December 25, 2012
Nuclear Emergency Response Headquarters
Government-TEPCO Mid-and-long Term Response Council
Working Council

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. 25-45℃. The release rate of radioactive materials has also been stable at low level (See 2. Parameters for Confirming Cold Shut Down Condition).
- Thermometer installation in Unit 2 TIP guide pipe
  On October 3, an alternative thermometer to replace the existing broken thermometer was installed from the SLC differential pressure detection pipe. Another thermometer is planned to be installed from the TIP guide pipe. A new isolation valve unit has been installed (December 17-20) and the thermometer insertion device, etc. are currently being designed and manufactured (since December 1). After mockup testing, etc. are performed, the thermometer is planned to be installed at the end of February 2013. As the TIP guide pipe is comprised of 4 systems and allows for a variety of usage (such as inserting a camera to check the condition inside the reactor), ways to maximize its usage will be considered as well.
- 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. Since the estimated hydrogen concentration had been reduced to below the flammability limit*[1] on November 26, nitrogen injection was temporarily suspended. For the purpose of further reducing the residual hydrogen, purging with an increased nitrogen injection amount is being performed (From December 7 to the end of December). While continuing to monitor the hydrogen concentration, nitrogen injection will be continued until the hydrogen concentration becomes sufficiently low (Nitrogen injection is planned to be restarted in early January). As for Unit 2, the nitrogen injection line will be installed by the end of March 2013 before starting nitrogen injection.
  *[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. Drilling for the pilot pump well has been completed (November 22 - December 3). Verification testing (to examine the pumped water amount and water quality) is currently being performed (Started on December 14 and planned to be completed in about 3 weeks). According to the verification test results, the system is planned to be put in operation at the end of March 2013 after installing the discharge equipment.
- Installation of multi-nuclide removal equipment (ALPS)
  A 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. As a result of drop test performed on the high integrity container (HIC) to store and transport the waste generated, the HIC was found to be damaged under harsh conditions (when dropped at an angle or onto the corner) though its soundness was secured in a vertical fall. The reinforcement will be adequately modified and the soundness of the HIC will be reevaluated for enhanced container reliability. Once a sufficient level of safety and reliability is secured and 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
  Treatment water receiving tanks of a total capacity of approx. 45,000m^3 have been secured as scheduled as a result of replacing the old tanks (December 21). Additional capacity of approx. 10,000m^3 is planned to be secured by adjusting tank locations. Underground water tanks are currently being installed, and a capacity of approx. 42,000m^3 out of the planned total capacity of 58,000m^3 has been secured as of December 25. The remaining capacity of approx. 16,000m^3 will be secured by the end of January 2013.
- Facility reliability improvement
  The reactor injection pipeline and the main line of the accumulated water transfer pipeline have been replaced with polyethylene (PE) pipe. The areas where pressure hose was previously being used (except for part of the pressure hose used for the water treatment facility) have also been replaced with polyethylene pipe (December 17).

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

- Effective dose reduction at site boundaries
  The annual total radiation dose at site boundaries as of December due to gaseous waste and temporarily stored solid waste was estimated to be approx. 9.86mSv/year (max.). We aim to achieve the annual total radiation dose of less than 1mSv/year in March 2013 by implementing radiation dose reduction measures.
- Closure of Unit 2 Reactor Building blow-out panel (BOP) opening
  For the purpose of reducing the amount of radioactive materials released from Unit 2 Reactor Building, the BOP opening will be closed (planned to be completed at the end of March 2013). The framing of the panels used to close the BOP opening has been built (December 13, 18).
- Radioactivity density of the seawater in the port
  Back in September, the radioactivity densities of 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 (Cs-137) stipulated by the Reactor Regulation. As a result of additional sampling performed in Units 1-4 screen pump rooms (November 30, December 6 and 11) and the water intake channel open duct (December 6), the results were within the range of fluctuation and there was no sampling point with particularly high radioactivity density. The radioactivity density of groundwater was below the detection limit (December 8). In order to further reduce the radioactivity density of the seawater in the port, purification will be continued with a

more efficient radioactive material removal method utilizing zeolite and other types of adsorbent. The radioactivity densities of the target nuclides will be measured again by the end of January to confirm that they are below the limit stipulated by the reactor Regulation.

- Decontamination within the power station site (The area near the main gate where security officers stay in)
  Radiation dose reduction measures are being implemented in the area near the main gate where security officers stay at in (Started on December 10, planned to be completed in February 2013). The grass will be flipped over and the asphalt will be shaved utilizing ultra-high pressure water to reduce the radiation dose.

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).

