

DEVELOPING INFRASTRUCTURE

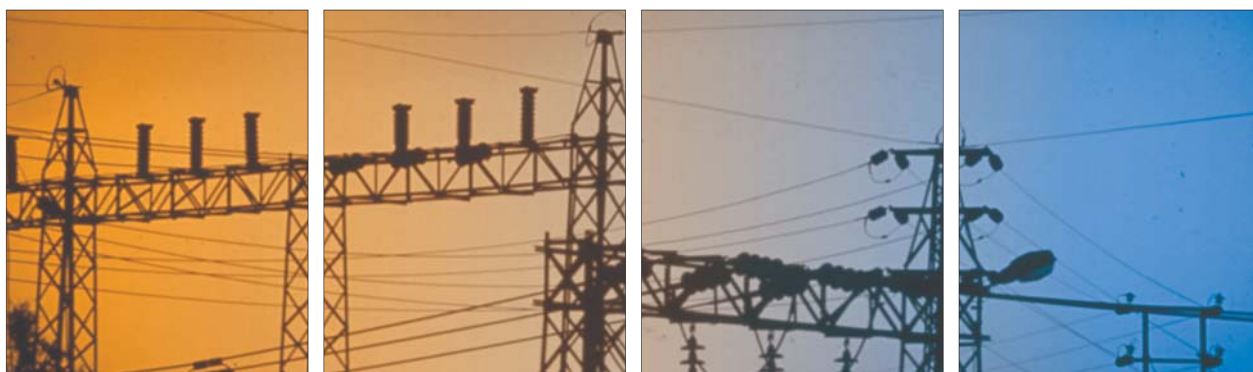
for **NEW NUCLEAR POWER**
Programmes

IAEA Services for **MEMBER STATES**



IAEA

International Atomic Energy Agency



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FOREWORD by the IAEA Director General



Many countries are interested in introducing or expanding nuclear energy programmes because they regard nuclear power as a stable source of electricity that can help to mitigate the impact of climate change. This was confirmed at an IAEA International Ministerial Conference on Nuclear Power in the 21st Century, held in June 2013 in St Petersburg, Russia. Since the March 2011 accident at the Fukushima Daiichi nuclear power plant in Japan — caused by a devastating earthquake and tsunami — many steps have been taken to improve global nuclear safety. IAEA Member States adopted a Nuclear Safety Action Plan, which includes specific actions for countries embarking on nuclear power. This is helping to ensure that a ‘safety first’ approach becomes fully entrenched among nuclear power plant operators, governments and regulators everywhere.

Nuclear power can make an important contribution to meeting growing energy demand. Every effort should be made to ensure that nuclear power plants are operated as safely as humanly possible. I believe that both developed and developing countries should have access to nuclear power if they wish to add it to their energy mix. While it is up to each country to decide whether or not to opt for nuclear power, the IAEA has a key role to play in ensuring that the development of nuclear power programmes takes place in a safe, efficient, responsible and sustainable manner.

The IAEA has developed guidelines and milestones to help countries work in a systematic way towards the introduction of nuclear power. Use of the ‘Milestones’ approach can increase transparency both within a country introducing nuclear power, and between it and other States.

This brochure summarizes the services which the IAEA offers to Member States considering the introduction of nuclear power. These include advice on proper planning, building the required human resources and infrastructure, establishing legal and regulatory frameworks, and ensuring the highest standards of safety and security, without increasing proliferation risks. The IAEA offers independent know-how on the construction, commissioning, start-up and operation of nuclear reactors. Through the IAEA’s technical cooperation programme, we provide targeted support to ‘newcomer’ countries in response to national development needs. The aim is that countries should be able to introduce nuclear power knowledgeably, profitably and safely.

I hope that readers will find this a useful and informative summary of IAEA services in the field of new nuclear power programmes.

Yukiya Amano

IAEA MILESTONES —

Launching a nuclear power programme is a major undertaking that requires careful planning, preparation and investment in time and resources. The infrastructure to support the successful introduction or expansion of nuclear power covers a wide range of issues, including: 1) the physical facilities for the delivery of electricity; 2) the site and supporting facilities for handling radioactive waste; 3) the legal and regulatory framework to the human; and 4) the financial resources necessary to implement the required activities. It entails attention to many complex and interrelated issues over a long duration — and a commitment of at least 100 years. This brochure identifies major components of the Milestones approach and highlights services available to IAEA Member States.

Planning for nuclear power can take 10–15 years until commissioning of the first plant. The IAEA

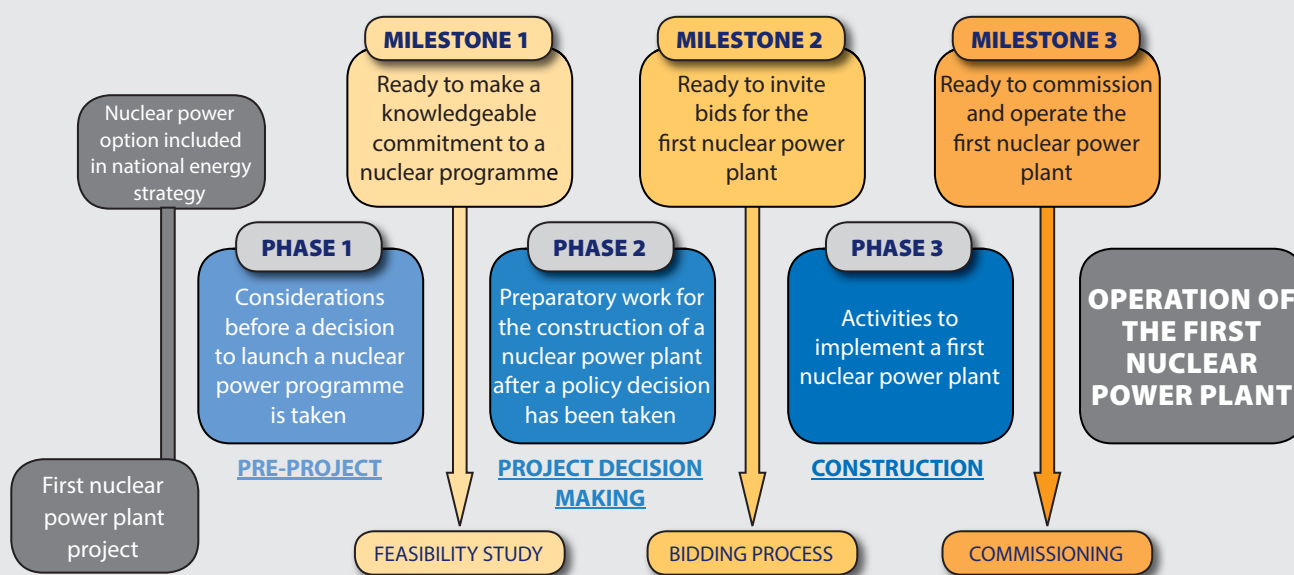
Milestones approach was developed to provide Member States with ‘guideposts’ that they can use to demonstrate progress during planning stages, and to demonstrate to national and international stakeholders their commitment to nuclear safety and control of nuclear materials. In this regard, the infrastructure for a nuclear power programme includes the elements necessary for the safe, responsible and sustainable use of nuclear technology. The IAEA Nuclear Energy Series publication *Milestones in the Development of a National Infrastructure for Nuclear Power* (NG-G-3.1.) documents this approach.

