Education and Training of Safety Regulation for Nuclear Safety Infrastructure: Its Necessity and Unique Features

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1. Introduction

Faced with global warming and electricity demands, countries over the world recognize the comparative advantages of nuclear energy. It is estimated that about 300 nuclear power plants (NPPs) expect to be constructed until 2030 worldwide. In addition, according to the IAEA, approximately 20 new countries might have their first NPP in operation by 2030 in the high projection compared with bout 5 new countries in the low projection. When introducing nuclear power, the implementation of an appropriate infrastructure to address all of the relevant issues is a central concern of international community. In particular, nuclear power program requires, at an earlier stage than when construction starts, the development of a legal and regulatory framework and training of regulators and safety experts whose combined knowledge adequately covers all areas of nuclear safety and regulation applied at a NPP construction and operation. As an essential component of such human resource development, special attention was paid to the provision of education and training to regulators of which countries plan to introduce NPPs. In term of education theory, safety regulation has some unique features in learning and teaching, which are different from those of nuclear engineering or development. This paper overviews nuclear safety infrastructure, explores the roles of exporting countries, and presents features and components in education of nuclear safety regulation.

2. Nuclear Safety Infrastructure

Infrastructure comprises the governmental, legal, regulatory, managerial, technological, human and other resource support for the nuclear program throughout its lifecycle. It covers a wide range of issues — from physical delivery of electricity, the transport of the material and supplies to the site, the site itself, and special facilities for handling the radioactive waste material, to the legislative and regulatory framework and the necessary human and financial resources. In short, infrastructures, as used in this context, include all activities and arrangements needed to set up and operate a nuclear program.

As it is stated that the first priority is to assure safety over utilization of nuclear energy, more attention should be given to safety infrastructure. In this regard, the country embarking on a nuclear power program should consider early establishment of a regulatory body to regulate nuclear power plants at all stages of siting, design, construction, commissioning, operation and decommissioning to protect the public from radiation hazards and to preserve the environment.

The regulatory process involves many activities related to safety reviews and inspections of nuclear power plants, and require in depth knowledge of technical matters over broad engineering fields, as well as of rules and regulations based on regulatory philosophy. Therefore, to ensure a competent regulatory staff, who are technically qualified and very knowledgeable of the regulatory administrative process, are performing regulatory functions as intended, a regulatory authority is established to maintain nuclear safety at an internationally acceptable level.

When a country starts establishing nuclear safety infrastructure, the country must bring up high-level policy makers to lead the establishment of legal and governmental infrastructure, nuclear regulators to perform regulatory activities, and safety experts to support regulators in resolving technical safety matters.

3. Exporting Countries' Supports in Establishing Nuclear Safety Infrastructure

A serious accident anywhere would impair any prospect for large-scale global growth of nuclear energy. Thus, countries that have concrete plans to promote nuclear power and international organizations such as the IAEA and OECD/NEA emphasize the exporting countries' support in establishing nuclear safety infrastructure of new entrants. These days it becomes a kind of obligation that vendor countries should observe.

3.1 IAEA

In the background report on Vision for the Future 20/20, the IAEA Secretariat suggested its new initiative, "the IAEA would work together with importing countries and reactor vendor countries and companies to ensure that the safety infrastructure is in place for new power reactors."

3.2 INSAG

International Nuclear Safety group (INSAG) noted the importance of vendor country's assistance in establishing new entrant's safety infrastructure. At the letter sent to the Director General of the IAEA and circulated to the Member States, it said:

> *The fulfillment of the safety obligations will be very challenging for many of the new entrants. This imposes special obligations on the vendor and regulators with*

experience with the vendor's design to assist a new entrant in understanding and fulfilling its safety obligations. ... It is in the interest of all countries to assist the new entrants in this effort. Additional resources are required and should be a high priority. Support for the enhancement of regulatory capacity will be particularly important in this connection, as operators generally receive significant assistance from vendors, while the regulators do not.

3.3 Senior Regulators

Senior Regulators discussed safety infrastructure at the Senior Regulators Meeting held within the auspices of the general Conference of the IAEA. They identified several aspects regarding the new obligations of vendor countries. They stressed:

- the importance of establishing at the earliest opportunity an independent, competent and well resourced regulatory body,
- the need to establish partnership between the regulatory bodies of vendor and buyer countries, and
- the usefulness of provisions for training staff abroad or inspectors observing construction.

3.4 OECD/NEA

OECD/Nuclear Energy Agency expressed its opinion in the new publication, "Nuclear Energy Outlook 2008" about the responsibility of the vendor countries:

If current trends continue, it seems likely that nuclear power programs will be developed in countries with little previous experience in nuclear operation and regulation. Ensuring that these "new" nuclear countries implement adequate legal and statutory provisions, create effective regulatory bodies, and establish strong nuclear safety cultures in their operating organizations will be a responsibility of the international community and, in particular, of the vendor countries.

4. Education of Nuclear Safety Regulation

Upon the request of the Member States, the IAEA has developed and provided many training courses in the area of nuclear safety and regulation as well as general nuclear engineering. Although some elements of training programs for regulatory body personnel may be similar to some elements of operator training programs, the overall training programs will inevitably be considerably different since the roles of regulatory staff and operating staff are quite different. It is required that the training for regulators should be implemented using a regulatory perspective rather than an operational perspective. The competency framework for regulatory body presents this point of differences. The competency model requires that regulators have competencies such as legal basis and regulatory processes, regulatory practical techniques, as well as technical disciplines.

According to education theory, this difference implies that different teaching concept should be used for regulator's education. Green, T.F. (1965) classified teaching concepts into 'teaching someone to ~' and 'teaching someone that ~'. While the former is related to shaping behavior or conduct, the latter is related to transferring knowledge. He divided the concepts more in detail and connected them to region of intelligence, which is shown in Figure 1.

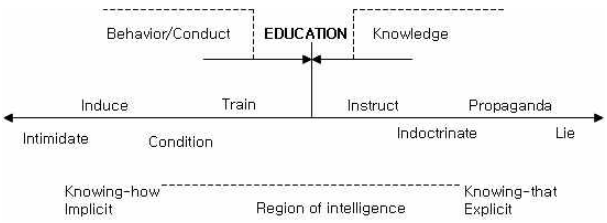

Figure 1. Topology of Teaching Concepts (Modified from T.F. Green)

Safety regulation is a governmental activity to ensure that nuclear utilities operate their plants at all times in an acceptably safe way. Such activity becomes manifested and motivated if a person has a strong view on safety – it is important and it is not achieved by operator itself. It is the subject that exporting countries should transfer to meet their obligation.

5. Conclusions

Unlike other energy sources, nuclear power programs require long lead time and comprehensive safety infrastructure. The key element of safety infrastructure is to secure teams of qualified personnel. The international community, therefore, emphasizes the importance of education and training, and encourages to establish partnership between exporting and buying countries to raise regulatory personnel.

From the reflections on the teaching concept, it may be concluded that education of safety regulation should be based on the experience and knowledge, and they should be designed to convey essential regulatory practices through on-the-job-training.

REFERENCES

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