High Quality Education & Training towards Monju Re-Operation

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Abstract: *To assure safe operation of the prototype FBR Monju, diverse remedies on educational training field have been taken based on the lessons learned from the sodium leak accident. These steps include opening a new Monju FBR Training School, improving simulator training including upgrading the performance of the Monju Advanced Reactor Simulator (MARS), and organizing a newly specialized training section. Twenty-nine training courses have been created and taught to prepare for restarting Monju. Monju also intends to introduce Systematic Approach Training (SAT) for more effective and systematic simulator training and its preparation work will be started from FY 2007. INITIC has been implementing Monju staff training and several international technology training courses aiming to become a central of excellent (COE) of international educational training in Asia.*

Keywords: Prototype FBR Monju, sodium handling technology, FBR Training School, Monju Advanced Reactor Simulator (MARS), Systematic Approach to Training (SAT)

1. INTRODUCTION

Presently, it is well known that the nuclear fuel cycle using a fast breeder reactor (FBR) enables more efficient use of uranium resources, which is indispensable in order to secure a stable supply of energy for the 21st century while maintaining the global environment.

The prototype FBR Monju which had a sodium leakage accident at 40% power during the performance test in December 1995 [1] is now under remodeling to attain re-initial criticality in 2008. As the Monju is a globally valuable FBR, the success or failure of its safety operation in the future will greatly influence the development of the FBR nuclear fuel cycle.

To assure safe operation of the Monju, high quality educational training is strongly required. Before the leak occurred, only a sodium fire extinguishing training has been carried out irregularly at the former Oarai Engineering Center (OEC, the Japan Nuclear Cycle Development Institute (JNC)) as sodium handling training. The main educational training for Monju staffs was represented by FBR operation technical training using the Monju Advanced Reactor Simulator (MARS), an operator training simulator [2].

Thus, based on the lessons learned from the Monju accident [3], Monju has defined the following improvements in basic policy aiming for higher quality educational training:

a) Necessity for building an educational training framework for systematic educational training for various FBR technologies

b) Necessity for providing unique training systems for comprehensively learning FBR inherent technologies and organizing new specialized educational training

c) Necessity for establishing extensive harmonized training courses including both lectures and exercises

d) Necessity for strengthening Monju operator training (simulator training)

Based on the above mentioned basic policy improvements, Monju has been taken the following measures:

(1) Building a new educational training framework

(2) Opening the Monju FBR Training School

(3) Strengthening Monju operator training

(4) Organizing a specialized educational training section

In addition, concerning simulator training, Monju attempts to introduce the Systematic Approach to Training (SAT) [4], which is an educational evaluation system for nuclear power plant operators in order to implement training more efficiently and systematically. Preparatory work aimed at introducing SAT in FY 2008 is planning to be started this year, in FY 2007.

A total of 29 training courses have been establish based on the above mentioned remedies and are being used to work towards Monju re-operation.

The INITC has also been carrying out manifold nuclear engineering educations for Monju staffs, for students and Asian nuclear engineers, aiming for personnel development of nuclear engineers for next generation.

2. IMPROVEMENT IN BASIC POLICY AFTER THE MONJU ACCIDENT

After the accident, it was revealed that sensitive issues existed regarding thermometer design, sodium draining system, human risk management and other factors. Based on learning from the accident, the educational training was also reviewed too, and the following issues must be addressed:

a) Establishing safe sodium handling is essential. The previous training was unsatisfactory since only sodium fire extinguishing had been practiced as sodium handling training. The training was not-periodical or un-planned.

b) Monju did not have any training systems on site for sodium handling training.

c) There were not enough training courses related to FBR plant system engineering on site.

d) An educational training framework was not established for systematically learning extensive FBR technologies.

e) Up to the accident, only simulator training had been carried out for educational training of Monju operators.

f) Regarding the simulator training, the following issues were pointed out:
-Carrying out practical simulator training adapted to the actual conditions of the sodium piping leak for more effective training
-Establishing a training guideline, to define training items, frequency, contents, textbooks, etc.
-Updating the training evaluation manual with the latest issues
-Arranging and preparing an E-learning environment for basic conventional technologies on mechanical and electrical technologies
-Upgrading analytical capability and introducing Emergency Operation Procedure (EOP) as advanced training in the future

The improvements in basic policy were fixed based on the above mentioned issues as follows:

(1) New construction of an educational training framework:
The educational training framework was categorized into four training fields for systematically learning multiple FBR technologies.