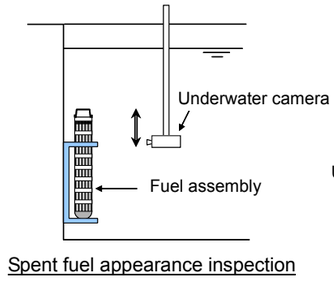
- Work towards spent fuel removal at Unit 4
  - Debris removal from the operation floor has been completed (October 3 - December 19). The cover installation for fuel removal is ongoing (to be completed at around mid FY 2013).
  - In order to recover the shallow draft quay to prepare for the delivery of equipment/materials necessary for the cover installation, the mega float which interferes with the recovery work has been relocated (December 24-25).
- 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).
  - In prior to removing the steel beam which fell into the spent fuel pool on September 22, the pool water purification system was put in operation (since December 10) to improve the visibility inside the pool. After a mockup test was performed to confirm the holding position of the fixture, etc. (started on November 19), the steel beam has been removed on December 20 (See 1 below).

Steel beam being lifted up

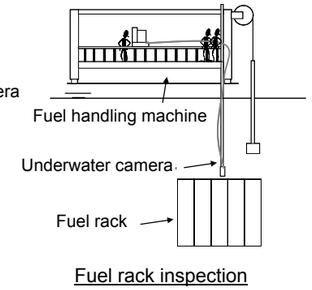
Steel beam after being removed

1. Removal of the steel beam which fell into the spent fuel pool

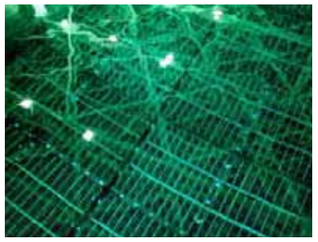
- Investigation of Unit 2 operation floor
  For the purpose of providing inputs on the operation floor decontamination and shield installation plan, the radiation released from the target surfaces will be measured utilizing a γ camera inserted from the BOP opening (early January 2013). The measurement results will be analyzed and the radiation distribution on the target surfaces will be confirmed.
- Inspection of the fuel and fuel racks in the common pool
  In prior to filling the spent fuel currently stored in the common pool in dry casks, the spent fuel soundness is being inspected utilizing an underwater camera by random sampling (from December 21). The appearance of the fuel rack and the seating condition of the foundation nuts/bolts are inspected by an underwater camera to evaluate its capability of long-term storage of spent fuel in the common pool (See 2 below).



Spent fuel appearance inspection



Fuel rack inspection



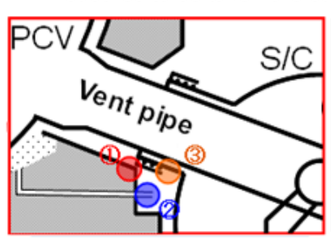
Example of the common pool at Fukushima Daiichi Nuclear Power Station (Before the earthquake)

2. Inspection of 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 remote control decontamination technology
  Remote control decontamination equipment is being developed in consideration of the contamination condition inside the buildings. Three types of remote control decontamination equipment will be developed by February 2013. After mockup testing is done at the factory, demonstration test (remote control running test, decontamination procedure confirmation test) will be performed at Fukushima Daini Nuclear Power Station in prior to putting the equipment in operation at Fukushima Daiichi Nuclear Power Station.
- Acquisition of data on facilities inside Unit 2 Reactor Building
  Data on facilities in Unit 2 Reactor Building (west side area) was acquired utilizing a laser scanner (December 26). The acquired data will be converted into image data to verify if it can be transformed into 3D CAD data (December 2012 - March 2013).
- Investigation and Repair of the PCV Leakage Location
  Precedent investigation is being carried out for the purpose of early understanding of plant condition and incorporating the investigation results into the research and development project. The lower part of Unit 2 vent pipe (all 8 vent pipes) is being investigated by utilizing a a quadrupedal walking robot. As a result of investigating the first vent pipe on December 11, no water leakage was found (See 3 below). The investigation on the second vent pipe started on December 12 was terminated due to robot failure. Measures to be taken are currently being discussed.



Enlarged image of the lower part of vent pipe

Edge of the vent pipe sleeve

Edge of the sand cushion drain pipe

Lower part of the vent pipe bellows cover

3. Investigation results of the lower part of Unit 2 vent pipe (December 11)

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). Debris transportation to the first one has been completed on November 17 and an impermeable liner and soil cover for shielding are currently being installed (See 4 below). Debris transportation to the second one is to be started on December 17.

- Removal of drums from the solid waste storage

  The drums previously stored in the solid waste storage are being transported to the temporary storage facility (starting from December 21) in order to secure space for highly radioactive debris to be stored in the storage. With its high shielding capability, the radiation dose inside and outside of the power station site will be reduced.

