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

## 1. Past One Month Summary and Future Plans

### 1) Maintenance of Cold Shutdown Condition

- Installation of alternative thermometer for Unit 2 RPV

  Installation of alternative thermometer to replace the broken Unit 2 thermometer is ongoing. The water remaining was removed from the SLC differential pressure detection pipe (where the alternative thermometer is planned to be installed) by high-pressure flushing (September 15) and a mockup test was done to examine the treatment of remaining water in the pipe (September 10-14). Water removal/filling, flushing and pipe modification on X-51 penetration side will be implemented in order before the thermometer installation planned in early October.

- Installation of Unit 2 PCV thermometer

  For the purpose of improving the reliability of PCV ambient temperature thermometer, a new PCV thermometer was installed. The temperature indicated on the newly installed thermometer was confirmed to be equivalent to that of the existing thermometer installed nearby (September 19) (See photo 1 below). We will monitor the performance of the thermometer for the month to come to determine whether or not it can be used for monitoring the cold shut down condition.

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

  Investigation of the inside of the PCV (Take photos and measure the radiation dose, temperature and water level, etc.) and installation of the permanent thermometer are planned in mid October.

- Nitrogen injection to Unit 1 suppression chamber (S/C)

  In order to investigate the mechanism of the intermittent increase in the hydrogen concentration, etc. at Unit 1, nitrogen was injected into the S/C. Since the hydrogen concentration, etc. increased as a result (September 4), it is assumed that air with high hydrogen concentration which was generated in the early stage of the accident still remains in the upper part of the S/C (There seems to be no or little oxygen in the S/C as no increase in oxygen concentration was detected). Hydrogen purge is to be performed inside the S/C in October.

- 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 planned. From early October, pump well installation will be started. Testing using the pilot pump well will be performed in early November and the groundwater bypass is planned to start operation in mid December.

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

  As a result of revalidating the confirmatory test results, it was confirmed that the radioactivity densities of the 62 nuclides targeted for removal can be reduced to less than the detection limits. Equipment/pipe installation has been completed (System A: August 23, system B: September 9, system C: September 23). Water leakage testing (using water not containing radioactive materials) and system testing are ongoing (System A: completed on September 6, system B: completed on September 18, system C: planned to be completed on October 4). System testing using actual accumulated water will be performed for system A once the preparation is complete.

- Reliability improvement of the accumulated water transfer pipe

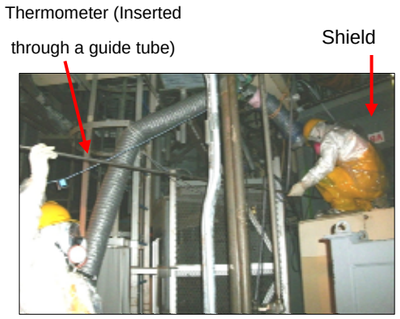
  The RO treatment water transfer pipe (the main route of the circulating injection water cooling pipeline) and the accumulated water transfer pipe between Unit 4 Turbine Building basement and Unit 4 valve unit have been replaced with polyethylene pipe at the end of August.

- Building additional treated water receiving tanks

  In addition to the tanks with the capacity of approx. 80,000m$^3$ to be built by the end of the first half of 2013, tanks with the capacity of approx. 300,000m$^3$ are planned to be built in the south area of the power station (The total capacity will be approx. 700,000m$^3$).

- Ducting of the drainage

  The drainage of the tank periphery was ducted (at the end of August) in order to prevent contaminated water from flowing into the sea in case of leakage from the tank.




1. Unit 2 PCV thermometer installation

Drainage before (left) and after (right) being covered

2.Ducted drainage

### 2) Radiation Dose Reduction and Contamination Mitigation in the Power Station Site

- Radiation dose evaluation at site boundaries

  The annual total radiation exposure dose at site boundaries generated from the gaseous waste and the temporarily stored solid waste has been evaluated to be approx. 9.7mSv/year (Max.) as of the end of September. Radiation exposure dose reduction measures will be implemented to achieve the target of less than 1mSv/year for the year starting from April 2013.

