

OVERVIEW

1. Introduction

This document is a report on the Peer Review (hereafter, "Review") of IHI Corporation. The Reviews conducted by Japan Nuclear Technology Institute (hereafter, "JANTI") are implemented by Review teams consisting of JANTI members and JANTI specialists visiting the business establishments of member companies. Under the theme of nuclear safety, the Review is carried out from a professional standpoint, eliciting any problems that may exist in the said business facility (division) as well as examples of good practices that other members could benefit from by following, and points that need improvement, and by introducing these practices far and wide, the aim is to contribute to the improvement of Safety Culture in the nuclear energy industry on the whole.

2. Overview of the Reviewed Facility

Since Ishikawajima-Harima Industries Co., Ltd. (which officially changed its name to IHI Corporation (hereafter, "IHI") as of July 1, 2007) commenced nuclear business in 1955, the company has designed, manufactured, installed, and serviced many machines and equipment for boiling water reactors (BWR). Among the principal machinery and equipment for light water reactors, so far, the company has a track record of manufacturing 25 reactor pressure vessels, as well as reactor containment vessels and large-component piping for nuclear reactor systems and the like.

In addition, making use of its BWR manufacturing expertise, the company also endeavors in the manufacture of new types of reactor apparatus such as fast reactors, high-temperature gas-cooled reactors and others. Since 1978, the company has also made inroads into the nuclear fuel cycle field, mainly in the design and construction of high level waste vitrification facilities and facilities for the storage of vitrified blocks. Since October 2006, the company has also been a player in the pressurized water reactor (PWR) market with production taking place at the Yokohama Machinery Works, which mainly manufactures apparatus exclusively for use in the nuclear power field.

The Nuclear Power Division which underwent the current Review is the division of IHI

that is centered around the nuclear power business.

As of July this year, the number of employees directly engaged in nuclear-related work in the Nuclear Power Division was about 400 persons, and with the inclusion of employees of contractors, the number is approximately 450.

3. Approach and Point of Review

In the current Review, attention was given to the quality assurance endeavors that lead to nuclear safety and communication between regular employees and the top strata of administration, and the operations that are related to the nuclear power apparatus design & manufacturing process.

In more concrete terms, four topics were taken up, which are the three fields of "organization & administration," "training" and "design & manufacturing," plus the item of "prevention of human error," which JANTI has made one of its priority issues.

4. Implementation of the Review

(1) Date

September 5 to 7 (Wednesday through Friday) 2007

(2) Review team members

Team Leader: JANTI NSnet Division personnel

Team Members: four persons under the Team Leader

(Nuclear Fuel Transport Co., Ltd.: 1, Japan Atomic Energy Agency: 1, JANTI NSnet 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 was carried out over a period of three days, for which the following table shows a summary of the schedule of each of the groups.

Implementation Schedule

		Group A (Organization & Management, Human Error Prevention)			Group B (Education & Training, Design & Manufacturing)			
5 September (Wed)	AM	Opening (Salutations, introduction of team members, explanation of recent circumstances at the plant, etc.)						
		I. Organization & Management IV. Human Error Prevention	<ul style="list-style-type: none"> • organizational policy & objectives • promotion of safety culture • campaigns to improve morals 	documents	II. Education & Training III. Design & Manufacturing	<ul style="list-style-type: none"> • planning and implementing training • method of implementation (passing down expertise) • recognition of qualifications • effective design management 	documents	
	PM	I. Organization & Management	Senior Division Manager class <ul style="list-style-type: none"> • organizational methods & objectives • leadership 	interviews	I. Organization & Management	Senior Division Manager class <ul style="list-style-type: none"> • organizational methods & objectives • leadership 	interviews	
		I. Organization & Management	managerial class <ul style="list-style-type: none"> • leadership (• initiative/recognition • clarification of objectives and scope of responsibility • delivering safety message) 	interviews	II. Education & Training	interviews with managerial class <ul style="list-style-type: none"> • training plans • understanding training effectiveness 	interviews	
		IV. Human Error Prevention	<ul style="list-style-type: none"> • human error prevention 	on-site	III. Design & Manufacturing	confirmation of manufacturing site by observation by designers	on-site	
			managerial class	interviews		<ul style="list-style-type: none"> managerial class • design management, design inspection • design standards • management of contractors in manufacturing • communication with site of manufacturing 	interviews	
		[consultations with host executive office]	confirmation of results of Review confirmation of plan for second day, etc.		[consultations with host executive office]	confirmation of results of Review confirmation of plan for second day, etc.		
	6 September (Thu)	AM	[observation of events]	morning meeting, state of parts management, etc.	event	[on-site observations]	in-plant worksite pre-work meeting and job performance	on-site
			I. Organization & Management IV. Human Error Prevention	<ul style="list-style-type: none"> • quality assurance programme • prevention of human error 	documents	II. Education & Training	member class <ul style="list-style-type: none"> • implementation and improvement of training 	interviews
			I. Organization & Management	managerial class <ul style="list-style-type: none"> • quality assurance programme (endeavors in product safety) contractors • endeavors in product safety 	interviews		member class <ul style="list-style-type: none"> • implementation of training • knowledge and experience • passing down expertise 	interviews
			member class <ul style="list-style-type: none"> • prevention of human error 	interviews	III. Design & Manufacturing	member class (design) <ul style="list-style-type: none"> • degree of knowledge and experience • passing down expertise 	interviews	

