

## Overview

### 1. Introduction

The Japan Nuclear Technology Institute (hereinafter “JANTI”) conducted a peer review (hereinafter “review”) with a review team comprising members and specialists from JANTI. The team visits member offices and conducts a review on themes related to nuclear power safety to extract issues and good practices from which other members can learn from. Goals of review activities are to bring a greater awareness of safety and achieve improvements in safety culture in the nuclear industry wide.

### 2. Overview of Subject Locations

The Mitsubishi Heavy Industries, Ltd. (MHI) Takasago Factory (hereinafter “The Factory”) commenced operation in 1962 as a factory dedicated to producing turbines as part of Kobe Shipyard & Machinery Works, but became a separate entity in 1964.

Presently part of MHI, The Factory is dedicated to the production of large-scale rotating equipment, and produces steam turbines, gas turbines, pumps and water wheels, etc. for nuclear power and thermal power stations which provide the electricity that is the foundation for living and industry.

The Factory engages in the design, manufacture, installation and after-sales service, etc. of equipment, such as turbines, condensers, feedwater heaters, and pumps that make up the secondary systems of nuclear power stations.

The nuclear power turbines for all 23 pressurized-water reactors (PWR) in Japan were manufactured by The Factory. When overseas exports are added, The Factory has been responsible for the construction of 25 nuclear power turbine plants that produce 20.72 million KW of electricity.

It is presently manufacturing Hokkaido Electric Power Co., Inc. Tomari Power Station Unit 3, and the Japan Atomic Power Company Tsuruga Power Station Unit 2 turbines.

As of April of this year, The Factory had 3,400 employees and 6,200 if subcontractor employees around Takasago are added.

### 3. Approach and Point of Review

This review focused on quality assurance efforts linked to corporate management, communication between upper management and employees, and nuclear power safety as they relate to the design and manufacture of nuclear power equipment at The Factory.

In addition to the three themes of “organization/management,” “education/training,” and “design/manufacturing”, “human error prevention,” which JANTI considered to be an important issue, was examined. In the review, JANTI put effort into finding those points that would be useful as reference for other members while keeping in mind the nuclear power station equipment designed and manufactured at The Factory.

#### 4. Conducting the Review

##### (1) Review period

Wednesday, June 20 - Friday, June 22, 2007

##### (2) Composition of review team

Team leader: JANTI NSnet Division personnel

Team members: 4 persons under the team leader

(Japan Nuclear Fuel Limited: 1, Mitsubishi Materials Corporation: 1, JANTI NS Net Division personnel: 2)

##### (3) Review team assigned areas

Group A: Organization/Management, Human Error Prevention

Group B: Education/Training, Design/Manufacturing

#### 5. Review Schedule

The review lasted three days and each group proceeded in accordance with the following schedule which has been simplified.

### Implementation Schedule

		Group A (organization/management, human error prevention)			Group B (education/training, design/manufacturing)		
Wednesday, June 20	AM	Opening (greeting, member introduction, explanation of latest news about the factory, etc.)					
	PM	I. Organization/management	Factory Director -Organization policies/objectives -Leadership	Interview	Event/site observation	Nuclear power safety/quality improvement PJ Working subcommittee 144 <sup>th</sup> patrol	On-site
		I. Organization/Management	Manager class -Leadership (-initiative/awards -objectives/clarification of scope of responsibility -safety message dissemination)	Interview	II. Education/training III. Design/manufacturing	Education/training planning and implementation Design management	Documents
		-Quality assurance program -Efforts regarding product safety		III. Design/manufacturing	Manager class interviews -Level of performance of designers	Interview	

