Appendix 2

“Roadmap towards Restoration from the Accident at Fukushima Daiichi Nuclear Power Station, TEPCO”

September 20th, 2011

Nuclear Emergency Response Headquarters

Government-TEPCO Integrated Response Office

I. Cooling

(1) Reactor

1. Target for Step 2 “Cold Shutdown Condition”

- Circulating water cooling will be continued and enforced, thus bringing the reactors to a “Cold Shutdown Condition” monitoring the RPV temperatures, etc.
- Maintain stable operation of accumulated water processing facility. (Implementation items are stated in II. (3))
- NISA to continue confirming operating status and related matters.

Definition of “Cold Shutdown Condition”

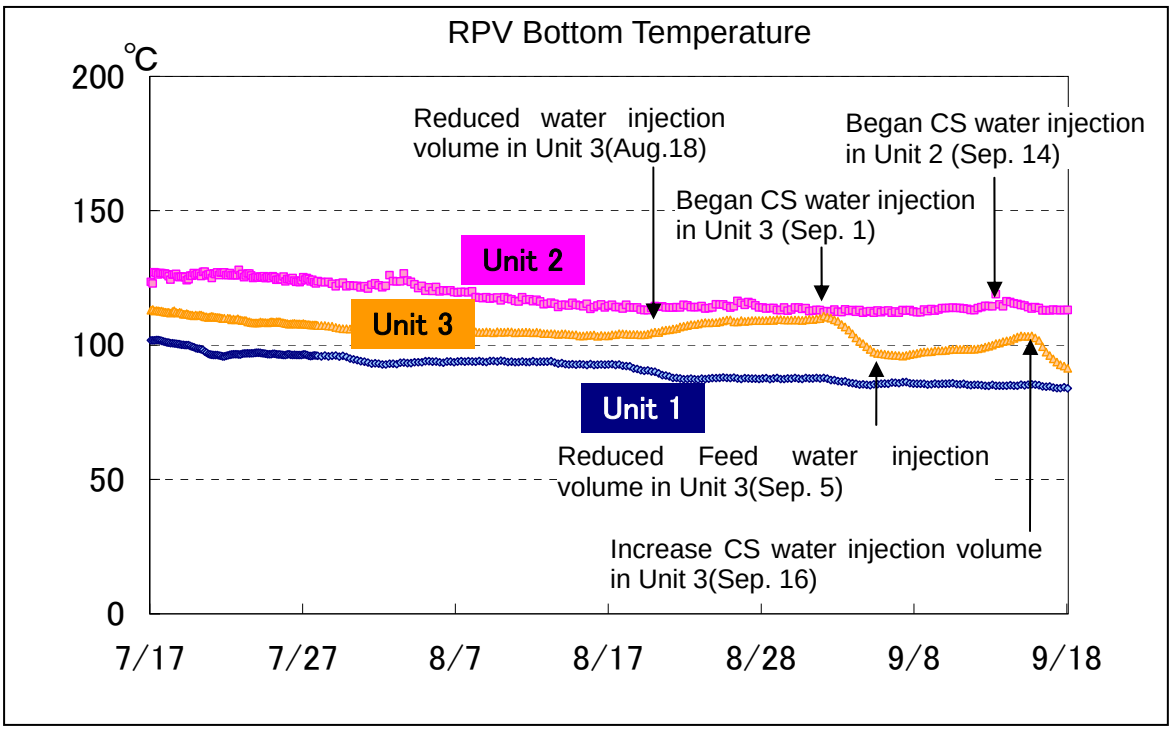
- Temperature of RPV bottom is, in general, below 100 degrees Celsius.
- Release of radioactive materials from PCV is under control and public radiation exposure by additional release is being significantly held down.

In order to keep satisfying the above two conditions, secure mid-term safety of the circulating water cooling system (reliability of parts and materials, redundancy and independency, assessment of slack time for emergency, detection of failure and trouble, confirmation of restoration measures and recovery time, etc.)

