Progress Status of Mid-and-long Term Roadmap towards the Decommissioning of Units 1-4 of TEPCO Fukushima Daiichi Nuclear Power Station (Outline)

At the second Government-TEPCO Mid-and-long Term Response Council held on July 30, 2012, revisions were made on the “Implementation Plan of Reliability Improvement Measures” and the mid-and-long term roadmap. Progress management will be done based on the revised roadmap.

1. Past One Month Summary and Future Plans

1) Plans to Maintain Plants’ Cold Shutdown Condition

- Installation of alternative thermometer for Unit 2 RPV

  Installation of alternative thermometer to replace the broken Unit 2 thermometer is being considered. Water was removed from SLC differential pressure detection pipe where the alternative thermometer is planned to be installed. As a result, obstruction inside the pipe was suspected based on the changes in hydraulic head pressure and the possibility of reactor water backflow was found to be low (August 6 and 7). Though high-pressure flushing of the pipe was done (August 10), the obstruction inside the pipe was not resolved. Based on these results, the feasibility of water removal from the pipe through the PCV penetration (X-51) will be studied. As mock-up testing needs to be done to ensure safety during water removal, the alternative thermometer is planned to be installed by the end of September.

- Investigation of the inside of Unit 1 PCV and installation of PCV thermometer, etc.

  In order to investigate the inside of PCV, preparatory work was started on August 22. During investigation, photos will be taken by a camera, data on radiation dose, ambient temperature, water temperature and water level will be collected and sampling of accumulated water will be conducted. PCV ambient temperature thermometer and water gauge will also be installed to allow constant monitoring (Early October).

- Nitrogen injection to Unit 1 suppression chamber

  As hydrogen concentration and Kr-85 radioactivity density have been changing since April, it is assumed that the hydrogen generated in the early stage of the accident and Kr-85 which remain in the upper part of the suppression chamber are intermittently released into the dry well. In order to investigate whether or not hydrogen and Kr-85 still remain in the suppression chamber, changes in hydrogen concentration and Kr-85 radioactivity density will be measured after injecting nitrogen into the suppression chamber (Early September).

- Installation of Unit 2 PCV thermometer

  For the purpose of improving the reliability of PCV ambient temperature thermometer, a new PCV thermometer

  which allows constant monitoring of PCV ambient temperature will be installed. The installation work is planned to start in mid September.

- Preventing groundwater to flow into the Reactor Building

  A system to prevent groundwater flowing into buildings by pumping the groundwater flowed from the mountain side in areas upstream of the buildings (groundwater bypass) is being considered. As a result of groundwater quality evaluation (samples collected in March, May and June 2012), the radioactivity densities of Cs-134 and Cs-137 were significantly lower than those detected in the river near the power station (Max. 1Bq/L) and the radioactivity densities of Sr, all-α and all-β nuclides were below the detection limits. Although tritium was detected, the radioactivity density was several hundredths or less of the value specified in the law and its impact on the human body, etc. is low. As the impact of releasing the pumped groundwater into the sea on the surrounding environment is considered to be fairly low based on the above, the installation of pumping well, etc. will start in early September (See Figure 1).

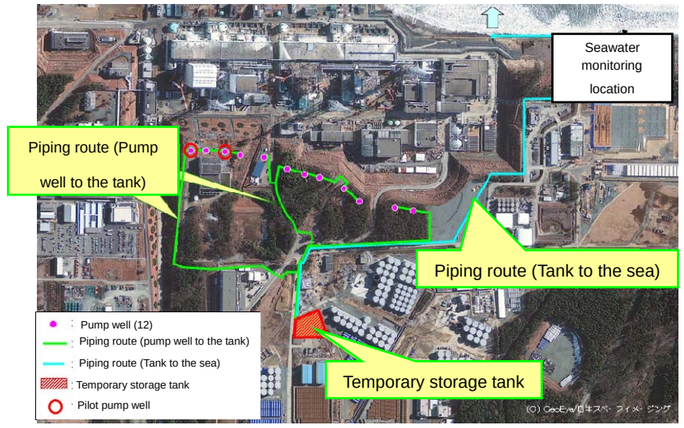
- Installation of multi-nuclide removal equipment (Advanced Liquid Processing System (ALPS))

  A multi-nuclide removal equipment which allows to further reduce the density of radioactive materials included in the water accumulated in the power station will be installed. As a result of confirmatory testing, the radioactivity densities of Sr-89, Sr-90 and Y-90 were reduced down to less than the detection limits (The reconfirmation testing results will be evaluated by the end of August). Equipment/pipe installation is in progress (Started on June 20. System A: Completed on August 23, Systems B and C: Will be completed in mid to late September) (See Figure 2). System testing utilizing actual treated water will be done and actual operation will be commenced in early September.

