March 7, 2013

Secretariat of The Council for the Decommissioning of TEPCO's Fukushima Daiichi Nuclear Power Plant

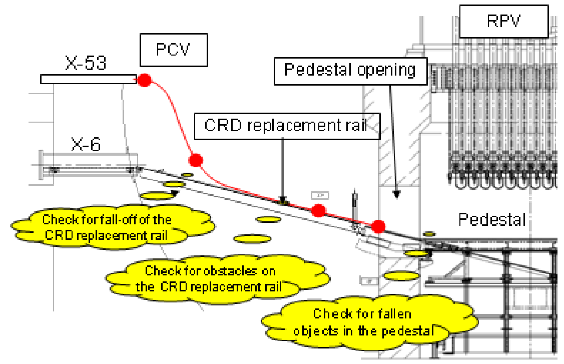
Progress Status and Future Challenges of Mid-to-long Term Roadmap towards the Decommissioning of Units 1-4 of TEPCO Fukushima Daiichi Nuclear Power Station (Outline)

1. Past One Month Summary and Future Plans

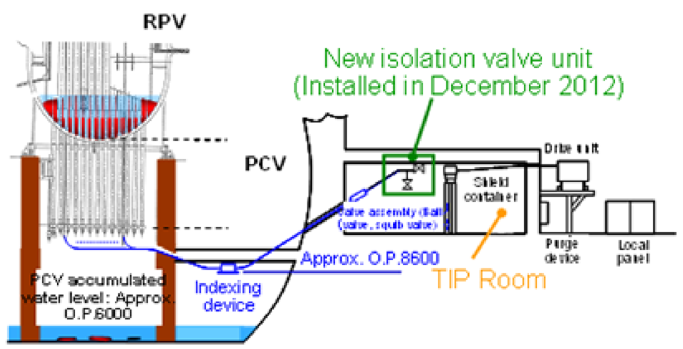
1) Reactor Cooling

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 RPV bottom temperatures and the PCV gaseous phase temperatures have been stable within the range of approx. 15 to 35℃ though the temperatures vary depending on the unit and thermometer locations. The release rate of radioactive materials has also been stable at low level (See 2. Parameters for Confirming Cold Shut Down Condition).
- Investigation of the inside of Unit 2 PCV and installation of permanent monitoring instruments
  For the purpose of complementing status monitoring and providing inputs for the future technical development, the investigation of the inside of the PCV and the measurement of PCV temperature and water level will be performed. Currently, investigation equipment, etc. are being designed and manufactured (to be completed in early March). As soon as the preparation is complete, the investigation of the inside of the PCV will be performed and the permanent monitoring instruments will be installed (planned in mid to late March). (See 1 below)
- Investigation of the inside of the reactor and thermometer installation utilizing Unit 2 TIP guide pipes
  The investigation of the inside of the reactor and installation of permanent thermometers will be performed by utilizing the TIP guide pipes. In addition to the alternative thermometer installation through the SLC differential pressure detection pipe on October 3, new thermometers are to be installed. After preparation such as decontaminating the TIP Room and removing obstacles was completed (February 11-24), the soundness investigation of the inside of the TIP guide pipes (4 lines) was done by inserting a fiberscope (February 25-28). As a result, we were unable to insert the fiberscope all the way through the guide pipes of all 4 lines due to substances attached inside and the limit switch roller of the indexing device not being pressed up. Thus, it has been judged that endoscope and thermocouple cannot be inserted into the TIP guide pipes under the current circumstances. We will consider ways to remove the substances attached inside of the guide pipes and to press up the limit switch roller. (See 2 below)
- Nitrogen injection into the suppression chamber (S/C) for the purpose of mitigating hydrogen-related risk
  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 will be purged. Though the estimated hydrogen concentration was reduced to below the flammability limit*[1] at Unit 1, nitrogen injection is continued for the purpose of further reducing the hydrogen concentration (December 7-26, January 8-24 and from February 26). As for Unit 2, the design and production of nitrogen injection equipment are ongoing (December 25-mid March). After the equipment is installed at the site (planned in mid March), 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%.