2. Current status and measures implemented

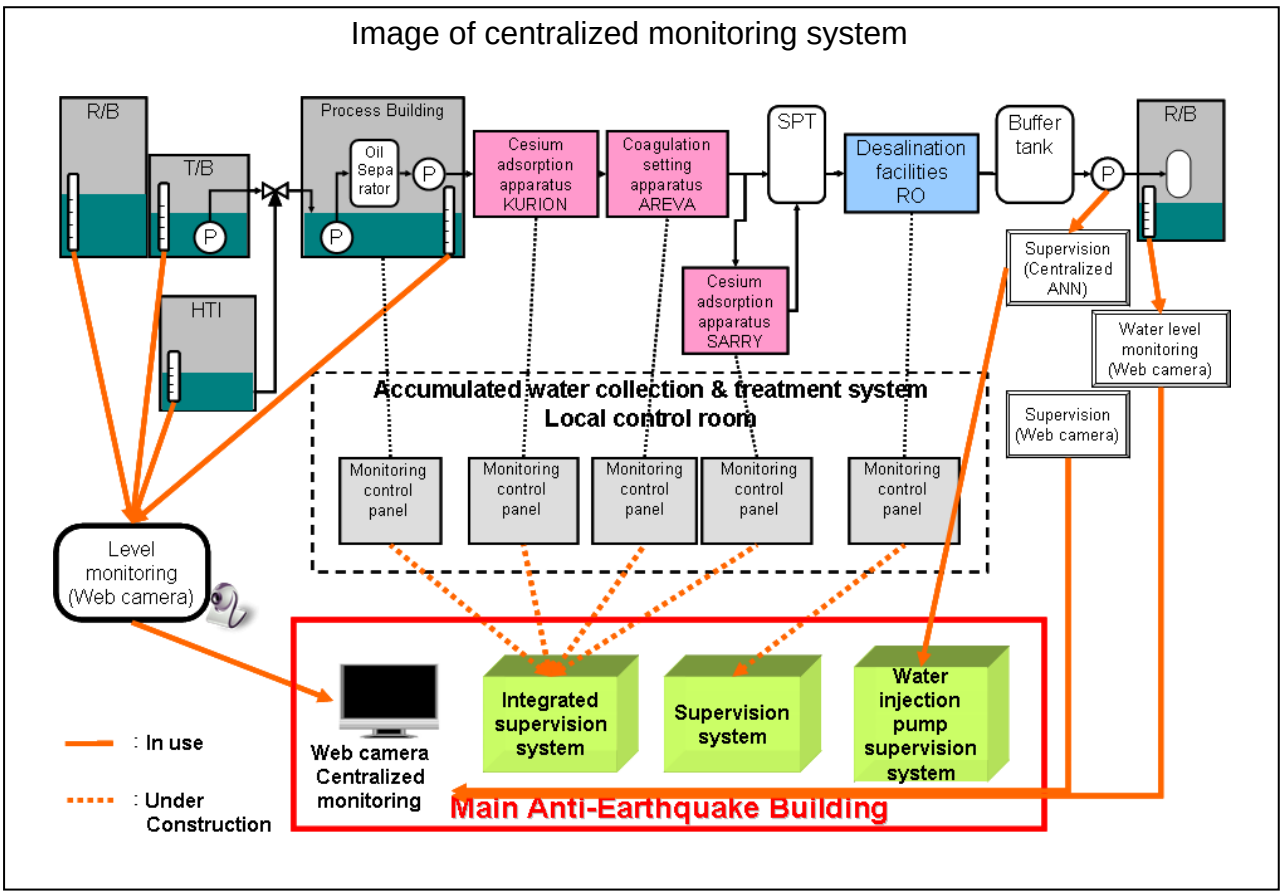
① Additional water injection line for more effective cooling [Countermeasures 12, 14, 45]

- In addition to the feed water line, water injection via the Core Spray (CS) has begun at Units 2 and 3 (Sep. 14 for Unit 2, Sep. 1 for Unit 3.)
- Water injection volume is approx. 3.6 m^3/h for Unit 1, approx. 7.6 m^3/h for Unit 2 and approx. 12 m^3/h for Unit 3.
- RPV bottom temperatures in Units 1 and 3 have decreased below 100 degrees Celsius. Aim for below 100 degrees Celsius in Unit 2 as well, determining the sufficient water injection volume to achieve Cold Shutdown Condition.



② Installation of centralized monitoring system in the Main Anti-Earthquake Building [Countermeasures 12,14,45]

- Installing a system that enables the monitoring of various parameters such as the water injection volume, injection pressure, buffer tank water level, etc., from monitors installed in the Main Anti-Earthquake building.



