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-010）
Date of publication: March 16, 2001

Summary Report of Peer Review

(Provisional Translation)

Place of Review:	**Ikata Nuclear Power Station, SHIKOKU ELECTRIC POWER CO.,INC. (Ikata-cho, Nishiuwa-gun, Ehime-pref)**
Date of Review:	**February 6-9, 2001**
Publisher :	**Nuclear Safety Network**

Contents

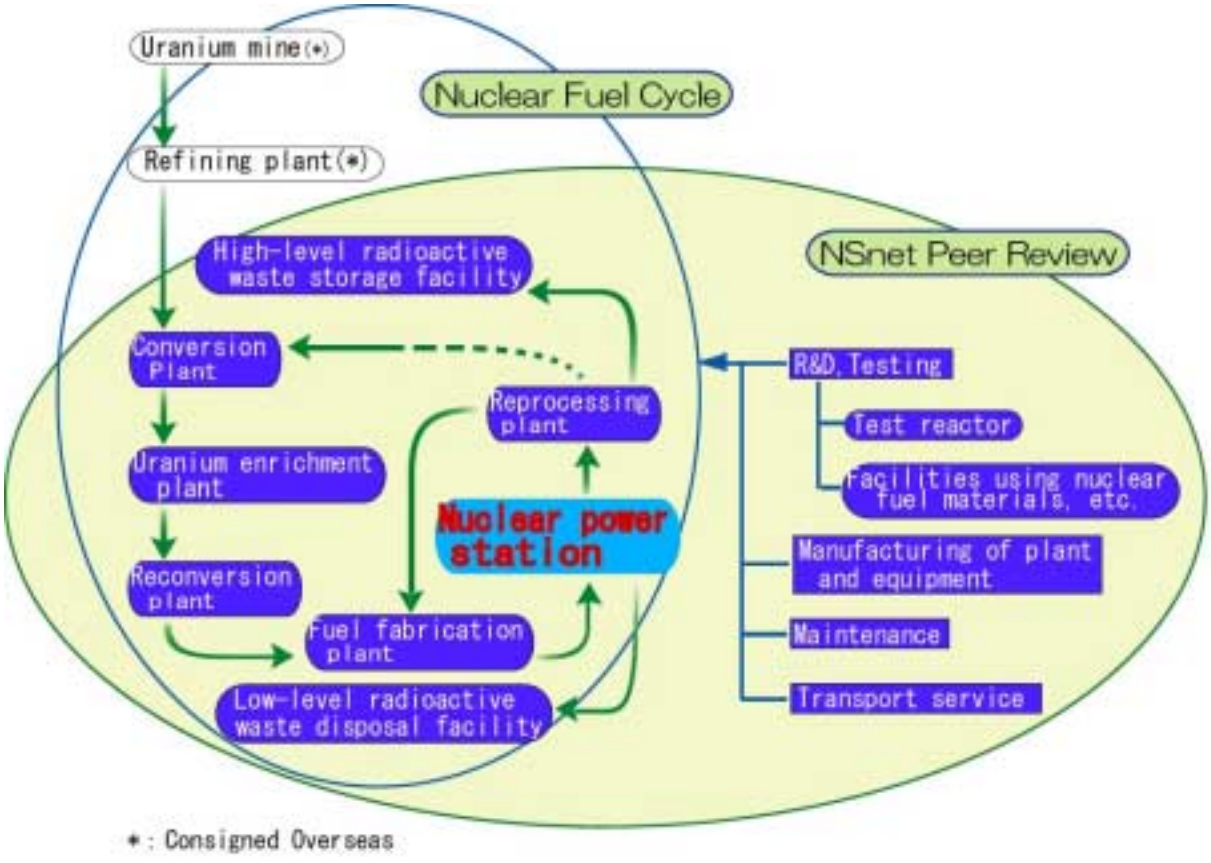
1. Objectives

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 of good practices as well as subjects that have been singled out.

2. Summary of Facility Operations

(1) Facility

Ikata Nuclear Power Station of Shikoku Electric Power Co., Inc.



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

(2) Summary of Facility Operations

Shikoku Electric Power Co., Inc. supplies electricity to four prefectures (Kagawa, Ehime, Tokushima, and Kochi) in Shikoku and has a total power generation capacity of 7,017 MW. The company has a nuclear power station with a total power generating capacity of 2,022 MW in Ikata-cho, Nishiuwa-gun, Ehime-pref. This power station accounted for 44% of the company’s total electric generation in FY 1999 and 28% of the total power generating capacity.

