the world to propose an original concept or project outline for advancing the decommissioning of nuclear facilities or environmental remediation of radiologically contaminated sites

The Agency continued its efforts to foster the exchange of scientific and technical information through the International Nuclear Information System (INIS) which has collected, processed and preserved information on 4.3 million nuclear-related publications. There are over 3.5 million page-views and 1.4 million unique visitors from Member States to INIS annually.

17. The International Ministerial Conference on Nuclear Power in the 21st Century is organized on a regular basis in cooperation with the OECD/NEA and a hosting Member State to provide a high level forum to discuss the role of nuclear power in meeting future energy demand, contributing to sustainable development and mitigating climate change. Preparations are ongoing for the organization of the fifth such Ministerial Conference which will be hosted by the United States of America in October 2021.

IAEA Communication, Cooperation with Other Agencies and Stakeholder Involvement

A. Background

1. In resolution GC(63)/RES/10.B.2, the General Conference encouraged the Secretariat to continuously assist Member States in enhancing public awareness and understanding of peaceful uses of nuclear energy, including by publishing reports on stakeholder involvement and public information as well as organizing conferences, technical meetings and workshops, among other mechanisms.
2. The General Conference also requested the Secretariat to continue cooperation with international initiatives such as UN-Energy; encouraged strengthening mutual cooperation between Member States by exchanging information through international organizations such as the IAEA, OECD Nuclear Energy Agency (NEA), the International Framework for Nuclear Energy Cooperation (IFNEC), the World Nuclear Association (WNA) and the World Association of Nuclear Operators (WANO); encouraged the Secretariat to cooperate with national and international industrial organizations for standardization; and recommended that the Secretariat continue to explore opportunities for synergy between the Agency's activities and those pursued under other international initiatives such as the Generation IV International Forum (GIF), IFNEC, the European Sustainable Nuclear Industrial Initiative (ESNII) and the International Thermonuclear Experimental Reactor (ITER).
3. Besides, the General Conference welcomed the revision of the Nuclear Energy Series structure, encouraged the Secretariat to continue to develop Nuclear Energy Series documents as a more integrated, comprehensive and clearly organized set of publications to be maintained up-to-date and further encouraged the Secretariat to continue consolidating the drafting and review of Nuclear Energy Series publications to establish a single, systematic, and transparent process.
4. The General Conference requested the Director General to report on progress made in the implementation of this resolution to the Board of Governors as appropriate and to the General Conference at its sixty-fourth (2020) regular session.

B. Progress Made Since the 63rd Regular Session of the General Conference

5. The Agency continued cooperation with international initiatives by actively following the activities of UN-Energy, as well as engaging with Sustainable Energy for All through the Vienna Energy Club meetings, the preparation of the Vienna Energy Forum, and an informal exploratory meeting held in January 2020.

<p>The Director General, as his first official trip after taking the Agency's helm, spoke at the Conference of the Parties to the United Nations Framework Convention on Climate Change (COP25) in Madrid in December 2019, delivering the message that greater use of low carbon nuclear power is needed to ensure the global transition to clean energy, including to back up variable renewables such as solar and wind. He also delivered remarks at a United Nations side event on Sustainable Development Goal 7 (SDG 7), which is about ensuring access to affordable and reliable energy.</p>



FIG. B.1 IAEA Director General Rafael Mariano Grossi and United Nations Secretary-General António Guterres at the UN Climate Change Conference (COP 25) (IAEA)

6. In order to ensure that the Agency's capacity building in energy planning be widely recognized within the United Nations system as an important contributor to the SDGs, the Agency, jointly with the United Nations Statistics Division and the African Institute for Economic Development and Planning, organized a workshop on energy statistics for African countries in October 2019 in Dakar with 30 participants from nine Member States. The Agency also participated in and introduced its energy modelling tools during the 4th Energy and Climate Technical Working Group meeting of the Energy Community held in November 2019 in Vienna, attended by 20 participants from nine Member States. The Agency also presented its tools and participated in Modelling for Energy Planning — Tools, Examples and Use, organized by the Institute of the Francophonie for Sustainable Development via an online seminar in May 2020 and attended by 800 participants from 55 Member States. The Agency conducted a national scoping mission on the application of the climate, land, energy and water framework, with cooperation of the United Nations Department of Economic and Social Affairs, in February 2020 in Manila attended by 20 participants.

7. The Agency continued to facilitate cooperation between Member States by exchanging information on relevant experiences and good practices with respect to nuclear power programmes through synergies with other international organisations. For example, in September 2019, the Agency, WANO and the Electric Power Research Institute published a White Paper on nuclear industry new build/new entrants and organized a side event to foster cooperation in support of new builds. The Agency and WANO are cooperating through regular interface meetings. WANO participated in the Agency's Technical Meeting on Topical Issues in the Development of Nuclear Power Infrastructure at the end of January 2020 and sent an observer to the INIR Phase 3 mission in Belarus. Strong collaboration with WANO also continued via the Power Reactor Information System, where operating experience and performance indicators are regularly shared; coordination of activities to support new nuclear power plant (NPP) projects to minimize duplicative effort while maximizing support to relevant stakeholders

in Member States; and the sharing of information related to NPP mitigation activities linked to the COVID-19 global pandemic.

8. The Agency participated in various subgroups of the Working Party on International Nuclear Data Evaluation Co-operation of the OECD/NEA in May 2020 and contributed to the OECD/NEA Joint Evaluated Fission and Fusion (JEFF) library project with nuclear data evaluations for various nuclides at the JEFF meeting of November 2019. The Agency also participated in several OECD/NEA Expert Groups, including the Ad hoc Expert Group on Reducing the Costs of Nuclear Power Generation, the Ad hoc Expert Group on the Economics of Long-term Operation of Nuclear Power Plants, and the Joint NEA/IEA Ad hoc Expert Group on Projected Costs of Electricity Generation. Also, the Agency continued to closely cooperate with the OECD/NEA Working Parties, including the Working Party on Scientific Issues of Reactor Systems, and finalized its contribution to the OECD/NEA Nuclear Innovation 2050 initiative. The Agency continued to work with the OECD/NEA on capacity building issues and in the preparation of key Agency publications, such as the next edition of the ‘Red Book’ on uranium. In this regard, the 56th Meeting of the Joint OECD/NEA–IAEA Uranium Group was held in February 2020, in Vienna. It was attended by 44 experts from 34 countries and 2 international organizations who presented their country reports and discussed inputs for the Red Book 2020 edition planned to be published by the end of the year.

9. The Agency continued cooperation with other international initiatives in areas relating to international cooperation in peaceful uses of nuclear energy, safety, proliferation resistance and security issues through hosting the Virtual Event of the 14th GIF–IAEA Interface Meeting in July 2020 with more than 20 participants from GIF. The meeting defined the scope and details of cooperation, meetings and joint activities between the Agency and GIF. Also, the Agency will be hosting consultancies to revise the INPRO Methodology for Sustainability Assessment of Nuclear Energy Systems with regard to proliferation resistance. This set of meetings and tasks endeavours to provide a robust and standardized definition of proliferation resistance for use in the industry. INPRO will engage with members of the GIF Proliferation Resistance and Physical Protection Working Group and experts from Member States for input.

10. In addition to having a presence in the IFNEC Steering Group, the Agency cooperates with IFNEC via its two Working Groups: the Infrastructure Development Working Group and the Reliable Nuclear Fuel Services Working Group. Representatives from IFNEC regularly participate at the Technical Meeting on Topical Issues in the Development of Nuclear Power Infrastructure, held annually in Vienna, most recently at the end of January 2020, and in the Technical Working Group on Nuclear Power Infrastructure. The Agency also supported and contributed to the IFNEC Ministerial Conference entitled “Bringing the World SMRs and Advanced Nuclear” held in Washington D.C. in November 2019.

11. The Agency continued to cooperate with national and international industrial standardization organizations, such as the International Organization for Standardization (ISO) through ISO/TC 85, the scope of which has recently been redefined in order to cover standardization in the field of nuclear power plants and research reactors.

12. The Agency continued to assist Member States in enhancing public awareness and understanding of peaceful uses of nuclear energy by launching an updated version of the Nuclear Communicator’s Toolbox (NCT) in September 2019, which provides resources to help in communication with the public. Also, to further enrich the contents of the NCT, the Agency held a Technical Meeting on Using Social Media for Public Communication and Stakeholder Involvement for Nuclear Programmes, in December 2019, with 130 participants from 66 Member States. The Agency continued to organize the webinar series on stakeholder involvement related to nuclear power, in December 2019 and March, June and September 2020, with each webinar seeing on average 250 participants (live and recorded views).



FIG. B.2 Agency's webinars on stakeholder involvement saw an average 250 participants each.

13. The Agency continued to ensure and improve long term accessibility and public access to digital information tools by developing a 'nuclear wiki' to serve as a knowledge platform to foster the exchange of scientific and technical information, supplementing other media used by the Agency for knowledge capture and sharing, such as published reports, e-learning materials and online databases. Current content is mainly focused on decommissioning and on knowledge management, with material from other domains, including waste management and environmental remediation, being added progressively. The Agency also launched an accessible animation on radioactive waste management.

The mechanism for Member States' review of IAEA Nuclear Energy Series publications has been further consolidated and enables all interested Member States to contribute to the review of draft publications. The information on publications under preparation and on those open for Member States' review is made available via the Department of Nuclear Energy's official web page. In January 2020, the new IAEA Nuclear Energy Series publications structure was adopted and a clickable poster of all issued publications in the series (excluding those superseded) was made accessible via the Department of Nuclear Energy's official web page in June 2020. Moreover, Technical Working Groups have been engaged as review committees of these publications in a more systematic way.

Nuclear Fuel Cycle and Waste Management

A. Background

1. In resolution GC(63)/RES/10.B.3, the General Conference recognized the importance of assisting Member States interested in uranium production to develop and maintain sustainable activities through appropriate technology, infrastructure and stakeholder involvement and the development of skilled human resources, encouraged the Agency to develop a guidance document with a step by step approach for countries considering or initiating a uranium production programme, and encouraged interested Member States to use the uranium production site appraisal team (UPSAT) missions which support Member States in this field.
2. The General Conference also encouraged the Secretariat to assist interested Member States in analysing the technical challenges that may hinder the sustainable operation of nuclear fuel cycle facilities, such as ageing management issues.
3. Furthermore, the General Conference requested the Secretariat to continue and strengthen its efforts relating to the fuel cycle, spent fuel, and radioactive waste management, and to assist Member States to develop and implement adequate programmes, in accordance with relevant safety standards and security guidance. It also encouraged the Secretariat to promote information sharing to better integrate approaches to the back end of the fuel cycle that impact processing, transport, storage, and recycling of spent fuel and waste management, and to provide more information on designing, constructing, operating, and closing a radioactive waste pre-disposal management and disposal facility, and thereby assisting Member States, including those embarking on nuclear power programmes, to develop and implement adequate disposal programmes, in accordance with relevant safety standards and security guidance.
4. In the same resolution, the General Conference requested the Agency to formulate guidance documents on decommissioning and action plans to support decommissioning, with a view to promoting the safe, secure, efficient, and sustainable execution of these activities, and to facilitate the systematic review of these guidance documents based on recent developments, as appropriate. It also encouraged the Agency to further strengthen its activities in the area of environmental remediation and supported Member States in the adoption of best practices for managing NORM residue/wastes and to remediate NORM contaminated sites.
5. The General Conference also encouraged the Agency to further strengthen its activities in support of the effective management of disused sealed radioactive sources (DSRS) through, inter alia, the development of Qualified Technical Centres for DSRS management and cooperative efforts to strengthen supporting information on the borehole disposal of DSRS, with a view to enhancing safety and security of DSRS in the long term.
6. The General Conference requested the Director General to report on progress made in the implementation of this resolution to the Board of Governors as appropriate and to the General Conference at its sixty-fourth (2020) regular session.

B. Progress Made Since the 63rd Regular Session of the General Conference

7. To assist Member States interested in uranium production to develop and maintain sustainable activities through appropriate technology, infrastructure and stakeholder involvement, to foster the development of skilled human resources, the Agency organized four expert missions, as well as one national and two interregional workshops in 2019 (in China, the Czech Republic, Jordan, Malaysia, Mongolia and the Philippines).

IAEA TECDOC SERIES



IAEA-TECDOC-1892

Thorium Resources as Co- and By-products of Rare Earth Deposits

FIG. B.1 The IAEA publication provides information on the natural occurrence of thorium, the geology of thorium and potential thorium resources.

8. The publication *Thorium Resources as Co- and By-products of Rare Earth Deposits* (IAEA-TECDOC-1892), published in December 2019, provides information on the natural occurrence of thorium, the geology of thorium and potential thorium resources. It presents an overview of exploration and evaluation of projects, including studies for project feasibility, principles of ore processing, and market and production scenarios. The publication *Descriptive Uranium Deposit and Mineral System Models*, issued in May 2020, provides a set of systematic descriptive models for each uranium deposit type, subtype and class, using a consistent approach to summarize the same types of information for each. The publication *World Uranium Geology, Exploration, Resources and Production*, published in June 2020, is a comprehensive contemporary ‘one stop’ summary and reference volume for world uranium geology and resources allowing insight into potential future uranium discoveries and supply.

9. The Agency is developing a ‘Milestones’ approach in the uranium production cycle to assist Member States in taking a systematic and measured approach to responsible uranium mining and processing. This approach will be outlined in an IAEA Nuclear Energy Series publication and will identify four milestones in the uranium production cycle, each representing the beginning or boundary point of a stage or phase in the progression of uranium production cycle development from exploration and feasibility analysis to mining and processing.



FIG B.2 Two IAEA Member States requested a Uranium Production Site Appraisal Team (UPSAT) review mission in 2019 while several others expressed interest.

10. Two Member States — Argentina and Mongolia — requested a Uranium Production Site Appraisal Team (UPSAT) review mission in 2019 and several others expressed interest (for example, the Plurinational State of Bolivia, the Islamic Republic of Iran, Jordan and Kyrgyzstan). However, no review missions were implemented in 2020, due to unavailability of funds or COVID-19 pandemic circumstances.

11. In pursuing activities to enhance Member State capabilities in modelling, predicting and improving the understanding of the behaviour of current and advanced nuclear fuel under accident conditions, the Agency issued *Fuel Modelling in Accident Conditions (FUMAC)* (IAEA-TECDOC-1889) in December 2019. The FUMAC coordinated research project (CRP) aimed at analysing and better understanding fuel behaviour in accident conditions, with a focus on loss of coolant accidents (design basis accidents), in line with the early phase of the Fukushima Daiichi accident. It also aimed at identifying best practices in the application of physical models and computer codes used in different Member States for modelling fuel in accident conditions and enhancing the predictive capacities of these models and codes.

