January 31, 2013
Agency for Natural Resources and Energy
Tokyo Electric Power Company

Progress Status and Future Challenges of Mid-to-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) Reactor Cooling

Cold shutdown condition will be maintained and measures to complement status monitoring will be continued to be implemented through reactor cooling by water injection.

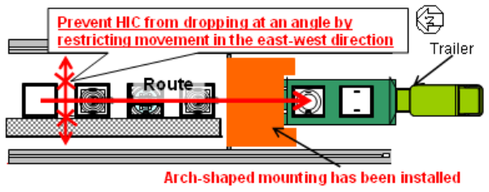
- Maintaining and monitoring stable reactor condition
  The reactor temperature has been stable between approx. 20-35℃. The release rate of radioactive materials has also been stable at low level (See 2. Parameters for Confirming Cold Shut Down Condition).
- Nitrogen injection into the suppression chamber (S/C) for the purpose of mitigating hydrogen-related risk
  Continuous nitrogen injection into Unit 1 S/C was started on October 23 in order to purge the residual air with high hydrogen concentration in the upper part of the S/C which was generated in the early stage of the accident. Though the estimated hydrogen concentration was reduced to below the flammability limit*[1] on November 26, nitrogen injection is continued to be performed for the purpose of further reducing the hydrogen concentration (December 7-26, January 8-24, late February-). As for Unit 2, the design and manufacture of nitrogen injection equipment are ongoing in order to perform nitrogen injection (December 25-February 28). After the manufacture is complete, the equipment will be installed at the site (March 1-mid March) and nitrogen injection will be started.

  *[1] The flammability limit represents the limit allowing for combustion (4% or more hydrogen and 5% or more oxygen need to be present). Combustion does not necessarily occur once the hydrogen concentration exceeds 4%.

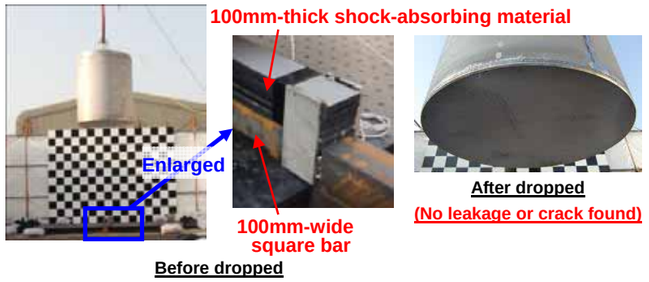
2) Accumulated Water Treatment

As a countermeasure for the increasing amount of accumulated water due to groundwater flowing in, a drastic measure to prevent groundwater from flowing into the Reactor Building will be implemented while improving the decontamination capability of the water treatment facilities and preparing facilities for contaminated water treatment.

- Preventing groundwater from flowing into the Reactor Building
  A system to prevent groundwater flowing into buildings by pumping the groundwater flowed from the mountain side in the upstream side of the buildings (groundwater bypass) is being planned. As a result of verification test (to confirm the amount and quality of pumped-up water) using the pilot pump well performed from December 14 to 25, the pumping capability of the pump well was confirmed. Water quality analysis is currently ongoing. The density of Cs-134+Cs-137 is approx. 0.02Bq/L, which is sufficiently lower than that of drinking water (10Bq/L). Pump well installation (Drilling for 6 out of 12 pump wells has been completed and the preparation for drilling for the remaining ones is ongoing) and discharge equipment installation are being carried out (planned to be completed at the end of March). The pump wells will be put in operation upon gaining understanding from the concerned parties.
- Installation of multi-nuclide removal equipment (ALPS)
  Multi-nuclide removal equipment is being installed for the purpose of further reducing the densities of the radioactive materials (except for tritium) included in the accumulated water in the power station site. Additional drop test of high integrity containers (HIC) to transport and store waste are being performed and the countermeasures to prevent HIC from dropping at an angle are being implemented while considering further measures (See 1 below). Once the approval among involved parties is gained, hot testing using radioactive water will be performed before putting the equipment in operation.
- Installation of additional treatment water receiving tanks
  The underground water storage tanks of the planned capacity of approx. 58,000m^3 have been installed (January 15). The treatment water receiving tanks of a capacity of approx. 320,000m^3 have been installed (the amount stored as of January 29: approx. 250,000m^3). Tanks of capacity of approx. 80,000m^3 are to be additionally installed by the end of the first half of FY 2013. Considering that a maximum of 700,000m^3 storage capacity may be necessary by mid 2015, additional tank installation of a maximum capacity of approx. 300,000m^3 in the south side of the power station site is being planned while confirming the necessary tank capacity.



