Post-quake status of the Kashiwazaki-Kariwa Nuclear Power Station (Report #12)

-The status of consideration by the Nuclear and Industrial Safety Agency-

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Japan Nuclear Technology Institute

The Nuclear and Industrial Safety Agency (NISA) of the Ministry of Economy, Trade and Industry (METI) established the "Nuclear Facility Investigative Taskforce in the Niigataken Chuetsu-oki Earthquake" (Headed by Professor Haruki Madarame of the University of Tokyo's Graduate School of Engineering) under the Nuclear and Industrial Safety Subcommittee of the METI Advisory Committee for Natural Resources and Energy to examine facts to identify the impact of the Niigataken Chuetsu-oki Earthquake on the Kashiwazaki-Kariwa Nuclear Power Station, and summarize future tasks and desirable responses of the national government and nuclear energy operators based on the lessons learned from the said Earthquake. This Report #12 describes the progress of deliberations by the Taskforce.

<Summary>

+ The Taskforce has the following Working Groups summarize and examine future tasks, and deliberates on their findings. **(See 1.)**
  - Working Group on in-house fire-fighting and information liaison / provision in the Niigataken Chuetsu-oki Earthquake
  - Subcommittee on anti-quake structural designs
  - Working Group on nuclear plant administration and assessment of facility integrity
+ The "Working Group on in-house fire fighting and information liaison / provision in the Niigataken Chuetsu-oki Earthquake" compiled a report (draft) on specific measures for addressing issues that came to light in relation to the transformer fire and the handling of information liaison. The WG presented the report to the Taskforce on December 19 for deliberation and subsequent approval. The report will be made open for comments from December 21 to January 25, and put to further deliberations by the Taskforce on possible revisions reflecting the comments gathered.

  Each of 10 electric power companies and Japan Nuclear Fuel Limited also presented its policy on immediate initiatives regarding in-house fire fighting and information liaison / provision. All the initiatives cited were in line with the Taskforce report, and included ones that had already been in place with content reflecting measures listed in the report. Each company aims to complete the initiatives by the end of 2008 or the next two periodical inspection according to its situation of plant operation.**(See 2.(1))**
+ The integrity assessment of reactor buildings, following the earthquake, indicated that the buildings were generally within the elastic region.**(See 2.(2))**
+ The Taskforce meeting on December 9 heard a report that the Kashiwazaki-Kariwa Nuclear Power Station had all the nuclear safety functions secured at the time of the earthquake.

  The Taskforce also heard a report about plant administration issues, although minor in nature, that have been identified as beneficial for ensuring safety of nuclear power stations, and how such issues are addressed.**(See 2.(3))**
+ The Taskforce heard the basic policy on the assessment of facility integrity, which represented summary of deliberations by the "Working Group on nuclear plant administration and assessment of facility integrity". Based on the basic policy, NISA issued a written instruction, dated November 9, that TEPCO draw up an inspection and assessment plan for each of the reactor units at the Kashiwazaki-Kariwa Nuclear Power Station, and submit it to NISA.

In response, TEPCO submitted an inspection and assessment plan for Unit 7 of the Kashiwazaki-Kariwa Nuclear Power Station, dated November 27. NISA confirmed that the plan covered all requirements presented in the instruction.**(See 2.(4))**

TEPCO intends to complete "seismic response analysis" and "facility inspections" on Unit 7, referred to in the plan, by March and May next year respectively, and use the information obtained to conduct a "general assessment on facility integrity" by June next year. The company also plans to draw up similar inspection and assessment plans for Units 1 to 6. (See the TEPCO press release dated November 27, 2007 for details.)

<Details>

1. Deliberation structure and issues for examination (See the attachment for details)

The Taskforce has the following Working Groups summarize and examine future tasks, and deliberates on their findings submitted.