The process begins with careful consideration of the nuclear power option in the context of the overall energy policy, leading to a knowledgeable decision whether or not to proceed with a nuclear power programme. Once a decision is taken, the



Developing the Infrastructure for Nuclear Power

NUCLEAR INFRASTRUCTURE DEVELOPMENT PROGRAMME



supporting frameworks, institutions and infrastructure need to be developed to initiate a successful bidding process for the nuclear power plant.

After a technology is selected and a contract awarded, the plant itself is constructed and readied for operation. These three actions are the major elements in the IAEA's Milestones approach for the development of a national infrastructure for nuclear power.

Many organizations will play roles in supporting decision making and implementation of a national nuclear programme. Government ministries, nuclear and other regulatory bodies, utilities, grid operators, research institutes and universities and the public all have a role to play. The Milestones approach describes a coordinating body, the Nuclear

Energy Programme Implementing Organization, as the team that brings together a wide range of technical expertise from across these various institutions.

There are three programme phases of development; the completion of each of these phases is marked by a specific 'milestone' at which the progress of the development effort can be assessed in order to move on to the next phase.

Member States often request Milestones workshops early in their consideration of nuclear power. These missions can help senior leaders to develop an understanding of the issues, international and national obligations, legal framework and other implications of starting a national nuclear power programme.

NATIONAL POSITION —

Making a knowledgeable decision to launch a nuclear power programme is based on the development of a national position on the nuclear power option in the country. Engaging the technical community, policy makers and politicians from across the political spectrum as well as the public can help to maintain stability in the planning process, which may take over a decade or longer. The process involves justifying the need for, and national benefits of, nuclear power, developing an understanding of what it would take to establish and implement, and communicating with national and international stakeholders.

Energy Planning

A clear justification of the nuclear option in the context of the country's national energy policy might include such drivers as diversifying the energy supply, reducing greenhouse gas emissions, increasing energy independence, reducing dependency on fossil fuels, reducing energy imports and other economic considerations. Understanding the economics of nuclear power in comparison to other power generation technologies is an important element of energy planning.

The IAEA offers analytical tools and capacity building for energy analysis and planning, for example, the Model of Energy Supply Strategy Alternatives and their General Environmental Impacts (MESSAGE), which can help design long term energy supply strategies or test energy policy options.

The IAEA Milestones approach suggests that in order to make a knowledgeable decision, a group of experts should be brought together to study the implications of nuclear power across 19 issues. The end of the process would be a national strategy and roadmap for decision makers.

This approach and supporting material has been translated into an e-learning format that can be used

online or downloaded from the IAEA website at: <http://www.iaea.org/NuclearPower/Infrastructure/>.

Stakeholder Involvement

Stakeholder involvement is a challenge in countries building their first nuclear power plant or expanding their existing programme. In either case, Member States agree that support from national stakeholders and local communities is essential for the sustainability of the programme. In order to meet Member States' needs, especially public involvement in the nuclear energy debate and national decisions, the IAEA is organizing technical meetings on common challenges and good practices in stakeholder involvement, focusing on



Nuclear Power as an Option

outreach, educational activities, engagement with local communities and communication with neighbouring countries.

The IAEA also offers activities at national and regional levels to embarking Member States or those with established nuclear power programmes. The IAEA can provide support in developing and reviewing stakeholder involvement strategies and plans. It also facilitates the participation of international experts in public information seminars that provide factual information on the benefits and risks of nuclear power and offer a useful framework for stakeholders to better understand and participate in the development of their national nuclear power programme.

An overview of stakeholder involvement in the context of the Milestones' approach is available in e-learning format (module 5) accessible at: <http://www.iaea.org/NuclearPower/Infrastructure/elearning/>.

Long Term Strategies for Sustainable Nuclear Energy Development

The IAEA also provides training to Member States that supports their long term strategic planning and decision making on nuclear power programmes. A Nuclear Energy System Assessment (NESA) using an internationally validated



An IAEA Nuclear Energy Series publication addresses *Stakeholder Involvement throughout the Life Cycle of Nuclear Facilities* (NG-T-1.4). Based on Member States' feedback, the IAEA is now complementing this report with a new publication on operational guidance for new build activities following the Milestones' approach.

approach, the INPRO Methodology, can assist energy planners in understanding the sustainability of a nuclear system as it evolves over time, and in making informed decisions.

Indonesia, Kazakhstan, Romania and Ukraine are currently performing NESAs. Belarus has completed a NESA that evaluated their planned development of two nuclear power plants and associated waste management facilities. Their report is published in IAEA-TECDOC-1716.

In addition, interregional workshops provide tools, training and exercises to help newcomers familiarize themselves with the large range of issues that must be considered when establishing a nuclear energy system.



LEGAL FRAMEWORK

Member States have long recognized that a coherent and comprehensive national legal framework is essential for ensuring the safe, secure and peaceful uses of nuclear energy.

Countries embarking on a new nuclear power programme need to establish such a framework, not only to implement relevant international instruments (listed below) to which they are parties but also to establish the duties and responsibilities of the various organizations required for the programme's success.