(2) Opening the Monju FBR Training School:
The Monju FBR Training School opened in October 2000 with unique training systems for sodium handling and maintenance technologies, extensive sodium and maintenance training courses (with coordinated lectures and exercises), and the FBR plant system engineering course based on the above framework.

(3) Strengthening FBR operation technical training:
Upgrading simulator training by remodeling MARS, establishing an educational training guide line and an evaluation manual, and providing an E-learning system had been performed.

(4) Organizing a specialized educational training organization:
Two new training groups were organized in July 2000 in the former International Cooperation & Technology Development Center (ICTDC), Japan Nuclear Cycle Development Institute (JNC), (presently INITC, JAEA).

3. NEW CONSTRUCTION OF EDUCATIONAL TRAINING FRAMEWORK

As described above in the basic policy, rebuilding the educational training framework was demanded in order to systematically learn FBR technologies.
Thus, Monju has established the educational training framework categorized into four training categories as shown in Table 1.

Table 1 Construction of Educational Training Framework

Training Framework	Course Number	Description
FBR Operation Technical Training	9 Courses	Classified individual courses (six grades), family course, refresh course, etc.
Sodium Handling Technical Training	7 Courses	Various unique courses for sodium properties, sodium loop operation, extinguishing sodium fires, sodium piping leak, sodium treatment, etc.
Maintenance Technical Training	8 Courses	Diverse courses using four Monju specific maintenance training models and four conventional maintenance technology training models
FBR Plant System Engineering Training	5 Courses	A fundamental course and an advanced courses divided into 4 classes

4. OPENING THE MONJU FBR TRAINING SCHOOL

4.1 New construction of the fast reactor training facility (FRTF)

After the Monju sodium leak accident, Monju recognized the importance of establishing sodium handling technology as a FBR development items. For achieving high quality educational training, useful training systems, superior instructors and good textbooks are needed.
Given this viewpoint, the FRTF, consisting of a sodium handling training facility (photo below left) and a maintenance training facility (photo below right) was constructed near Monju in March 2000.

Fig. 1 FRTF Overview (Monju FBR Training School)

The FRTF opened as the Monju FBR Training School in October 2000. The training systems installed in the FRTF were after consulting with major engineering manufactures in Japan (Toshiba, Hitachi, Mitsubishi and Fuji Electric). The FRTF was also based on the results of a questionnaire completed by Monju operators and maintenance workers

4.2 Providing unique training systems

To systematically learn manifold sodium handling technologies, the training categories are categorized as follows:

- Learning sodium properties
- Learning sodium loop operation technique
- Learning sodium compounds treatment skill
- Learning correspondence technology against sodium leakage from piping

Corresponding to the above categorization, sodium handling training courses are provided as the following groups: sodium properties; operation of sodium loop; sodium handling skill including treatment of its compounds; sodium piping leakage; sodium license for sodium handling work, etc..

Thus, diverse kinds of unique sodium training systems are furnished such as a multiple-purpose sodium training cell, a sodium training loop, two observation devices for sodium combustion and flowing, a sodium compounds treatment system and so forth.

Fig. 2 Overview of Sodium Training Cell and Sodium Training Loop

While, the maintenance training models located in the maintenance training facility are primarily divided into two categories. One is a total of five kinds of training models peculiar to Monju, which are duplicated sodium components of Monju such as a sodium pump mechanical seal mock-up model, a fuel handling system model, an upper core fuel handling machine model, etc..

The other category is four kinds of conventional maintenance technologies, which are electrical training model, mechanical training model, instrument & control training model, and non-destructive inspection model.

