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NSnet document number : ( NSP-RP-016 )  
Date of publication: October 31, 2001

## Summary Report of Peer Review

(Provisional Translation)

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Place of  
Review:

**Tokai Research Establishment,  
JAPAN ATOMIC ENERGY RESEARCH INSTITUTE  
(Tokai-mura, Naka-gun, Ibaraki)**

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Date of  
Review:

**September 18-21, 2001**

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Publisher  
:

**Nuclear Safety Network**

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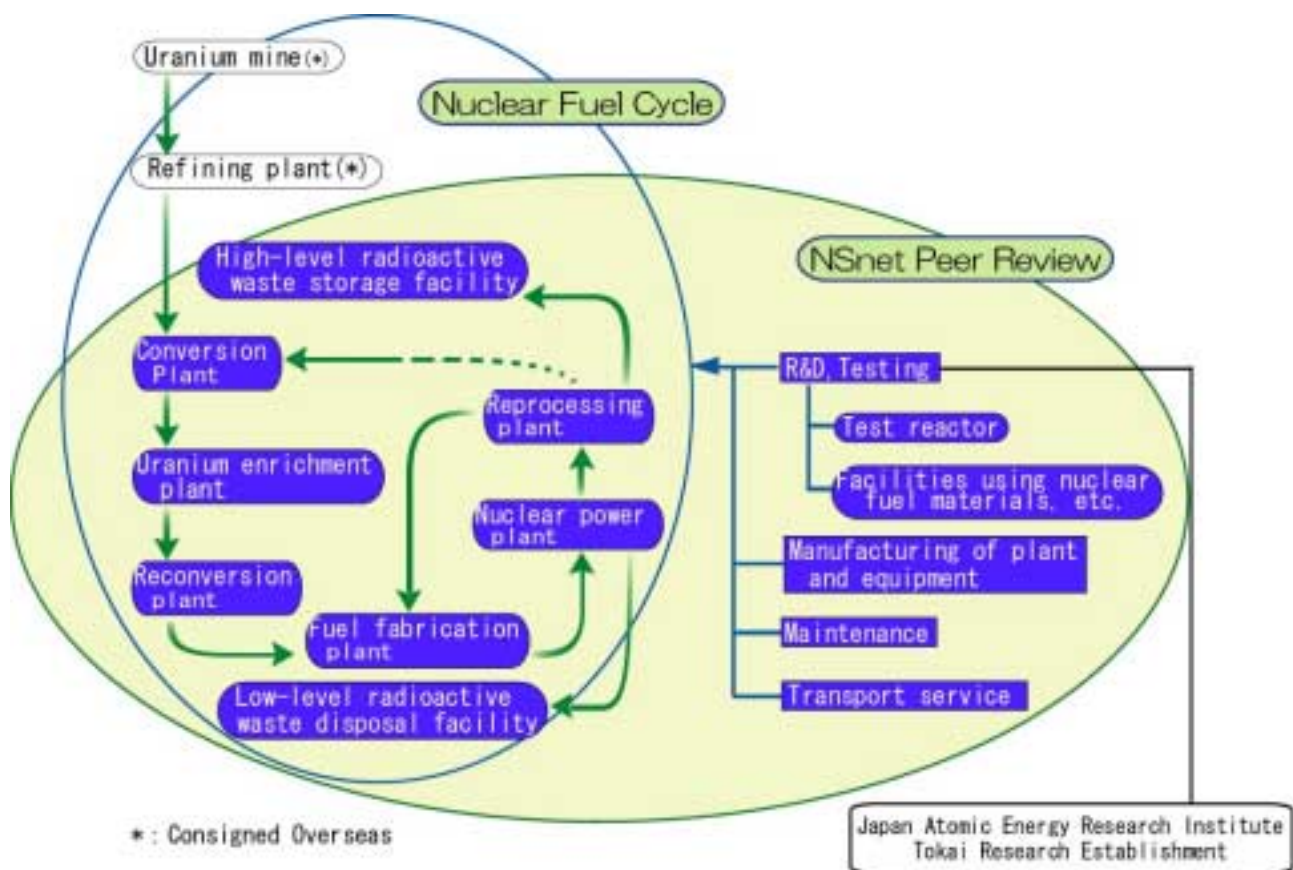
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## 1. Objectives

The purpose of the NSnet peer review (hereafter referred to as “the review”) is to achieve an improvement in the “safety culture” of the entire nuclear power industry by sending review teams of specialists to member facilities, where they conduct reciprocal evaluations on common nuclear safety subjects among members and share mutual knowledge of good practices as well as subjects that have been singled out.