1. Overview of investigation of the inside of the PCV



2. Overview of the TIP guide pipes

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 water quality test of the groundwater sampled from the pilot pump well, the radioactivity densities of Cs-134, 137, Sr-89, 90, ^{3}H, all α and all β were confirmed to be sufficiently low being equivalent to those of the water sampled from the deep well located within the power station site. The construction of 12 pump wells has been completed (as of February 28) and the water pumping/transfer facilities are currently being installed (System A: to be completed by the end of March, systems B and C: the planned timing of completion has been changed to late April due to work termination because of weather conditions (snow, strong wind, etc.) and human disasters). Based on the water quality test results, the facilities will be put in operation once agreement is gained from the parties concerned.
- 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. As a result of implementing safety measures for the high integrity containers (HIC) to transport and store waste, no problem was found with the soundness. The preconditions of starting the hot testing using radioactive water are currently being discussed with the involved parties. Once the approval is gained from the involved parties, hot testing will be performed and the equipment will be put in operation.

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 radiation exposure dose at site boundaries due to the radioactive materials to be released and the temporarily stored solid waste, etc. as of the end of March is estimated to achieve the goal of 1mSv/year as a result of implementing dose reduction measures such as transporting debris to the soil-covered-type temporary storage facilities and additional shielding for the temporary storage facility for

absorption towers. The breakdown of radiation exposure amount is as follows. Gaseous waste: 0.03mSv/year, solid waste: 0.69mSv/year, Total: 0.72mSv/year.

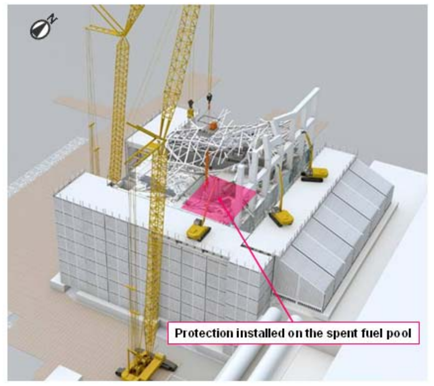
- Radioactivity density of the seawater in the port
  Back in September 2012, the radioactivity densities (Cs-134, 137) of the samples obtained in some locations (such as the inside of the silt fence installed near Units 2-4 water intake channel) exceeded the density limit stipulated by the Reactor Regulation. Measures to prevent further contamination of the seawater in the open duct and to purify Cs and Sr are currently being considered. As for Cs, the purification equipment is being designed in prior to starting the purification from the inside of the silt fence utilizing fiber adsorbent at the end of March. As for Sr, enhanced monitoring is performed. For efficient Sr purification, purification techniques such as adsorption and sedimentation are being studied and verified in collaboration with the Central Research Institute of Electric Power Industry. Purification implementation plan based on feasible purification techniques is to be considered.
- Decontamination performed within the power station site
  Radiation dose reduction through decontamination has been ongoing for the purpose of reducing radiation exposure doses among workers. The paved ground at the main gate where security officers stay in was cleaned by ultrahigh pressure water (December 10-February 4). After dose reduction measures are implemented in the parking lot located adjacent to the area mentioned above, the effectiveness of implemented measures will be confirmed (Planned in May). For the parking lots inside and outside of the power station site, measures such as removing the surface soil are ongoing (From January to May).
- Countermeasures for fish and shellfish with high cesium density
  We are getting rid of the fish and shellfish living in the port and have installed a bottom gill net at the entrance of the port (on February 8) in order to prevent the fish and shellfish from moving out of the port.