Legislative Assistance Programme

NUCLEAR LAW SPECIALISTS AT THE DISPOSAL OF MEMBER STATES

In helping Member States to meet this need, the IAEA offers a comprehensive legislative assistance programme covering the main branches of nuclear law: safety; security; safeguards; and civil liability for nuclear damage.

The objectives of the programme include creating awareness in Member States of the relevant international instruments, assisting them to comply with their international obligations and commitments and establishing the needed national legislative framework, as well as transferring relevant knowledge to them.

The programme is implemented through a multi-faceted approach, including national workshops, the training of individuals, such as the annual Nuclear Law Institute (NLI), the development of reference and training material and, importantly, the provision of bilateral assistance in drafting national nuclear laws.

Handbooks on Nuclear Law

A useful resource is provided by the two Handbooks on Nuclear Law, developed by the IAEA Office of Legal Affairs. **Volume I** of the Handbook, published in 2003, inter alia, sets out the basic principles of nuclear law. **Volume II** focuses on implementing legislation and the practical side of drafting national nuclear laws. In this context, it also includes model provisions.

The IAEA Secretariat is developing a third volume of the Handbook on Nuclear Law to cover various areas of nuclear law beyond regulatory matters covered in the first two volumes.

There also exists an **IAEA International Law Series** of publications, available at <http://ola.iaea.org/ola/publications.html>.

Nuclear Law Institute

In 2011, the IAEA Office of Legal Affairs established an annual Nuclear Law Institute in Vienna, in order to meet the increasing demand for legislative assistance by Member States, in particular, in the drafting of national nuclear legislation.

RELEVANT INTERNATIONAL LEGAL INSTRUMENTS FOR A NUCLEAR POWER PROGRAMME ADOPTED BY OR UNDER THE AUSPICES OF THE IAEA INCLUDE:

NUCLEAR SAFETY

- Convention on Early Notification of a Nuclear Accident (INFCIRC/335);
- Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (INFCIRC/336);
- Convention on Nuclear Safety (INFCIRC/449);
- Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (NFCIRC/546).

NUCLEAR SECURITY

- Convention on the Physical Protection of Nuclear Material (INFCIRC/274);
- Amendment to the Convention of the Physical Protection of Nuclear Material (GOV/INF/2005/10-GC(49)/INF/6).

SAFEGUARDS

- Structure and Content of Agreements Between the Agency and States Required in Connection with the Treaty on the Non-Proliferation of Nuclear Weapons (INFCIRC/153 Corrected);
- Model Protocol Additional to the Agreement(s) Between State(s) and the Agency for the Application of Safeguards — INFCIRC/540 Corrected.
- Standard Text of the Small Quantities Protocol — GOV/INF/276
- Revised Standard Text of the Small Quantities Protocol — GOV/INF/276/Rev. 1

NUCLEAR LIABILITY

- Vienna Convention on Civil Liability for Nuclear Damage (INFCIRC/500);
- Joint Protocol Relating to the Application of the Vienna Convention and the Paris Convention (INFCIRC/402);
- Protocol to Amend the 1963 Vienna Convention on Civil Liability for Nuclear Damage (INFCIRC/566);
- Convention on Supplementary Compensation for Nuclear Damage (INFCIRC/567).



SAFEGUARDS and SECURITY

Safeguards and Non-Proliferation

The IAEA's Department of Safeguards provides training for all Member States in implementing safeguards under the Comprehensive Safeguards Agreement (INFCIRC/153), Additional Protocol (INFCIRC/540) and Small Quantities Protocol (GOV/267), as applicable. In general, these training objectives are targeted towards establishing and maintaining the State System of Accounting for and Control of Nuclear Material (SSAC) as required by a comprehensive safeguards agreement.

The SSAC comprises both the State authority responsible for safeguards implementation and the facilities which it regulates, and serves as the mechanism for cooperation with the IAEA in fulfilment of the legal undertakings of the State. The SSAC also provides a State with an effective system for the implementation of domestic safeguards for national purposes that may contribute to nuclear security and safety.

International and regional SSAC courses are offered yearly to provide training to both State authority and facility operators. These courses provide an important means of human resource development and capacity building. Including safeguards in nuclear power planning and pursuing consultations with the IAEA at an early stage of a programme are important factors for confidence building and cost effectiveness. One of the key issues for newcomers to nuclear power is the establishment of a legal, organizational and technical framework in the area of safeguards commensurate to the increase of nuclear or nuclear related activities in the country. Several important steps need to be considered like rescinding a Small Quantity Protocol, sending information to the IAEA on the design of the future power plant as early as possible, and submitting and updating AP declarations on nuclear fuel cycle related plans. For each of these steps, the IAEA can provide specific, targeted support, based on continuing communication between the State and the IAEA in order to develop the most appropriate plan, in cooperation with all the departments of the IAEA.

In addition, at the request of a Member State, targeted training courses can be arranged to address

specific areas of safeguards interest. Courses can also address follow-on recommendations from an IAEA Integrated Nuclear Infrastructure Review mission and/or from the IAEA SSAC Advisory Service (ISSAS) missions, which offer a consultancy service aimed at furthering the effectiveness of the SSAC through a thorough review of the legal, regulatory and technical framework of the Member State's safeguards system.

Nuclear Security

The IAEA provides advisory services to Member States to establish or enhance the necessary infrastructure to protect nuclear and other radioactive materials from theft and diversion, protect nuclear installations and transport against sabotage and other malicious acts, and to combat illicit trafficking in nuclear and other radioactive materials.

In a new nuclear power programme, the IAEA focuses on knowledge building through workshops and training courses on the methodology to develop a design basis threat, the physical protection of a plant and the development of nuclear security culture.

In addition, International Physical Protection Advisory Service (IPPAS) missions serve as the IAEA's chief tool for evaluating and providing recommendations to improve the legal and regulatory infrastructure for physical protection of nuclear material and also the existing physical protection arrangements in Member States. The IPPAS mission can be adapted to the needs of new nuclear power programmes.

