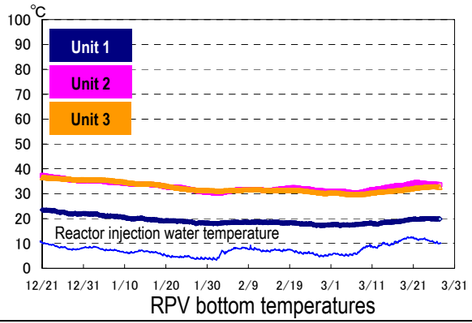
March 28, 2013
Secretariat of the Council for the Decommissioning of TEPCO Fukushima Daiichi Nuclear Power Station

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

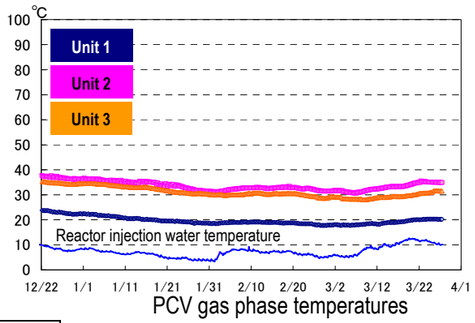
I. Status check inside the reactors

1. Temperatures inside the reactors

Through continuous reactor cooling by water injection, the temperatures of the RPV bottom and PCV gas phase have been stabilized within the range of approx. 15 to 40℃ for the past month, though they vary depending on the unit and the location of the thermometer.



RPV bottom temperatures



PCV gas phase temperatures

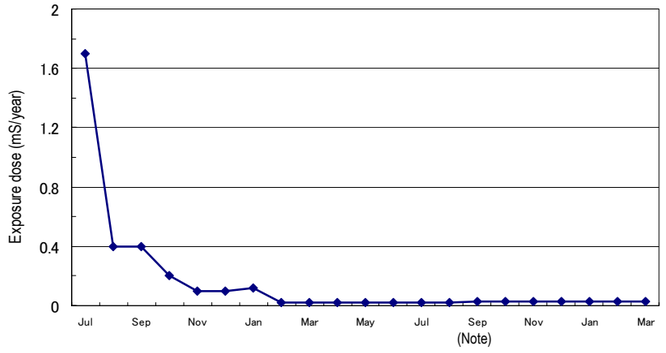
2. Release of radioactive materials from the Reactor Buildings

The radioactivity densities of the air at site boundaries due to the radioactive materials newly released from Units 1-3 Reactor Buildings were evaluated to be approx. 1.4×10^{-9} Bq/cm^3 for both Cs-134 and Cs-137. The radiation exposure dose due to the radioactive materials released was 0.03 mSv/year (equivalent to approx. 1/70 of the annual radiation dose by natural radiation (annual average in Japan: about 2.09 mSv/year).

(Reference)

* The radioactivity density limit 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)

Annual radiation dose at site boundaries by radioactive materials (cesium) released from Units 1-3 Reactor Buildings



(Note) For the radiation dose evaluation, different formulas and coefficients had been used in the facility operation plan and the monthly report. The evaluation method was integrated in September 2012.

3. Other indexes

There was no significant change in parameters including the pressure in the PCV and the PCV radioactivity density (Xe-135), and no abnormality of cold shut down condition or sign of criticality was detected.

Based on the above, it was confirmed that cold shut down condition has been maintained and the reactors have been in the stabilized condition.

II. Progress Status by Field

1. Reactor cooling plan

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

➢ Investigation on the inside of Unit 2 PCV and installation of permanent monitoring instruments

- For the purpose of complementing status monitoring and providing inputs for fuel debris removal, the investigation on the inside of the PCV, the measurement of PCV temperature and water level and sampling of accumulated water inside the PCV were performed. As the investigation equipment inserted from the PCV penetration (X-53) could not reach the control rod drive (CRD) replacement rail, the investigation on the rail and the area around the pedestal opening could not be performed (March 19). A reinvestigation is under consideration.
Future schedule is also under consideration including the timing of reinvestigation. (see Figure 1)

➢ Nitrogen injection into the suppression chamber (S/C) for the purpose of mitigating hydrogen-related risks

- 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 was purged to reduce hydrogen-related risks. 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, February 26 - March 19, and from early April). As for Unit 2, the design and production of nitrogen injection equipment are ongoing (December 25 – March 12). The equipment installation at the site was completed (March 13-17). 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%.