4) Fuel Removal from the Spent Fuel Pools

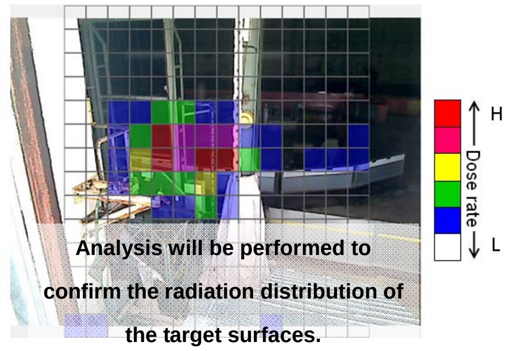
Work towards spent fuel removal is being steadily progressed while ensuring seismic capacity and safety. In particular, efforts are being made to achieve the early start and completion of Unit 4 spent fuel removal (Planned to be started in November 2013 and completed at around the end of 2014).

- 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 on January 8 and the second layer (out of 5 layers) has been completed on February 28 (See 3 below).
- Work towards spent fuel removal at Unit 3
  Platform installation and debris removal from the upper part of the Reactor Building are ongoing. The steel truss debris which had remained in the upper part of the spent fuel pool has been removed (February 6). After the area surrounding the pool is cleaned up, protection will be installed on the spent fuel pool and debris removal from the upper part of the operation floor will be started (See 4 below). Though the fuel handling machine mast fell into the pool during the steel truss debris removal, it was confirmed upon investigation that the mast did not directly contact the spent fuel storage rack and the liner (February 13).
- Soundness inspection of Unit 4 Reactor Building
  The fourth regular inspection was performed in order to confirm the soundness of the Reactor Building and the spent fuel pool (February 4-12). As a result, it was confirmed that the soundness of the building is secured and the building is capable of safely storing spent fuels. An outside expert participated in the inspection to confirm the results of evaluation performed so far including seismic analysis results.
- Investigation of Unit 2 Reactor Building operation floor
  The radiation released from the target surfaces has been measured utilizing a γ camera inserted from the blow-out panel opening (February 21). The results obtained will be provided as inputs for developing an effective and efficient plan for decontamination and shielding which will be essential for the preparation for fuel removal in the future. (See 5 below)

3. The second layer of the steel frame completed (Photo taken on February 28)



4. Simulated image of Unit 3 debris removal



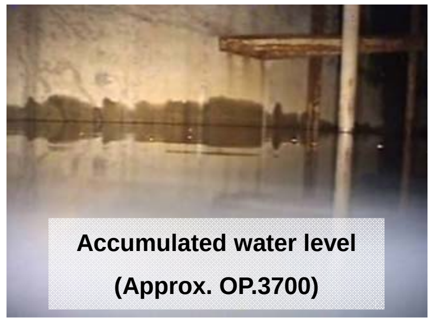
5. γ camera measurement results

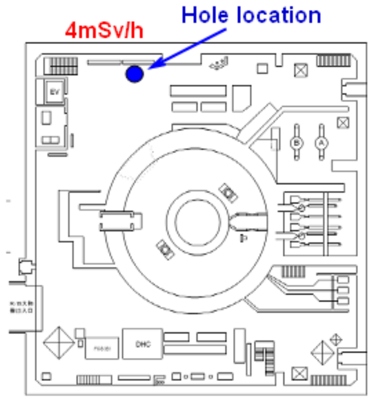
5) Fuel Debris Removal

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
  Comprehensive radiation dose reduction plan is being developed for the purpose of improving the environment of the Reactor Building. Environment improvement technologies to be applied under high radiation were discussed with 6 overseas organizations (completed on February 28). A report on concrete dose reduction measures to be implemented on the first floor of Units 1-3 Reactor Building has been developed.
- Development of remote control decontamination technology
  The production of 3 types of remote control decontamination equipment (high-pressure water decontamination, dry ice blast and blast/suction) has been completed (January 31). Demonstration test of the equipment was performed at Fukushima Daini Nuclear Power Station for the purpose of identifying issues to be resolved before putting them in operation at Fukushima Daiichi Nuclear Power Station (From January 15 to February 28). Demonstration observation of dry blast was held on February 15. The results of evaluation (on-site simplified analysis done by the plant manufacturers and detailed analysis performed by the JAEA) of the contaminated samples collected in Units 1-3 Reactor Buildings during site investigation in FY2012 have been summarized.
- Removal of obstacles (such as debris) from the first floor of Units 1 and 3
  Before performing decontamination in the Reactor Buildings, obstacles, etc. will be removed by unmanned machinery to secure the access route for decontamination equipment and investigation of the inside of the PCV. Obstacle removal will be done by September for Unit 1 and by June for Unit 3.
- Investigation of Units 1-2 Torus Room
  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. At Unit 1, the Torus Room was investigated by drilling a