Furthermore, the IAEA assists States in establishing Integrated Nuclear Security Support Plans (INSSPs), which are comprehensive work plans for States' nuclear security activities and enables increased coordination. The INSSPs are developed jointly with States and are based on findings and recommendations from the IAEA's range of nuclear security missions, such as IPPAS. The IAEA has developed or otherwise finalized INSSPs with several States embarking on nuclear power programmes including Bangladesh, Belarus, Jordan, Nigeria, UAE and Vietnam. Development with several more newcomer countries is currently underway.

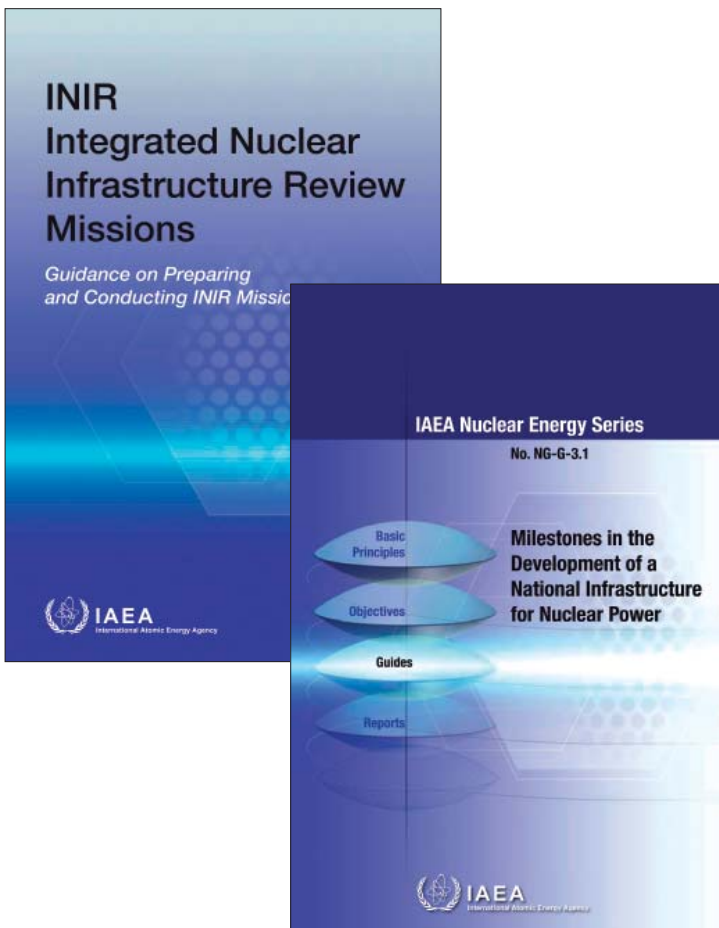
NUCLEAR POWER INFRASTRUCTURE —

Evaluating Infrastructure for Continuous Improvement

Self-evaluations and international peer reviews, encouraged by the IAEA Action Plan on Nuclear Safety, can be a means for identifying weaknesses, prioritizing activities and continuously improving the infrastructure for a new nuclear power programme. The IAEA offers an Integrated Nuclear Infrastructure Review (INIR) which covers the comprehensive infrastructure and can be performed when a Member State is nearing a Milestone. Other services, such as the International Regulatory Review Service (IRRS) focus on specific institutions or issues. These services also include methodologies for self-evaluations and assessments which can be performed by Member States at regular intervals to check their own progress.

Integrated Nuclear Infrastructure Reviews

The INIR mission reinforces continual improvement in the planning process, identifying gaps, focusing resources in national action plans, and contributing to confidence building by reviewing the infrastructure status at or near a Milestone. The INIR mission is conducted by a team of international experts and specialized IAEA staff through interviews, site visits and document reviews. Suggestions and recommendations are provided in a report to the Member State, enabling it to update its national action plan accordingly. Since 2009, 12 INIR missions have been conducted in Belarus, Bangladesh, Indonesia, Jordan (2), Poland, South Africa, Thailand, Turkey, the United Arab Emirates (UAE) and Vietnam (2).



IAEA REVIEWS PROGRESS OF NUCLEAR POWER PROGRAMMES

"The INIR mission has strengthened the expertise and also the cooperation amongst the nuclear industry in South Africa. This mission could not have come at a more important time for our country."

Nelisiwe Magubane
Director General of South Africa's Department of Energy

"The UAE considers the INIR mission an important milestone for its civil nuclear energy programme"

H.E. Ambassador Hamad Al Kaabi,
UAE Permanent Representative to the IAEA,
Special Representative for
International Nuclear Cooperation

Evaluating Programme Developments

Integrated Regulatory Review Service

The IRRS is designed to enhance the effectiveness of the regulatory infrastructure of States for nuclear, radiation, radioactive waste and transport safety and security of radioactive sources, by reviewing both regulatory technical and policy issues against IAEA safety standards and good practices in other countries.

IRRS missions provide a balance between technical and policy discussions among senior regulators and the opportunity to share regulatory experiences, to harmonize regulatory approaches among countries and to create mutual learning opportunities among regulators.

Regulatory technical and policy discussions take into account current issues coming from the State's self-assessment and resulting from the evaluation of technical areas. IAEA fundamental safety principles provide the basis for IAEA safety standards and its safety related programmes.

Services Available to Newcomers

Milestone 1

- Integrated Nuclear Infrastructure Review Mission Phase 1
- Site and External Events Design Review
- International Nuclear Security Advisory Service

Milestone 2

- Integrated Nuclear Infrastructure Review Mission Phase 2
- IAEA SSAC Advisory Service
- International Physical Protection Advisory Service
- Integrated Regulatory Review Service, and Follow Up
- Emergency Preparedness Review Service
- Peer Review Services (WANO and OSART)

Milestone 3

- Integrated Nuclear Infrastructure Review Mission Phase 3
- Other Missions and Review Services, as appropriate

Additional Review Services

As Member States progress towards commissioning their first nuclear power plant, they may consider additional reviews in specific areas such as emergency preparedness and nuclear security, or of specific institutions such as the IAEA Operational Safety Team (OSART) reviews and peer reviews of the future operator organization by the World Association of Nuclear Operators (WANO).





HUMAN RESOURCES DEVELOPMENT —

A competent and skilled workforce is a critical element in building the infrastructure for a new nuclear power programme. Human resource development is a cross-cutting activity involving several national institutions, especially the government, regulatory bodies, future owner–operators, technical support organisations (TSOs) and the education sector.

