Summary

1. Overview of the Reviewed Power Station

The Japan Nuclear Technology Institute (JANTI) conducted a peer review (Review) at Ikata Nuclear Power Station (Station) of Shikoku Electric Power Company from Monday, September 28 to Friday, October 9, 2009.

The Station is located along the coast of Seto Inland Sea in Ikata-cho, Ehime Prefecture. It has three Pressurized Water Reactors (PWRs). During the review period all three units were under operation at rated thermal output. As shown in the table below, Unit 1 commenced commercial operation in 1977, Unit 2 in 1982, and Unit 3 in 1994. The Station has maintained a high level of capacity factor and the average capacity factor of the Station in 2008 fiscal year was 84.5%.

In the most recent outage, the control panel and control system of Units 1 and 2 main control room (MCR) were replaced with the latest digital models to improve the reliability as well as both operability and monitoring. Units 1 and 2 have a common MCR, while Unit 3 has a separate MCR of its own.

The General Manager of the Station operates the plant, under quality assurance activities giving maximum priority to nuclear safety, with this fiscal year's policies following: "maintain and improve safe and reliable operation", "obtain understanding and trust of the local residents", and "create an energetic workplace climate that is open for communication". In addition, the "Ikata Net 21 Activities" was begun in May 2000 for all personnel of the Station. The objectives of the activities are to deepen day-to-day communication among Shikoku Electric employees, Shikoku Electric Group companies (affiliated companies), and other companies including manufactures (contractors), foster awareness of safety, safety culture and a feeling of unity, as well as create a satisfying work atmosphere.

As of September 1st, 2009, the station had approximately 300 personnel, approximately 500 personnel of affiliated companies, and approximately 1000 contractor employees.

Unit	Rated electric output (MWe)	Commercial operation commencement date	Operation performance (as of March 31st, 2009)	
			Generated energy*1 (billion kWh)	Capacity factor*2 (%)
1	566	September 1977	122.7	78.5
2	566	March 1982	110.6	82.4
3	890	December 1994	97.1	87.0

*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 on Thursday, September 24th and Friday, September 25th, 2009, the Review was conducted at the station for two weeks from Monday, September 28th to Friday, October 9th, as shown in Table 1.

Prior to the Review, field observations were conducted at the Station to observe field works during the outage of Units 1 and 2 for three days from Tuesday, March 31st to Thursday, April 2nd, 2009 (work observations).

Also, on Wednesday, April 8th and Thursday, April 9th, 2009, operations shift crew performances at training using the full-scope simulator was observed at Nuclear Research & Training Center in Matsuyama city (simulator training observation).

Table 1: Review schedule at the Station

		Review Description
Sep. 28th (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.
29th (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
30th (Wed) Oct. 1st (Thu) 2nd (Fri)		・Field observations, interviews, document reviews and discussion about these results with station counterparts. ・Team meeting including station representatives
3rd (Sat)		Day off
4th (Sun)		・Team meeting including station representatives (discussion on strengths and areas for improvement)
5th (Mon.) 6th (Tue)		・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
7th (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
8th (Thu)		・Review and finalization of strengths and areas for improvement ・Discussion between team leader and station representatives on strengths and areas for improvement ・Compile material for exit meeting
9th (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 in spite that INPO[*3] (Institute of Nuclear Power Operations) has its own PO&C, 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 in around April 2007 or later 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 and WANO review methodology.

It should be noted that JANTI conducted peer review at the Station from July 27th to 29th, 2005, however, the objectives of the peer review at that time were to share information among JANTI members, to raise awareness of safety, and to share safety culture by visiting plants mutually to identify issues on nuclear safety and learn good practices. Therefore, this was the first time for JANTI to conduct the WANO/INPO style peer review at the Station

*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 326 in total. When sorted by appropriate review area, there were, approximately, 160 issues in operations, 120 issues in maintenance, 130 issues in engineering

support, and 20 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 affiliated company and 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 affiliated companies and 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:	Oide, Technical Advisor of JANTI
Team Leader:	Kawashima, Director of JANTI
Team Members:	15 members excluding Exit Representative and Team Leader (2 WANO reviewer; 2 JANTI member organization personnel; 11 JANTI personnel)

4. Summary of results

The following strengths and areas for improvement (AFI) were identified.

4.1 Strengths

The following seven strengths were identified.

[Operations]

(1) The Nuclear Power Plant Operating Analysis System (NOAS) was introduced in 1984 to detect precursors of equipment abnormality and take appropriate actions. This leads to reduction of operators' burden and a high level of monitoring.

