Review Paper

Human Development in Japan and Abroad Using the Prototype FBR Monju Towards the Next-Generation Age

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Abstract. Aiming at contributing to human development in Japan and abroad towards the next-generation, the International Nuclear Information and Training Center (INITC) has been working on educational training which consists of various educational training programs using the Fast Reactor Training Facility (FRTF) including prototype FBR "Monju".

1. Introduction

Japan is striving to establish the FBR fuel cycle as the national energy policy, which enables the use of uranium resource more effectively, and is aiming at starting commercial operation of a demonstration FBR around 2025 in the FaCT (Fast Reactor Cycle Technology Development) project. To prepare for such as the new FBR age, INITC has been working on human resource development using the prototype FBR "Monju" towards the next-generation age not only for Japanese young engineers and students but also for the world aiming at becoming a base of the international educational training.

The human resource development organizing by INITC is categorized into the following two groups: 1) The domestic educational training activity consists of the FBR Engineer Educational Training which targets young engineers and researchers engaged in Monju, and the Student Educational Training for enhancing the understanding of the nuclear technology and increasing the interest and care for environmental energy; 2) The international educational training activity is composed of two types of nuclear technology training courses, i.e., the International Sodium Handling Training Course and the International Reactor Plant Safety Course.

Regarding the FBR Engineer Educational Training positioned as the core of Monju educational training, new establishment of a training framework, new construction of FRTF [1] as provision of a training facility and remodeling Monju Advanced Reactor Simulator (MARS) [2], were respectively carried out for improving the existing educational training hold before the Monju sodium leak accident occurred in December, 1995 [3].

It was newly established the training framework for FBR Engineer Educational Training composed of a total of 27 training courses categorized into the following four kinds of training categories; FBR operation technical training; sodium handling technical training; maintenance technical training and FBR plant system engineering training. Each training course has been continuing even while Monju operation has been stopped over a decade.

FRTF was newly built near Monju in May, 2000 and has two types of training facilities for synthetically learning sodium handling and maintenance technologies. Also, the hardware of MARS was remodeled corresponding to the sodium leak safety measures applied to Monju actual plant, and the simulator function of MARS was also improved for upgrading the operator training. Moreover, the FBR plant system engineering training course was newly established for systematically learning wide FBR plant system engineering technologies based on their carrier.

With respect to the Student Educational Training, the educational activity is divided into two parts: The Tsuruga Summer Institute on Nuclear Energy for graduate students of the whole country including local universities, which is organized as one of the collaborative activities with CEA/Cadarache, France from 2006; the energy environmental education for under high school students in local community from 2007.

On the other hand, INITC is presently organizing two types of international educational training programs for around one month, sponsored by Ministry of Education, Culture, Sports, Science and Technology (MEXT). One is the International Sodium Handling Training Course for China and U.S.A from 2004. The other one is the International Reactor Safety Plant Course for eight countries in Asia for leaning variety reactor safety technologies from 2006.
These various educational training activities mentioned above will be expected to contribute to the development of human resource in Japan and abroad towards the next-generation age.

2. Improvement of Monju Educational Training triggered by Monju Leak Accident

After the Monju leak accident, the following points were revealed as the main issues which should be resolved:

— There is no specialized educational training section;
— The educational training for sodium handling technology is insufficient: No training facility; plan-less educational training program; lack of teaching materials;
— Remodeling of the hardware of MARS is required to follow the safety measures against sodium leak accident took in the Monju reconstruction including improvement of human-machine interface of MARS;
— The educational training for operator is inadequate: Poor educational training guideline; necessity of operation manual’s revision; no evaluation system of training results and so on;
— There is poor educational training program for learning FBR plant system engineering technology.

As the remedy against the issues described above, the following measures were taken in order to improve the poor Monju educational training which is categorized into the FBR Engineer Educational Training [1].