- Building additional treated water receiving tanks
  - In the past month, tanks with capacity of 8,000m^3 were installed and the tank installation work originally planned (the total of approx. 50,000m^3) was completed (August 6). Additional tanks are planned to be built (approx. 80,000m^3) starting from mid October.
  - Additional underground water storage tanks are being built (More tanks will be built than originally planned (Total of approx. 54,000m^3). To be completed by the end of December).
  - Cylinder shape steel tanks (approx. 4,000m^3) have been installed (August 24) to replace the old ones. More tanks with capacity of approx. 37,000m^3 will be installed as replacement (by the end of November).

- Measures against water leakage from water treatment facilities

  The causes of the water leakages from Unit 4 contaminated water transfer pipe and the joint area of RO system are currently being investigated. The schedule for the replacement of Unit 4 transfer pipeline with polyethylene pipe has been moved up and the operation with polyethylene pipe will be started on September 2.



1. Underground water bypass facility

2. Multi-nuclide removal equipment installation (August 19)

2) Plans to Reduce Overall Onsite Radiation Dosage and Mitigate Contamination

- Radiation dose evaluation at site boundaries

  There are two types of radiation dose evaluation of radioactive materials released into the air conducted at site boundaries. One is done every month in order to check the achievement of cold shut down state, and the other is done to check the achievement of the annual goal (1mSv/year or less). Since the formulas and coefficients used for these evaluations are different, it has been decided that the latter evaluation method (same method used in the facility management plan) will be used starting from September.

3) Plans to Remove Fuel from the Spent Fuel Pools

- Debris removal from the upper part of Unit 3-4 Reactor Buildings
  - At Unit 3, debris removal from the upper part of the Reactor Building is ongoing (To be completed around the end of FY 2012) and the protective platform is being installed.
  - At Unit 4, removal of large equipments from the Reactor Building operation floor is ongoing (from July 24 to October) (See 3 below) and the cover installation for fuel removal is being carried out (Ground improvement work: April 17-August 24, Foundation work: Started on August 17).
- Soundness inspection of the unused fuel (unirradiated fuel) removed from Unit 4 spent fuel pool

  The soundness of the two unused fuel rods removed from Unit 4 spent fuel pool in July was inspected for damages such as abnormal corrosion at the common pool (August 27-29).
- Unit 4 Reactor Building soundness inspection

  The second regular inspection of Unit 4 Reactor Building and spent fuel pool was carried out (August 20-29).
- Unit 1 operation floor investigation

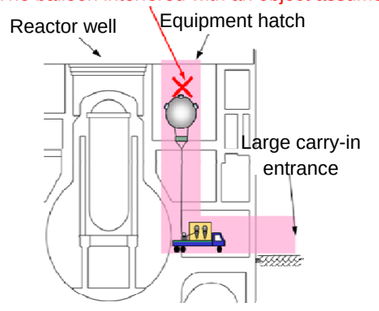
  For the purpose of providing inputs for the fuel removal from spent fuel pool, an investigation on the operation floor utilizing a balloon with a camera attached was attempted (August 8). However, the balloon was unable to reach the operation floor as it interfered with an object assumed to be a cable (See 4 below). Investigation methods are being reconsidered for the next attempt.

Lifting up PCV upper lid in the upper part of the operation floor

Lifting down PCV upper lid

3. Removal of large equipments (PCV upper lid) (August 10)

The balloon interfered with an object assumed to be a cable



Reactor Building (Cross-section)

Appearance of the balloon

4. Unit 1 operation floor investigation

4) Fuel Debris Removal

- Decontamination of the inside of the buildings

  For the purpose of selecting the optimum decontamination method, a simplified analysis of contaminated samples obtained in Unit 1-3 Reactor Buildings was done in Unit 5. As a result, the main radiation sources were Cs-137 (60%) and Cs-134 (40%). A part of the samples was sent to JAEA for detailed analysis (June 25-the end of December). Simulated decontamination test utilizing stable cesium is in progress (August 6-late September).
- Inspection and Repair of PCV Leakage Points
  - Researched on existing technologies, assumed the water leakage points, and considered methods to investigate and repair the assumed leakage points.
  - Water level measurement, sampling and temperature measurement will be conducted on the accumulated water in Unit 1 triangle corner (Early September).