Subcommittee / Working Group	Tasks for examination
Working Group on in-house fire fighting and information liaison / provision in the Niigataken Chuetsu-oki Earthquake	Examining how nuclear plant operators should conduct in-house fire-fighting, report information within themselves and provide information to local communities in the event of an earthquake
Subcommittee on anti-quake structural designs (Existing committee under the Nuclear and Industrial Safety Subcommittee)	Assessing anti-quake safety based on the insight obtained from the Niigataken Chuetsu-oki Earthquake
Working Group on nuclear plant administration and assessment of facility integrity	Examining nuclear reactors' administration status at the time of the Niigataken Chuetsu-oki Earthquake, as well as the facilities' integrity and future handling

2. Deliberation status of the Taskforce

The Taskforce has convened four times since the first meeting on July 31. The deliberations at the fourth meeting, convened on December 19, went as described below:

(1) The Taskforce deliberated on and approved a report compiled by the "Working Group on in-house fire fighting and information liaison / provision in the Niigataken Chuetsu-oki Earthquake". The table below gives the outlines of the report. The report will be made open for comment from December 21 to January 25, and put to further deliberation by the Taskforce on possible revisions reflecting the comments gathered.

Each of 10 electric power companies and Japan Nuclear Fuel Limited also presented its policy on immediate initiatives regarding in-house fire fighting and information liaison / provision. All the initiatives cited were in line with the Taskforce report, and included ones that had already been in place with content reflecting measures listed in the report. Each company aims to complete the initiatives by the end of 2008 or the next two periodical inspection according to its situation of plant operation (See the TEPCO press release issued on December 20, 2007 for details of TEPCO.)

<In-house system for fire fighting>

Item	Findings
a. Tasks identified in the transformer	- Lack of sufficient manpower for conducting initial fire-fighting efforts - Damage to or lack of fire-fighting equipment - Delay in reporting the fire to the Fire Department - Lack of training among workers involved in initial fire-fighting efforts

fire	
b. Allocation of roles between the in-house fire-fighting corps and the Fire Department	- The in-house fire-fighting corps is assigned the role of using the company's own defensive means to handle areas that the Fire Department may find difficulty in covering due to time constraints. The corps conducts initial fire-fighting efforts to minimize damage. - In a large-scale earthquake and other emergency, there may be times when the Fire Department cannot fulfill its normal operations. The in-house fire-fighting corps must have the ability to handle an anticipated level of fire.
c. Specific measures for fundamentally reinforcing the in-house fire-fighting system	- Enhancing the initial fire-fighting system (conducting round-the-clock monitoring, securing around ten workers as reserve staff for initial operations, etc.) - Improving the reliability of fire-fighting equipment (ensuring anti-quake performance, achieving diversity / multiplexing, etc.) - Improving the reliability of associated facilities essential for fire-fighting operations (establishing a direct communications line with the Fire Department at the Main Control Room, securing anti-quake resilience for the emergency management office, etc.) - Implementing and reviewing practical drills in coordination with the Fire Department (drawing up a plan for fire-fighting activities, applying the PDCA cycle in drills and their reviews, etc.)

<System for information liaison / provision>

Item	Findings
a. Tasks on information liaison / provision at the Kashiwazaki-Kariwa Nuclear Power Station	- Lack of sufficient initial response - Difficult-to-understand expressions used - Lack of sufficient considerations to the recipients of information - Compromise of information liaison attributable to problems with associated facilities or lack of protocols on the part of the power company - Problems surrounding NISA's on-site system for information gathering, liaison and provision
b. Specific measures for ensuring swift and accurate liaison / provision of information	- Using diverse means to deliver information swiftly to local residents, etc. (issuing press releases from the initial response stage, using various means to repeatedly provide information, etc.) - Adjusting expressions to provide information in an easy-to-understand manner (citing daily life situations as metaphors, swiftly giving a tentative rating to an event according to the INES scale, etc.) - Reinforcing the government's information liaison / provision system with focus on on-site operations (swiftly dispatching NISA's senior staff to the site, building a system that automatically gathers important information, etc.) - Having nuclear energy operators develop communications facilities and systems that can withstand a major earthquake (improving the installation of such equipment with due considerations to earthquakes, securing staff for measuring and analyzing the leakage of radioactive substances, etc.) - Implementing practical drills and trainings (conducting trainings and

	examination under the partnership of NISA, local government and nuclear energy operators)

(2) The "subcommittee on anti-quake structural designs" reported the following as the status of its activities:

a. The integrity assessment of reactor buildings, following the earthquake, indicated that the buildings were generally within the elastic region. The Subcommittee also summarized the approach to selecting parameters used in the analysis, and explained the concept of auxiliary walls employed in the analysis.

b. TEPCO presented its seismic observation records and reported its plan for conducting geological surveys in and around the power station premises.

c. TEPCO presented its interim assessment on the marine sonic prospecting.