Debris transportation completed (in the first storage facility) (November 19)

Impermeable liner installation in progress (in the first storage facility) (December 13)

4. Current condition of the soil covering type temporary storage facility

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 (August-October) 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 January (about 3,900 cooperative company workers) will be secured.
  - The local employment rate of cooperative company workers was approx. 65% as of November.
- Securing fair working conditions for workers

  A survey on actual working environment, working conditions and employment situation among the workers at Fukushima Daiichi Nuclear Power Station was done (summarized on December 3). Though it is difficult to judge if there is law violation by just looking at the survey results, the following measures to improve working environment are being implemented assuming the possibility of inappropriate form of employment.

  1. Investigation of the progress status and the effectiveness of measures to prevent inappropriate form of employment taken by the main contractors (from the end of December)
  2. Feedback on survey results
  - Provide feedback on survey results and explanation on work contract fraud and securement of fair work conditions to J-Village, etc. (From December 3)
  - The president of TEPCO and the station chief of Fukushima Daiichi Nuclear Power Station gave an explanation on the survey results to main contractors and requested for cooperation in labour law compliance, etc. (December 3)

  3. Educational activities

  A seminar on work conditions will be held by the Ministry of Health, Labour and Welfare (date and contents in detail are to be determined). The contents of the seminar will be incorporated into the orientation for new workers at Fukushima Daiichi Nuclear Power Station.

  4. Enhanced PR for the consultation service
  - Renew the posters and put them on more visible locations, prepare small flyers for workers to take home with (From November 21).
  - Distribute the posters to main contractors at the safety promotion meeting (December 22).
- Expansion of area allowing full-face mask with a dust filter attached for the purpose of ensuring work safety

  As iodine 131 density in the air surrounding Units 1-4 and in the buildings nearby is sufficiently below the level requiring full-face mask, workers are now allowed to wear full-face mask with a dust filter attached which is lighter and has smaller inhalation resistance compared to that with charcoal filter attached in Units 1-4 (except for some areas in Units 1-3) starting from December 19, while continuing thorough radiation exposure control.

8) Others

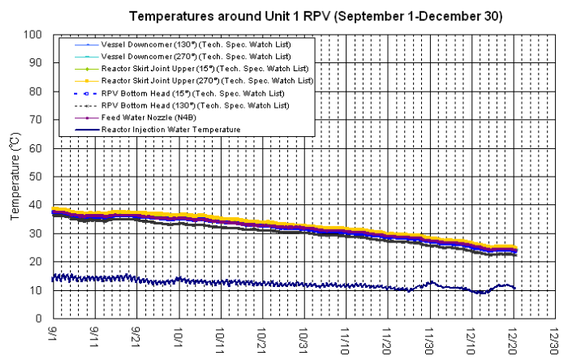
- Long-to-mid term roadmap seminar (December 19)

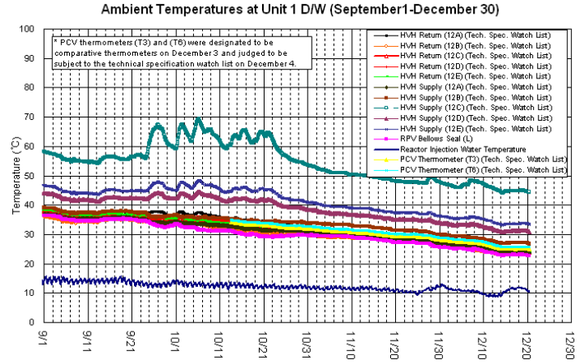
  After a year has past since the long-to-mid term roadmap was developed, a long-to-mid term roadmap seminar was held to report on the current plant conditions and the progress status of measure implementation towards future challenges to the people in the surrounding area of the power station. Opinions about future measure implementation were gathered from the people in the surrounding area.
- The second Fukushima workshop on equipment/device development (December 19)

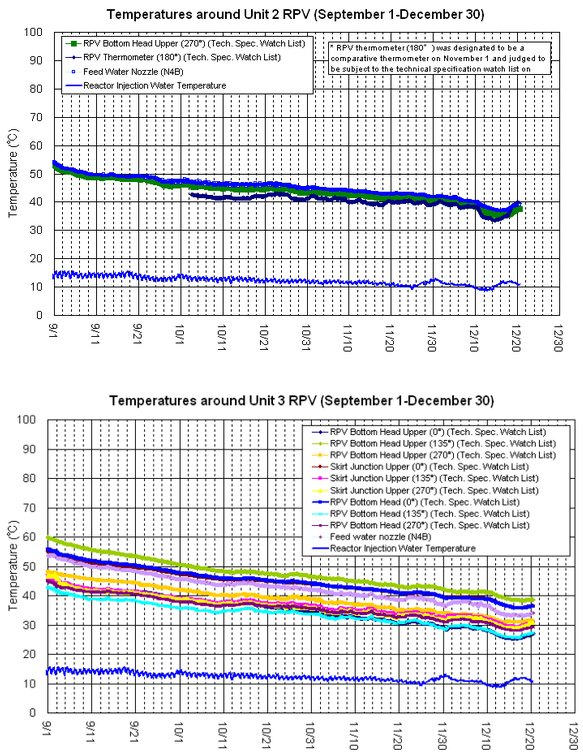
  As part of introducing superior local technologies, business enterprises, research institutes and academic experts in Fukushima Prefecture were gathered to introduce the latest equipment developed for decommissioning and exchange opinions.
- Fukushima ministerial meeting held by the IAEA and the Japanese government (December 15-17)