(2) Spent Fuel Pool

1. Target for Step 2 “More stable cooling”

- “More stable cooling” (target for Step 2) for Units 2 and 3 was achieved by the end of Step 1 by having installed heat exchangers and maintaining pool water level.
- Circulating cooling systems for Units 1 and 4 have been installed, thus the target for Step 2 was achieved in all Units. (Aug. 10.)

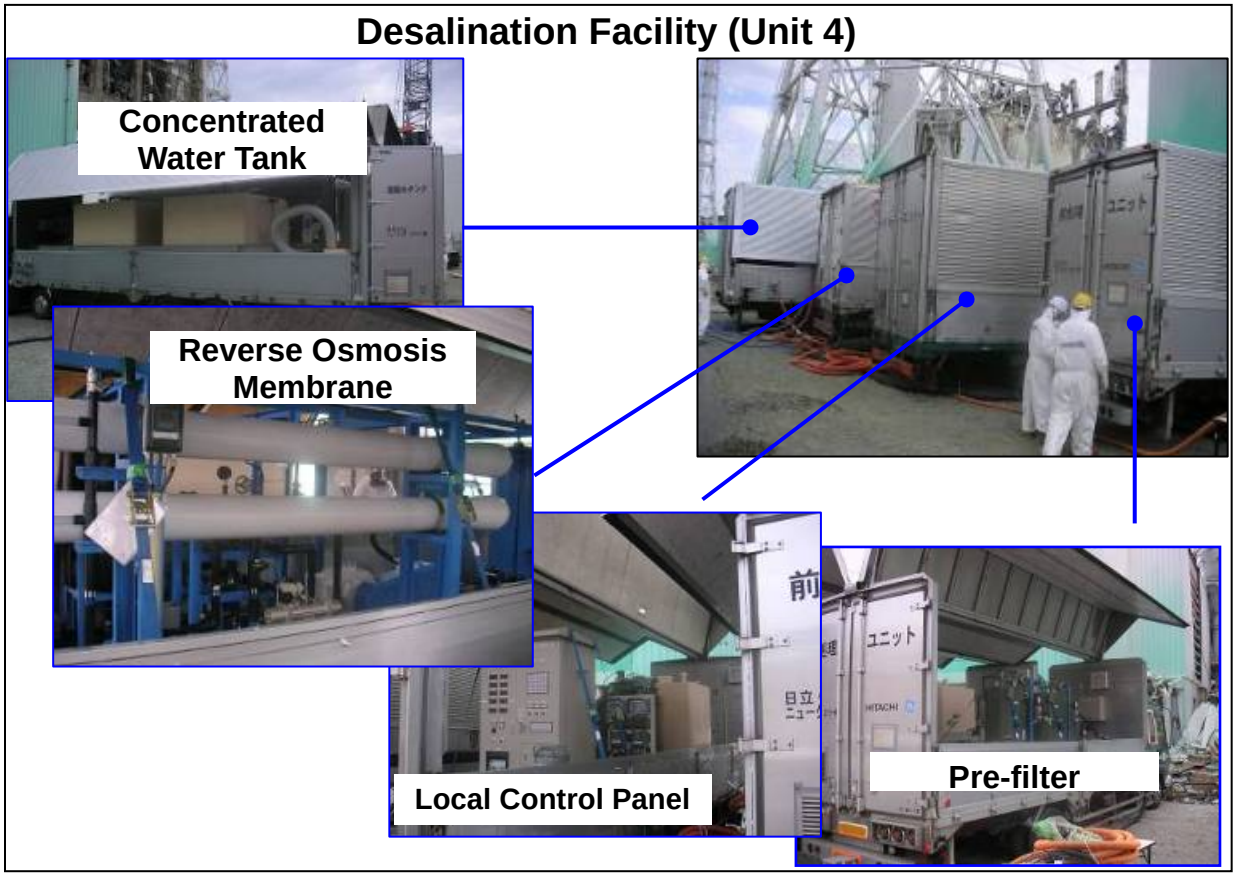
2. Current status and measures implemented

① Current status of Spent Fuel Pool

- Unit 1: 31 degrees Celsius, Unit 2: 34 degrees Celsius, Unit 3: 33 degrees Celsius and Unit 4: 40 degrees Celsius (as of Sep. 19.)

② Operation of Unit 4 desalination facility (Aug. 20) [Countermeasures 25, 27]

- In order to prevent corrosion of spent fuel pools, the desalination facility has begun operation (Aug. 20.)
- The salt concentration of water (chloride ion concentration) in spent fuel pool of Unit 4 before the operation of the desalination facility was 1,944 ppm (Aug. 20), while its concentration after the operation was 770 ppm (Sep. 7).
- The desalination facilities for Units 2 and 3, in which sea water injections were carried out, are planned to be installed in turn.



