

Summary

1. Overview of the Reviewed Power Station

The Japan Nuclear Technology Institute (JANTI) conducted a peer review (Review) at Shika Nuclear Power Station (Station) of Hokuriku Electric Power Company from Monday, November 9 to Friday, November 20, 2009.

The station is located along the coast in Shika-machi, Ishikawa prefecture. It has one Boiling Water Reactor (BWR) and one Advanced Boiling Water Reactor (ABWR). Unit 1 commenced commercial operation in 1993, and Unit 2 in 2006. The station is the only nuclear power station of Hokuriku Electric Power Company. As of the end of 2008 fiscal year, the generation capacity of nuclear power accounted for a 22% of whole generation capacity of the company.

Although the operation of Unit 1 had been suspended since March 2007 when the company disclosed the criticality accident that occurred in June 1999, it resumed in March 2009. Operation of Unit 2 was resumed in March 2008 from the suspension since July 2006 due to the maintenance on the steam turbines. Both units were under operation at rated thermal output when we started the Review, however, Unit 2 was shut down on Friday, November 13, 2009 in order to investigate the causes of emergency diesel generator event and implement measures.

The station completed seismic modification work and had improved earthquake-proof in January 2009 for Unit 1 and in March 2008 for Unit 2.

Hokuriku Electric Power developed "Concrete Action Plans for Recurrence Prevention Measures Pertaining to Power Generation Equipment" (consisting of 28 items) in May 2007, as recurrence prevention measures in response to a series of inappropriately handled matters pertaining to power generation equipment including a criticality accident (June 1996) at Unit 1 of the Station. The Station has been carrying out the plans. The Station has been also carrying out "Clean Activities" with the three pillars of "clean action", "clean environment", and "clean facility" under the slogan of "we aim to realize the cleanest power station in the world". The activities include greeting campaign and a station-wide building cleanup.

As of August 1, 2009, there were approximately 330 station personnel and 2,200 contractor personnel.

Unit	Rated electric output (MWe)	Commercial operation commencement date	Operation performance (as of March 31, 2009)	
			Generated energy ^{*1} (billion kWh)	Capacity factor ^{*2} (%)
1	540	July 1993	52.7	69.6
2	1358	March 2006	16.2	36.7

Due to the rectifiers installed in turbines, the present rated electric output is 1206MWe.

*1) Generated energy: includes periods of operational testing

*2) Capacity factor: since commencement of commercial operation

2. Review schedule

After the reviewer training and preparation at JANTI office from Wednesday, November 4th to Friday, November 6th, 2009, the Review was conducted at the station for two weeks from Monday, November 9th to Friday, November 20th, as shown in Table 1.

Prior to the Review, field observations were conducted at the Station to observe field works during the outage of Unit 2 for three days from Tuesday, September 1st to Thursday, September 3rd, 2009 (work observations).

Also, on Tuesday, October 27th and Wednesday, October 28th, 2009, operations shift crew performances at training was observed at the full-scope simulator facility of BWR Operator Training Center in Kariwa-mura, Niigata prefecture (simulator training observation)

Table 1: Review schedule at the Station

		Review Description
Nov. 9th (Mon)	(Morning)	· Entrance meeting (introduction of review team, review plan, etc.)
	(Afternoon)	· Schedule arrangement with the station counterpart in each review area · Plant inspection to observe plant equipment conditions, etc.
10th (Tue)		· Plant inspection to observe plant equipment conditions, field observations, interviews, document reviews and discussions about these results with station counterparts. · Team meeting including station representatives
11th (Wed)		· Field observations, interviews, document reviews and discussion about these results with station counterparts.
12th (Thu)		· Team meeting including station representatives
13th (Fri)		· Discussion between team leader and station representatives on the review status regarding strengths and areas for improvement (on Wednesday)
14th (Sat)		Day off
15th (Sun)		· Team meeting including station representatives (discussion on strengths and areas for improvement)
16th (Mon.)		· Field observations, interviews, document reviews
17th (Tue)		· 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 · Discussion between team leader and station representatives regarding strengths and areas for improvement
18th (Wed)		· Discussion with station counterpart in each review area · Discussion between team leader and station representatives regarding strengths and areas for improvement · Team meeting including station representatives
19th (Thu)		· Review and finalization of strengths and areas for improvement · Compile material for exit meeting
20th (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

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. In addition, sharing strengths with nuclear industry as assistance is the purpose as well.

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, considering the continuity of JANTI and WANO peer reviews since JANTI and WANO have implemented reviews with each other and the relationship is mutually complementary.

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 (AFIs)".

Strengths are items which have been judged to have reached the highest level possible. On the other hand, AFIs are items for which effort is required to reach the highest level possible, but does not always mean insufficient, inadequate or poor performance compared with industry standards.

The Station performance for around three years before the Review was determined to be reviewed. The review team conducted the Review as described below, focusing on field observations and closely discussing with station counterparts in accordance with INPO^{*3} (Institute of Nuclear Power Operations) 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 work 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 the Station

First of all at the station, all reviewers conducted plant inspection and observed equipment conditions in the area assigned to each of them and noted any issues noticed. The number of collected issues was 232 in total. When sorted by appropriate review area, there were, approximately, 100 issues in operations, 90 issues in maintenance, 120 issues in engineering support, and 10 issues in radiation protection. 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

Following the observation of equipment conditions, the reviewers assigned to the specific review area started observations of the condition of the station facilities and equipment, and performance and behaviour of station personnel including contractor employees from a point of view of expert. Then, they made interviews and reviewed documentation to follow-up

the results obtained through detailed observations. Each reviewer decided whether the gathered information was significant or not based on the review standard (PO&C) and his/her 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 was 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 AFIs were developed based on the results.