The review was conducted at Ikata Nuclear Power Station (hereafter referred to as “Ikata”), which is the only nuclear power station of the company and plays an important role in power generation.

Equipped with three PWRs[1], Ikata is located facing the Seto Inland Sea at the base of the Sadamisaki Peninsula spindling from the northwestern tip of Shikoku toward Kyushu.

Unit 1 has been continuing safe and stable operation for over twenty years since the start of commercial operation in September 1977. It has one of the longest operation hour track records among domestic PWR plants. Subsequently, Units 2 and 3 started commercial operation in March 1982 and December 1994, respectively. In June 2000, the cumulative power generation of Ikata reached 200 billion kWh (see the table below).

Unit	Electric Output (MW)	Reactor Type	Start of Commercial Operation	Performance (total) (As of the end of January 2001)		
				Power Generated (billion kWh)	Operation Hours (h)	Capacity Factor[2] (%)
1	566	PWR	1977/09	89.7	161,253	77.5
2	566	PWR	1982/03	78.1	139,604	83.4
3	890	PWR	1994/12	41.0	46,361	85.7
Total	2,022	-	-	208.8	347,218	81.2

Ikata has approximately 430 employees. There are approximately 20 people on the management staff including the Superintendent. The Operation Department has approximately 145 personnel (approximately 80 people are in charge of Units 1 and 2, 50 are in charge of Unit 3, working in six teams respectively on three shifts on an around-the-clock basis). The Maintenance Department and Technical Support Department have approximately 110 and 75 personnel, respectively. There are approximately 80 office workers in the General Affairs Department and other departments. In addition, approximately 1,500 employees of cooperating companies are stationed at Ikata, supporting plant operation and maintenance.

The total capacity factor of Ikata since the start of commercial operation was approximately 81% (as of the end of January 2001), which is considered favorable.

3. Points of Review

The NSnet was established following the first criticality accident to ever occur 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 criticality 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 awareness of nuclear safety:

(1) Foundation to ensure nuclear safety (contain communication with cooperating companies)
(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 selected and compared with the best practices in the nuclear power industry by classifying individual elements of the above five points into the following six areas: ① organization/administration, ② emergency measures, ③ education/training, ④

[1] PWR: Pressurized Water Reactor

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

operation/maintenance, ⑤ radiation protection, and ⑥ addressing important issues.

"(1) Foundation to ensure nuclear safety (include communication with cooperating companies):" Safety culture should be fostered to establish an effective organization. Sufficient education and training should be provided to operators and maintenance personnel. Effective documentation of operation and maintenance administration should be promoted and complied with. Appropriate communication with cooperating companies 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:" Criticality safety control[3] at new fuel storage warehouses, spent fuel storage pools and other facilities handling nuclear fuel should be thoroughly ensured. In-core fuel management should be carried out appropriately to ensure neutronics safety[4]. Activities should be promoted to foster and improve the nuclear safety culture in view of factors that have caused the JCO accident.

"(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. Activities should be promoted to develop measures to prevent human error and ensure safety during reactor shutdown.

4. Period and Outline of Review

(1) Date
February 6 (Tuesday) to February 9 (Friday), 2001

(2) Formation of Review Teams
1st group : Fuji Electric Co., Ltd.; Nuclear Fuel Transport Co., Ltd.
2nd group : The Tokyo Electric Power Company, Incorporated; Nippon Nuclear Fuel Development Co., Ltd.
3rd group : Mitsubishi Materials Corporation; 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. Document examinations in operation/maintenance, were carried out with respect to Unit 3 as representative of the facility.

---

[3] 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.")

