

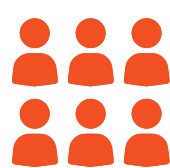


Nuclear Power, Fuel Cycle and Nuclear Science

over 1100  **on-line training and education courses** hosted on **CLP4NET**

34  **coordinated research projects**

8  **nuclear back end webinars**  with **1100 participants**



over 8000 participants

in about 50 webinars 

 **over 1.7 million INIS users**

2.5 million unique searches

4 million pageviews

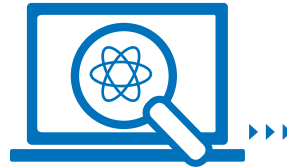
50 years INIS 

40 

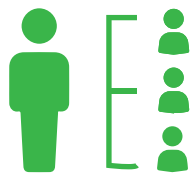
publications in 2020

Internet Reactor Laboratory

3 host institutions



6 guest institutions



19
professional networks



19
databases



6 IAEA-designated International Centres
based on Research Reactors

in **6** countries



over
260
meetings



8
active IAEA Collaborating Centres
within the Department of Energy

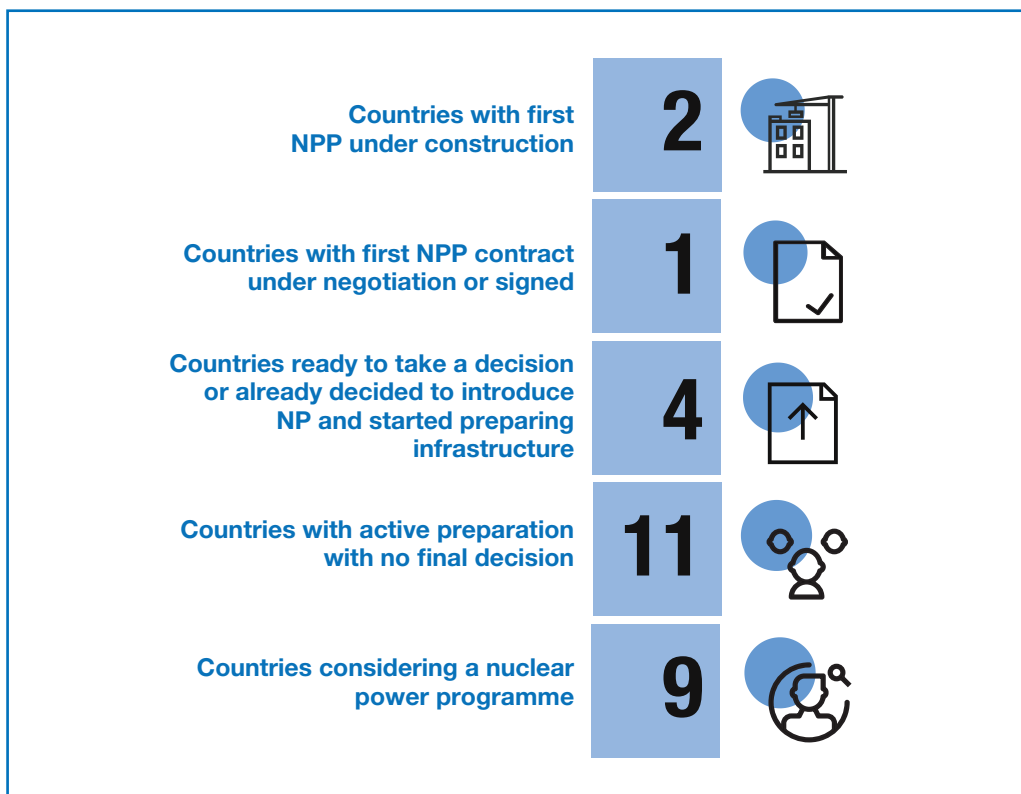
Nuclear Power

Objective

To support Member States with existing nuclear power plants to enhance operating performance and safe, secure, efficient and reliable long term operation, including development of human resource capability, leadership and management systems. To support Member States embarking on new nuclear power programmes in planning and building their national nuclear infrastructures, including development of human resource capability, leadership and management systems. To provide methods and tools to support modelling, analyses and assessments of future nuclear energy systems for sustainable development of nuclear energy, and collaborative frameworks and support for technology development and deployment of advanced nuclear reactors and non-electric applications.