➢ Desalination completed at Unit 3 spent fuel pool

- By maintaining the salinity in the spent fuel pool at appropriately low level, the corrosion of the structure materials can be prevented. As for Unit 3, desalination using a mobile reverse osmosis membrane equipment (RO equipment) was completed (March 18). As desalination was also completed at Units 2 and 4, (at Unit 1, into which seawater was not injected, the salinity level has been low after the accident), the low salinity level has been maintained in all spent fuel pools at Units 1-4 at present (see Figure 2 below).

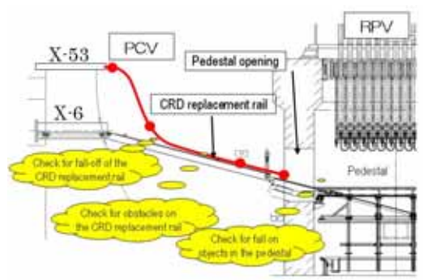


Figure 1: Overview of the inside investigation of the PCV

Sample Name	Sampling Date	pH	Conductivity	Cl (chloride ion)	Cs137	Cs134	Note
		—	mS/m	ppm	Bq/cc	Bq/cc	
Unit 1	2013/1/23	8.1	18	6	1.6E+04	7.7E+03	
Unit 2	2013/1/17	8.8	53	13	1.2E+02	5.4E+01	
Unit 3	2013/3/15	9.1	17	5	9.1E+02	4.7E+02	
Unit 4	2013/1/22	8.9	36	57	3.3E+00	1.2E+00	

Figure 2: Water quality in the spent fuel pools (as of March 18)

2. Accumulated water treatment plan

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 from flowing into buildings by pumping the groundwater flowed from the mountain side in the upstream side of the buildings (groundwater bypass) is being built. 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 March 29, systems B and C: to be completed by late April). Based on the water quality test results, the facilities will be put in operation in order starting from system A once agreement is gained from the parties concerned.

➢ Installation of multi-nuclide removal equipment

- 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 approval was gained on the preconditions of starting the hot testing (system A) by the Nuclear Regulation Authority. Once the preparation is completed after the verification test for all systems, the hot testing will be performed (from March 30).

➢ Installation of additional treated water receiving tanks

- Treated water receiving tanks of a total capacity of about 325,000 m^3 have been installed (storage amount as of March 26: about 270,000 m^3). The storage capacity is scheduled to be increased to about 450,000 m^3 by mid FY2013 with tanks currently being installed (about 80,000 m^3) and tanks to be additionally installed (46,000 m^3). Based on the estimate that the maximum storage capacity of 700,000 m^3 will be required by mid FY2015, tanks of a total capacity of about 300,000m^3 (max.) are planned to be additionally installed in the south side area of the site while confirming the necessary tank capacity.

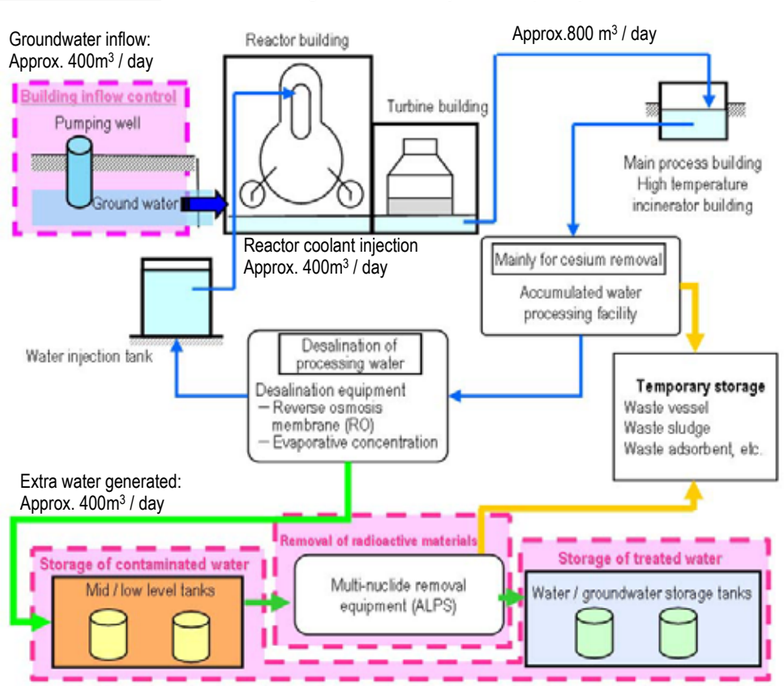


Figure 3: Overview of the accumulated water treatment

3. Plan for radiation dose reduction and contamination mitigation

Effective dose reduction at site boundaries (aiming to achieve 1 mSv/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

