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Summary Report of Peer Review

(Provisional Translation)

Place of Review:	**Fukushima Daiichi Nuclear Power Station, TOKYO ELECTRIC POWER COMPANY (Ohkuma-machi & Futaba-machi, Futaba-gun, Fukushima-pref)**
Date of Review:	**October 17-20, 2000**
Publisher :	**Nuclear Safety Network**

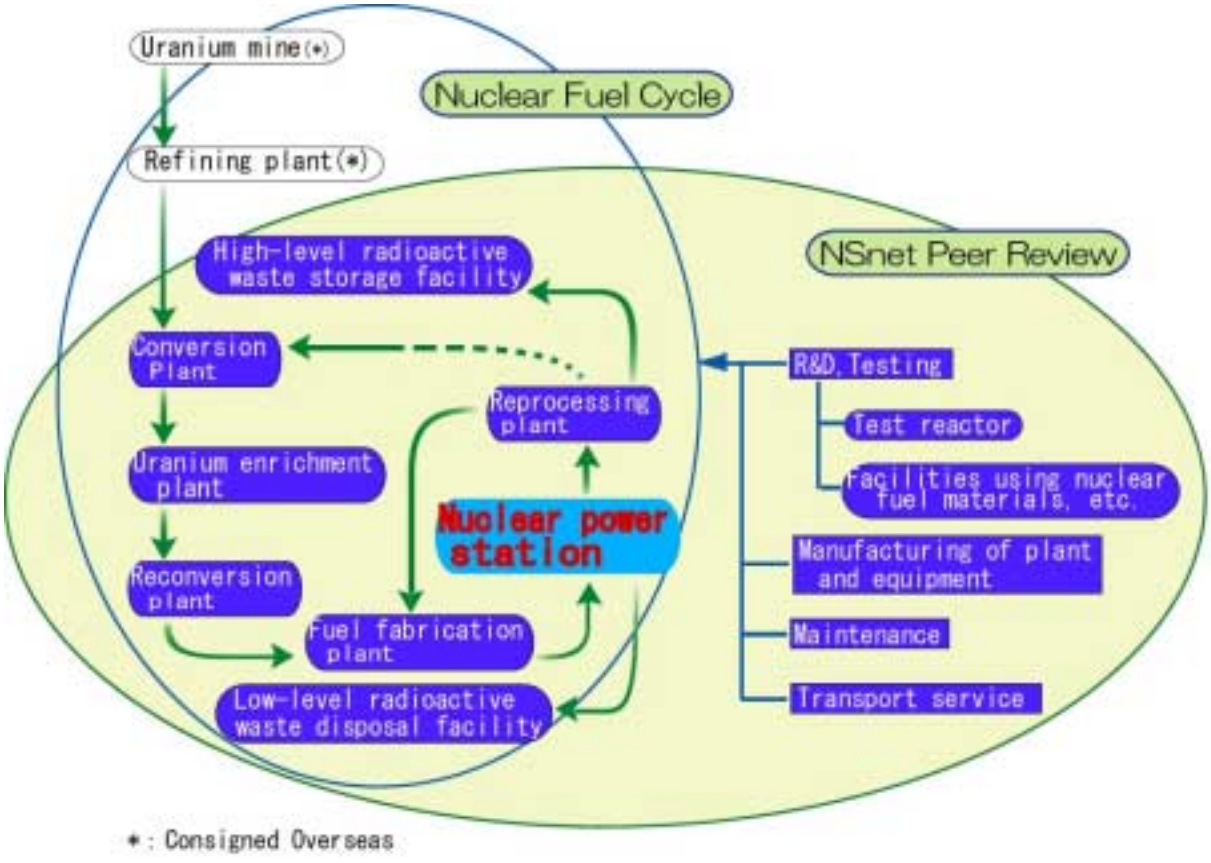
Contents

1. Objectives

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

2. Summary of Facility Operations

The Tokyo Electric Power Co., Ltd. (TEPCO) has three nuclear power stations: Fukushima Daiichi, Fukushima Daini, and Kashiwazaki Kariwa. Nuclear power accounts for approximately 49% of its total power generation (FY 1999).



