Regulatory issues for new nuclear build and new entrants

by J. Nakoski*

Many countries are showing growing interest in using nuclear power to meet increased energy demands, even in the current economic environment. Some 70 countries are discussing nuclear power as a potential part of their national energy policies. The level of interest in these countries does, however, vary. Of these countries, only a handful will make the commitment to license, construct and operate their first nuclear power plant before 2020. These "new entrants" are in addition to those countries that already have established nuclear power programmes and are increasing their nuclear capacity.

Nuclear power plants under construction
(as of 17 November 2010)

Country	No. of units	Capacity (MWe)
Argentina	1	692
Brazil	1	1 245
Bulgaria	2	1 906
China	22	22 020
Chinese Taipei	2	2 600
Finland	1	1 600
France	1	1 600
India	4	2 506
Iran, Islamic Republic of	1	915
Japan	2	2 650
Korea, Republic of	5	5 560
Pakistan	1	300
Russian Federation	11	9 153
Slovak Republic	2	782
Ukraine	2	1 900
United States	1	1 165
Total	**61**	**59 194**

Source: IAEA Power Reactor Information System (PRIS).

Lessons learnt from the past have demonstrated the impact that an event at a nuclear power plant in one country can have on the nuclear power programmes in other countries. These lessons, as well as others, have been incorporated into the nuclear power programmes of countries with established programmes and contribute to the excellent safety performance of nuclear power plants in these countries. However, recent experience shows that even for countries with mature programmes, challenges remain for licensing and constructing new nuclear power plants. For new entrants, the challenges will potentially be more significant.

There are many challenges that countries adding new nuclear power capacity will face. To support a country's decision on the nuclear power option, the International Atomic Energy Agency (IAEA) issued NG-G-3.1, "Milestones in the Development of a National Infrastructure for Nuclear Power". This report provides a roadmap that addresses essentially all the issues a country may face as it seeks to introduce nuclear power in its energy mix. Included here is a brief overview of the main challenges associated with developing regulatory infrastructure, the subject of two forthcoming NEA reports due to be issued shortly.

Fundamental safety principles

Many of the countries starting a nuclear power programme have little experience in the safe application of this technology. An issue that new entrants need to address is understanding, then applying, fundamental safety principles to their decision-making processes. This concerns the licensees (owners and operators), the construction organisations, and the nuclear steam supply system (NSSS) vendors, as well as the government and the regulator.

While the licensee is primarily responsible for all aspects of plant safety, the latter starts with the design developed by an NSSS vendor. The regulator has a role in ensuring safety by verifying that the NSSS vendor's design incorporates the concept of defence-in-depth to protect the public and the environment, and that the licensee applies this concept as it operates and maintains the plant in a manner consistent with the design.

In addition, during construction, the operator, the NSSS vendor, the construction organisations and the regulator need to ensure that the plant is constructed as designed and licensed. This includes conducting reviews, tests or analyses that demonstrate that the structures, systems and components are manufactured and constructed with the necessary quality to provide confidence that the plant can be operated as designed.

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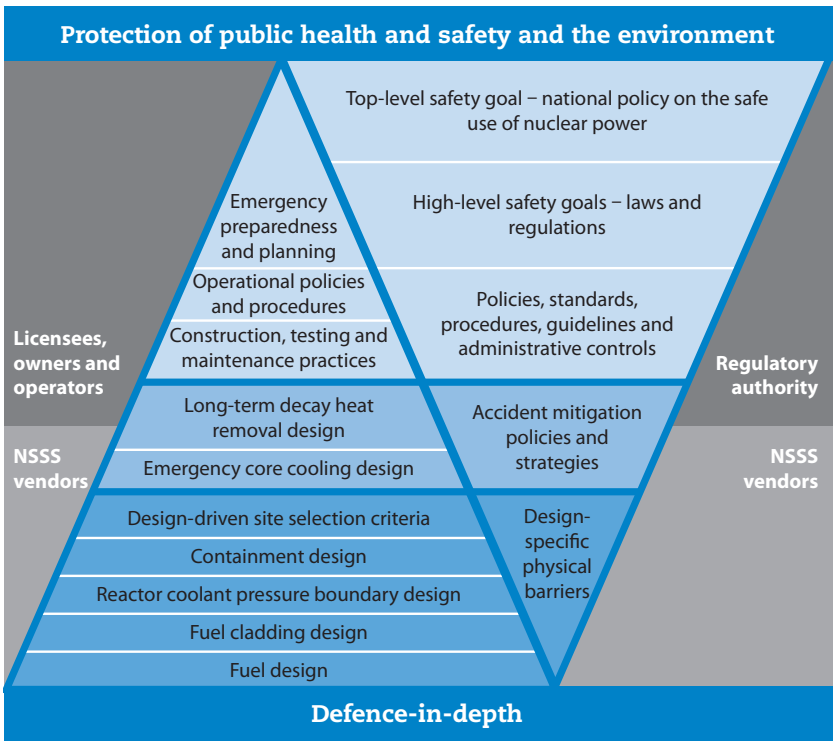

Applying the fundamental safety principles to decision-making processes can be challenging as schedule and costs are also factors that influence the introduction of nuclear power to a country's energy supply. Licensees, vendors and construction organisations are responsible for implementing their decision-making processes such that there is a clear demonstration that the fundamental safety principles are being met while meeting schedules and keeping costs within budget. Regulators have the role of establishing the framework that requires safety to come before cost and schedule. Regulatory oversight needs to focus on ensuring that nuclear safety is the first component of the decisions made during all phases of a nuclear power programme, from design through decommissioning and long-term storage of spent fuel.