➢ Closure of the blow out panel (BOP) opening at Unit 2 Reactor Building

- A construction work to close the BOP opening was performed. For the purpose of further mitigating the radiation release from the Reactor Building, ventilation facilities and ducts were installed (completed on March 8) and a closure panel was installed on the BOP opening (March 11). At present, adjustment operation of the ventilation facilities is being conducted (from March 8). (see Figure 4)

➢ Installation of impermeable walls

- To prepare for the case of groundwater contamination, impermeable walls will be installed to prevent contamination from spreading to the sea (planned to be completed by mid FY2014). At present, preliminary drilling is being performed on the bedrock in the area where steel pipe sheet piles are to be installed (from June 29, 2012). The installation of steel pipe sheet piles is planned to be started (from March 30).

➢ Effective dose reduction at site boundaries

- The annual radiation exposure dose at site boundaries due to the radioactive materials newly released and the temporarily stored solid waste generated after the accident as of the end of March is estimated to achieve the goal of 1 mSv/year as a result of implementing dose reduction measures such as transporting debris to the soil-covered-type temporary storage facilities and installing additional shielding for the temporary storage facility for absorption towers. The breakdown of radiation exposure amount is as follows: Gaseous waste: 0.03 mSv/year, solid waste: 0.91 mSv/year, Total: 0.94 mSv/year.

➢ Radioactivity density of the seawater in the port

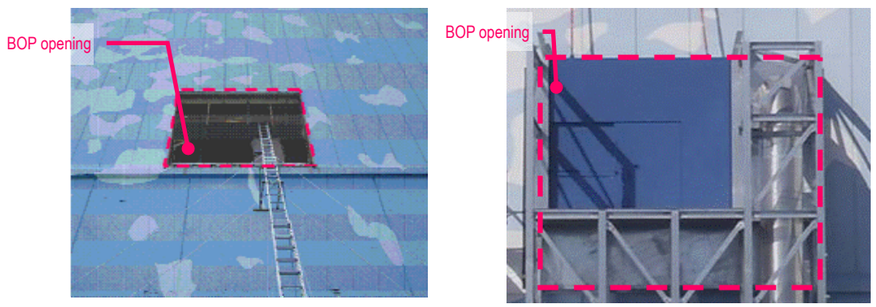
- Back in September 2012, the radioactivity densities (Cs-134, 137) of the samples obtained in some locations (such as the inside of the silt fence installed near Units 2-4 water intake channel) exceeded the density limit stipulated by the Reactor Regulation. Measures to prevent further contamination of the seawater in the open duct and to purify Cs and Sr are currently being considered. As for Cs, fiber adsorbent has been installed on the inside of Unit 3 silt fence and purification will be started on March 29. As for Sr, purification implementation plan utilizing techniques which can be applied at the site is being considered.

➢ Countermeasures for fish and shellfish with high cesium density

- We have been getting rid of the fish and shellfish living in the port by basket trap fishing and bottom gill net fishing based on the consultation results with organizations concerned since last October. In February, we have captured greenling with high cesium density (near the open duct of Units 1-4 water intake channel (740,000 Bq) and at the port entrance (510,000 Bq)). A bottom gill net is being installed at the port entrance (work started on February 8) for the purpose of preventing fish and shellfish from moving out of the port. A partition net is being installed inside the bank (work started on March 23).

➢ Establishment of a review committee consisting of experts

- To examine the factors contributing to the radioactivity density of seawater in some locations of the port not reducing to below the density limit stipulated by the Reactor Regulation and verify the measures implemented by TEPCO, a review committee consisting of experts will be established to verify the issue in a reliable manner (by the end of May).



Before the closure panel installation **After the closure panel installation**

Figure 4: Closure of the BOP opening

4. Plan for 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 around mid FY 2013). In addition to the foundation work, the steel frame construction was started on January 8 and the third layer (out of 5 layers) has been completed on March13. The steel frame construction will be completed around June 2013 (see Figure 5 below).

➢ Work towards spent fuel removal at Unit 3

- The platform installation was completed (March 13) and debris removal from the upper part of the Reactor Building is ongoing. 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.