hole on the first floor of the Reactor Building (Hole drilling: February 13-14, investigation: February 20, 22). As a result, the accumulated water level was approx. OP. 3,700 (depth: approx. 4.9m), the water temperature was approx. 23℃ and the maximum radiation dose was 920mSv/h. No major damage was found on the structures. (See 6 below) As for Unit 2, the hole location is currently being selected. As for Unit 3, investigation will be performed after decontamination, etc. since the radiation dose inside the building is too high.





First floor of Unit 1 Reactor Building
Hole location at Unit 1

Unit 1 Torus Room investigation

6. Results of Unit 1 Torus Room investigation

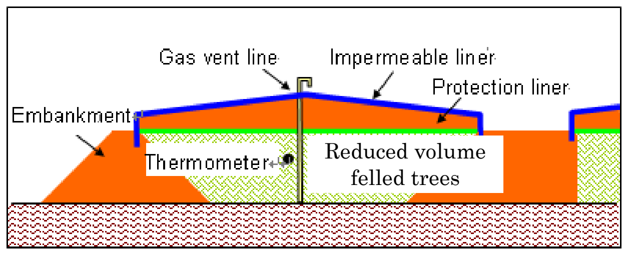
6) Reactor Facilities Dismantling and Radioactive Waste Processing/Disposal

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

- Dose reduction measures for debris and felled trees

  Debris and felled trees are being covered by soil 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). As for the soil-covered type temporary debris storage facilities, the soil cover for shielding is being installed at the first facility and the impermeable liner is being installed at the second facility (See 7 below). As for the temporary storage facility for felled trees, the preparation work was started on November 8 and the transportation of felled trees was started on February 5 (See 8 below).

7. Current progress status of the second soil-covered type temporary debris storage facility (Photo taken on February 26)



Overview of the temporary storage facility for felled trees (Embankment type)

8. Current progress status of the temporary storage facility for felled trees (Photo taken on February 19)

7) Staffing Plan and Work Safety Securement Plan

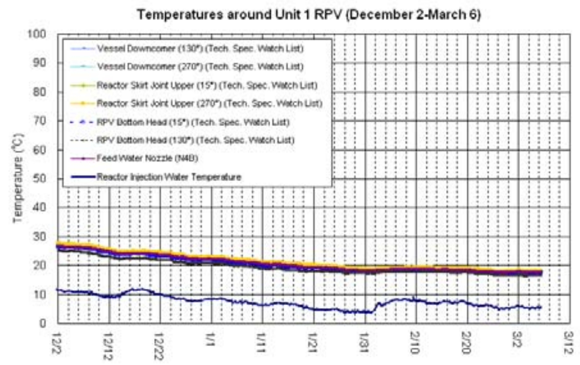
Secure long-term staffing while thoroughly implementing workers' exposure radiation control. Continuously improve working environment and work conditions based on understanding of needs among workers at site.