Workforce development

Closely related to understanding and implementing strong safety principles is having a workforce with the technical, programmatic, trade and regulatory skills, as well as the knowledge and experience to support a nuclear power programme. Each organisation needs to understand its role in the overall programme; what skills, knowledge and experience are necessary to effectively implement this role; the gap between the skills, knowledge and experience of its staff; and what the organisation needs to be successful.

Before the recent renewed interest in nuclear power, very few countries had built any nuclear power plants over the past 30 years. These countries have educational and development programmes to maintain and expand their workforce to support the increased scope of their nuclear programmes.

Other countries with mature nuclear power programmes have not been building new nuclear power plants and have been focusing on replacing the experienced workforce as its members retire. As these countries begin to add new nuclear plants, they are implementing programmes to increase the numbers of staff with the knowledge and skills to support their planned expansions. Building upon their existing staff, the programmes are transferring the knowledge and experience from their senior staff to recently hired personnel.

For new entrants, it is more challenging since they likely do not have a workforce that has the skills, knowledge and experience necessary to support a nuclear power programme. They need to build on the experience of countries with established programmes and by working with international organisations. Many new entrants have established bilateral and multilateral arrangements with experienced regulators to develop needed regulatory skills. IAEA Member States have established a Regulatory Co-ordination Forum to facilitate capacity building in countries adding nuclear power to their energy supply.

Legislative and regulatory infrastructure

Undergirding a nuclear power programme are the laws and regulations that provide a legal framework for the peaceful use of nuclear energy. For countries with established nuclear power programmes, such frameworks are in place. However, for new entrants

it is an issue that should be addressed very shortly after the decision is made to pursue the addition of nuclear power to the energy supply.

While many new entrants have existing legislative and regulatory infrastructures supporting the peaceful use of nuclear energy for industrial and medical uses, a more robust system is required for using nuclear energy for power production in order to comply with international treaties and to meet international standards for safety, security and safeguards. With the objective of sharing information on regulatory infrastructure, the NEA Working Group on the Regulation of New Reactors (WGRNR) sponsored a workshop[1] on "New Reactor Siting, Licensing and Construction Experience" in September 2010. The State Office for Nuclear Safety of the Czech Republic hosted the workshop in Prague. Many of the 60-some participants were from countries developing their regulatory authorities to support new nuclear build. During the workshop insights were shared, with developing regulators encouraging experienced regulators to examine their practices for enhancements, and experienced regulators encouraging developing regulators to continue their focus on protection of the public and the environment.

IAEA Member States have worked together to develop safety standards that reflect an international consensus on what constitutes a high level of safety for protecting people and the environment from the harmful effects of ionizing radiation. The IAEA safety standards and safety guides provide a framework for establishing legislative and regulatory policies and programmes. By following the framework established by these safety standards, new entrants can benefit from the experience of mature regulatory programmes as they build capacity to support a nuclear power programme.

A key part of the legal framework is the licensing process during which the regulator reviews and approves an application for a new nuclear power plant. During this process, the regulator assesses the technical aspects of the design; the organisational capability of the applicant to effectively manage the design, construction, testing, operation and maintenance of the reactor; the suitability of the site for the selected reactor design; and the plans for security and emergency response, among other issues.

As the regulatory body develops its licensing process, it will need to create the programmes and procedures to guide its staff in conducting these reviews and assessments consistent with the overarching legal framework and nuclear safety principles. The WGRNR is drafting a report that will describe the regulatory structure, licensing processes and resources used by a cross-section of experienced regulators and by the new entrants working with the group. This report will serve as a guide for regulators starting the review of their first new reactor application and provide a benchmark against which more developed regulators can assess their programmes.

After a nuclear power plant has been licensed for construction, the regulator's role needs to shift from design reviews and analyses to verification that construction is being carried out in accordance with the design and to the appropriate level of quality. The licensee has the primary responsibility for ensuring that the plant is constructed as designed. However, within the regulatory framework the regulator is responsible for overseeing the activities of the licensee and construction work. This provides an additional assessment to ensure that the plant is being constructed as the regulator licensed it.

When the regulatory body is developing its construction oversight programme, it faces the challenge of balancing its need to independently observe construction activities with the construction schedule. In some regulatory programmes, hold points are established for the regulator to witness specific activities, approve the use of specific components, or approve the continuation of construction activities. Other programmes rely on close co-ordination between the regulator body's staff overseeing the construction activities and the construction organisations to identify opportunities for the regulator to witness a sample of activities to gain confidence in the processes being used to ensure that the design is being respected and the necessary quality being achieved.

The WGRNR is also preparing a report that will provide insights into the policies and practices being used by mature regulators to oversee construction. These insights can serve as a guide for regulators developing or enhancing their construction oversight programmes.

Conclusions

As countries develop their legislative and regulatory frameworks for new nuclear power programmes, it is necessary to ensure that the regulatory authority understands the fundamental nuclear safety principles and applies them to its decision-making processes. It needs to develop and maintain an experienced staff with the knowledge and skills to review the design and licensing of the plant, and to verify that the plant is constructed as designed and licensed. Finally, the legislative and regulatory framework must be in place to support the regulatory body, giving it the independence, responsibility and authority to implement the licensing reviews and oversight of construction. Without the legal framework supporting the regulatory programmes, the ability of the regulatory body to enforce its mandate to protect public health, safety and the environment cannot be met.

Note

1. See www.oecd-nea.org/nsd/workshops/new-reactor-siting/ for more information.