Launching Nuclear Power Programmes

The Agency continued to support Member States interested in or embarking on new nuclear power programmes by providing assistance in line with the Milestones approach. In 2020, 27 Member States were actively considering, planning or embarking on a nuclear power programme.



The Agency continued to support all embarking countries in developing the required nuclear power infrastructure. Three in-person Integrated Work Plan–Country Nuclear Infrastructure Profile meetings were conducted for Belarus, Jordan and Saudi Arabia at the beginning of 2020. Five Integrated Work Plan mid-term review meetings were held virtually with Egypt, Jordan, Kenya, Poland and Saudi Arabia. Meetings with other Member States were scheduled for early 2021.

The Agency conducted four interregional training courses within the Integrated Nuclear Infrastructure Training programme on the following topics: economic and financing aspects to be considered when developing a national position on nuclear power; nuclear power plant financing and risk allocation; nuclear power plant contract specifications and reactor technology assessment, to support Member States in preparing to invite bids or negotiate a contract for a nuclear power plant with a technology-neutral approach; and nuclear power infrastructure development, providing an overview of the Agency’s Milestones approach (Fig. 1).

The Agency updated *Initiating Nuclear Power Programmes: Responsibilities and Capabilities of Owners and Operators* (IAEA Nuclear Energy Series No. NG-T-3.1 (Rev. 1)), which provides information on the establishment and development of the owner/operator organization and its responsibilities and interfaces with other organizations involved throughout the programme phases.

The Technical Meeting on the Application of the IAEA Integrated Nuclear Infrastructure Review Evaluation Methodology for Small Modular Reactors served as a forum for the exchange of information on the deployment business models offered by technology suppliers and on expectations of Member States interested in small modular reactors in terms of nuclear power infrastructure support.



FIG. 1. A technical visit to the Zwentendorf nuclear power plant within the framework of the IAEA Training Course on Nuclear Power Infrastructure Development (file photograph).

Operating Nuclear Power Plants and Expanding Nuclear Power Programmes

The Agency launched the ‘Nuclear Supply Chain’ webinar series. The new series presents a global overview of the nuclear supply chain, highlighting future challenges and avenues and taking stock of the Agency’s work in this area. Over 230 participants from 30 Member States took part in two webinars on this topic.

The new publication *Challenges and Approaches for Selecting, Assessing and Qualifying Commercial Industrial Digital Instrumentation and Control Equipment for Use in Nuclear Power Plant Applications* (IAEA Nuclear Energy Series No. NR-T-3.31) focuses on the activities required to demonstrate the suitability of commercial off the shelf digital instrumentation and control equipment in nuclear safety applications.

The Agency signed Practical Arrangements with the National Nuclear Laboratory of the United Kingdom, strengthening cooperation in support of a sustainable future for nuclear power, including activities on existing and emerging nuclear reactor technologies, decommissioning and radioactive waste management.

The new publication *Reload Design and Core Management in Operating Nuclear Power Plants, Experiences and Lessons Learned* (IAEA-TECDOC-1898) outlines the main issues to be considered when developing and improving strategies for reload design and core management in nuclear power plants.

The publication *Quality Assurance and Quality Control in Nuclear Facilities and Activities* (IAEA-TECDOC-1910) presents the relevant concepts and good practices for their implementation within the processes of the management systems of nuclear facilities (Fig. 2). *Management of Nuclear Power Plant Projects* (IAEA Nuclear Energy Series No. NG-T-1.6) provides information on the implementation of a project management framework and the systems necessary to manage the activities within nuclear projects.



FIG. 2. Inside the power plant’s control room at Dukovany nuclear power plant (file photograph).

The publication *Implementation and Effectiveness of Actions Taken at Nuclear Power Plants following the Fukushima Daiichi Accident* (IAEA-TECDOC-1930) discusses good practices and effective solutions to issues related to the implementation of post-Fukushima actions in operating nuclear power plants.