- Radioactivity density of seawater in the port

  - As a result of covering the marine soil and putting the seawater circulating purification equipment in operation to achieve the radioactivity density below the limit specified by the Reactor Regulation (applied to the outside of the monitoring area) by the end of September, the radioactivity densities of the seawater sampled at 8 locations where the seawater flow is larger compared to others (the port entrance, shallow draft quay, in front of Unit 6 water intake canal, etc.) were less than the density limit (cesium) specified by the Reactor Regulation.
  - On the contrary, the radioactivity densities of seawater in 5 locations where seawater flow is smaller (such as the inside of Unit 2-4 water intake canal silt fence) were still above the density limit. Radioactivity density reduction measures such as continuous filtration and replacement of the silt fence (assumed to be the source of contamination) will be implemented while discussing additional measures in collaboration with external research institutions.

### 3) Fuel Removal 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 (To be completed by the end of 2012).
  - At Unit 4, large equipments are being removed from the Reactor Building operation floor (Started on

July 24, to be completed in October) (See 3 below) and the cover for fuel removal is being installed (foundation work started on August 17).

- Control of Common pool water quality

  It has been decided that a partition will not be installed in the common pool (where Unit 1-4 spent fuel will be stored) for controlling its water quality due to the following reasons (See 4 below)

  - The chloride concentration of Unit 4 spent fuel pool has reduced from 6,000ppm (sampled on April 12, 2011) to 24ppm (September 16, 2012) as a result of desalting. The chlorine ion amount to be brought into the common pool is evaluated to be minimal.
  - At the end of April 2012, the filtration function of the common pool (chlorine ion etc.) was restored by putting the existing filter demineralizer in operation. Accordingly, its purified water quality is maintained at adequate level.

- Soundness inspection of the unused fuel (unirradiated fuel) removed from Unit 4 spent fuel pool

  The two unused fuel rods removed from Unit 4 spent fuel pool in July were inspected for damages such as abnormal corrosion in the common pool (August 27-29). Since no corrosion or oxidation was found, it was evaluated that spent fuel removal will not be affected significantly by material corrosion (See 5).

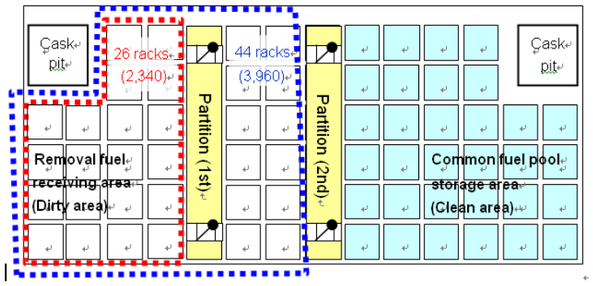
- Unit 4 Reactor Building soundness inspection

  The second regular inspection of Unit 4 Reactor Building and spent fuel pool was carried out (August 20-28). No problem was found with the building soundness as a result of performing building tilt measurements (reactor well/spent fuel pool water level measurement and exterior wall measurement), visual inspection of the walls and the floor and concrete strength evaluation (similarly to the previous inspection).

- Unit 3 spent fuel pool investigation for debris removal (Second investigation)

  - The inside of the spent fuel pool was investigated for the purpose of checking the interference of the debris in the surrounding area of the pool with fuel removal (September 13).
  - After the debris in the surrounding area of the pool are removed, the third investigation of the inside of the pool will be performed (Planned on September 25-27).

3. Removal of large equipment (RPV lid) (September 13)




4. Previously planned fuel receiving by installing partitions

Inspection of the unused fuel

Discoloration of fuel rod
(Confirmed on 1 fuel rod)

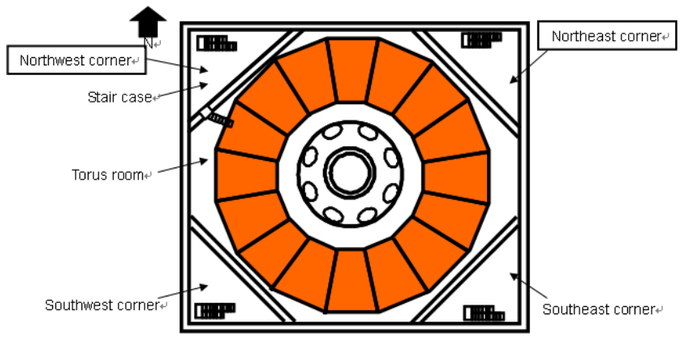
Discoloration removed after wiping

5. Soundness inspection of the unused fuel (unirradiated fuel) removed from Unit 4 spent fuel pool

4) Fuel Debris Removal

- Inspection and Repair of PCV Leakage Points

  Accumulated water level measurement, sampling and temperature measurement were conducted in Unit 1 triangle corners (Northeast, Northwest) (September 20). Considering that the radioactivity densities of the accumulated in these triangle corners are about the same, it is assumed that the accumulated water goes back and forth among each triangle corner and the torus room. Since the water level of the northeast corner is low, it is possible that there is a comparatively large leakage route to the Turbine Building (penetration hole) at around OP3900 (See 6).




