

Overview

1. Introduction

This report discusses the results of a peer review ("Review") conducted by Japan Nuclear Technology Institute (JANTI) at Global Nuclear Fuel-Japan Co, Ltd. ("GNF-J"). The purpose of the review is to promote safety culture in the whole nuclear industry by identifying good practices from which other members can learn and areas for improvement of the facility. To achieve this purpose, review teams consisting of experts from JANTI member organizations and JANTI itself visit the member facilities to conduct a specialized technical review regarding the theme of nuclear safety.

2. Overview of the Facility Reviewed

GNF-J undertakes design, development and manufacture of fuel to be used in BWR nuclear power plants. Its predecessor Japan Nuclear Fuel Co., Ltd. was established as a nuclear fuel manufacturing joint venture of General Electric Company ("GE") of the United States, Toshiba Corporation and Hitachi Limited in 1967. In January 2000, the three companies transferred the responsibility for design, development and sales as well as the employees to Japan Nuclear Fuel, which started to carry out in an integrated manner the design, development, manufacture and sale of fuel. In September 2001, the company changed its name to the current GNF-J.

Both the corporate office and the fuel processing facility are located in the Kurihama area of Yokosuka, Kanagawa Prefecture where the design and manufacture of BWR uranium fuel, core design as well as core management service operations are carried out. Recently, the company has undertaken MOX fuel design for BWR use and relevant quality assurance operations. As of October 2008, there are approximately 500 employees, including those employed by contractors.

GNF-J has two processing facilities (1st processing unit and 2nd processing unit). At the 2nd processing unit, the principal processes of fuel processing are undertaken in an integrated manner, which include the fabrication of fuel pellets (casting, sintering, grinding, and pellet inspection), the manufacture of fuel rods (fuel rod loading, end plug welding, and

fuel rod inspection), and the assembling as well as inspection of fuel assemblies is undertaken. At the 1st processing unit, the manufacture of pellets with gadolinium, and analysis of impurities of metallic components are conducted.

GNF-J has fabricated approximately 77,000 rods (as of September 2008) since the time of Japan Nuclear Fuel Co., Ltd. and its products have been supplied to all BWR nuclear power stations in Japan.

3. Review Viewpoint

Including two reviews conducted by Nuclear Safety Network, JANTI's predecessor, in June 2000 and January 2005, this is the third review. Therefore, this Review focuses on the current activities and changes of system/process after the previous review as well as the actions for the two events, in which uranium was dispersed, on July 9 and August 8, 2008 described below.

Until recently, no major events had occurred at GNF-J. However, on July 9, 2008, at a press machine for manufacturing uranium dioxide pellets, the fabrication work was restarted without closing the inspection lid, which had been removed earlier, when cleaning up the press machine (cleaning is done when the degree of enrichment of the uranium being handled changes). As a result, uranium powder was dispersed from the opening. In addition, on August 8 just as these countermeasures were being implemented, the splash of liquid containing uranium scattered in a uranium recovery room. The splash was made from the bubbles generated from hydrogen peroxide water solution injected into the tank on the floor. Since the uranium dispersion of these events were limited within the radiation controlled area, where the atmosphere was maintained at negative pressure, no air inside the room passed to outside and radioactive materials were not released to the environment. However, the uranium dispersion caused internal exposure of five workers including radiation protection staff, even though it was only a trace amount.

GNF-J has taken the successive uranium dispersion seriously. It conducted a root cause analysis of the events and has implemented measures to prevent recurrence of similar events. "Uranium Safety Measures Enhancement Office" was established in order to verify the implementation status and effectiveness of the measures and lead activities to have a safety

culture rooted deeply in the company. The company president has been confirming the progress of the improvement based on the report by the office. In addition, to establish and further foster a safety culture, August 8th, the day on which the second uranium dispersion event occurred, has been designated as "Safety Day". Furthermore, a message from the president was communicated and company-wide safety inspection activities have been conducted.