The 2020 edition of *Country Nuclear Power Profiles* summarizes organizational and industrial aspects of nuclear power programmes across Member States and provides information about their respective legislative and regulatory frameworks and bilateral, multilateral and international agreements.

Human Resource Development and Management and Stakeholder Involvement Support

The Agency published *Assuring the Competence of Nuclear Power Plant Contractor Personnel* (IAEA-TECDOC-1232/Rev.1), which offers a framework for assuring the competence of contractors who provide essential services to nuclear power plants.

Participants in a training course on the assessment of behavioural competencies for safe, secure and effective performance in nuclear organizations learned about the relevant guidelines, methodologies and practices for enhancing employee related decision making processes and practices. The Agency also published *Assessing Behavioural Competencies of Employees in Nuclear Facilities* (IAEA-TECDOC-1917), outlining a variety of tools and approaches that can aid in behavioural assessment processes.

Four webinars in the series entitled ‘Stakeholder Involvement Related to Nuclear Power’ were attended by 550 participants from 63 Member States, with 672 additional viewings of the recordings.

Nuclear Reactor Technology Development

Advanced water cooled reactors

The webinar entitled ‘Nuclear–Renewable Integrated Energy Systems: Prospects and Issues’ introduced the concept of combining clean energy sources to provide reliable, sustainable electrical energy, with 400 participants from 54 countries. In another webinar, attended by 556 participants from 63 Member States, the Agency presented its suite of nuclear power plant simulators that enable efficient hands-on learning of the physics and engineering designs of various reactor types.

Small and medium sized or modular reactors, including high temperature reactors

The webinar entitled ‘Small Modular Reactors in Integrated Energy Systems’ provided insights on small and medium sized or modular reactor (SMR) technology for deploying SMRs in different near-future scenarios, such as for replacing fossil fuel plants and for smaller grids or remote communities. The webinar entitled ‘Molten Salt Reactors: A Game Changer in the Nuclear Industry’ offered an overview of the status of molten salt reactor technology and the feasibility of deploying molten salt reactors in the near future. The new edition of *Advances in Small Modular Reactor Technology Developments*, which was presented during a webinar of the same title, reported on progress made by SMR technology frontrunners and on the advances in global SMR designs and technologies.

The publication *Considerations for Environmental Impact Assessment for Small Modular Reactors* (IAEA-TECDOC-1915) provides current information on considerations about environmental impact assessments related to SMRs and is intended for both technology holders and licensing authorities.

At the third research coordination meeting of the coordinated research project entitled ‘Development of Approaches, Methodologies and Criteria for Determining the Technical

Basis for Emergency Planning Zone for Small Modular Reactor Deployment’, participants concluded that methodologies and criteria for defining emergency planning zone boundaries vary among Member States, as they depend on different allowable dose or risk values at the boundary or different values used to measure effectiveness.

The Agency, through its technical cooperation programme, launched a two year regional project to assist countries in the Europe and Central Asia region in energy planning and determining the role of SMRs in helping them meet their climate targets.

The new coordinated research project entitled ‘Economic Appraisal of Small Modular Reactor Projects: Methodologies and Applications’ focuses on techno-economic assessment approaches for SMRs, including microreactors.

The Agency circulated a draft advance publishing copy of *Technology Roadmap for Small Modular Reactor Deployment*, scheduled for publication in 2021. The Agency’s new three year project for the development of generic user requirements and criteria on small modular reactor technology was started.

The transfer to the Agency of the knowledge base and code package system for high temperature reactors of Germany’s Jülich Research Centre was completed as part of the initiative to preserve knowledge in the field of high temperature gas cooled reactors.

Fast reactors

The publication *Passive Shutdown Systems for Fast Neutron Reactors* (IAEA Nuclear Energy Series No. NR-T-1.16) details the findings of a study of and provides comprehensive information about passive shutdown systems for fast neutron reactors.

The fourth and final research coordination meeting of a coordinated research project entitled ‘Radioactive Release from the Prototype Fast Breeder Reactor under Severe Accident Conditions’ reviewed the work and scientific contributions of the participants, identified remaining gaps and wrapped up the project.