	PM	I. Organization & Management	member class • safety culture promotion campaigns • campaigns to improve morals	interviews	III. design & manufacturing	worker class (manufacturing) • degree of knowledge and experience • work environment	interviews
[confirmation of facts] affirmation and coordination of Review results with host / preparation of closing report documents							
7 Sept mber (Fri)	AM	team meeting (80 minutes)					
		[confirmation of facts] final coordination with host / final check of closing report documents					
		preparation for closing (copy documents, prepare assembly hall)					
	PM	closing (explanation of results, closing remarks)					

6. Review Method, Items Reviewed, and Summary of Review Results

The Review method, items reviewed, and summary of Review results are presented below.

6.1 Review Method

(1) Verification of documents

The Review was carried out by having the business policy, explanation of standard documents, and various other related documents presented for each respective Review item.

(2) Interviews

Interviews on the theme of "endeavors in nuclear safety" were carried out with a total of approximately 40 persons including the Senior Division Manager who is the top administrator, managers, and regular employees. Also, whenever there were any uncertainties while documents were being verified, it was investigated through interviews.

(3) On-site observations

Direct observations were made to find out how things were being handled at the worksites, and the matters verified through document verification and interviews were reviewed along with activities of the Division.

In addition, while the Review team member were observing the worksites, conducting interviews, and verifying documents, opinions were exchanged between the Division and the Review team, with the Review team citing information and examples of "best practices" that are employed within the nuclear power industry at large that would serve as useful reference.

6.2 Items Reviewed

The four items reviewed are the three fields of "Organization & Management," "Education & Training" and "Design & Manufacturing," plus one item of "Human Error Prevention."

6.3 Summary of Review Results

Documents were verified, interviews conducted, and actual worksites observed with regard to each Review item, and examples of good practices and areas needing improvement were elicited.

For the purpose of this discussion, "good practices" shall be defined as "examples of customs that are especially exemplary and which yield good results from among those safety assurance activities being practiced by the said division, the adoption of effective, precise, original techniques, best practices or processes that JANTI sees appropriate to pass on not only to other JANTI members, but widely throughout the entire nuclear industry as well."

"Suggested improvements" shall be defined as "from the perspective of striving for the ultimate best level of nuclear safety, in line with the best practices from among the nuclear power industry, proposed in order to raise and improve the safety assurance activities of the said division." Toward this aim, suggestions for improvement are sometimes made, even though the current state of activities is the same as or better than what are considered average standards throughout the nuclear power industry.

7. Summary of Interview with Senior Division Manager

A summary of the interview with the Senior Division Manager is as follows.

- (1) Endeavors toward improving and promoting safety culture

Endeavors are being made to promote safety culture through the further unified emphasis on quality, compliance, and adherence to ethics by engineers. With regard to compliance, company-wide lecture courses were established about two years ago and in addition to carrying out education, e-learning programs are also being effectuated. New employees are being taught intensively of the need for quality, compliance, and adherence to ethics by engineers.

(2) Strengths and weaknesses of the Nuclear Power Division

The Nuclear Power Division supplies cutting edge quality products and its TQM activities won the Deming Prize in 1995. The Senior Division Manager selects three important themes from among those themes put forward by all divisions in regard to quality control, and specialists from outside the company are brought in during TQM training sessions to provide guidance. Furthermore, it is requisite that IHI must make a success of the Rokkasho vitrification facility by whatever means necessary, and reliable techniques and quality engineering went into the design of that facility. Specialist from outside the company were also brought in to provide guidance.

On the other hand, the passing down of expertise is a challenge. Nuclear related orders have tapered off and efforts are being made in the passing down of expertise in the field of chemical engineering machinery, but it is felt that when nuclear related orders start picking up again, it will be necessary to reconsider the required technology and human resources.

