

Effective Use of Plant Simulators and Mock-up Facilities for Cultivation and Training of Younger Regulators

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Abstract.

In order to achieve effective safety regulation, the staff members of a regulatory body who are engaged in regulatory work are requested to be well familiar with the characteristics, operations and maintenances of nuclear power plants at a practical level as far as possible. Although the regulators are not always required to have the same level of skills as those of plant designers or operators, the skills of the regulatory staff are essential elements to achieve high quality of the national nuclear safety regulation. Especially understanding of fundamentals such as operations, transient behaviors, trouble responses and plant inspections is indispensable not only to practical regulatory work but also to the establishment of the trust and confidence in safety regulation. To acquire these skills, the use of facilities such as plant simulators and inspection mock-up facilities is very effective to back up classroom lectures on theories and procedures. Practical training using these facilities under the guidance of well-experienced instructors inspires motivations and enhances capabilities of younger regulators. To support the countries newly embarking on nuclear power programs, JNES will continue to cooperate with those countries in cultivating and training younger regulators, by focusing on the training by veteran instructors using full-scale plant simulators and inspection mock-up facilities to give the trainees more practical skills and knowledge difficult to obtain through classroom lectures or textbooks.

1. Introduction

In recent years, the enhancement of nuclear power generation has become a world-wide trend to cope with global warming. Nuclear power generation means not only the installation of a power plant but also the establishment based on the various infrastructures of software and hardware. In the so-called “advanced nuclear power countries” including Japan, it was the key to success that the technical developments and the enhancement of safety regulation have been performing as two wheels of one cart from the introduction phase of nuclear power.

For the countries planning to introduce or strongly enhance nuclear power generation in the near future, in addition to the introduction of state-of-the-art technologies, it is the first priority to bring up younger regulators who work for nuclear safety regulation.

Japan has been conducting the technical cultivation and training programs in a wide range of the nuclear utilization fields. The Japan Nuclear Energy Safety Organization (hereinafter referred to as JNES) has been also conducting the cultivation and training programs for mainly Asian countries as a governmental Technical Support Organization.

The traditional programs were developed based on lectures of nuclear theory and exercises of nuclear technology. Nowadays the Internet has been so popular that people can easily access to the information and materials in their own countries. In addition, there are many young trainees who had

studied abroad and highly educated with expert knowledge. To address these situations, it will be better to develop the programs that will fit to the current requests from the Asian regulatory bodies to bring up their younger regulators by quickly teaching them practical skills through the training. This may not be possible in their own countries but in Japan.

To meet such requirements for younger regulators, JNES considers the following trainings very effective to provide the trainees with the chances to utilize the practical facilities with well experienced instructors, which are very difficult for Asian regulatory bodies to equip them so quickly.

- i) Operation training using full-scale plant simulators
- ii) Non-destructive inspection training using the mock-up equipment

This paper introduces the latest program given to 10 Chinese trainees in March 2010 as an example, and includes the result of a questionnaire to them.

2. Program

The program was developed to train younger trainees to master the fundamental practical skills required on site considering the following points:

- The outline of Japanese regulations related to the trainings shall be learned.
- The contents shall be focused on acquisition of fundamental skills rather than advanced ones.
- A trainee should directly operate and inspect the actual facilities under the instructions by well-experienced instructors.

Taking into account the suggestions from the professional companies where the trainings were done, the detailed program was developed for PWR plant operations such as normal operations during start-up and shut-down and some operations during incidents. It also covered training on the main non-destructive inspection methods. The total period of training including the plant tour and a visit to manufacturing company extended almost 3 weeks as shown in Table-1 below.