(1) For carrying out educational training systematically and intentionally, two specialized educational training sections were newly organized in the former International Cooperation & Technology Development Center (ICTDC), Japan Nuclear Cycle Development Institute (JNC), (presently INITC of JAEA) in July 2000.
(2) The educational training framework, containing a total of 27 training courses divided into four kinds of training categories, was newly established in order to learn multiple FBR technologies systematically and effectively.
(3) For strengthening sodium handling technical training, FRTF, which equips various kinds of unique training devices and models related to sodium and maintenance technologies, was newly constructed as a training facility. Besides, a total of 15 educational training courses were also established together with construction of FETF.
(4) MARS was remodeled based on the Monju reconstruction, such as, supplement equipping of a synthetic sodium leak monitoring system, improvement of the human-machine interface and of the calculation plant dynamic analysis model. Additionally, the following improvements for Monju operator training were performed: Review of an educational training guide line; new introduction of a training evaluation system and new provision of an E-learning system.
(5) In order to learn wide FBR technologies, one FBR basic course and four FBR advanced courses were newly established for effectively learning corresponding to their career.

3. Establishment of Educational Training Framework for FBR Engineer Educational Training

3.1. Training Goal for Each FBR Engineer

To ensure the safety of FBR plant, each engineer, i.e., operator, maintenance technician and FBR engineer has to master the expertise in their specialized field. Therefore, the training goal for each FBR engineer has to be clearly defined for conducting educational training systematically and efficiently prior to establishing an educational training framework. ICTDC sets the training goal for each FBR engineer, as shown in Table 1.

Table 1. Training Goal of Each FBR Engineer

Target	Goal Point
Monju Operator	Mastering not only operational technology but also sodium handling technology containing knowledge about sodium and FBR basic knowledge.
Monju Maintenance technitian	Mastering not only maintenance technologies peculiar to Monju including conventional maintenance technologies but also sodium handling technology containing knowledge about sodium and FBR basic knowledge.
FBR Engineer	Mastering not only manifold FBR technologies but also sodium handling technology containing knowledge about sodium.

3.2. Establishment of Educational Training Framework

For achieving each engineer's training goal, the educational training framework, grouped into four kinds of technical trainings as described in Table 2 below, was newly established together with the new construction of FRTF. Thus, a total of 27 training courses categorized into FBR Engineer Educational Training were built up to learn effectively and systematically each technology.
In subsequent from chapter 4 to chapter 6, it is described how training was strengthened or how training was newly established for each training course, respectively.

Table 2. Composition of Educational Training Framework for FBR

Training Framework	Course Number	Description
FBR Operation Technical Training	8 Courses	Learning operation technologies for normal and abnormal operation modes by using the operator training simulator (MARS) based on their carrier or with a crew team.
Sodium Handling Technical Training	7 Courses	Learning various kinds of sodium handling technologies, such as sodium fire fighting, sodium loop operation, sodium piping leak response, sodium corrosion and purification, sodium compounds treatment, etc.
Maintenance Technical Training	7 Courses	Learning four kinds of maintenance technologies peculiar to Monju components and three types of conventional maintenance technologies.
FBR Plant System Engineering Training	5 Courses	Learning manifold FBR plant technologies based on their carrier through the fundamental and advanced FBR plant engineering training courses

4. Strengthening Sodium Handling and Maintenance Technical Trainings

4.1. New Construction of FRTF

4.1.1. Composition of FRTF

Establishment of sodium handling technology was set as one of goals of Monju R&D after the leak accident. Since Monju did not have any training systems on site for sodium handling technical training and maintenance technical training before the accident, FRTF was newly built at Monju beside in May, 2000 in order to perform high quality educational training related to both technologies.
In the design of FRTF, the results of a questionnaire by persons engaged in Monju were reflected in the design of training devices and training models. In the next photo, sodium handling training facility is the building on the left side while the right side building is the maintenance training facility.

FIG. 1. Overview of Fast Reactor Training Facility (FRTF)

4.1.2. Unique Training Equipments in the Sodium Handling Training Facility of FRTF

In order to synthetically master the sodium handling technology, the technical subjects which should be learned were categorized as follows:

- Sodium general knowledge;
- Sodium physical and chemical properties;
- Sodium loop operation techniques (Sodium charge and drain operations);
- Sodium purification control technique;
- Sodium corrosion mechanism;
- Treatment skill for sodium compounds;
- Response and treatment skills against sodium piping leak.