Measure to prevent HIC from dropping at an angle



Before dropped

Additional drop test (Jan. 22: Falling onto the corner)

1. Safety measures for HIC

3) Radiation Dose Reduction and Contamination Mitigation

Effective dose reduction at site boundaries (aiming to achieve 1mSv/year by the end of FY 2012) and purification of the water in the port for the purpose of mitigating radiation impact on the outside environment

- Radioactivity density of the seawater in the port
  Back in September 2012, the radioactivity densities (Cs-134, 137) of the samples obtained in some locations (such as the inside of the silt fence installed near Units 2-4 water intake channel) exceeded the density limit stipulated by the Reactor Regulation. As a result of radioactivity density measurement of target nuclides (Cs-134, 137, Sr-89, 90) performed during the period from October to December, 2012, the densities measured at all measurement points except for those in the open ducts of Units 1-4 water intake channel were below the density limit stipulated by the Reactor Regulation. As for the inside of the open duct, measures to mitigate contamination will be implemented along with the following measures.
  - As for Cs, purification from the inside of the silt fence utilizing fiber adsorbent will be started at the end of March.
  - As for Sr which will require a substantial amount of time for analysis, the frequency of sampling will be increased to more than twice a month and the measurement data will be accumulated to understand the fluctuation tendency. With cooperation from external organizations such as the Central Research Institute of Electric Power Industry, a verification test utilizing sedimentation purification method (selected as a method other than adsorption purification) will be performed in order to consider a feasible purification implementation plan.
- Countermeasure for fish and shellfish with high cesium density

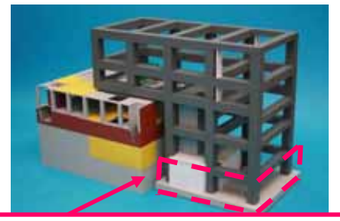
Last August, high densities of Cs-134 and 137 were detected in greenling sampled at the offshore of Ota River at the regular sampling. As a result of sampling performed in the port as part of cause investigation, common Japanese conger with high cesium density was found. In response to this, we are getting rid of the fish and shellfish living in the port (from last October) while discussing the issue with concerned parties and organizations. Measures to prevent fish and shellfish to move out of the port are also being prepared.

4) Fuel Removal from the Spent Fuel Pools

Work towards spent fuel removal is being steadily progressed while ensuring seismic capacity and safety. In particular, efforts are being made to achieve the early start and completion of Unit 4 spent fuel removal (Planned to be started in November 2013 and completed at around the end of 2014).

- Work towards spent fuel removal at Unit 4

  The cover installation for fuel removal is ongoing (to be completed at around mid FY 2013). In addition to the foundation work, the steel frame construction was started and the first layer (out of 5 layers) has been completed on January 14 (See 2 below).



Simulated image of cover installation completion

The first layer of the steel frame completed (Jan. 14)

2. Steel frame construction for the cover to be installed for fuel removal at Unit 4

- Work towards spent fuel removal at Unit 3

  Platform installation and debris removal from the upper part of the Reactor Building are ongoing (to be completed around March 2013).