Taking account of these circumstances, following points were focused in the Review.

- Efforts for cultivating a safety culture
- Disseminating top-management policy to the workers at front lines
- Training of engineers, and knowledge transfer to the next generation
- Efforts for radiation protection
- Communication between workers and managers in the field
- Efforts to prevent human errors
- Management of infrequently conducted works
- Efforts regarding the uranium dispersion event countermeasures

Specifically, four areas including "organization/administration," "training," "work management and maintenance," and "radiation protection" were reviewed as well as the four key topics of "critical safety," "nonconformance management and human error prevention," "risk management" and "measures for preventing recurrence of uranium dispersion events."

4. Conduct of the Review

(1) Review period

From November 25 (Tue) through November 28 (Fri), 2008

(2) Review team composition

Team leader: JANTI NS Network

Team members: a team leader and six reviewers

(Toshiba Corporation employee: 1; Nippon Nuclear Fuel Development Co., Ltd. employee: 1; JANTI NS Network: 2; and JANTI technical advisors: 2)

(3) Responsibilities in the review team

Group A: organization/administration, key topics

Group B: training, work management/maintenance, radiation protection, key topics

5. Review Schedule

The Review had conducted for four days following the schedule shown below.

		Group A (Organization/administration, key topics)			Group B (Training, work management/maintenance, radiation protection, key topics)		
Nov. 25 (Tue)	AM	Team meeting					
		Opening (greeting, member introduction)					
		Interview with President					
		General	Non-conformity follow-up	Document review	General	Follow-up concerning time of previous visit	Document review
	PM	I Organization/administration V Key topics	Managers	Interview	III Work management/maintenance	Work in controlled areas	Field observation
		I Organization/administration V Key topics	Work of replacing clogged filters, packing and transfer of fuel assemblies	Field observation	IV Radiation protection	Managers	Interview
Review team meeting							
Debriefing with host secretariat, confirm review results, confirm schedule for 2nd day, etc.							
Nov. 26 (Wed)	AM	General	Morning briefing	Field observation	General	Morning briefing	Field observation
		V Key topics	Managers and staff	Interview	IV Radiation protection	Water analysis and other radiation protection activities	Field observation
					II Training IV Radiation protection V Key topics	Managers and staff	Interview
	PM	I Organization/administration	Lean activities	Event observation	III Work management/maintenance	Component processing work, etc.	On-site observation
		I Organization/administration V Key topics	Personnel responsible	Interview	II Training III Work management/maintenance IV Radiation protection	Personnel responsible	Interview
	Review team meeting						
Debriefing with host secretariat, confirm review results, confirm schedule for 3rd day, etc.							
Nov. 27 (Thu)	AM	I Organization/administration V Key topics	Staff	Interview	II Training III Work management/maintenance IV Radiation protection V Key topics	Staff	Interview
	PM	I Organization/administration	Fire extinguishing training	Event observation	General	Monthly general safety walk down	Event observation
		V Key topics	Staff	Interview	II Training III Work management/maintenance IV Radiation protection V Key topics	Managers	Interview
	Team meeting						
Debriefing with host secretariat, confirm review results and the schedule for 4th day, etc.							
Nov. 28 (Fri)	AM	[Fact confirmation] Final adjustments with host					
	PM	Closing (explanation of results)					

6. Review Method and Categories of Review Results

6.1 Review Method

(1) Document Review

Policies, rules and related documents for each review area were presented and explained, and issues to be focused and activities to be observed were identified.

(2) Interview

Interviews were conducted on the theme of "efforts for nuclear safety" and "measures for preventing recurrence of uranium dispersion events" with the president as an executive officer, managers and a total of 54 workers. Discussions were also conducted on questions and other concerns which arose when documents were reviewed.

(3) Field observation

Along with document review and interviews, field activities of were observed.

While conducting the document review, interviews and field observations, the review team carried out mutual opinion exchanges, providing information and cases which should be useful for GNF-J including best practices in the industry.