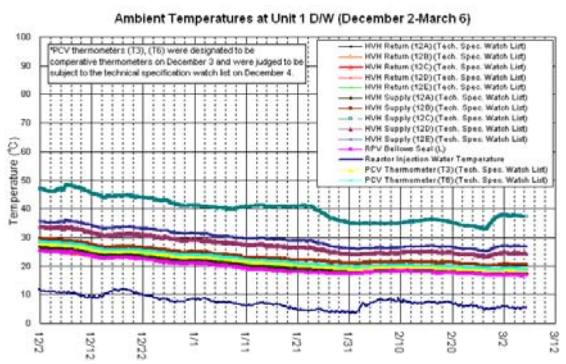
- Staff management
  - The number of people who were registered (for one day or more in a month) to work at the power station in the past 3 months (October-December) was approx. 8,000 (TEPCO and cooperative company workers), which is more than the number of people who actually worked (approx. 6,000: 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 March (about 4,100 cooperative company workers) will be secured.
  - The local employment rate of cooperative company workers was approx. 65% as of January.
- Seminar on work environment

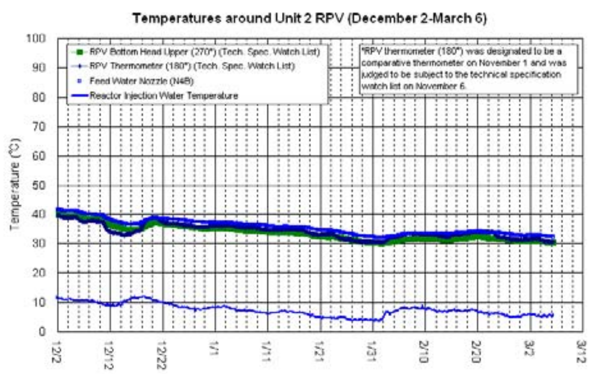
  In response to the results of the survey on actual working environment announced in December, seminars on working conditions (including the contents related to contract fraud such as difference among contract, commission and dispatch and the important points of labor-related laws such as clarification of working conditions in writing upon concluding a labor contract) taught by instructors invited from the Ministry of Health, Labour and Welfare and Fukushima Labor Department were held at J-Village on February 14 and 28 (About 150 people attended the seminar on Feb. 14 and about 110 people attended the one on Feb. 28). A total of four seminars are planned to be held by the end of March.
- Implementation of dose reduction measures

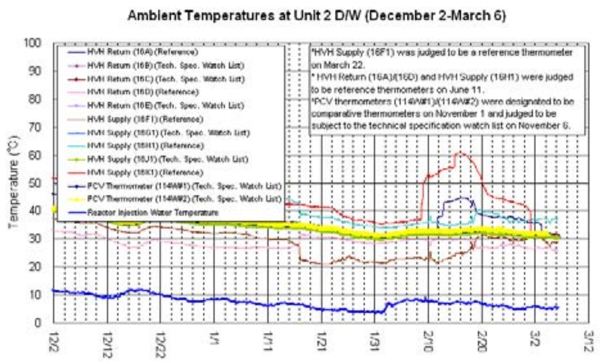
  Measures such as shielding have been implemented in the rest areas and the Main Anti-earthquake Building where workers spend a long time in order to reduce their radiation exposure doses. Radiation dose reduction work has been completed in the rest areas in the Administration Office Building and the Main Anti-earthquake Building (locations which have a great impact on workers' exposure doses) (October 22-February 22). The effectiveness of the measure implementation will be evaluated through performing dose measurement.

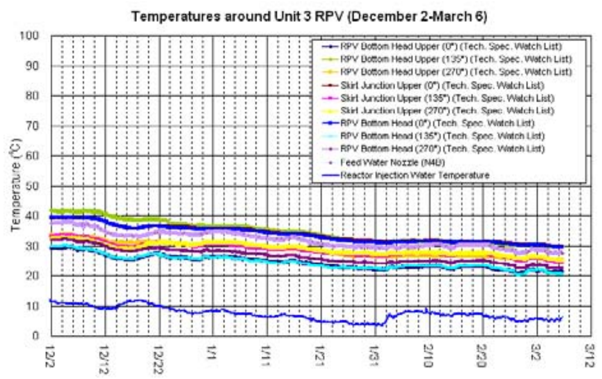
2. Parameters for Confirming Cold Shut Down Condition