Table-1 Program

No.	Contents of training	Period
I	Introduction of Japanese Regulations <ul style="list-style-type: none"> -Outline of Regulations -Regulations on Inspection 	1 day
II	Outline of PWR Basic Design <ul style="list-style-type: none"> -Fuel and Reactor Coolant System -Turbine and Generator -Electrical Facilities and Auxiliary Systems -Reactor Control System -Reactor Protection System & Engineered Safety Feature Actuation System 	3 days

III	<p>Operation Training Using PWR Full-scale Plant Simulators</p> <p>1) Normal Operations</p> <ul style="list-style-type: none"> -Start-up Operation:Increase of RCS Pressure/ /Start of RCP/ / RCS Heat-up/ /Steam Formation of Pressurizer/ /Critical Operation/ /Generator Connection to Transmission Line/T-D FWP Start -Shut-down Operation:Generator Load-down/ /Generator Disconnection/ /Shut-down Reactor/ /RCS & Pressurizer Cool-down/ /Decrease of RCS Pressure <p>2) Major Operations during Events</p> <ul style="list-style-type: none"> -Rapid Load Reduction Operation -Plant Trip Operation -Loss of AC Power -Loss of Coolant in Small Break and Large Break -Steam Generator Tube Leak and Tube Rupture -Steam Line Break 	5 days
IV	<p>Non-destructive Inspection Training Using Mock-up Equipment</p> <ul style="list-style-type: none"> -Metallurgical Structure and Defects -Flaw Evaluation -Eddy Current Testing -Liquid Penetrant Testing -Magnetic Particle Testing -Ultrasonic Testing/Radiographic Testing 	5 days
V	<p>Observation Tour</p>	
	<p>“Ikata Nuclear Power Station” and “Nuclear Research and Training Center” of Shikoku Electric Power Co., Inc.</p>	1 day
	<p>“Kobe Shipyard and Machinery Works” of the Mitsubishi Heavy Industries, Ltd.</p>	half day

3. Implementation of Training

JNES presented the outline of the Japanese regulations first to make the trainees well understand the operation and inspections in Japan.

JNES did not have its own full-scale simulator or mock-up facilities with texts and instructors for the training, so the trainings were given by the following expert companies:

-PWR Plant Operation Training: Nuclear Power Training Center, Ltd. (NTC)

-Non-destructive Inspection Training: Nondestructive Evaluation Center of the Japan Power Engineering and Inspection (JAPEIC)



Photo.-1 PWR Plant Simulator Training



Photo.-2 Magnetic Inspection Training

4. Information Exchange with Japanese Regulators

At the reception, the trainees expressed their interests to communicate with the Japanese regulators in the regional offices. The information exchange meeting with the Japanese regulators was held at Tsuruga Nuclear Safety Inspectors Office in Tsuruga City close to NTC. The trainees also observe the Off Site Center, the emergency preparedness facility. In the meeting three Japanese regulators explained in detail the functions of the Off Site Center and emergency procedures showing the emergency equipment. The trainees were very impressed by extensive provision of the equipment at the Off Site Center and exchanged information on their responsibilities, dairy tasks and emergency preparedness procedures, establishing their mutual understanding and friendship.

5. Result of the Questionnaire

We asked the trainees the questionnaire to improve the training program in the future. According to the result, they were satisfied with the contents of training as described below;

- i) Training using simulator and mock-up equipments: Never experienced before and very valuable in deeping their knowledge through exercise.
- ii) Texts: Very easy to understand
- iii) Interpretation: Japanese-Chinese interpretation was very effective to fully understand.
- iv) Training Schedule: Some preferred a shortened course.

6. Conclusion

According to the questionnaire to the trainees, the trainings using full-scale plant simulators and non-destructive inspection mock-up facilities provided them a precious opportunity to gain more practical skills and knowledge with the instructions by veteran operators and inspectors. This would be difficult to obtain through classroom lectures or textbooks alone. So it was concluded that the use of full-scale plant simulator and mock-up facilities for cultivation and training of younger regulators was very effective.

JNES hopes that, through the fruitful trainings for younger regulators from countries newly embarking on nuclear power programs, trainees will be a bridge of friendship and mutual understanding between China and Japan in the future.