5) Reactor Facilities Demolition and Radioactive Waste Processing/Disposal

- Processing/Disposal of Secondary Waste Produced by the Treatment of Contaminated Water
  - As a part of the examination of the long-term storage and waste solidification of secondary waste, various characteristic tests are ongoing. These include aspect surveys via heating tests and solidification tests using mock sludge, as well as tests to confirm effects on the decrease in the amount of hydrogen generated with salt removal (by the end of FY2013).
  - In order to estimate the radioactive inventory of important nuclides included in secondary wastes from the perspective of processing and disposal, radioactivity density of nuclides in accumulated water and outlet water samples of the water treatment facilities is being analyzed by each nuclide. Though analysis is almost complete, some nuclides such as I-129 are still under analysis (Planned to be completed on August 31) (*[1]). Samples including accumulated water will be continued to be sampled and analyzed.

(*[1]) As the samples collected this time contain a large amount of radioactive materials such as Sr due to the accident, separation processing and improving analysis procedures require a substantial amount of time. Also, because of the high radioactivity densities of the samples and the small amounts of samples transported, measurement requires a long period of time to ensure accuracy.

- Processing & Disposal of Radioactive Waste

  The radioactivity densities of the nuclides included in the sampled debris are analyzed in order to evaluate the densities of radioactive nuclides which are deemed important from the perspective of waste processing and disposal. The sampled debris and trimmed trees will be transported to JAEA in mid September for analysis.

6) Organization and Staffing Plan

- Staff management
  - The manpower necessary for the work in September (about 3,000 people) will be provided by cooperative companies.
  - In order to comply with the legally mandated limit of 100mSv/5 years while considering the future mid-to-long-term work, personnel relocation of the employees whose dose exceeds 75mSv began in October 2011. Of the approx. 345 employees with dose exceeding 75mSv as of the end of July 2012, 216 employees have been relocated as of August 1.
  - The local employment rate of cooperative company workers was approx. 65% as of July.
- Work/living environment and actual working conditions
  - Based on the requests received in the survey on improving working environment at Fukushima Daiichi Nuclear Power Station, adequate measures will be implemented (In response to the requests for reduced

radiation dose in the rest areas, radiation dose reduction work is being prepared for the rest areas in the Administration Office Building and in front of the Main Anti-earthquake Building. For the purpose of mitigating anxiety about internal radiation exposure among those who use the rest areas, surface contamination measurement results will be posted at each rest area). The implemented measures will be notified on the bulletin board.

- In order to eliminate inappropriate subcontracts, hearing on the measures being taken at cooperative companies is continuously held. Adequate measures are being implemented in response to the opinions and requests received through the consultation service. Survey on the actual working conditions is planned.
- The results of hearings and survey will be reported to cooperative companies as feedback.

➢ Full-scale operations of vehicle screening and decontamination area

From April 24, test operations of the vehicle screening and decontamination area at Fukushima Daiichi Nuclear Power Station have been carried out. As the evacuation order for Naraha Town was lifted, the full-scale operations have started on August 10. (See 5 below). The Entry Control Facility is being built near the main gate of Fukushima Daiichi Nuclear Power Station (to be completed at the end of FY 2012). Entry/exit control will be entirely managed at the facility once upon completion.

5. Vehicle screening/decontamination area

7) Ensuring work safety

➢ Radiation dose reduction

Radiation dose reduction work for the rest areas in the Administration Office Building and in front of the Main Anti-earthquake Building (which are deemed to have great impact on workers' exposure dose) will be commenced in mid October.

➢ Thorough implementation of individual radiation control, collaboration with cooperative companies

In response to the inappropriate usage of alarm pocket dosimeter (APD) by some workers, we are currently evaluating the impact of inappropriate APD usage on radiation control and considering recurrence prevention measures. As a recurrence prevention measure, workers who engage in work with high exposure dose will be required to wear protective clothes with the chest area being transparent (currently being prepared for implementation in October). Considering the cases where some workers did not put on APD during work, countermeasures have been implemented such as checking for APD usage by touching the workers from above their protective clothes and identifying the workers who are required to put on APD by the color of their protective clothes. We will continue to enhance compliance with the current radiation control rules among workers and consider further recurrence prevention measures.

