



Nuclear Safety Network (NSnet)
Otemachi Building #437
1-6-1 Ote-machi, Chiyoda-ku, Tokyo 100-0004
Tel: +81-3-5220-2666 Fax: +81-3-5220-2665
URL: <http://www.nsnet.gr.jp>

NSnet document number : (NSP-RP-005)

Date of publication: October 23, 2000

Summary Report of Peer Review
--

(Provisional Translation)

Place of Review:	Nippon Nuclear Fuel Development Co., Ltd. (Oarai-machi, Higashi Ibaraki-gun, Ibaraki Prefecture)
---------------------	---

Date of Review:	September 19-22, 2000
--------------------	-----------------------

Publisher:	Nuclear Safety Network
------------	------------------------

Contents

1. Objectives	1
2. Summary of Facility Operations	1
3. Points of Review	3
4. Period and Outline of Review	3
5. Schedule of Review	4
6. Methods and Items of Review	5
7. Main Conclusions	8

NFD was established by Hitachi, Ltd. and Toshiba Corporation in February 1972. In addition to its 60 employees, approximately 10 employees of Japan Nuclear Fuel Co., Ltd., a joint research partner, and 20 employees of other cooperating companies are stationed there.

NFD's facilities include Hot¹ Laboratory, in which post-irradiation tests on irradiated fuel, reactor pressure vessels, and in-core structural materials are conducted and an Uranium Fuel Laboratory, in which the development of new types of fuel and the trial production and characteristic testing of non-irradiated uranium pellets are conducted. As cold² facilities, in which no radioactive substances are handled, NFD also has a Materials Laboratory, in which the characteristic testing of metallic materials, such as fuel cladding tubes and structural materials, are conducted mainly. In addition, NFD has electric and air-conditioning utilities facilities and a Services Building equipped with emergency power generators for the Hot Laboratory.

The review was conducted with respect to the Hot Laboratory, Uranium Fuel Laboratory, and Services Building. The Materials Laboratory, which is a part of the cold facilities, was excluded from the scope of the review.

NFD conducts research, development, and testing of nuclear fuel and materials having been used in reactors as shown below.

- 1) Post-irradiation testing of BWR fuel
 - Characteristic study of BWR fuel
 - Development of high performance fuel
 - Development of high burn-up fuel
 - Development of MOX fuel(Through the above, 24 fuel assemblies and 108 fuel rods have been tested.)
- 2) Research and development of reactor structural materials
 - Research to cope with IASCC
 - Development of maintenance technology
 - Research to extend the life of pressure vessels(Through the above, approximately 1,200 irradiation samples have been tested and 46 surveillance tests have been carried out.)
- 3) Development of post-irradiation testing technique
 - Improvement and laborsaving of precision macro observation
 - Upgrading of micro observation and analysis
 - Upgrading of materials strength measuring technique
 - High-temperature pellet behavior evaluation technique
- 4) Transportation of irradiated fuel and materials
 - Transportation of irradiated fuel assemblies for testing
 - Transportation of irradiated fuel rods for testing
 - Transportation of irradiated metallic materials for testing

¹ A term qualitatively referring to a state where a high level of radiation exists. A "hot lab" is a laboratory in which highly radioactive substances can be handled safely and is equipped with a well-shielded cell, in which testing can be conducted using manipulators from outside the cell.

² A term qualitatively referring to a state where weak or no radiation exists.

3. Points of Review

NFD conducts extensive research and development as exemplified above at its hot lab facilities in which irradiated fuel and radioactive metallic materials can be handled, rather than manufacturing regular products routinely.

Accordingly, the review focused on NFD's efforts in ensuring the safety of various tasks involving new research and development subjects and systems modifications, as well as preventing serious accidents, such as criticality and fire accidents at the facilities handling nuclear fuel materials.