It is unlikely that Member States embarking on a nuclear power programme will already have all the competencies necessary to implement such a programme, though they may have some relevant experience with regulation and the operation of nuclear research facilities.

Developing Knowledge and Skills

The focus of developing human resources is two-fold: (i) generic capacity building at the national level in nuclear sciences and technology to support the government and other stakeholders in preparing for a knowledgeable decision on nuclear power, as well as creating a resource pool of potential industry recruits, and (ii) developing personnel to perform specific functions in stakeholder organizations to implement the nuclear power programme.

For the IAEA assistance to the owner-operators, the IAEA focuses on the non-commercial phases of infrastructure development, helping them to become an ‘intelligent customer’, with the expectation that after a contract is signed, the vendor will provide technology specific training. Special emphasis is also placed on supporting the development of the nuclear regulatory bodies in the non-commercial phases, as they will need to determine the regulatory framework and be prepared for licensing activities in advance of the bid being submitted. Owing to the long training and development times needed for some of the more specialist roles in the key organisations, it is

necessary to recruit and train them well in advance. It is of vital importance to remember that while many graduates are needed, from different fields, the majority of the overall workforce requirements for implementing a nuclear power programme are skilled craftsmen/technicians with vocational qualifications.

National Workforce Planning

A national workforce plan to develop and maintain a human resource base across all of the implementing institutions should be developed to ensure coordination of supply and demand. Even if much of the initial knowledge and skills are to be provided by foreign sources, long term expertise to manage and oversee the project should be developed, refined and retained within the country.

The IAEA has conducted many workforce planning workshops at both the regional and national levels to support Member States in this crucial task. A review service is also available to help Member States enhance initial plans at the national and organisational levels.



A Crucial Infrastructure Element

Education and Training

Education and Training is an important aspect of capacity building. An important activity during the infrastructure development phase is to review the national secondary and tertiary education systems to ensure the curricula are broad enough to create the necessary workforce.

SCHOOL OF NUCLEAR ENERGY MANAGEMENT

The IAEA supports training and education in the nuclear area through many activities. For example, in cooperation with the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy, the IAEA has developed a three-week School of Nuclear Energy Management for young professionals from different nuclear organizations. The school provides a unique international educational experience aimed at building future leadership to manage nuclear energy programmes. It targets young professionals with managerial potential from developing countries — particularly new-comer countries that seek to develop nuclear power or other nuclear applications — who show promise as future leaders of the nuclear industry, academia and public sector entities in their coun-

try. The School of Nuclear Energy Management enables the transfer of IAEA specific knowledge to Member States towards their capacity building efforts. Due to the programme's success, new schools of Nuclear Energy Management have also opened in both Japan and the United States.

CYBER LEARNING PLATFORM FOR NUCLEAR EDUCATION AND TRAINING

E-learning is regarded as the modern and cost effective means to supplement traditional face-to-face education, and the way forward to provide Member States with more opportunities to access valuable information and knowledge regardless of time and place.

The Cyber Learning Platform for Nuclear Education and Training (CLP4NET) has been developed and installed upon the request of the Khalifa University of Science, Technology and Research in Abu Dhabi, UAE, where there is increasing need for nuclear human resource development to build the country's first nuclear power plant.

The cyber learning platform is expected to serve as the hub to facilitate self-learning and deliver e-training courses at the University and in the region in the near future. Other Member States, for example Argentina and Ghana, have requested IAEA assistance in installing the CLP4NET in their regions.

MANAGING NUCLEAR KNOWLEDGE

Putting in place and sustaining knowledge in the nuclear area is crucial for any country embarking on a new nuclear power programme. The IAEA offers missions which support newcomers in developing policies and strategies for nuclear knowledge management, review nuclear education and training programmes and facilitate the transfer of methodologies and tools to manage nuclear knowledge.



SAFETY INFRASTRUCTURE —

Nuclear safety is an important aspect of the infrastructure necessary to support a nuclear power programme. Nuclear safety is a national responsibility, and nations planning nuclear programmes must develop, maintain and improve safety through international and national cooperation. These efforts are necessary to protect citizens, neighbouring countries, the region, and the world.

Safety Standards

A key component of the overall preparations required for emerging nuclear power programmes is the application of the IAEA safety standards to support the development of effective national safety infrastructure and the implementation of

international instruments, such as the *Convention on Nuclear Safety*, the *Joint Convention on the Safety of Radioactive Waste and Spent Fuel Management*, and *Codes of Conduct*.

Establishing the Safety Infrastructure for a Nuclear Power Programme (SSG-16) provides a roadmap for Member States to apply the IAEA safety standards and other elements of the global nuclear safety regime progressively during the early phases of the implementation of a nuclear power programme.

In conjunction, the IAEA safety review missions — based on internationally agreed safety standards — build up confidence on the capacity of a country to develop nuclear energy in a safe way.



and Regulatory Framework

Regulatory Framework

Crucial to the long term success of a nuclear energy programme is the establishment of an independent and competent regulatory body. The confidence of the public and the international community depends heavily on effective regulation. The need for a competent and effective regulatory body must be understood and given priority.

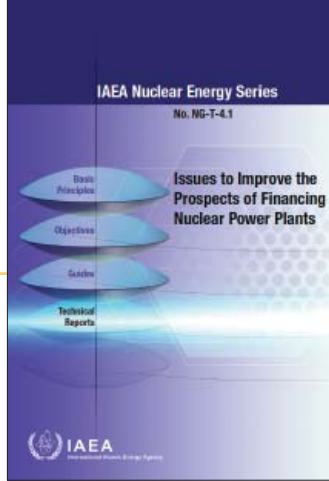
Experience has shown that safety and credibility are best served by a complete separation of the regulatory body from the promotional and implementing organizations and the political process. The primary reason for independence of the regulatory body is to ensure that regulatory deci-

sions can be made and enforcement actions taken without pressure from interests that may conflict with safety.

While not all governments have begun their nuclear programmes with this provision, almost all are adopting this approach.