➢ Reduction of full-face mask requirement area

For the purpose of reducing the burden for workers, wearing full-face mask will no longer be required in the vehicle screening area and the Cooperative Company Building (Announced on August 2 and implemented on August 9).

➢ Heat stroke prevention measures

Heat stroke prevention measures for FY 2012 are being implemented.

- Number of heat strokes reported: 7 (As of August 20) (21 reported in the same month of FY 2011, 23 reported in total)
- Work hours, frequency and length of breaks and work contents were changed according to WBGT.
- In principle, work during the period from 2:00 PM to 5:00 PM under blazing sun is prohibited.
- Health condition check using a check sheet must be done before work and during breaks.
- Encourage workers to wear a cool vest.

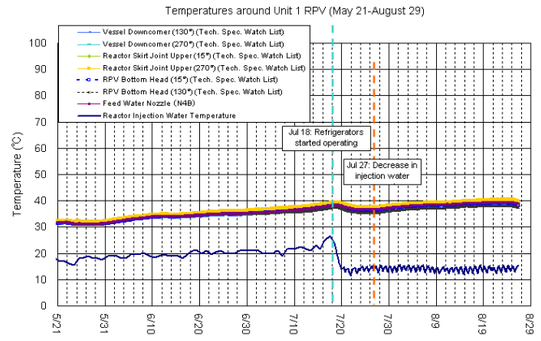
8) Miscellaneous

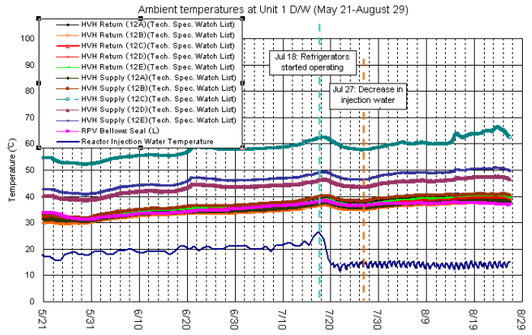
➢ "Fukushima workshop on equipment and device development towards decommissioning of TEPCO Fukushima Daiichi Nuclear Power Station" was held (August 7).

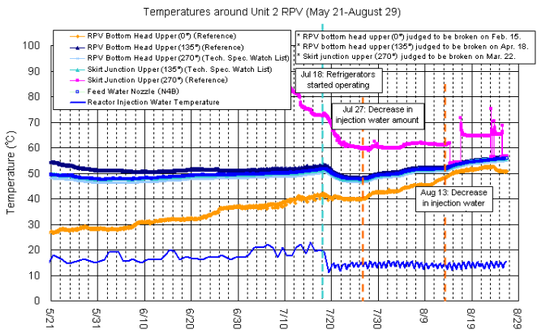
A workshop on equipment and device development targeting companies and research institutes in Fukushima Prefecture was held for the purpose of sharing information and exchanging opinions concerning R&D schedule and related technologies through active discussions. Approx. 150 people (from companies in Fukushima Prefecture, etc.) participated in the workshop.

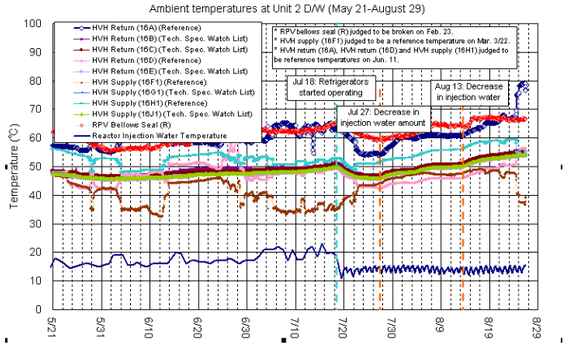
2. Confirmation of Cold Shut Down State

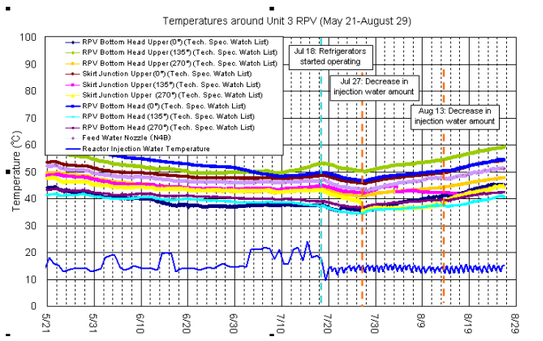
Temperatures of Unit 1-3 RPV bottom part and PCV gaseous phase are approx. 35-55℃ (as of August 26). No significant change in the parameters indicating radioactive materials being released from RPV and PCV is found, and it is judged that the cold shut down state is being maintained.

