

CREATING AN ENVIRONMENT FOR EXPANDED ACCESS TO PEACEFUL USES: FOSTERING SUPPORTIVE NUCLEAR SAFETY AND SECURITY CULTURES

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Abstract

Global challenges such as poverty, hunger, disease and climate change require that more be done to expand access to nuclear technologies and applications for peaceful uses. The COVID-19 pandemic has significantly reduced the timeframe for action in this regard. To this end, more should be done to promote and demonstrate the benefits of safe, secure and sustainable peaceful uses of nuclear technology as an important vehicle to achieving the United Nations Sustainable Development Goals (SDGs). Effective nuclear safety and security increases public confidence and promotes international cooperation for peaceful uses. States should therefore endeavour to achieve the highest levels of nuclear safety and security. The question is how to foster these cultures whilst ensuring that developing and least developed countries benefit from the full potential of peaceful uses. Human and financial resources as well as the necessary political commitment to develop and maintain an effective regulatory capability are some of the key challenges that face many developing countries. This is particularly the case in countries that do not have nuclear power. The authors will explore this question and consider potential pathways to expanding access of developing and least developed countries to peaceful uses of nuclear technology, while contributing to a stronger global culture of safety and security.

1. INTRODUCTION

In the past two decades the international legal framework for nuclear safety and security has become strong and comprehensive. With two new conventions,¹ the international legal framework covers all radioactive materials, whether fissile or not, and outlines objectives, obligations and undertakings for safety and security for materials in use, storage and transport. Voluntary guides and recommendations issued by the IAEA add substantial information on how to achieve high levels of nuclear safety and security.

In 1957 Unites States President Dwight D. Eisenhower proposed a “grand bargain” in terms of which the Unites States would share nuclear technology and know-how for civilian or peaceful uses with all countries and in return these countries would relinquish any aspiration for nuclear weapons. This gave birth to the International Atomic Energy Agency (IAEA) with the mandate to work with its Member States and multiple partners worldwide to promote safe, secure and peaceful nuclear technologies and to seek to accelerate and enlarge the contribution of atomic energy to peace, health and prosperity throughout the world. The balance of access to nuclear technologies

¹ CPPNM-A, ICSANT

with non-proliferation also became an important factor in the subsequent process that resulted in the Non-Proliferation Treaty and is still a subject of discussion at NPT Review Conferences.

The countries that made use of the opportunity to embark on nuclear power in the 60s and to build research reactors, expanded their peaceful uses programme to support the development of their health, agriculture and industrial sectors. Two countries, the Republic of Korea and Sweden serve as good examples of accelerated development resulting from adequate supply of electricity or energy for peaceful purposes. Both countries transformed into fully industrialized countries with the help of electricity generated in national light-water reactors (LWRs) programmes. In both cases, the peaceful nuclear energy programme was referred to as an important enabling factor in their development.

In all, 32 countries make use of nuclear power as an additional source of electricity in their national energy mix. Twenty six other countries, that are mostly low-and middle income countries (LMICs), are actively considering or already embarking on new nuclear power programmes. For several of these “newcomer” countries, a traditional large nuclear power plant is not a viable option. This would also be the case for the majority of other LMICs that may want to consider nuclear power in the future. Several of these countries typically consider a nuclear research centre, including a research reactor as being a starting point for a national nuclear power programme. The activities conducted at these research reactor centres often lead to improved safety and security culture in other peaceful use applications of nuclear technology. The IAEA Research Reactor Database lists 224 operational research reactors in 53 countries. However, the majority of these research reactors are in high income countries, with currently only seven operational research reactors in Africa, of which two (in Egypt and South Africa) produce radioisotopes.² Radioactive sources and radioisotopes are essential to a wide range of nuclear applications, but access by many LMICs to radioactive sources and radioisotopes is decreasing for a variety of reasons which is further impacted by the Covid-19 pandemic and the war in Ukraine.

2. CREATING AN ENVIRONMENT FOR EXPANDED ACCESS TO PEACEFUL USES

Through the peaceful application of nuclear science and technology, countries can make significant progress towards achieving their development goals particularly those related to human health, food security and economic development. The contribution of nuclear technology to climate mitigation and to achieving international climate change goals is also widely recognised. Unfortunately, the COVID pandemic and the war in Ukraine has derailed progress on sustainable development goals and will have long-term consequences for energy and food security especially in LMICs. Past history in several countries shows that the peaceful use application of nuclear technology can fast track development, and hence access to peaceful uses should be expanded in LMICs. Countries and multilateral bodies providing development support should recognize and support a wider function of peaceful nuclear activities and include these activities in their development agendas.

One should keep in mind that countries were and are encouraged to become State Parties to the NPT in exchange for the sharing in benefits of the peaceful uses of nuclear energy. Joining the NPT puts obligations on the State ahead of realising the impact and benefits of peaceful uses. Not experiencing the benefits of membership, weakens trust and can compromise commitment to the non-proliferation goals. Countries must be allowed to reap the rewards, at pace, of being party to the NPT.