## 2. Summary of Establishment Reviewed

The Japan Atomic Energy Research Institute (hereafter referred to as “JAERI”) was established in 1956 as a Japan’s core organization for comprehensive research in the area of nuclear energy. In 1957, the Tokai Research Establishment (hereafter referred to as “the Tokai Establishment”), which was subjected to the review, was established. The Tokai Establishment has played a role as a comprehensive nuclear research center by conducting extensive research and development using research reactors, facilities for safety research, accelerators, etc., as well as promoting basic nuclear research and the development of fundamental technologies.



The position of the Tokai Research Establishment in the nuclear fuel cycle

The Tokai Establishment has 987 personnel (as of FY 2001) comprising of 435 researchers, 453 engineers, and 99 office workers. In addition, 259 people are stationed at, for example, the Advanced Science Research Center, in the Tokai area and a total of 1,246 personnel are working for the Tokai Establishment.

The Tokai Establishment has research reactors, such as Japan's first nuclear reactor, JRR<sup>1</sup>-1 (first criticality in 1957), JRR-2 (first criticality in 1960), JRR-3 (first criticality in 1962), and JRR-4 (first criticality in 1965).

Research reactors are used for basic research, neutron beam experiments<sup>2</sup>, fuel and material irradiation, radioisotope production, nuclear reactor engineering experiments, medical irradiation, activation analysis<sup>3</sup>, education and training, etc. In general, some of these purposes are combined in the use of research reactors. Research reactors are designed so that high-density neutrons with the necessary energy can be used efficiently. Therefore, appropriate reactor power, core size, fuel, moderator<sup>4</sup> type, etc. are selected according to the purpose. In addition, research reactors are operated on a day-to-day basis by changing power according to different purposes, such as experiments, irradiation, and operation training, unlike power generation reactors that are operated at constant power over a long term.

At present, the operation of JRR-1 and JRR-2 has ceased after achieving their intended objectives. JRR-3 was modified for performance improvement, attained criticality again in 1990, and became a high-performance multi-purpose research reactor. JRR-4 was modified to be a nuclear reactor equipped with the latest research facilities, such as medical irradiation systems. The both are being operated utilizing their respective features and used for many experiments and research projects. The table below shows the features of JRR-3 as a representative of the research reactors currently in use.

Features of JRR-3

Name	JRR-3
Objective	Neutron beam experiments Fuel and material irradiation RI production
Type	Light water cooled and moderated pool type research reactor with low enriched uranium fuel <sup>5</sup>
Maximum thermal power	20,000 kW
Core shape and dimension	Cylinder, diameter: 60 cm, height: 75 cm
Month/Year of Criticality	March 1990
Remarks	Attained criticality in 1962, before modification.

### 3. Points of Review

The motive for the establishment of the NSnet was the unprecedented criticality accident in Japan (hereafter referred to as JCO accident), which occurred on September 30, 1999 at the Conversion Test Building (Fuel Processing Facility) of JCO Co. Ltd. The peer review for nuclear fuel facilities and nuclear power plants is characterized by the peculiarity of the facility to be reviewed in such a manner that the emphasis of review is put on "prevention of serious accidents such as criticality accidents" for the former and on "appropriate management of reactor cores" for the latter.

On the basis of the above facts and recent tendencies in nuclear safety, three fundamental points are set up for review at the Tokai Establishment as follows:

- (1) Basis of ensuring safety
- (2) Incorporating and addressing lessons learned from the JCO accident
- (3) Incorporating the features of research reactors.

Review items were decided and compared with the best practices in the nuclear industry by classifying individual elements of the above-mentioned three viewpoints into the following six areas: organization/administration, emergency measures, education/training, operation/maintenance, radiation protection, and addressing important issues.

As for “(1) Basis of ensuring safety”, the review points are enhancement of the safety culture, establishment of an effective organization, promoting the sufficient education and training to employees, achievement the effective operation and maintenance administration by provision and observance of the documents/manuals, conducting radioactive waste treatments and radiation protection appropriately.

As for “(2) Incorporating and addressing lessons from the JCO accident” the review points are ensuring criticality safety control<sup>6</sup> at unused fuel and spent fuel storage facilities, and activities and efforts at the Establishment, aiming to promote and improve its nuclear safety in view of the background and factors led to the accident.