The position of "NUCLEAR POWER STATION" in the nuclear fuel cycle

Fukushima Daiichi, comprising of six BWR units, is the first nuclear power plant of TEPCO with a vast site of approximately 3.5 million square meters, facing the Pacific Ocean in Okuma-machi and Futaba-machi in Fukushima-pref, approximately 250 km north of Tokyo.

At Fukushima Daiichi, the first unit started commercial operation in March 1971, continuing a safe and stable operation over 29 years since then. In September 2000, it became the first nuclear power plant in Japan that generated a total of 650 billion kWh since the start of its commercial operation (see the table below).

Unit	Output (MW)	Reactor Type	Start of Commercial Operation	Main Contractor	Record of Operation (Total) (As of the end of September 2000)	
					Power Generation (Billion kWh)	Capacity Factor (%)
1	460	BWR-3	1971/03	GE[1]	67.7	56.9
2	784	BWR-4	1974/07	GE/Toshiba	107.1	59.5
3	784	BWR-4	1976/03	Toshiba	109.1	64.9
4	784	BWR-4	1978/10	Hitachi	111.5	73.9
5	784	BWR-4	1978/04	Toshiba	109.4	70.9
6	1,100	BWR-5	1979/10	GE/Toshiba	148.3	73.4
Total	4,696	-	-	-	653.4	67.0

The number of employees at Fukushima Daiichi is approximately 970, 220 of which engage in actual operation in six groups on three shifts. Approximately 330 of the remaining employees belong to the maintenance department, 170 belong to the technical support department, and 250 belong to other departments, such as the general affairs department. In addition, approximately 5,000 employees of subcontractors are stationed at Fukushima Daiichi to support plant operation and maintenance.

The cumulative capacity factor[2] of Fukushima Daiichi is approximately 67%. However, the figure reaches 72% on average over the last ten years, which is considered favorable.

3. Points of Review

The NSnet was established following the first criticality accident that ever occurred in Japan at the conversion test building (fuel processing facilities) of JCO on September 30, 1999 (hereafter referred to as "the JCO accident"). The NSnet peer review on operations that has nuclear fuel facilities, including fuel-processing facilities, has focused on "the prevention of fatal accidents, such as critical accidents." In this review, in view of the recent trends in nuclear safety and accident prevention, we focused on the following five basic points in terms of both technical and social safety:

(1) Foundation to ensure nuclear safety
(2) Relationship with the community (improving anti-disaster measures)
(3) Incorporating operating experience into the improvement of safety
(4) Reflecting and addressing lessons from the JCO accident
(5) Recent issues concerning LWRs

Review items were decided and compared with best practices in the nuclear industry by classifying individual elements of the above five viewpoints into the following six areas: ① organization/administration, ② emergency measures, ③ education/training, ④ operation/maintenance, ⑤ radiation protection, and ⑥ addressing important issues.

"(1) Foundation to ensure nuclear safety:" Safety culture should be fostered to establish an effective organization. Sufficient education and training should be provided to operators and

[1] General Electric: U.S.A.

[2] Capacity factor (%): [total power generation (kWh)] x 100 / [licensed output (kW) x total hours of operation (h)]

maintenance personnel. Effective documentation of operation and maintenance administration should be promoted and complied with. Appropriate communication with subcontractors should be ensured. Radioactive waste disposal and radiation protection should be conducted appropriately.

"(2) Relationship with the community (improving anti-disaster measures):" Emergency measures should be implemented without fail. Efforts should be made to coexist with the community and promote the safety of nuclear energy through disclosure and public acceptance activities.

"(3) Incorporating operating experience into the improvement of safety:" Problems that occurred at nuclear power generation facilities in the past should be incorporated into the subject facilities in an appropriate manner to facilitate the improvement of equipment and operating methods.

"(4) Reflecting and addressing lessons from the JCO accident:" Critical safety control[3] at new fuel storage warehouse, spent fuel storage pool, and so on should thoroughly be ensured. In-core fuel management should be carried out appropriately to ensure nuclear safety[4]. Activities should be promoted to foster and improve the nuclear safety culture in view of factors that have caused accidents.