To benefit from peaceful uses countries must be able to establish and maintain a national system with adequate and sufficient attention to radiation safety and nuclear security. Many LMICs have limited human and financial resources with which to address a wide range of often competing priorities. Establishing and maintaining a complex regulatory system which does not reflect the scope of their nuclear activities is often not sustainable and can limit the ability of the country to expand its peaceful uses activities and improve its regulatory competencies.

To this end the following maxim should be adopted: *A country wanting to expand its peaceful uses programme should also be able to grow into a more comprehensive regulatory programme and establish the necessary functions in parallel with an expanding programme.*

The analysis performed indicates that the following measures may foster an effective and supportive nuclear safety and security culture for countries with growing peaceful use programmes.

² IAEA Database on Research Reactors. Available at <https://www.iaea.org/resources/databases/research-reactor-database-rrdb>

2.1 Fostering Supportive Nuclear Safety and Security Cultures

The IAEA characterises an effective national infrastructure as one “based upon a legislative and regulatory framework and implemented by adequately empowered and resourced competent authorities, including an independent regulatory body”³.

2.1.1 National legislation

The establishment of effective nuclear safety and security cultures require time and a national approach to establish the culture and implement benchmarks for achievement that can be used to communicate success in its development. A robust international legal framework, with conventions that have entered into force, lay the foundation for national systems that govern small and large programmes. The international legal instruments have “built-in” flexibility and recognition that implementation may be profiled to fit an individual country. A case in point is the Convention on the Physical Protection of Nuclear Material (CPPNM) and its amendment with its recognition that a small programme may be adequately governed by a regulatory system that is smaller in size and functions than the regulatory system of a country with a nuclear power programme.

The national legal system should reflect undertakings made by the country in international conventions that lay the necessary foundation and serve as a starting point for establishing national governance with a supportive regulatory system.

To be effective, a regulatory system should be anchored in a national law. It can be a simple law that establishes the general functions of use of radioactive substances, including nuclear material which would allow for some expansion of the country’s peaceful uses programme without having to amend the law. The law should also establish exempt quantities of radioactive material and the conditions for licencing. In LMICs the promulgation of laws and their amendments is usually a lengthy process. In a country with very limited peaceful uses activities, for example in the medical or agriculture sector, an interim arrangement with a government directive making provision for civil and environmental protection from harmful substances, anchored in a national law, could be useful until such time as the appropriate law is promulgated.

2.1.2 A growing national regulatory system.

A regulatory system should have a mandate and size that suits the peaceful uses programme in the country. A country with few sealed radioactive sources for medical and/or industrial use will not require all the functions of a regulatory system in a country with research or nuclear power reactors. The challenge emerges when the peaceful use programme grows to include more complex activities than the regulatory system was established to cover.

To this end the following steps are recommended: (1) The functions that are indispensable for any regulatory system should be identified and presented broadly, to help create confidence with the regulatory body, the Government and the public that the necessary governance is being applied, 2) identify the additional regulatory functions to be implemented for a slightly more complex programme, and (3) recall the full-scope regulatory functions for a programme that includes nuclear facilities such as large research and nuclear power reactors.

In the following, some characteristic regulatory functions are identified for different size programmes. However, it must be emphasised that this is not the result of a detailed evaluation and analysis, rather a selection that may be valuable in the start of a conceptual discussion. Three levels of a regulatory system could be outlined to allow a useful discussion and systematic planning of a regulatory system that can grow organically with its peaceful uses activities:

- *A small regulatory system* suitable in a country with only few applications, e.g. a few sealed high-activity radioactive sources for medical and industrial use. *Initial proposals to be further evaluated:* Regulatory functions may include: a nuclear law or a government directive making provision for civil and environmental protection from harmful substances, anchored in a national law, as an interim arrangement; the appointment of a regulatory body or where this is not possible a regulatory function as an interim

³ IAEA Regulatory Infrastructure Development Projects www.iaea.org/topics/regulatory-infrastructure/regulatory-infrastructure-development-projects-ridp

arrangement with another national entity; a national register of radioactive sources; a licencing system, and annual summary reports provided to the regulatory body or regulatory function by the operator.

- *A medium sized regulatory system* in a country with several application using sealed radioactive sources, replacement of or transfers to storage of disused radioactive sources, research in which radioactive substances are used, including nuclear material for laboratory work and a small research reactor for education and training. *Initial proposals to be further evaluated:* Regulatory functions may include: a nuclear law, the appointment of a regulatory body and its mandate, national regulations including a national register of radioactive sources and export and import licenses. With nuclear material in research and development activities, in particular in a research reactor, undertakings in safeguards agreements must be fulfilled and followed-up. Inspections by the regulatory body may take place in an ad hoc manner. Annual reports by the operator and by the regulatory body to the IAEA and for the public will be important.
- *A full size national regulatory system*, in a country with nuclear power plants, large research reactors and storages of nuclear material, including some stage of disposal facility, national export control system and use of sealed radioactive sources and substances. The regulatory system should include all functions that were mentioned above and more. *Initial proposals to be further evaluated:* Appointment of a fully independent regulatory body; identification of other competent authorities e.g. law enforcement; a national coordination body for all authorities involved in safety and security, and the Government; a national series of regulations; a licensing system and inspection rights and reporting obligations for the regulatory body.