II. Mitigation

(3) Accumulated Water

1. Target for Step 2 “Reducing the total amount of accumulated water”

- Reduction of the total amount of accumulated water by processing the accumulated water in the buildings via the stable operation of processing facility.
- Augmentation of reuse by expansion of high-level contaminated water processing facility, steady operation and desalination of decontaminated water.
- Begin consideration of full-scale water processing facilities for high-level contaminated water.
- Storage/management of sludge waste generated from high-level contaminated water processing facility.
- Implement installation work for steel pipe sheet pile at the port to mitigate contamination to the ocean.

2. Current status and measures implemented

① Status of the accumulated water processing

- Regarding accumulated water processing performance, approx. 95,420 tons have been processed in total (as of Sep. 18) and the average availability factor for one week is 83% (as of Sep. 18.)
- The accumulated water level reached the target level (O.P. 3,000.) In other words, the total amount of accumulated water has reached the point where it is able to withstand heavy rains as well as long-term processing facility outage (Sep. 11).
- Decontamination factor* of the processing facility for cesium is 10^6 in the apparatus of Kurion – Areva (as of Aug. 9) and 10^5 in SARRY (as of Sep. 1.)

*Decontamination factor = cesium concentration of a sample before processing / cesium concentration of a sample after processing

② Implemented reliability enhancement countermeasures towards stable processing [Countermeasure 43]

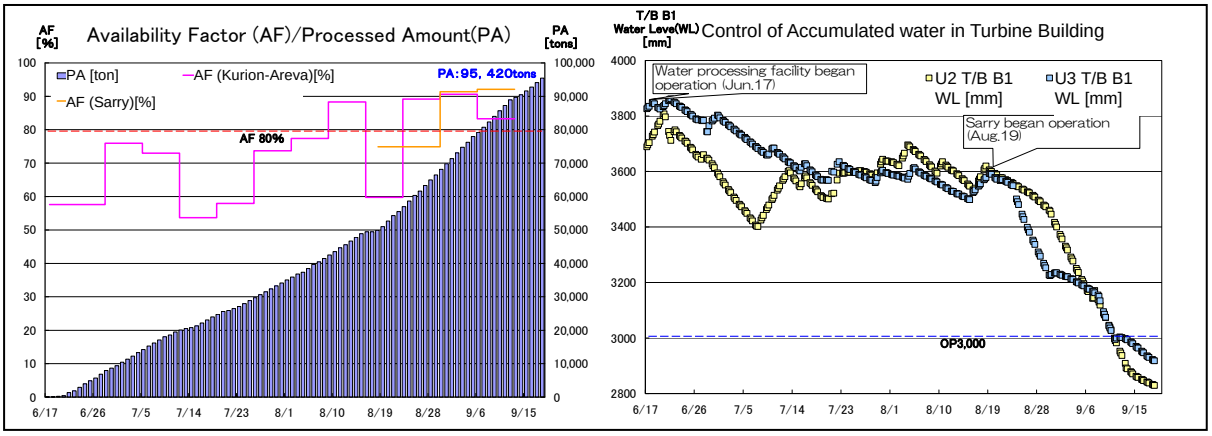
- Installed cesium adsorption apparatus (SARRY) and completed the augmentation of decontamination facility (Aug. 18.)

③ Augmenting desalination processing facility [Countermeasure 43]

- Installed the evaporative concentration apparatus (two lines, Aug. 7 and 31) in addition to the reverse osmosis membrane method (Jun. 17.)
- Confirmed that chlorine concentration had been decreased from 6,000 ppm to approx. 20ppm by the reverse osmosis equipment (per the Aug. 9 results) and that had been decreased from 12,000 ppm to less than 1 ppm by the

evaporative concentration apparatus (per the Aug. 16 results).

- Further more, the exaporative concentration apparatus is being reinforced (mid of Oct.).



④ Storage/management of sludge waste, etc. [Countermeasure 81]

- Sludge waste with high radioactive concentration generated by processing the high-level contaminated water is properly being secured and managed in the Centralized Waste Processing Building.
- Implementing preparation work to install storage facility for sludge waste in order to expand storage capacity for sludge waste.