12. The Second Research Coordination Meeting on Spent Fuel Performance Assessment and Research (SPAR-IV) by the 11 chief scientific investigators was held in Buenos Aires with six observers, in October 2019. Each researcher provided an overview of their research results to date and a draft Technical Document was discussed. Besides, a Technical Meeting on Strategies and Opportunities for the Management of Spent Fuel from Power Reactors in the Longer Timeframe was held in Bahadurgarh, India, in November 2019, at which 46 experts from 17 countries discussed their strategies and plans to ensure nuclear energy sustainability through the reduction of waste burden, through the improvement of efficiency and reliability of nuclear energy systems, and through the development of more proliferation resistant fuel cycles in the long term. Part of the information gathered will be included in an IAEA Nuclear Energy Series publication under preparation addressing existing and advanced nuclear fuel cycle technical options for waste burden minimization.



FIG. B.3 The IAEA's Conference on the Management of Spent Fuel from Nuclear Power Reactors, held from 24 to 28 June 2019, attracted over 250 participants and observers from 45 Member States and seven organizations. (IAEA)

13. The Agency published *Management of Spent Fuel from Nuclear Power Reactors: Learning from the Past, Enabling the Future* in June 2020, presenting the outcome of the IAEA International Conference held in 2019 with the theme 'Learning from the Past, Enabling the Future', that provided a forum of information exchange on national spent fuel management strategies and on the ways in which a changing energy mix could influence these strategies. Some Agency-developed e-learning material on spent fuel management (SFM) was translated into Japanese and posted on the Cyber Learning Platform for Network Education and Training and other Agency network websites in October 2019. Other lectures on spent fuel storage facility design and operation, SFM safety and security fundamentals, spent fuel characteristics, and spent fuel transportation were published from November 2019 to February 2020, and a webinar, organized in April 2020 on the SFM training modules, was attended by about 200 participants.

14. To assist interested Member States in analysing the technical challenges that may hinder the sustainable operation of nuclear fuel cycle facilities, the Agency organized, in October 2019 in Vienna, a Technical Meeting on Ageing Management for Nuclear Fuel Cycle Facilities, attended by 28 experts from 19 Member States, who exchanged their experiences on the development and implementation of systematic ageing management programmes for nuclear fuel cycle facilities.



FIG. B.4 On 10 December 2019 the IAEA accepted its second and final delivery of a shipment of low-enriched uranium (LEU) at the Ulba Metallurgical Plant in Ust-Kamenogorsk, Kazakhstan. (IAEA)

On 17 October 2019, the Ulba Metallurgical Plant (UMP) completed the receipt activities in the IAEA LEU Storage Facility of the 32 full 30B cylinders from the supply contract with Orano Cycle. Upon the receipt of those 30B cylinders, the IAEA LEU Bank was established and became operational. This followed successful transportation from France, through the Russian Federation and Kazakhstan to UMP using the Agency's contracts with Orano Cycle, TENEX and KTZ Express. This transportation also successfully tested one of the transport routes for supply out of the IAEA LEU Bank. The transport contracts with TENEX and KTZ Express remain available for use in both directions in the future. On 10 December 2019, UMP completed the receipt activities in the IAEA LEU Storage Facility of the 28 full 30B cylinders from the supply contract with Kazatomprom, thereby completing the Agency's acquisition of LEU for the IAEA LEU Bank.

15. The Agency completed the development of the Spent Fuel and Radioactive Waste Information System (SRIS). SRIS provides a single, authoritative view on national spent fuel and radioactive waste management programmes, spent fuel and radioactive waste inventories and facilities, as well as relevant laws and regulations, policies, plans and activities, and global inventories of spent fuel and radioactive waste. SRIS has been developed by the IAEA in close cooperation with the European Commission and the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development (OECD/NEA).

16. To continue and strengthen its efforts relating to radioactive waste management and to assist Member States to develop and implement adequate programmes, and as part of the work of the International Low Level Waste Disposal Network (DISPONET), a Technical Meeting on Lessons Learned in the Disposal of Low Level Waste (the International Low Level Waste Disposal Network) was organized in Cherbourg, France, in October 2019. The meeting was attended by 31 participants from 27 Member States. The Agency held a Training Workshop on Planning and Implementing Site Investigations for Geological Disposal in November 2019, in Honorobe, Japan. The workshop was attended by five participants from three Member States. The Agency also hosted the 43rd Symposium on the Scientific Basis for Nuclear Waste Management, organized by the Materials Research Society, in October 2019, in Vienna, involving 64 participants from 17 Member States.

17. The Agency's International Radioactive Waste Technical Committee (WATEC) provided advice and guidance to the Secretariat on themes for the 2022–2023 Programme and Budget in the areas of radioactive waste management, decommissioning and environmental remediation. This was achieved using virtual mechanisms (online shared documents and web conferences) between 11 May and 19 June 2020. Overall 31 participants from 24 Member States and five international organizations provided contributions.

18. In collaboration with the Abdus Salam International Centre for Theoretical Physics, the Agency developed an International School on Radioactive Waste Cementation. In response to the global pandemic, the planning for this joint school was carried out completely virtually.

The Agency continued to develop guidance documents on decommissioning and action plans to support decommissioning. The Agency designated as Collaborating Centres the Norwegian Institute for Energy Technology (IFE) and the Italian company Sogin, involved in planning for and implementation of decommissioning of research reactors (IFE) and nuclear power plants and fuel cycle facilities (Sogin).



FIG. B.5 Nils Morten Huseby, President of the Institute for Energy Technology (left), signed the Practical Arrangements with IAEA Deputy Director General and Head of the Department of Nuclear Energy, Mikhail Chudakov. (IAEA)

19. A Technical Meeting on Human Resource Development for Decommissioning was held in Vienna in July 2019, involving 32 participants from 22 Member States. The meeting discussed the revision of the Agency's publication *Decommissioning of Nuclear Facilities: Training and Human Resource Considerations* (IAEA Nuclear Energy Series No. NG-T-2.3) issued in 2009.

20. The Agency organized an International Workshop on Preparing for Implementation of Decommissioning of Nuclear Facilities in Fukui, Japan, in November 2019, which was attended by 40 participants from eight Member States.

21. The Agency published *Environmental Impact Assessment of the Drawdown of the Chernobyl NPP Cooling Pond as a Basis for its Decommissioning and Remediation* (IAEA-TECDOC-1886), which

outlines practical experience gained throughout the cooling pond decommissioning project, which started in 2014 and continues until the present.

22. Following a request of the Government of Japan, the Agency provided a review of the management of the stored water at the Fukushima Daichi nuclear power plant, including of the report by the Subcommittee on Handling of the ALPS Treated Water issued on 10 February 2020. The Agency team of experts completed the review on 2 April 2020, considering all technical options for treated water management addressed in the report.

23. The Agency's International Project on Completion of Decommissioning held its second Technical Meeting in September 2019, attended by 30 participants from 20 Member States. The project focuses on the definition and implementation of decommissioning end states. On the same topic, a Technical Meeting on Achieving the Site End State: Characterization Strategies and Instrumentation for Land Contamination, was held in Dounreay, United Kingdom, in October 2019. Fifty experts from 26 countries discussed approaches and technologies for the characterization of radioactively contaminated land. The meeting included workshops and site access to the Dounreay site which is currently undergoing decommissioning and remediation to achieve the site end state in 2033.



FIG. B.6 Participants in the Technical Meeting on Achieving the Site End State: Characterization Strategies and Instrumentation for Land Contamination learn about beach monitoring equipment. (IAEA)

24. The Agency continued strengthening its activities in the area of environmental remediation, including by holding the Annual Meeting of the Network on Environmental Management and Remediation which marked the 10th anniversary of the network and examined the progress of environmental remediation over the past decade. Thirty-five experts from 24 Member States and three international organizations discussed a variety of remediation cases as well as the value of an effective environmental management approach. In 2019, the Agency also launched the MAESTRI (Management Systems Supporting Environmental Remediation) project with the overarching objective of developing a structured framework that considers, in an integrated manner, the different dimensions and activities

that are relevant to the proper management of sites that have been contaminated by ongoing or past activities (including accidents), with a view to bringing them to sustainable end states suitable for beneficial use.

25. A Technical Meeting on Remediation of Legacy Trenches Containing Radioactive Waste — The LeTrench Project, was held in Sydney, Australia, in August 2019. Twenty-one experts from 12 countries discussed the challenges associated with the evaluation, remediation and long term stewardship of sites comprised of buried wastes from past activities. A site visit to the Little Forest legacy site enabled participants to understand the status of the site and the test trenches which have been installed for field-based experiments on contaminant migration. A key challenge for these sites is the definition of site interim states or the site end state; the meeting therefore included a workshop to simulate the options assessment for the Little Forest legacy site.

26. In 2019, the Agency issued *Developing Cost Estimates for Environmental Remediation Projects* (IAEA Nuclear Energy Series No. NW-T-3.8), addressing the individual phases of an environmental remediation project, demonstrating how they can be calculated, and how they can be structured and documented. The publication provides the methodology of cost estimation and includes examples of cost estimate models, development plans, cost elements and work breakdown structures. The publication also contains an overview of potentially suitable remediation technologies, which may help the reader to structure the options study.

27. At the request of Member States, the Agency completed two Integrated Review Service for Radioactive Waste and Spent Fuel Management, Decommissioning and Remediation (ARTEMIS) missions to Germany (September 2019) and Latvia (December 2019). At the request of the Government of Japan, an ARTEMIS mission to review the Japan Atomic Energy Agency's *Back-end Roadmap* is planned to take place in October 2020. At the request of the Government of Cyprus, an ARTEMIS mission is planned for October 2020.

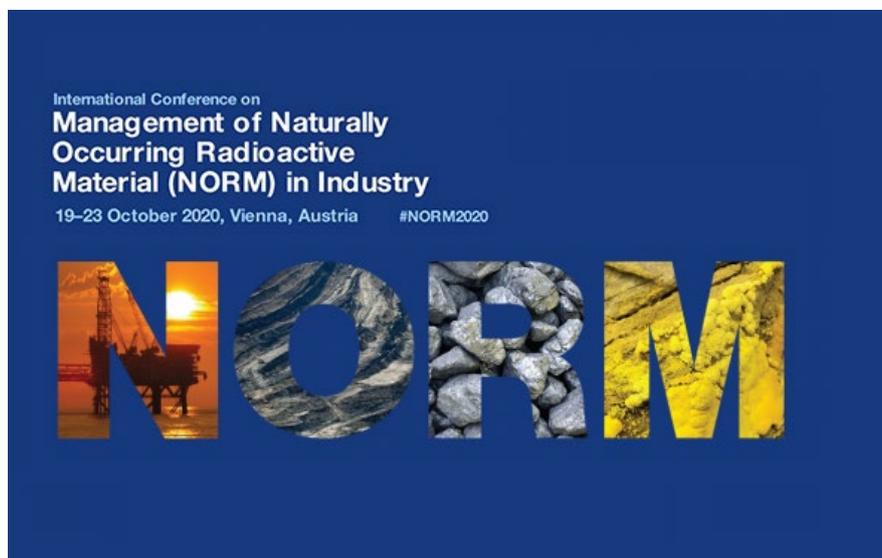


FIG. B.7 More than 400 participants from over 70 Member States registered for the IAEA International Conference on the Management of Naturally Occurring Radioactive Materials (NORM)

28. To support Member States in the adoption of best practices for managing naturally occurring radioactive material (NORM) residue/wastes (including inventory determination, reuse, recycle, storage, and disposal options) and to remediate NORM contaminated sites, the Agency launched a series of webinars on environmental remediation and NORM-related topics, starting with a webinar on the

difficulties and challenges associated with laboratory measuring techniques for radionuclides in NORM samples, delivered in May 2020 in collaboration with the University of Seville, Spain, and attended by 249 persons from all over the world. The organization of the International Conference on the Management of Naturally Occurring Radioactive Materials (NORM) in October 2020 is ongoing with 270 abstracts received and more than 400 participants registered from over 70 Member States.

29. The Agency further strengthened its activities in support of the effective management of DSRS by developing Qualified Technical Centres for DSRS management, by fostering cooperative efforts to further strengthen supporting information on the borehole disposal of DSRS, with a view to enhancing safety and security of DSRS in the long term. Over the reporting period, there were fourteen active projects to support the removal of Category 1 and 2 (higher activity) DSRS from Bahrain, Burkina Faso, Cambodia, Chile, Croatia, Cyprus, Dominican Republic, Ecuador, Jordan, Nepal, Nicaragua, Peru, Slovenia and Tunisia. A project was initiated for the safe management of disused radioisotope thermoelectric generators (RTGs) in Tajikistan. The Agency conducted five expert missions in the framework of the nuclear security project on enhancing nuclear security through the sustainable management of disused sealed radioactive sources: in Cameroon (February 2020), Chile (December 2019) and Costa Rica (November 2019) to review management options for Category 1 and 2 DSRS; in the Dominican Republic (November 2019) to review the policy and strategy for DSRS management; and in Zambia (October 2019) to establish an inventory of Category 1 and 2 DSRS. Three additional expert missions, in the framework of the Agency's technical cooperation programme, were conducted to establish radioactive source inventories in Barbados, Grenada (both September 2019), and the Marshall Islands (October 2019).

The Agency completed the development of the Disused Sources Integrated Decision Evaluation Support (DSIDES) tool and tested it in October 2019 at an interregional workshop in Tunisia attended by 36 participants from 26 Member States.

30. The Agency further strengthened its range of professional networks in radioactive waste management, with the launch of the Disused Sealed Radioactive Sources Network (DSRSNet), which enables the exchange of experiences in managing DSRS.

Research Reactors

A. Background

1. In resolution GC(63)/RES/10.B.4, the General Conference encouraged the Secretariat to continue to foster regional and international collaboration and networking that expands access to research reactors, such as international user communities. It also encouraged the Secretariat to inform Member States considering the development or installation of their first research reactor of the issues related to utilization, cost-effectiveness, environmental protection, safety and security, nuclear liability, proliferation resistance, including the application of comprehensive safeguards, and waste management associated with such reactors, and, on request, to assist decision makers in pursuing new reactor projects following the Agency-developed Specific Considerations and Milestones for a Research Reactor Project systematically and on the basis of a robust, utilization-based strategic plan.
2. The General Conference also urged the Secretariat to continue to provide guidance on all aspects of the research reactor life cycle, including the development of ageing management programmes at both new and older research reactors, to ensure continuous improvements in safety and reliability, sustainable long-term operation, the sustainability of fuel supply, exploration of efficient and effective disposition options for spent fuel and waste management, and the development of a knowledgeable customer capability in Member States decommissioning research reactors.
3. Furthermore, the General Conference encouraged the Secretariat to further strengthen its efforts to support capacity building based on research reactors, including with the IAEA Internet Reactor Laboratory project which could be expanded in the Asia-Pacific, Europe and Africa regions.
4. Finally, the General Conference called on the Secretariat to continue to support international programmes working to minimize the civilian use of HEU where such minimization is technically and economically feasible.
5. The General Conference requested the Director General to report on progress made in the implementation of this resolution to the Board of Governors as appropriate and to the General Conference at its sixty-fourth (2020) regular session.