(3) In regard to the operational / administration status of the Kashiwazaki-Kariwa Nuclear Power Station at the time of the earthquake, the Taskforce was presented with a report by the "Working Group on nuclear plant administration and assessment of facility integrity" on its findings over whether the power station secured the nuclear safety functions of "Shut Down", "Cool" and "Contain", and what future tasks and responses should be addressed in plant operation / administration to help assure further safety of the power station. The outlines of the report are as detailed below:

<Assessment on to what extent each of the nuclear safety functions was secured at the time of the earthquake>

Function	Result	Reason
a. Shut Down	Secured	- At the nuclear reactors that were operational or being started up at the time of the earthquake, the detection of "large seismic acceleration" set off a scram signal, which resulted in swift full insertion of all control rods. All operations were implemented appropriately through to the confirmation of sub-criticality. - The safety of the reactors that were shut down at the time of the earthquake (Unit 5 and Unit 6) was secured with all control rods in full insertion, and no significant fluctuations observed in the Source Range Neutron Monitor.
b. Cool	Secured	- At the nuclear reactors that were operational or being started up at the time of the earthquake, all heat removal systems were working correctly, and handled all associated operations, such as reactor depressurization, from the reactor scram to cold shutdown. - Although the shutdown reactors at Unit 5 and Unit 6 had fuel loaded, all heat removal systems were working correctly. The heat removal system for these Units' spent fuel pool was also functioning properly.
c. Contain	Secured	- The reactor water and the water of the spent fuel pools were checked for iodine concentration at all Units. Its comparison with pre-quake levels indicated that the earthquake caused no fuel damage. - There was no leakage observed in the reactors' pressure boundaries or in the reactor containment vessels. - Radiation monitors indicated no significant increase in all areas except for the reactor buildings' operation floors. - The reactor buildings maintained the negative pressure.

		- No significant fluctuations were reported in the readings at monitoring posts.
d. Power supply with external power sources and emergency D/G	Secured	- Facilities that supply external power are required to have the seismic rating of Class C, which is the same as that for general industrial facilities. In this earthquake, three external power systems (two systems subsequently) were secured immediately after the quake despite it having the intensity that surpasses the design-basis seismic motion. - The post-quake patrol and subsequently-conducted detailed inspections identified no damage to the emergency D/G, which has the seismic rating of "Class As". The operation check on the same D/G after the earthquake also confirmed its integrity. This indicates that, even if the earthquake caused the loss of external power sources, the emergency D/G would have secured power supply.

(Lessons learned and future tasks)

As detailed above, the functions of "Shut Down", "Cool", "Contain" and "Power Supply" were secured in the earthquake. From the perspective of further ensuring safety, it is necessary to acknowledge and address the following lessons learned:

1) The method for simulator trainings for plant operators should be reviewed in anticipation of composite events in future earthquakes.
2) The staff mobilization system, including the protocol for emergency mobilization, should be developed and reinforced so as to conduct plant operations and on-site checks simultaneously in emergency.
3) The emergency D/G should undergo a regular test as soon as the preparation is completed, regardless of its normal frequency for routine tests, from the perspective of ensuring power supply to the plants.

<Assessment of non-conformities associated with the earthquake>

It is beneficial to identify minor events and use the information to apply preventive measures at other nuclear power stations. All non-conformities (3,100 events) were examined to identify ones that could be beneficial for preventive purposes in terms of the safety functions of "Shut Down", "Cool" and "Contain.