[Maintenance]

(2) The Station continuously improves maintenance program systematically and effectively by making use of IT technology "Enterprise Asset Management System (EAM)" in the maintenance effectiveness assessment process. This increases the equipment reliability. Results of inspections and condition based maintenance are put into database so that maintenance records can be perused for all equipment. With these data together with surveillance test results from the Operation Division, the Maintenance Planning Comprehensive Evaluation Committee, which is made up of managers, evaluates the effectiveness for each outage, and these evaluations are fed back into the Maintenance Plans.

[Engineering Support]

(3) In the most recent outage, the control panel and control system in the Units 1 & 2 main control room (MCR) were replaced with the latest digital models, raising the reliability as well as both operability and monitoring. The replacement work was completed as planned with no problems due to a rigorous plan and strict execution of the plan through close cooperation with affiliated companies. Furthermore, some designs of the control panel design was modified uniquely for the Station. For example, hardware switches are adopted for vital equipment such as the reactor auto-shutdown system.

(4) Proactive endeavours are being implemented to enhance the diagnosis of equipment. For example, the Station constructed a warehouse for new oil to improve the reliability of equipment by controlling the purity of lubricating oil for its lifespan by managing in the power station throughout. Another example is the introduction of a monitoring unit for diagnosing the vibrations in all equipment that is operated intermittently.

[Radiological Protection]

(5) When workers exit from controlled areas, each worker checks his/her own work clothes for contamination by himself/herself using a dedicated "clothing monitor". Each worker also checks the contamination of safety belts and shared tools using a dedicated "protective gear monitor". The effective use of "clothing monitors" and "protective gear monitors" have resulted in the prevention of unnecessary spread of contamination. In addition, contamination survey by workers has raised the workers' awareness toward preventing the spread of contamination.

[Operating Experience]

(6) By applying IT technology, the Station has effectively and surely implemented the operating experience program including reporting, screening, and corrective actions, which contribute to maintaining and improving Station's performance. This IT technology is also utilized by the maintenance in managing maintenance work flow including the work sorting, work planning, work implementation, and evaluation after work. This established flow enables the Station to share equipment failure timely throughout the Station, and to control the maintenance work progress surely and easily.

[Organization and Administration]

(7) Recognizing the utmost importance of the human factor in achieving safe and reliable operation, the Station has taken actions to reduce human related events. For example, the Station had established a method of human factor analysis in early times comparing other nuclear power stations in Japan, and implemented various actions based on the analysis.

4.2 Areas for improvement

The following seven 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) Some inadequate conditions were observed regarding the use of and adherence to procedures, operators' safety-related work practices, and housekeeping. Improvement is needed.

In the main control room, for instance, some areas in front of the control panels where entry by maintenance personnel is prohibited are not indicated.

[Maintenance]

(2) There are instances where managers, supervisors, or workers failed to properly confirm the isolations, or to properly carry out isolation and clearance that the maintenance is responsible for. Improvement in these areas is desired.

For instance, having the mistaken idea that inlet valve to an instrument was closed, a supervisor requested to remove the instrument. As a result, pressurized demineralised water leaked out when filling the system with water.

[Engineering Support]

(3) In some instances, sufficient consideration is not given to the mitigation of the impact of temporary storage or permanent storage to equipment around the storage in case of earthquake or unexpected knock by personnel. There is room for improvement.
For instance, there was an unsecured step ladder on a cart near an instrument.

(4) In some cases, the reduction of combustibles is not sufficient, or fire fighting equipment is not clearly labelled. Improvements are desired.
For instance, some fire doors are not labelled as such.

[Radiological Protection]

(5) In some cases, workers practices to prevent spread of contamination or signs of contamination in radiation controlled area is in sufficient due to the lack of directions of radiological protection personnel or awareness by workers about contamination works. Improvement is desired.
For instance, after wiping down contaminated equipment, a worker touched another machine in the same contamination controlled area without changing rubber gloves.

[Organization and Administration]

(6) The station does not set clear expectations in some areas including operations, maintenance, radiological protection and industrial safety, or always reinforce the established expectations to station personnel, affiliated companies or contractors due to the insufficient activities to monitor and observe operations or work practices, or correct issues. Improvement is needed.
For instance, briefings prior to operations were insufficient comparing the best practices in the industry.

(7) Inappropriate work practices and failure to wear personal protective equipment by operators and maintenance personnel in the field were observed. Improvement is needed to enhance industrial safety further.
For instance, when moving lifted cargo, sufficient warning was not given to personnel around the cargo.