AFIs including their nature, causes and contributors 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 causes, 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:

- Exit Representative: Okuno, Technical Advisor of JANTI
Team Leader: Kawashima, Director of JANTI
Team Members: 14 members excluding Exit Representative and Team Leader
(2 WANO reviewer; 2 JANTI member organization personnel;
10 JANTI personnel)

4. Summary of results

The following strengths and AFI's were identified by the review team.

4.1 Strengths

The following seven strengths were identified:

[Operations]

- (1) The Station developed software which easily locates any valves in the condenser room of the Unit 2 turbine building.

Since the condenser room is a high-radiation dose area, this software has greatly reduced the exposure of operators when operating these valves.

[Maintenance]

- (2) For further improvement of maintenance work, the Station has benchmarked systematically since 2007 fiscal year against the other power stations to identify good practices comparing the Station's performance and reflect them to daily works. Identified good practices are sorted into those which should be put into practice in the short term and those which will be implemented over the medium to long term. The sections responsible for the implementation of the good practices are assigned and the implementation status is reviewed periodically.

- (3) Before the plant start-up after outage, all control panels and sample racks, except for auxiliary equipment, are comprehensively checked in order to prevent events due to omission of isolation or clearance for maintenance works. As a result, such events have never occurred approximately for 15 years since the first outage of Unit 1.

[Engineering Support]

- (4) "Nuclear Power Safety Steering Committee" chaired by General Manager of the Station is held frequently and thoroughly discusses the nuclear safety in detail. For instance, the committee discuss the regular receipt and the inspections of new fuels to confirm the matters to pay attention.
- (5) In order to manage huge volumes of inspection data of the important buildings such as reactor buildings and turbine buildings, the Hokuriku Electric developed "Building Preservation Management System" by themselves at the early stage of just after the commencement of operation of Unit 1 (1997). As a result, inspection & maintenance planning and maintenance history management are efficiently carried out.

[Radiological Protection]

- (6) The information necessary for each worker to access radiation controlled area including training records and physical examination results are stored in the access card (ID card) of each worker under the Station's access control system. This system eliminates the entry/exit apparatus with gates requiring ID card and pocket dosimeter, which are installed at many other power stations. The system also reduces time to process with main computer when workers enter or exit from the radiation controlled areas. As a result, workers can enter the controlled area speedy and correctly. With the introduction of this system, smooth entry and exit has been accomplished, even in periods of heavy in-out traffic during outages.

[Organization and Administration]

- (7) From the perspective of fostering early detection capability of abnormalities in equipment, "patrols accompanied by managerial personnel" and "training in raising abilities of observation" have been enforced since 2007. These have been instrumental in raising the level of field skills of younger station personnel.

The "patrols accompanied by managerial personnel" provide the opportunity for the younger station personnel (maintenance division and operations division) to receive instruction of equipment expertise and the points detecting abnormalities of equipment from experienced managers.

"Training in raising abilities of observation", using the facilities in the training center, coaches trainees for detection of simulated equipment deficiencies and responses to the deficiencies.

4.2 Areas for improvement

The following eight areas for improvement were identified.

The order of importance of areas for improvement suggestions are "improvement is needed," "improvement is desired," or "there is room for improvement."

[Operations]

- (1) There were instances of operation manuals not being used sufficiently and further improvement is desired.

For instance, when shutting off the supply of lubricating oil to the main turbine, lubricating oil leaked out because "cautionary points" in the operation manual were overlooked and some operations were skipped.

[Maintenance]

- (2) Foreign material exclusion area such as around the spent fuel pool is not necessarily sufficient. Therefore, improvement is needed to enhance the foreign material exclusion. For instance, while unloading fuel during the outage, a white cloth was discovered on a spent fuel, which was presumed to be used for inspection.

[Engineering Support]

- (3) In some cases, sufficient consideration is not given to temporary storage from the viewpoint of minimizing the impact on plant equipment in case of earthquakes or fire. For instance, plywood and cardboard boxes are temporarily stored near the heat exchanger of the residual heat removal system.

[Radiological Protection]

- (4) Inappropriate practices of workers and condition were observed in the contamination controlled areas with regard to contamination control. Improvement is desired. For instance, after the completion of decontamination work, seven workers simultaneously changed their contamination-protection clothing in the dress changing place of the field. If one or more of them had been contaminated, secondary contamination could have resulted through physical contact among the workers.

[Operating Experience]

- (5) The Station does not thoroughly control the status of non-conformity including reporting, prioritising, developing corrective action, and implementing corrective actions. Improvement is desired to prevent recurrence of similar non-conformities. For instance, the target dates of developing corrective actions are three months after the events, however, the target dates are not strictly required or controlled. In addition, the target dates are set without considering the significance of the events.

[Organization and Administration]

- (6) Clear expectations are not set in some cases including operations, foreign material exclusions, temporary storage, contamination control, industrial safety, and improvement of human performance. In addition, accurate observation and monitoring of these performance and identification of issues are insufficient. Improvement is needed. For instance, sufficient consideration is not always given to temporary storage from the viewpoint of minimizing the impact on plant equipment in case of earthquakes or fire.
- (7) The Station is implementing various actions to improve human performance for reliable operations, however, there is room for further improvement to assure results. For instance, similar human related non-conformities are still occurred at the present time, even though they are minor.
- (8) In some cases, inappropriate work practices and personal protective equipments not used were observed in the field. Improvement is desired for further industrial safety. For instance, unsafe behaviours of workers while moving hoisted cargo and some operators not using ear protections when working in noisy areas were observed.