						-Invigoration of communication -Work environment	
		IV. Human error	-Human error prevention	On-site		Personnel class interviews -Status of obtaining knowledge about products and manuals -Work environment	Interview
		Meeting with host office	Review result confirmation Confirmation of schedule for second day, etc.		Meeting with host office	Review result confirmation Confirmation of schedule for second day, etc.	
Thursday, June 21	AM	Event observation	Morning meeting (stretching, TBM)	On-site	Event observation	Morning meeting (stretching, TBM)	On-site
		I. Organization/management IV. Human error	-Organization policies/objectives - Quality assurance program -Cultivating safety culture -Activities aimed at improving morale -Human error	Documents	II. Education/training	-Education/training planning and implementation -Implementation method (passing down technical knowledge) -Certification	Documents
					III.	-Effective	

			prevention		Design/manufacturing	design/manufacturing management a. Design/manufacturing organization b. Design/manufacturing manuals and abiding by them c. Design/manufacturing management	
		IV. Human error	Manager class -Human error prevention	On-site	III. Design/manufacturing	-Effective manufacturing management b. Design/manufacturing manuals and abiding by them c. Equipment maintenance d. Manufacturing planning/management	On-site

				Interview		Manager class - Grasping level of performance of workers -Invigoration of work site communication -Work environment	Interview
	PM	I. Organization/management	Personnel class -Safety culture cultivation activities -Activities aimed at improving morale -Human error prevention	Interview	III. Design/manufacturing	Worker class -Level of knowledge and experience -Degree to which procedures are followed -Work environment	Interview
		[Fact confirmation] -Confirmation and coordination of review results with host -Creation of closing report					
Friday, June 22	AM	[Fact confirmation] -Final coordination with host/final revision of closing report					
		Closing preparations (copying of documents, preparing venue)					
		Closing (explanation of results, closing address)					

## 6. Review method, Review Items, and Summarizing Review Results.

The following explains review method, review items and how review results were summarized.

### 6.1 Review Method

#### (1) Document review

Documents for each review item were explained, presented and then reviewed.

#### (2) Interviews

The Factory Director, who is the head of management, managers and general employees were interviewed under the theme of, “initiatives, etc.” Further, questions were asked with respect to documents.

#### (3) Site Observation

Team reviewed The Factory activities by observing closely how The Factory personnel conduct activities on site in conjunction with the result of document reviews and interviews.

Furthermore, team proactively developed mutual communication with NFT by providing beneficial information and examples like best practices in industry during document reviews, interviews and observations.

### 6.2 Review Items

The review items are the three areas of “organization/management,” “education/training,” and “design/manufacturing” as well as “human error prevention.”

### 6.3 Summarizing Review Results

For each review item, document review, interviews and site observations are conducted, and good practices and areas for improvement are extracted.

Here, a “good practice” is a case “among activities to ensure safety at the Factory that has implemented an appropriate, effective and unique method, and that JANTI members wish to further convey to the nuclear power industry and that is an excellent case study.

An “area for improvement” is “a matter that seen from the perspective of aiming to bring nuclear safety to the highest standard, a proposal or the like that references best practices in the nuclear power industry for further improvements in activities to ensure safety at the Factory.” Therefore, some cases, even if the current state of activities is at or above general standards in the nuclear power industry, may be used as a subject for an area for improvement.

## 7. Overview of Review Results

The Factory has learned the lesson of “the unraveling of safety culture” from the secondary piping rupture accident<sup>1</sup> and mislabeled piping problem<sup>2</sup> at Kansai Electric Co., Inc. Mihama Unit 3.

Under the strong leadership of the Factory Director, managers and employees are striving to assure safety and improve the quality of nuclear power products.

The Factory Director believes that a “reconstruction of the quality management system (QMS)” is indispensable in the wake of the piping mislabeling problem and has been developing “QMS reconstruction” activities since 2006. Through these activities a QMS reconstruction system has been established, and various activities are underway. However, the superintendent is aware that these activities have yet to permeate to the far reaches of the organization and therefore devised the “QMS deepening” plan in 2007 and is strongly promoting the following as a way to permeate QMS through site improvement activities.

In particular, (1) 2-day, 1-night leadership training for all section managers; (2) the implementation of face-to-face talks between the Factory Director and managers; (3) the implementation of compliance meetings as small group activities that include subcontractor employees; and, (4) the use of check sheets in order to clearly identify those items to be checked during patrols, is well under way.