4.3 Establishment of training courses with coordinated lectures and exercises

Seven sodium training courses and eight maintenance training courses have been established for efficiently learning both extensive sodium handling and maintenance technologies categorized above, as shown in Table 2.

All the training courses are compose of both lectures and practices for the purpose of implementing more efficient training.

Table 2 Categorized Sodium Handling and Maintenance Training Courses

	Sodium Handling Courses	Maintenance Courses
1	Sodium Beginner Course	Fuel Handling System Course
2	Sodium Expert Course	Control Rod Driving Mechanism Course
3	Sodium Loop Operation Course (Charge & Drain)	Na Pump Mechanical Seal Overhaul Course
4	Sodium Loop Operation Course (Purification)	Water Pump Overhaul Course
5	Sodium Fire Extinguishing Course	Power Supply Panel Overhaul Course
6	Sodium Leak Correspondence Course	Instrumentation & Control Course
7	Sodium Handling License Course	Non-destructive Inspection Course
8	-	Maintenance Beginner Course

4.4 Evaluation of training results

All sodium handling courses and partial maintenance courses have comprehension examination in order to effectively evaluate the progress in trainee knowledge for each course.

The examination process will help the trainees have the necessary stimulation to participate efficiently in the training help them understand more deeply.

To be in specific, examinations take place portrayed in the following scenario:

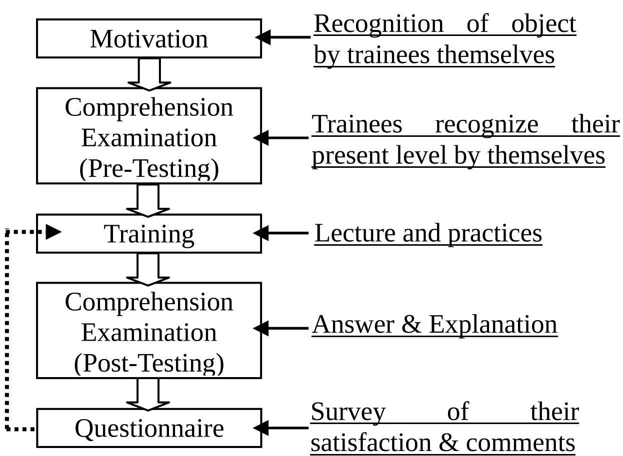
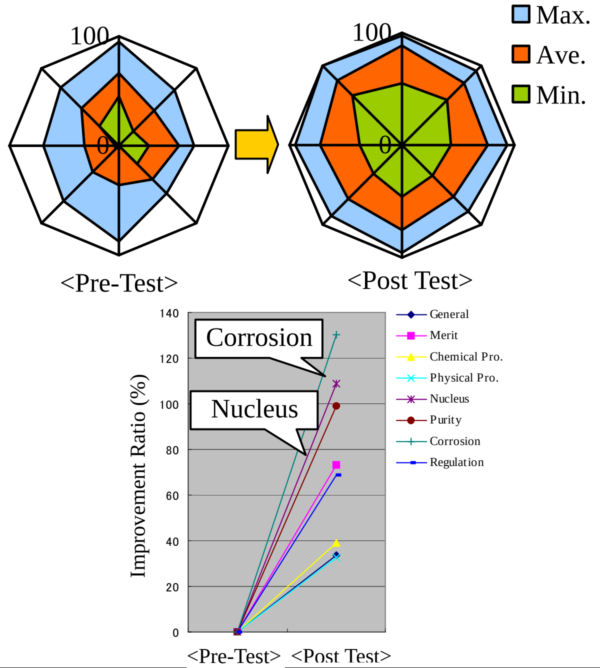


Fig. 3 Scenario Flow of Comprehension Examination

The following graphics and table describe an example of analysis results for the sodium expert course, which was obtained from the examination results of 22 trainees who participated in four times of the course dedicated at the time of the first stage of Monju FBR Training School.



