<Appendix>

Improvement of radiation exposures by workers who exceeded the dose limit while engaging in emergency works at Fukushima Daiichi Nuclear Power Station

August 12, 2011
Tokyo Electric Power Company

As we identified that two of TEPCO workers exceeded the dose limit during emergency works, we reported the cause and measures to NISA on June 17, 2011.
In response to that, NISA indicated 8 points for improvement on July 13, 2011.
In addition to countermeasures to those 8 points, we clarified the cause and set out the recurrence prevention measures for persons exceeding the dose limit on top of two TEPCO workers reported on June 17, 2011 and reported to NISA today.
Also, we identified that a person incorrectly wore a mask at Fukushima Daiichi Nuclear Power Station on July 26, 2011. In order to prevent internal exposure, we consider that establishment of countermeasures is urgent. We compiled the cause and countermeasures. We report this together with the above.
Below is the summary.

NISA Instruction
1. To adhere to the dose limits, increase the number of persons for exposure management, expedite measurement of the effective dose of TEPCO workers and co-operating companies' workers at work at Fukushima Daiichi NPS and establish the administration system that can accurately administer the exposure dose.

Outline:

-Personal dose administration of workers in charge of restoration of Fukushima Daiichi Nuclear Power Station is one of the important aspects in conducting works smoothly. As such, on July 1, 2011, we established a new organization "Fukushima Daiichi Stabilization Center". In this Center, we established Personal Dose Administration Group, Safety and Environment Department, dedicated to personal dose administration.

-This group summarizes external dose and internal dose of all persons,

TEPCO workers and subcontractors, in charge of restoration works of Fukushima Daiichi Nuclear Power Station and confirms that the dose limit is observed.

NISA Instruction

2. When working in areas with high concentrations of radioactive substances, establish the work procedures as follows: (i) determine the content of work by estimating the internal dose in advance; and (ii) check the exposure dose during work by WBC etc.

Outline:

-We are conducting an organized dose administration by measuring the density of radioactive substances (i) outdoor everyday and (ii) before work in buildings with relatively higher density of radioactive substances. However, internal exposure dose can be ascertained only after measurement.

-As such, as for works identified as with high density of radioactive substances by measurement before works, we set out a procedure to measure the internal dose before and after work for evaluation.

NISA Instruction

3. Set out and implement the screening procedures in order to adequately evaluate the contamination that may cause internal exposure at areas with high level of radioactive substances.

Outline:

-Under the former procedures, we checked by surface contamination density survey meter. After detecting contamination from nose or mouth, we evaluated the internal dose.

-In addition to the above, we set out procedures for internal dose evaluation for cases such as (i) getting wet with contaminated water, (ii) the full-face mask comes off and (iii) there is contamination on the temple of glasses.

NISA Instruction

4. Conduct appropriate exposure administration as follows: (i) establish the administration system and secure equipments for measurement of exposure dose to administer the sum of internal exposure dose (preliminary assessment) and external exposure dose; and (ii) determine the final internal exposure dose in cooperation with specialized medical institutions.

Outline:

-As we initially did not gather correct personal identification information when we measured external exposure dose and internal exposure dose, it took time to comb through the name list.

-Also, because of the power loss and increase in background radiation, we could not use the on-site Whole Body Counter ("WBC"). We borrowed WBC from Japan Atomic Energy Agency ("JAEA") while the number of WBC was insufficient to measure all persons concerned.

-In addition, we did not have the concrete evaluation methodology at the time of the incident. As such, it took time to notify the primary evaluation result.

-To solve the above, we began using Worker License to grasp correct personal identification information. Also, we are increasing the number of WBC and are planning to implement once a month measurement from September.

-In relation the evaluation methodology, we will enhance accuracy with the cooperation from JAEA.

-In the event that there is a risk to exceed the dose limit or there is enormous dose due to unforeseeable events, we will implement appropriate detailed evaluation with cooperation from medical institutions with expertise on dose evaluation. We will verify by bio assay, lung monitoring etc. including doctors' opinion.