Review items were decided and compared with best practices in the nuclear industry by classifying individual items into the following six areas: organization/administration, emergency measures, education/training, operation/maintenance, radiation protection, and serious accident prevention.

Regarding serious accident prevention, the review was conducted to prevent criticality accidents, fires and explosions, as well as power losses and other accidents due to erroneous operation.

In addition to reviewing the efforts in ensuring the safety of various tasks involving new research and development subjects and systems modifications as mentioned above, in view of the factors that caused the criticality accident at JCO (hereafter referred to as the "JCO accident"), NFD's activities to promote and improve "nuclear safety culture" were reviewed. They include organizational policies and activities, clarification of organizational structures and responsibilities, employee education and training, employees' knowledge and skills, compliance with work procedures, technology transfer, and so on. In particular, the review focused on voluntary safety activities concerning the operation of systems and equipment, as well as how well safety awareness and morality have been established concerning employees' activities.

4. Period and Outline of Review

(1) Date

September 19 (Tuesday) to September 22 (Friday), 2000

(2) Formation of Review Teams

1st group: Kyushu Electric Power Co., Ltd. and NSnet Office

2nd group: Mitsubishi Materials Corporation and Kobe Steel Ltd.

3rd group: Central Research Institute of Electric Power Industry and Tohoku Electric Power Co., Ltd.

Coordinators: NSnet Office

(3) Areas of Responsibility

1st group: Organization/administration, emergency measures, and education/training

2nd group: Operation/maintenance, and radiation protection

3rd group: Serious accident prevention

5. Review Schedule

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

		1 st Group	2 nd Group	3 rd Group
Sept. 19 (Tue.)	A	Opening (Introductory outline of company/facilities, etc.)		
	M	Document examination (1. Organization/administration)	Document examination (4. Operation/maintenance)	Document examination (6.1 Criticality safety)
	P M	Document examination (1. Organization/administration)	Field observation [Uranium Fuel Research Building] [Power Building]	Field observation [Hot Lab facilities]
			Document examination (4. Operation/maintenance)	Document examination (6. 1 Criticality safety)
Sept. 20 (Wed.)	A	Field observation [Hot Lab facilities]	Document examination (4. Operation and maintenance)	Document examination (6.1 Criticality safety) (6. 4 Loss of power accident)
	M	Document examination (2. Emergency measures)	Field observation [Hot Lab facilities]	
	P M	Document examination (2. Emergency measures) (3. Education/training)	Document examination (4. Operation and maintenance) (5. Radiation protection)	Field observation [Uranium Fuel Research Building] [Power Building]
		Field observation [Uranium Fuel Research Building]		Document examination (6.3 Accidents from faulty operation)
	Sept. 21 (Thu.)	A	Interview [Management, administrators] [Researchers]	Document examination (5. Radiation protection)
P M		Verification of Fact	Interview [Administrators] [Researchers]	
		Verification of Fact		
		Verification of Fact		
Sept. 22 (Fri.)	A M	Verification of Fact, Closing		

6. Methods and Items of Review

6.1 Review Methods

The review was conducted with respect to various activities promoted by NFD to improve plant safety as outlined below. Good practices and items to be improved were identified through field observations of such activities, examination of the documents presented by the plant, and interviews with the employees.

During the review process, the review teams also introduced useful examples of activities in a timely manner to facilitate nuclear safety cultural exchange. These include safety and quality control during periodic inspections, and research results concerning human factors, and internal code of ethics.

(1) Field Observations

Direct observation was made with regard to actual activities compared with the items confirmed through document examinations and interviews. Findings were compared with reviewers' knowledge and experience.

(2) Document Examination

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

(3) Interviews

Interviews were conducted with respect to management, administrators and researchers with the following objectives:

- (a) Collecting additional information that cannot be verified by documents
- (b) Questions and answers on problems identified during document examination
- (c) Grasping the degree of understanding of determined items and responsibilities imposed on each individual
- (d) Understanding the compliance status of determined items and whether such items have become dead letters
- (e) Understanding the attitude and awareness toward nuclear safety

6.2 Items of Review

Based on the following items of review, field observations, document examinations, and interviews were conducted. Results were evaluated and itemized. They were then summarized in "Main Conclusions."