Event	Description
a. Damage to the insulation material for the boric acid solution injection system	- The earthquake shifted a heavy item, which subsequently came in contact with the piping for the boric acid solution injection system laid in the room, and damaged the insulation material covering the piping. - Although the incident did not damage the piping of the boric acid solution injection system itself, there was a possibility that the heavy item could have damaged other piping with a high level of importance in nuclear safety.
b. Evacuation of workers from radiologically controlled	- The earthquake caused a failure of six of the seven monitors, used to examine radiation contamination of plant operators as they leave a radiologically controlled area. - After the earthquake, approximately 400 workers in the radiologically

areas after the earthquake	controlled areas of Unit 1 were ordered to evacuate, and rushed to the only available radiation monitor. The radiation control staff had to let the workers leave without undergoing a contamination check through the monitor from the perspective of human safety. - The workers were in areas where the level of contamination was kept below the legal limit. Their contamination therefore did not exceed the maximum surface contamination level stipulated by law. However, no contamination checks were conducted following their evacuation to a safe location.
c. Positions of fuel assemblies when loaded in a reactor	- While fuel was transported from the reactor to the spent fuel pool at Unit 5 (which was in the shut-down state at the time of the earthquake), it was found that the fuel assemblies had been dislodged from the support fittings on the underside. - The records taken during fuel loading indicated that the applicable fuel assembly had the mounting position (vertical) approx. 25mm higher than other assemblies. TEPCO recorded the mounting positions of all fuel assemblies, but did not examine whether the positions were within a specific range.
(Lessons learned and future tasks) Other nuclear power stations must recognize and address the following issues, in addition to lessons learned from non-conformities disclosed by TEPCO as items that require safety considerations: 1) The items in temporary storage for use in , must be affixed properly so that they would not damage important equipment in terms of nuclear safety in the event of an earthquake. 2) There should be an emergency protocol, stipulating where workers should gather after evacuating from radiologically controlled areas in an earthquake, and how their surface contamination level should be gauged. 3) Power stations should control the mounting locations (vertical) of fuel assemblies in fuel loading, and check whether they are properly mounted.	

(4) The Taskforce heard the basic policy on the assessment of facility integrity, which represented summary of deliberations by the "Working Group on nuclear plant administration and assessment of facility integrity" and its sub-Working Group.

<Basic policy on integrity assessment>

a. Inspection and analysis	- Important facilities in terms of nuclear safety (Class 1 facilities in importance-based classification, Class A / As facilities in seismic design classification and other facilities that could affect these facilities) should be subject to inspections and seismic response analysis to determine the effects of earthquakes. The findings from such inspections and analysis should be combined to achieve comprehensive integrity assessment. Association should be established between the results of inspections and findings from analysis (e.g. implementing a focal inspection in response to the result of analysis) to examine facility integrity in details. - Other facilities should be inspected in relevant techniques to assess their integrity.

b. Assessment of seismic impact on facilities based on the results of inspections and analysis	- Facilities at the Kashiwazaki-Kariwa Nuclear Power Station, which was struck by the Niigataken Chuetsu-oki Earthquake, are required to contain its overall structural deformation within the elastic region, and maintain their respective functions required in terms of engineering standards, so as to ensure engineering conformance.

		Presence of damage that could affect the facilities' structures or functions required by engineering standards	
		No damage identified in inspections	Damage identified in inspections
Result of analysis conducted with currently available techniques based on floor response data obtained in this earthquake	Elastic state	The facility has integrity.	Repair or replacement work is required after an investigation into the cause of the damage.
	Beyond the elastic state	Detailed examination is required with additional inspections and analysis incorporating realistic conditions (*)	

(*)The Working Group on nuclear plant administration and assessment of facility integrity or the sub-Working Group on the assessment of facility integrity should conduct a detailed investigation into the integrity of the applicable facility.

<Past actions based on the above policy>

a. Instruction on the planning of inspections and assessment regarding facility integrity

Based on the above basic policy, NISA issued a written instruction, dated November 9, that TEPCO draw up an inspection and assessment plan for each of the reactor units at the Kashiwazaki-Kariwa Nuclear Power Station, and submit it to NISA.

b. Considerations concerning the inspection and assessment plan

TEPCO submitted an inspection and assessment plan for Unit 7 of the Kashiwazaki-Kariwa Nuclear Power Station, dated November 27, in response to the above instruction. NISA confirmed that the plan covered all requirements presented in the instruction.