⑤ Securing storage [Countermeasure 42]

- Implemented construction work to install tanks for high level contaminated water in order to expand storage facility for high level contaminated water (Sep.17).

⑥ Prevent contamination in the ocean [Countermeasure 64]

- Plan to complete the placement of the steel pipe sheet pile in order to block the damaged parts of permeation prevention structure due to the tsunami at the south side of the intake canal of Units 1 to 4 as a countermeasure to mitigate contamination in the ocean (end of Sep.)

Status of placing steel pipe sheet pile

(4)Groundwater

1. Target for Step2 “Mitigating contamination in the ocean”

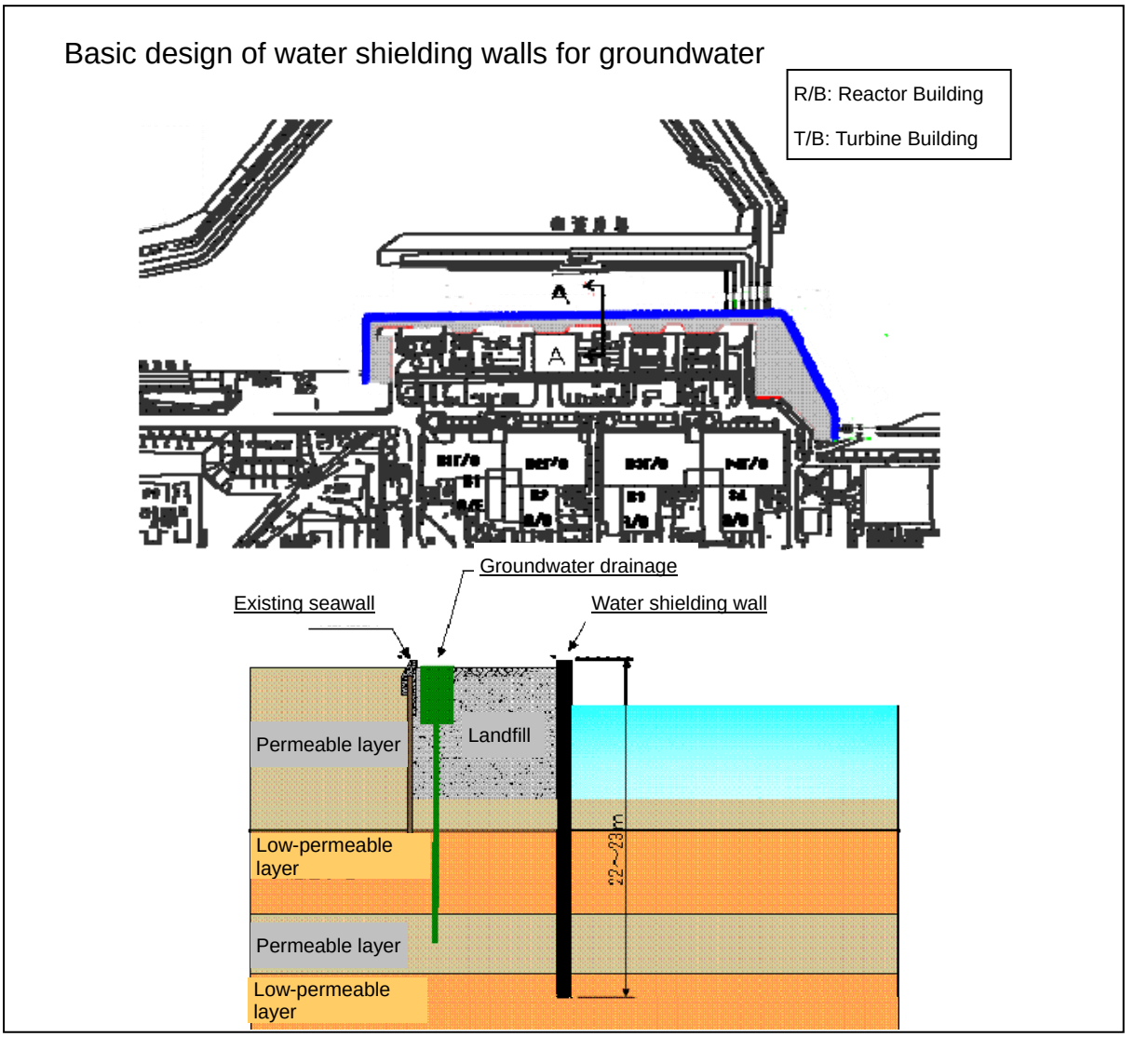
- Mitigate contamination in groundwater as well as contamination to the ocean via groundwater by controlling accumulated water inflow into groundwater.
- Commencing installation work for water shielding wall in front of existing seawalls of Units 1 to 4, with the expectation of mitigating contamination in the ocean via groundwater.