Reactor Building mid-basement floor

| Location | Water level |
|---|---|
| Northeast corner | OP 3910 mm |
| Northwest corner | OP 4420 mm |

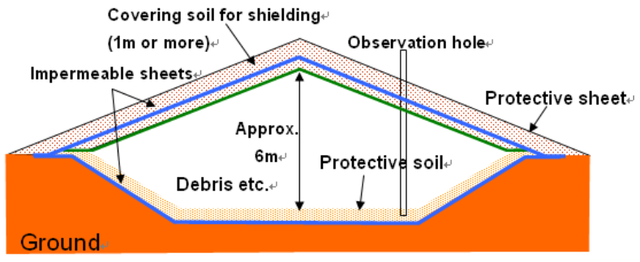
| Location | Temperature |
|---|---|
| Northeast corner | 32.4℃ |
| Northwest corner | 32.6℃ |

| Sample | | Unit 1 R/B accumulated water (Triangle corner) | | Reference (Past Unit 1 measurement results) |
|---|---|---|---|---|
| | | Northeast corner | Northwest corner | Northwest corner (Data obtained on November 25, 2011) |
| γ nuclides (Bq/cm³) | I-131 | ND | ND | ND |
| | Cs-134 | 4.1E+04 | 3.8E+04 | 1.4E+05 |
| | Cs-137 | 7.4E+04 | 6.8E+04 | 1.9E+05 |
| Chloride concentration (ppm) | | 200 | 100 | 170 |

6. Unit 1 triangle corner accumulated water investigation results

5) Reactor Facilities Dismantling and Radioactive Waste Processing/Disposal

- Processing/Disposal of Secondary Waste Produced by the Treatment of Contaminated Water
  - As a part of considering the long-term storage and solidification of the water treatment secondary waste, a variety of tests are ongoing (property investigation by heating test using mock sludge and solidification test, characteristic tests such as impact evaluation of desalting on the hydrogen reduction (Until the end of FY2013).
  - The radioactivity density analysis of the accumulated water and the samples obtained at the outlet of each water treatment facility (32 nuclides of those important in terms of processing and disposal for which analysis method is established) has been completed (August 31). As a result, Co-60, Cs-137, H-3, Ni-63, Se-79, Sr-90 and I-129 were detected. The radioactivity density of the water treatment secondary waste (waste zeolite, sludge, etc.) is being evaluated based on the analysis results of water samples obtained before and after the contaminated water treatment.
- Radioactive Waste Processing and Disposal
  - Measures such as temporary storage facility (soil covering type) installation, covering cut down trees with soil, and debris storage in the solid waste storage will be implemented in order to reduce radiation dose at site boundaries. Debris storage in the temporary storage facility (soil covering type) was started on September 5 (See 7)
  - Debris will be sampled for radioactivity density analysis of the nuclides that are important in terms of processing and disposal. The samples collected are being prepared to be shipped to JAEA. In parallel with the analysis, the future sampling plan will be developed by the end of October and sampling will be restarted based on the plan.




Cross section (Image)


7. Debris storage in the temporary waste storage facility (Soil covering type)

6) Organization and Staffing Plan

- Staff management
  - The manpower necessary for the work in October (about 3,500 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. 219 out of approx. 350 employees with dose exceeding 75mSv (as of the end of July 2012) have been relocated as of September 12.
  - The local employment rate of cooperative company workers was approx. 70% as of August.
- Work/living environment and actual working conditions
  - A survey on actual treatment and working environment of workers at Fukushima Daiichi Nuclear Power Station was done (Questionnaires were sent on September 20 and the results will be summarized by the end of October).
  - For the purpose of eliminating inappropriate subcontracts, an opinion exchange meeting was held between TEPCO and the subcontractors. We requested the subcontractors to submit countermeasures to inappropriate subcontracts in writing, and are currently reviewing them. Various measures are being implemented in response to the opinions and requests received through the consultation service.