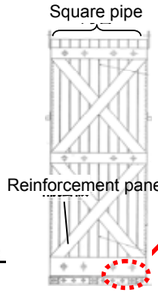
- Dry cask temporary storage facility installation

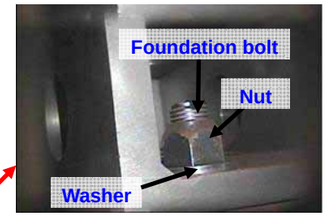
  Preparation was started on June 18. The foundation work and crane installation are currently ongoing. A concrete module is being manufactured and the assembly has been started at the site (From early February). Once the preparation is complete, dry casks will be carried into the facility.

- Inspection of the fuel and fuel racks in the common pool

  As a result of random inspection of the appearance of the spent fuel and fuel rack in the common pool and the seating condition of the foundation nuts/bolts performed during the period from December 21, 2012 to January 19, 2013, no major damage was found and the soundness of the spent fuel and fuel rack was confirmed (See 3 below).

Appearance inspection of the spent fuel pool (Example)





Fuel rack inspection (Example)

3. Inspection of the fuel, etc. in the common pool

5) Fuel Debris Removal

In addition to decontamination and shield installation being carried out for improved accessibility to the PCV, technology development and data acquisition necessary to prepare for fuel debris removal (such as investigating and repairing the leakage location of the PCV) are being advanced.

- Development of comprehensive radiation dose reduction plan

  Radiation dose reduction plan to improve the environment in the first floor of the Reactor Building is being developed in collaboration with ATOX Co., Ltd. (To be completed at the end of March). Radiation dose reduction plan for the second floor and up will be developed by the end of FY2013. We have started discussing environment improvement technologies to be applied under high radiation with overseas organizations (6 of them are planned) (until the end of February).

- Development of remote control decontamination technology

  The development of remote control decontamination equipment is being carried out by 3 plant manufacturers. The manufacturing of 3 types of remote control decontamination equipment (high-pressure water decontamination, dry ice blast and blast) has been completed (by February), and demonstration test is currently being performed at Fukushima Daini Nuclear Power Station (From January 15 to the end of February). Remote control running test and decontamination procedure confirmation test are performed to confirm the equipment capability. The equipment will be put in operation at Fukushima Daiichi Nuclear Power Station after improvements are made for the issues found at the demonstration test and the preparation for decontamination (removal of obstacles such as debris, etc.) is completed (planned at the end of July). The investigation of dose rates, radiation source, surface conditions and contamination conditions in the aisles of Units 1-3 Reactor Buildings performed for the purpose of understanding the contamination condition inside the Reactor Buildings has been completed at the end of January.

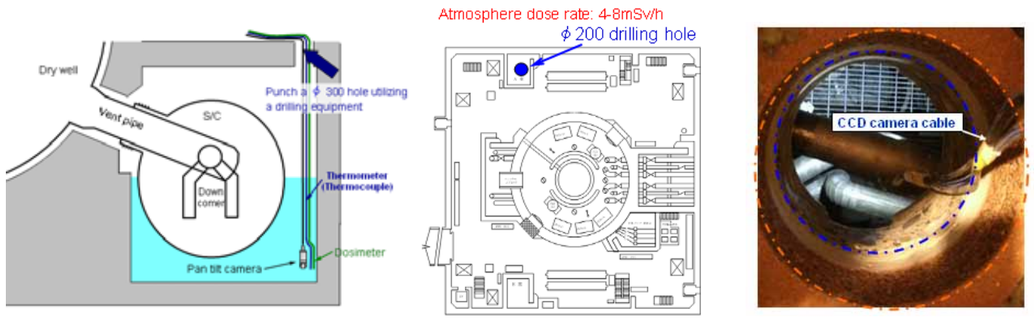
- Investigation and Repair of the PCV Leakage Location

  The development of equipment to investigate the leakage location and repairing (water stop) equipment is being carried out by 3 plant manufacturers. For the purpose of early understanding of the conditions of the area of concern and gaining information useful for the equipment development, the lower part of Unit 2 vent pipe was conducted utilizing existing technologies. The investigation has been completed in one out of 8 target locations. Though the investigation is currently suspended due to issues found with the robot, it will be restarted once the issues are resolved. In response to the robot issues, a quadrupedal walking robot technology WG was established under the Task Force for Remote Control Technology in the Headquarter of Research and Development Promotion in order to gain opinions on countermeasures for the robot issues. Furthermore, the Agency for Natural Resources and Energy has started accepting candidates of remote control technology development project aiming for underwater investigation and S/C

water level measurement discussed in the WG of the Remote Control Technology Task Force.

