Newcomer countries face common challenges in nuclear infrastructure development

Belarus is constructing its first NPP at the Ostrovets site.
(Photo: Directorate for Nuclear Power Plant Construction/Belarus)

Countries embarking on a nuclear power programme need to make sure that the development of their legal, regulatory and support infrastructure keeps pace with the construction of the power plant itself. This is the only way to ensure that the programme proceeds in a safe, secure and sustainable way, concluded participants of a workshop on nuclear power infrastructure development hosted at the IAEA last February. "Embarking on a nuclear power programme is a serious undertaking that requires significant financial resources, as well as the implicit responsibility to ensure that the necessary infrastructure is in place," said Milko Kovachev, Head of the IAEA Nuclear Infrastructure Development Section. "A country should start a nuclear power programme only when it is ready and can be realistic about the time and resources involved."

Countries introducing nuclear power for the first time, called 'newcomers,' face a number of similar key challenges in infrastructure development: completing a national policy and strategy for the programme, developing a legal framework and an independent nuclear regulatory body, strengthening project management and building a skilled workforce.

Participants at the 10th annual technical meeting on Topical Issues in the Development of Nuclear Power Infrastructure from 2 to 5 February included representatives of national governments, future owner/operator organizations, regulatory bodies and other institutions from both nuclear newcomer and operating nuclear power countries.

Presenting case studies, the participating newcomer countries discussed different issues including the complexity of developing a regulatory framework and licensing process. "A knowledgeable and independent regulator is essential to balance the role of the operator of a nuclear power plant and set standards for nuclear safety and a nuclear safety culture in a transparent way," said Meeting co-chair Per Lindell from Sweden.

Nuclear milestones

"All newcomer countries have adopted the framework of the IAEA's Milestones approach which is the Agency's key guidance for developing the nuclear infrastructure for a nuclear power programme," said Abdelmajid Caoui, former General Secretary of the Nuclear Research Center of Morocco, who co-chaired the meeting. "This is reflected in Member States' expressed commitment to the safe, secure and peaceful use of nuclear energy, strong government support as a key pillar for a new nuclear power programme, and the early creation and involvement of the regulator, owner/operator and technical support organizations." Morocco is considering nuclear power as a long term low-carbon energy source and hosted an IAEA Integrated Nuclear Infrastructure Review (INIR) mission in October 2015.

Belarus is currently constructing its first nuclear power plant at Ostrovets. Two 1170 MW(e) units are scheduled to be in operation by 2018 and 2020, respectively. At the meeting, Mikhail Mikhadiuk, Deputy Minister of Energy of Belarus, presented the roadmap and key milestones for the nuclear power programme development.

"Belarus made the decision to embark on a nuclear power programme in 2008 in order to enhance security of energy supply by diversification of energy resources, reduce electric power production costs and curb greenhouse gas emissions," Mikhadiuk said. "We are realizing the nuclear power programme based on IAEA standards." Belarus hosted an INIR mission in 2012.

INIR: Assistance from the IAEA

INIR missions are the most important service a Member State can request in the area of nuclear infrastructure development, said Mikhail Chudakov, IAEA Deputy Director General and Head of the Department of Nuclear Energy. "I strongly encourage any Member State that is seriously considering the introduction of nuclear power to discuss the possibility of hosting an INIR mission." Since 2009, the IAEA has conducted 17 such

missions in 13 countries and recently published a document that summarizes six years of experience with INIR missions.

Participants also addressed financial risks, which include regulatory risks, and how to mitigate them. In light of the ever-changing cost of energy and the costs and complexity of nuclear power, this is a growing area of interest for Member States, to be also addressed at future IAEA meetings.

In addition, human resource development remains a consistent challenge. Not only do countries have to find the right personnel and train them, but they also have to ensure that there is a place for them to work once they are trained, for example if a programme encounters delays.

Concerning initial considerations that many Member States are making as they determine whether to embark on a nuclear power programme, energy planning is the first step toward the consideration of nuclear power. Such studies will lead to further analysis through prefeasibility studies and comprehensive reports. The IAEA will shortly publish new guidance on this process and on the development of a national position, as well as several other relevant publications for countries considering nuclear power.