Section 1: Organization/Administration

To ensure nuclear safety, the review was conducted to check whether the necessary personnel are assigned to ensure safe operation, whether “safety culture” that always prioritizes safety is fully recognized, and whether sufficient consideration is given to human-errors.

(Review Items)

(1) Effective Organization Management

- a. Clarifying line-organizations and the system of responsibility
- b. Justifying the operation system
- c. Responsibility and management of the employees from affiliate companies
- d. Setting up goals of the organization
- e. The leadership of middle to upper managers

(2) Cultivating Safety Culture

- a. Promoting a work environment where each individual of the organization prioritize safety

(3) Human Factors

- a. Further consideration to human factors

Section 2: Emergency Measures

Considering the enforcement of the Nuclear Disaster Special Measures Law in June 2000 (hereafter referred to as the “Nuclear Disaster Law”), the review was conducted to examine whether emergency plans and equipment are in place and whether training is carried out responsibly.

(Review Items)

(1) Emergency Plans

- a. Adoption of emergency plans
- b. Organizational preparedness for emergency
- c. Maintenance of emergency manuals
- d. Information dissemination to employees

(2) Emergency Facilities, Equipment, and Resources

- a. Maintenance of facilities, equipment, and resources

(3) Emergency Training

- a. Execution of accident trainings

Section 3: Education/Training

Based on the idea that improving technical skills and safety awareness among employees contributes to preventing accidents, the review was conducted to examine whether effective education and training systems have been developed, whether credential certification systems have been introduced, and whether they have been implemented responsibly.

(Review Items)

(1) Qualifications

- a. System of certificate qualifications

- b. Evaluation criteria
- (2) Implementation of Trainings
 - a. Systems of education and trainings

Section 4: Operation/Maintenance

The review was conducted to check whether high-level safety is ensured with regard to various items concerning operation and maintenance work. Regarding personnel, it was examined whether documents, including work procedures and manuals, have been well developed, whether the employees understand them sufficiently, and whether technology transfer is conducted appropriately. In terms of systems and equipment, it was examined whether safety functions are clearly classified and are under favorable control.

(Review Items)

- (1) Implementation of Operation/Maintenance
 - a. Methods, procedures, and verification for safe operation
 - b. Methods, procedures, and verification for confinement and prevention of radiation problems
 - c. Methods, procedures, and verification for non-routine work
- (2) Employee Skill and Knowledge
 - a. Knowledge about general safety
 - b. Knowledge about radiation safety
- (3) Manuals and Documents Regarding Operation/Maintenance
 - a. Preparation of documents and manuals
 - b. Methods for preparing, checking, and certifying documents and manuals
 - c. Alignment with authorized items
 - d. Revision of documents and manuals
- (4) Operation Facilities and Equipment
 - a. Clarification of safety functions
 - b. Interlocking systems and equipment
 - c. Inspection of equipment and facilities
- (5) Work Experience
 - a. Past trouble instances and the countermeasure

Section 5: Radiation Protection

To ensure the adequate administration of radioactive substances, thereby preventing leakage into the surrounding environment and improving employee dose control, relevant measures and their implementation status were examined.

(Review Items)

- (1) Administration of Radioactive Substances
 - a. Administration of nuclear fuel materials
 - b. Administration of radioactive waste

- (2) Confinement of Radioactive Substances
 - a. Optimal control of negative pressure
- (3) Dose Control
 - a. Employee dose control
- (4) Monitoring Radiation Dose
 - a. Routine monitoring
 - b. Emergency monitoring

Section 6: Serious Accident Prevention

To prevent accidents that might have a serious impact on the surrounding environment, it was examined whether systems that are likely to cause accidents have been identified, whether multiple measures have been taken against them, and whether any systems are in place, which enables quick detection when an accident occurs.