Non-electric Applications of Nuclear Power

The webinar entitled ‘Cogeneration: Nuclear Energy Beyond Electricity Production’ presented the status of ongoing activities and cogeneration projects worldwide.

At the Technical Meeting on Assessing Technologies that Enable Nuclear Power to Produce Hydrogen, participants gained a better understanding of several issues, including challenges related to the commercialization of technologies involved in nuclear hydrogen production; the need to identify societal and regulatory barriers for nuclear hydrogen production; and the importance of international cooperation for the demonstration of nuclear hydrogen production.

Enhancing Global Nuclear Energy Sustainability through Innovation

The Agency hosted the 14th Generation IV International Forum (GIF)–INPRO/IAEA Interface Meeting as a virtual event. The meeting defined the scope and details of cooperation, meetings and joint activities between the Agency and GIF, including for next generation nuclear power technologies, early deployment of innovative nuclear reactor systems and revision of the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) Methodology for Sustainability Assessment of Nuclear Energy Systems with regard to proliferation resistance.

The Agency released a new e-learning course to help countries gain a broad understanding of a new INPRO service, Analysis Support for Enhanced Nuclear Energy Sustainability (ASENES). The new service makes it possible for countries to evaluate and compare different nuclear energy systems and nuclear energy scenarios and develop roadmaps to strategically plan how to move towards enhanced nuclear energy sustainability.

CASE STUDY

Nuclear Power Expansion Achieves Historic Milestones with Agency Support

The role of nuclear power in mitigating climate change while reliably providing electricity continues to grow with Agency help. After years of working closely with the Agency on developing the necessary infrastructure and enabling environment for a new nuclear power programme, Belarus and the United Arab Emirates (UAE) began producing electricity in 2020, becoming the first countries to introduce nuclear power in almost a decade. And the community of what are now 32 countries with operating nuclear power plants looks set to expand further, with the Agency supporting around 30 other newcomers interested in nuclear power, including Bangladesh and Turkey, which are building their first nuclear power plants.

Implementing a nuclear power programme is a complex endeavour. It requires the development of a legislative and regulatory framework and a radioactive waste management plan, as well as stakeholder involvement. The Agency supports Member States that choose to introduce nuclear power through a range of initiatives, including the Integrated Nuclear Infrastructure Review (INIR) and a host of other peer review services, as well as technical training activities, customized workshops and advisory services.

The Barakah nuclear power plant, consisting of four APR-1400 units, is the first nuclear power plant built in the UAE, a country with a population of nearly 10 million. The first unit came on-line on 19 August, and the plant will provide up to 25% of the country's electricity

The Barakah nuclear power plant in the United Arab Emirates, connected to the electricity grid in 2020, is the country's first nuclear power station. The Agency supported the development of the facility with training and review missions.



once all four units are connected to the grid. “What makes our programme successful is our Government’s robust commitment, a viable business model, high public acceptance and strong international cooperation and support, including with and from the IAEA,” said Ambassador Hamad Alkaabi, the UAE’s Permanent Representative to the IAEA. “The UAE’s commitment to the highest standards of operational transparency, safety, security and non-proliferation, as well as our cooperation with the IAEA have enabled our country to serve as a model for many countries embarking on nuclear power.”

Belarus, which connected the first of two VVER-1200 units to its electricity grid on 3 November, has benefitted from Agency advice, and invited and received numerous expert review missions during the planning and construction of its plant. “The recommendations and suggestions we received have been an important guidance for our continuous efforts aimed at ensuring the highest level of safety and reliability of the Belarusian nuclear power plant,” said Mikhail Mikhadyuk, Deputy Minister of Energy. Once fully operational, the Astravets nuclear power plant will provide around one third of the country’s electricity needs.

Construction of the first nuclear power plants in Bangladesh and Turkey is well under way, with commissioning of their first units planned for 2023. Both countries have received support from Agency activities and remain in close contact with Agency experts as they look to join the growing list of countries using low carbon nuclear power to meet their needs on energy security, climate change and sustainable development.