B. Progress Made Since the 63rd Regular Session of the General Conference

6. The Agency conducted the International Conference on Research Reactors: Addressing Challenges and Opportunities to Ensure Effectiveness and Sustainability, hosted by the Government of Argentina, in Buenos Aires in November 2019. Three hundred participants from 55 Member States attended the Conference, exchanging and sharing experience in all relevant areas of research reactors including safety, security, operation, utilization, infrastructure development, and management. In cooperation with the Government of Argentina, in December 2019, the Agency conducted a Workshop

on Simulation of a Non-Power Reactor for Training Purposes in Bariloche, Argentina, attended by 45 participants from 19 Member States.



FIG. B.1 The IAEA's International Conference on Research Reactors: Addressing Challenges and Opportunities to Ensure Effectiveness and Sustainability was held in Buenos Aires, Argentina in November 2019. (IAEA)

7. A Training Workshop on the Advanced Use of Neutron Imaging for Research and Applications was conducted in September 2019 in Daejeon, Republic of Korea, with 36 participants representing 20 Member States. The most recent information on the use of neutron imaging for both research and industrial applications was delivered, with a focus on cultural heritage applications. The Agency also continued to implement the coordinated research project (CRP) on enhancing nuclear analytical techniques to meet the needs of forensic science, to develop and utilize the unique capabilities of nuclear analytical techniques for forensic sciences and to establish long term collaboration with forensic science stakeholders.

8. Two requests to conduct an Integrated Research Reactor Utilization Review (IRRUR) mission were received but missions were postponed due to COVID-19. The Agency published a brochure to promote the IRURR service.

9. The Reactor Institute Delft was re-designated as an Agency Collaborating Centre supporting utilization for a wide range of applications, including isotope production, use of neutron beams, irradiation and analytical services, material characterization and testing, and nuclear education and training, for the period 2020–2024.

10. The Agency's database of neutron imaging facilities, which includes technical data and capabilities, was maintained and updated in cooperation with the International Society for Neutron Radiography. A round robin exercise on standardization of neutron imaging, in cooperation with the Paul Scherrer Institute, Switzerland, was finalized as an important step towards development of international standards on the subject. Furthermore, a worldwide proficiency testing exercise for neutron activation analysis laboratories was finalized, providing a mechanism for laboratories to demonstrate their analytical performance and identify areas for improvement.

11. The Agency updated the e-learning course entitled Strategic Planning for National Nuclear Institutions, which provides guidelines and methodologies for the development of a strategic plan for the efficient and sustainable utilization of facilities. The Agency also reviewed and provided feedback on two preliminary strategic plans for new research reactor projects developed by Member States.

12. To assist Member States in pursuing new reactor projects, the Agency conducted a Training Workshop on Assessment of the National Nuclear Infrastructure to Support a New Research Reactor Project, hosted by the Government of India through the Global Centre for Nuclear Energy Partnership in Bahadurgarh, India, in October 2019. The workshop provided 41 participants from 12 Member States with knowledge and practical information on the Agency-developed milestones methodology, safety standards and other relevant Agency technical publications. The participants were trained in evaluating the status of national nuclear infrastructure in support of a new research reactor project in the application of the Agency's methodology. A training workshop on the same topic is planned for December 2020 in Vienna. In November 2019, in Vienna, the Agency also conducted a Training Workshop on Technical Requirements in the Bidding Process for a New Research Reactor, attended by 20 representatives from ten Member States.

13. In December 2019, the Agency, upon request of the Government of Senegal, conducted a National Workshop on the Milestones Approach for a Research Reactor Programme in Dakar with the participation of 44 high level representatives of national authorities. The participants were provided with basics and practical information on the safety and utilization of research reactors and on specific considerations of the Agency's milestones approach for a new research reactor programme.

The Agency also continued to provide the Integrated Nuclear Infrastructure Review for Research Reactors (INIR-RR) peer review service to interested Member States. Upon request of the Government of Thailand, an INIR-RR Phase 1 mission was planned in Thailand for July 2020 and then rescheduled for December 2020. INIR-RR Follow-Up missions to Nigeria and Viet Nam were planned in 2020 but postponed due to COVID-19, in coordination with Member States.



FIG B.2 The total number of IAEA designated International Centres of Excellence Based on Research Reactors reached six in six Member States

14. The Agency continued to support the International Centres of Excellence Based on Research Reactors (ICERR) scheme by facilitating networking among designated ICERRs and promoting access to their facilities through different Agency mechanisms. In this regard, two more research centres were

designated as ICERRs during the reporting period: the Korea Atomic Energy Research Institute (KAERI) in the Republic of Korea in September 2019, and the Institute for Nuclear Research in Pitești, Romania, in January 2020. The total number of ICERRs reached six in six Member States. The Agency also cooperated with ICERRs in France (French Alternative Energies and Atomic Energy Commission) and Belgium (Belgian Nuclear Research Centre) in organizing and conducting a workshop on capacity building in research reactors for Agency Member States from Africa, and the Asia and the Pacific region. The workshop was organized in February 2020 in Cadarache and Saclay, France, and Mol, Belgium, and was attended by 13 participants from ten Member States.

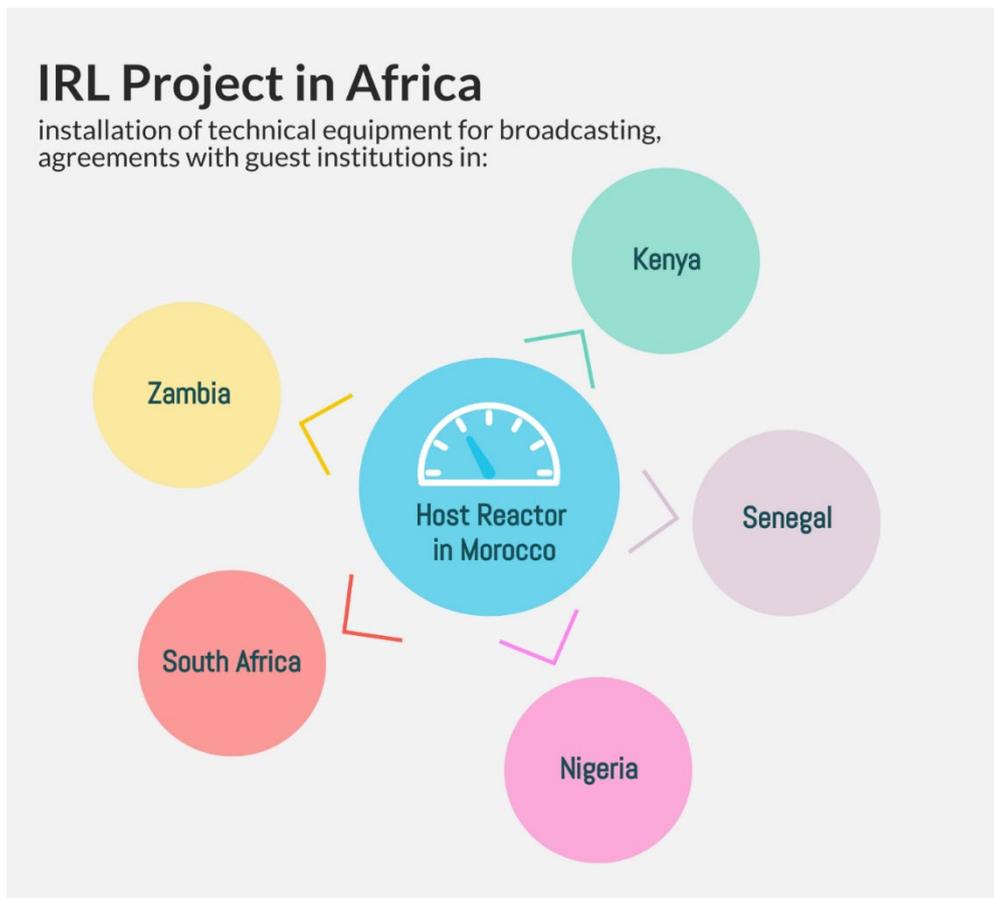


FIG. B.3 Morocco will provide online access to its research reactor to guest institutions from Kenya, Nigeria, Senegal, South Africa and Zambia

15. The Agency further strengthened its efforts to support capacity building based on research reactors. In September and November 2019, the Agency, in cooperation with the Eastern European Research Reactor Initiative, conducted the 15th Research Reactor Group Fellowship Training Course in Austria, the Czech Republic and Slovenia, with 11 participants from six Member States. Live transmissions of Internet Reactor Laboratory (IRL) exercises to university classrooms in Latin America were continued by the host reactor in Argentina. In the Europe region, the VR-1 reactor at the Czech Technical University in Prague replaced the ISIS research reactor in France, shut down in December 2018, as an IRL host reactor. New IRL agreements with guest institutions are at different stages of finalization and signing. Furthermore, there was significant progress in the implementation of an IRL project in Africa: the host reactor in Morocco has completed the installation of technical equipment for broadcasting, and agreements with guest institutions in Kenya, Nigeria, Senegal, South Africa and Zambia have been either signed or are in the process of being signed. The kick-off meeting and first transmission are expected by the end of 2020. In the Asia and the Pacific region, the Agency provided equipment for IRL guest institutions in Azerbaijan, Mongolia and the Philippines. The kick-off meeting

and first transmission from the host reactor in KAERI, Republic of Korea, is expected to take place by the end of 2020.

16. To continue supporting Member States on all aspects of the research reactor life cycle, including the development of ageing management programmes, and to ensure continuous improvements in safety and reliability and sustainable long term operation, an expert mission to review the reactor upgrade and technical specifications update for the RECH-1 research reactor in Santiago was conducted in March 2020.

17. The publication *Material Properties Database for Irradiated Core Structural Components for Lifetime Management for Long Term Operation of Research Reactors* (IAEA-TECDOC-1871) was issued in 2019.

18. In October 2019, an Operation and Maintenance Assessment for Research Reactors mission was conducted at the Bandung TRIGA 2000 research reactor facility in Indonesia which supported the preparation of an action plan for operation of the reactor for a period of 15–20 years.

19. In the area of research reactor fuel cycle, the Agency completed a CRP on options and technologies for managing the back end of the research reactor nuclear fuel cycle and conducted a workshop on use of related decision support tools in August 2019 in Vienna, attended by 38 participants from 24 Member States. The Agency also hosted meetings in November 2019 and January 2020 in Vienna to prepare generic terms of reference for facilitated meetings and training workshops to assist Member States in using the decision support tools developed as part of the CRP. The terms of reference, generic meeting agenda, and preparation guidance for Member States were formulated, and are ready for use upon Member State request for assistance. A publication on research reactor spent fuel management options and support to decision making is in the final stages of editing.

20. The Agency completed a CRP on benchmarks of computational tools against experimental data on fuel burnup and material activation for utilization, operation and safety analysis of research reactors and held a technical meeting on the same topic in September 2019 in Vienna, attended by 37 participants from 25 Member States. Revision of the database of benchmarks and associated experimental data and a publication of the benchmark analyses are ongoing.

21. The Agency completed a CRP on accelerator-driven system (ADS) applications and use of low-enriched uranium in ADSs; the primary output is a collection of experiments and analyses related to LEU-fuelled ADS facilities that propose or confirm expansion of applications using ADSs, as well as development and refinement of analytical tools for ADSs. A consultancy meeting was held in Vienna to coordinate the completion of the related publication in December 2019.

The Agency continued to support, upon the request of Member States, international programmes working to minimize the civilian use of highly enriched uranium (HEU). Two HEU minimization projects were supported in Kazakhstan: preparations for the return of spent HEU fuel from the IVG.1M research reactor to the Russian Federation, and down-blending of the irradiated HEU graphite fuel unloaded from the IGR research reactor.

22. The Agency participated in the meeting in Nur-Sultan in November 2019, hosted two meetings in Vienna in December 2019 to plan and coordinate project activities, provided expert assistance and organized procurement of services to prepare for importing and reprocessing of the spent HEU fuel in Russian Federation. In February 2020, the Agency hosted in Vienna a consultancy meeting to discuss a scope of work for the conversion of the Syrian Miniature Neutron Source Reactor to low enriched uranium and the removal of HEU. A list of technical activities required for the reactor conversion and HEU removal was developed. The annual Technical Meeting on Lessons Learned from High Enriched

Uranium Take-back Programmes was planned to be held in Plzen, Czech Republic, in June 2020, but was postponed to October 2020.

23. The Agency continued cooperation with Argonne National Laboratory for the organization of the 40th International Meeting on Reduced Enrichment for Research and Test Reactors, held in Zagreb in October 2019. The meeting, attended by 150 participants representing 22 Member States, covered all aspects of research reactor conversion and HEU minimization from the development of new LEU fuels to replace current HEU fuels, to the removal and disposition of HEU fuel once a suitable LEU fuel has been developed.



FIG. B.4 Workshop participants undertaking group exercises for decommissioning of a typical research reactor (IAEA)

24. A technical meeting and associated workshop on planning and costing of research reactor decommissioning was held in October 2019 in Cadarache, France, attended by 40 participants from 35 Member States. The meetings explored the practical, financial and regulatory dimensions of research reactor decommissioning. Feedback was provided on a draft Agency publication containing the final report of the Data Analysis and Collection for Costing of Research Reactor Decommissioning project, that is expected to be approved for publication in 2020.

25. Research reactor operations and decommissioning generate radioactive waste that requires management. In May 2019, the Agency held a joint technical meeting involving two scientific secretaries, one international expert and 27 participants from 22 Member States. The objective of the meeting was to bring together owners, operators, designers and regulators of research reactors to discuss and exchange information, experiences, and practical knowledge related to the management of radioactive waste and spent fuel from research reactors. The output of the meeting was a report which is available on the IAEA CONNECT International Predisposal Network platform that compiled the current status of management of waste from research reactors and the principle outstanding challenges.