7) Ensuring work safety

- 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. From September 26, a trial implementation of checking for APD usage at the main gate has started (full-scale implementation will be started on October 1). We will continue to enhance compliance with the current radiation control rules among workers and consider further recurrence prevention measures.
  - Consulting service for APD usage (handled by TEPCO employee) was started on August 27. Consulting service for Fukushima Daiichi Nuclear Power Station (handled by a lawyer) was also established on September 12 for the purpose of encouraging workers to use the service. Workers can consult a lawyer on not only APD usage but also other issues such as working conditions and business ethics issues.
- Radiation dose reduction

  Radiation dose reduction measures for the rest areas in the Administration Office Building and in front of the Main Anti-earthquake Building (which are deemed to have a great impact on workers' exposure dose) will be implemented with high priority (from late October).
- Heat stroke prevention measures

  Heat stroke prevention measures for FY 2012 are being implemented.
  - Number of heat strokes reported: 7 (As of September 18) (22 reported as of the end of September 2011, 23 reported in total)

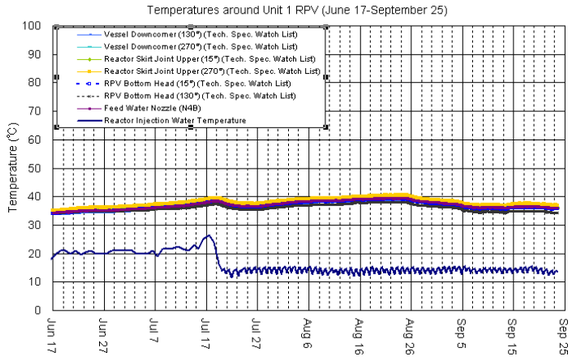
    * Though the number of emergency medical transports in July and August increased compared to 2011 throughout Japan (announced by the Fire and Disaster Management Agency), the number has decreased significantly at Fukushima Daiichi Nuclear Power Station as a result of thorough implementation of heat stroke prevention measures.
  - Work hours, frequency and length of breaks and work contents were changed according to WBGT.
  - The prohibition of work during the period from 2:00 PM to 5:00 PM under blazing sun continues to be effective due to the long lasting summer heat.
  - Health condition check using a check sheet must be done before work and during breaks.
  - Encourage workers to wear a cool vest.

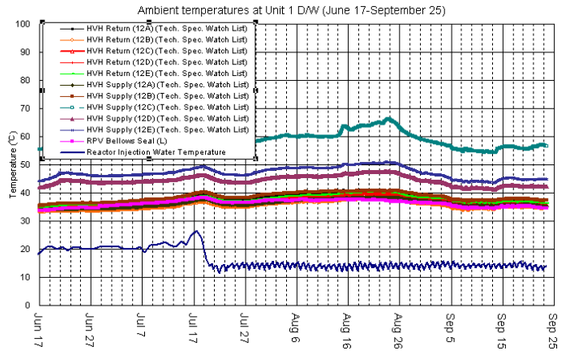
8) Miscellaneous

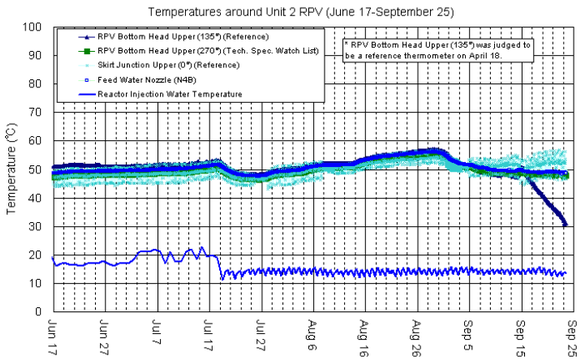
- "IAEA General Conference side event" (September 17)

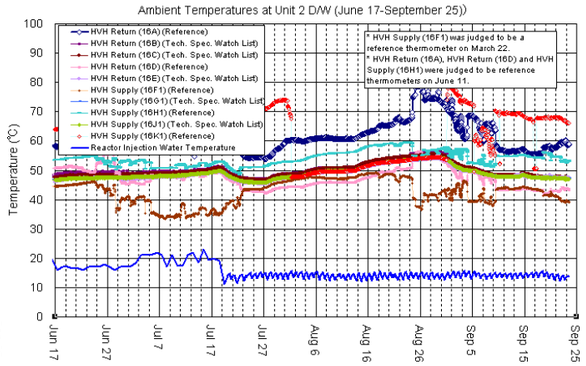
  At the side event of IAEA General Conference, we reported on future nuclear power regulations, the current condition of Fukushima Daiichi Nuclear Power Station and the progress and future plan of measure implementation towards reactor decommissioning. Approx. 300 people attended the event indicating high interest from the overseas.

