

Development of Reference Training Courses for the Countries Introducing Nuclear Power

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1. Introduction

Human resources development is an important issue for the countries introducing their first nuclear power plant. Countries, which are considering introducing the nuclear power programs, will have to establish their infrastructure required for such programs. Since Korea has successfully achieved her self-reliance in nuclear power technology over the last 3 decades with a rapid expansion of nuclear power program, most of the countries have been interested in the Korean experience on human resources development and also hoped to share the experiences on nuclear training and education.

The purpose of this paper is to present reference training courses developed at KAERI which can be shared with countries that need an infrastructure development for nuclear power.

2. Review and Analysis

KAERI's experiences on providing training courses for the nuclear power personnel are reviewed to identify the needs on training from the countries which are trying to develop their nuclear power infrastructure. Training needs identified from the KAERI's bilateral cooperation activities are put together to develop reference training courses for those countries.

2.1 Review of Experiences on Providing Training Courses for Nuclear Power Personnel

Since the establishment of the Nuclear Training and Education Center of KAERI in 1967, the center has offered various kinds of nuclear training courses for domestic nuclear power related personnel. At the stages of introduction and capacity building for nuclear power, from 1967 to 1984, the center provided basic training courses on nuclear power and fuel technology. Specialized training courses relied on suppliers. Also, IAEA training and bilateral training in foreign countries were utilized during this period. When the self-reliance program was started in the middle of 1980s, the center offered specialized training courses on NSSS design, while the suppliers offered those on the design and fabrication of nuclear fuel. During this period, the center also built up its capability for the development of specialized training courses on safety analysis, project management, nuclear fuel, etc.

When Korea implemented successfully the self-reliance program on nuclear power, IAEA and its Member States showed their interests in the Korean

experiences on nuclear self-reliance and expressed hope to share the experiences. During this time, KAERI offered KOICA training courses on nuclear policy, planning and project management, PSA and NDT for the IAEA Member States. Up to now, there have been many requests from IAEA Member States for taking training in Korea. Table 1 shows a summary of the experiences on providing training courses for domestic nuclear power personnel at KAERI [1].

Table 1. Experiences on Providing Training Courses for Nuclear Power Personnel

Year	1967 - 1984	1985-1995	1996- Present
Contract Type	Turn-Key, Component Approach	Joint Design	Self-Reliance
Training Courses	<ul style="list-style-type: none"> · Fundamentals on nuclear engineering · System technology of NPP · Planning and implementation of nuclear power project management. · Basic design of NPP · Quality assurance · Safety analysis review · Codes and standards · Nuclear fuel technology 	<ul style="list-style-type: none"> · NSSS design and reactor safety · Fuel design · Fuel assembly mechanical design · Safety analysis · Thermal hydraulic core design · Fuel service and fuel rod design 	Share of Korean experiences with IAEA Member States in the field of infrastructure development for nuclear power program

2.2 Analysis of Training Needs

In order to analyze training needs from the countries, bilateral cooperation experience on training and education were utilized. The result shows different characteristics of training needs as shown in Table 2.

Table 2. Training Needs from the Countries

Region	Training Needs
Asia and Pacific Region	<ul style="list-style-type: none"> · Nuclear policy and energy planning · Nuclear engineering · Nuclear safety · Nuclear thermal hydraulics · Nuclear fuel technology · Radioactive waste management
Middle East Asia and North Africa Region	<ul style="list-style-type: none"> · Feasibility study on nuclear power project · Project management of nuclear power project · Construction management of NPP · Nuclear architecture engineering · Basic design of nuclear power plant system

It is recognized that the countries in Asia and Pacific region are interested in the development of their basic infrastructure on human resources; the countries in Middle East Asia and North Africa region are interested

in building up their infrastructure for the preparation of nuclear power project.

3. Development of Reference Training Courses

Training and education fields which were identified at KAERI for the countries introducing nuclear power are as follows;

- Nuclear policy and experiences on self-reliance of technology
- Advanced reactor design technology
- Nuclear power and nuclear fuel cycle technology
- Nuclear safety improvements
- Radioactive waste management technology
- Radiation protection
- Radioisotope production and radiation application technology
- Non-destructive testing technology
- Basic nuclear science and technology.

Through its bilateral cooperation with member countries, KAERI provided training courses for the countries, i.e., nuclear policy for high-level decision makers for Vietnam [2], feasibility study on nuclear power project (SMART) for Arab Emirates [3], energy planning/safety analysis/thermal hydraulic analysis for Vietnam [4], nuclear policy, planning and project management for Egypt [5], etc. Table 3 shows the developed training courses which could serve as a reference for providing a course to countries in need of an infrastructure development.

Table 3. Developed Reference Training Courses

Target	Training Courses
High-Level	· Nuclear policy for high-level decision makers
Middle-Level	· Nuclear power policy, planning and project management · Economic considerations and national energy Planning · Feasibility study on nuclear power project · Nuclear engineering and system technology · Safety analysis review · Probabilistic safety analysis of NPP · Safeguards on nuclear materials
Newcomers' Level	· Nuclear engineering · Nuclear reactor safety · Nuclear thermal hydraulics · Health physics and radiation protection · Introduction to nuclear power plant system · Fundamentals on safety analysis review · Introduction to advanced nuclear power reactor

There is wide range of infrastructure issues that need to be considered in introducing a nuclear power program. Human resources development is considered as one of the important issues. This means that each country should establish a system of training and education for nuclear technology in advance [6]. The following are examples of training to support an infrastructure development in terms of human resources;

- Nuclear policy of importance to nuclear power development
- Nuclear engineering
- Nuclear reactor safety
- Nuclear thermal hydraulics
- Health physics and radiation protection
- System technology of nuclear power plant
- Safety analysis review.

Nuclear power project can be categorized simply into pre-project, project implementation, commissioning and start-up [7]. Duration of the pre-project stage depends on countries' situation and intention. However, during these time owners need more practical works for the preparation of the project. For the achievement of successful implementation of the project, a country should consider linking human resources development including training and education with technology transfer from suppliers. The followings are examples of the training needed for a pre-project stage;

- Economic consideration and energy planning
- Feasibility study on nuclear power project
- Nuclear power project management
- Advanced safety analysis review
- Safeguards on nuclear materials.

4. Conclusions

Fifteen reference training courses are developed in terms of training target audience and project phase. These courses need continuous improvement to be a useful tool for future bilateral cooperation with these countries. Training and education activities for the infrastructure development should be considered as a long-term base program. For such a long-term program, training and education activities need to be linked with technology transfer from suppliers. Some of the training could be available through cooperation, while some others could only be available under contract.

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