— Lenka Kollar and Elisabeth Dyck

Safety and licensing requirements for small modular reactors: IAEA hosts first workshop for regulators

A new generation of advanced, prefab nuclear power reactors called small modular reactors (SMRs) could be licensed and hit the market as early as 2020, and the IAEA is helping regulators prepare for their debut. In a series of workshops that began earlier this year, the IAEA is working closely with regulators on approaches to safety and licensing ahead of potential SMR deployment worldwide.

Safety requirements, guidelines and licensing procedures for SMRs were among the topics that participants from the Arab Atomic Energy Agency (AAEA) and the Arab Network of Nuclear Regulators learnt about during an IAEA workshop held in Vienna in January 2016.

"Small modular reactors are a very attractive proposition for the Arab world as more than half the countries in our region don't have the resources to build large, traditional nuclear power plants. SMRs are more feasible, manageable and require lower investment — it is a very realistic option for Arab countries to consider," said Abdelmajid Mahjoub, Director General of the AAEA and the Chairman of the workshop.

Co-sponsored by the United States Nuclear Regulatory Commission, the workshop brought together regulatory bodies, operator companies, and other governmental organizations, working or expected to work towards the establishment of national safety and technical infrastructures for SMRs.

Advances in SMR technology development. (Image: IAEA)

Workshop participants received detailed information about the role of regulatory bodies and licensing requirements, including the approval of SMR designs, siting and operations. The IAEA facilitated discussions among regulators on the use of relevant IAEA safety standards and on changes that may be needed in national regulations.

Small and safe

Designed to be modular using prefabricated modules, SMRs, with an output of less than 300 MW, will have shorter construction times and are expected to be cost-competitive to build. Four SMRs in three countries are

already under construction. "Though smaller, the safety and security measures for this next generation of nuclear power reactors are no different from the international obligations that present-day reactors are subject to," said Stewart Magruder, a senior nuclear safety officer at the IAEA.

The global safety and security standards that are applicable to existing nuclear power reactors as well as those under construction are mostly applicable to SMRs, too. "We need to establish a set of clear and pragmatic requirements for safety and licensing," said Greg Rzentkowski, Director of the Division of Nuclear Installation Safety at the IAEA. "Regulatory certainty is essential for successful deployment of SMRs."

The IAEA will coordinate additional work in this area in coming years. This is likely to include the development of an overarching safety objective and a guidance document on establishing relevant requirements in accordance with the facility type and size, Rzentkowski said.

Develop, assess and deploy

These prefabricated nuclear reactor modules can be shipped to specific destination points, much like transporting a manufactured component from one industrial park to another. The potential benefits to countries and end users resulting from the commercial operation of SMRs are immense — for example, by providing much needed electricity to remote regions, thereby enhancing the dynamics of worldwide energy supply.

The development of SMRs began nearly two decades ago, and several countries are independently engaged in deploying prototypes. The IAEA has observed a significant increase in Member State participation in SMR technology development that reflects the vast potential seen in the deployment of such reactors with regard to expanding national electricity grids, and improving energy supply security.

The IAEA is also drawing up a technology roadmap for SMR deployment and conducting a study on SMR deployment indicators in developing countries to assist Member States in developing, assessing or deploying SMRs.

Current developments

There are around 50 SMR designs under development for various purposes and applications, and four reactors under construction: CAREM-25, an industrial prototype in Argentina; KLT-40S and RITM-200, floating SMRs in the Russian Federation; and HTR-PM ('High Temperature Reactor–Pebble-Bed Module'), an industrial demonstration plant in China. Last year, Saudi Arabia's atomic energy authority signed an agreement with the Republic of Korea to build an SMR called SMART ('System-integrated Modular Advanced Reactor') in Saudi Arabia. Even traditional fossil fuel producers are now looking at the potential which SMRs offer to provide a more diversified energy supply to national and regional electric grids.

"SMRs are among the most advanced reactor technologies for meeting future energy demands, and Member States need to be fully aware of the applicable safety standards and regulations to enable successful deployment of this new type of power reactor," said Hadid Subki, a nuclear engineer at the IAEA Nuclear Power Technology Development Section.