6.2 Categories of Review Results

"Good practices" and "areas for improvement" were developed based on the results of document review, interviews, and field observations with regard to each review area.

"Good practices" shall be defined as "exemplary, effective, and unique practices and/or processes of the facility that ensure safety and are worthy to be widely shared with JANTI members and those in nuclear power industry."

"Areas for improvement" shall be defined as "suggestions for further improvement/refinement of reviewed facility's activities made through the comparison with industry best practices, in order to achieve the excellence in nuclear safety." Due to this definition, areas for improvement are sometimes made even though the current activities are

above the average of nuclear industry standards.

7. Summary of Interview with President

The review team interviewed the President of GNF-J in order to understand senior management policies. Following is the summary of the interview.

(1) What is nuclear safety at GNF-J?

ISQO (Integrity^{*1}, Safety, Quality, and Output) has been established as the management philosophy of GNF-J. We need sound soil (integrity) first. A powerful trunk (safety) grows on the sound soil and puts out shiny green leaves (quality), and an abundant harvest (output) can be reaped finally. This is talked about at company-wide assemblies and various other occasions. At the general manager meetings, where all general managers and higher management meet once a week to confirm the progress of the preceding week, I have the attendance report those related to the most important concept of integrity first. The, those related to safety and quality are reported and those related to output are reported at last.

(Why was the second uranium dispersion event not able to be prevented?)

In short, our cause analysis of the first event was insufficient. We were inattentive because we had not experienced any major events for 40 years and had been accustomed to a good situation. This was identified as one of the contributors of the first event, but we did not investigate the root causes closely and concluded with superficial measures. The first and second events were independent and the causes also differ superficially, but they have a common fundamental cause.

I regret that I did not grasp the gravity of the problem after the first event and did not give

^{*1} “ Code of Conduct of GE ” which is followed by all companies within the GE Group

a strong warning to the employees.

(President's resolution)

I want to heighten the tension regarding the work in the field. First of all, we are aiming to be number one throughout the world in the area of safety, quality, product performance, and operational efficiency by having all employees work in a body. I feel that our sights have declined and we have lost the mentality to strive to be the best. Next, I want to go around the workplace myself and acquire live information. I am making it my custom to go to the workplace twice a week, but if possible, I would like to go everyday. I want the unit leaders and general managers also to have the same awareness. The third is to ascertain the essence of near miss events in the field on the same day and then formulate and implement simple countermeasures.

(2) Efforts to cultivate a safety culture

It is to implement the aforementioned "President's resolution" itself. In addition, we must acquire knowledge and experience as well as learn lessons from the experience of other companies. Another one is to hold a lecture by Dr. Ishikawa, Senior Advisor of JANTI.

(3) Communicating the President's policy to the workplace

(Frequency of workplace visits)

Before the uranium dispersion events, I went on "safety patrol" activities only about once a month, but now I visit the workplace twice a week.

(Observation in the workplace)

In the field, I confirm that the "potential checks" and non-stationary work are written on the KY board. In addition, I pay attention to the handling of the zirconium chips because of the fire at the other company. I have also been watching the works and areas with a high potential for safety risks, which were thoroughly inspected after the uranium

dispersion events. I have been paying attention to cleanliness and changes in the workplace such as trash under/behind equipment and in gutters too. I think that the workplace has become cleaner since the accident. I speak to the workers and see whether or not they look back, reply, what their expression is.

In order to confirm that the President's policy is being conveyed, in addition to the conversation with workers at the worksite, I conduct the activity called "round tables" in which I assemble five or six workers together and discuss it with them on a topic chosen in advance for one or two hours to get their feedback.

As the lean activities^{*2} are conducted by a wide range of personnel, I exchange ideas with the members over dinner to understand actual conditions.