(3) Disseminating top-tier policy among the on-site frontline workers

Every April, the Senior Division Manager Policies are drawn up and made known at assemblies attended by all personnel. As for the set policies, the policies are expanded in concrete terms within each stratum of the hierarchy, and eventually reflected in the MBO (Management By Objectives and self control sheets) used by all employees. The important policies for each of the departments are indexed, checked at the monthly general quality assurance deliberation committee, and the needed instructions are given.

(4) Lessons learned from the Monju incident and activities to prevent the lessons from being forgotten

The "Monju" sodium leak accident set the development schedule for fast breeder reactors back by a large margin and dealt a strong blow to the development of nuclear power in Japan, for which our company keenly feels the responsibility. Recently the number of people who know about this trouble is increasing, but this is a problem which absolutely must not be forgotten, and this theme has been worked into the training. We are trying hard to prevent the problem from being forgotten, even now that it is 12 years later.

(5) Endeavors in passing down expertise

Expertise is passed down while keeping in mind the machinery itself and its relation to the engineering expertise needed for its production. Regulations and standards are necessary conditions, but these conditions alone are not enough. Sufficient conditions can only be met by passing engineering expertise down from person to person. A chain of engineers passing information along is what is needed, and the insufficient expertise can be augmented by experienced elder workers.

(6) Report culture

As far as report culture is concerned, efforts have been being made for some time already to improve communications as part of a company-wide campaign for the reformation of awareness. During training, the opportunity is provided for executive staff, personnel in key positions, those who are in line for key personnel positions, and the staff to take part in opinion exchange sessions about 30 times per year. These start off with explanations of objectives by each individual person, followed by one to two hours of free discussion. In the beginning there were mainly calls for the improvement in the working environment, but gradually their true feelings started coming out.

Efforts are made to refrain from becoming angry when subordinates make mistakes, but to admonish them calmly instead. Anger is but a display of emotions, whereas calm admonishment is a form of educating.

(7) On-site patrols by upper management

Whenever there is any major engineering project at the work site, before the start of the engineering work, upper management personnel go to the worksite to issue advisory

instructions concerning safety and quality. In addition, safety patrols are dispatched to the worksite about twice per year. The advisories issued at the worksite mainly focus on the assurance of safety and quality discussions. Even the employees of fourth and fifth tier subcontractors take part.

(8) Expectations for peer reviews

We believe that inadequacies exist in IHI safety culture activities, and expectations for the current peer Review are for guidance in these areas. We also hope that good practices in use at other companies will be shared.

8. Synopsis of Review Results

A synopsis of the Review results is as follows.

Adhering to the IHI administrative concepts of "Promoting Social Development through Engineering Technology" and "Human Resources Comprise the One and Only Asset," and based on the idea that the assurance of nuclear safety by a power plant manufacturer is the foremost administrative policy to be emphasized in quality, the Fundamental Policy of the Division and Quality Policy of the Division were formulated, and in the drive for assurance of safety, reliability, quality, and engineering expertise, it was confirmed that employees, including those of contractors, are making efforts in this regard.

Over a long period of years, efforts have been made to promote a corporate culture of emphasis on quality through education carried out separately according to each stratum (training for Senior Managers, training for managers in which the Senior Manager of the Nuclear Power Division also participates, and for training for ordinary employees) and TQM (Total Quality Control) activities, and as one part of that, the endeavors in campaigns to reduce the ratio of defectively welded joints is paying off.

Furthermore, in regard to endeavors toward corporate ethics, in light of the company-wide endeavors to spiral upward toward an even more robust compliance structure, campaigns continue with the objective of putting problem solving into practice with the participation of all members of the Nuclear Power Division as a new campaign launched this fiscal year to reform awareness "Team IHI Campaign -- vivacious IHI."

As the concrete result of the Review, it was confirmed that steady progress is being made

in the implementation of (1) thoroughness of policy management by the Senior Manager of the Division at the workplace level, (2) progress in the campaign to reduce the ratio of defectively welded joints, (3) establishment and execution of the action program for passing down expertise, (4) personnel training program for new employees, (5) technical retention and succession by means of "expert worker system" and "key personnel system," and (6) technical standards (QOT) committee activities and the like.

However, further improvements are still desirable in the areas of (1) further raising awareness of nuclear safety culture, (2) even greater utilization of data collection and analysis, (3) explicitly stating reasons for changes when in-house regulations and the like are revised, and (4) effective use of a uniform management system for non-conformity events.

Six concrete examples of good practices and four suggested improvements were elicited through the Review results, and are listed below.