However, since there are some activities that need improvement, such as safety hazards prediction activities, and the basis for design technology standards, etc., it would be good if the improvement activities currently underway were enhanced on-site as well.

The following is an overview of the interview with the Factory Director and an explanation of the 6 good practices and 3 areas for improvement that were extracted from the results of this review. **Note that these improvement items are not**

matters for which immediate response is required from the perspective of nuclear safety.

The following is a summary of the interview with the Factory Director

(1) Issues that The Factory is facing

The Factory is engaged in “Quality Management System (QMS) deepening” and “the pursuit of V21-07 strategies<sup>3</sup>.”

QMS is thought of as a management method and includes compliance, development ability enhancement, independence (the ability to think for yourself, create a plan and carry it out), and leadership enhancement. “V21-07 strategies” is an issue that The Factory should execute during 2007.

(2) Monitoring the performance status of The Factory

The Superintendent’s office has a process map of 10 indices, such as “profit and loss,” “productivity,” “VOC (voice of the customer),” etc., that are checked periodically. Currently, each department is in the process of creating similar process maps and there are approximately 80 such indices that are to be confirmed by everyone above section manager level.

(3) What to expect in terms of processing when a mistake is made

For mistakes that do not involve compliance, we believe that it is important that the individual not be blamed and that measures are taken to prevent reoccurrence. However, there are times when individuals must be scolded and during these times it is important to scold them while conveying a sense of comradery.

(4) Expectations regarding the ability of managers to solve problems and self-assessments

The section managers of The Factory are like presidents of small and mid-sized enterprises, and their expected performance is of the utmost importance to the management of the site. Their leadership, technical knowledge and communication skills are in question. Therefore, overnight leadership enhancement training for all section managers (80 persons) was implemented five times last fiscal year.

There is a self-evaluation framework established within the QMS, and HSB (HSB Japan, Inc.) participates in the third-party assessment. However, there is still room for improvement and we are aware that there are weaknesses. “QMS deepening” is an issue for this fiscal year.

(5) Characteristics of, and situations involving, The Factory that the review team should be aware of

The secondary piping rupture accident and mislabeled piping problem at Kansai Electric Co., Inc. Mihama Unit 3 lead to a development of QMS activities. And, we are leveraging this grueling experience to manage The Factory from a position that puts importance on “quality” and aim to build a good and strong organization that can always maintain excellent product quality.

## 7.1 Good Practices

(Organization/management)

-Strong leadership

The lessons of the secondary piping rupture accident and mislabeled piping problem at Kansai Electric Co., Inc. Mihama Unit 3 have been learned, and the Factory Director et al are showing their leadership and strongly promoting the improvement of the Quality Management System (QMS), and the QMS framework<sup>4</sup> is continuing to permeate. For example, interviews with managers confirmed that leadership training and face-to-face meetings with the Factory Director and managers are effective.

-Compliance meetings

Approximately 4,000 employees (including site, part-time, and affiliate company personnel) partake in compliance meetings once every two months as part of small group activities.

Themes discussed here are selected by the employees based on those issues that are most likely to occur in the work place. For example, real-work situations, such as, “what do you do when you discover an extremely minor discrepancy in design pressure,” are debated. Meeting results are reported to the department in charge, and those examples that are discussed to be useful for other work sites are posted on and shared via a virtual bulletin board while implementation rate, follow-ups with those people who do not understand, and the adequacy of theme selection are evaluated. Since the meetings are small group activities, there is an atmosphere that makes it easy to consult with people at the work site and voice concerns, all of which consequently leads to improved adherence to rules.

(Education/training)

-Improving the passing down of technical knowledge and comprehension in the Design Department through the effective leveraging of e-learning

In the Design Department, there are efforts (e-drills) to leverage e-learning as activities to improve quality. In these e-drills there are a lot of questions concerning design basis and “know why,” and they aim to improve the passing down of technical knowledge and comprehension by periodically forcing the drill-taker to solve problems. Also, these drills are leveraged for educational guidance based on ascertaining the degree of utilization.