Subject	Before Ave. (point)	After Ave. (point)	Rise Ratio (%)
Basic Items	66.3	88.5	33.5
Strength Point	45.3	78.2	73.0
Chemical Pro.	54.9	76.4	39.2
Physical Pro.	43.7	64.9	32.7
Nuclear Character	36.1	75.4	108.9
Purity Control	34.0	67.7	99.1
Corrosion	31.6	72.8	130.4
Regulation	48.1	81.3	69.0

Fig. 4 Sample Analysis of Test Results for Sodium Expert Course after Pre and Post Tests

The examination for the sodium expert course covers eight subjects: basic items, sodium's strengths as a coolant, chemical properties, physical properties, nuclear character, purity control, corrosion, and regulation. It was clear, based on the above analysis results, after pre and post-testing that the knowledge, especially regarding corrosion and nuclear character were improved remarkably.
In this way, the acquired analysis data is made available to trainees to help them self-study and it is reflected in how to teach future lectures.

4.5 Strengthening sodium handling technical training

(1) Development of a training course corresponding to sodium piping leaks

This course is the only training course available worldwide and is very meaningful for staff without any knowledge of experience of a sodium leak from a pipe. An imitation of a pipe leaking sodium was designed with a structure similar to a real pipe, i.e., equipping a sodium leak detector, some thermometers and electrical heaters including an outer insulator. However, there is difference from the original because there is a gap an inside-rod and the outer insulator.
In the training, sodium is charged into that gap. Then the charged sodium leaks through the clearance between the insulator and leak detector, or thermometers or electric heaters as shown in Figure 5.

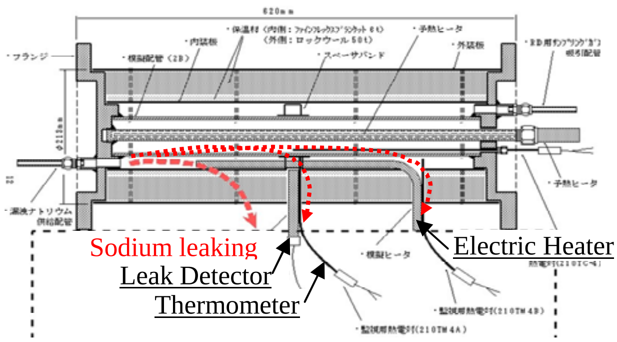


Fig. 5 Structure of Imitation of Sodium Leakage from Piping

During training the leakage quantity is about 2kg, sodium temperature approximately 500° C, and sodium leakage rate about 100kg/h (The Monju accident was ca. 170kg/h).
The actual practice in the sodium leakage training is shown in Figure 6.

Fig. 6 Actual Training for Sodium Piping Leakage Accident

(2) Prevailing new knowledge obtained from the Monju accident

In order to study about the Monju leak accident in more details from an engineering perspective, a reappearance experiment duplicating the accident was carried out at the OEC in March, 1996. At that time, some holes had penetrated the 6mm thick liner plate an occurrence that had not been anticipated in the Monju design.
After inspecting the cause of this penetration, the experiment verified that an unexpected phenomenon was occurred causing Molten Salt Type Corrosion, which happens in humid conditions [5].
In a humid environment, a large quantity of sodium

peroxide (Na_2O_2) which is a strong oxidizer will corrode much faster the liner plate.
Though the environment was humid during the duplication experiment because the experiment had taken place in a small room, the actual environment in Monju is very different from that because each room is so large.
In such low humidity, Na-Fe Double Oxidization Type Corrosion will occur. For this type of corrosion the dominant compounds is sodium oxide (Na_2O) and its corrosion speed is not so fast.
A comparison of Molten Salt Type Corrosion and Na-Fe Double Oxidization Type Corrosion is shown in the next figure.