As for “(3) Incorporating the features of research reactors”, the review points are efforts to cope with extensive aging of reactor components and to conduct various tests safely.

#### **4. Performing of the Review**

Date

September 18 (Tuesday) to September 21 (Friday), 2001

Formation of Review Teams

1<sup>st</sup> group : Shikoku Electric Power Company, Incorporated; Mitsubishi Electric Corporation

2<sup>nd</sup> group : The Tokyo Electric Power Company, Incorporated; Toshiba Corporation

3<sup>rd</sup> group : Global Nuclear Fuel Japan Co., Ltd, NSnet Office  
Coordinators : NSnet Office

Fields of Responsibility

1<sup>st</sup> group : Organization/administration, Emergency measures, Education/training

2<sup>nd</sup> group : Operation/maintenance, Radiation protection

3<sup>rd</sup> group : Addressing important issues

Facilities Subjected to the Review

The whole of the Tokai Establishment was reviewed with regard to “Organization and Administration,” “Emergency Measures,” “Education and Training,” and “Radiation Protection (in connection with waste).” JRR-3 was reviewed as a representative of research reactors with regard to “Operation and Maintenance,” “Radiation Protection (excluding Waste),” and “Addressing Important Issues.”

## 5. Review Schedule

The review was carried out over a four-day period according to the schedule shown below.

		1 <sup>st</sup> Group	2 <sup>nd</sup> Group	3 <sup>rd</sup> Group	
Sep. 18 (Tue.)	A M	Opening (Greetings, Introductory outline of facilities, etc.)			
		Plant Tour			
	<b>Document Confirmation</b> (1. Organization/ administration)	<b>Document Confirmation</b> (4.1 Effective operation administration)	<b>Document Confirmation</b> (6.1 Criticality Safety)		
	P M	Presentation of the examples of safety activities by reviewers			
		<b>Document Confirmation</b> (1. Organization/ administration)	<b>Document Confirmation</b> (4.1 Effective operation administration)	<b>Document Confirmation</b> (6.1 Criticality Safety)	
		<b>Field Observation</b> [Main control room]	<b>Interview</b> [Responsible personnel]		
Sep. 19 (Wed.)	A M	<b>Document Confirmation</b> (2. Emergency measures)	<b>Document Confirmation</b> (4.2 Effective Maintenance administration)	<b>Document Confirmation</b> (6.2 Incorporating past problematic events)	
		<b>Interview</b> [Director General] [Responsible personnel]	<b>Interview</b> (Maintenance personnel) [Managers] [Responsible personnel]	<b>Document Confirmation</b> (6.3 Efforts to cope with extensive aging)	
	<b>Field Observation</b> [Reactor building, etc.]		<b>Field Observation</b> (Criticality Safety) [New fuel storehouse, etc.]		
	<b>Interview</b> (Operating personnel) [Managers] [Operators]		<b>Field Observation</b> (Incorporating past problematic events) [Fuel treatment area, etc.]		
		<b>Field Observation</b> [Protection Headquarters Room]			
Sep. 20 (Thu.)	A M	<b>Document Confirmation</b> (3. Education/training)	<b>Document Confirmation</b> (5. Radiation protection)	<b>Document Confirmation</b> (6.4 Efforts for various tests)	
			<b>Field Observation</b> [Radioactive waste treatment facility, etc.]	<b>Field Observation</b> (Incorporating past problematic events) [Labo building, etc.]	
	P M	Verification of Fact	Verification of Fact	Verification of Fact	
Sep. 21 (Fri.)	A M	Verification of Fact, Closing			

## **6. Procedures and Items of Review**

### **6.1 Review Procedures**

The review was conducted with respect to various activities that the Tokai Establishment promotes to improve safety. The review identified good practices and items to be improved by observing the spots at which such activities are practiced and confirming the documents presented by the Tokai Establishment as described below, as well as through discussions and interviews with the personnel based on the above-mentioned observations and confirmations.

Additionally, in the process of review, the review team timely introduced useful instances regarding nuclear safety related activities at other operations to promote nuclear safety cultural exchange.

#### **6.1.1 Review Methods**

##### **(1) Field Observations**

Field observations were performed to check whether actual activities corresponded to items listed in documents and interviews. Findings were evaluated by reviewers' knowledge and experience.