To cover all technical issues described above, it were provided the following various kinds of unique sodium handling training systems or devices.

(1) Multiple-purpose sodium training cell: Since an exhaust system which can treat sodium aerosol is connected to this cell, manifold trainings, such as sodium fire fighting training, sodium handling work training, sodium piping leak response training, etc., can be performed here.

(2) Sodium training loop: By using this training loop, it can be trained both sodium charge-drain and purification operations. The loop consists a sodium tank, cold trap, sodium electro magnetic pump, sodium flow meter, sodium sampling box, etc.

(3) Sodium combustion observation device: By using this device, it can be observed directly the scene of sodium combustion. The device has an exhaust system which can make a tornado for clearly seeing the combustion scene.

(4) Sodium property measuring device: The measuring device consists of three glove boxes, and a total of six kinds of physical properties are measured i.e., density, melting point, kinetic viscosity, specific heat, thermal conductivity and surface tension. By measuring sodium physical properties, the trainees are expected to become familiar and acquire a deeper knowledge about sodium.

(5) Liquid sodium flowing observation device: The device is very useful in teaching beginners about sodium via showing a scene of liquid sodium flowing directly.

(6) Imitation sodium leakage pipe: The imitation pipe was developed for the sodium leak response course will be explained in detail in chapter 4.3. Its structure was designed similar to a real pipe, i.e., equipped with a sodium leak detector, some thermo-couples and electrical heaters including an outer insulator. However, there is difference from the actual one because there is a gap between inside-rod and the outer insulator. In the training, sodium is charged into that gap and the charged sodium leaks through the clearance between the inside-rod and insulator.

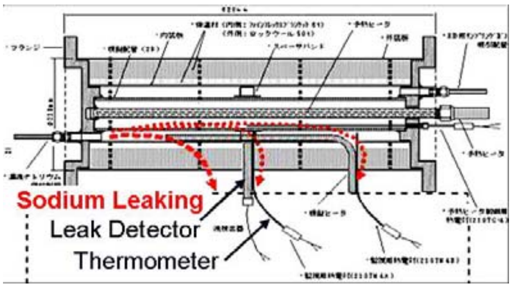

FIG. 2. Structure of the Imitation Sodium Leakage Pipe

4.1.3. Unique Training Models in FRTF for Maintenance Training Facility of FRTF

The following four kinds of training models peculiar to Monju are located in the maintenance training facility. They are duplicated for each actual sodium component.

(1) Sodium pump mechanical seal mock-up training model: Maintenance worker or technician can experience overhaul maintenance work for secondary main pump's mechanical seal part by using this model.

(2) Fuel handling system training model: This training model is imitated using a 1/12 scale model in order to help understanding all fuel handling processes, i.e., internal and external reactor core handlings for a fresh fuel and a spent fuel, and cleaning, canning and storage works for a spent fuel.

(3) Control rod driving mechanism training model: Although Monju has tree types of control rod which has a different driving mechanism respectively, this training model directly shows each model's operating movement, such as latch and de-latch actions, scram action, etc..

(4) Fuel Handling Machine (FMH) training model: Experience and technique is necessary to correctly installing FMH with a heavy weight component in the narrow space of the core upper part. This training model is duplicated with a 1:1 size and is useful for getting technical know-how.

The other group includes three kinds of conventional maintenance technologies: A power supply panel overhaul training model, an instrumentation and control training model, a water pump overhaul training model.

4.2. Establishment of Sodium Handling and Maintenance Technical Training Courses

For achieving the training goal for operator and maintenance technician, mentioned in chapter 3.1, seven technical training courses for sodium handling and maintenance technologies were established as shown in Table 3. Particularly, the sodium handling training courses were divided into seven courses in order for trainees to learn effectively and gradually each sodium technical issue which should be mastered. All training courses are coordinated with both a lecture and a practice. In addition, some distinctive items for strengthening sodium handling training are introduced in the following chapter.