Operating Nuclear Power Plants

A. Background

1. In resolution GC(63)/RES/10.B.5, the General Conference requested the Secretariat to promote collaboration among interested Member States for strengthening excellence for the safe, secure, efficient, and sustainable operation of nuclear power plants, and to continue its support to interested Member States, in particular through strengthening their knowledge, experience, and capacity in management of ageing and plant life management.
2. The General Conference also encouraged the Secretariat to identify best practices and lessons learned with respect to procurement, supply chain, engineering, and related issues in the delivery of large, capital-intensive nuclear engineering projects and to promote and disseminate them through publications and web-based tools with respect to supply chain management.
3. Furthermore, the General Conference recognized the need to enhance further the support for grid and nuclear power plant interfaces, grid reliability, and cooling water usage, and recommended that the Secretariat collaborate on these matters with Member States that have operating nuclear power plants.
4. The General Conference requested the Director General to report on progress made in the implementation of this resolution to the Board of Governors as appropriate and to the General Conference at its sixty-fourth (2020) regular session.

B. Progress Made Since the 63rd Regular Session of the General Conference



FIG. B.1 Participants at the Global Forum on Innovation for the Future of Nuclear Energy, held in June 2019 in Gyeongju, the Republic of Korea (KHNP)

5. The Agency continued to support interested Member States in their activities to improve the safe, secure and economical operation of existing nuclear power plants (NPPs) throughout their operational lifetime. Following the successful implementation of the first Global Forum on Innovation for the future of Nuclear Energy hosted by the Korea Hydro & Nuclear Power Company in Gyeongju, Republic of Korea, the Agency developed and deployed an international peer network to facilitate collaboration around that subject. The Global Forum for Nuclear Innovation Network is hosted on the IAEA CONNECT platform and will be used to support the second Forum event that is being rescheduled as a result of the global pandemic.



FIG. B.2 The IAEA Technical Meeting on Challenges in New Build Projects in Countries with Nuclear Power Programmes (IAEA)

6. The Agency held a Technical Meeting on Challenges in New Build Projects in Countries with Nuclear Power Programmes in November 2019. It was attended by 36 experts from 18 Member States and four international organizations and examined a wide range of issues, from schedule management to implementation challenges, and explored potential pathways for optimizing the construction and commissioning of new plants.

7. The Agency organized a Technical Meeting on Critical Challenges with Digital Instrumentation and Control Systems at Nuclear Power Plants, hosted by the Government of Hungary in Budapest in October 2019. The objective of the meeting was to serve as an international forum for presentations and discussions and for sharing experiences and lessons learned in the subject area. The event was attended by 81 experts from 25 Member States and one international organization

8. To further enhance the support for grid and NPP interfaces, grid reliability, and cooling water usage, the Agency conducted a Technical Meeting on Electric Grid Reliability and Resilience in Relation to Nuclear Power Plants in Stockholm in October 2019. It was attended by 34 participants from 18 Member States.

9. In June 2020, the Agency published *Quality Assurance and Quality Control in Nuclear Facilities and Activities* (IAEA-TECDOC-1910).

In September 2019, the Agency organized a Pilot Training Course on Nuclear Supply Chain Management and Procurement in Vienna, attended by 30 participants and 7 lecturers from 26 Member States. The Agency also launched a toolkit on nuclear supply chain management in June 2020 as part of the IAEA CONNECT Management System Network of Excellence (MSN).

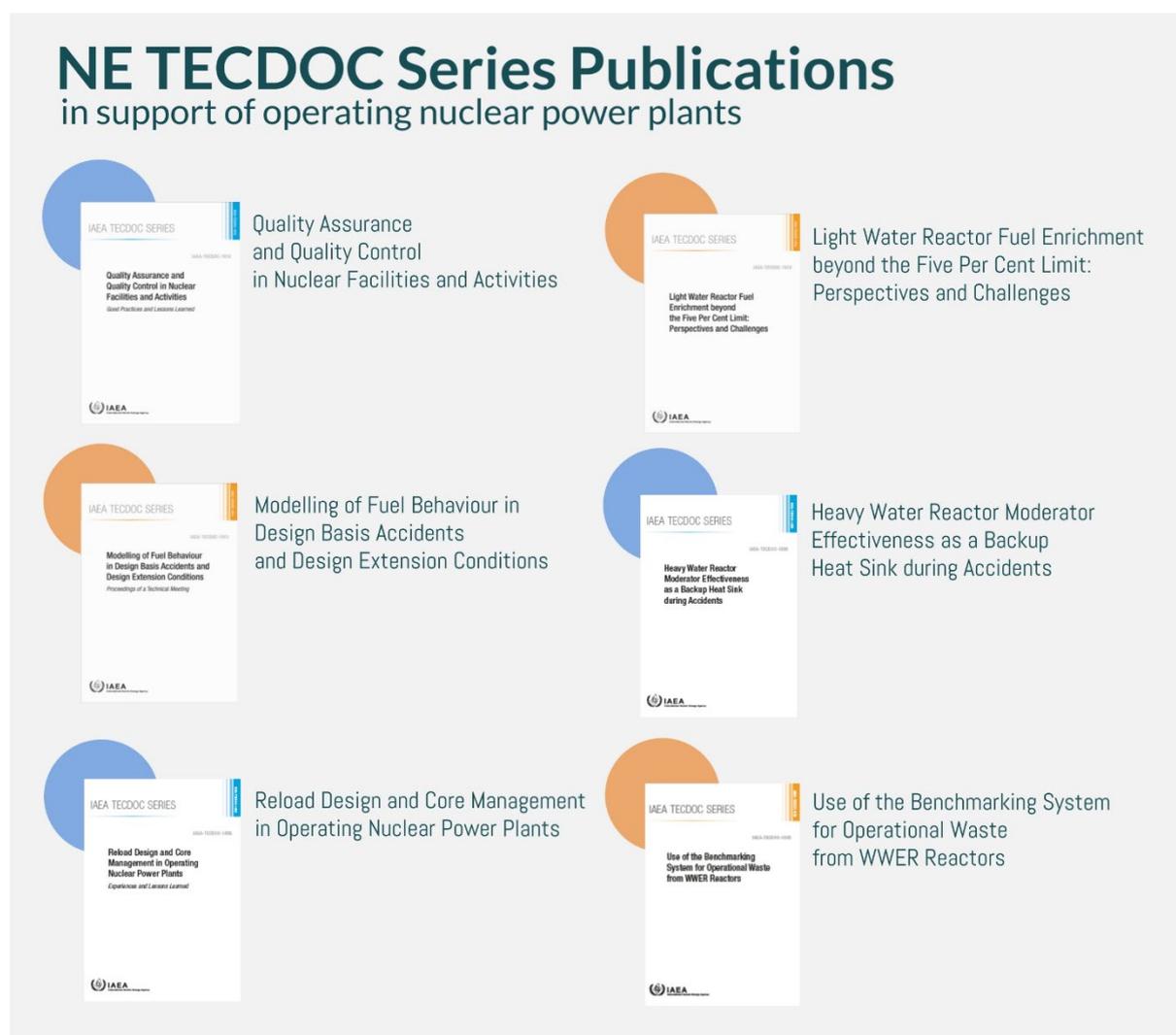


FIG. B.3 The IAEA issued several publications in support of operating nuclear power plants

10. To continue its support to interested Member States, in particular through strengthening their knowledge, experience, and capacity in management of ageing and plant life management, the Agency delivered a series of three workshops in Mexico City on ageing and plant life management at the request of Mexico via the technical cooperation programme. The first, on the implementation of ageing management programmes was held in November 2019. The second, on environmental effects on fatigue in NPPs was held in December 2019. Finally, the third, on subsequent licence renewal was held in February 2020. The scope of the workshops included programmatic and technical activities that would permit operators to extend NPP operation to 80 years. The Agency also launched a new version of the nuclear leadership development toolkit as a part of the IAEA CONNECT Nuclear Energy Capacity Building Hub in February 2020. Furthermore, a beta version toolkit on regulations and standards in nuclear management systems and quality is planned to be launched in August 2020 as a part of the IAEA CONNECT MSN.

11. In November 2019, the Agency issued *Review of Fuel Failures in Water Cooled Reactors (2006–2015)* (IAEA Nuclear Energy Series NF-T-2.5). It summarizes fuel failure occurrences, their mechanisms and root causes, as well as fuel failure prevention and management in plant operation for 97% of light and heavy water cooled nuclear power units operated worldwide during the period 2006–2015. The Agency also published in June 2020 *Modelling of Fuel Behaviour in Design Basis Accidents*

and *Design Extension Conditions - Proceedings of a Technical Meeting* (IAEA-TECDOC-1913) and, in July, *Light Water Reactor Fuel Enrichment beyond the Five Per Cent Limit: Perspectives and Challenges* (IAEA-TECDOC-1918). The Agency is also developing a Technical Document on coolant chemistry control and effects on fuel reliability in pressurized heavy water reactors.

12. In February 2020, the Agency issued *Reload Design and Core Management in Operating Nuclear Power Plants* (IAEA-TECDOC-1898).

13. With an in-kind contribution from the State Atomic Energy Corporation “Rosatom”, the Agency published, in September 2019, a Russian translation of the publication *Use of the Benchmarking System for Operational Waste from WWER Reactors* (IAEA TECDOC- 1815).

14. The Agency held a Technical Meeting on Decontamination Approaches during Outages at Nuclear Power Plants in Vienna in October 2019, attended by 12 experts from 11 Member States. The Agency also continued the development of a publication on the same topic based on the lessons learned.

15. In December 2019 the Agency issued *Heavy Water Reactor Moderator Effectiveness as a Backup Heat Sink during Accidents* (IAEA-TECDOC-1890), benchmarking computational methods against an experiment on the complex and transient phenomena that determine heavy water reactor fuel channel behaviour in an accident. To foster knowledge and experience sharing related to methods and strategies for the implementation of post-Fukushima-accident actions at NPPs, the Agency finalized a publication that shares post-Fukushima-accident actions taken by NPPs around the world.

The Agency continued to maintain its Power Reactor Information System (PRIS), a comprehensive, authoritative database on NPP capacity and performance. The database directly supports two annual publications — *Operating Experience with Nuclear Power Stations in Member States* and *Nuclear Power Reactors in the World*—as well as the PRIS nuclear power status infographic poster. The Agency also continued to host the Country Nuclear Power Profile (CNPP) programme, an Agency resource that provides an historical overview of energy and nuclear power development in different countries. Current PRIS quantitative data feed into the qualitative summaries provided in the CNPPs, which outline legislative, organizational, and regulatory frameworks of participating Member States in its own annual publication.

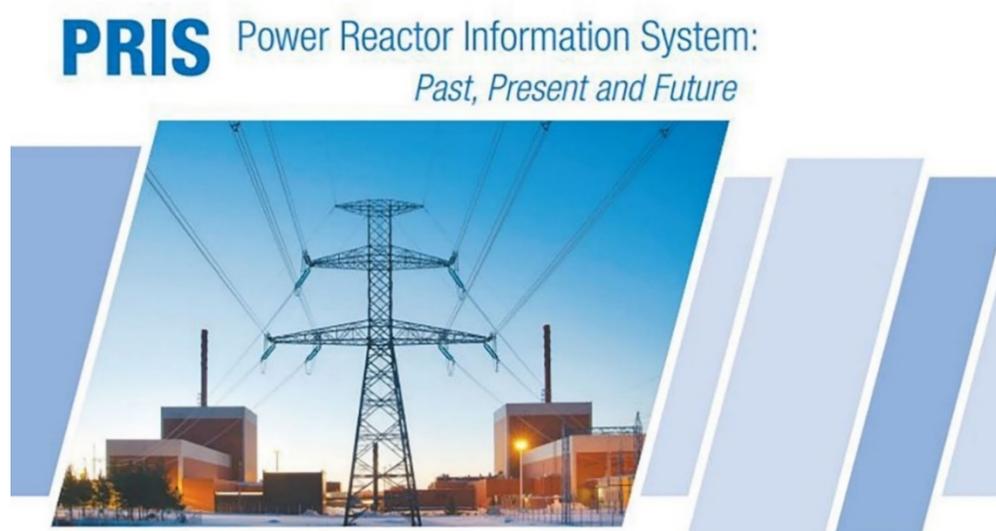


FIG. B.4 PRIS, developed and maintained by the IAEA for over five decades, contains authoritative historical and current quantitative information on nuclear power reactors in operation and under construction or in decommissioning phase.

Agency Activities in the Development of Innovative Nuclear Power Technology

A. Background

1. In resolution GC(63)/RES/10.B.6, the General Conference requested the Secretariat to promote collaboration among interested Member States in developing innovative, globally sustainable nuclear energy systems and to support the establishment of effective collaboration mechanisms to exchange information on relevant experiences and good practices. It also encouraged the Secretariat to consider further opportunities to develop and coordinate the services it provides to interested Member States in building long-term national nuclear energy strategies and in long-term sustainable nuclear energy deployment decision-making using, inter alia, the analytical approaches and tools developed by INPRO.
2. The General Conference also encouraged the Secretariat to study cooperative approaches to the back end of the nuclear fuel cycle to ensure effective cooperation among countries towards the long-term sustainable use of nuclear energy and requested the Secretariat to facilitate discussion among developers of advanced reactors (e.g. SMRs, Generation IV reactors) on the challenges and technologies related to decommissioning and radioactive waste management at the earliest stage of their design thinking.
3. Furthermore, the General Conference encouraged the Secretariat to further its efforts on distance learning/training on development and evaluation of innovative nuclear technology for students and staff of universities and research centres, and to further develop tools supporting this activity that supports efficient delivery of services to Member States.
4. The General Conference requested the Director General to report on progress made in the implementation of this resolution to the Board of Governors as appropriate and to the General Conference at its sixty-fourth (2020) regular session.