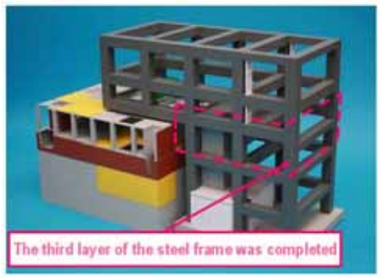


Image of completed steel frame

The 3rd layer of the steel frame completed and the 4th layer started (Photo taken on March 26)

Figure 5: The cover installation for fuel removal at Unit 4

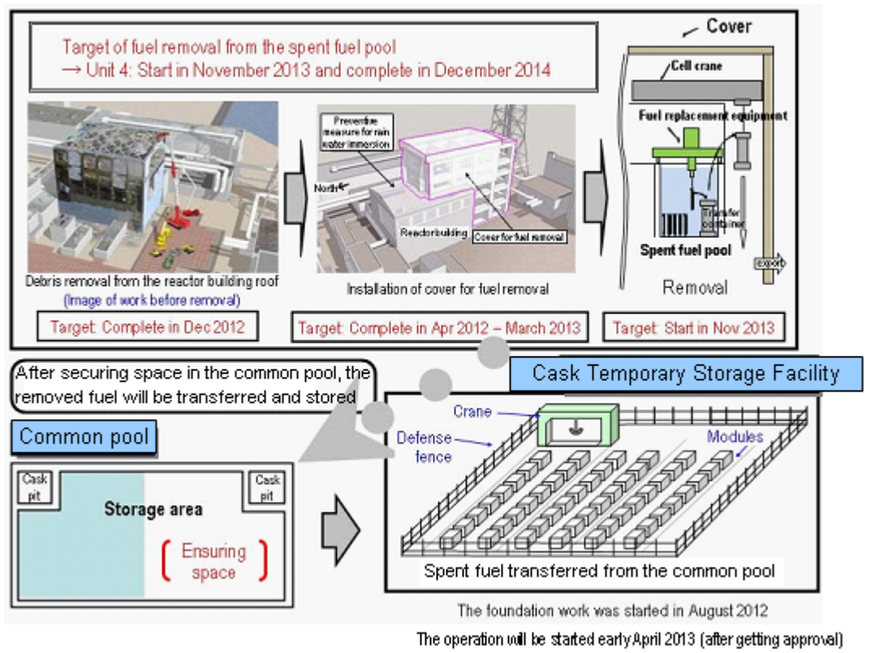


Figure 6: Spent fuel transfer flow

5. Fuel debris removal plan

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

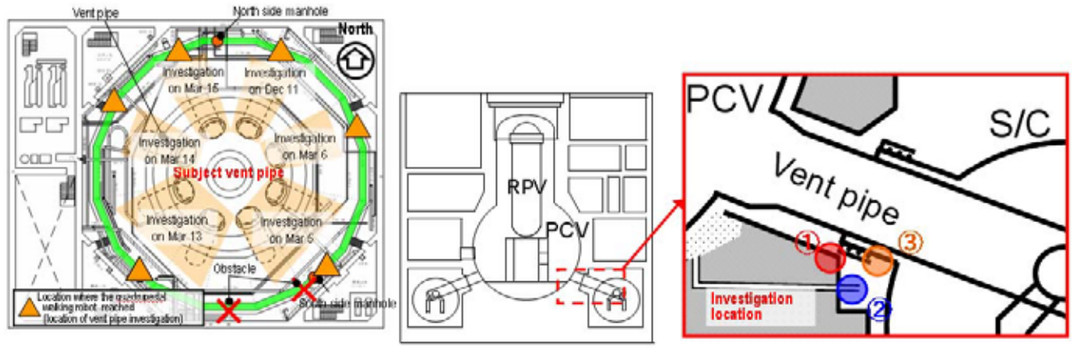
- For the production of 3 types of remote control decontamination equipment (high-pressure water decontamination, dry ice blast and blast/suction), the demonstration test results of the equipment performed at Fukushima Daini Nuclear Power Station were evaluated (completed on March 21) for the purpose of identifying tasks such as collection work performed by machine (cable/hose winder) (high-pressure water cleaning) and stabilization of communications by replacing the composite cables (dry ice blast).
- The tasks identified will be fed back. Once the preparation for obstacle removal is completed, the feasibility of equipment application will be verified at Fukushima Daiichi Nuclear Power Station next Summer.
- Demonstration observation of the high-pressure water decontamination equipment was held on March 8.