(Design/manufacturing)

-Effective leveraging of site patrols as a link in the chain of activities to prevent troubles in advance in the Manufacturing Department

The nuclear power safety/quality improvement project working subcommittee meets twice a month for the main purpose of implementing site patrols. At the meetings, a check list that identifies particular items for the patrol to look for is drawn up, and a Q&A sheet is used to interview members about past non-conformities, such as the Mihama power station mislabeling problem. Furthermore, a pointed out item correction recommendation is issued for those items pointed out during patrol and the items are followed up with. Through these improved, specialized patrols, non-conformity information is laterally dispersed and non-conformities, such as mislabeling problems, are prevented from being ignored.

(Human error prevention)

-Utilization of a personalized daily calendar

In order to prevent human error, each group of the Manufacturing Department personalized “daily quality diaries” and “daily safety diaries” are created in accordance with the work that one is responsible for. These diaries are presented to the site and are read out loud in unison during the morning meetings before beginning work in an effort to continue education. This daily diary is being leveraged effectively in regards to assuring quality and safety.

Reflecting past non-conformity information in procedures and confirming procedures before beginning work

Quality information based on non-conformity information (combat lessons<sup>5</sup>), and suitable information from past non-conformity records compiled by each section (know-why, non-conformity map, near-miss experience sheet, etc.) are reflected in

Manufacturing Department procedures that include work warnings, etc., and human error is being prevented by checking these procedures before beginning work. Past non-conformity information is being leveraged effectively to prevent human error.

## 7.2 Area for improvements

### (Organization/Management)

#### -Diagnosing work site safety culture (climate survey)

A safety culture policy has been enacted and it is being developed and activities to improve it are being implemented. Confirmation of the results of cultivating education concerning compliance, safety awareness and moral value is being done in some sections through tests and interviews, but it would be good to objectively ascertain the status of safety culture at The Factory through questionnaires concerning work place climate surveys and e-learning concerning safety culture.

### (Design/Manufacturing)

#### -Linking design technology standard basis and know why, etc.

The revision of technology standards is promoted and done with the help of younger employees, but it would be good, for example, if during the revision, younger employees were forced to make e-learning questions (e-drills) and link them with technology standards, thereby further improving basis and know why.

### (Human Error Prevention)

#### -Invigorating danger prediction activities

In the RKY activities after morning meetings, the leader was extracting and noting dangerous elements, danger levels and countermeasures involved in the work on the RKY (risk assessment/danger prevention) chart by him/herself. There are efforts to engage in effective RKY activities by thinking of the dangers that are present for each person and discussing them as a group, however these efforts should be accelerated since the activities have not been fully developed.

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<sup>1</sup> (p6) On August 9, 2004, a secondary system pipe ruptured at Kansai Electric Co., Inc. Mihama Unit 3 and high temperature secondary system cooling water spurted out killing five workers and injuring six who were working in the turbine building.

<sup>2</sup> (p6) During replacement of the aforementioned ruptured pipe, the labeling of the aforementioned piping was inappropriately corrected at Mitsubishi Heavy Industries who had been charged with the manufacturing of it in February, 2005.

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<sup>3</sup> (p7) Mitsubishi Heavy Industries' management process includes mid/long-term plans and short-term operation strategies, and strategies for surely and steadily implementing these plans at The Factory are referred to as V21-07 strategies

<sup>4</sup> (p8) This QMS framework is comprised of, "top-down quality policy given to departments and sections aimed at developing quality objectives," "bottom-up format in which small group activities that soak up on-site issues, and dept./section QMS committee are improved," "a management review that fuses these two things and serves as a way to decide policy," "work improvement conference, monitoring committees (internal audit) as support organizations" thereby constructing a QMS that is unique to The Factory.

<sup>5</sup> (p9) In the manufacturing department, non-conformity information is referred to as "combat experience."