Table 3. Sodium Handling and Maintenance Technical Training Courses

No.	Sodium Handling Technical Training Courses	Maintenance Technical Training Courses
1	Sodium Beginner Course	Fuel Handling System Course
2	Sodium Expert Course	Control Rod Driving Mechanism Course
3	Sodium Loop Operation Course (Charge and Drain)	Sodium Pump Mechanical Seal Overhaul Course
4	Sodium Loop Operation Course (Purification)	Water Pump Overhaul Course
5	Sodium Fire Fighting Course	Power Supply Panel Overhaul Course
6	Sodium Piping Leak Response Course	Instrumentation & Control Course
7	Sodium Handling Internal License Course	Maintenance Beginner Course

4.3. Development of Sodium Leak Response Course

This training course is the only training course available worldwide and is a very meaningful training for staff that has never seen a sodium leak scene from a pipe. The sodium leak training is carried out in the multiple-purpose sodium training cell where trainees can observe the sodium piping leak’s scene over glass. The leak conditions are as follows:

- The amount of leaking sodium: About 2 kg;
- Sodium temperature: Approximately 500ºC;
- Sodium leakage rate: About 100 kg/h (the Monju accident was around 170kg/h) .

The training also includes a dismantling work of the leaked pipe. The trainees are able to observe the residual sodium compounds in insulator of the leaked pipe and also can experience the waste processing work of sodium compounds. The actual training scenes are shown in Fig. 3.

FIG. 3. Actual Training Scenes in Sodium Leak Response Training

4.4. Familiarization of New Knowledge Learned from the Monju Leak Accident

From the viewpoint of investigation of technical knowledge, a reappearance experiment simulated the Monju leak accident was conducted at the former Oarai Engineering Center, JNC in March, 1996. At that time, an unexpected phenomenon in design that some holes penetrated the liner plate of 6mm thickness was occurred. According to the investigation report [4], the following points were revealed.

- This corrosion phenomenon is based on so called Molten Salt Type Corrosion which occurs in a humid environment. Humidity plays a key role in the process.
- Under a humid environment, the leaked sodium compounds on a liner plate forms liquid environment by sodium hydroxide (NaOH).
- Consequently, a lot of sodium peroxide (Na_2O_2) produced by sodium combustion dissolve into the liquid environment and they can easily reach the surface of the liner plate.
- Na_2O_2 is a strong oxidizer and it quickly corrodes the liner plate.

While, in case of the Monju leak accident, other type of corrosion arose.

- The Monju accident’s environment was not humid due to the following cinditions: The accident occurred in a large room; sodium combustion’s temperature was not so high.
- Under low humidity environment, the dominant sodium compound is sodium oxide ((Na_2O) and environment on the liner plate is in solid state.
- Under such condition, Na_2O_2 cannot reach easily to the liner plate, moreover, lots of Na_2O_2 are reduced by the leaked sodium.
- The Monju accident’s corrosion is a Na-Fe Double Oxidization Type Corrosion type which has a not so fast corrosion speed.

A comparison of Molten Salt Type Corrosion and Na-Fe Double Oxidization Type Corrosion is shown in Fig. 4. The new knowledge mentioned above is reported to young engineers in a lecture.

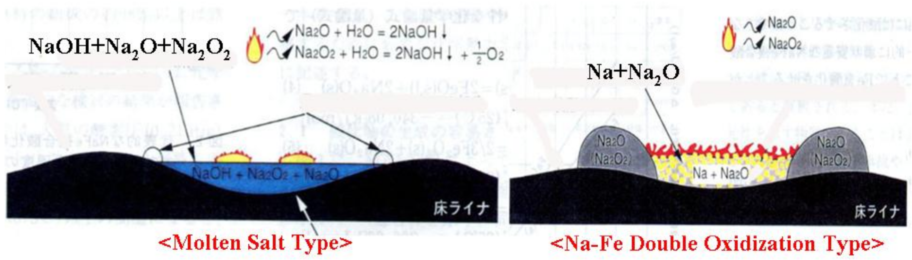

FIG. 4. Comparison of Molten Salt Type and Na-Fe Double Oxidization Type Corrosions

4.5. Introduction of Sodium Handling Internal License Course

The maintenance building's fire due to the cause of a carelessness of sodium handling happened in the experimental fast reactor "Joyo" in October, 2001. From the teachings learned from this accident, ICTDC newly introduced the sodium handling license course to prevent the occurrence of the same kind of accident at Monju.

