**Nuclear Regulatory and Technical Assistance Programs in Support of the International Mission of the US Nuclear Regulatory Commission**

J. E. Ramsey1, E. A. Smiroldo1, P. Kohut2, W. Horak2

1US Nuclear Regulatory Commission, Office of International Programs

Rockville, Maryland, USA

E-mail: jack.ramsey@nrc.gov

2Brookhaven National Laboratory, Nuclear Science and Technology Department

Upton, New York, USA

E-mail: kohut@bnl.gov

**Abstract.** Nuclear energy offers long-term economic and environmental benefits providing a reliable energy source with significant environmental advantages in reducing the effect of human activities on global warming. National governments in countries operating or planning to establish nuclear facilities have instituted regulatory regimes on the use of nuclear materials and facilities to insure a high level of operational safety. International cooperation allows addressing safety problems in an international forum going beyond national regulatory regimes and offers the potential for cooperation and promotion of common nuclear standards through international regulatory coordination. The US Nuclear Regulatory Commission (NRC) supports the international safe and secure use of nuclear materials and actively participates in various international organizations. The NRC through the Office of International Programs (OIP) supports an international nuclear regulatory assistance program that provides critical training and technical knowledge of regulatory personnel using US technical experts based at NRC and Department of Energy (DOE) laboratories such as Brookhaven National Laboratory (BNL).

The OIP’s international assistance, training, and technical support include wide ranging regulatory and technical areas through cooperative training programs, workshops, and joint projects. The main benefit of the regulatory and technical cooperation is the improvement in regulatory and technical capabilities both at the nuclear regulatory agencies and the respective Technical Support Organizations (TSOs). The future challenge is to ensure that the cooperation between NRC and foreign regulatory agencies responds to the country specific regulatory needs and further increase the capabilities with an overall increase in the safety of the nuclear facilities. The cooperative regulatory and technical assistance program improves the capabilities of the regulatory agencies and TSOs in the licensing process allowing improved reviews and confirmation of technical approaches selected by the licensees and insuring that adequate safety is maintained. The paper will further explore the history and various components, which are used to transfer technologies and establish cooperative projects.

1. **Introduction**

Nuclear energy offers long-term economic and environmental benefits providing a reliable energy source with significant environmental advantages in reducing the effect of human activities on global warming. National governments in countries operating or planning to establish nuclear facilities have instituted regulatory regimes on the use of nuclear materials and facilities to insure a high level of operational safety. The national regulatory environments fully recognize the potential risk involved in operating nuclear facilities and the additional risk that could extend beyond national boundaries. This unique feature of the risk in operating nuclear facilities require international cooperation among nation states regardless whether they actually operate any nuclear facility. International cooperation allows addressing safety problems in an international forum going beyond national regulatory regimes and offers the potential for cooperation and promotion of common nuclear standards through international regulatory coordination.

In the US the Atomic Energy Act of 1954 together with the Energy Reorganization Act of 1974 (establishing US Department of Energy (DOE) and Nuclear Regulatory Commission (NRC)) provide for the development and regulation of the uses of nuclear materials and facilities with the general goals of promoting “world peace, improve general welfare, increase the standard of living, and strengthen free competition in private enterprise.” The Acts empower the NRC to establish rules and orders governing the use of nuclear materials “to protect health and safety and minimize danger to life and property.” The NRC supports the international safe and secure use of nuclear materials and actively participates in various international organizations. It aims to provide advice and assistance to international organizations and foreign countries to develop effective regulatory organizations and safety standards. Many of these activities are carried out in direct cooperation with the International Atomic Energy Agency (IAEA), the Nuclear Energy Agency (NEA), or other international organizations. In addition, a number of programs in foreign countries are conducted directly with the counterpart agencies under bilateral regulatory and research cooperation agreements.

One of the key elements determining the operational safety of nuclear facilities is an appropriate regulatory regime establishing the regulatory requirements and the safety envelope for nuclear operations. The US NRC Office of International Programs provides overall coordination for NRC's international activities, in concert with other NRC offices, carrying out policies in the international arena. The OIP establishes and maintains working relationships with individual countries and international nuclear organizations, as well as other involved U.S. Government agencies. The NRC actively participates in international working groups and provides advice and assistance to international organizations and foreign countries to develop effective regulatory organizations and enforce rigorous safety standards.

Many activities are conducted directly with counterpart agencies in other countries pursuant to regulatory and research cooperation agreements. NRC has close working relations with nuclear agencies in more than 35 countries and exchange operational safety data and other regulatory information. The NRC provides safety and safeguards advice, training, and other assistance to countries that seek U.S. help to improve their regulatory programs. The NRC originally worked primarily with major nuclear power countries, but later expanded its cooperation to include countries with small nuclear power programs, as well as some of those about to enter the nuclear field.

NRC's information exchange arrangements serve as communications channels with foreign regulatory authorities, establishing the framework for NRC to gain access to non-U.S. safety information. The international cooperative programs also serve as vehicles for the health and safety assistance NRC supplies to less-developed countries in their attempts to prevent accidents and to develop and improve their regulatory capabilities and nuclear safety infrastructure. The international cooperation arrangements facilitate NRC's strategic goal to support the safe and secure use of nuclear materials and in nuclear non-proliferation both in the US and abroad.