B. Progress Made Since the 63rd Regular Session of the General Conference

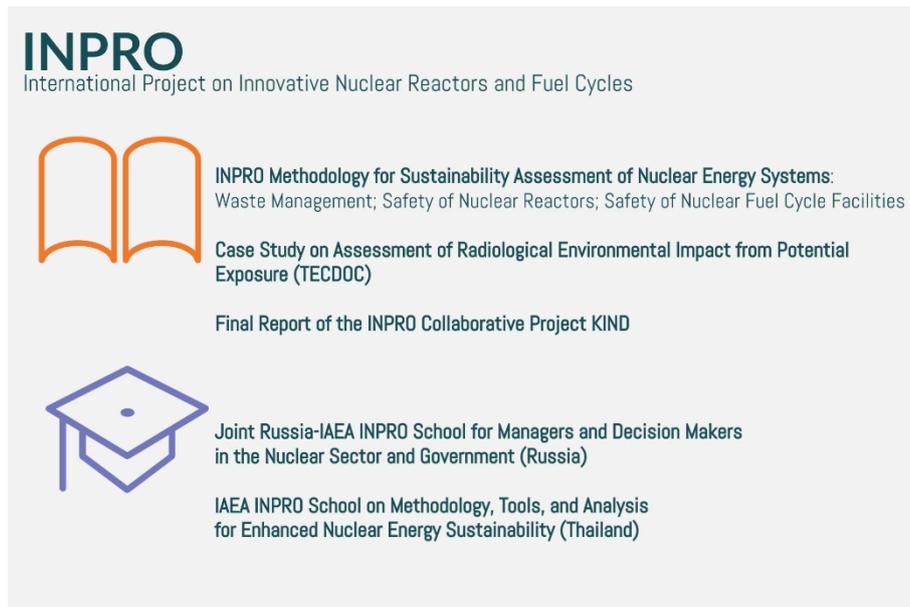


FIG. B.1 Several publication and reports have been published within INPRO, as well as online e-learning material on development and evaluation of innovative nuclear technology

5. To assist interested Member States in building long-term national nuclear energy strategies and in long-term sustainable nuclear energy deployment decision-making, the Agency issued in 2020 three Technical Documents related to the INPRO methodology, namely *INPRO Methodology for Sustainability Assessment of Nuclear Energy Systems: Waste Management* (IAEA-TECDOC-1901), *INPRO Methodology for Sustainability Assessment of Nuclear Energy Systems: Safety of Nuclear Reactors* (IAEA-TECDOC-1902), and *INPRO Methodology for Sustainability Assessment of Nuclear Energy Systems: Safety of Nuclear Fuel Cycle Facilities* (IAEA-TECDOC-1903). The Agency also issued *Case Study on Assessment of Radiological Environmental Impact from Potential Exposure* (IAEA-TECDOC-1914) looking at various scenarios referencing Member State collaborations and experiences. The development of reports on the Comparative Evaluation of Nuclear Energy System Options and the Roadmaps for a Transition to Globally Sustainable Nuclear Energy Systems (ROADMAPS) projects that will guide States in evaluating areas of global and regional nuclear energy scenarios has also progressed, as has the development of a publication addressing a limited scope sustainability assessment of planned nuclear energy systems based on BN-1200 fast reactors to evaluate the economics and reactor safety of a fast reactor system, in cooperation with the Russian Federation.

6. To encourage the use of methods and tools developed by the Agency for nuclear energy evolution scenario modelling, nuclear energy system economic assessments, comparative evaluation of nuclear energy system or scenario options, and road mapping, the Agency organized two meetings on trial implementation and review of the e-learning course on scenario analysis and decision support for development of nuclear energy systems with enhanced sustainability in Mexico City with 16 participants from six Member States in October 2019, and in Moscow with 20 participants from four Member States in December 2019.

7. To promote application of the ROADMAPS templates for national case studies, including case studies based on cooperation among technology holder and technology user countries, and for national and regional long-term energy planning to enhance sustainability of nuclear energy systems, the Agency has developed tools and approaches with a vision for use in International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) schools to coordinate and promote the use of these tools globally. The Agency has planned to hold INPRO schools in the Russian Federation and Thailand in the last

quarter of 2020 to show Member States how to apply ROADMAPS templates. To support the further use of web-based tools, the Agency has also created online e-learning material to support analysis support for enhanced nuclear energy sustainability in English and Russian with a Spanish edition in the planning.

8. To promote collaboration among interested Member States in developing innovative, globally sustainable nuclear energy systems and to support the establishment of effective collaboration mechanisms, the Agency is developing capabilities to analyse how advanced nuclear power technologies and alternative non-electric nuclear energy systems and their applications can operate together and what is the optimal mixture of these technologies. In October 2019, the Agency issued *Nuclear–Renewable Hybrid Energy Systems for Decarbonized Energy Production and Cogeneration* (IAEA-TECDOC-1885) based on the outcome of a technical meeting held in 2018 presenting updates on the status of and new concepts in nuclear–renewable hybrid energy systems for decarbonized energy production and cogeneration.

9. To promote further application of multi-criteria decision analysis methods to support decision analysis and prioritization in national nuclear energy programmes, the Agency issued, in 2019, *Application of Multi-criteria Decision Analysis Methods to Comparative Evaluation of Nuclear Energy System Options: Final Report of the INPRO Collaborative Project KIND* (IAEA Nuclear Energy Series No. NG-T-3-20) describing the approach and several case studies performed by Member States to evaluate, on a comparative basis, both nuclear energy system and nuclear energy evolution scenario options. The Agency has also developed the KIND-ET Excel based tool for performing key indicator evaluations for nuclear energy system deployment.

10. In July 2019, the Agency organized the 17th INPRO Dialogue Forum on Opportunities and Challenges in Small Modular Reactors in Ulsan, Republic of Korea. The 18th Dialogue Forum is planned to take place on 9 to 11 December 2020 in Vienna and will address the topic of partnerships for nuclear development and deployment.

11. A group scientific visit on the state-of-the-art knowledge of advanced nuclear power reactor designs with educational tools supporting regional human capacity development was held at North Carolina State University, Raleigh, United States of America, in September 2019. The event provided to seven participants from six Member States a comprehensive overview of the physics and technology of water cooled reactors. A group scientific visit on the same topic was held at Agency Headquarters in Vienna in November 2019. The event provided a review of recent innovations in water cooled reactor designs and lectures on their physics and technology.

12. A Regional Training Course on Science and Technology of Water-Cooled Reactors and Supercritical Water-Cooled Reactor Concepts was held in Vienna, in November 2019, attended by ten participants from four Member States. The course provided wide-ranging training on the physics and technology of evolutionary and innovative water cooled reactor designs and focused on various designs of supercritical water cooled reactor. Furthermore, a Regional Training Workshop on Phenomenology, Application, and Assessment of Passive Systems in Advanced Water Cooled Reactors was held in September 2019 at Tsinghua University, Beijing attended by 11 participants from six Member States. Also, in June 2019, the Agency conducted in Trieste the 2nd Joint ICTP–IAEA Course on Scientific Novelties in Phenomenology of Severe Accidents in Water Cooled Reactors attended by 22 participants from 16 Member States.

13. In February 2020, the Agency published *Understanding and Prediction of Thermohydraulic Phenomena Relevant to Supercritical Water Cooled Reactors (SCWRs)* (IAEA-TECDOC-1900).

14. The Agency continued to explore innovative nuclear technologies, including fast neutron systems. In this regard, in October 2019, seven chief scientific investigators of the newly launched coordinated

research project (CRP) on fuel materials for fast reactors from six Member States and one international organization participated in the first Research Coordination Meeting in Vienna to provide overviews of their planned research programmes, and to discuss and agree on a coordinated approach of their efforts for the first step of the project. Also, in October 2019, the Agency conducted a Technical Meeting on Structural Materials for Heavy Liquid Metal Cooled Fast Reactors in Vienna, attended by 36 participants from 14 Member States. Furthermore, in October–November 2019, the Agency conducted in Beijing the 2nd Research Coordination Meeting of the CRP on neutronics benchmark of CEFR start-up tests attended by 32 participants from 17 Member States. In February 2020, the 4th Research Coordination Meeting of the CRP on Radioactive Release from the Prototype Fast Breeder Reactor under Severe Accident Conditions was held in Vienna and attended by eight participants from six Member States.

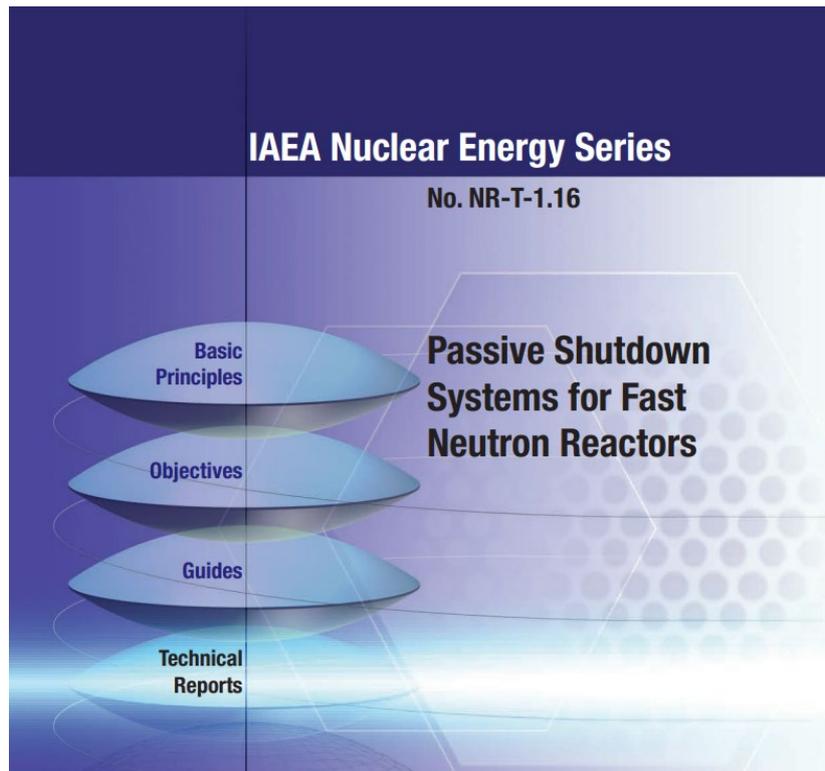


FIG. B.2 The Agency issued several publications in support of activities for the development of innovative nuclear power technology

15. In August 2019, the Agency updated the online Catalogue of Facilities in Support of Liquid Metal Cooled Fast Neutron Systems adding 38 new items and updating 41 existing ones. The catalogue now contains 190 experimental facilities. In March 2020, the Agency issued *Passive Shutdown Systems for Fast Neutron Reactors* (IAEA Nuclear Energy Series No. NR-T-1.16).

16. In June 2020, an international advisory committee shaped the structure and formulated the programme of the International Conference on Fast Reactors and Related Fuel Cycles (FR21) which will take place in Beijing in May 2021.

<p>A Technical Meeting on the Status of the IAEA Nuclear Graphite Knowledge Base was held in November 2019 in Vienna, with ten participants from nine Member States. The records of the 20th International Nuclear Graphite Specialist Meeting held in Bruges, Belgium, in September 2019 in cooperation with the Agency, was loaded into the IAEA Nuclear Graphite Knowledge Base.</p>

17. The Agency held a meeting of the Technical Working Group on Gas Cooled Reactors in November 2019 in Vienna attended by 14 participants from 14 Member States. The TWG acknowledged the increased synergies of gas cooled reactors with SMRs compared to the fast reactors and took note of the good progress made to preserve the complete High Temperature Reactor (HTR) knowledge and codes from the Research Centre Jülich and the implementation of a HTR basic training simulator (being prepared together with INET, China).

18. Under the Waste from Innovative Types of Reactors and Fuel Cycles project, the Agency is working to publish the results from studies on how to handle waste arising from innovative reactors and fuel cycles and also all back-end fuel cycle activities of Generation IV reactors and fuel cycles.

19. In December 2019, to further strengthen its efforts on distance learning/training on development and evaluation of innovative nuclear technology for students and staff of universities and research centres, the Agency issued *Classification, Selection and Use of Nuclear Power Plant Simulators for Education and Training* (IAEA-TECDOC-1887). The objective of the publication is to provide guidance to education institutions, training centres and suppliers on classification of various types of nuclear power plant simulators for education and training, suitable selection of simulators according to assessment of education and training needs as well as technical characteristics of the simulators, and integration of simulators into educational and training programmes to enhance knowledge based skills. Furthermore, in May 2019, the Agency conducted a webinar on basic principle nuclear reactor simulators, which was attended by more than 600 participants from 63 countries.

20. In the area of nuclear fusion, the Agency issued in 2020 two publications resulting from CRPs, namely *Challenges for Coolants in Fast Neutron Spectrum Systems* (IAEA-TECDOC-1912) and *Pathways to Energy from Inertial Fusion: Structural Materials for Inertial Fusion Facilities* (IAEA-TECDOC-1911). Also, a new CRP has been launched entitled “Pathways to Energy from Inertial Fusion: Materials Research and Technology Development”.

21. The second meeting of the Nuclear Fusion Coordination Committee (NFCC), representing all Departments in the Secretariat, was held in December 2019 in Vienna, where management of radioactive waste from fusion facilities was discussed with contributions from two international experts. The third NFCC meeting took place in June 2020, where progress on implementation of the Agency’s activities on nuclear fusion research and technology was discussed, with emphasis on activities requiring cross-cutting coordination.

22. The IAEA Fusion Energy Conference, planned in October 2020 in Nice, France, has been postponed to May 2021 due to the COVID-19 outbreak.

Approaches to Supporting Nuclear Power Infrastructure Development

A. Background

1. In resolution GC(63)/RES/10.B.7, the General Conference encouraged the Nuclear Infrastructure Development Section to pursue its activities integrating the Agency's assistance provided to Member States embarking on or expanding nuclear power programmes, and encouraged Member States interested in or embarking on new or expanded nuclear power programmes to make use of Agency services related to nuclear infrastructure development.
2. The General Conference also requested the Secretariat to continue to incorporate lessons learned from INIR missions and to enhance the effectiveness of such INIR activities, urged Member States to develop and keep updated action plans to address the recommendations and suggestions provided by the INIR missions, and encouraged them to participate in the development of their Member State-specific Integrated Work Plans (IWPs).
3. The General Conference also encouraged the Secretariat to facilitate, where possible, international coordination to improve efficiency of multilateral and bilateral assistance to these Member States, and encouraged the strengthening of activities undertaken by Member States, both individually and collectively, to cooperate on a voluntary basis in nuclear infrastructure development.
4. The General Conference requested the Director General to report on progress made in the implementation of this resolution to the Board of Governors as appropriate and to the General Conference at its sixty-fourth (2020) regular session.

B. Progress Made Since the 63rd Regular Session of the General Conference

5. The Secretariat continued its efforts in providing integrated Agency assistance to Member States embarking on or expanding nuclear power programmes based on the Agency's Milestones approach (IAEA Nuclear Energy Series No. NG-G-3.1 (Rev. 1)) through the inter-Departmental Nuclear Power Support Group, the Infrastructure Coordination Group, as well as through the enhanced accountability of the Member State specific 'core teams'. Over the reporting period, the cross-Departmental core teams participated in six bilateral meetings with the respective Member States to develop or update their national IWPs and Country Nuclear Infrastructure Profiles to plan and tailor Agency assistance to the current needs of each Member State and to monitor the progress of national infrastructure development following an Integrated Nuclear Infrastructure Review (INIR) mission.



FIG. B.1 An IAEA team of experts concluded a mission to Belarus in March 2020 to review the status of nuclear infrastructure development (IAEA)

6. The Secretariat continued to learn lessons from the conduct of self-evaluation report support missions, as well as pre-INIR, INIR and INIR Follow-Up missions, which are taken into consideration during the conduct of further missions, as well as overall support to Member States to enhance its effectiveness. Additionally, a registry containing all recommendations and suggestions made during previous missions is maintained. The Agency finalized a Technical Document addressing ten years of INIR missions, covering lessons learned, challenges and solutions, which is expected to be issued by the end of 2020.