Before being engaged in sodium handling work at Monju, all the members relating to work have to attend this license course. The training course consists of a lecture, and an exercise, with a written examination at the end of training. To get a license, both following conditions are required: Take more than 60 points in the examination; experiencing sodium handling work for a half day.

4.6. Evaluation of Training Results

Trainees should take part in training with motivation that the training is going to improve their knowledge and experience. In order to enhance that motivation, a comprehension test is carried out in all sodium handling training courses as a part of maintenance training courses. The test is taken place twice before and after training; for instance, one hundred questions categorized into eight categories are made in the sodium expert course.

Through these tests, trainees can grasp by themselves how much their knowledge has improved. Moreover, by performing the test is expected to give to trainees a measurable feeling of tension during training, while the analysis of test results is useful in how to teach the after following lectures. To be specific, a comprehension test is conducted along with the following scenario in Fig. 5.

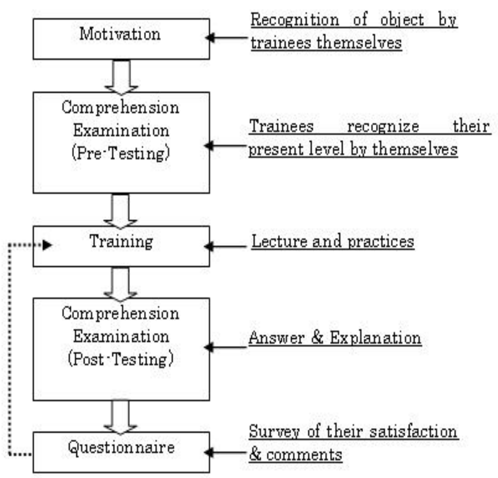

FIG. 5. Scenario Flow of Comprehension Examination

5. Strengthening FBR Operation Technical Training

5.1. Remodeling of MARS towards Upgrade of Simulator Technical Training

5.1.1. Outline of MARS

MARS has been contributing to personnel development of Monju operators since April 1991 prior to the Monju pre-operation test. MARS is a full scope type simulator, which faithfully duplicates all main control panels and partial local panels, which are located in a central control room. As a computer system, MARS has three kinds of computers: A plant computer; a main process computer; a process linkage (input/output) control unit. The plant computer consists of a dynamic computer for simulating plant behaviors in a real time simulation and a front-end computer for controlling interlock actions and interface between the duplicated control panels and each computer via a process linkage control unit. The system scope of MARS covers a reactor system, a main heat transfer system (HTS), an auxiliary system, a power supply system and so on. MARS can offer a total of 320 training cases as malfunctions and 73 normal operation cases from standby operation mode to rated power operation mode including shutdown operation mode. Furthermore, MARS satisfies the plant simulation accuracy demanded by ANSI/ANS-3.5-1985 (Nuclear Power Plant Simulator).

5.1.2. Supplement of Synthetic Sodium Leak Monitoring System

MARS introduced a synthetic sodium leak monitoring system as an extra system, which was equipped as one of remedies in the Monju reconstruction work, in order to implement simulator training against sodium piping leak incident under the condition similar to actual environment. This system links to MARS's computer system and is able to automatically offer virtual graphics depending on small or large sodium leaks signaled by MARS. As shown in Fig.6 below, a sodium leak scenario is displayed on a CRT screen of the system, which is created by combining a three dimension computer graphic and an actual picture.