In the early 1990s the NRC OIP established an international regulatory safety assistance program in countries with Soviet-designed nuclear reactors. In many of those countries the nuclear regulatory authorities were not well established, had no clear division of responsibility, and had difficulty in enforcing regulatory requirements due to lack of basic nuclear regulatory laws and legal requirements. The initial safety assistance programs provided critical training and technical knowledge of regulatory personnel using US technical experts based at NRC and DOE laboratories such as Brookhaven National Laboratory (BNL).

The international assistance, training, and technical support include wide ranging regulatory and technical areas containing a significant infrastructure component. The nuclear regulatory support program is part of a large US international nuclear technical and regulatory assistance that is authorized by the US Government. Figure 1 indicates the various institutional components and participants in this wide ranging cooperative program that involves governmental institutions with appropriate industrial partners.

*Fig. 1 US International Regulatory Support Process*

The TSOs traditionally have been a significant factor in contributing to the regulatory process of the licensing, constructions, and operation of nuclear power plants. Historically, the TSOs helped establishing the licensing framework in conformance of the regulatory standards existing in each country including appropriate laws and regulations. In many countries, the TSOs have seen increased activities due to potential expansion of the nuclear industry including plans for constructing new reactors and becoming a critical resource in the licensing process. The regulatory bodies play a significant role in clarifying the role of TSOs, the expectation of their responsibilities, and support the TSOs efforts in improving their in-house technical capabilities and financial resources. The US NRC’s regulatory assistance program fully recognizes that while the TSOs are largely independent organizations, they still have a specific relationship and perform most technical work at the request of the nuclear regulator.

1. **Program Challenges**

The US NRC fully recognizes that TSOs providing support in regulatory decisions, in general, do not carry out technical developments to improve technologies or operational methodologies, which are more appropriate for the nuclear industry. The technical developments performed by TSOs are primarily serving the needs of the licensing processes and regulatory decisions making sure that the methods used by industries provide adequate safety. The TSOs also need to expand their developmental horizons for potential future needs based on industry initiatives or general research directions. The technical assistance program must respond to not only the regulatory needs of each country, but also provide support in developing TSO’s capabilities in wide-ranging technical areas that may serve future research and/or regulatory methodologies. Regulatory reviews require certain capabilities that provide the basis for selecting the organizations serving as a TSO for the nuclear regulator, such as a) technical competency in reviewing licensee’s methodology and proposed actions, b) capability of carrying out plant specific analysis, and c) have analytical capabilities, computer codes, and sufficient plant operating experience.

In the early 1990s, the US NRC regulatory assistance program was originated under the Lisbon Nuclear Safety Initiative recognizing the potential nuclear safety concerns in countries that had Soviet-designed nuclear reactors. The objective of the US NRC’s technical assistance program is the comprehensive improvement in the regulatory capability of not only the nuclear regulator, but also the TSOs technical ability to provide significant support in regulatory decisions and also developing a regulatory regime that insures adequate nuclear safety. One of the key elements that determine the nuclear safety is a robust nuclear regulatory regime with an independent nuclear regulator at its center. In many countries, there is an expectation of a large expansion of nuclear power in the coming decades raising the concern of the nuclear regulator’s status, the organization and relationship of the nuclear industry, regulator, and the TSOs, and the availability of critical manpower for all these institutions. The assistance program, besides providing specific technical assistance, all along emphasized the importance of an effective regulatory structure to help sustaining a viable nuclear industry and establishing and maintaining an independent and effective nuclear regulation. Figure 2 shows the most common organizational structures found in many countries either with an independent nuclear regulator or as part of a larger ministerial institution.

*Fig. 2 Nuclear Regulatory Organizations - Common Institutional Arrangements*

The international regulatory assistance program faced many challenges and successes in strengthening the regulatory and technical capabilities of the foreign nuclear regulatory organizations and the TSOs. Over the years the NRC’s international regulatory support program has expanded beyond its original scope encompassing many countries with operating or planned nuclear facilities. The international assistance, training, and technical support include wide ranging regulatory and technical areas through cooperative training programs, workshops, and joint projects, such as:

* Safety analysis methodologies and code applications, design basis analyses
* Life cycle management, maintenance optimization, support periodic safety reviews
* Licensing and inspection procedures,
* Risk informed and analytical methods design basis analysis,
* Severe accident methodologies and procedures,
* Emergency response and infrastructure development,
* Development of regulatory guidelines and bases for regulatory actions
* Significant infrastructure component providing improvement in analytical hardware, dosimeter equipment, networking capabilities, and communication infrastructure

The technical assistance program is tailored encouraging the TSOs to develop and maintain close contact with the nuclear installations through the regulatory agencies. In addition, the support programs have a significant component providing access and information exchange on international experience and regulatory standards [1]. Safety assessment methodologies are established insuring in-depth technical knowledge of the installation, supporting exchanges with the design and operating organizations, and providing the latest technical and scientific results from the international nuclear community.