- Investigation of Units 1-2 Torus Room

Preparation for the investigation of the Torus Room in the Reactor Building basement and the conditions of the accumulated water there (for the purpose of providing inputs for the development of equipment to investigate the leakage location, etc.) is ongoing. Thermometer, dosimeter, etc. will be inserted through the holes drilled on the floor of the first floor of the Units 1-2 Reactor Buildings to conduct measurements and sampling of accumulated water and sediments (as much as possible) (the investigation is planned in February and later). Though we attempted to drill holes at Unit 2 (January 27, 28), the work was terminated due to obstacles (such as pipe and grating) found underneath the drilling locations. The future plan is currently being considered (See 4 below).



Investigation **Hole drilling at Unit 2**

4. Investigation of Units 1-2 Torus Room

6) Reactor Facilities Dismantling and Radioactive Waste Processing/Disposal

Installation of radioactive waste storage facility with high shielding capability and adequate and safe storage of radioactive waste

- Installation of soil covering type temporary waste storage facilities

Soil covering type temporary waste storage facilities are being installed in order to achieve the target effective radiation dose of less than 1mSv/year (radiation attributable to the radioactive materials released from the radioactive waste generated after the accident as well as those to be released). At the first facility, debris transportation and installation of shock-absorbing material/impermeable liner have been completed (December 19). Soil cover for shielding is currently being installed (to be completed at the end of March). As for the second one, debris transportation was started on December 17 and soil covering is planned to be completed at the end of March (See 5 below).

5. Statuses of the soil covering type temporary waste storage facilities

7) Staffing Plan and Work Safety Securement Plan

Secure long-term staffing while thoroughly implementing workers' exposure radiation control. Continuously improve working environment and work conditions based on understanding of needs among workers at site.

- Staff management
  - The number of people who were registered (for one day or more in a month) to work at the power station in the past 3 months (September-November) was approx. 8,000 (TEPCO and cooperative company workers), which is more than the number of people who actually worked (approx. 6,000: TEPCO and cooperative company workers). Thus, there are a sufficient number of people registered to work at the power station.
  - As a result of interview with main contractors about the number of available workers, it was confirmed that the manpower necessary for the work in February (about 4,200 cooperative company workers) will be secured.
  - The local employment rate of cooperative company workers was approx. 65% as of December.
- Securing fair working conditions for workers

Based on the results of a survey on actual working environment, working conditions and employment situation among the workers at Fukushima Daiichi Nuclear Power Station, the following measures are being implemented.

  - Educational activities

Seminar on working conditions will be held by the Ministry of Health, Labour and Welfare in February and March (twice for each month).

  - Investigation of main contractors regarding the measure implementation to prevent inappropriate working conditions

Investigation of the main contractors' employment relationships with subcontractors including the lowest tier subcontractors (by directly visiting main contractors) was started on December 13 to examine if the relationships are functioning properly. As of the end of January, the investigation was done for 9 companies and no problem was found as a result. The investigation of the remaining 17 companies will be performed by the end of March.