➢ Investigation of Unit 2 Torus Room

- Towards the development of the leakage location detection equipment, etc., the investigation of the Torus Room in the Reactor Building basement (radiation dose, temperature, accumulated water level and images acquired) is being performed. As for Unit 2, hole drilling was performed (March 24 and 25) and the investigation of the Torus Room will be performed. As for Unit 3, the investigation will be performed after decontamination, etc. since the radiation dose inside the building is too high.

➢ Investigation and repair of the leakage location of the PCV

- For the purpose of early understanding of the plant conditions and incorporation of the information obtained into the R&D project, a preliminary investigation was performed. A quadrupedal walking robot was used to investigate the lower part of the vent pipes at Unit 2 (a total of 8 vent pipes). As a result, no leakage was found in the lower part of all the vent pipes. The leakage location at the bottom of the PCV will be identified in a government project using the investigation equipment which is currently under development. (see Figure 7)



Investigation location (top view of Torus Room)

Investigation location (side view of Torus Room)

Figure 7: Investigation of the lower part of the vent pipes at Unit 2

6. Plan for 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 was installed at the first and second facilities (March 25). As for the temporary storage facility for felled trees, the installation of soil cover for shielding will be completed on March 30. (See Figure 8 below)

➢ Processing/disposal of the secondary waste generated from contaminated water treatment

- By performing nuclide analysis on the samples collected before and after water treatment, the radioactivity density of the secondary waste generated from the water treatment process is evaluated. The analysis was completed for about 30 nuclides in 9 samples, and 3 samples are currently under analysis. A sampling plan will be developed for further analysis.
- Investigation of the property of the secondary waste, a corrosion test performed on the storage container materials, etc. have been performed for the purpose of providing inputs for long-term storage of secondary waste generated from water treatment.

Figure 8: Dose reduction measures for debris and felled trees

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 the 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 (November - January) was approx. 8,500 (TEPCO and cooperative company workers), which is more than the number of people who actually worked (approx. 5,500: TEPCO and cooperative company workers). Thus, there is 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 April (approx. 2,800 cooperative company workers) will be secured.
- The local employment rate of cooperative company workers was approx. 65% as of January.

➢ Measures for ensuring appropriate work conditions

- In response to the survey results on the actual working environment announced in December, seminars on working conditions (including the contents related to contract fraud and the important points of labor-related laws) taught by instructors invited from the Ministry of Health, Labour and Welfare and Fukushima Labor Department were held at J-Village on March 7 and 12. A total of 4 seminars have been held since this February. (About 480 people attended the seminar*)
  (* Including the 60 participants from TEPCO)
- For 26 out of 31 main contractors registered in the disaster restoration safety promotion association for Fukushima Daiichi Nuclear Power Station and currently engaged in the restoration work at Fukushima Daiichi Nuclear Power Station, survey on the measures implemented by main contractors for ensuring appropriate working environment (identifying the employers of the workers and subcontract structure, clarification of employment conditions for subcontractors, etc.) is being performed from December to March.

➢ Implementation of dose reduction measures

- Measures such as shielding have been implemented in the rest areas of the Main Anti-earthquake Building and adjacent buildings in order to reduce workers' 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-March 9). The radiation dose in the rest areas of the Administration Office Building was reduced from 9.6 μSv/h to 6.5 μSv/h while the dose was reduced from 18.3 μSv/h to 10.0 μSv/h in the Main Anti-earthquake Building.

➢ Expansion of areas not requiring full-face mask

- As for the following construction areas of new buildings in the power station site ((1) Multi-nuclide removal facility area, (2) Temporary cask storage facility area, (3) Parking areas inside and outside the power station site and (4) Incinerator facility area) will be designated as areas not requiring full-face mask from April to May 2013. The burden of workers will be reduced and the workability will be improved while implementing all possible measures for radiation control.

➢ Measures to improve the working environment

- A survey on the overall working environment is being performed for workers. Based on the survey results to bel be summarized at the end of April, improvement measures will be implemented as necessary.

8. Others

➢ The third Fukushima workshop on the development of machinery and equipment (March 7)

- As a part of the measures for introducing excellent local technologies, local companies were invited to give presentations on their technologies to the staff engaged in R&D. After the presentation, individual consultation was performed between the local companies and the staff engaged in R&D.

➢ Recurrence prevention measures for power supply failure within the power station

- As a result of investigating the cause of power supply failure, recurrence prevention measures such as power supply reliability improvement (power supply duplication for Units 1-4 spent fuel pool alternative cooling systems and the common pool cooling system, etc.) and measures to prevent the entry of small animals (closing the cable penetration opening for the high voltage power panel cables) will be implemented.