The next IAEA workshop on the safety and licensing requirements for SMRs is for members of the Forum of Nuclear Regulatory Bodies in Africa and will take place in June 2016.

— By Aabha Dixit and Miklos Gaspar

IAEA reaches milestone in disposal of radioactive sources

Successful tests of a promising technology for moving and storing low level radioactive sealed sources are paving the way for a new disposal method for dealing with small volumes of radioactive waste around the world. The method, which involves placing and covering sealed sources in a narrow hole a few hundred metres deep, would allow countries to safely and securely take charge of their own disused radioactive sources. The proof of concept for the technology was tested in Croatia late last year — without the use of actual radioactive material.

Virtually all countries use radioactive sources in health care, industry and other sectors. Many, though, do not have the equipment or staff needed to deal with these once they are no longer usable. Under typical circumstances, a developing country using sealed radioactive sources may generate hundreds of disused sources with low levels of radioactivity over several years, according to IAEA estimates.

"Low activity sources pose the larger challenge because they exist in large quantities around the world and in different forms and variations," said Andrew Tompkins, a nuclear engineer at the IAEA.

In most developing countries, sealed radioactive sources are stored temporarily. Some developed countries have disposal facilities close to the surface. Both of these pose a security risk if they are not sufficiently protected. The new disposal method represents a long term solution to this problem, and will ultimately help protect people and the environment.

Equipment tests conducted by IAEA engineers and a Croatian radiation protection company confirm the feasibility of a system that safely moves and inserts low activity sources into boreholes for disposal.

IAEA engineers and a Croatian radiation protection company test a new system used to safely and securely dispose of low-activity sources in boreholes. (Photo: L. Gil/IAEA)

The tested technology, developed for disused sources with low levels of radioactivity, relies on a robust metal platform and a mobile container called a transfer cask, which is used to move the sources into the borehole safely. "It's simple, affordable and can be deployed worldwide," said János Balla, a waste technology engineer at the IAEA.

"We realized that countries that had low levels of waste, modest infrastructure and limited human and financial resources needed a safe, straightforward and practical solution," said Balla.

Preventing theft and terrorism

Increasing nuclear security is an important driver behind the development of the new method. "Given that disused sources remain radioactive, we want to limit the probability of these being reached and used for terrorist activities," said Gert Liebenberg, a nuclear security officer at the IAEA. "Once in the borehole, they are no longer easily accessible to anyone."

The original borehole idea was developed by the South African Nuclear Energy Corporation (Necsa), and subsequently adapted by the IAEA to incorporate the disposal of sources with higher levels of radioactivity. Today, borehole technical preparations and safety assessments are taking place in several countries, including Malaysia and the Philippines, so that the method can be implemented in the coming years.

The IAEA is ready to train experts in countries interested in using the borehole disposal method and provide them with the necessary assistance, either equipment or technical specifications, to build their own transfer cask. The technology to drill the hole is similar to that used to extract water, and is widely available in most countries, including less developed ones.

Treating sources

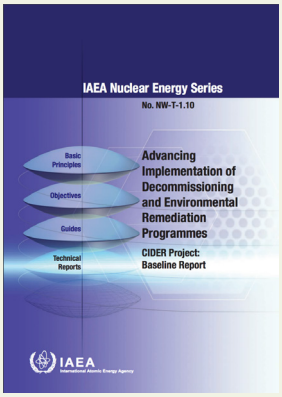
Radioactive sources are used widely in medicine and industry, from radiotherapy machines for treating cancer, to industrial tools for sterilizing disposable medical supplies. The most common sealed sources have low levels of radioactivity or a short half-life, meaning they will remain radioactive for only a few months to a few hundred years.

Before disposal, all sources are treated and repackaged through a process called conditioning. When prepared according to this method for disposal, hundreds of sources — the typical amount generated by a developing country each year — take up less than a cubic metre, the size of a small wardrobe.

Once the borehole is in place, the conditioned sources will be loaded into a specially-designed canister, or disposal package, which is then sealed. The sealed canister will then be placed inside the transfer cask and moved over — and eventually into — the borehole.