(4) Reporting culture

Matters involving quality and safety including near miss events are reported as CARs (Corrective Action Requests) and compiled every month and quarter. As for the matters related to integrity, concerns are reported by all employees once annually through a mechanism called "bottom-up" and necessary actions are taken. However, although it is just a hunch, I believe that the number of items being reported is fewer than the actual number for both categories and. Matters that have arisen are reported to the general manager level staff meetings and warnings are given.

I think that the leaders need to gain a high level of sensitivity in order to continue the activities on near miss events. To achieve this, there should be an external impetus and we should attend to matters with a sense of tension and be rigorous down even to the minute details, which will convey the ideas of top-level management downward. We need to address additional efforts which include inviting outside lecturers, dispatching personnel to outside of the company and enhancing communicative abilities.

(5) Strengths and Challenges of GNF-J

(Strengths)

^{*2} Activities which have been advanced in GE businesses throughout the world since 2003 and are processes of improvement based on behavioral science whose doctrine is cost reduction through the thorough elimination of waste

More than anything else, our strength is the integrity and high quality of the fuel assemblies. In spite that more than 70,000 assemblies have been supplied to power stations, there has been no fuel failure at the stations caused by our company's manufacturing. It is our employees' loyalty, their strong passion for and pride in the work and products as well as our skilled engineering and workmanship that allows us to provide highly reliable products.

(Challenges)

Over 10 years have passed since we started manufacturing Step Fuel. Before that, new type fuels were introduced around every five years, however, the innovation pace of our products has slowed down recently. I fear that our capability to challenge new technologies has become dull. The uranium dispersion event might occur inevitably against this background.

We have to develop new products for longer operation cycle and other changes in the near future. We will have to restore our capabilities in the field required for this objective. I would like to use the uranium dispersion event to our advantage and rebuild our site capabilities.

(6) Understanding the state of GNF-J performance

With regard to quality, actual performance and problems are reported in monthly quality meetings. Safety is discussed in the periodic assessments (Mini-Management Committee) of the Radiation Safety Committee, which is held every three months. As for the matters regarding integrity, achievements are assessed annually through bottom-up activities. Reports are also given at the weekly general manager level staff meetings.

Personnel at the manager level or higher enter the individual performance targets of their subordinates in a format known as “dashboard” at the beginning of the year, and confirm their progress.

(7) Expectations for Managers

I expect the managers to implement the above President's resolution.

(8) Technology Transfer to the Next Generation

About 100 employees will retire in five years. Although we have been implementing new hiring for direct workers involved in manufacturing since about one year ago and indirect workers involved in design and development since 2003, we have not been able to compensate for the shortage of mid-career personnel as seen in the composition of our employees according to age.

Focusing on the important key processes that require high level techniques including sintering and fuel rod (end plug) welding, we are developing a database of past failures to transfer the experience to the next generation.

Since the training for supervisors and group leaders may have been disregarded, we are reviewing and enhancing training. Experienced personnel still have a tendency to just say "watch my back and follow me."

I intend to establish Shop Leader Council in order to build lateral ties among shop leaders, who have an important role in developing safety culture.

We are also looking for systems to transfer the basis and background of procedures.

(9) Expectations for the peer review

After the first event, I just sent a message to our employees by email, which is very easy, because I understood the issues superficially. As a result, I could not appeal to each individual's feelings, or change his/her behavior. Since then, I have sent many messages to employees via various ways. I am making an effort to get feedback from the employees to see if these messages have filtered down, however, the number of people whom I listen to is limited.

Since many interviews with employees are scheduled during the peer review, I expect the review team to hear the employees' opinions and make use of the opinions to understand to what extent my message is being comprehended by the employees.

8. Summary of Review Results

The foundation for GNF-J's approach to nuclear safety is the doctrine of ISQO, which was mentioned with the company president in the interview. The Safety Quality Policy states that: "nuclear safety shall be recognized as the most important, legal and regulatory requirements shall be observed, and all employees shall strive for safe operation." On a daily basis, efforts toward ensuring industrial safety in the manufacturing workplace are actively being made. A "Disaster Prevention Team" has been formed to be a private disaster prevention brigade, which is trained daily so that it will be able to respond to all disasters. Coexistence with the community is provided through the disaster prevention support activities of PONY, the Yokosuka fire fighting cooperation brigade, which was commissioned by the Mayor of Yokosuka in July 1998.