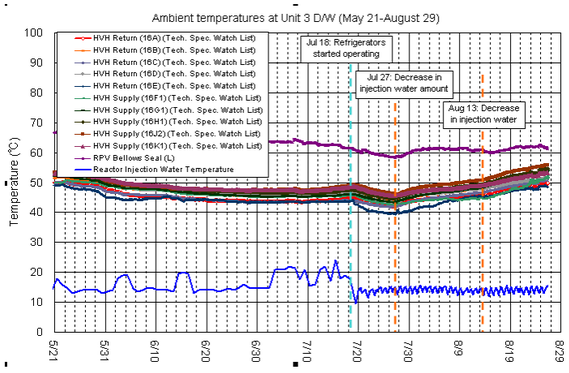








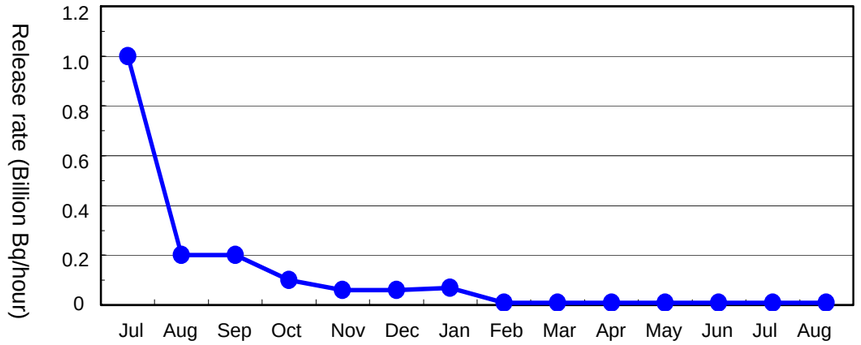




- Temperatures of the RPV bottom and PCV gaseous phase area are checked regularly. Decrease in the RPV/PCV temperatures was confirmed after refrigerators were installed (July 18). Since the RPV/PCV temperatures increased as a result of decreasing the injection water amount for improved cooling efficiency (July 27, August 13), the temperatures are continuously being monitored.
- The pressure inside the PCV is also regularly checked, and no significant change in the pressure has been confirmed.

- As a result of checking the air inside the PCV gas control system by the noble gas monitor, the following xenon 135 amounts were confirmed. Unit 1: Approx. 0.003Bq/cm^3 or less, Unit 2-3: Below the detection limits (Detection limit: Approx. 0.4Bq/cm^3 or less). All of these results are far below the re-criticality criteria (1Bq/cm^3).
- The current release rates of cesium at Unit 1-3 Reactor Buildings were evaluated to be approx. 0.0002 Billion Bq/h (Unit 1), 0.0002 Billion Bq/h (Unit 2) and 0.0004 Billion Bq/h (Unit 3) based on the radioactivity density (dust radioactivity density) of the air in the upper part of the Reactor Buildings. The maximum total release rate of cesium (Unit 1-3) is approx. 0.01 billion Bq/h, which is the same as the previous month considering that the same equipments are used. Based on this, the radiation exposure dose at site boundaries is evaluated to be 0.02mSv/year (excluding the effects of the radioactive materials so far released).

Release rate of radioactive material (cesium) at Unit 1-3 Reactor Building per hour



Furthermore, the monitoring posts (MP-1-8) and temporary monitoring posts (South side of the Administration Office Building, main gate and west gate) are continuously monitored, and no change in the radiation dose at site boundaries has been detected so far.

End

[Abbreviations]

- SLC differential pressure detection pipe: Standby liquid control system differential pressure detection pipe
- Sub drain: Equipment which pumps up the groundwater around buildings
- Operation floor: Floor where the upper lid of PCV is opened for fuel replacement, inspection of structures inside the reactor at regular inspection, etc.
- Working platform: Installed as the running roadbed for heavy machinery at debris removal from the upper part of the Reactor Building.
- Triangle corner: Stair case to go through to get to the Torus Room.
- Torus Room: Room where S/C is stored in.
- S/C (Suppression Chamber): Pressure suppression pool. Used as water source, etc. for the emergency reactor core cooling system.
- Vehicle screening: Testing the contamination of vehicles to screen out the highly contaminated ones.