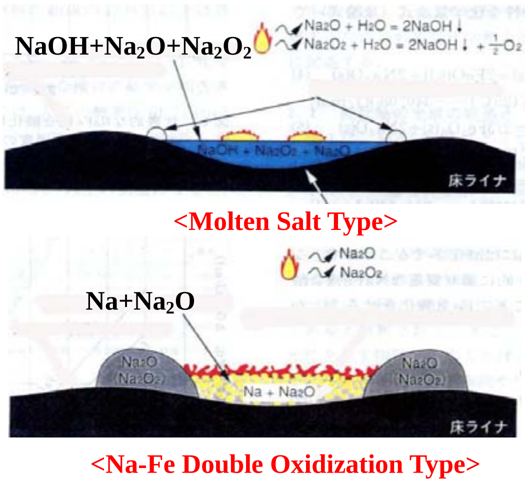


Fig. 7 Comparison of Molten Salt Type and Na-Fe Double Oxidization Type Corrosions

The new organized knowledge was presented to the young engineers in a lecture.

4.6 Establishment of New FBR plant system engineering training

Before the Monju accident, there were no on-site dedicated training courses concerning FBR plant system engineering.
Consequently, a new educational training course relating to FBR pant system engineering has been prepared in order to enhance Monju staff's knowledge on the FBR plant system engineering. Its course is classified into the FBR basic course and the FBR advanced course for effectively learning based on their career.
The FBR basic course is for three days and contains a total of twelve lectures including a history of FBR development, the future of FBR nuclear fuel cycle, FBR plant system configuration, FBR plant safety, core physics, fuel and structure materials, the sodium component, instrumentation & control, radiation control and radioactive waste treatment.
On the other hand, FBR advanced course is categorized into four courses as described in table 3, for more deeply learning manifold FBR plant system engineering.
A total of twelve distinctive lectures including 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., are contained in this advanced course. Each FBR advanced course hold two days, respectively.

Table 3 FBR Basic & FBR Advanced Courses

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

5. STRENGTHENING MONJU OPERATOR TRAINING

5.1 Remodeling MARS to upgrade simulator training

(1) MARS Outline

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 and a process linkage (input/output) control unit. The plant computer is composed of a dynamic computer for simulating plant behaviors in a real time simulation under normal and abnormal conditions, and a front-end computer for controlling interlock actions and interface between simulated control panels and each computer through 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 forth.
The plant simulator software consists of plant dynamic models, control system models, logic models and automatic operation models, all of which are modeled according to the characteristics of their equipment, instrumentation diagrams, and interlock block diagrams and so on. MARS can offer a total of 320 training cases that are malfunctions and 73 that are normal operation cases from standby operation mode to rated power

operation mode including shutdown operation mode.
Accordingly, it was confirmed that the plant simulation satisfied the accuracy demanded by ANSI/ANS-3.5-1985 (Nuclear Power Plant Simulator). The picture below shows the MARS overview.

Fig. 8 MARS Overview

(2) Supplement of a synthetic sodium leak monitoring system

As previously mentioned in the basic policy improvements in section-2, carrying out practical simulator training adapted to the more similar actual conditions of the sodium piping leak incident was required for more effective training.
Since Monju equipped a synthetic sodium leak monitoring system as one remedy in the Monju reconstruction, MARS also introduced the same system as an extra system.
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 figure 9, a sodium leak scenario is displayed on a CRT screen of the system, which is created by combining a three Dimension (3D) computer graphic and an actual picture.

Fig. 9 Synthetic Sodium Leak Monitoring System

(3) Advancing the plant dynamic analysis model of MARS

As a progressive future training, performing simulator training corresponding to an emergency operation procedure (EOP) for a loss of coolant accident (LOCA), a loss of flow accident (LOFA), a loss of heat removal system (LOHRS) is requested. To realize the above training, more accurate analysis of behaviors in a reactor core is necessary.
On this basis, the 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 figure 10. Both models are concatenated to each other with momentum equations and a friction factor for the pressure drop of each S/A that is provided by the in-water tests.