On the other hand, uranium dispersion events occurred twice in succession. Therefore, the entire company is addressing measures to prevent any recurrence, and activities for improvement are being promoted. In this review, work observation in the field and interviews with managers and employees were conducted in order to confirm the effectiveness of the recurrence prevention measures. As a result, following opportunities for further improvement were identified. (1) With regard to infrequently conducted work, improvements such as confirming the presence or absence of any infrequently conducted work in the pre-job meeting have been implemented. In addition to this, the employees should always pose questions as to whether or not it is infrequently conducted work, and talk with their supervisors. (2) In addition to efforts to prevent human errors which has been started, right manner of human error prevention tools such as "pointing and calling," should be instructed so that they can be utilized when necessary. (3) With regard to radiation protection, additional device to control radioactive material and prevent spread of contamination in a controlled area should be adopted. (4) Since the sense of solidarity should be given when promoting improvement activities company-wide, there should be system to share the good activities of other departments as well as continuous information exchange over the barriers between departments and positions.

For more effective activities for improvement, the review team expects that these will be included in the current activities.

As the company-wide improvements are being carried out, some employees in the manufacturing workplace mentioned that workers started to speak up in the morning meeting and interactive conversations were taking place between workers and managers. Some senior staff and shop leaders stated that it was important to have opportunities like off-site meetings to communicate over vertical and horizontal barriers. Some employees felt that the company were move in the right direction.

An open atmosphere and communication within an organization are the elements for cultivating a safety culture. Good atmosphere and communication enable the company's top policy and sense of crisis to permeate rank and file employees, and lead to an improved safety culture.

Continuous improvement activities are crucial rather than sporadic activities. It is expected that everyone in the company keep competing with each other, each department incorporates good practices of other departments, and managers take initiative in caring out improvement activities.

Three good practices and six areas for improvement identified as review results are discussed below.

Please be noted that these areas for improvement do not need to be responded to immediately to ensure nuclear safety, but actions for improvement are expected to be considered and implemented.

8.1 Good Practices

(Organization/administration)

- Wearing safety goggles with thoroughness

All employees working inside the plant, even those performing walk down and or light work, wear safety goggles without exception. At GNF-J, safety goggles have been worn since the time when operations were commenced under its predecessor Japan Nuclear Fuel Co., Ltd. in 1970. Subsequently, because it was a requirement of the Global Star Activities introduced in 2001 (GE Group's exclusive labor safety management system),

wearing safety goggles has been incorporated into manuals, which reinforced the practice.

In the nuclear industry of Japan, there is no other company where safety goggles are so thoroughly worn in the workplace throughout a wide range of operations as GNF-J. In many cases, only workers who are close to high-risk work wear safety goggles. Therefore, the practice at GNF-J should be referred to by the nuclear power industry of Japan.

(Radiation protection)

- Establishment of a method for quick calculation of uranium dispersion amounts

With regard to the total of 28 rooms where there is a risk of uranium dispersion within the facility, the volume of the room and the area of floor, wall and other surface were measured and put into a database. In addition, a way of sampling, counting radioactivity, and calculating the amount of dispersed uranium were standardized. As a result, GNF-J established the method for calculating the amount of dispersed uranium quickly and accurately when a uranium dispersion event occurs.

This method enables GNF-J to calculate the amount of uranium dispersion quickly in case of uranium dispersion events only by sampling the uranium particles in the air by collecting dust, or those attached to the floor and walls by smearing, and by measuring radioactivity in these samples.

This method has been applied in the emergency drill, which was introduced after the uranium dispersion events, for faster calculation.