[4] Neutronics safety :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. 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="4">Feb. 6
(Tue.)</td><td>AM</td><td colspan="3">Opening (Introductory outline of company/facilities, etc.)</td></tr>
<tr><td>AM</td><td colspan="3">Plant Tour
[Main control room and fuel handling building for Unit 3]</td></tr>
<tr><td>PM</td><td>Document examination
(1. Organization/ administration)</td><td>Document examination
(4. Operation/maintenance:
(2) Effective maintenance administration)</td><td>Document examination
(6. Addressing important issues:
6.1. Addressing nuclear safety centering on neutronics safety
6.3 Activities to improve the safety and reliability of the power station
6.2 Reflecting on past problems)</td></tr>
<tr><td rowspan="5">Feb. 7
(Wed.)</td><td rowspan="2">AM</td><td rowspan="2">Interview
[Superintendent]
[Managers]
[Responsible personnel]</td><td>Interview
[Managers]
[Responsible personnel]
(Maintenance engineer)</td><td rowspan="2">Document examination
(6. Addressing important issues:
6.2 Reflecting on past problems
6.3 Activities to improve the safety and reliability of the power station)</td></tr>
<tr><td rowspan="2">Document examination
(4. Operation/maintenance:
(1) Effective operation administration)</td></tr>
<tr><td>AM</td><td>Field observation
[Emergency Operation Room]
[Night-duty room]</td><td></td></tr>
<tr><td rowspan="2">PM</td><td rowspan="2">Document examination
(2. Emergency measures)</td><td>Field observation
[Unit 3 Main control room]</td><td>Document examination
(6. Addressing important issues:
6.2 Reflecting on past problems)</td></tr>
<tr><td>Interview
[Managers]
[Responsible personnel]
(operator)</td><td rowspan="2">Field observation
[Units 1 and 2 Main control room]
[Units 1 and 2 Turbine buildings]</td></tr>
<tr><td>PM</td><td>Interview
[Responsible personnel]</td><td>Field observation
[Unit 3 Main control room]</td></tr>
<tr><td rowspan="3">Feb. 8
(Thu.)</td><td rowspan="2">AM</td><td>Document examination
(3. Education/training)</td><td>Document examination
(5. Radiation protection)</td><td>Document examination
(6. Addressing important issues:
6.1. Addressing nuclear safety centering on neutronics safety)</td></tr>
<tr><td>Field observation
[Education room for operators]</td><td>Field observation
[Radioactive waste incinerator]
[Radioactive solid waste storage facility]</td><td>Interview
[Responsible personnel]</td></tr>
<tr><td>PM</td><td>Verification of Facts</td><td>Verification of Facts</td><td>Verification of Facts</td></tr>
<tr><td>Feb. 9
(Fri.)</td><td>AM</td><td colspan="3">Verification of Facts, Closing</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 suggestions for improvement 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 Educational Material for improving safety, to facilitate nuclear safety cultural exchange.

(1) Field Observations

Direct observation was made of actual activities to check whether they corresponded to items listed in documents 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 arose. In-depth examination was conducted, asking for relevant documents after observing field facilities and activities.

(3) Interviews

Interviews were conducted with directors, managers, operators, and maintenance personnel with the following objectives:

a. Collecting additional information that could not 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

(4) Good Practices

Following are the reason how good practices are picked up:

"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 power industry."

(5) Suggestions for Improvement

Following are the reason how suggestions for improvement are picked up:

"After comparing the facilitiy's practices with the best in the nuclear power industry, suggestions to improve and enhance safety activities should be implemented so as to achieve the highest level of nuclear safety. " So that, even if current activities are equal to or higher than general standards in the nuclear power industry, there is still room for improvement.

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 were assigned to ensure safe operation, whether safety culture that always prioritizes safety was fully recognized, whether effective communication with cooperating companies was maintained, and whether public acceptance activities for the local community were promoted through disclosure.

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

(Review Items)

(1) Effective organization management
    a. Clarifying the line-organization and the system of responsibility
    b. Setting up goals of the organization
    c. Leadership of the managers
(2) Activities to promote safety culture and improve morality
    a. Specific activities to promote safety culture (contain communication with cooperating companies)
    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
    c. Improving documents associated with the revision of safety regulations

Section 2: Emergency Measures

A review was conducted in accordance with the Nuclear Disaster Special Measures Law enacted in June 2000, to examine whether emergency plans and equipment were in place and whether training was carried out responsibly.

(Review Items)

(1) Emergency plans
    a. Drawing up emergency plans
    b. Improving emergency organizations (including notification and liaison systems)
    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 cooperating companies, 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 (including voluntary efforts) and evaluation criteria

(2) Training plans and implementation
    a. Education and training plans
    b. Implementation of education and training plans
(3) Technology (know-how) hand-over

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. The common issue of whether adequate organization, including those from cooperating companies, is formed (including personnel assignation) and whether documentation is facilitated and complied with in the Operation and Maintenance Departments was examined. 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 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, etc.)

(2) Effective maintenance administration
    a. Maintenance organization
    b. Maintenance documents and procedures, and compliance with them
    c. Maintenance systems and equipment (Clarify the safety function, etc.)
    d. Work plans and administration (Shortening the duration of annual inspection, etc.)

Section 5: Radiation Protection

To ensure adequate dose control for employees based on ALARA[5], 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

In addition to ensuring criticality safety at nuclear fuel facilities, this policy must be applied to nuclear power stations as well. Thus, each step of nuclear fuel handling at power stations was examined the point of neutronics safety from the acceptance of new fuel, fuel loading/operation/removal to spent fuel storage and transportation. Also, activities concerning risk

[5] 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).

evaluation were examined, such as periodic safety review (PSR)[6] reports and accident management (AM)[7] measures.