Additionally, through the **Regulatory Cooperation Forum**, the IAEA supports nuclear newcomer countries in their efforts to launch safe, secure, efficient, responsible and sustainable nuclear power programmes. While the Forum is member driven, the IAEA facilitates and promotes coordination and collaboration among regulators.





FIRST NUCLEAR POWER PLANT PROJECT —

In parallel with building the infrastructure for a nuclear power programme, the future owner organization will begin preparing the project for the nuclear power plant itself. The IAEA's services are focused on supporting the future owner to become a knowledgeable customer.

"With the help of the IAEA, we now have an integrated Master Plan for nuclear infrastructure development in direct support of our two planned power reactors."

*Anh Tuan Hoang,
Vietnam Atomic Energy Agency*

Feasibility studies

The future owner commissions a nuclear power plant feasibility study to demonstrate that nuclear power will be a technically and economically viable option to achieve the power production objective. The IAEA has developed several resource and guidance documents to assist Member States with feasibility studies, including planning and technical evaluation of the electrical grid, preparing the environmental impact assessment and reviewing technology options.

The IAEA is supporting Member States with guidance and capacity building for undertaking feasibility studies, as, for example, recently provided to Indonesia, Jordan and Kenya.

Site Selection and Evaluation

Site selection and evaluation are a crucial part of establishing a nuclear programme. A survey of potential sites is conducted and evaluated against national criteria. The IAEA has a well-developed programme to support Member States in site selection and evaluation.

Reactor Technology Assessment

The IAEA can assist Member States in capacity building on reactor technology evaluation. This process supports newcomers in determining national requirements and those reactor characteristics fulfilling the requirements.

This IAEA assessment process helps countries in preparing well for the technical aspects of the bidding process, including developing design specifications and evaluation criteria.

Managing Financing Risk

The IAEA does not finance nuclear power plants. However, it offers workshops to introduce the technical community to the principles of nuclear financial risk management. For example, a national workshop was conducted in Belarus to raise the level of understanding of the national project team on the importance of, and means for, managing financial risk.

Becoming a Knowledgeable Customer

Developing Future Nuclear Operators

The IAEA has prepared an assistance package for future owner-operators because it has been decades since a new owner-operator organization has constructed a first nuclear power plant.

The primary responsibility for nuclear safety lies with the operator. The organizational culture and management system of the future owner-operator is established while the institution develops — before the contract for the first nuclear power plant is signed and before there is a plant to operate. An executive leadership programme was piloted in 2013 with the Massachusetts Institute of Technology to help top level managers develop an understanding of their responsibilities for nuclear safety.

“I remember the early stages of the nuclear power construction programme in my country.

Now it is our turn to help the newcomers in the nuclear industry. We are ready and willing to help, hand in hand with the IAEA.”

*Jong Shin Kim,
President and CEO of KHNP*



RADIOACTIVE WASTE MANAGEMENT —

Radioactive waste of all categories is generated during operation and decommissioning of a power reactor; planning for its management should be initiated in the early stages of considering a new nuclear power programme.

National Policy and Technical Strategy

Ideally, countries should have a national policy and a technical strategy, or strategies, for the management of radioactive waste. The two components are linked — the policy establishes the principles for radioactive waste management and the strategy contains the approaches for the implementation of the policy. For this reason, their development should be closely coordinated.

A policy for spent fuel and radioactive waste management provides the basis for:

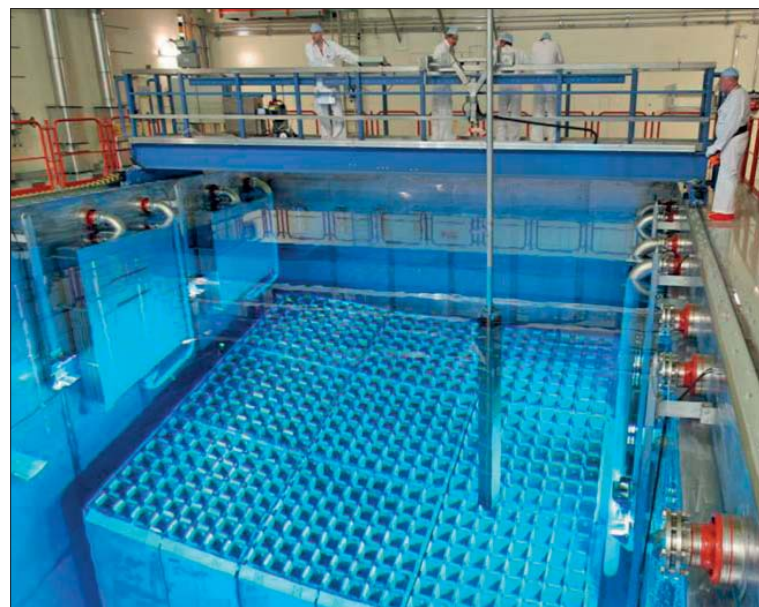
- Developing and establishing legislative and regulatory frameworks including export/import principles;
- Developing an adequate radioactive waste management system or improving the existing one;
- Allocating responsibilities for waste management;
- Planning and developing the required capabilities, i.e. facilities and human resources;
- Creating a system for financing waste management; and
- Involving stakeholders and the public.

The consequent formulation of strategies for radioactive waste management enables development of a technical infrastructure in due course. When commissioning a reactor, certain fuel and waste management facilities must exist, such as reactor cleaning systems, raw waste collection and spent fuel cooling ponds.

In addition, waste processing and storage facilities are also needed. Usually they are located at or close to the reactor site; facilities can be ordered from the reactor vendor or procured separately. Disposal facilities are mostly located away from the reactor site and can be built later, provided that sufficient storage capacities exist for radioactive waste and spent fuel.

Managing Spent Fuel and Radioactive Waste

The IAEA assists Member States, in particular strategic planners, waste managers, operators of waste management facilities and regulators in managing spent fuel and radioactive waste in a safe and responsible manner by developing international standards and disseminating proven technical



Developing Policies and Strategies

approaches. As part of these efforts, the IAEA provides guidance to countries on establishing national radioactive waste management policies and relevant strategies. This guidance is also relevant to spent fuel after it is declared as waste.

