

I. Summary

1. Overview of the Reviewed Power Station

The Japan Nuclear Technology Institute (JANTI) conducted a peer review (review) at Fukushima Daini Nuclear Power Station (station) of Tokyo Electric Power Company from Monday, July 28 to Friday, August 8, 2008.

The station is located along the coast of the Pacific Ocean in the eastern part of Fukushima Prefecture and is situated extending across both Narahamachi Town and Tomioka Town. It has four Boiling Water Reactor (BWR) units. During the review period all four units were in rated thermal operation. There is one main control room for Units 1 and 2 as well as one for Units 3 and 4. Also, the point for accessing the radiological control area is also common to Units 1 and 2 as well as Units 3 and 4.

The Station Director has set forth a management policy of "listening to the community, equipment and site, striving to improve daily by joining together with our contractors, maintaining safe and reliable operation of the plant, and realizing the world's securest and safest power station," and is undertaking a variety of activities. For example, station has instituted performance indicators, been monitoring, and monthly evaluated health of the station. Measures for improvement are implemented when the level of achievement is inadequate. Also, approximately three years ago, Total Productive Maintenance (TPM) was introduced to clarify any shortcomings at the power station. Activities are also being conducted by all personnel to prevent any sort of loss from occurring. The Operations Department recently started work on a management observation program (site observations conducted by managers).

Additionally, work on the stations is currently being conducted to make the station more seismically-resistant based on the Chuetsu-oki Earthquake and measures, including those to enhance the disaster prevention facilities and improve the seismic capacity of transformers, are being successively implemented.

As of the beginning of July, 2008, the station has 716 personnel, and there were 2,610 contractor employees.

Unit	Rated electric output (MWe)	Commercial operation commencement date	Operation performance (as of July 30, 2008)	
			Generated energy*1 (billion kWh)	Capacity factor*2 (%)
1	1100	April 1982	1,950	76.0
2	1100	February 1984	1,770	74.1
3	1100	June 1985	1,496	66.3
4	1100	August 1987	1,477	71.9

*1) Generated energy: includes periods of operational testing

*2) Capacity factor: since commencement of commercial operation

2. Review schedule

After reviewer training and preparation at the JANTI office from Wednesday, July 23rd to Friday, July 25th, 2008, the review was conducted at the station for two weeks from Monday, July 28th to Friday, August 8th, as shown in Table 1.

Prior to the review, field observations were conducted to observe field works during an outage of Unit 4 at the station for the three days from Wednesday, March 26th to Friday, March 28th, 2008 (outage observations).

Also, on Thursday, May 8th, 2008, operations shift crew performances during training was observed at the full-scope simulator facility of the BWR Operator Training Center (Fukushima Center), and similar training were observed at the on-site simulator on Thursday, June 19th, 2008 (simulator training observation).

Table 1: Review schedule at power station (actual performance)

		Matters reviewed
July 28th (Mon.)	(Morning)	<ul style="list-style-type: none"> Entrance meeting (introduction of review team, review plan, etc.) Schedule arrangement with station counterparts in each review area
	(Afternoon)	<ul style="list-style-type: none"> Plant inspection to observe plant equipment conditions, etc.
29th (Tue.)		<ul style="list-style-type: none"> Field observations, interviews, document reviews and discussions about these results with station counterparts. Team meeting including station representatives
30th (Wed.) 31st (Thu.) August 1st (Fri.)		<ul style="list-style-type: none"> Field observations, interviews, document reviews and discussion about these results with station counterparts. Team meeting including station representatives
2nd (Sat.)		Day off
3rd (Sun.)		<ul style="list-style-type: none"> Team meeting (refine strengths and areas for improvement)
4th (Mon.) 5th (Tue.)		<ul style="list-style-type: none"> Field observations, interviews, document reviews Discuss causes and contributors related to problem areas with station counterpart Confirm and review facts related to strengths and areas for improvement Team meeting including station representatives
6th (Wed.)		<ul style="list-style-type: none"> Discussion with station counterpart in each area Discussion between team leader and station representatives regarding strengths and areas for improvement Team meeting including station representatives
7th (Thu.)		<ul style="list-style-type: none"> Review and finalization of strengths and areas for improvement Discussion among exit representative, team leader and station representatives on strengths and areas for improvement Compile material for exit meeting

8th (Fri.)	(Morning)	• Exit meeting (explanation from review team regarding strengths and areas for improvement, as well as supplementary explanations when requested by the station)
	(Afternoon)	• Press conference organized by JANTI (at Fukushima Daini Power Station Visitors Hall)

3. Review methodology and review scope

The objective of the review conducted by JANTI is to promote further improvements in the safety and reliability of the nuclear power stations.

3.1 Review methodology

The Performance Objectives and Criteria (PO&C) used by WANO^{*3} (World Association of Nuclear Operators), were applied to the review as a standard. Besides the WANO standards, INPO^{*3} (Institute of Nuclear Power Operations) has also set down its performance objectives and criteria. However, since JANTI and WANO have implemented reviews with each other and the relationship is mutually complementary, the continuity of both organizations' peer reviews was taken into consideration in adopting the WANO PO&C.