NISA Instruction

5. Set out the manual, educate and train in order that the instruction for usage of equipments for unforeseen circumstances, such as elevated levels of radioactive substances (full-face mask fitted with charcoal filters against radioactive iodine, iodine preparation and protective garments for high dose) is issued promptly.

Outline:

-At Fukushima Daiichi Nuclear Power Station, all areas are designated as “wear mask area” except Main Anti-Earthquake Building, each rest station and Main Control Room for Units 5 and 6 with the density of aerial radioactive substances below mask wearing threshold.
-In order to prevent dose intake should unforeseeable events occur, we set out the procedures to wear protective garments at Main Anti-Earthquake Building, each rest station and Main Control Room for Units 5 and 6. We also implement education and training.

NISA Instruction
6. Consider the fitting and workability of full-face mask fitted with charcoal filters against radioactive iodine and introduce promptly.

Outline:
-In power stations, we have been, from before the earthquake, using several kinds of masks such as “for dust” and “for Iodine” to account for the status of the work site.
-At the time of the incident, as the entire areas within Fukushima Daiichi Nuclear Power Station were with high level of radioactive Iodine, we used “full-face mask with charcoal filter”.
-This mask is negative-pressure type (inhale filtered air by one’s own breathing). This does not account for temples of glasses. As such, there could have been gaps between the body of the mask and the face made by temples resulting in leakage of unfiltered air and intake of radioactive substances.
-To account for this, we deployed powered air-purifying respirator that makes pressure inside of the mask positive to prevent leakage of external air.
-In order to mitigate the risk of intake of radioactive substances by workers, we will utilize “mask fitting check, instruction” by each mask manufacturer to wear existing masks properly.

NISA Instruction
7. Ban food and drink at areas currently allowed to do so and future additional areas if unforeseen circumstances, such as elevation in level of radioactive substances occurs again that may cause internal dose.

Outline:

-At this moment, we are allowing food and drink at Main Anti-Earthquake Building, Main Control Room for Units 5 and 6 and each rest station by TEPCO and subcontractors.
-If periodic radiation measurement (dose rate, density of aerial radioactive substances, density of surface contamination) goes beyond the standard, we forthwith prohibit food and drink.
-We will conduct the radiation measurement as and when necessary such as the occurrence of unforeseen events.

NISA Instruction
8. Ensure that the instruction under "Regarding the evaluation result of radiation administration at Fukushima Daiichi NPS and Fukushima Daini NPS (instruction)" (May 25, 2011, NISA No 1) is thoroughly adhered to.

Outline:
-We received 7 instructions dated May 25, 2011. We are continuously implementing these.

1. Reinforcement of the system by increasing the number of staff to measure radiation so that advance radiation dose measurement of operational site and appropriate operational supervision should be implemented.
2. Sufficient number of personal dosimeter should be secured so that every worker can carry one. Until sufficient number of personal dosimeter is secured, if a representative person carries a dosimeter in areas where radiation dose should be controlled, operational sites should be limited to areas that are confirmed to have homogenous radiation dose inside the controlled area in advance.
3. Assessment of radiation exposure dose of workers who have not completed it should be implemented promptly and internal radiation dose assessment should be implemented quarterly (once a month for female workers) without fail in accordance with the Operational Safety Programs of Fukushima Daiichi and Daini NPSs.
4. Health examination necessary for registration of radiation worker in accordance with the company regulations should be implemented promptly.
5. In order to manage exposure dose of radiation workers, the system

related to exposure dose should be recovered quickly and registration to the Central Registration Center should be conducted without fail.

6. Survey reported to NISA on May 11 regarding the number of female radiation workers was undertaken in inappropriate manner. Measures against recurrence should be formulated.
7. If radiation-work related event that violates the law occurs, it should be reported to NISA immediately.