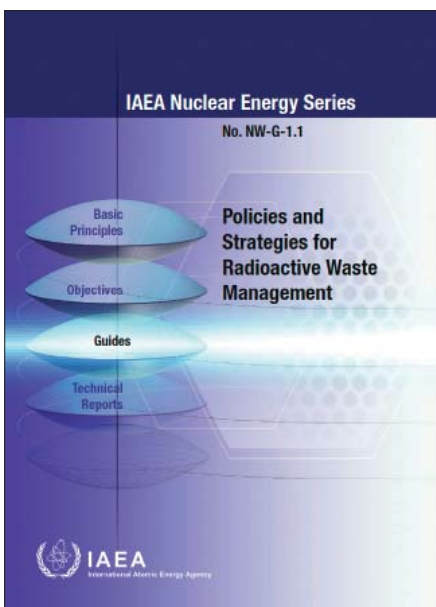
Several series of documents, such as the IAEA Safety Standards Series, the Nuclear Energy Series and Technical Documents (TECDOCs), can be helpful for Member States in establishing the necessary infrastructure for spent fuel and radioactive waste management.

For example, *Policies and Strategies for Radioactive Waste Management* (IAEA Nuclear Energy Series NW-G-1.1) describes the principles for establishing a national waste management infrastructure and intends to help in facilitating proper and systematic planning and safe implementation of all waste management activities.

To facilitate information and experience sharing amongst organizations and encourage knowledge transfer with regard to good practices in managing radioactive waste, the IAEA is supporting networks that connect practitioners in specific areas

of radioactive waste management: DISPONET on Low Level Waste Disposal, URF on Underground Research Facilities and Geological Disposal and LABONET on Waste Characterisation.

In order to enable the networks to function beyond the normal IAEA mechanisms of closed workshops, meetings, and other limited events, the IAEA is building a web-based platform called CONNECT to deliver online collaboration and training access for a much broader audience. The CONNECT platform is available at: <http://nucleus.iaea.org/sites/connect/>.





TECHNICAL COOPERATION —

Reliable energy is essential, not only for economic development, but also for food security and human health. Without increased investment in the energy sector, and major improvements in energy services in developing countries, it will not be possible to meet the Millennium Development Goals (MDGs). The Agency helps Member States to build energy planning capabilities, and supports countries that are exploring the establishment of, or already have, a nuclear power programme.

The IAEA's technical cooperation (TC) programme is the main mechanism for the delivery of IAEA services to Member States. TC projects are collaborative undertakings between Member States, partners and the IAEA. Projects respond to priority national developmental needs where the IAEA has a unique role to play, where nuclear technology has a comparative advantage, or where the IAEA can add value to the work of other development partners.

What TC projects do

TC projects provide interdisciplinary assistance to Member States with up-to-date and objective information and guidance on energy planning models and nuclear energy technologies. TC project scope ranges from small projects to help with the development of energy strategies using energy

planning models to much more integrated and comprehensive multidisciplinary projects to assist newcomer countries to make knowledgeable decisions about the nuclear power options and to build national nuclear power infrastructure for countries which decided to embark on a nuclear power programme. Projects range from the development of government policy for the safe management of nuclear power facilities to more tangible assistance with power plant siting, construction, commissioning and safe operation.

National projects address the specific needs of a given Member State while regional and inter-regional projects target regional needs which are common to a group of countries. In all TC project categories, beneficiary Member States are expected to show strong commitment, and to assume full ownership of their infrastructure development.

A cross-cutting aspect of IAEA assistance is human capacity building at all stages. This is usually achieved through advisory assistance and mentorship, as well as through training courses and workshops. Networks created through TC projects generate a long-lasting legacy, providing a continuing resource for finding information, lessons and partners for future activities.

TC SUPPORTS NEWCOMERS IN

- Building capacity
- Developing networks
- Sharing knowledge
- Facilitating partnerships

within the portfolio of
IAEA services





Arthus-Bertrand

A Mechanism to Deliver IAEA Services

Expert assistance makes available on-the spot training in a developing country through missions by international experts. Their objectives are to find out facts, introduce and explain the IAEA guidance publications and available services, and respond to specific needs identified by Member States.

Training fellowships prepare local personnel to take over the responsibilities for nuclear power. Fellows are sent abroad for comprehensive training to a suitable institution for several months.

The IAEA has produced a catalogue of services that brings together in one place materials about the wide range of support and assistance that can be provided to its Member States. The catalogue is organized by the phase of development of the nuclear power infrastructure, as well as by the organization for whom the assistance is designed. It is intended to be a resource and tool for countries as they plan their TC projects. Information on the general topics covered by workshops, expert missions and review services is available, and the services can be customized and tailored to countries' specific needs.

How TC Supports Member States — Some Examples for Interregional and Regional TC Projects

Supporting Nuclear Power Infrastructure Capacity Building in Member States Introducing and Expanding Nuclear Power (INT/2/013)

The IAEA is supporting institutional capacity building in several Member States around the world on nuclear power infrastructure requirements for the introduction and expansion of nuclear power programmes. The project also aims to support the establishment of a global network for the exchange of information, sharing of experi-



ences and transfer of knowledge required to strengthen the *Milestones* approach. Member States participating in the project have received tools and mechanisms to support the establishment of a sustainable infrastructure.

Strengthening Planning Capabilities for Sustainable Energy Development in Africa (RAF/0/028)

In recent years, several African countries have expressed a strong interest in energy strategy development using the IAEA energy planning tools. A number have decided to update their existing energy mix, and are investigating the appropriateness of the nuclear power option. The region, however, lacks infrastructure, suitable analytical tools, adequately skilled professionals and funding to promote effective energy planning, limiting the region's ability to address energy development challenges. The increasing complexity of energy planning necessitates the use of sophisticated mathematical modelling techniques.

The regional TC project RAF/0/028 was designed to enhance the capabilities of African Member States in the development of national energy strategies for sustainable development. Participants completed energy planning training and prepared



national energy planning strategies, using the IAEA's suite of energy planning models.

As a result, participating Member States were able to prepare and validate national energy demand reports. In addition, Member States strengthened their planning capabilities for sustainable energy development. With comprehensive national energy plans and strategies in place, the energy development of participating countries in Africa can move forward on a solid foundation.