The Secretariat continued to perform INIR missions, where appropriate, in a mixture of English and one of the other United Nations official languages to facilitate the highest level of information exchange. The main INIR mission report is published in English. Additionally, to meet growing recognition and use of the Milestones approach, the Secretariat completed the translation of the publication into Arabic, French and Russian, and initiated the translation into Chinese and Spanish.
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7. The Secretariat undertakes regular systematic reviews of the Nuclear Infrastructure Bibliography to identify areas not covered by existing Agency publications as well as publications in need of revision. The regularly updated infrastructure bibliography is published on the Agency website. The revision of *Initiating Nuclear Power Programmes: Responsibilities and Capabilities of Owners and Operators* (IAEA Nuclear Energy Series No. NG-T-3.1 (Rev. 1)) was published in January 2020.

8. The Agency reviewed and confirmed the applicability of the Milestones approach and of the conditions listed in *Evaluation of the Status of National Nuclear Infrastructure Development* (IAEA Nuclear Energy Series No. NG-T-3.2 (Rev. 1)) for the development of infrastructure in the light of the deployment of small and medium sized or modular reactor (SMR) technology. Most recently the issue was discussed during the meeting of the Technical Working Group on Nuclear Power Infrastructure in November 2019 in Vienna, attended by 19 members, with the conclusion that the Milestones approach is applicable to any nuclear installation including SMRs and is intended to create an enabling environment for nuclear power deployment. Moreover, the INIR evaluation methodology is applicable for SMR deployment with specific considerations. Once guidance materials are developed by the SMR

Regulators' Forum, they will be reflected in the SMR graded approach application of the Milestones approach and INIR methodology.



FIG. B.2 William Owuraku Aidoo, Deputy Minister of Energy (middle) and Benjamin J. B. Nyarko, Director General, GAEC (second from right) with members of the INIR follow-up mission team and officials from Ghana in Accra, in October 2019 (GNPPO)

9. Within the framework of the relevant Peaceful Uses Initiative projects, the Agency continued to assist Member States embarking on new or expanding existing nuclear power programmes in the development of management systems, enhancing understanding and execution of leadership and responsibility for management systems to ensure safety, security, effectiveness and sustainability, and in establishing an adequate organizational culture in key organizations through the organization of capacity building workshops for senior management. Four expert missions and workshops to Turkey (December 2019), Saudi Arabia (December 2019), Ghana (January 2020) and Poland (February 2020) were conducted for senior managers of owners/operators and regulatory bodies in embarking countries. A virtual debrief was conducted with Egypt in June 2020 and one is planned to be conducted with Ghana in August 2020, replacing face to face expert missions, to discuss the expert reviews of Member State documents.

10. In order to update the reactor technology assessment methodology to incorporate the lessons learned in five years of its application with embarking countries, and to expand the methodology to be relevant to advanced reactor technology, the Agency held the second consultancy meeting on refining and advancing data support for the Agency's reactor technology assessment methodology in June 2020 as a virtual meeting. The revision of IAEA Nuclear Energy Series No. NP-T-1.10 was completed, incorporating lessons learned in five years of its application with embarking countries, and expanding the methodology to be relevant to advanced reactor technology, including SMRs, non-electric applications and hybrid energy systems. The meeting was attended by nine experts from eight Member States.

11. The Secretariat continued its efforts to pursue a comprehensive capacity building approach for newcomer countries and to work with Member States that are providing financial support for training courses on nuclear infrastructure development. The Secretariat through its coordination activities continues to streamline and reduce overlap and duplication in the offer of training courses implemented within the framework of technical cooperation project INT2018 and its succeeding project INT2021, as well as to increasingly encourage technology neutral multi-donor courses.

12. An annual meeting with the participation of representatives from Member States providing financial support and expertise for training courses was organized for this purpose in Vienna during the 63rd regular session of the General Conference in September 2019, during which the calendar and scope of proposed training events on integrated nuclear infrastructure training (INIT) for the year 2021 was discussed. Additionally, the Secretariat published a brochure on INIT providing an overview and a report on the results of the INT2018 project.

Small and Medium Sized or Modular Reactors — Development and Deployment

A. Background

1. In resolution GC(63)/RES/10.B.8, the General Conference encouraged the Secretariat to continue consultations and interactions with interested Member States, the competent organizations of the United Nations system, financial institutions, regional development bodies, and other relevant organizations regarding advice on the development and deployment of SMRs. It also encouraged the Secretariat to continue working on defining indicators of safety performance, operability, maintainability, and constructability to assist countries in assessing advanced SMR technologies and developing guidance for SMR technology implementation.
2. The General Conference called upon the Secretariat to continue to promote effective international exchange of information on options as regards SMRs available internationally and invited the Secretariat and Member States that are in a position to offer SMRs to foster international cooperation in undertaking studies of the social and economic impacts of SMR deployment in developing countries, their potential integration with renewables, and their non-electric applications.
3. The General Conference requested the Director General to report on the implementation of this resolution to the Board of Governors as appropriate and to the General Conference at its sixty-fourth (2020) regular session.

B. Progress Made Since the 63rd Regular Session of the General Conference

4. The Agency continued to assist Member States in their efforts to deploy safe, secure and economically viable small and medium sized or modular reactors (SMRs) by conducting a Technical Meeting on the Design, Experimental Validation and Operation of Small and Medium Sized or Modular Reactors in Islamabad in November 2019 with 15 participants from six Member States. The Agency also conducted a Technical Meeting on the Competitiveness and Early Deployment of Small Modular Reactors and High Temperature Gas Cooled Reactors in November 2019 in Vienna with 32 participants from 15 Member States.
5. The Agency continued working on defining indicators of safety performance, operability, maintainability, and constructability so as to assist countries in assessing advanced SMR technologies and developing guidance for SMR technology implementation. In this regard, in September 2019, a Technical Meeting on the Benefits and Challenges of Fast Reactors of the SMR Type was conducted in Milan, Italy, attended by 40 participants from 15 Member States.

To continue providing guidance to Member States for safety, security, economics, licensing, and regulatory reviews of SMRs of various designs, the Agency hosted the Joint IAEA–GIF Technical Meeting on the Safety of High Temperature Gas Cooled Reactors in December 2019 in Vienna attended by 15 participants from 12 Member States and Generation IV International Forum (GIF) representatives.

6. The Agency participated in the Working Group on the Safety of Advanced Reactors of the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development in October 2019 in Paris, reporting on the status of ongoing IAEA activities related to SMRs.

7. In August–September 2019, in Daejeon, Republic of Korea, the Agency conducted the third Research Coordination Meeting (RCM) of the coordinated research project (CRP) on Design and Performance Assessment of Passive Engineered Safety Features in Advanced Small Modular Reactors. The RCM was attended by 14 CRP participants from nine Member States. The third RCM on Development of Approaches, Methodologies and Criteria for Determining the Technical Basis for Emergency Planning Zone for Small Modular Reactor Deployment is planned to be conducted in August 2020 in Vienna. The proposal for the CRP on Economic Appraisal of Small Modular Reactor (SMR) Projects: Methodologies and Applications was approved in December 2019, and 73 proposals from 33 Member States have been received.

8. A consultancy meeting to address the development of generic user requirements and criteria for SMR technology was postponed later in 2020. Efforts to secure funds from extrabudgetary sources to support this activity led to the development of a Peaceful Uses Initiative proposal on the same topic, currently under consideration by potential donors.

9. A regional workshop on technology assessment of SMRs was held in June 2019 in Vienna to enable participants to exchange information on Member States' approaches to reactor technology assessment, provide training in the use of the Agency's reactor technology assessment (RTA) methodology, and to perform group exercises to apply the methodology to SMRs using the RTA IT toolkit. Eighteen participants from 10 Member States attended the workshop.

10. Over the reporting period, the Agency facilitated discussion among developers of advanced reactors on the challenges and technologies related to decommissioning by organizing a meeting on SMR design for decommissioning in December 2019, attended by five experts from three Member States.

11. In August 2019, the Agency conducted, at its Headquarters, an informal technical briefing to summarize the work on transportable nuclear power plants (TNPPs) as well as the outcomes of a meeting held in Vienna in July 2019 with developers of TNPPs from China, the Russian Federation and the United States of America. The Agency is also implementing a collaborative project on floating nuclear power plants incorporating the lessons learned from the deployment of the Akademik Lomonosov floating nuclear power plant. The overall objective of this activity is to examine in detail legal and institutional issues for export deployment of a TNPP with a factory fuelled and tested reactor and to investigate other aspects of transportable and modular reactor facilities. To achieve this objective, the activity is expected to provide insights that could be used to: fill the gaps identified in international nuclear law to cover the operational cycle of factory fuelled SMRs and its entire life cycle; fill the gaps identified regarding fuel-loaded NPP relocation and international law, including cases of fuel-loaded SMR transport through the territorial waters and territories of a third country; make recommendations with respect to control and supervision over the whole life cycle, both in relation to utilities and authorities; identify possible allocation of responsibilities, including sharing between the authorities and any stakeholders, including those in an emergency and related to civil liability; and identify possible adaptations of the licensing process.



FIG. B.1 The Agency is implementing a collaborative project on floating nuclear power plants incorporating the lessons learned from the deployment of the Akademik Lomonosov floating nuclear power plant (Photo: Rosatom)

12. The Agency presented two papers at the American Nuclear Society's annual meeting in June 2020 related to SMRs entitled *IAEA activities to facilitate near term deployment of SMRs* and *Considerations for Environmental Impact Assessment for Small Modular Reactors*, the latter being a summary of IAEA-TECDOC-1915, published in 2020. Another paper entitled *Considerations in radioactive waste management for SMRs — the role of the IAEA* was published in the proceedings of the International Nuclear Fuel Cycle Conference. In addition, a paper entitled *Potential of Hybrid Energy Systems based on SMRs and Renewables for Energy Supply and Security* was presented at the International Conference on Climate Change and the Role of Nuclear Power, in October 2019 in Vienna.

13. In June 2020, the Agency issued *Considerations for Environmental Impact Assessment for Small Modular Reactors* (IAEA-TECDOC-1915). A Technical Document addressing options to enhance energy supply security using hybrid energy systems based on small modular reactors, synergizing nuclear and renewable energies, is planned to be published by end of 2020.

14. The new edition of the booklet *Advances in Small Modular Reactor Technology Developments* is planned to be issued in August 2020.

Nuclear Knowledge Management

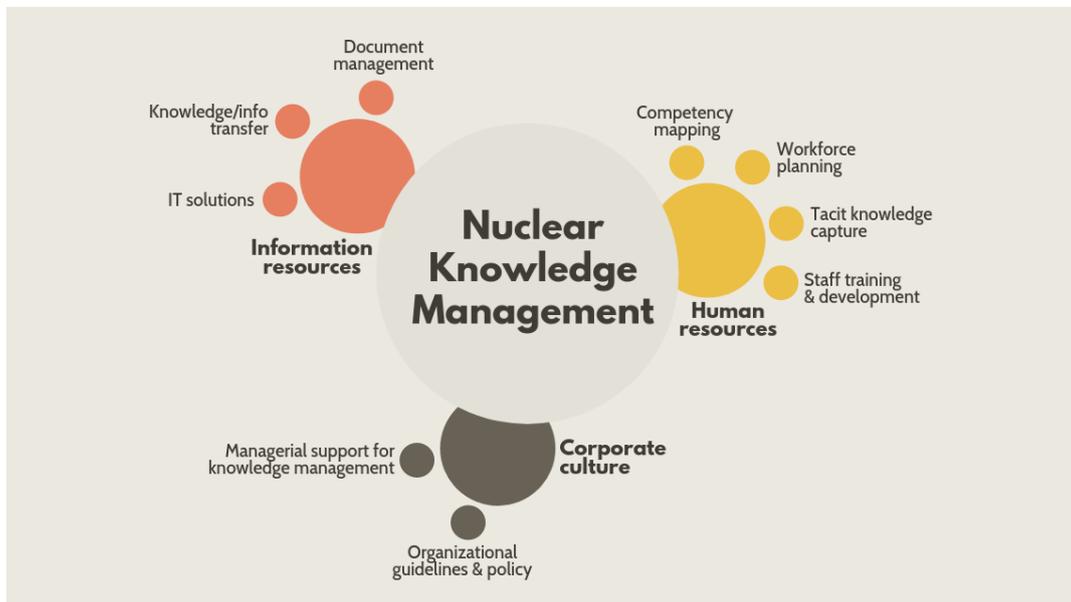


FIG. A.1 NKM Schools have trained more than 700 professionals from over 80 countries on the development and implementation of nuclear knowledge management programmes in various nuclear science organizations.

A. Background

1. In resolution GC(62)/RES/9.C, the General Conference commended the Director General and the Secretariat for their significant, interdepartmental efforts in addressing issues of preservation and enhancement of nuclear knowledge, and encouraged the Director General and the Secretariat to continue to strengthen their current and planned efforts in this area, in a holistic, interdepartmental manner, while consulting and engaging Member States and other relevant international organizations, and to further increase the level of awareness of efforts in managing nuclear knowledge.

2. The General Conference requested the Secretariat to continue to gather, and make available to Member States, nuclear data, information and knowledge resources on the peaceful use of nuclear energy, including the International Nuclear Information System (INIS) and other valuable databases as well as the IAEA Library and the International Nuclear Library Network. The General Conference also called on the Secretariat to continue to focus, in particular, on activities aimed at helping interested Member States assess their human resource needs and to identify ways to address those needs, inter alia by encouraging the development of new tools and opportunities to gain practical experience through fellowships.

3. The General Conference also invited the Secretariat, in consultation with Member States, to further develop and disseminate guidance and methodologies for planning, designing, implementing, and evaluating nuclear knowledge management programmes and practices. It also encouraged the

Secretariat to continue to facilitate the establishment of effective human resource and knowledge management networks in developing countries, and where appropriate in collaboration with other United Nations organizations and with the support of existing such networks in developed countries.

4. The General Conference requested the Director General to take into account the continuing high level of interest of Member States in the range of issues associated with nuclear knowledge management when preparing and carrying out the Agency's programme, and to report on progress made to the Board of Governors and to the General Conference at its 64th regular session. This Annex has been prepared in response to that request.

B. Strengthening Nuclear Knowledge Management

To promote gender equality and diversity in the context of nuclear knowledge management activities and to encourage Member States to establish an inclusive workforce within their nuclear industry, the IAEA Director General launched, in March 2020, the Marie Skłodowska-Curie Fellowship Programme (MSCFP) for up to 100 female graduate students per year to help close a persistent gender gap in the nuclear field. The Agency will provide scholarships for up to 2 years for women pursuing a graduate degree in nuclear science and technology or non-proliferation studies. Fellows will also be offered internships at the IAEA.