Many of the program elements were developed supporting comprehensive data bases at the TSOs including operating events, installation specific design and operating information, technical data, technical and regulatory assessments utilizing knowledge management systems. Obtaining and transferring critical scientific tools, computer codes, and methodologies were and still are a significant component of the cooperative programs allowing the TSOs to perform analytical assessment as an independent agency, and providing sound scientific and technical bases for critical regulatory decisions. The international regulator assistance program consider and use the basic principles applied in US NRC and international regulatory experience such as, the defense-in-depth concept, risk-informed regulatory approaches, and sound radiation protection principles.

The NRC’s nuclear regulatory assistance program has changed over the years responding to new, international developments, specifically the planned expansion of nuclear installations in countries with relatively limited nuclear regulatory infrastructure. The program provides assistance to countries with new or expanding nuclear power programs helping to establish and maintain effective nuclear safety and security regulatory authorities. The cooperation program assists in the development of regulatory agency infrastructure, organization, staffing, training, and also providing significant technical support. It also supports the development of nuclear regulatory programs, overview of laws and regulations related to nuclear industry and regulation as well as regulatory guidance, and the development and delivery of training for regulatory agency management and staff.

In recent years the cooperation has increased to technical areas beyond safety analysis, severe accident events, and initial licensing methodologies, issues related to new construction of nuclear facilities, and the application of a risk-informed regulatory regime [2]. A limited sample of recent cooperative programs indicates a wide-ranging interest among nuclear regulators in these specific technical areas reflecting the need to expand the scientific knowledge base at the TSOs enabling a better response to industry initiatives and future regulatory challenges:

* Assist in improving training guidance and instructions in, a) inspection procedures and b) targeted inspections plans
* Cooperate on construction inspection methods as applicable to certified designs
* Assist in implementing risk-informed inspection processes, developing risk-informed regulatory regime and severe accident managements, external hazard analyses
* Provide support in using PRA techniques for Technical Specification improvements
* Information exchange on NPP license extension, aging, reduction of uncertainties in safety analysis assumptions and methodologies
* Evaluate methodologies assessing operating margins
* Safety issues in application of digital instrumentation
* Support establishing a regulatory review framework for standardized/certified designs
* Treatment of human and organizational factors
* University based regulatory training – providing potential future regulatory personnel
* Modification of fuel cycle facilities, decommissioning approaches.

In contrast to US practices, most countries have limited sets of TSOs that the nuclear regulator may rely on to supplement and augment regulatory review capabilities. In addition, some of the countries have institutional arrangements assigning dedicated TSOs for regulatory review functions. Normally, a few dedicated TSOs are available as separate legal entities allowing direct contractual relationship between the TSOs and international organizations. The technical assistance for TSOs concentrate on two general areas, a) developing very specialized skills and experience applicable to nuclear regulatory reviews and b) improving or developing general engineering expertise. In awarding contracts, the NRC encourages and supports assistance that avoids conflict of interests that may arise due to the limited nuclear expertise available in many countries. In order to maintain public confidence in the regulatory reviews, the conflict of interest issues are extremely important and are fully recognized by nuclear regulators. Due to the institutional arrangements, where dedicated TSOs are preselected for regulatory reviews, the contracting procedure is using mostly sole source processes, which pose difficult issues in the US involving sensitivities to legal requirements. A sound contracting process ensures that the regulatory agency has access to experienced and knowledgeable TSO staff that can provide technical expertise enhancing the capabilities and public confidence of the regulator.

1. **Conclusion**

One of the important objectives of the US NRC’s international regulatory assistance program is to strengthen the oversight capabilities and effectiveness of the foreign nuclear regulatory agencies and improve the TSO’s ability to carry out the required technical supports. In each respective country, the OIP’s regulatory assistance program further enhances the regulatory regimes; improve nuclear regulations and standards, which are more consistent with international and IAEA practices. The main benefit of the regulatory and technical cooperation is the improvement in regulatory and technical capabilities both at the nuclear regulatory agency and the TSOs. The future challenge is to ensure that the cooperation between NRC and foreign regulatory agencies responds to the country specific regulatory needs and further increase the capabilities with an overall increase in the safety of the nuclear facilities.

International cooperation among the nuclear regulatory agencies and TSOs significantly enhances nuclear safety in all the respective countries. The nuclear regulatory agencies have many important responsibilities, which are complimented by the TSOs technical expertise on specific technical and scientific areas. One of the important functions of the TSOs is to develop and maintain well trained experts in the respective technical and scientific fields. The international nature of the nuclear industry also requires the cooperation among the regulatory bodies including TSOs contributing to the development of global network of institutions, which may serve as the basis for a coordinated approach to improved nuclear regulatory methodology and increased nuclear safety.

1. **References**
2. Layton, M., et al., “Emerging need for Nuclear Security Technical and Scientific Support,” Challenges Faced by Technical and Scientific Support Organizations in Enhancing Nuclear Safety and Security (Proc. Int. Conf. Tokyo, 2010) IAEA, Vienna 2011.
3. “Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission,” NUREG/BR-0058, August 2004