##### **(2) Document Confirmation**

With regard to each review item, documents were confirmed while receiving explanation on them and requesting relevant documents as the need arose. In-depth confirmation was conducted, asking for relevant documents after observing field facilities and activities.

##### **(3) Interviews**

Interviews were conducted with the Director General, general managers and operators with the following objectives:

- a. Understanding the attitude and awareness toward nuclear safety
- b. Collecting additional information unconfirmed through documents
- c. Questions and answers on problems identified during document confirmation
- d. Grasping the degree of understanding of determined items and responsibilities imposed on each individual
- e. Understanding the compliance status of determined items and no ruination of such items.

#### **6.1.2 Good Practices and Suggestions for Improvement**

##### **(1) Good Practices**

"Information on good practices incorporating appropriate, effective, and unique methods into activities to ensure safety should be widely distributed to the members of the NSnet and the nuclear industry"

##### **(2) Suggestions for Improvement**

"After comparing the station's practices with the best in the nuclear industry, suggestions to improve and enhance safety activities should be recommended for

further improvement so as to achieve the highest level of nuclear safety.”

Even if current activities are equal to or higher than general standards in the nuclear industry, there is still room for improvement.

## 6.2 Items of Review

Based on the following review items identified and developed in “3. Points of Review,” field observations, document confirmation, and interviews were conducted, and the results were summarized into “7. Main Conclusions.”

### Section 1: Organization/Administration

To ensure nuclear safety, the review was conducted to check whether the personnel were appropriately assigned necessary for safe operation and experiment, whether safety culture that always prioritizes safety was fully recognized, and whether effective communication with the local community were promoted through the information disclosure.

(Review Items)

- (1) Effective organization management
  - a. Determination of security system and responsibility
  - b. Setting up goals of the organization
- (2) Activities to promote safety culture and improve morality
  - a. Specific activities to promote safety culture and morality
  - b. Information disclosure to the local community
- (3) Quality control
  - a. Effective audit system

### Section 2: Emergency Measures

Emergencies here mean the events described in the Special Measures Law for Nuclear Disasters (hereafter referred to as Nuclear Disasters Law) and other events defined as emergency and abnormal in the Safety Rule for Tokai Research Establishment Nuclear Reactor Facilities and the Safety Rule for Tokai Research Establishment Facilities Using Nuclear Fuel Materials, etc. (hereafter referred to as Safety Rules). In the review, the activities based on the Nuclear Disasters Law and the Safety Rules were focused.

(Review Items)

- (1) Emergency plans
  - a. Drawing up emergency plans
  - b. Establishment of emergency organizations (including notification and liaison systems)
  - c. Education of emergency plans, etc. to the employees and well known
- (2) Emergency equipment, tools and resources
  - a. Inspection and maintenance of equipment, tools, and resources
- (3) Emergency training
  - a. Implementation of training (results)



### Section 3: Education/Training

Based on the idea that improving technical skills and safety awareness among employees contributes to improving nuclear safety, the review was conducted to examine whether effective education and training systems, including the systems of cooperating companies, have been established, and whether they have been implemented responsibly.

How to incorporate the accumulation and transfer of technical know-how in the education and training system was included in the review items. Furthermore, some items on the education and training for researchers were also examined.

(Review Items)

- ( 1 ) Training plans and implementation
  - a. Education and training plans
  - b. Implementation of education and training (Improvement skill, Technical transfer)
- (2) Education and training for researchers
  - a. Implementation of education and training

### Section 4: Operation/Maintenance

The review was conducted to examine whether a high-level of safety is ensured concerning work items on operation management and maintenance management. With respect to each of operation and maintenance, it was examined whether documents such as work procedures and manuals have been developed and observed without fail. The review focused on the operation program and advance-confirmation of safety in operation management and implementation of maintenance and checking with special consideration of safety in the maintenance management.

(Review Items)

- (1) Effective operation administration
  - a. Operation organization
  - b. Documents and procedures regarding to the operation
  - c. Design management
  - d. Operation/ experiment plans and their management
- (2) Effective maintenance administration
  - a. Maintenance organization
  - b. Maintenance documents and procedures
  - c. Maintenance of equipments and machines/tools
  - d. Work plans and administration

### Section 5: Radiation Protection

To ensure adequate dose control for employees based on ALARA<sup>7</sup>, monitoring of radiation dose inside/outside the controlled area, and treatment and reduction of radioactive waste, various measures and their implementation status were reviewed.