This standard was formulated as a guideline to promote the highest level of the performance of nuclear power plant operations. In the review, the PO&C was used to identify "strengths" and "areas for improvement (AFI)". Strengths are items which have been judged to have reached the highest level possible. On the other hand, AFI are items for which effort is required to reach the highest level possible, but does not always mean insufficient, inadequate nor poor performance compared with industry standard.

The review team conducted the review as described below, focusing on field observation and closely discussing with station counterparts in accordance with the INPO and WANO review methodology.

*3) WANO was founded in 1989 by nuclear operators world-wide, after the 1986 accident at the Chernobyl Nuclear Power Plant made it painfully clear that a global information network of nuclear power utilities was needed. Its mission is to improve the operational safety and reliability of nuclear power stations to the greatest extent possible, by implementing a variety of support activities for nuclear power stations. These include reviews of nuclear power stations throughout the world, as well as exchanging information concerning accidents and problematic events.

INPO was established by the US nuclear power industry after the 1979 accident at Three Mile Island nuclear power station. Regular review of US nuclear power stations is one of INPO's principal activities, and these are mainly accomplished by staying at the nuclear power station for two weeks and conduct on-site observations. The JANTI review follows this method. Since 1990, the contributions of INPO are recognized as being among the most extensive from those involved with nuclear power in improving safety and reliability at US nuclear power stations.

3.1.1 Information gathering and analysis

Reviewers for each area analyzed the information provided by the station in advance, which included:

in-station operating experiences, procedures, meeting minutes, and outage observations and simulator training observations developed by JANTI. This is in order to prepare a review plan for effective implementation of station review.

3.1.2 Observations of equipment and facility conditions at station

First of all at the station, all reviewers conducted plant walkdown and observed equipment conditions in the area assigned to each of them and noted any issues noticed in Units 3 and 4 mainly. The number of collected issues were 300 total. When sorted by appropriate review area, there were approximately 130 issues in operations, approximately 80 issues in maintenance, approximately 110 issues in engineering support, and approximately 20 issues in radiological protection. These records were classified by target area and assigned to the reviewer responsible. Each reviewer utilized these records as material to understand the current situation of the station for the subsequent review.

Since the content of many items falls under several categories, the sum of all categories is greater than the total number of items.

3.1.3 Field observations and follow-up

The reviewers assigned to the specific review area started observations of the condition of the station facilities and equipment, and performance and behavior of station personnel including contractor employees from a point of view of expert after conducting plant inspection. Then, they made interviews and reviewed documentation to follow-up the results obtained through detailed observations according to the pre-developed review plan. Each reviewer decided whether the gathered information was significant or not based on the review standard (PO&C) and their own practical experience. The significant facts identified as beneficial or problematic were recorded and noted as the issues need further evaluation. Each reviewer exchanged opinions about these facts with station counterpart and, if necessary, employees of contractors over and over.

The results of the aforementioned were presented at the evening review team meeting, and matters considered as excellent or problematic were deliberated by all members of the team.

3.1.4 Analysis of observation results

Reviewers for each area identified the excellent points and problematic issues according to the review standard (PO&C) from among matters gathered through the processes listed in 3.1.1, 3.1.2, and 3.1.3.

The excellent points were consolidated as "strengths," and information about them were included so that other stations may use them as reference.

The problematic issues were further analyzed to clarify what the problem nature was, why they occurred (causes and contributors), and how they could be solved (how to make improvement). In cases where additional information was required for this work process, additional field observations, document reviews, or interviews were conducted once more, and AFI were developed based on the results.

AFIs including their nature, cause and contributor were presented to the station counterparts with reference to the PO&C and actual industry best practices. Discussions were repeated until a mutual understanding about the nature of the problem, the cause, and the background.

The details of these discussions and feedbacks from station personnel were presented again at the review team meeting. All of review team member made further discussion and analysis in order to brush up strengths and AFIs in terms of accuracy and appropriateness from multiple perspectives considering the feedback.

3.2 Review Scope

3.2.1 Review Areas

In the review, six functional areas listed in (1) through (6) below were reviewed. The other areas (7) through (10) were reviewed as required as part of six functional areas.

- | | |
|--|---------------------------------|
| (1) Organization and administration | (2) Operations |
| (3) Maintenance | (4) Engineering support |
| (5) Radiological Protection | (6) Operating Experience |
| (7) Chemistry | (8) Training |
| (9) Fire protection | (10) Emergency Preparedness |

3.2.2 Review Team Composition

The review team consists of:

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|----------------------|----------------------------------|
| Exit Representative: | Matsushita, Director of JANTI |
| Team Leader: | Kawashima, Director of JANTI |
| Team Members: | 19 members including team leader |

(3 WANO personnel; 2 JANTI member organization personnel; 14 JANTI personnel)

4. Summary of results

The following strengths and AFIs were identified by the review team.

4.1 Strengths

The following nine strengths were identified:

[Operations]

(1) A program for management observations in operations department has started in order to improve the performance of operators since April, 2008. The Operations department managers have so far conducted 21 field observations and identified the weak area and weakness by classifying observation results according to factors, such as operators' basic behavior.

