I Summary

1. Overview of the Reviewed Establishment

1.1 Overview

The peer review team of the Japan Nuclear Technology Institute (hereafter, JANTI) conducted a peer review (hereafter, review) at Takahama Nuclear Station (hereafter, station) of Kansai Electric Power Co, Inc. from Monday, July 31, 2006 to Friday, August 11, 2006. The station has four pressurized water reactors (PWR) and all of them were in operation with rated thermal power output during the review period.

The station has 504 personnel (as of the end of June 2006) and 207 contractors with approximately 1,700 employees (as of the end of April 2006).

Unit	Rated Electric Output (MWe)	Commercial Operation Started	Operating Performance (As of the end of July 2006)	
			Electricity Generated*1 (billion kWh)	Capacity Factor*2 (%)
1	826	November 1974	158.007	68.0
2	826	November 1975	154.123	68.2
3	870	January 1985	141.318	84.9
4	870	June 1985	138.359	84.8

*1) Electricity Generated: Including the commissioning (trial operation) period

*2) Capacity Factor: Since commercial operation started

1.2 Conditions surrounding the Station and its activities to deal with them

To prevent the recurrence of the piping rupture accident that occurred at the secondary system of Mihama Unit 3 in August 2004, Kansai Electric Power Co., Inc. announced the five basic action policies together with 14 action plans and 29 activities based thereon.

[Basic Action Policy to Prevent the Recurrence of the Accident of Mihama Unit 3]

① We will give safety the highest priority.
② We will actively make investments to ensure safety.
③ We will continuously improve maintenance management and establish a cooperative relationship with contractors to ensure safety.

④ We will endeavor to regain the trust of local residents.
⑤ We will objectively review and widely announce our activities to ensure safety.

The above is the action taken by the company as a whole. Based on it, activities have been being carried out at the station. It is worthy of special mention that the occupational safety and health management system[*3] has been put into trial operation since the second half of FY 2005 (16th outage of Unit 4); that maintenance management personnel have been increased (158 as of the end of June 2006); and that engineering advisors (one advisor in each of the areas of Electric Maintenance, Mechanical Maintenance, and Industrial Safety), and one full-time information manager have been assigned. In addition, the areas in the vicinity of high-energy piping in the turbine buildings of all units in operation are subjected to access control and no preparation work is being performed prior to outages.

Wednesday, August 9 during the review period was the day set for them to "vow to ensure safety" as one of the above-mentioned recurrence prevention activities. All personnel simultaneously paid silent tribute to the victims at the time when the accident had occurred.

*3) As part of the activities to prevent accidents, this management system was put into operation to reduce potential risks of industrial accidents by assessing risks.

2. Review Schedule

After reviewer training and preparations at the JANTI office from Wednesday, July 26, 2006 to Friday, July 28, 2006, the review was conducted at the station for two weeks from Monday, July 31, 2006 as shown in Table 1.

Table 1: Review Schedule at the Station

		Review Description
Monday, July 31	(Morning)	・ Entrance meeting (introduction of the review team and the station counterparts, briefing of plant operating status and issues)
	(Afternoon)	・ Observation of plant equipment conditions, etc. ・ Schedule arrangement with the counterparts in each review area
Tuesday, August 1		・ Observation of plant equipment conditions and field, interviews, document reviews, and exchange of views on results with the counterparts ・ Team meeting including the station representatives
Wednesday, August 2 Thursday, August 3 Friday, August 4		・ Field observations, interviews, and document reviews, and exchange of views on results with the counterparts ・ Team meeting including the station representatives
Saturday, August 5		Day off
Sunday, August 6	(Morning)	・ Team meeting (to discuss Strengths and Areas for Improvement (hereafter, AFIN))
	(Afternoon)	・ Analyzing observations in each review area
Monday, August 7 Tuesday, August 8		・ Field observations, interviews, and document reviews ・ Discussing the causes and contributors of problems with the counterparts ・ Confirming and discussing the facts concerning Strengths and AFINs ・ Team meeting including the station representatives
Wednesday, August 9		・ Discussing with the counterparts in each review area ・ Managing representative, team leader and the station representatives to discuss Strengths and AFINs ・ Team meeting including the station representatives
Thursday, August 10		・ Review and finalize Strengths and AFINs ・ Preparing for the exit meeting
Friday, August 11	(Morning)	・ Exit meeting (review team to explain Strengths and AFINs and give supplementary explanations as requested by the station)
	(Afternoon)	・ Press conference organized by JANTI (at the station visitor house)

3. Review Methodology

The objective of review conducted by JANTI is to promote the highest level of excellence in the operation, maintenance and support of operating nuclear power plants.