<Future actions>

a. About Unit 7

- Conduct a safety inspection, routine check and on-site inspection to examine TEPCO's overall inspection process and the implementation status of individual inspections, in light of the findings of seismic response analysis, so as to determine the validity of inspection results.
- NISA should examine the validity of analysis methods and parameters used by TEPCO in assessing the impact of the Niigataken Chuetsu-oki Earthquake, if the methods or parameters are different from those applied in the design stage.
- Japan Nuclear Energy Safety Organization (JNES) should conduct a cross-check of the

results of seismic response analysis to verify their validity.

- Assess the facility's general integrity based on the results of inspections / assessment by TEPCO and other inspections mentioned above, and make a strict confirmation on whether the facility requires repair work.

b. Application to other Units

Examine the inspection and assessment plans to be submitted by TEPCO for other reactor Units, to verify that items specific to individual Units are reflected to the plans.

c. Summarization of judging criteria for determining the need for repair work

When the validity of inspection procedures and methods for seismic response analysis for initial reactor units is verified, confirm the need for repair work for the applicable units according to the aforementioned basic policy on integrity assessment, extract items that can be applied to other units, and compile them into common judging criteria.

3. Other actions by NISA

(1) Report to the Nuclear Safety Commission of Japan (NSC)

The following information is to be reported to the NSC in its meeting on December 20, 2007.

a. WG report (draft) regarding in-house fire-fighting and information liaison / provision

b. Results of the assessment on the administration status of the Kashiwazaki-Kariwa Nuclear Power Station at the time of the earthquake

c. Basic policy on the integrity assessment of facilities at the Kashiwazaki-Kariwa Nuclear Power Station

(2) Second investigation by the International Atomic Energy Agency (IAEA)

In a follow-up to its first investigation (August 2007), IAEA plans to conduct a second investigation to examine subsequently-obtained information, check the progress and results of on-going examination, and internationally disseminate information about future schedule and lessons learned. Specific content and timing of the investigation (around late January 2008) are currently being coordinated with IAEA.

END

Attachment

Deliberation structure and issues for examination by the "Nuclear Facility Investigative Taskforce in the Niigataken Chuetsu-oki Earthquake" under the Nuclear and Industrial Safety Subcommittee of the METI Advisory Committee for Natural Resources and Energy