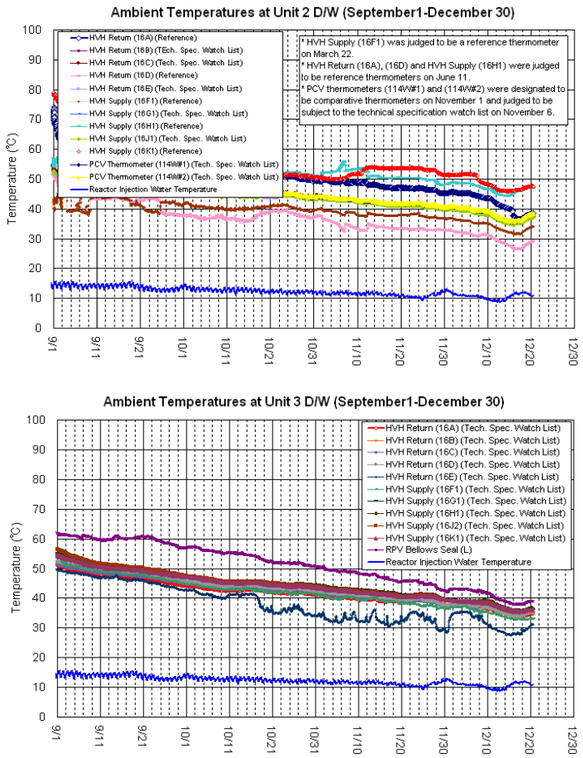
  Side events were held to provide detailed explanation on the progress status of decommissioning at Fukushima Daiichi Nuclear Power Station. The Japanese government requested the IAEA for accepting an international peer review mission. The details including the date are to be discussed.

2. Parameters for Confirming Cold Shut Down Condition

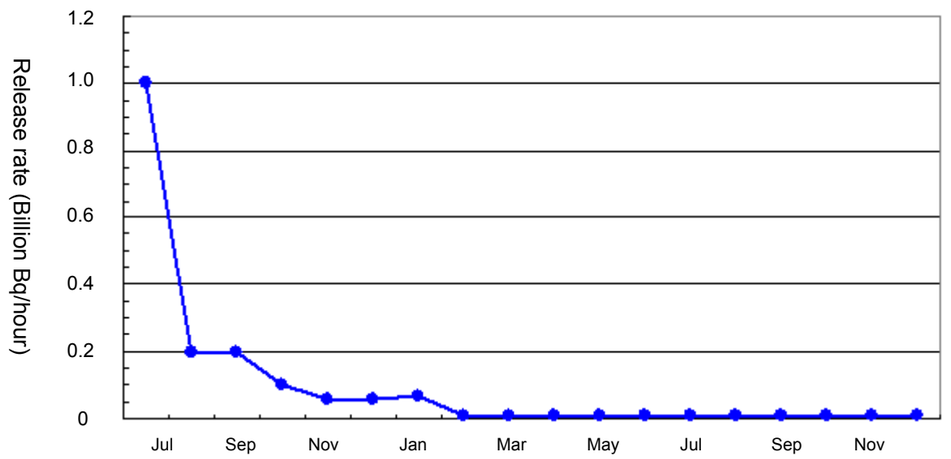








Release rate of radioactive material (cesium) per hour at Unit 1-3 Reactor Building



The current release rates of cesium at Units 1-3 Reactor Buildings were evaluated to be approx. 0.0002 Billion Bq/h (Unit 1), 0.0007 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]

- TIP: Portable in-core instrumentation system which measures the neutron flux distribution in the reactor.
- SLC differential pressure detection pipe: Standby liquid control system differential pressure detection pipe. Boric acid inhibits the nuclear fission in the fuel.
- Mockup test: Training/testing in the environment simulating the actual condition.
- 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.
- BOP (Blow-out Panel): Panel that opens to release pressure in the case of an excessive pressure increase in the building.
- Silt fence: Curtain-like underwater fence which is used to accumulate contaminated water.
- 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.
- Vent pipe sleeve: Hole that penetrates through the concrete frame supporting the dry well.
- Sand cushion: Sand installed on the border between the dry well and the concrete frame of the foundation as a stress buffer.
- Sand cushion drain line: Pipe that detects water immersion of the sand cushions.
- Vent pipe bellows: Extendable pipe used as a stress buffer for the vent pipe.
- 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.