2. Current status and measures implemented

①Consideration of water shielding wall [Countermeasure 68]

- In order to further ensure the mitigatation of contamination in the ocean, the basic design for installing the water-proof steel pipe sheet piles in front of the existing seawalls of Units 1 to 4 has been completed (Aug. 31.)
- Currently the design specificaitons for construction are under consideration.

Basic design of water shielding walls for groundwater



② Implementing prevention against expansion of contamination of groundwater [Countermeasure 67]

- Installed pumps at sub-drainage pit on the turbine building side at seven places (Jul. 29.)

(5)Atmosphere/Soil

1. Target for Step 2 “Mitigating dispersion of radioactive materials”

- Reduce dispersion of radioactive materials deposited in the site.
- Continue dust inhibitor spraying as well as removal of debris.
- Installation of the reactor building cover (Unit 1)
- Commencing removal of debris on top of the reactor buildings (Units 3 and 4.)
- Consideration of containers for the reactor buildings.

2. Current status and work implemented

①Installation measures for the Unit 1 reactor building cover [Countermeasures 54, 55]

- Steel frames has been installed (Sep. 9.)
- Panels, which are to be the cover, are being installed.

Installation work of the cover

②Removal of debris at the upper part of the reactor buildings (Units 3 and 4) [Countermeasure 84]

- Began removing the debris at the upper part of the reactor building of Unit 3 (Sep. 10.)
- Preparation work is under way at Unit 4.

Removing debris at Unit 3

Preparation work for removing debris at Unit 4 (Demolition at the work yard)

③ Removal and management of debris [Countermeasures 53, 84, 87]

- The volume of approx. 800 containers of debris has been removed (as of Sep. 20.) [Countermeasures 53, 84]
- The waste such as the removed debris and the trees cut down for site preparation are classified according to their kinds as well as the amount of radiation dose and managed in the storage area.

<Management in the storage area>

- Debris are stored in the containers and reserved in the buildings according to the amount of radiation dose.
- The approach lane to the waste storage area is marked off and a No Entry sign was posted to prevent entrance of unauthorized personnel.

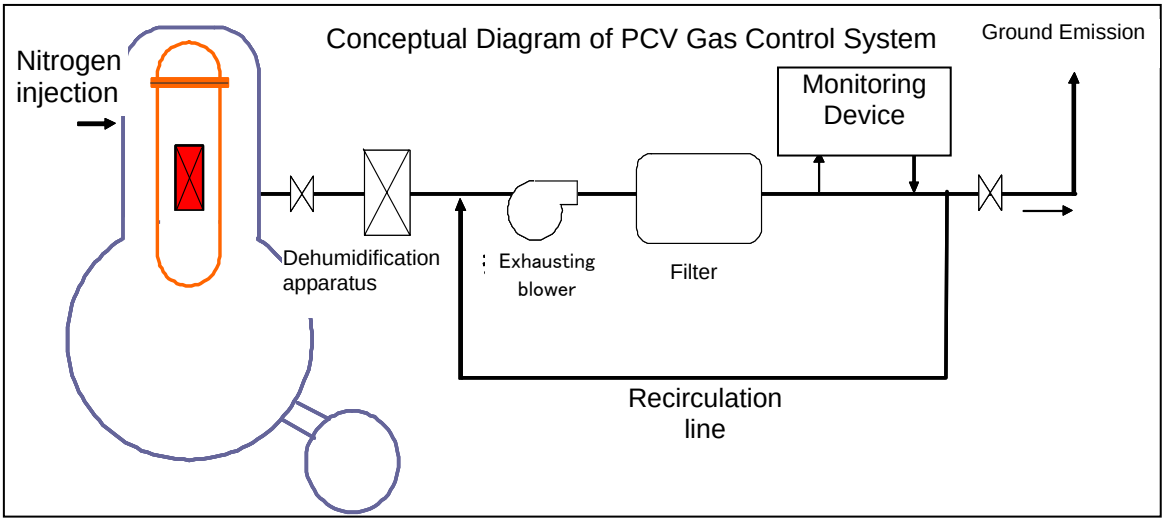
<Securing the storage area>

- Except for the radioactive accumulated water treatment facilities and the other areas under construction, the storage areas are secured, fully utilizing the land within the site.