— By Laura Gil

Publications Alert



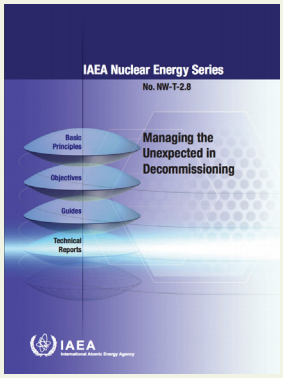
Advancing Implementation of Decommissioning and Environmental Remediation Programmes

CIDER PROJECT: Baseline Report

discusses the barriers that prevent decommissioning and environmental remediation projects from being implemented and provides options to overcome these barriers. Despite significant progress in recent years, much remains to be done to address legacies from the early development of nuclear energy, including the dismantling of redundant research and fuel cycle facilities and power plants, and the remediation of sites affected by past uranium mining and processing operations. Several countries are dealing with such legacy issues, and have built up appropriate technical resources and expertise, but many national programmes still face significant challenges.

IAEA Nuclear Energy Series No. NW-T-1.10; ISBN: 978–92–0–101316–3; 37.00 Euro; 2016

www-pub.iaea.org/books/IAEABooks/10993/CIDER

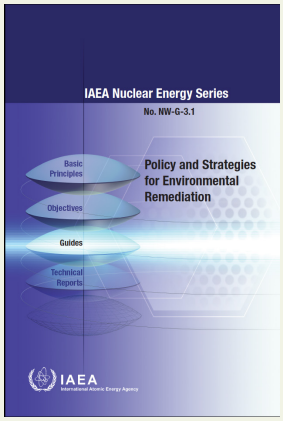


Managing the Unexpected in Decommissioning

explores the implications of unexpected events encountered during decommissioning and ways to mitigate them. It provides practical guidance on how to plan and manage such projects, taking into account unexpected events. It classifies and sets out some instances where unexpected findings made it necessary to either suspend or reconsider the decommissioning work. The publication includes an evaluation of past experience in tackling decommissioning challenges. It will enable future decommissioning teams to learn from these lessons, thereby helping them to reduce additional costs, time delays and unnecessary radiation exposure.

IAEA Nuclear Energy Series No. NW-T-2.8; ISBN: 978-92-0-103615-5; 35.00 Euro; 2016

www-pub.iaea.org/books/IAEABooks/10786/Unexpected



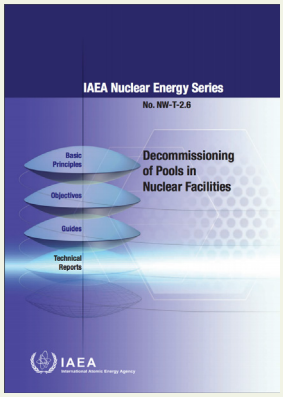
Policy and Strategies for Environmental Remediation

describes the goals, timescales and efforts needed to implement environmental remediation. It clarifies the differences between a policy and a strategy, and provides advice to Member States on how to formulate and compose these types of documents. It touches on aspects such as cost allocation and the different interests of the parties concerned in environmental remediation.

Along with previously issued IAEA safety publications on environmental remediation, this book will help national authorities to recognize the need for including environmental remediation as a required component in the planning and execution of nuclear-related initiatives.

IAEA Nuclear Energy Series No. NW-G-3.1; ISBN: 978-92-0-103314-7; 20.00 Euro; 2015

www-pub.iaea.org/books/IAEABooks/10622/Policy



Decommissioning of Pools in Nuclear Facilities

describes the technical and planning aspects of decommissioning nuclear pools. It reviews and consolidates globally available experience related to pool decommissioning, including project planning, health and safety and the management of resulting waste.

A number of nuclear installations utilize pools to cool spent fuel or to shield research reactor cores or irradiator sources. Over a service lifetime that can span decades, nuclear pools may become contaminated as a result of the deposition of radioactive substances. Although cases of pool decommissioning have been sporadically described in the technical literature, no report had covered the treatment of decontamination and dismantling strategies and technologies for contaminated pools as comprehensively as this publication.

IAEA Nuclear Energy Series No. NW-T-2.6; ISBN: 978-92-0-103115-0; 55.00 Euro; 2015

www-pub.iaea.org/books/IAEABooks/10669/Pools