NISA Instruction

9. In addition to two workers TEPCO reported the cause analysis by ("Cause analysis and formulation of preventive measures of exposure dose exceeding the dose limit for radiation workers engaged in emergency work at Fukushima Daiichi NPS" June 17, 2011, nuclear admin report to the government 23 No 153), conduct the cause analysis and formulate the preventive measures for exposure dose exceeding the dose limit for other workers and report to NISA.

Outline

-The design of Main Control Room includes Main Control Room Ventilation System that substantially contains radiation dose of workers in the event of emergency. At the time of this incident, Main Control Room Ventilation System did not operate due to all AC power source loss.

-Under such circumstance, shift operators and maintenance staffs were occupied with restoration of facilities and containment of the incident. They were doing their best on their own radiation protection on top of responsive work to the earthquake.

-What they did was the maximum of could have been done within a limited time. We presume that cumulative occurrence of below factors resulted in the intake of radioactive substances:

<a>Due to the torrential propagation of events, it was extremely difficult to undertake the protective measures for radiation administration such as appropriate selection of masks, putting on and deployment.

<b>In order to contain the abnormalities, they had to work in the Main Control Room for an elongated duration. They had no choice but to eat and drink in the Main Control Room.

<c>As for worker E, it was possible that the temple of his glasses caused gaps when he wore the mask. As to workers C and D, likewise.

<d>Workers D to F worked close to the emergency exit of Main Control Room (connected to outside) where the density of aerial radioactive substances was supposed to be high. It was impossible for them to take immediate action for unforeseen events such as explosion of the upper part of R/B, Unit 1.

<e>Workers D and F made gaps between the masks and their faces to conduct work safely.

Especially item <d> is considered as the common cause for Main Control Room for Units 1 and 2 and Main Control Room for Units 3 and 4. We presume this is the main cause for workers A, B and C for their intake of radioactive substances.

These are similar to causes indicated in “The Report to NISA on cause analysis on exposure of radiation workers exceeding dose limit and development of measures on recurrence prevention at emergency work in Fukushima Daiichi Nuclear Power Station” reported to NISA on June 17, 2011(under nuclear admin issuance to government 2011, No 153). By implementing measures set out in this report and contents reported per "Improvement instruction regarding the exposure of radiation workers exceeding dose limit at emergency work in Fukushima Daiichi Nuclear Power Station (instruction)" (July 12, 2011 nuclear number 6), we believe we can prevent recurrence.

Others

10.Develop and report the cause analysis and recurrence prevention measures for the oversight in attaching the charcoal filter to the full-face mask occurred at Fukushima Daiichi Nuclear Power Station on July 26, 2011

Outline

-There have been 3 incidents in relation to wearing masks incorrectly. As countermeasures, we have been implementing below:

-Designate a “mask check chief” responsible for wearing the mask adequately per work team. Under the direction of that chief, before going to the work site, make sure to check for leaks of masks.

-Two to form a pair, point and check off aloud at each other's equipments to confirm adequateness. Or, to look at oneself in the mirror at the entrance of Main Anti-Earthquake Building and confirm.

-However, at the time of this incident, both of the above countermeasures were not done due to oversight. As such, we will implement below measures to make certain for prevention of recurrence.

-In addition to Main Anti-Earthquake Building and rest stations where administrators are changing charcoal filters, at all starting points to Fukushima Daiichi Nuclear Power Station (J Village, Visitors hall at Fukushima Daini Nuclear Power Station and Gymnasium at Fukushima Daini Nuclear Power Station), to hand over all full-face masks with charcoal filters attached.

-At the ingress and egress administration area of Main Anti-Earthquake Building and rest stations each individual is changing charcoal filters, the administrator will call at workers for leak check and confirm that masks are worn adequately. With this, at all places where each individual may remove charcoal filters, a third person confirms that masks are worn adequately.

-We printed calling for attention posters to prevent oversight of attaching charcoal filters. We are putting up those posters in plain view of workers such as Main Gate, each resting station and transportation buses.

END