Note, however, that the suggested improvements are not necessarily matters that need to be dealt with immediately from the standpoint of nuclear safety.

8.1 Good Practices

(Organization & Management)

- **Thoroughness in communicating of policy management by the Division Senior Manager at the workplace level**

The Senior Manager of the Nuclear Power Division himself conducts opinion exchange sessions regarding the setting of objectives separately for each hierarchical level (training in accordance with hierarchical stratum) including the strata of division managers, managers, and deputy managers for the purpose of achieving thoroughness and objective management of the Nuclear Power Division Senior Manager policies for each fiscal year. Since fiscal 2006 this has been extended to the staff (persons in charge) level, and efforts have been shifted toward activities in thoroughness in policy management and communications efforts.

- **Progress in the campaign to reduce the ratio of defectively welded joints**

A welding quality committee has been established within the manufacturing division, where a target management value has been set for the ratio of welding

defects, and every month, the causes of welding defects are analyzed and counter-measures are discussed. What is more, this has been taken up as a TQM activity, and welding work KY sheets have been brought into use in the long-term improvement campaign endeavors and favorable results are being achieved.

(Education & Training)

- **Establishment and execution of the action program for passing down expertise**

The current state of technical prowess is analyzed every year in the Nuclear Power Plant Engineering Department, and based on that analysis, a priority field is decided on for the passing down of technical expertise, an action plan for the passing down of technical expertise is settled, and the state of progress is evaluated on a regular basis. If there is no progress being made, the action plan is carried over to the following fiscal year and continues to be implemented until the expertise is reliably passed down.

- **Personnel training program for new employees**

A "new employee training record" is created for each individual new employee, and a three-year concrete training plan is established. In addition, training instructors who undergo a company-wide boarding-house style training course for instructors are assigned on a one to one basis to new employees so that they directly coach the new employees in the performance of work duties over the three-year training period.

- **Technical retention and succession by means of "expert worker system" and "key personnel system"**

Two systems have been established: there is the "expert worker system" for welding work and work-site technical skills and the like, and for welding expertise and other forms of expertise there is the "key personnel system," and lists have been drawn up of all the personnel in the company who possess such technical and technological skills. The company is striving to pass down expertise by having personnel who have been designated under the "expert worker system" and "key personnel system" as possessing technical and technological expertise provide guidance to the next generation.

(Design & Manufacturing)

- **Technical standards (QOT) committee activities**

Inter-departmental working groups have been established across multiple departments to deliberate on common technical standards for materials, vibration, structural design and the like, and in addition to proactively discussing revisions of technical standards tailored to the progress in technology, they strive to disseminate the newly established technical standards. Also, all technical standards are in principle reviewed once every three years.

(Human Error Prevention)

None in particular

8.2 Areas for Improvement

(Organization & Management)

- **Further raising awareness of nuclear safety culture**

It was confirmed through interviews with personnel having connections with the manufacturing division that there is a sense of pride in the production of nuclear products, but in the case of a few personnel, it was noticed that there seems to be hardly any distinction for them between nuclear plant items and ordinary chemical engineering products. At the Yokohama Machinery Works, quality control management for nuclear products is substantially applied uniformly across the board to all products, except for welding management and inspection, even including chemical engineering machinery. This practice, however, carries with it the potential risk that by applying nuclear products quality control uniformly to chemically engineered products, it could lead to bringing the level of nuclear products quality control down. Recognizing this as a potential risk, it would be desirable to devise some scheme for maintaining and further improving awareness of nuclear safety by all concerned personnel.

- **Even greater utilization of data collection and analysis**

On the matter of collecting data on examples of trouble at other companies and

revisions of laws and the like, it was noted that the data collected by IHI consisted of data provided by power companies and customers. It would be desirable to take a more assertive and active role in acquiring data so that information that might possibly affect IHI's own business will not escape notice.

- **Explicitly stating reasons for changes when in-house regulations and the like are revised**

As for revisions to regulations that accompany remedial actions in cases of non-conformities, there are some for which the reasons for the revision are not made explicit. It is very important in order to convey proper understanding that the reason for the change was to amend an incident of non-conformity, so therefore, it would be desirable to make reasons for changes to rules and regulation explicit, or cite book references and the like.

- **Effective use of a uniform management system for non-conformity events**

A system exists for the uniform management of non-conformity events and it is made use of from the standpoint of management, but it cannot be said that use is being made of the system on the higher plane of analyzing non-conformity events and deliberation on wide-scale policies. Hereafter, it would be desirable to give consideration to making more efficient use of the system.

(Education & Training)

None in particular

(Design & Manufacturing)

None in particular

(Human Error Prevention)

None in particular