FIG. 6. Synthetic Sodium Leak Monitoring System

5.1.3. Improvement in the Plant Dynamic Analysis Model of MARS

As a progressive future training, it is requested to perform simulator training corresponding to an emergency operation procedure (EOP) for a loss of coolant accident (LOCA), a loss of flow accident (LOFA), and a loss of heat removal system (LOHRS). To realize the above training, more accurate analysis of behaviors in a reactor core is necessary. From this viewpoint, a reactor core model within the plant dynamic analysis model, which consists of a core channel model and two plenum models, was remodeled from a single fuel channel model to a multi-channel fuel models as illustrated in Fig. 7. Both models are concatenated to each other with momentum equations and a friction factor for the pressure drop of each subassembly (S/A) that is obtained by the in-water tests.
Each S/A in a reactor core is modeled into 11 representative channels of six inner core, two outer core, and three blanket core channels. The reactor power is calculated from fission and decay heat. The reactor's fission power is obtained from one point prompt jump approximation of reactor kinetics with six energy groups of delayed neutron at one point representation with reactivity inventory. The advancement of the reactor core model will lead to improving analytical accuracy for the whole HTS.

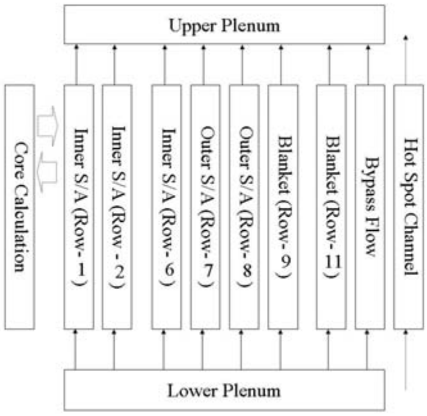

FIG. 7. Configuration of Reactor Core Model within Plant Dynamic Analysis Model

5.1.4. Improvement of human-machine interface

In remodeling of MARS, human-machine interface, which is an interface between the instructor console and each panel simulated as installed in the central control room, including the simulated main control panel, the supervisory panel and the local panels, have also been improved together. By this reformation, the operability of the instructor console has become very good.

5.2. Improvement of FBR Operation Technical Training's Method

5.2.1. Establishment of Educational Training Guideline

Before Monju leak accident, the educational training guideline was insufficient to perform the training systematically and intentionally. Accordingly, establishment of the guideline containing the following items were required: educational training items; frequency of educational training; training contents; teaching materials. This guideline, of course, is applied not only to simulator training but also to sodium handling and maintenance technical trainings.

5.2.2. Introduction of simulator training evaluation manual

Not only establishment of an educational training guideline, but implementing evaluation of training results is also very important for attaining high quality and useful educational training. ICTDC introduced the simulator training evaluation manuals for two ways for evaluation for an individual and for a shift crew, respectively.

(1) Evaluation for an individual

Since this evaluation aims at upgrading operator's operating skills, it is applied to young and middle standing's operators, i.e., novice, middle and senior classes. Two instructors evaluate their operating skills depending on their class for normal and abnormal operation modes by using an evaluation check sheet which has about twenty checking items. The evaluation results by two instructors are submitted to their shift supervisor and an individual interview by a shift supervisor is held. At that time, an operator can be coached on any weak points observed from the evaluation check sheet. The interview result is reported to the Monju operation section's manager. The evaluation flow for an individual is shown in Fig. 8. This evaluation is carried out when there is a promotion examination for promoting their class.

(2) Evaluation for a shift crew

For evaluating a shift crew, the contents of a directive order from a shift supervisor, the flow of command's transfer and teamwork operation corresponded unusually are checked by a licensed reactor engineer and section manager or assistant section manager. The monitors make a comment sheet as the evaluation of training results and it is informed a shift supervisor. A shift supervisor must reply any remedies against the pointed-out comments. This shift crew evaluation takes place once a year.