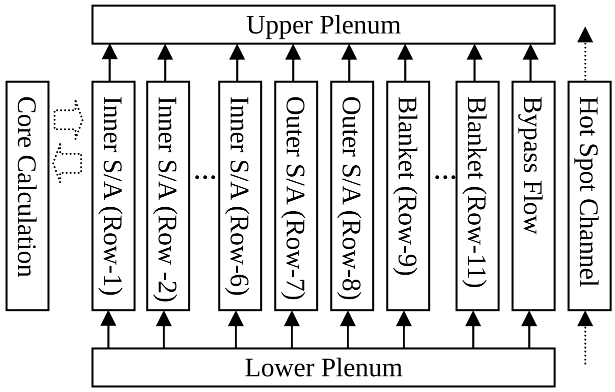


Fig. 10 Configuration of Reactor Core Model within Plant Dynamic Analysis Model

Each subassembly (S/A) in the reactor core is modeled into 11 representative channels of six inner core, two outer core, and three blanket core channels.
In addition, a bypass channel is installed as a precaution against a coolant leakage flows between each S/A and core structure. A hot spot evaluation channel is also provided to calculate the S/A's temperature under the most severe conditions set based on the safety assessment condition in order to evaluate whether fuel melts or not.
Besides, the core calculation model and each fuel channel including blanket channels have a correlation, that the core calculation model offers a reactor power calculated for the each fuel channel, and each channel returns back a fuel temperature for calculating feedback relativities.
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.

(4) Improvement of human-machine interface

In accordance with the remodeling above, 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 Establishment of educational training guideline

Before the sodium leak accident occurred in Monju, an educational training guideline was not sufficiently established. One result of the operating section's self review was a demand for establishing.

So, its guideline containing the following items was defined:

- ◆Educational training items
- ◆Frequency of educational training
- ◆Training contents
- ◆Textbooks

This guideline, of course, is applied not only to simulator training but also to sodium handling and maintenance trainings.

5.3 Introduction of simulator training evaluation manual

Implementing evaluation of training results is very important for attaining high quality and useful educational training.
Founded on this, Monju assigned evaluations from a simulator evaluation manual composed of the following two parts:

- ◆Evaluation for an individual
- ◆Evaluation for a shift crew

(1) Evaluation for an individual

The evaluation for an individual is aimed at upgrading the skills of operators and is for the core members of each shift crew that are divided into three classes of novice, middle and senior. Two instructors evaluate their operation skills with an evaluation check sheet for accuracy of operation including their approach for some operation modes, such as fundamental operations and/or an operation under a malfunction mode.
This check sheet is provided depending on their class and there are approximately twenty checking items in each sheet. Check sheets evaluated by the instructors are submitted to shift supervisors. The supervisors hold individual interviews and coaches the operators on any weak points observed from the evaluation check sheet.
The interview results are reported to the operation section managers. The evaluation flow for an individual is as follows:

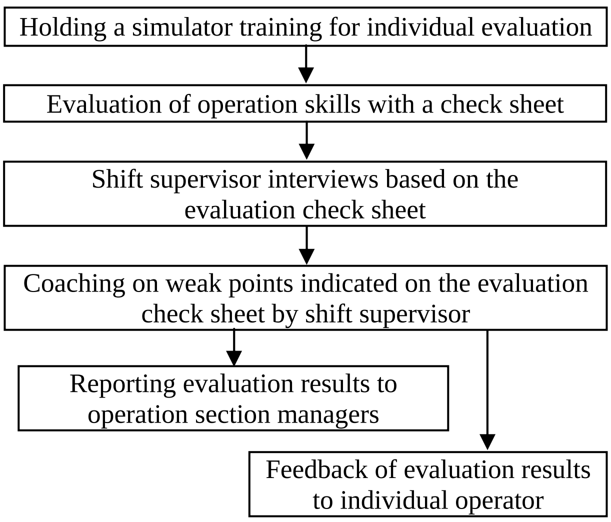


Fig. 11 Evaluation Flow for an Individual

The evaluation for an individual is performed when there is a promotion examination for promoting their class.