A graded approach for a national regulatory system could contribute positively to the confidence placed by the public in the national governance system and would enable the country to develop its peaceful uses programme and regulatory system in a sustainable manner.

2.1.3 *Challenges and opportunities*

Competent human resources and adequate funding are key prerequisites for the establishment of an effective national infrastructure for nuclear safety and security. At the same time, it is integral to increasing the peaceful uses of nuclear technologies and materials. However, in circumstances with constrained resources and urgent needs, the strengthening of a regulatory body may be perceived as an investment without obvious revenue. In countries with urgent social and economic challenges to address, it may be difficult to obtain the necessary political commitment to give sufficiently high priority to strengthening the existing regulatory infrastructure. Increased awareness of the potential of nuclear technology and applications to contribute to development could initiate the political commitment necessary to raise the profile of peaceful uses in these countries. Sustaining the political commitment and the allocation of appropriate funding to strengthen regulatory system, to the appropriate level, would then become an investment to enable the desired increase in peaceful uses. It is also challenging when the peaceful uses activities are not increasing sufficiently to support the financing, for example of the administrative support that is required for an independent regulator. E.g. expanding the peaceful uses activities in the medical field by increasing cancer treatment facilities, could also generate funding within the licensing system, thereby also strengthening safety and security cultures. In the energy field, experience shows that countries considering new nuclear power programmes also, early in the process, embark on a route of improving their legal and regulatory systems over time. For many countries interested in nuclear energy programmes, the large nuclear power plants currently available are not a viable option. Recent nuclear technology developments, e.g. the forecasts that SMRs could provide a safer, less costly and more accessible source of energy, may potentially be attractive for more countries interested in introducing nuclear power in their energy mix. Political commitment with investments in the regulatory infrastructure would inherently contribute to a stronger global culture of safety and security.

The challenge for a newcomer state, currently, which is embarking on a nuclear power programme without prior experience of activities involving either a large number of radioactive sources or activities with nuclear material is easily recognized. During an initial phase, support from the supplier may be critical. The supplier often has access to education possibilities, can share experiences from national systems and can offer technical support functions. The supplier could be contracted to provide reliable support during a defined period of time, when the regulatory body grows into new functions and responsibilities

International contributions provided in the development of the regulatory body in a country with a growing nuclear programme, should be provided in a profiled manner that suits the individual state, with both short-term and long-term planning. Thereby, a State with e.g. a growing radiation therapy programme, whether

based on radioactive sources or alternative radiation technologies, may invest in appropriate regulatory functions to ensure excellence in both safety and security. A country that considers embarking on a nuclear power programme, be it large NPPs or Small Modular Reactors (SMRs), should also plan for the implementation of a growing national regulatory system, in line with the IAEA Milestones approach. International contributions should more often be provided through twinning projects among partners of cooperation where advances in experience of one party could directly contribute to building up of a new, effective function with the other partner. The projects should identify specific functions and associated deliverables e.g. a licensing system for radioactive sources with identified deliverables. The IAEA's Regulatory Infrastructure Development Project (RIDP)⁴ is designed and customized to strengthen existing regulatory infrastructure through a flexible open-ended programming approach, tailored to address both known and unforeseen needs of target countries in an effective, efficient and timely manner.

Certifying achievement may be done through the invitation of an international peer review. The IAEA offers such services and would be in a good position to further diversify its services to evaluate regulatory systems with a focus on the size of the programme and whether the necessary regulatory requirements are implemented.

Communication and information are fundamental contributions in the building of confidence, within the international community or with the general public. Annual reports, licenses and applications, when made available to the public, all build confidence of a trustworthy governance system.

2.1.4 International interaction and cooperation

The strength of the international legal framework in the nuclear and radiological field is international cooperation and interaction. The framework identifies shared values and outlines obligations that are to be implemented by all parties. This is a valuable platform to build a regulatory infrastructure, and one that invites for additional interaction. Information from Governments, regulatory bodies and operators all contribute to maintaining the fundamental values of the system.

Mechanisms should be developed to measure the effectiveness of regulatory systems. International peer reviews may be one way, but other mechanisms may also be available. Further evaluations in this regard may help in establishing, with confidence, effective regulatory systems that are able to grow organically with nuclear activities.

3. CONCLUSION

A graded approach that builds on scalability in the development of regulatory systems that would foster sustainable safety and security cultures and provide a way forward for particularly the least developed countries to enhance and expand their peaceful uses activities programme to reach the SDGs. The elements that comprise a graded regulatory system require discussion and analysis. Combined with efforts to increase awareness about the benefits of peaceful uses for development and combating climate change and building on existing efforts by the IAEA and other partners to support infrastructure and capacity development, this approach could contribute meaningfully to enhance the use of nuclear technologies for development and, at the same time, strengthen non-proliferation and security implementation, as forecasted *inter alia* in the Non-Proliferation Treaty.

⁴ IAEA Regulatory Infrastructure Development Projects. Available at: www.iaea.org/topics/regulatory-infrastructure/regulatory-infrastructure-development-projects-ridp