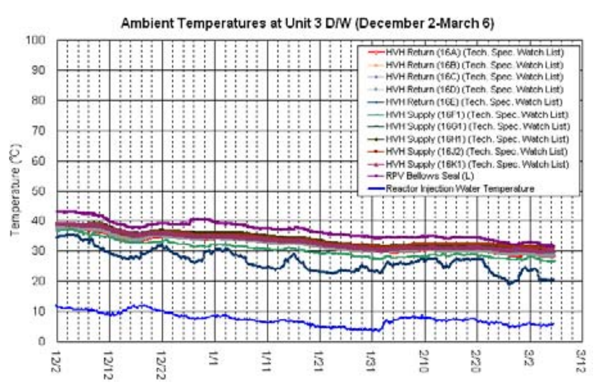




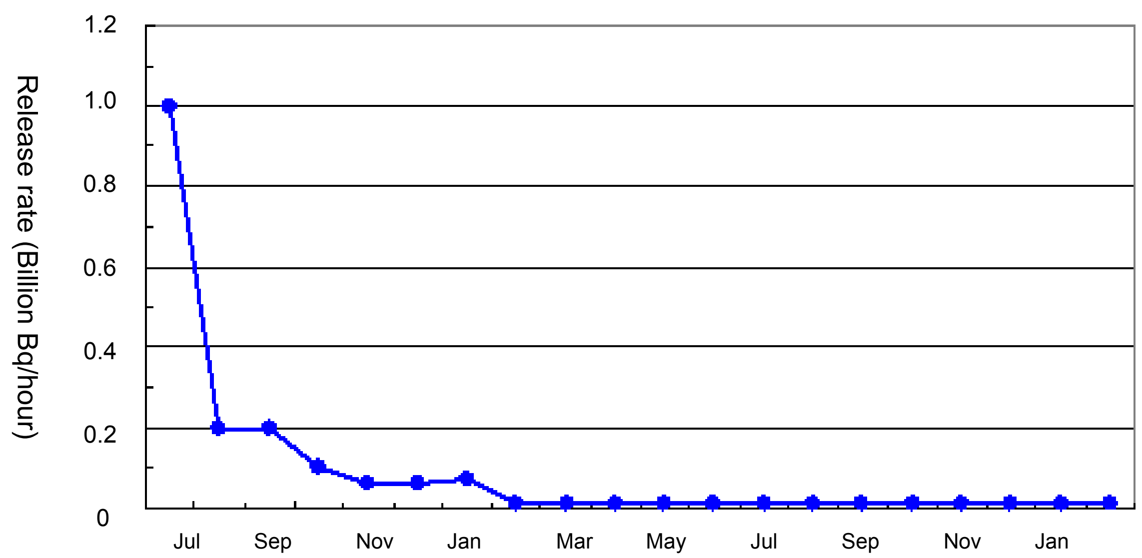








Release rate of radioactive material (cesium) per hour at Unit 1-3 Reactor Building



The current release rates of cesium (total of Cs-134 and 137) at Units 1-3 Reactor Buildings were evaluated to be approx. 0.0003 Billion Bq/h (Unit 1), 0.005 Billion Bq/h (Unit 2) and 0.0005 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]

- RPV: Reactor Pressure Vessel. Stores fuel assemblies, control rods and other structures inside the reactor and generates steam through nuclear reaction of the fuel.
- PCV: Primary Containment Vessel. Steel vessel with a thickness of about 3cm. The PCV stores primary nuclear facilities including the Reactor Pressure Vessel (RPV).
- TIP: Traversing in-core probe 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.
- S/C (Suppression Chamber): Pressure suppression pool. Used as water source, etc. for the emergency reactor core cooling system.
- ^{3}H (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.
- Silt fence: Curtain-like underwater fence which prevents the seawater inside the fence from being diffused.
- 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.
- Blow-out panel: Panel that opens to release pressure in the case of an excessive pressure increase in the building.
- Torus Room: Room in which S/C is stored in.