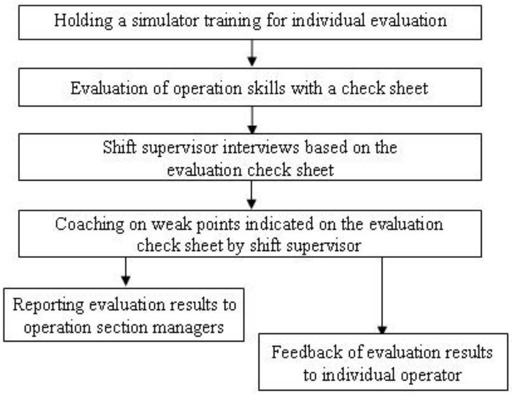

FIG. 8. Evaluation Flow for an Individual

5.2.3. Introduction of E-Learning System

Not only enhancement of knowledge related to FBR technology but conventional mechanical and electrical engineering technologies were also required by the operation section's voluntary check.
Consequently, an E-learning system was introduced to serve an educational environment for studying basic engineering technologies. This system has a total of 29 training items as follows: 13 items for electric and instrumentation/control, 11 items for mechanic, and 5 items for human error, core physics, and sodium handling. This system moves beyond operators to also include all JAEA staffs in Tsuruga.

5.2.4. Preparation of Introducing Systematic Approach Training (SAT)

With the aim of performing educational training more efficiently and systematically, Monju is now preparing to introduce a new operator training evaluation system called SAT which has been developed for light water reactor plant's operator [5]. By applying the SAT, the potential issues hidden in the present education structure is able to be revealed. The main evaluation flow of the SAT is illustrated in Fig. 9.

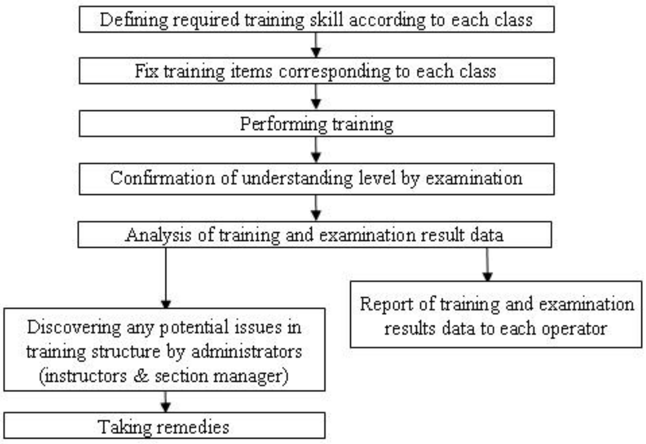

FIG. 9. Summary Evaluation Flow of the SAT

6. Establishment of the New FBR Plant System Engineering Training

Before Monju leak accident, the training course for learning FBR plant system engineering was not provided on site. Since upgrading knowledge with respect to FBR plant system engineering technology of young engineers including operator and maintenance technician is to lead enhancing safety of Monju, a total of five educational training courses composed of one FBR basic course and four FBR advanced courses have been prepared for learning manifold FBR plant system engineering technologies step by step as described in Table 4.

In the FBR basic course, fundamental contents covered the whole FBR plant system engineering, i.e., FBR plant system configuration including a core, sodium components, FBR plant safety, core physics, fuel and structure materials, seismic design, radiation control and radioactive waste processing, etc., are contained in a total of 12 lectures.

On the other hand, in order to learn extensive FBR plant system engineering technologies more deeply and expertly, the FBR advanced course categorized into four courses which contains plant system design, safety design and safety assessment, core design, fuel design, structure material & design, core structure design, sodium components feature, plant operating experiences, etc., in a total of 12 distinctive lectures, is designed.

Table 4. FBR Basic and FBR Advanced Courses

	Course	Outline
1	FBR Basic Course (for 3 days)	Cover basic manifold FBR systems via twelve lectures including current development situation and FBR cycle feature.
2	FBR Advanced Course-1 (for 2 days)	Cover three technical fields: FBR plant system design, safety design & safety assessment, plant application license.
3	FBR Advanced Course-2 (for 2 days)	Cover three technical fields: core design & characteristic, core shielding design & calculating radiation source, fuel design & assessing fuel behavior.
4	FBR Advanced Course-3 (for 2 days)	Cover three technical fields: structure material & design, core structure & fuel handling system, sodium components & feature.
5	FBR Advanced Course-4 (for 2 days)	Cover three technical fields: plant operating experience, radiation control, radioactive waste treatment.