(Review Items)

- (1) Dose control for employees and ALARA plans
- (2) Monitoring radiation dose
  - a. Monitoring radiation dose in normal, abnormal and accident situations
- (3) Disposal and reduction of radioactive waste
  - a. Radioactive waste disposal
  - b. Reducing the amount of radioactive waste

Section 6: Addressing important issues

Activities to ensure nuclear safety centering on criticality safety were reviewed with the aim of extensively disseminating criticality safety for nuclear fuel facilities throughout the Tokai Establishment, taking notice of the storage control of unused and spent fuel, core control, and shutdown safety measures. In addition, efforts to incorporate past problematic instances and cope with extensive aging and for various tests were reviewed.

(Review Items)

- (1) Activities concerning nuclear safety centering on criticality safety
  - a. Storage control of unused and spent fuel
  - b. Core control
  - c. Shutdown safety measures
- (2) Incorporating past problematic instances
  - a. Modification of equipments and improving operating methods
  - b. Activities to prevent human errors
  - c. Response to emergencies
  - d. Response to problematic instances at commercial reactors
- (3) Efforts to cope with extensive aging
  - a. Plans to cope with extensive aging
  - b. Examples of measure to cope with extensive aging
- (4) Efforts for various tests
  - a. Safety review system for various tests
  - b. Safely conducting various tests

## 7. Main Conclusions

Summarizing the results from the review of the Tokai Establishment of JAERI, no problematic items, which might cause a serious accident unless nuclear safety improvement measures were taken immediately, were identified.

In addition, it was confirmed that the Director General and all employees are seriously endeavoring to continue and enhance nuclear safety.

The Tokai Establishment is playing a leading and dominant role in nuclear safety, recognizing its important responsibilities as the largest and central nuclear research institute in Japan in both historic and positioning terms. In other words, it was strongly felt that the Tokai Establishment is aiming to set a good example of Japan's nuclear operations by utilizing its research /technical resources and its ample knowledge /information about domestic /overseas nuclear energy, as well as making great efforts in promoting high awareness of nuclear safety and succeeding in improving nuclear technologies.

It is expected that the Tokai Establishment will continue its safety activities, aiming to further improve its safety culture, rather than being satisfied with the current status.

It is also expected that the fruitful results from the review will be incorporated into other establishments of JAERI and among cooperating companies.

The following major good practices were identified during the review, which should be introduced extensively to other members of the NSnet and the nuclear industry:

- Ensuring the safety of nuclear facilities through the Nuclear Establishment Safety Cooperation Agreement\_(Tokai NOAH Agreement<sup>8</sup>)

The Tokai Establishment has played a core role in activities concerning the Nuclear Establishment Safety Cooperation Agreement\_(Tokai NOAH Agreement), which was concluded in January 2000 following the JCO accident. Twenty-one nuclear establishments located in Tokai-mura, Naka-machi, Oarai-machi, Asahi-mura, and Hitachinaka-shi are cooperating with one another during both ordinary times and in emergencies. The Tokai Establishment also contributes to ensuring the safety of individual nuclear establishments through these activities. The homepage of the Tokai NOAH was instituted in August 2001.

- Improving and enhancing protective activities by the Comprehensive Emergency Response Information System, etc.

To improve and enhance its response to emergencies and abnormal events described in the Nuclear Disasters Law and the Safety Rules, the Tokai Establishment is equipped with high-performance systems for protective activities at the Protection Headquarters. These include the following: 1) the Comprehensive Emergency Response Information System, which facilitates notification and communication with relevant personnel and allows the unified collection and sharing of information about protection activities and accidents; 2) the Emergency Response Surveillance System, which automatically notifies relevant personnel of fire alarms, displays and prints information about facilities that caught fire; and 3) the Administration System for Emergency Information and Communication, which stores facility information into a

database to provide appropriate information when an accident occurs and allows all JAERI's establishments to confirm information transmitted by facsimile. Some of these systems are utilized in emergencies not only by the Tokai Establishment, but also by the Tokai NOAH member's establishments .

- Establishing and practical using methods for evaluating personal radiation exposure in compliance with international standards

The personal dose evaluation method developed by JAERI has been adopted and utilized in the domestic evaluation standard manual, namely the Dose Measurement and Evaluation Manual (Nuclear Safety Technology Center). Regarding internal dose evaluation techniques, dose evaluation codes, namely the Internal Dose Evaluation System (INDES), etc., which are in compliance with the revised statute incorporating the latest ICRP<sup>9</sup> recommendations, have been developed and used.