"(5) Recent issues concerning LWRs:" Quality control should be enhanced to prevent the problem of data manipulation in inspections of piping welds, spent fuel transportation containers, and MOX fuel[5]. Activities should be promoted to develop measures to prevent human error and ensure safety at reactor shutdown and aged plants.

4. Period and Outline of Review

(1) Date
October 17 (Tuesday) to October 20 (Friday), 2000

(2) Formation of Review Teams
1st group: Mitsubishi Heavy Industries Ltd.; Electric Power Development Co.
2nd group: The Hokkaido Electric Power Co., Inc.; Japan Atomic Energy Research Institute
3rd group: Mitsubishi Nuclear Fuel Co., Ltd.; NSnet Office
Coordinators: NSnet Office

(3) Fields of Responsibility
1st group: Organization/administration, emergency measures, education/training
2nd group: Operation/maintenance, radiation protection
3rd group: Addressing important issues

(4) Facilities to be Reviewed
Organization/administration, emergency measures, and education/training were reviewed for the entire operation. Field observations and document examinations in other areas, including operation/maintenance, were carried out with respect to Unit 3 as a

[3] To ensure safety so that fissile substances must not reach criticality to cause critical 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.")

[4] Referring to the safety of nuclear facilities against nuclear accidents. A nuclear accident at a nuclear reactor means an accident in which reactivity increases sharply due to failure or breakdown of equipment that affects reactivity (e.g., reactivity control system), causing the thermal output of the reactor to increase rapidly, which in turn causes the fuel to overheat (excerpted from "Nuclear Dictionary: The Nikkan Kogyo Shimbun Ltd.")

[5] Mixed-Oxide Fuel: Nuclear fuel that contains fissile nuclides composing of two or more types of oxides. Generally, it refers to nuclear fuel mainly composing of uranium oxide and plutonium oxide (excerpted from "Nuclear Dictionary: The Nikkan Kogyo Shimbun Ltd.")

representative.

5. Review Schedule

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

<table>
<tr><th colspan="2"></th><th>1st Group</th><th>2nd Group</th><th>3rd Group</th></tr>
<tr><td rowspan="3">Oct. 17
(Tue.)</td><td rowspan="2">AM</td><td colspan="3">Opening (Introductory outline of company/facilities, etc.)</td></tr>
<tr><td colspan="3">Plant Tour
[Main control rooms for Units 3 and 4, reactor buildings]</td></tr>
<tr><td>PM</td><td rowspan="2">Document examination
(1. Organization/
administration)</td><td>Document examination
(4. Operation/maintenance:
(1) Effective operation
administration</td><td>Document examination
(6. Addressing important issues: 6-1. Addressing nuclear energy safety centering on nuclear safety)</td></tr>
<tr><td rowspan="2">Oct. 18
(Wed.)</td><td rowspan="2">AM</td><td>Field observation
[Unit 3 Main control room]</td><td>Interview
[Responsible personnel]</td></tr>
<tr><td>Document examination
(2. Emergency measures)</td><td rowspan="2">Document examination
(4. Operation/maintenance:
(2) Effective maintenance
administration</td><td rowspan="2">Document examination
(6.2 Reflecting on past problems)</td></tr>
<tr><td>Oct. 19
(Thu.)</td><td>AM</td><td>Field observation
[Emergency Operation Room]</td></tr>
<tr><td></td><td>PM</td><td rowspan="2">Interview
[Directors]
[Managers]
[Responsible personnel]</td><td rowspan="2">Interview
[Managers]
[Responsible personnel]</td><td rowspan="2">Field observation
[Unit 3 Main control room]
[Unit 3 spent fuel pool]
[Centralized radiation waste treatment facility]
[Shared auxiliary facilities]</td></tr>
<tr><td rowspan="3">Oct. 19
(Thu.)</td><td rowspan="2">AM</td><td>Document examination
(3. Education/training)</td><td>Document examination
(5. Radiation protection)</td><td rowspan="2">Document examination
(6.3 Coping with aged plants)</td></tr>
<tr><td>Field observation
[Fukushima nuclear power plant training center]</td><td>Field observation
[Radioactive solid waste storage facility]</td></tr>
<tr><td>PM</td><td rowspan="2">Verification of Fact</td><td>Field observation
[Unit 3 Main control room]</td><td rowspan="2">Verification of Fact</td></tr>
<tr><td>Oct. 20
(Fri.)</td><td>AM</td><td>Verification of Fact</td></tr>
<tr><td colspan="5">Verification of Fact</td></tr>
</table>