FIG. B.1 The Marie Skłodowska-Curie Fellowship Programme seeks to enable more women from around the world to pursue a STEM career, with a focus on nuclear science, technology and non-proliferation studies

5. The membership of the Technical Working Group on Nuclear Knowledge Management (TWG-NKM) was reviewed in 2018 and expanded to include a broader number of Member State participants and organizations that have an interest in nuclear knowledge management activities. The fourth meeting of the TWG-NKM took place in May 2019. TWG-NKM members reiterated that nuclear knowledge management (NKM) is an increasing priority and needs to reflect the integrated approach to NKM and human resource development (HRD) now in place across nuclear operating organizations. TWG-NKM members welcomed the cross-cutting, interdepartmental contribution to the implementation of the Agency's activities on NKM, for example as part of Safety Aspects of Long Term Operation (SALTO) peer review missions.

6. The International Conference on Nuclear Knowledge Management and Human Resources Development: Challenges and Opportunities, planned to be held in the Russian Federation in June 2020, had to be postponed owing to the COVID-19 outbreak and is now proposed to be held in 2022. The conference, which is the fourth in its series, is expected to further strengthen the concept of an integrated approach to NKM and HRD and support the development of additional tools and services to support capacity building.

7. The Knowledge Management Assist Visit (KMAV) programme improvement plan was completed. The plan provides for the revision of the Agency's knowledge management maturity self-assessment questionnaire, the training of experts for conducting KMAV missions and the preparation of new guidance documents to ensure the efficient conduct of KMAV missions. The guidance document for developing and implementing KMAVs to universities has been developed as part of KMAV support/review missions. Pilot University Assist Visits and Peer Review Assessments are being organized with potential hosts in Belarus and Bulgaria.

C. Implementing Nuclear Knowledge Management and Building Capacity



FIG. C.1 NKM Schools have trained more than 700 professionals from over 80 countries on the development and implementation of nuclear knowledge management programmes in various nuclear science organizations (IAEA)

8. By the end of 2019, approximately 1800 participants from 85 Member States had attended the Agency's Nuclear Energy Management (NEM) and NKM Schools. Gender balance continues to be a key deliverable in the School programmes and the number of women participants continues to increase, with an average of 45% in the 2019 programmes. During the reporting period, nine NEM Schools and five NKM Schools were conducted.

- In September 2018, the Agency organized the third regional NEM School in Saint Petersburg, Russian Federation, in cooperation with the State Atomic Energy Corporation "Rosatom" through the Rosatom Technical Academy. A total of 23 participants from 15 Member States, from various nuclear operating, regulatory and state atomic energy organizations as well as academia, attended the School. The fourth Russian Federation-IAEA NEM School was organized in August 2019, also in Saint Petersburg, Russian Federation. The school brought together 21 professionals from 16 Member States.

- In October 2018, the ninth Abdus Salam International Centre for Theoretical Physics (ICTP)–IAEA NEM School took place in Trieste, Italy. This international NEM School has been organized yearly by the Agency in cooperation with the ICTP since 2010. The School was attended by 33 participants from 27 Member States. In October 2019, the tenth international ICTP–IAEA NEM School took place in Trieste, Italy and was attended by 30 from 19 Member States.
- The second South Africa–IAEA NEM School took place in Johannesburg, South Africa, in November 2018, in cooperation with the University of the Witwatersrand and in association with the Department of Energy of South Africa, the National Nuclear Regulator, the South African Nuclear Energy Corporation, Eskom, the South African Network for Nuclear Education, Science and Technology and the AFRA Network for Education in Nuclear Science and Technology (AFRA-NEST). The School was attended by 23 participants from 13 Member States.
- The second Advanced Russian Federation–IAEA NEM School was held in April 2019 in Sochi, Russian Federation, during the 2019 International Forum “ATOMEXPO”. The event was organized in cooperation with the State Atomic Energy Corporation “Rosatom” through the Rosatom Technical Academy. and attended by 39 managers and leaders from 16 Member States.
- In October 2019, the Agency organized the first Egypt–IAEA NEM School. The curriculum and content of the School was adapted to the needs of national participants and the host organization. The School took place in Cairo and was organized by the Egyptian Nuclear Power Plants Authority (NPPA) in cooperation with the Agency. The School was attended by 32 professionals from various institutions in the Egyptian nuclear sector, including the NPPA, relevant ministries, academia, the national regulatory body and the nuclear energy industry.
- The eighth Japan–IAEA NEM School took place in July 2019 in Tokyo, Fukushima, Fukui and Hyogo, Japan. In cooperation with the Agency, it was organized by the JAIF International Cooperation Center; the Japan Atomic Energy Agency; the Japan Atomic Industrial Forum (JAIF); the Japan Nuclear Human Resource Development Network (JN-HRD NET); the National Institute of Technology; the National Institute of Technology, Fukushima College; and the University of Tokyo. The School brought together 34 participants from 18 Member States.
- The USA–IAEA NEM School was organized by the Agency in Oak Ridge, United States of America in November 2019 in cooperation with the US Department of Energy through the Oak Ridge National Laboratory. A total of 21 professionals from 4 Member States, from

nuclear operating and regulatory organizations, the nuclear energy industry, academia and nuclear research organizations, participated in the School.



FIG. C.2 The IAEA's pioneering School of Nuclear Knowledge Management for the Central American and Caribbean region was held in December 2018 in Costa Rica (National University of Costa Rica)

- In December 2018, the Agency organized the first regional NKM School for the Latin America and the Caribbean region. The School took place in San José and was organized through the Agency's technical cooperation (TC) programme in cooperation with the National University of Costa Rica, Costa Rica's Atomic Energy Commission and the Latin American Network for Education in Nuclear Technology (LANENT). The School brought together 22 professionals from various nuclear and governmental organizations, as well as academia, from 8 Member States in the region. Half the participants and over 60% of the experts were women, reflecting a drive towards addressing gender balance in the region's nuclear sector
- The second Republic of Korea–IAEA NKM School took place in Daejeon, Republic of Korea, in June 2019. The School was organized in cooperation with the Korea Atomic Energy Research Institute. The School brought together 22 professionals from 13 Member States, from various nuclear and governmental organizations and academia.
- In August 2019, the 15th Joint ICTP–IAEA NKM School took place in Trieste, Italy. Such NKM Schools have been organized yearly by the Agency and the ICTP since 2004. The School was attended by 45 participants from 21 Member States. Notable in this year's School was the greater participation of professionals from nuclear power plant (NPP)-related organizations.
- In October 2019, the Agency organized the first Russian Federation–NKM School. This regional School took place in Saint Petersburg, Russian Federation and was organized by the Agency in cooperation with the State Atomic Energy Corporation "Rosatom" through the Rosatom Technical Academy. The School was attended by 24 professionals from various nuclear and governmental organizations in 11 Member States.
- In November 2019, the Agency organized a regional NKM School for the Latin America and the Caribbean region. The School took place in Asunción and was organized through the Agency's TC programme in cooperation with Paraguay's National Atomic Energy Commission and LANENT. The School brought together 15 professionals from Argentina, Brazil, Chile, Paraguay, Peru and Uruguay.

Through the Sandwich Training Educational Programme (STEP), conducted in cooperation with ICTP, the Agency supported three fellowships for PhD students from developing countries in the fields of physics and mathematics. The goal of STEP is to strengthen the scientific capabilities of young scientists and researchers from developing countries so that they can better contribute to the scientific, technical and economic development of their home countries. With a STEP fellowship, PhD students study at their home universities but receive financial support to spend three to six months at ICTP or a collaborating institute each year for up to three successive years. Under the fellowships, PhDs are awarded by fellows' home institutes. STEP fellowships are awarded on the basis of a thesis project proposed by students and their home-institute advisors.

9. During the reporting period, the following Knowledge Management Assist Visits (KMAV) missions were conducted: December 2018, Ulaanbaatar, Mongolia, to address national level NKM issues; April 2019, Electronuclear, Angra NPP, Brazil, to help develop a strategic knowledge management programme; April 2019, Pakistan Atomic Energy Commission, Islamabad, Pakistan, to help develop a strategic knowledge management programme; August 2019, Korea Hydro Nuclear Power (KHNP), Ulsan, Republic of Korea, a workshop to share successful approaches and practices in knowledge management; November 2019, Armenian NPP, Yerevan, Armenia, KMAV to help address the knowledge management issues related to long term operation.

10. During the reporting period, the Agency conducted four International Nuclear Management Academy (INMA) missions, an INMA Initial Assist mission to the Budapest University of Technology and Economics, Hungary, and INMA Final Assessment missions to the National Polytechnic University of Armenia (NPUA) and, in South Africa, North-West University and the University of the Witwatersrand. The nuclear technology management (NTM) programme at the Budapest University of Technology and Economics will be assessed in a virtual final assessment mission in July 2020. Based on the positive assessment, the North-West University and the University of the Witwatersrand were awarded the INMA membership as of May 2020.

D. Applying Nuclear Knowledge Management to Development

11. Several NKM activities were included in national, regional and interregional technical cooperation projects. Some examples from regional technical cooperation projects are presented in the following paragraphs.

12. HRD is a priority in the African region. The successful implementation of nuclear technology-related programmes requires the training of skilled mid-level personnel such as engineers and technicians through on-the-job and academic programmes. This will contribute to the effective operation and utilization of available and future facilities in Africa and help Member States to maximize the peaceful use of nuclear science and technology for their socio-economic development. Several initiatives focused on postgraduate training for enhancing human resources capacity building and nuclear knowledge management are being undertaken in Africa under the regional TC programme. These initiatives include a two-year master's degree programme in nuclear science and technology, a postgraduate educational course on radiation, transport and waste safety, and a PhD sandwich fellowship programme. In addition, the Regional Meeting of Vice Chancellors and Representatives of Regional Bodies and Networks Involved in Education and Training to Address Human Resource Development Needs in Africa was held in Marrakesh, Morocco, in June 2019, supported by project RAF0052, 'Supporting Human Resource Development in Nuclear Science and Technology (AFRA)'. During the meeting, hosted in collaboration with the Moroccan National Centre for Nuclear Energy, Sciences and

Technology, representatives of the World Bank, the United Nations Educational, Scientific and Cultural Organization, the World Academy of Sciences, the Association of African Universities, and a number of Vice-Chancellors of African universities discussed strategic partnerships for the effective and successful implementation of graduate and postgraduate academic programmes in Africa. The participants also agreed on actions to collaborate with the Agency in order to work towards training a critical mass of next-generation African leaders in nuclear science and technology through a PhD sandwich fellowship programme and other programmes. Under regional project RAF0052, 13 candidates (9 of whom were from least developed countries and 5 of whom were female) were supported through a PhD sandwich fellowship programme so that they could carry out their PhD research work at a foreign university.

13. Building, collecting, maintaining, sharing, preserving and utilizing knowledge is important for Member States in the Asia and the Pacific region, particularly with regard to gaining the necessary technical expertise and competencies required for nuclear power programmes and the application of other nuclear technologies. In the Asia and the Pacific region, the TC programme collaborates with Member States to maintain and preserve nuclear knowledge and institutional memory by establishing platforms for Member States to exchange knowledge, by promoting nuclear science and by fostering interest in nuclear science and technology, including among secondary school pupils. An example is the regional project RAS0080, 'Promoting Self-Reliance and Sustainability of National Nuclear Institutions', where the participating Member States, using toolsets developed under the project, reviewed and updated their relevant activities, including strategic planning, feasibility studies and economic analyses of research and development products and services, and human resource development and management.

14. In the Latin America and the Caribbean region, efforts are continuing to promote the education and training of young professionals in the field of nuclear science and technology. Innovative tools developed by countries participating in projects and disseminated within the framework of LANENT are vital in attracting and training the new generation of nuclear scientists. The Agency also continues to strengthen strategic management and sustainability in national nuclear institutions. In addition, the regional TC programme emphasizes gender equality in all activities and offers development opportunities for young women in the nuclear sector. For example, several activities were conducted to build capabilities and foster growth under TC project RLA0057 'Enhancing Nuclear Education, Training, Outreach and Knowledge Management'. Over the years, specialized education and training on the development and implementation of knowledge management programmes in nuclear science and technology organizations has been imparted through regional NKM Schools. This TC project also supported the attendance of seven participants from the region (Argentina, Bolivia, Brazil, Costa Rica and Cuba) at the Joint ICTP-IAEA NKM School held in Trieste, Italy, in August 2019.

15. In Europe and Central Asia, the TC programme supports the development, maintenance and exchange of knowledge and technical expertise in four thematic areas: nuclear and radiation safety, nuclear energy, human health and isotope and radiation technology applications. Within the framework of TC project RER9144, 'Building Capacity for Infrastructure Development and Safety Assessment of Water Cooled Water Moderated Power Reactor Technology with Advanced Safety Features: the Case of WWER/PWR', in 2018, the Agency trained over 50 officials from Armenia, Belarus, Bulgaria, Croatia, the Czech Republic, Hungary, Kazakhstan, Lithuania, Poland, Slovakia, Slovenia, the Russian Federation and Turkey. The Russian Federation provided in-kind support, hosting three regional training courses at the premises of the Rosatom Technical Academy in Obninsk and Sosnovy Bor, Russian Federation. Also, within the framework of regional TC project RER0043, 'Enhancing Capacity Building Activities in the European Nuclear and Radiation Safety Organizations for the Safe Operation of Facilities', capacity building activities to ensure the safe operation of nuclear and radiation facilities were implemented in 2019. The Regional School of Nuclear and Radiological Leadership for Safety,

held in April-May 2019 in Ankara, aimed at enabling junior and middle management professionals to learn about and apply leadership concepts for safety in their respective organizations. The participants enhanced their ability to lead in nuclear and radiological working environments, which feature inherent complexities and often competing considerations. One of the major outcomes of the School was the participants' increased ability to effectively engage and constructively influence others on safety matters, in both routine and emergency situations.

E. Applying Nuclear Knowledge Management to Nuclear Safety, Security and Safeguards

16. The Agency held a Regional Workshop on the Development of Nuclear Safety Knowledge Management Programmes for the Regulatory Body in Vienna in November 2019. The Agency also held four national and regional workshops to transfer knowledge on HRD planning in nuclear security between August 2018 and July 2020 (in Chile, Nigeria, the Russian Federation and Senegal).

17. The Steering Committee on Regulatory Capacity Building and Knowledge Management held its annual meetings in Vienna in December 2018 and December 2019. The Committee discussed the implementation of the Strategic Approach to Education and Training in Nuclear Safety 2013–2020. It also addressed other matters relevant to education and training, such as knowledge management, the methodology for Systematic Assessment of Regulatory Competence Needs and the possible set of indicators for the implementation of the Strategic Approach 2013–2020.