- Exchanging and providing domestic and overseas information about research reactor operating experience

JAERI actively exchanges information concerning the operation control of research reactors as a core institute of the Research Reactor Liaison Council and the Research Reactor Consulting Group organized by domestic institutions equipped with research reactors. Also, to facilitate information exchange, JAERI actively participates in international information exchange and cooperation networks, such as ASRR (Asian Symposium on Research Reactors), FNCA (Forum for Nuclear Corporation in Asia), and IGORR (Meeting of International Group on Research Reactors). JAERI also provides its ample experience in operation for research reactor operating groups around the world, including Asian countries.

On the other hand, several suggestions are made to improve the activities to ensure safety at the Tokai Establishment. The major proposals are as follows:

- Sending more information concerning the Emergency Response Plan, etc to cooperating companies

The Tokai Establishment is endeavoring to promote information sharing and a sense of unity through activities of the Safety Joint Council for Cooperating Companies and the Safety and Health Committee held by individual sections of each facility and workplace. Information regarding emergency response in connection with the institution of the Emergency Response Plan is also shared among sectional the Safety and Health Committee, etc. It is desirable, however, to endeavor to realize further information sharing with cooperating companies by utilizing information exchange forums, such as the Safety Joint Council for Cooperating Companies.

- Clarifying emergency notification and liaison interfaces among operation manuals for individual facilities

The JRR-3 Operation Division, Research Reactor Utilization Division, and Facility Operation and Engineering have developed the JRR-3 Reactor Facility Operation Manual, JRR-3 Utilization Facility Operation Manual, and JRR-3 Ancillary Facility Operation Manual and are in charge of the operation of JRR-3, respectively. Each manual prescribes that mutual notification and liaison should be conducted. However, it is necessary to conduct liaison timely and without fail among the

operation groups of individual facilities, especially in emergencies. It is, therefore, desirable to clearly describe interfaces for liaison, requests, and notifications among these manuals, for example, by utilizing flow charts.

- Further incorporating experience in decay heat removal operations into operation manuals

Quantitative target values regarding the termination of decay heat removal operation by forced cooling after shutting down operation are not specified in the JRR-3 Reactor Facility Operation Manual, etc. To incorporate these into education for new employees and transferred operators and thus prevent human errors, it is desirable to specify standard values based on past operating experience in the JRR-3 Reactor Facility Operation Manual or know-how collections.

Itemized reports are published on the Japanese homepage.

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<sup>1</sup> JRR: “Japan Research Reactor,” an abbreviation for a JAERI research reactor.

<sup>2</sup> Neutron beam experiments: Neutron scattering experiments to clarify physical properties of substances by irradiating a measurement sample with a neutron beam extracted from a nuclear reactor. These include neutron radiography by which photographs are taken utilizing the characteristics of neutrons (see Reference Figure 12).

<sup>3</sup> Activation analysis: A method for chemical analysis based on the identification and measurement of characteristic radiation from a nuclide (isotope) produced by irradiation (excerpted from “Nuclear Dictionary: The Nikkan Kogyo Shimbun Ltd.”)

<sup>4</sup> Moderator: Substances that are used to reduce neutron energy by scattering it without remarkable capture. These include “light water,” “heavy water”, and “graphite.” (excerpted from “Nuclear Dictionary: The Nikkan Kogyo Shimbun Ltd.”)

<sup>5</sup> Pool type research reactor: nuclear reactor in which fuel elements are soaked in a water pool as moderator, cooler, and biological shield.

<sup>6</sup> Criticality safety control: To ensure safety so that fissile substances do not reach criticality and cause criticality accidents in facilities handling fissile substances, such as nuclear fuel processing plants and spent fuel reprocessing plants (excerpted from “Nuclear Dictionary: The Nikkan Kogyo Shimbun Ltd.”)

<sup>7</sup> ALARA stands for as low as reasonably achievable. It is the basic concept for conducting radiation protection recommended by the International Commission on Radiological Protection (ICRP).

<sup>8</sup> Tokai NOAH Agreement: The Nuclear Establishment Safety Cooperation Agreement is referred to as the Tokai NOAH Agreement, using the initials of the municipalities, namely Tokai-mura, Naka-machi, Oarai-machi, Asahi-mura and Hitachinaka-shi, in which 21 nuclear establishments signed this agreement are located.

<sup>9</sup> ICRP: International Commission on Radiological Protection