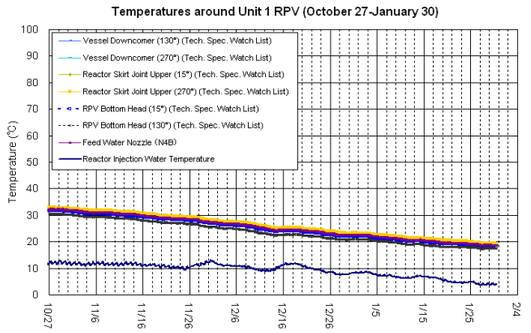
- Restoration of the Cooperative Company Building

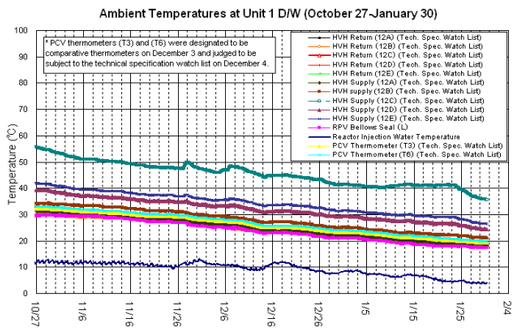
The restoration of the Cooperative Company Building in Fukushima Daiichi Nuclear Power Station has been progressing steadily in response to the needs of cooperative companies. The building is currently being used as a rest area by one cooperative company. For the purpose of reducing burden on workers, the restored part of the area surrounding the Cooperative Company Building has been designated as area requiring no mask after confirming a sufficient decrease of dust density.

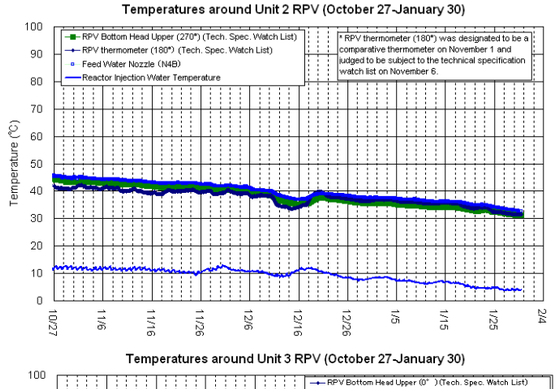
- Environment improvement of the new Hirono single-person dormitory

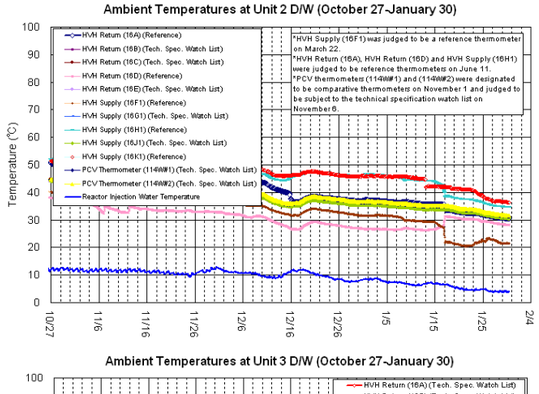
Currently about 1,000 employees live in the new Hirono single-person dormitory built in J-Village. In order to improve the living environment for these employees, concrete measures such as building bathrooms, shower rooms and washrooms in each building are under consideration.

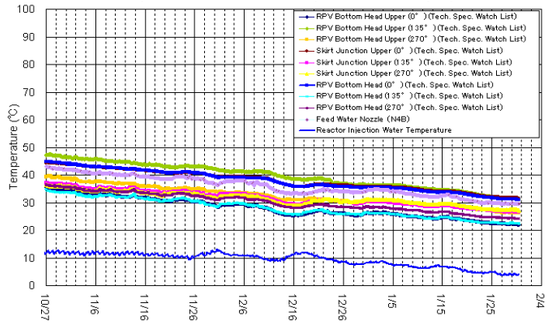
2. Parameters for Confirming Cold Shut Down Condition