(Review Items)

- (1) Criticality Safety
 - a. Criticality safety education for employees and their knowledge
 - b. Procedures, equipment, and instrument that need criticality safety control
 - c. Criticality safety administration methods
- (2) Accidents Caused by Fires/Explosions
 - a. Procedures, equipment, and instrument that may cause fires/explosions
 - b. Administrative methods for preventing fires/explosions
 - c. Detection and alleviating of fires/explosions
- (3) Accidents Caused by Faulty Operation
 - a. Procedures, equipment, and instrument that may cause accidents by faulty operations
 - b. Administrative methods for the prevention of accidents by faulty operations
 - c. Detection and alleviation of accidents caused by faulty operations
- (4) Loss of power accidents
 - a. Procedures, equipment, and instrument that may have a significant impact in the event of power loss
 - b. Administrative methods for preventing power loss

7. Main Conclusions

Summarizing the results from the review of NFD, no problematic items were identified, which may cause a severe accident if no nuclear safety improvement measures would be taken immediately. In addition, it was confirmed that at NFD, all the employees, including General Manager and employees of cooperating companies, are seriously endeavoring to continue and enhance nuclear safety. In particular, in conducting research, development, and testing, which are their key features, “control area work plans” are prepared in advance for all work, requiring the approval of the safety control group, chief engineer in charge of handling nuclear fuel, and leader of

the safety control group. It was confirmed that sufficient consideration and measures are taken to ensure safety. It is expected that NFD will continue its voluntary safety efforts, aiming to further improve its safety culture

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:

- “Safety principles” are written on stone monuments so that employees can always see them from places facing main roads in the site. They say, “Giving the highest priority to all aspects of safety assurance is: The most important principle for keeping NFD. The major premise to obtain the public acceptance for our being. The basis for ensuring our healthy and happy lives.” The “safety principles” and the “management principles”, saying “Observing both the law and local agreements, and always giving top priority to safety assurance” are made into portable cards, which are distributed among employees. Efforts are being made to promote safety awareness by organizing admonitory lectures given by the president of NFD at the beginning of the year and the term, as well as safety assemblies during the national labor safety week.

- To ensure quality control, locations of radioisotopes (RI) are kept track of for each sample and container on a real-time basis in accordance with the “Sample Numbering Rule” and the “Sample Container Numbering Rule” by using a computer system, which has been rewarded with excellent results.

- Criticality safety education is offered for all executives and employees including the employees of the cooperating companies stationed at NFD. The textbook for criticality safety education contains basic items that are easy for general personnel to understand. In addition, questionnaires are given after “criticality safety education” and “periodic education for personnel engaging in tasks involving radiation” programs, contributing to verifying the trainees’ comprehension levels and incorporating the necessary information into training materials.

On the other hand, several suggestions are made to further improve the current safety activities at NFD. Major proposals are as follows:

- Regarding nuclear safety control, it is desirable to continue voluntary safety efforts to further improve its safety culture, including medium to long-term measures in addition to conventional activities so as not to weather the lessons from the JCO accident.

- Chemical substances are administered strictly and effectively in accordance with the “Hazardous Substance Handling Standards” and the “Chemicals Handling Standards.” Aiming to improve safety, however, it is desirable to collect and utilize “Materials Safety Data Sheets (MSDS),” in which manufacturers of chemicals describe information about hazardous substances and ways to handle them.

- The measurement and criticality control of nuclear fuel materials are processed by separate computers and administered responsibly in accordance with respective procedures.

To achieve data sharing and input error reduction, however, referring to the computer system achieving good results on the administration of radioisotopes, it is desirable to make efforts in establishing a system integrating measurement and criticality control.

Itemized reports are published on the Japanese homepage.