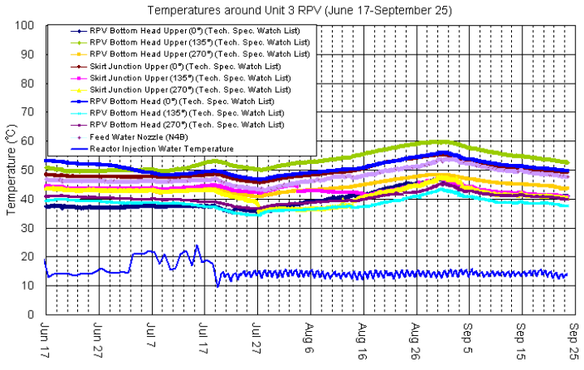
## 2. Parameters for Confirming Cold Shut Down Condition

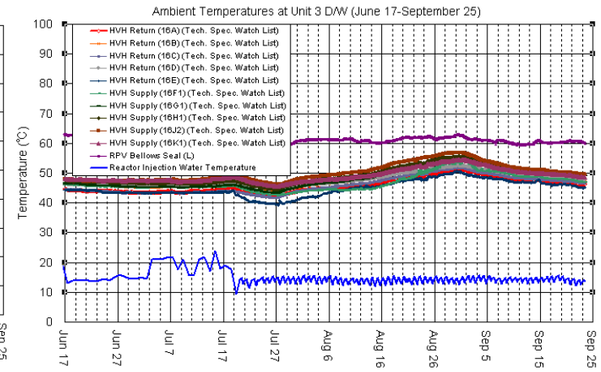


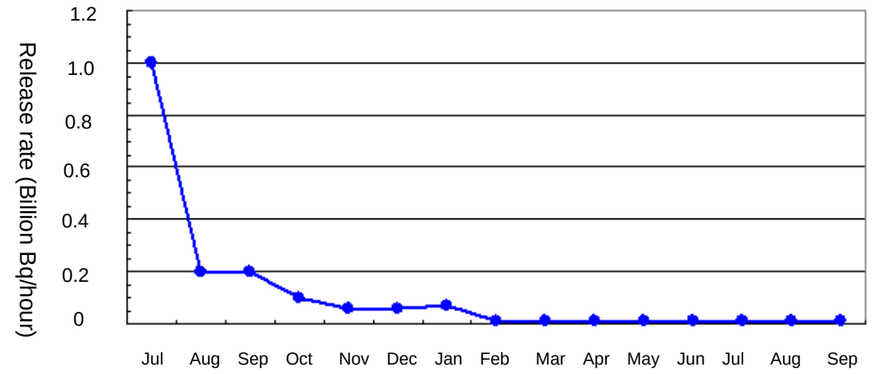




Release rate of radioactive material (cesium) at Unit 1-3 Reactor Building per hour




The current release rates of cesium at Unit 1-3 Reactor Buildings were evaluated to be approx. 0.0003 Billion Bq/h (Unit 1), 0.0005 Billion Bq/h (Unit 2) and 0.002 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 0.03mSv/year (excluding the effects of the radioactive materials so far released).

End

[Abbreviations]

- SLC differential pressure detection pipe: Standby liquid control system differential pressure detection pipe. Boric acid inhibits the nuclear fission in the fuel.
- Flushing: Washing away the radioactive materials accumulated inside the pipe with clean water.
- Mockup test: Training/testing in the environment simulating the actual condition.
- Penetration: Penetration area in the PCV, etc.
- S/C (Suppression Chamber): Pressure suppression pool. Used as water source, etc. for the emergency reactor core cooling system.
- Hydrogen purge: Replacing hydrogen with other gaseous body.
- Pilot pump well: Pump well where pumping test is performed ahead of other pump wells.
- Silt fence: Curtain-like underwater fence which is used to accumulate the contaminated water.
- Platform: Installed as the running roadbed for heavy machinery at debris removal from the upper part of the Reactor Building.
- Operation floor: Floor where the upper lid of PCV is opened for fuel replacement, inspection of structures inside the reactor at regular inspection, etc.
- Fuel debris: Fuel and fuel cladding tube, etc. melted and resolidified
- Triangle corner: Stair case to go through to get to the Torus Room.
- Torus Room: Room where S/C is stored in.
- Sludge: Secondary waste generated in water treatment.
- WBGT value: An index of humidity, radiant heat and air temperature which has a significant impact on the heat balance of a human body.
- IAEA: International Atomic Energy Agency