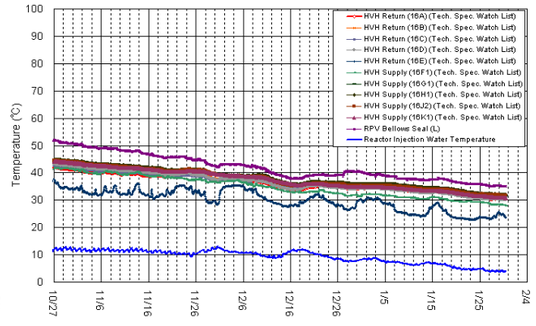




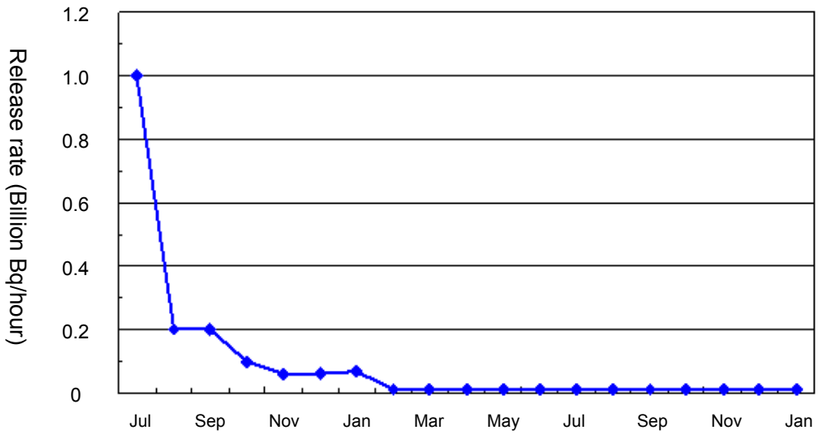








Release rate of radioactive material (cesium) per hour at Unit 1-3 Reactor



The current release rates of cesium (total of Cs-134 and 137) at Units 1-3 Reactor Buildings were evaluated to be approx. 0.0002 Billion Bq/h (Unit 1), 0.002 Billion Bq/h (Unit 2) and 0.003 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. The radioactivity density (both Cs-134 and 137) of the air at site boundaries was approx. 1.4×10^{-9}Bq/cm^3. The radiation exposure dose at site boundaries is evaluated to be 0.03mSv/year (excluding the effects of the radioactive materials so far released).

(Reference)
*The maximum limit of radioactivity density of the air outside the surrounding monitoring area
[Cs-134] 2×10^{-5}Bq/cm^3, [Cs-137] 3×10^{-5}Bq/cm^3
*Dust density around the site boundaries of Fukushima Daiichi Nuclear Power Station (actual measurement value)
[Cs-134] ND (Detection limit: approx. 1×10^{-7}Bq/cm^3)
[Cs-137] ND (Detection limit: approx. 2×10^{-7}Bq/cm^3)

End

[Abbreviations]
- S/C (Suppression Chamber): Pressure suppression pool. Used as water source, etc. for the emergency reactor core cooling system.
- Tritium: Tritiated hydrogen. Radioactive material which emits β ray. Natural tritium is generated by nuclear reaction with cosmic ray in the upper layer of the atmosphere. It is contained in the moisture in the air and falls down due to its property similar to hydrogen. In nuclear power stations, tritium is generated by nuclear reaction with neutron and nuclear fuel fission.
- Platform: Installed as the running roadbed for heavy machinery at debris removal from the upper part of the Reactor Building.
- Operation floor: The highest floor of the Reactor Building where the upper lid of the PCV is opened for fuel replacement, inspection of structures inside the reactor at regular inspection, etc.
- Fuel rack: Dedicated rack for safe fuel storage.
- Vent pipe: Pipe that guides the mixture of water and steam released into the dry well to the suppression pool and have it condensed in the case of loss-of-coolant accident.
- PCV: Primary Containment Vessel. Steel vessel with a thickness of about 3cm. The PCV stores primary nuclear facilities including the Reactor Pressure Vessel (RPV).
- RPV: Reactor Pressure Vessel. Stores fuel assemblies, control rods and other structures inside the reactor and generates steam through nuclear reaction of the fuel.