The review also focused on the system for evaluation of events that have occurred at domestic and overseas nuclear facilities in the past along with the activities that have been taken to prevent such events from occurring in the future.

In addition, the company's activities to improve the safety and reliability of the plant were examined, such as PSR conducted at Unit 1 and specific examples of renewal work on the major equipments of Units 1 and 2.

(Review Items)

Section 6.1: Addressing nuclear safety centering on neutronics safety

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

Section 6.2: Reflecting on past problems

(1) Improving equipments and modifying operating methods
(2) Activities to prevent human-errors
(3) Response for unusual sign
(4) Measures to prevent fuel leakage and fuel integrity monitoring (specific example 1)
(5) Fire and explosion prevention (specific example 2)

Section 6.3: Activities to improve the safety and reliability of the power station

(1) Periodic safety review (PSR)
(2) Renewal work on major equipments of Units 1 and 2

7. Main Conclusions

Summarizing the results from the review of Ikata Nuclear Power Station of Shikoku Electric Power Co., Inc., no problematic items were identified which could cause a severe accident unless safety improvement measures were taken immediately. In addition, it was confirmed that at Ikata, all the employees, including the Superintendent, and employees of cooperating companies are seriously endeavoring to continue to enhance nuclear safety. For example, they are implementing an activity called "Ikata Net 21," aiming to establish a working environment in which the sense of unity and gratefulness toward work can be developed by further promoting daily exchange among employees of Ikata and cooperating companies, thus improving safety awareness and promoting safety culture based on such a working environment.

During the review, the status of safety activities at Ikata was presented specifically and clearly. The idea of emphasizing appropriate information disclosure, which is promoted by the Superintendent and other management staff, seems to have been disseminated among the employees.

It is expected that Ikata 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 by cooperating companies of Ikata.

---

[6] 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").

[7] AM stands for Accident Management. This refers to measures to be taken to mitigate the effects of severe accidents caused by an event exceeding the scope of design standard events (events that may lead to abnormal status and are used to evaluate the safety design of nuclear facilities), which may cause significant damage to the reactor core (excerpted from "1998 Nuclear Safety White Paper").

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

- Established operating procedures for emergency notification and liaison to related external agencies

  Emergency notification and liaison manuals are well developed and procedures for an operating system to quickly and accurately notify related external agencies of diverse information have been established based on such manuals. In addition, relevant personnel are well informed of operating procedures through notification and liaison training conducted periodically.

- Open opinion exchange with cooperating companies and resulting improvements

  Ikata arranges informal gatherings and dinners between responsible sections and cooperating companies during annual inspections provides opportunities for open opinion exchange regarding demands in pursuing maintenance activities and improvements in the working environment. Improvements are made in terms of working safely and quality assurance by organizing opinion exchange meetings with the Superintendent class after annual inspection to directly hear demands and proposal for equipment improvement from cooperating companies.

- Radiation control activities from the standpoint of users

  Considering the convenience of the personnel working at Ikata, the effective "Personal Radiation Exposure Information Management System" is in place and "shoe sizes are distinguished by color (to be used in controlled areas)." In particular, the "Personal Radiation Exposure Information Management System" is well devised to ensure effective radiation worker and work registration, contributing to reducing burdens on cooperating companies.

- Complete improvement and installation of switch covers to prevent human errors

  To prevent human errors, switch covers on local panels have been changed from the magnetic type into the fixed hinge[8] type to prevent them from being dropped and erroneous operation due to unexpected contacts and other reasons. Moreover, switch covers are completely installed on the operating switches on the consoles in the central control room.

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

- Documenting the activities of "Ikata Net 21"

  It is desirable to document and clearly state the sprit and core activities of "Ikata Net 21" to promote activities to cultivate safety culture including cooperating companies.

- Stipulating standard requirements for individual positions of operators

  It is desirable to stipulate objective and easy-to-understand requirements concerning credentials, education, and training for sub shift supervisors, chiefs, and group leaders.

- Utilizing PSR for technology (know-how) hand-over education

  PSR is designed to evaluate the plant's overall reactor facilities, containing useful

[8] Hinge: A fixed hinge type switch cover connects the cover block and the cover by means of a hinge and fixes the cover block on the console. The cover part can be opened for switch operation because of the hinge. The hinge also prevent the cover from dropping.

information as materials for technology (know-how) hand-over. It is desirable to utilize such information in technology (know-how) hand-over education at Ikata.

Itemized reports are published on the Japanese homepage.