3.1 Review Process

The “Performance Objectives and Criteria” (PO&Cs) used for World Association of Nuclear Operators (WANO) Peer Review were applied to the review as a standard.

These criteria are guidelines for leading the way to promote highest level of safe and reliable nuclear power plant operation. In this review, they were used to identify “Strengths” and “Areas for Improvement Needed”.

Strength is a significant beneficial practice, activity, or process employed by a station that results in achieving a high level of performance or desired high quality results and benefits. On the other hand, AFIN is a problem or vulnerability that needs to be resolved to enhance the ability of the station to safely and reliably operate the plant and to make and sustain future improvements. Identified AFIN is for worthwhile improvement from the standpoint of excellence, but does not always mean insufficient, inappropriate nor poor performance compared with industry standard.

The review team conducted the review as described below, focusing on field observation and closely exchanging opinions with the counterparts in accordance with the INPO[*4] review methodology.

*4) INPO (Institute of Nuclear Power Operations) was established by the U.S. nuclear electric utility industry, following the Three Mile Island accident in 1979. It is an organization that is reviewing nuclear power stations in U.S. periodically. The main process of INPO review is field observation conducted at station for two weeks. It is known world nuclear industry-wide that INPO has contributed a great deal to improve safety and reliability of U.S. nuclear power stations since the 1990s.

3.1.1 Collecting information

First, all reviewers conducted plant walkdown and observed equipment conditions in the areas assigned to each of them. The number of white cards on which they wrote down issues they noticed during walkdown amounted to 240. Some of the items written on the cards extend over several review areas. Sorting them out by appropriate review area, there were approximately 116 cards in Operations area, 99 in Maintenance, 42 in Engineering Support, 19 in Radiological Protection, and so forth. These cards were distributed to each review area and used as a starting point of the review.

Subsequently, the review started in each area separately. Specifically, two or three reviewers formed a team in each area to observe plant equipment conditions and daily activities of the station personnel including employees of contractors. Each reviewer conducted field observations elaboratively in accordance with the review plan drawn up in advance, followed by interviews and document reviews. Reviewers judged whether the obtained information was important or not based

on the review criteria (PO&Cs) and their own experiences. The significant facts identified in the observations, interviews, and document reviews were recorded as excellent or problematic examples for further deliberation. The Review team frequently exchanged opinions on these facts with the counterparts and, if necessary, employees of contractors.

The results of the above activities were introduced and discussed if it should be determined as either excellent or problem based on each team member's experience and the best practice in the industry at the daily team meeting (held for an hour 5:00 p.m.) .

3.1.2 Analyzing information

Reviewers in each area identified excellent and problematic practices in comparison with the review criteria (PO&Cs). Among these, excellent practices were put together as Strengths, including the necessary information so as to provide reference for other stations.

On the other hand, problematic issues were further analyzed and discussed to clarify what the problem nature was, why they occurred (analysis of causes and contributors), and how they could be solved (how to make improvement). When additional information was required in this process, additional field observations, document reviews, or interviews were conducted and AFINs were developed based on analysis and evaluation of these facts.

AFINs including specific problem examples were explained to the counterparts with reference to the review criteria (PO&Cs) and industry best practices. Discussions were repeated until mutual understanding and recognition with respect to the nature, route cause and contributors of the problems were attained.

The details of these discussions and the feedbacks from the counterparts were presented again at the review team meeting. All of the review team made further discussion and analysis to brush up Strengths and AFINs in terms of accuracy and appropriateness from multiple aspects considering the feedbacks.