(2) Evaluation for a shift crew

For evaluating a shift crew, a chain of command and teamwork for an operation corresponding to a malfunction are checked by a licensed reactor engineer, section manager or assistant section manager.
The monitors create a comment sheet concerning the training results observed, and give the sheet to a shift supervisor. The shift supervisor has to reply regarding measures responding to their comments on the sheet. This shift crew evaluation takes place once a year.

5.4 E-learning system

The necessity for progress with the knowledge related to FBR technology and to enhance the knowledge on conventional technologies such as mechanical and electrical engineering were pointed out as one result of the operation section's voluntary check on the Monju staffs educational training, concerning Monju accident reviewing.
Consequently, an E-learning system was introduced to service an educational environment aiming for strengthening in basic knowledge. This system has a total of 29 training items as follows: 13 items for electric/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.

6. ORGANIZING SPECIALIZED EDUCATIONAL TRAINING

In order to achieve a substantial educational training, preparing forceful training systems and textbooks, and also having experienced instructors, are necessary. Two training sections specialized in educational training were newly organized in the former ICTDC, JNC (presently INITC, JAEA) in July 2000 together with opening the Monju FBR Training School.
Now, three instructors supported by five technicians are in charge of sodium handling and maintenance trainings and two instructors and four technicians are working on simulator training.
Equally, rich experiences and expertise of retirees on FBR technology, from the perspective of technology transition, is required too.
Thus, some retirees act as senior instructors and are involved in the Monju FBR Training School.

7. EDUCATION ACTIVITIES FOR STUDENTS AND ASIAN ENGINEERS

7.1 Supporting nuclear energy education for students

Energy education for students is important, leading directly to personnel development of the students who are expected to shoulder development of future energy. Therefore, JAEA Tsuruga has been supporting the organization of energy education for university students, mainly at the master's level, in western Japan in cooperation with other domestic organizations including

Wakasa-Wan Energy Research Center, some private electric companies, private electronic companies and CEA, France.
More specifically, for example, the student educational seminar titled Tsuruga Summer Institutes on Nuclear Energy 2006 was started last year, in 2006, hosted by Wakasa-Wan Energy Research Center.
A total of 34 students participated. The seminar topics included lectures and also offered various kinds of practices and facilities tours of real nuclear power plants including LWR, which cannot usually be experienced by students.
Moreover, an English discussion and special lectures by French instructors were also conducted, aiming for internationally accepted engineering training. This seminar is incorporated in one of the items in the agreement between CEA and JAEA, in the specific topic of cooperating in education and training field in the “Reactor Research & Advanced Nuclear Energy System”.

7.2 International technical training aimed at COE at Asia

To perform nuclear energy education for engineers and researchers in Asia is an important issue for Japan in order to promote a nuclear safety culture and secure the safety of nuclear power plants in Asia.
So, INITC has been performing the nuclear energy education for not only Japanese students but also for Asian nuclear engineers and researchers.
The following several international technical trainings as a part of the Asian training programs sponsored by MEXT (Ministry of Education, Culture, Sports, Science and Technology):

- Sodium handling technology training course for one month (or three months) based on the nuclear researcher exchanging program
- Nuclear plant safety course for three weeks based on the international seminar on nuclear safety program
- Young leader winter mission course for one week based on the international reactor safety foundation training program
- Instructor training course for one week based on the Asian training program

Through the activities of these trainings, INITC leads to become a COE of the international technology training in Asia.
In the future, the student energy education activities and the international training activities described above will lead to personnel development of young nuclear engineers and researchers who are expected to shoulder the development of our future energy.