(Key topics)

- Active efforts for disaster prevention activities

The "Disaster Prevention Team" has been organized as a private disaster prevention brigade. The "Disaster Prevention Team" has seven small units: headquarter, security, rescue, fire fighting, radiation control, information, and engineering so that the team can respond to earthquakes, terrorism and every possible disaster as well as fire fighting and rescue. The team consists of the members selected from the employees and receives a variety of drills preparing emergency. A general drill of the team as well as a specialized drill for each unit is conducted monthly. In addition to that, a comprehensive emergency drill, a fire drill and a physical protection drill are carried out once a year. GNF-J holds

intracompany competitions. The team also actively participates in outside competitions. The cooperation system in case of emergency has been established since the team was commissioned by Yokosuka in July 1998. The team also provides coexistence with the community through active participation in volunteer activities, such as the New Year parade of fire brigades.

8.2 Areas for Improvement

(Training)

- Efforts technology transfer to the next generation

In order to hand down technology to the next generation, the knowledge and experience is being recorded in technical reports or manuals, however, the approaches of each department including manufacturing, inspection and engineering are not always systematic. The approaches are expected to be systematic in order to ensure that valuable technology is transferred to the next generation.

(Work management/maintenance)

- Effective use of near miss events

Near miss events related to industrial safety are being reported and shared through the "near miss event reporting" system. However, reporting practices of the near miss events related to nuclear safety and product quality vary with the departments and these events are not being effectively utilized by the whole company.

Near miss events are useful to prevent non-conformities. These are expected to be used in daily work as appropriate.

(Radiation protection)

- Improvement in way of containment of radioactive materials and prevention of spread of contamination

It is expected to improve the way of containment of radioactive materials and prevention of spread of contamination to enhance the radiological cleanliness of the facility by information exchange and mutual visits with other organization including nuclear fuel manufacturers.

(Key topics)

- Reinforcement of use of human error prevention tools for the reduction of non-conformities

Reduction of human errors is one of the most important challenges of nuclear industry. The use of human error prevention tools such as questioning attitude, point and call, and STAR^{*3} is important for the reduction. In order to reduce human errors more effectively, it is expected to define when human error prevention tools are to be used, and give training to employees so that they can learn about these tools and use them when necessary. In addition, managers are expected to confirm that the human error prevention tools are used.

- Distinction of infrequently conducted work

The direct cause of the non-conformity in August was reported that the infrequently conducted work was undertaken before scheduled time since the work was recognized as frequently conducted work. The countermeasures taken include effective pre-job meetings, proper direction by managers, and communication of the definition of infrequently conducted work once again.

In addition to these countermeasures, it must be effective that the workers make initial distinction of infrequently conducted work according to easy words, such as 3H (*hajimete* (first time), *henko* (change), and *hisashiburi* (long interval)), and then discussed with supervisors.

- Efforts to cultivate a sense of solidarity among all company employees

Inadequate communication between "supervisors and workers of Manufacturing Department" as well as "engineers and personnel at the worksite" was reported as one of the causes of the non-conformity in August. To prevent the recurrence of similar events, off-site meetings were held as a part of the training for supervisors of Manufacturing Department at workplace to enhance the communication between senior staff of the Manufacturing Department and the managers of indirect departments including Environmental Health & Safety, Nuclear Safety Administration Group and Quality Assurance Department as well as Chief Engineer of Nuclear Fuel Handling.

*³ Stop, Think, Act, and Review.

On the other hand, the section managers of the Manufacturing Department have found a way to manage their workplaces. However, good practices for a certain work of a section are not always shared with other sections that carry out similar works.

For the continuous improvement of the nuclear safety and reliability within the entire company, such system that enables each section to share its good practices with other sections and compete with each other is expected. Continuous information exchange beyond the barriers between positions, sections and departments is also expected.

An open atmosphere, communication, and a learning attitude are the elements for cultivating a safety culture. Good atmosphere, communication, and a learning attitude enable the company's top policy and sense of crisis to permeate rank and file employees, and lead to an improved safety culture.