Debris storage area (Left: Containers storing the debris, Right: Storage tent)

④Installation of PCV gas control system [Countermeasure 86]

- In order to reduce the release of radioactive materials from PCV, systems which extract the almost same amount of gas as the nitrogen fill ration in the PCV and keep the pressure of PCV to the almost same level as the atmosphere are planned to be installed in Units 1 to 3 after temperature of RPV bottom is below 100 degrees Celsius.
- Extracted gas is to be filtered and emitted after monitoring.
- As the temperature in the reactor declines, the emission of radioactive materials from PCV should decreases. In addition, the emission of radioactive materials from PCV can be further mitigated by this system.



III. Monitoring and decontamination

(6) Measurement, reduction, disclosure

1. Target for Step 2 “Sufficient reduction of radiation dose”

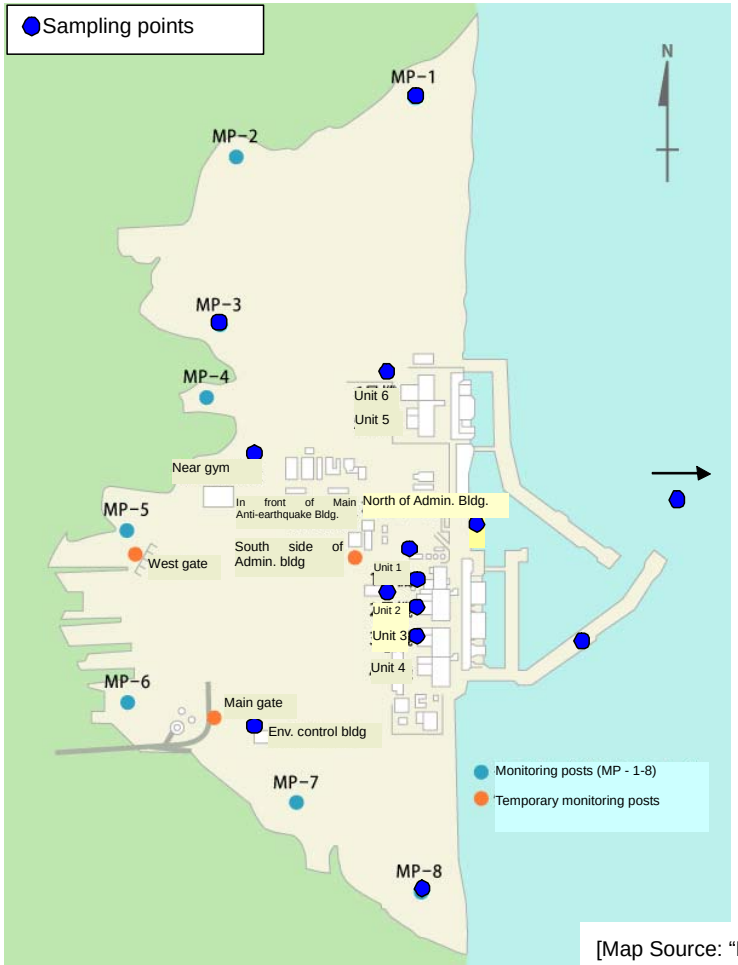
- Expansion and enhancement of monitoring, and continuation of disclosure.
- Monitoring by government, prefectures, municipalities and operators.
- Commencement of full-scale decontamination.

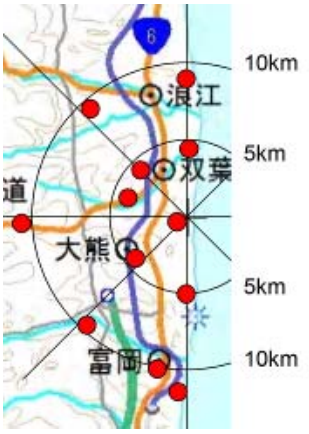
2. Current status and measures implemented

①Evaluate the amount of radioactive materials currently released [Countermeasures 60, 61]

- In order to evaluate the individual current release rate from Units 1 to 3, implement sampling and measurement the airborne radioactivity concentration at the upper part of the reactor buildings and at land and sea, as showing following figures.