3.2 Review Scope

3.2.1 Reviewed Areas

In the review, six fundamental areas [(1) through (6)] were reviewed.

(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 Members

The review team consisted of:

Managing Representative： Matsushita, Director of JANTI
Team Leader ： Naruse, Director of JANTI
Team Members ： 14 members including Naruse
(3 INPO staff members, 3 staff members from JANTI member organizations and 8 JANTI staff members)

4. Outline of the Results

The following Strengths and AFINs were identified. However, these AFINs were not the kind necessitating immediate corrective actions to ensure nuclear safety.

4.1 Strengths

Strengths identified by the review team are the following six items.

[Operations]

(1) "Techniques Dissemination Database" and "Regular Inspection Database" are developed and utilized to transfer tribal knowledge among operators.
Specifically, approximately 1,300 historical station experienced issues which are recognized to be transferred to following generations are registered with the "Techniques Dissemination Database" and this is utilized to improve the engineering ability of the operators and prevent human errors. In addition, approximately 1,740 items concerning the results and notes of periodic operator inspections and outage inspections are registered with the "Regular Inspection Database" which is used as human error prevention tools and reference tools for operator activities during periodic inspection and outage.

(2) To prevent human errors, the color-coded controls and voice announcement devices are implemented and they enable station personnel to identify particular units visually or existence of important equipment aurally.
For example, to prevent operators and maintenance workers from mistaking units and performing erroneous operations or jobs, particular unit's colors are painted on the main control panels, local panels, doors, component casings, valve nameplates, and so on to allow for identification of individual units, i.e. white for Unit 1, yellow for Unit 2, blue for Unit 3, and pink for Unit 4.
No human errors due to mistaking units have occurred over the past ten years or so, owing to consistent visual and audio identification.

[Maintenance]

(3) The grounds for maintenance intervals and details have been organized clearly by the Comprehensive Nuclear Maintenance System (M35) and other measures. The database system makes a vast amount of related documents readily available.
As a result, a scheme has been established to utilize the database and review whether it is necessary to change the grounds for setting maintenance intervals and details. The information of grounds stored in the database could be in beneficial use.

[Engineering Support]

(4) Online monitoring helps find abnormal symptoms of components early enough to deal with them before problems occur.
For example, the status of the electromagnetic valve adjusting the feedwater control valve is monitored online. When the monitored parameter reaches the predetermined threshold, the indicator lamp will be turned on to prompt someone to take action quickly.

[Radiological Protection]

(5) The Radiation Management Section has established a long-term goal to reduce exposure and has been carrying out its own programs and developing a long-term action plan to achieve the goal. As one of its own exposure reduction programs, for example, the trial implementation of the Radiation Management ALARA[*5] Sheet was started in the 23rd outage of Unit 2 (April 14, 2006 through June 30, 2006) and would be fully applied within FY 2007. The ALARA Sheet is a tool for PDCA for exposure reduction to allow for close analysis of difference between planned and actual exposure, follow-up, and information sharing for other jobs. It is an effective means to achieve a long-term exposure reduction goal.

*5) ALARA stands for "As Low As Reasonably Achievable." A basic concept for radiological protection presented in a recommendation made by the International Commission on Radiological Protection

(ICRP).

[Organization and Administration]

(6) A great deal of effort is being made to ensure close communication with contractors. A favorable relationship is maintained among the station and the contractors. The station is being operated under appropriate cooperation.
In connection with the introduction of the Occupational Safety and Health Management System, for example, occupational safety-related requests submitted by the contractors are managed using the “Improvement Request Management Table” as to whether they should be accepted and how they have been dealt with. Information about unaccepted requests, including why they were rejected and how they are being dealt with, is shared with the contractors. Approximately 800 improvement requests have been accepted out of 1,200 requests made over the past year.

4.2 AFINs : Areas for improvement needed

On the other hand, 13 areas for improvement needed were identified.