Subcommittee / Working Group	Issues for examination	Specific issues	Meetings convened
Working Group on in-house fire-fighting and information liaison / provision in the Niigataken Chuetsu-oki Earthquake (Project Manager) Professor Hirotada Ohashi, Graduate School of Engineering, University of Tokyo	1.In-house fire-fighting	(1)Examining TEPCO's response and tasks in relation to this earthquake, and exploring an in-house fire-fighting system and future challenges for nuclear energy operators (2)Exploring an in-house fire-fighting system and fire-fighting facilities for nuclear energy operators	1st meeting: August 27 2nd meeting: September 20 3rd meeting: October 11 4th meeting: November 14 5th meeting: December 7
	2.Information liaison system within the plant operator	(1)Examining TEPCO's response and tasks concerning radiation leakage, and exploring nuclear energy operators' response system and tasks at the time of radiation leakage (2)Exploring an information liaison system for nuclear energy operators	
	3.Initial action and preparation system in emergency	(1)Examining TEPCO's initial action in this earthquake, and exploring tasks concerning the government's initial response system (including an investigation into facilities required for making the initial response system function properly) (2)Exploring a liaison system for local governments, national government and nuclear energy operators (including a system for gathering information that facilitates liaison)	
	4.Information provision to local governments and residents	(1)Investigating and exploring TEPCO's information provision to local governments and residents (2)Investigating and exploring the governments' information provision to local governments and residents (3)Examining and exploring easy-to-understand press releases by the government and TEPCO (conveying a sense of security and reducing adverse effects based on misunderstanding)	
Subcommittee on anti-quake structural designs (Chairman) Professor emeritus Katsumasa Abe of the University of Tokyo	1.Examining the research data of relevant organizations on this earthquake, observation data of the seismic motions and survey data used as design basis to determine why the seismic motions observed in this earthquake exceeded the design-basis seismic motions at the foundations of reactor buildings at the power station		(Subcommittee) 1st meeting: August 24 <WG on plant structures> 1st meeting: September 13 2nd meeting: October 23 3rd meeting: November 27 4th meeting: December 25 <Joint WG on earthquakes, tsunami, geology and subgrade> 1st meeting: October 12 2nd meeting: December 5 3rd meeting: December 25
	2.Impact of this earthquake on the Kashiwazaki-Kariwa Nuclear Power Station	(1)Examining the earthquake's impact on plant buildings / structures that are deemed important in terms of anti-quake safety, and verifying their integrity (2)Examining the earthquake's impact on equipment and piping that are deemed important in terms of anti-quake safety (The Working Group on nuclear plant administration and assessment of facility integrity is in charge of assessing the integrity of equipment and piping that received force beyond the elastic region.) (3)Examining the earthquake's impact on other facilities (the facilities that the Working Group on in-house fire-fighting and information liaison / provision in the Niigataken Chuetsu-oki Earthquake has earmarked for the enhancement of anti-quake resilience.)	
	3.Issues that should be reflected to future anti-quake safety assessment of the Kashiwazaki-Kariwa Nuclear Power Station	(1)Examining the research data of relevant organizations on this earthquake to identify which undersea active faults should be reflected in defining the level of an earthquake that forms the basis of anti-quake designs (2)Examining the observation data of seismic motions in this earthquake, and findings on the investigation into why the observation data exceeded the design-basis figures at the foundations of reactor buildings at the power station, so as to identify issues that should be reflected in defining the design-basis seismic motion (3)Examining the analysis results of seismic data observed at plant buildings in this earthquake, to identify issues that should be reflected to anti-quake safety assessment of buildings, structures, equipment and piping that are deemed important in terms of anti-quake safety (4)Examining the findings of the study into the earthquake's impact on facilities deemed important in terms of anti-quake safety at the Kashiwazaki-Kariwa Nuclear Power Station, to identify issues that should be reflected to the improvement of anti-quake performance for plant facilities (5)Examining the findings of the impact study on other facilities, to identify issues that should be reflected to the anti-quake performance of plant facilities	

		(6)Summarizing the anticipated level of earthquakes and seismic motions that should be reflected to future anti-quake safety assessment at the Kashiwazaki-Kariwa Nuclear Power Station, anti-quake safety assessment and anti-quake performance improvement measures for the power station's facilities that are important in nuclear safety, and issues associated with anti-quake performance improvement for other facilities	
	4.Summarizing the insight obtained from this earthquake and examining issues to be reflected to other nuclear power stations from the perspective of anti-quake safety assurance for nuclear facilities		
Working Group on nuclear plant administration and assessment of facility integrity (Project Manager) Professor Naoto Sekimura, Graduate School of Engineering, University of Tokyo	1.Operation management immediately after an earthquake	(1)Assessing the operation management measures the utility implemented immediately after the earthquake, identifying tasks that should be addressed, and reflecting the knowledge to manuals as required a.Confirming the status of automatic shutdown (status of first scram, neutron flux fluctuations, and the operation / standby state of safety systems) b.Confirming the relevance of operation procedures c.Examining the operation management that led to the iodine detection in the exhaust stack at Unit 7 d.Examining non-conformity management regarding the release of leaked water at Unit 6	(WG) 1st meeting: September 4 2nd meeting: October 2 3rd meeting: November 1 4th meeting: December 1 <Sub-WG> 1st meeting: November 12 2nd meeting: November 27
	2.Assessment of facility integrity	(1)Grasping the status of plant facilities, examining what inspections are needed, and assessing the plant operator's facility inspection plan and its outcome (2)Examining the method for assessing facility integrity, and exploring judging criteria on the need for repair work (3)Examining the results of inspections and assessment, to explore the method for repair work (4)Identifying items that should be reflected to guidelines and criteria to be applied in individual stages of assessment	