<p>The Nuclear Safety and Security Online User Interface provides users with easy access to the content of publications in the Safety Standards Series and the Nuclear Security Series. It facilitates direct access to the content of the publications as well as navigation within them. An interactive user interface has also been introduced, in addition to the official communication channels, so that authorized users can provide feedback on relevant publications at any time.</p>
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18. To assist Member States in developing a national-level strategy or a coordination mechanism for nuclear safety knowledge management, the Agency held a workshop in Berlin in December 2018, based on a draft Safety Report entitled *Managing Nuclear Safety Knowledge: National Approaches and Experience*. Furthermore, the Agency held a Regional Workshop on National Policy and Strategy for Safety, Including Knowledge Transfer for Safety in Bangkok in November 2018 for Asian Nuclear Safety Network (ANSN) member countries.

19. The Agency held a Regional Workshop on Nuclear Safety and Security Education for European Member States in Athens in October 2019 to share reports from Member States on their education and training programs; to discuss the possibilities for regional implementation of the proposed master's degree programme in nuclear safety and security; to consider the establishment of a regional education network; and to brief the participants on the development of a methodology for the self-assessment of their national capacity building in nuclear, radiation and transport safety as well as emergency preparedness and response.

20. The Agency held a Regional Meeting on the Management of Training Systems for Nuclear and Radiological Safety for ANSN member countries in Jakarta in November 2019 to present the latest developments and share experiences in managing training systems in nuclear and radiation safety, in particular with regard to the development and updating of training programmes, identification and certification of trainees, and evaluation of training effectiveness.

21. The Agency evaluated the Pilot International School of Nuclear and Radiological Leadership for Safety and, as a result, enhanced role-playing exercises and expanded the training materials with a view to extending the programme for the School from one week to two. The Agency held a one-week regional School on this topic for the Asia and the Pacific region in New Delhi in November 2018 and a one-week national School in Rio de Janeiro, Brazil, in June 2019. The Agency also held two two-week Schools on this subject: one for the Latin America and the Caribbean region in Mexico City in November 2018 and another for the Europe region in Ankara in April–May 2019. The Agency held a consultancy meeting in Vienna in April 2019 to develop a train-the-trainers package for the School. The Agency held three International Schools of Nuclear and Radiological Leadership for Safety: in Pakistan in July 2019, in Morocco in November 2019 and in Japan in February 2020.

The Agency continued to assist Member States in building capacity in nuclear security, including by developing educational and training programmes. This included e-learning modules, where nuclear security e-learning modules accounted for more than 70 per cent of the total learning time on the Agency's learning management system.
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22. During the reporting period, two new modules entitled 'Transport Security' and 'Nuclear Material Accounting and Control (NMAC) for Nuclear Security' were developed, and five e-learning modules were translated and made available in Arabic, Chinese, English, French, Russian and Spanish on the Agency's open e-learning platform. To extend its range of training options, the Agency, working in collaboration with Member States, used information from Integrated Nuclear Security Support Plans and the Nuclear Security Information Management System to identify areas where new and updated training courses are needed. During the reporting period, more than 80 items in the Nuclear Security Training Catalogue were reviewed, training materials for 47 courses and workshops were updated and revised, and training materials for 19 new courses or workshops were developed. In addition, materials for four training courses were translated into French, Russian and Spanish.

23. To assist Member States in better identifying their HRD needs, to establish HRD plans for nuclear security, and to promote a systematic approach to training (SAT), the Agency conducted two Technical Meetings in support of HRD in nuclear security, as well as four national and regional workshops to transfer knowledge on HRD planning in nuclear security. The Technical Meetings were conducted in Vienna during October 2019 and focused on management of training in nuclear security by training organizations and on HRD in nuclear security. A national workshop on this topic was conducted in Abuja in August 2019. The national and regional workshops were conducted between August 2018 and July 2020 in Chile, Nigeria, the Russian Federation and Senegal. More broadly, the SAT methodology continued to be further implemented in developing, revising, evaluating and improving Agency training courses and in the development of instructor training courses, including on nuclear security detection for front line officers, on physical protection of nuclear material and nuclear facilities and on regulatory inspections for nuclear security at nuclear facilities.

24. The Agency, jointly with senior international experts, also held a Technical Meeting on Leadership Development for Nuclear Security, and developed training materials, case studies and exercises for the first session to be held in 2021. The International and Regional Schools on Nuclear Security continued to attract considerable interest from States and relevant authorities. Two Schools were held in 2018 and 2019 in Trieste, Italy, jointly with the ICTP, while regional Schools were held in Indonesia (for the Asia-Pacific region) and Spain (for Spanish-speaking countries) as well as in Morocco and South Africa (for French- and English-speaking countries in Africa, respectively), attracting over 180 participants from more than 100 countries in total.

The Symposium on International Safeguards: Building Future Safeguards Capabilities was held at the Agency Headquarters in November 2018. The Symposium, which was the 13th in its series, focused on identifying innovative technologies that could be used for safeguards; on strengthening existing partnerships and creating new ones; and on improving the day-to-day work of safeguards implementation.

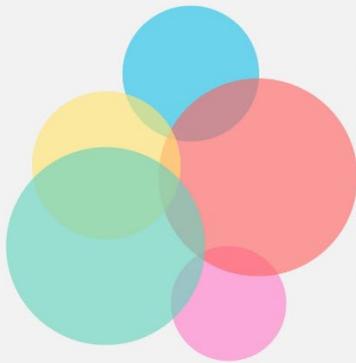


FIG. E.1 The Agency's 13th Symposium on International Safeguards focused on innovative technologies and partnerships

25. More than 800 participants from 90 States attended the Symposium on International Safeguards: Building Future Safeguards Capabilities, resulting in greater geographic diversity in comparison to previous editions. During the Symposium, the Secretariat and other participants presented nearly 400 papers and posters in a range of interactive sessions designed to encourage information exchange, experience sharing and networking. The new ideas and practical proposals generated during the Symposium were summarized in a report issued in July 2019 (document STR-392), which is being used as guidance for further actions on innovation, as well as partnering and improving communication and collaboration among States, industry, academia, non-governmental organizations and the Agency. The Agency, together with external partners, is following up on a number of ideas resulting from the 2018 Symposium.

F. Strengthening Networks related to Nuclear Education and Training and Nuclear Information

Nuclear Information & Nuclear Education and Training Networks



Asian Network for Education in Nuclear Technology (ANENT)
 Cyber Learning Platform for Network Education and Training (CLP4NET)
 Global Nuclear Safety and Security Network (GNSSN)
 Human Resource Knowledge Development Network (HRKD)
 IAEA CONNECT platform
 International Nuclear Information System (INIS)
 Internet Research Reactor Laboratory (IRL)
 International Network for Nuclear Security Training and Support Centres (NSSC)
 Latin American Network for Education in Nuclear Technology (LANENT)
 OECD/NEA Data Bank

FIG. F.1 The Agency maintains a number of international networks and data bases in support of nuclear education and information sharing

In order to ensure the wide dissemination of nuclear safety knowledge, the Secretariat developed a nuclear safety knowledge base under the Global Nuclear Safety and Security Network (GNSSN). It provides Member States with access to good practices, presentations and reports in relation to nuclear safety and security. In addition, to enhance outreach and promotion of the Agency's safety standards, over 20 e-learning modules are accessible through this network. The e-learning modules cover topics such as research reactor safety, safety assessment, licensing and safety of small modular reactors, and nuclear safety knowledge management. The GNSSN Steering Committee met in Vienna in November 2018 and in May 2019 to advise the Agency, inter alia, on capacity building methodologies and nuclear safety knowledge management to sustain national safety programmes.

26. In response to State requests for assistance to strengthen the sustainability of nuclear security through HRD programmes and through technical and scientific support for the prevention and detection of and the response to nuclear security events, the Agency launched the development of the International Network for Nuclear Security Training and Support Centres (NSSC Network) in 2012. The NSSC Network, with representatives from 64 Member States, facilitates the sharing of information and resources to promote coordination and collaboration among States with a Nuclear Security Support Centre (NSSC) or those having an interest in developing such a centre. During the reporting period, NSSC Network members held 478 training courses, workshops and other events to build capacity in nuclear security. Of these, 70 were implemented by, or in cooperation with, the Agency. To facilitate information sharing among NSSCs, the Agency organized an International Workshop on Nuclear Security Support Centre Programmes on the Security of Radioactive Material and Associated Facilities in Vienna in July 2019.

27. The Agency provides support to LANENT through project RLA0057, 'Enhancing Nuclear Education, Training, Outreach and Knowledge Management'. The project has made an essential contribution to preserving, promoting and sharing nuclear knowledge, as well as fostering nuclear knowledge transfer in the Latin America region in areas such as education, health, industry, agriculture, government, the environment and mining. LANENT also seeks to communicate the benefits of nuclear technology to the public, with the aim of stimulating interest in nuclear technology in younger generations. In July 2019, representatives from LANENT joined representatives from other regional educational networks in Vienna in order to share best practices and enhance interregional cooperation.

LANENT has developed a multimedia educational programme, entitled ‘NUCLEANDO’, that equips both primary and secondary school teachers with tools and resources, allowing them to introduce nuclear and isotopic sciences into their curricula in an engaging and innovative manner, and to clearly demonstrate the benefits of peaceful applications of nuclear technologies to younger generations. The NUCLEANDO programme was first introduced as a pilot course in July 2019 in San José to demonstrate the applicability of the programme to Costa Rican educators. Further courses have been scheduled for early 2020 in Chile and Uruguay, with the aim of encouraging the engagement of 250 000 young students in nuclear science and technology by 2021.

28. Under TC project RAS0075, ‘Networking for Nuclear Education, Training, and Outreach Programmes in Nuclear Science and Technology in the Framework of ANENT (Asian Network for Education in Nuclear Technology)’, a web portal has been developed consisting of a learning management system (LMS) and a learning object repository (LOR); this platform also grants provision of access to the Agency’s Internet Research Reactor Laboratory project. The portal’s resources help in capacity building and HRD in the Asia-Pacific region, particularly for developing countries and countries with limited access to high-quality educational resources in nuclear science and technology. A total of 26 fellows from 11 Member States have been provided with one-month fellowship training to learn the skills of creating high-quality interactive e-learning courses. This support helps in creating high-quality interactive e-learning courses at national level. One expert mission and two consultancy meetings were conducted to improve the ANENT web portal, and its LMS and LOR, to improve its structure, layout and governance. The final coordination meeting of ANENT was conducted with the participation of national coordinators, with a view to identifying outputs, outcomes and achievements, and to develop a future strategic path for the Network.

29. The third AFRA-NEST General Assembly was held in April 2018 in Sharm el-Sheikh, Egypt. During the Assembly, attended by 35 participants from 27 Member States, the processes and potential application of the Education Capability Assessment and Planning methodology were discussed to address strategic national plans for nuclear HRD and the promotion of national networks for education in nuclear science and technology in Member States.

30. In February–March 2019, an expert mission on strengthening stakeholder networking for human resource knowledge development (HRKD) took place in Japan, with the participation of experts from Indonesia, Japan, Malaysia, Poland, South Africa and Turkey. The purpose of the mission was to update the status of existing national HRKD networks; to share experiences and lessons learned through the activities of JN-HRD NET, which was established in 2010; and to provide Indonesia and Poland, both of which have expressed an interest in establishing national HRKD networks, with appropriate guidance and recommendations. A document containing case studies of HRKD networks in Japan, Malaysia and Turkey was developed as a part of the mission. The need for processes and methods for establishing a national HRKD network was also recognized, and the experts conducting the mission agreed to initiate the drafting of guidance to be included in the case-studies document.

31. The INIS continues to be maintained and expanded as one of the world’s leading trusted repositories of information on the peaceful uses of nuclear energy. In cooperation with Member States, around 100 000 high-quality metadata records have been acquired per year — reaching over 4.3 million by the end of 2019. The information is indexed and made freely available to Member States and global users through the INIS repository, which registered 3.6 million page views, 1.4 million unique visitors, and 2 million searches in 2019. The use of open-access resources has been established, in support of open science. Major improvements have been introduced to the INIS repository search feature regarding its functionality, user interface and technical infrastructure. The INIS Multilingual Thesaurus, a knowledge organization system containing over 31 000 descriptors, is continuously being enriched with

new relevant terms, taking into account input from Member States and the INIS Thesaurus Advisory Group. Thesaurus management software is currently being implemented to provide for semantic searches using synonyms, relations and facets, as well as for the enhancement of taxonomies and thesauri with ontology features.



FIG. F.2 The Agency's INIS hosts one of the world's largest collections of published information on the peaceful uses of nuclear science and technology

32. The IAEA Library improved access to nuclear information by connecting users to a print collection of over 90 000 items, nearly 60 000 electronic journal titles, and 68 electronic databases. In addition, the Library introduced virtual training to its portfolio of services while continuing to provide research consultations, interlibrary loans and article delivery to Agency staff in support of their work. Information sharing and cooperation continued to be optimized through coordination of the International Nuclear Library Network and the addition of 5 new members, bringing its current roster to 61 members from 42 Member States.

33. The Cyber Learning Platform for Network Education and Training (CLP4NET) achieved significant growth during the reporting period as an Agency-wide service to promote in-house e-learning materials. The number of registered users had increased to around 33 000 by the end of April 2020, and the number of courses hosted also grew significantly, to close to 400. CLP4NET is effectively used to train participants at NEM and NKM Schools and helps to deliver cost-effective training to large groups of participants from several Member States. An increasing number of Agency Sections/Departments showed interest in hosting courses and using the platform to leverage e-learning materials. The platform has reached users in 142 Member States via the professional network sites it hosts.

34. An expanded 'Nuclear Wiki' has been developed to serve as a knowledge platform for fostering the exchange of scientific and technical information, and supplements other media used by the Agency for knowledge capture and sharing, such as published reports, e-learning materials and online databases. Its current content is mainly focused on decommissioning and on knowledge management approaches and techniques, with material from other domains, including waste management and environmental remediation, being added progressively. The current content includes more than 80 articles on decommissioning technologies, more than 200 case studies and summary information on more than 1000 nuclear facilities. Although currently aimed mainly at professionals working in relevant fields, it is planned that all articles —with the exception of case studies— will be made accessible to the public

later in 2020. Access to case studies will be reserved for members of the IAEA CONNECT platform in order to encourage information exchange between Member States and professionals working in relevant fields.

Following the reinstatement of a Memorandum of Agreement between the Agency and the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development (OECD/NEA), the OECD/NEA Data Bank has recommenced distribution of nuclear computer codes and processed nuclear data libraries to eligible IAEA Member States that are neither OECD/NEA nor OECD members, upon request.



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