[Operations]

(1) Operators’ plant monitoring performance in the main control room can still be improved in comparison with the best practice in other station.
For example, pre-job briefings within the shift are conducted with all the shift crew members sitting at the desk located in the center of the main control room. During these briefings, operators’ plant monitoring of the main reactor panel appeared to be ineffective. There is room for improvement.

[Maintenance]

(2) Inappropriate lifting and rigging might cause damage to components or worker’s injury.
Specifically, birdcaged wire rope slings were used to remove fan couplings.

(3) Some supports for outdoor equipment and seawater system equipment need repairing. Repairs are made during outages taking into account the importance of equipment and the rust development. However, systematic activities are required to prevent further degradation based on long-term planning.
For example, rust was observed on the surface of the support for small-bore piping and the surface of the bolts fixing the ladder to the seawater pump motor.

[Engineering Support]

(4) Testing the functionality of pumps provide a good opportunity for collecting data for preventive

maintenance. In some cases, however, it was observed that test results were not used for trending, and it might means there are rooms for improving test methods.
For example, the current test method for residual heat removal pumps can examine performance when two pumps are in operation, but not when a single pump is in operation. The trend of pump degradation can be evaluated by testing one pump at a time. Methodology of performance evaluation of each pump should be worked out.

(5) When storing or temporarily placing articles within the plant, it is necessary to take quake-proof measures, adequately consider the adversely impact on safety-related or other components that may trigger plant shutdown signals because of possible interaction during a seismic event.
For example, a ladder was placed near safety-related equipment. Temporary articles should be evaluated the adversely effect of its falling down on safety-related equipment during seismic event.

(6) There is room for more appropriate management to prevent foreign materials from entering the spent fuel pit.
At Unit 1, for example, the gap between the spent fuel pit and protective fence is narrow, but the fuel pit is accessible. There seems to be some risk of dropping something into the fuel pit.

(7) To detect degradation trends early enough, analysis and monitoring tools are used separately and independently by personnel in charge of components belonging to different departments. It is desirable to further upgrade systematic trend analysis in the future.
For example, the results of running and vibration tests on a single pump are analyzed separately by different departments. Analysis can be upgraded further by conducting trend analysis in accordance with the guidelines systematically integrated across the station.

[Radiological Protection]

(8) The Radiation Control Manager, who is responsible for directing and supervising radiation control, needs to encourage radiation control personnel and full-time radiation control mangers from contractors to demonstrate their knowledge and ability concerning on-site radiation control more effectively.
For example, although it was observed in an instance that the dose equivalent rate and surface contamination measuring point was not indicated on-site, no corrective measures were taken.

(9) There is still room for reinforcing consciousness among those engaged in radiation control to ensure radiological protection and prevent contamination from spreading.
For example, it was observed in an instance that some worker was sitting on a box partitioning the area in which contaminated working clothes were changed.

[Operating Experience]

(10) To promote higher level of the safety and reliability of the station, operating experience of the nuclear industry should be utilized consistently.
At some pre-job briefings for maintenance works and surveillance tests, for example, operating experience such past non-conformity events relating to the jobs or tests were not introduced.

[Organization and Administration]

(11) At the station, a tremendous amount of effort have been put into measures to prevent the recurrence of the Mihama-3 accident, the priority of industrial safety has risen as part of such measures, and outage has been planned one after another. It is understandable that they have been extremely busy. However, it is important to constantly realize that the highest priority should be given to the nuclear safety of the units in operation. As an example in which more attention is paid to the unit in outage than the others in operation, one senior manager stated that he would visit the field twice a day during an outage, but he would do so only once in every two weeks and would just visit the control room during normal operation.

(12) To achieve safe and reliable plant operation, it is desirable to establish standards specifying practical point of view, thoroughly inform them to plant personnel, and take preventive measures and early action.
For example, safety patrols are conducted by managers specifying a subject matter each time. However, it is not clearly decided what to check specifically.

(13) To further reduce the possibility of industrial safety events, there is room for improvement because some jobs are performed by workers wearing neither earplugs nor protective glasses as required.
For example, workers not wearing safety glasses were observed during the job to cut the small-bore piping in the auxiliary building.