6. Methods and Items of Review

6.1 Review Methods

The review was conducted with respect to various activities 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, such as the Periodic Educational Material (critical safety control), to facilitate nuclear cultural exchange.

(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 directors, managers, operators, and maintenance personnel with the following objectives:
a. Collecting additional information that cannot be verified through 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

Field observations, document examinations, and interviews were conducted based on the review items identified in "3. Points of Review." Results were evaluated and itemized. They were then summarized in "7. 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, whether effective communication with subcontractors is maintained, and whether public acceptance activities for the local community are promoted through disclosure.

The issue of data manipulation was examined in terms of quality control enhancement and morality.

(Review Items)

(1) Effective organization management
a. Clarifying the line-organization and the system of responsibility
b. Setting up goals of the organization
c. The leadership of the managers

(2) Activities to promote safety culture and improve morality
a. Specific activities to promote "safety culture"
b. Specific activities to improve morality
c. Public acceptance activities for the local community

(3) Quality control
a. Effective audit system
b. Preventing data manipulation

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. Drawing up emergency plans
    b. Improving emergency organizations
    c. Developing emergency procedures
    d. Keeping employees well informed
(2) Emergency facilities, equipment, and resources
    a. Inspection and maintenance of facilities, equipment, and resources
(3) Emergency training
    a. Implementation of training (actual 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 subcontractors, have been developed, whether credential certification systems have been introduced, and whether they have been implemented responsibly.

How the accumulation and transfer of technical know-how is incorporated in the education and training system was also included in the review items.

(Review Items)
(1) Qualifications
    a. System of certificate qualifications
    b. Evaluation criteria
(2) Training plans and implementation
    a. Education and training plans
    b. Implementation of education and training plans

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 administration. Regarding the Operation and Maintenance Departments, it was examined as a common issue whether adequate personnel, including those from subcontractors, are assigned and whether documentation is facilitated and complied with. In addition, the review focused on compliance with operating limits in the area of operation administration and functional classification of individual systems and equipment as well as corresponding maintenance and inspection in the area of maintenance administration. Paying attention to shortened annual inspection, moreover, it was examined whether inspection periods are not shortened disregarding safety.

(Review Items)
(1) Effective operation administration
    a. Operation organization
    b. Operating books and manuals, and compliance with them
    c. Design control (compliance with operating limits)

(2) Effective maintenance administration
    a. Maintenance organization
    b. Maintenance documents and procedures, and compliance with them
    c. Maintenance systems and equipment
    d. Work plans and administration

Section 5: Radiation Protection

To ensure adequate dose control for employee based on the idea of ALARA[6], monitoring of radiation dose outside the controlled area, and disposal and reduction of radioactive waste, various measures and their implementation status were reviewed.

(Review Items)

(1) Dose control for employees engaging in radiation related tasks and ALARA plans
(2) Monitoring radiation dose
    a. Monitoring radiation dose in normal and accident situations
(3) Disposal and reduction of radioactive waste
    a. Radioactive waste disposal
    b. Reducing the generation of radioactive waste

Section 6: Addressing Important Issues

Each step of nuclear safety was examined from the acceptance of new fuel, fuel loading/operation/removal to spent fuel storage and transportation to extend criticality safety at nuclear fuel facilities to nuclear power stations. In addition, activities concerning risk evaluation were examined, such as periodic safety review (PRS)[7] reports and accident management (AM)[8] measures.

The review also focused on the system and record reflecting problematic events that have occurred at domestic and overseas nuclear facilities in the past.