8. PREPARATION TOWARDS MORE ENHANCEMENT OF FUTURE TRAINING

With the aim of more efficiently and systematically implementing educational training, Monju is attempting to introduce the SAT starting from FY 2008. The SAT is an operator training evaluation system, which aims to discover potential issues hidden in the present education structure.
During the SAT introduction, the actual simulator training evaluation manual will be changed according to the SAT requirements. The main evaluation flow of the SAT is as follows:

a) Defining necessary operation skills corresponding to each level of apprentice, novice, middle, and senior classes

b) Setup of training items corresponding to each level

c) Practice of simulator training

d) Confirmation of comprehension level by examination

e) Analysis of individual training and examination result data

f) Report of analysis results including any potential issues defined on operation skills to each trainee

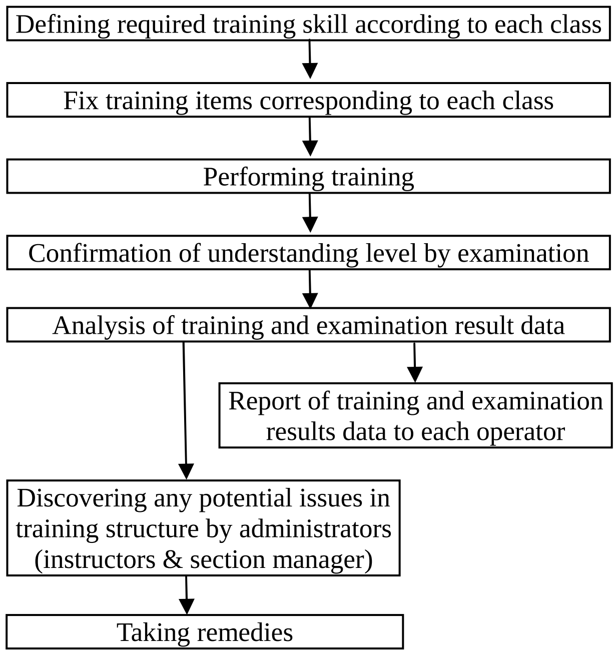


Fig. 12 Summary Evaluation Flow of the SAT

Preparation work for introducing the SAT will start from this year FY 2007 with a review of the required training items mentioned and examination’s questions.

9. CONCLUSION

Based on the lessons learned from the Monju accident, Monju took various remedies which are mainly divided into the following three groups:

- First, an educational training framework categorized into four training categories was newly created for systematically learning manifold FBR technologies.
- Second, to practice the various educational trainings based on the above framework, the Monju FBR Training School which has a total of twenty-nine training courses combining diverse lectures and exercises, was opened. One distinctive training course, for instance, is the sodium piping leakage training, which is the only course available worldwide. This

course is very important for staff who have never seen a sodium leak from a pipe.

Moreover, the specialized educational training organization was also newly organized together with the Monju FBR Training School.

- Third, the simulator training for the FBR operation technical training has been reinforced by taking the following variety of remedies: upgrading the MARS performance with a supplementary sodium leak monitoring system, and advancing the plant dynamic analysis model; establishing an educational training guideline including educational training items, frequency, and training contents; introducing simulator training evaluation manual and more.

A total of nine simulator training courses are now being conducting presently. Monju also intends to introduce the SAT, an operator training evaluation system, from FY 2008 for the purpose of implementing more effectively and systematically simulator training.

In addition, the INITC also has been performing several educational energy courses for Japanese students and Asian nuclear engineers and researchers aiming at becoming a COE of international educational training in Asia.

REFERENCES

[1] A. Miyakawa, "Sodium Leakage Experience at the Prototype FBR Monju", Unusual Occurrences during liquid Metal Fast Reactor Operation, TCM, IAEA, Vienna, 1998

[2] N. Koyagoshi, et al., "1993 Simulation Multiconference Society for Computer Simulation (SCS)", Simulation International X, Advanced Simulators and Workstations, pp. 72-77, 1993

[3] R. Nakai, "Lessons Learned from Monju Accident", International Conference on Probabilistic Safety Assessment and Management, International Association for Probabilistic Safety Assessment and Management, Osaka, 2000

[4] JEAG 4802-2002, Guide for Education and Training for Nuclear Power Plant Operator, Vol. 2, Japan Electric Association, 2002

[5] K. Aoto, "Corrosion Mechanism of Ferraus Materials Exposed to the Leaked Sodium and Its Compounds", PNC Technical Report No. 103, pp. 35-45, 1997.