7. Deployment of Student Educational Training

The Student Educational Training is separated into two parts, i.e., the “Tsuruga Summer Institute on Nuclear Energy” and energy environmental education for under high school students in the local community.

(1) Tsuruga Summer Institute on Nuclear Energy

Energy education for students who are expected to shoulder the development of future energy is very important. From this viewpoint, INITC is holding the “Tsuruga Summer Institute on Nuclear Energy” cooperated with Fukui University and Wakasawan Energy Research Center for mainly graduate student every year. This educational activity is performed as an educational seminar which is one of collaborative items based on a cooperation agreement in education and training field with CEA/Cadarache, France.

In this one week seminar, students can learn the importance of nuclear energy and the meaning of its development via various kinds of lectures, practices, sight tours including LWR plants and open speeches. Moreover, this seminar aims at the contribution to international human resource development by incorporating in this seminar English debates and lectures in English given by CEA specialists.

This seminar was started from 2006, and about 40 students have participated in the seminar each time from two local universities and seven or eight universities from Kansai, Hokuriku and Kanto areas.

(2) Energy environmental education for under high school students in local community

It is indispensable for a nuclear power plant to strive symbiosis with local community. As a part of the cooperation activities with local community, INITC is supporting energy environmental education for under high schools in local community from 2007. More specifically, students learn the importance of energy and relationship between environment and energy through a variety of science experiments and basic lectures about environment and energy and global environment.

8. Deployment of International Educational Training Programs

INITC presently provides two types of the following international educational training programs sponsored by MEXT. INITC aims to become a central of excellent (COE) of the international technology training in Asia through these educational activities.

(1) International Sodium Handling Training Course

The course is organized based on the nuclear researcher exchanging program presented by MEXT from 2004 and has been mainly applied to China. In addition, U.S.A. has also participated in this course based on a nuclear agreement with the department of energy (DOE) of U.S.A. This course is coordinated with manifold lectures and exercises and is carried out for one month. The exercises cover all kinds of sodium handling technologies, such as sodium chemical reaction, sodium fire fighting, sodium loop operation, sodium compounds treatment, sodium piping leak and so on. Not only the lectures relating to sodium handling technology directly but also manifold lectures, such as FBR plant system design, safety measure, sodium component's design, etc. are prepared.

(2) International Reactor Safety Plant Course

To perform nuclear energy education for Asian engineers and researchers is an important issue for Japan, in order to promote a nuclear safety culture and secure the safety of nuclear power plants in Asia. INITC has been dedicating this course from 2006 for leaning a variety of reactor safety technologies covering configuration and features of nuclear power plant (NPP), nuclear safety culture, safety design principle, safety measures, safety assessment, seismic design, quality assurance, etc. From 2008, a total of 20 persons, from eight countries in Asia, take part in this course which is held twice a year.

9. Conclusion

INITC has been organizing a total of 27 training courses, that were established based on the teachings obtained from the Monju leak accident as FBR engineer educational training, and used FRTF which was constructed after the Monju accident. The student educational training activities has also been carrying out for contributing to the personnel development of students who are expected to engage in the development of future energy and supporting education and training in local community. Besides, two types of the international educational training programs presented by MEXT have been holding for familiarizing nuclear power plant safety technologies to Asian countries, especially.

After FRTF was opened in October, 2000, 28 training courses of FBR engineer educational training has been performing over 1,100 times and a total of about 7,000 participants attended it until July, 2009. Regarding the Student Educational Training, the "Tsuruga Summer Institute on Nuclear Energy" is held each year from 2006 and a total of 153 students participated for four times so far. About the under high school student's education, approximately 5,000 students in local community took a lecture every year. In addition, two types of the International Educational Training courses were held 11 times starting from 2006 and a total of 51 trainees were joined so far. The variety of the educational training's activities mentioned above will contribute to the development of the human resource in Japan and abroad, towards the next-generation age.

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