(2) Work Management Group have been set up in the Operations department and are actively providing support for shifts during operation. The outage preparations conducted by the Work Management Group provides

preparation work for outages and panel monitoring during shift turn over and periodic surveillances, and this reduces the burden on shifts and improves the quality of shift work.

For example, one member of the Work Management Group is responsible for monitoring the panel for Unit 3 during the startup test of the Unit 3 diesel generator.

[Maintenance]

(3) Approximately one year prior to the commencement of an outage, station wide project team are formed to undertake preparations for outage such as formulation of a plan. Also, during the outage, project team monitors the progress of the outage schedule and provides coordination. This has lead to establish highly reliable schedule and this reduce urgent changes in the planned schedule, human errors resulting from insufficient communication among the departments, and burden on who involved.

[Engineering Support]

(4) At the entrances of the reactor building, turbine building and radioactive waste building, hot work maps are displayed, which indicates hot works being conducted in the building. This has made it easy for operators, various employees patrolling on-site and fire protection brigades to identify the place where hot works are conducted in the case of patrol and emergency.

[Radiological Protection]

(5) The performance of two kinds of monitors (dust monitors and gate monitors) has been improved, and good progress has been made in increasing the efficiency of radiation control and early detection of abnormal events at the plant.

For example, the dust monitor has been improved so that it has the capability to distinguish artificial radioactivity and natural radioactivity when measuring such radioactivity, and it is being effectively utilized to quickly identify equipment failures and deviations in the radiation work environment.

[Operating Experience]

(6) An integrated management system for reporting, approval and monitoring the progress of nonconformance reports is available on the station and contractor intranet. This system provides for the prompt processing of nonconformance reports and is effectively working through daily work in the station.

The system is easily accessible to station personnel and reinforces to initiate nonconformance reports. It is also possible to search past nonconformance reports and data from the minutes of nonconformance management committee meetings by initiated date, grade, cause and other keywords. It is effectively utilized to manage the status of progress and analyze past data.

[Organization and Administration]

(7) In order to improve communication with contractors, a feeling of solidarity has been aroused as a result of various measures which have been taken to explicitly glean the opinions and needs of the various positions which vary by differences in company size, management, site work supervisors, and other factors. This solidarity has contributed to the safe and stable operation of the station.

(8) Performance indicators (PI) to measure the performance of the station have been standardized for fleet wide three nuclear power stations. The ranking of the station in question can be confirmed through a comparison of the three stations and a comparison with nuclear power stations around the world using the WANO PI.

Also, meetings (performance review meetings, "PRM") are held monthly to confirm the status of performance achievement using this PI. In the meeting, Issues are identified and the appropriateness and effectiveness of measures to address issues are evaluated so that continuous improvements are systematically achieved in the manner of using PDCA cycle trial.

(9) In order to promote nuclear safety and higher reliability of the station, the Station Director leads the station by strong leadership. The Station Director establishes clear policy based on the station weakness and problem in the job site he is aware of. Under the strong leadership of the Station Director, issues of the station are appropriately recognized, clearly reflected in the policy for station management, and this contributes safety and reliability of the station.

4.2 Areas for improvement

The following 7 areas for improvement were identified.

[Operations]

(1) Operations management does not clearly establish high standards to achieve best performance in the industry for limit of main control room access, panel monitoring, use of human performance tools such as three-way communications, use of procedures, nor does thoroughly reinforced.

For example, at the entrance to the main control room, there is a sign indicating "Unauthorized persons are prohibited from entering; the Shift Supervisor," but anyone who has an ID card is able to enter.

(2) There are instances when the shift supervisor and assistant shift supervisor are inconsistent in conducting their work of supervising.

For instance, during a surveillance test, the assistant shift supervisor stood right next to the control panel and conducted the operations as an operator, confirming and resetting the alarm.

[Engineering Support]

(3) There is room for improvement as there are some inadequacies in the control, review and monitoring of temporary modifications.

For instance, the temporary sampling line for the coolant clean-up system was used over a longer period than initially planned.

[Radiological Protection]

(4) Radiological protection has deficiencies in worker's radiation dose control, contaminated material control and signs for dose reduction and prevention of spreading contamination.

For example, workers standing outside a contaminated area (Area C) were observed to behave in ways that would lead to spreading contamination, such as touching a curing sheet in Area C which had slipped over the fence.

[Operating Experience]

(5) Use of industry operating experiences is somewhat ineffective and needs to improve

For example, in the pre-job brief of the transporting empty casks for spent fuel, cautionary matters concerning the work were briefed, but examples of problems related to lifting work were not introduced.

[Organization and Administration]

(6) Inappropriate circumstances were observed with regard to the wearing of personal protection equipment during lifting jobs and other works. There is room for further improvement in order to make it safer when working.

For example, when undertaking work to hang an actuator for a valve on the floor during an inspection of an air-operated valve for high conductivity condensate waste, a worker put his leg under the load of the actuator.

(7) Improvement is needed to establish clear high-level expectations and reinforce them thoroughly in several areas including operations and radiological protection.

For example, the Operations management has not established high standards to achieve best performance in the industry nor reinforced thoroughly.