Supporting Decision Making for Nuclear Power Planning and Development - Phase II (RAS/2/016)

Within the Asia and the Pacific region, regional project RAS/2/016 has provided assistance to participating Member States in building capabilities for the introduction of nuclear power. During 2012, support was provided through regional training courses and workshops on topics related to the *Milestones* approach, including human resource development, financial models, regulatory and legal infrastructure, education and training programmes, public information and stakeholders involvement. Furthermore, a successful mentoring programme has been established under the project in the region, where advanced nuclear power countries such as China, Japan and the Republic of Korea share their experience with newcomers in launching successful nuclear power programmes.

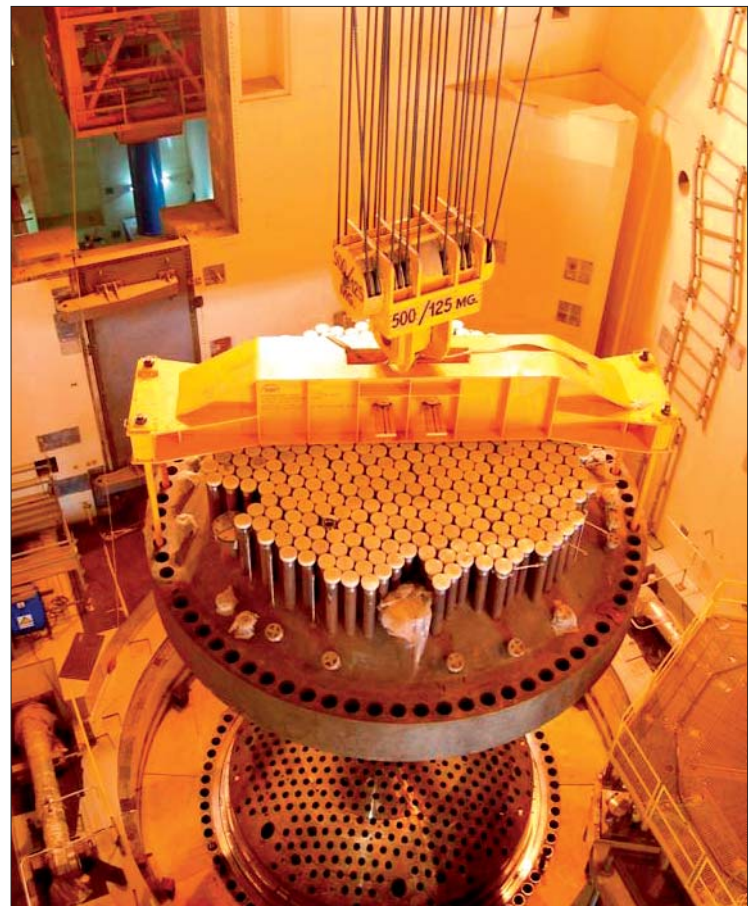
Enhancing Nuclear Power Infrastructures for Countries Considering Developing or Expanding Nuclear Power Programmes (RER2007)

In Europe, RER/2/007 is intended to support the development of nuclear power infrastructure, including planning, building and assessing a nuclear power infrastructure for the introduction and expansion of nuclear power in the region. This includes strategy development, feasibility, financing and nuclear power infrastructure programme

management as related to the 19 issues identified in the *Milestones* document.

Building Capacity for the Development of Sustainable Energy (Phase II) (RLA/0/040)

This TC project has been very important for the Latin America region, providing participating counterparts with the information and knowledge necessary to advise policy and decision-makers on diversifying supply and rationalizing energy use. The project has strengthened different national capabilities in the energy sector for energy analysis and planning. The results will contribute to improving the efficient use of energy resources, and will reduce uncertainty in regard to international market supply. It is expected that a higher level of energy independence, in accordance with national development plans, will be achieved. The project benefited from collaboration with regional organizations such as the Latin American Energy Organization (OLADE).



Additional **RESOURCES**

Websites

Nuclear Infrastructure Development Section: <http://www.iaea.org/NuclearPower/Infrastructure/>

Department of Nuclear Energy: <http://www.iaea.org/OurWork/ST/NE/Main/>

Division of Nuclear Fuel Cycle and Waste Technology: <http://www.iaea.org/OurWork/ST/NE/NEFW/>

Division of Nuclear Power: <http://www.iaea.org/NuclearPower/>

Department of Nuclear Safety and Security: <http://www-ns.iaea.org>

Office of Legal Affairs: <http://ola.iaea.org>

Department of Safeguards: <http://www.iaea.org/safeguards>

Department of Technical Cooperation: www.iaea.org/technicalcooperation

IAEA Publications on Nuclear Power Infrastructure Development

A comprehensive nuclear infrastructure bibliography covering all areas addressed in this brochure is available at the website of the Nuclear Infrastructure Development Section at:

<http://www.iaea.org/NuclearPower/Infrastructure/Bibliography/>

Publications can be ordered from the IAEA Publication Section at:

<http://www.iaea.org/Publications/>

Selected Publications

Milestones in the Development of a National Infrastructure for Nuclear Power (NE-Series NG-G-3.1)

Evaluation of the Status of National Nuclear Infrastructure Development (NE-Series NG-T-3.2)

INIR — Integrated Nuclear Infrastructure Review Missions: Guidance in Preparing and Conducting INIR Missions (Booklet Rev.1, 2011)

Managing Human Resources in the Field of Nuclear Energy (NE-Series NG-G-2.1)

Issues to Improve the Prospects of Financing Nuclear Power Plants (NE-Series NG-T-4.1)

Responsibilities and Capabilities of a Nuclear Energy Programme Implementing Organization (NE Series No. NG-T-3.6)

Initiating Nuclear Power Programmes: Responsibilities and Capabilities of Owners and Operators (NE Series No. NG-T-3.1)

Policies and Strategies for Radioactive Waste Management (IAEA Nuclear Energy Series NW-G-1.1)

Options for Management of Spent Fuel and Radioactive Waste for Countries Developing New Nuclear Power Programmes (IAEA Nuclear Energy Series NW-T-1.24)



IAEA

International Atomic Energy Agency



For further information:

Nuclear Infrastructure Development Section (NIDS)
IAEA Department of Nuclear Energy
<http://www.iaea.org/NuclearPower/Infrastructure/>

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