Considering that it is nearly 30 years since Unit 1, the first reactor of Fukushima Daiichi, started commercial operation, TEPCO's efforts in Plant Life Management activities were examined with special attention.

(Review Items)

Section 6.1: Activities for nuclear safety

(1) New and spent fuel management
(2) In-core fuel management
(3) Shutdown safety measures
(4) Activities concerning risk criteria

Section 6.2: Reflecting past problematic events

(1) Modifying and improving systems and operating methods
(2) Emergency response
(3) Measures to prevent fuel leakage and fuel integrity monitoring (specific example 1)
(4) Fire and explosion prevention (specific example 2)

Section 6.3: Efforts in coping with aged plants

(1) Long-term maintenance program
(2) Examples for large-scale improvement work

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[6] 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).

[7] PSR stands for Periodic Safety Review. It means to conduct a periodic review on nuclear reactor facilities that have been in operation for a certain period since the start of operation with regard to the status of incorporating operating experience and the latest technical knowledge and information (excerpted from "1999 Nuclear Safety White Paper").

[8] AM stands for Accident Management. Measures to be taken to mitigate the effect of severe accidents caused by an event exceeding the scope of design standard events (events that may lead nuclear facilities to the abnormal status and are determined to be considered when evaluating the safety design of nuclear facilities) to cause significant damage to the reactor core (excerpted from "1998 Nuclear Safety White Paper").

7. Main Conclusions

Summarizing the results from the review of TEPCO's Fukushima Daiichi, no problematic items were identified, which may cause a severe accident if no nuclear safety improvement measures were taken immediately. In addition, it was confirmed that at Fukushima Daiichi, all the employees, including General Manager and employees of subcontractors, are seriously endeavoring to continue and enhance nuclear safety.

It is expected that Fukushima Daiichi will continue its voluntary safety efforts, 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 in Fukushima Daini, Kashiwazaki Kariwa, and subcontractors.

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:

- As part of activities to promote safety culture among subcontractors, front line work group leaders from the subcontractors and Deputy Director of Fukushima Daiichi are exchanging opinions. So are young employees of the subcontractors and Fukushima Daiichi. Efforts are being made to ensure smooth communication with the subcontractors.
- "Dose reduction tasks" have been performed three times since 1985 to reduce radiation exposure. These include reducing radioactive substances contained in coolant and improving annual inspection methods through work analysis and the "incorporate-good-practices-only" method based on comparison of exposure dose among units. During the shroud replacement carried out for Units 3, 2 and 5 from FY 1997, active exposure reduction measures have been taken to achieve favorable results.
- Instances of problems and accidents that occurred at other nuclear power stations are collected and examined in a timely manner. If it is determined necessary to take urgent measures, the "Quick Letter System" allows immediate notification to relevant sections and rapid comment processing, ensuring horizontal deployment and recurrence prevention at Fukushima Daiichi.
- Considering past fire accidents, the use of incombustible sheets is thoroughly ensured and the allocation of full-time supervisors according to the degree of risk involved with fire-related work is established as a rule. These are also incorporated in the "Work Safe Handbook (Handling Flammable and Hazardous Substances)," which are distributed among the employees and personnel of Fukushima Daiichi and subcontractors, so that they are well informed.

On the other hand, several suggestions are made to improve the activities to ensure safety at Fukushima Daiichi. Major proposals are as follows:

- As part of public acceptance activities, they actively accept visitors in the controlled area giving diverse attention in terms of safety. For example, a visitors' area is set up at the spent fuel pool, which is covered with transparent boards to prevent foreign objects from dropping into the fuel pool. It is desirable, however, to take additional measure to keep visitors from carelessly approaching the spent fuel pool along the tour path.
- To further promote safety culture among the employees of the subcontractors, it is desirable to make additional effort, such as including "safety culture" as a separate training program for the "Certification System for Work Group Leaders from Subcontractors."
- Although criticality safety education using the text "Regarding Sub criticality Control at Nuclear Power Stations" that was developed after the JCO accident is offered for the entire employee, it is desirable to establish a system to offer this educational program on a

periodic basis.

Itemized reports are published on the Japanese homepage.