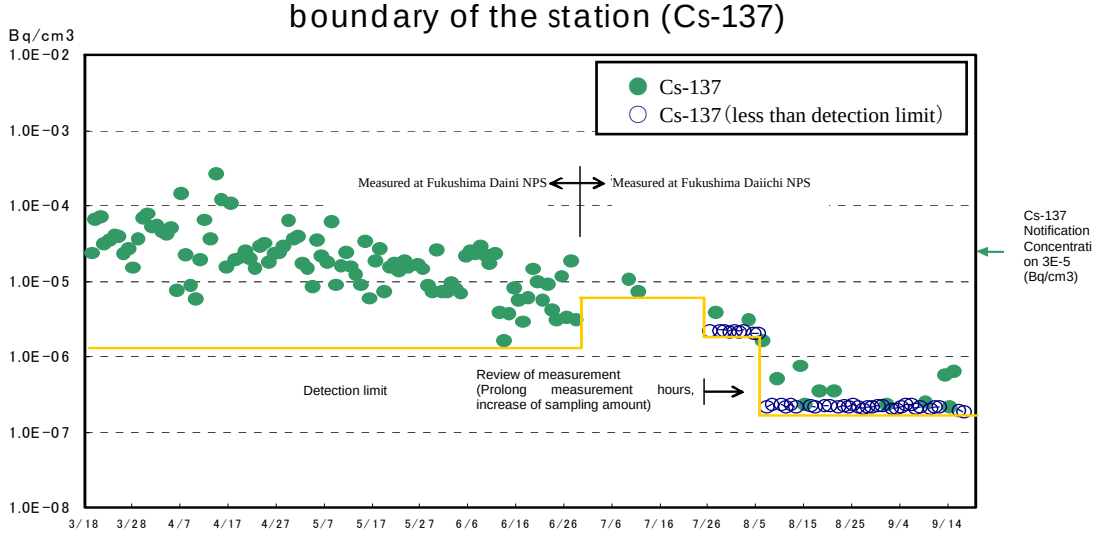
Monitoring points of airborne radioactivity concentration (left) and sampling points of radioactive fallout (right)





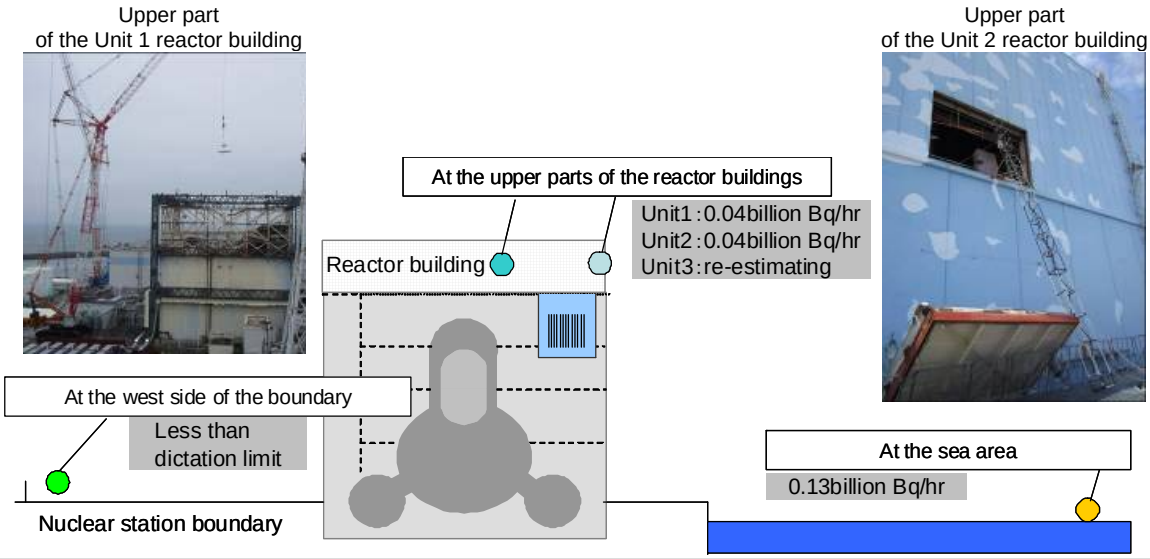
[Map Source: “Digital Japan" URL http://cyberjapan.jp/]

Trend of aerial radioactivity concentrations near the west side boundary of the station (Cs-137)

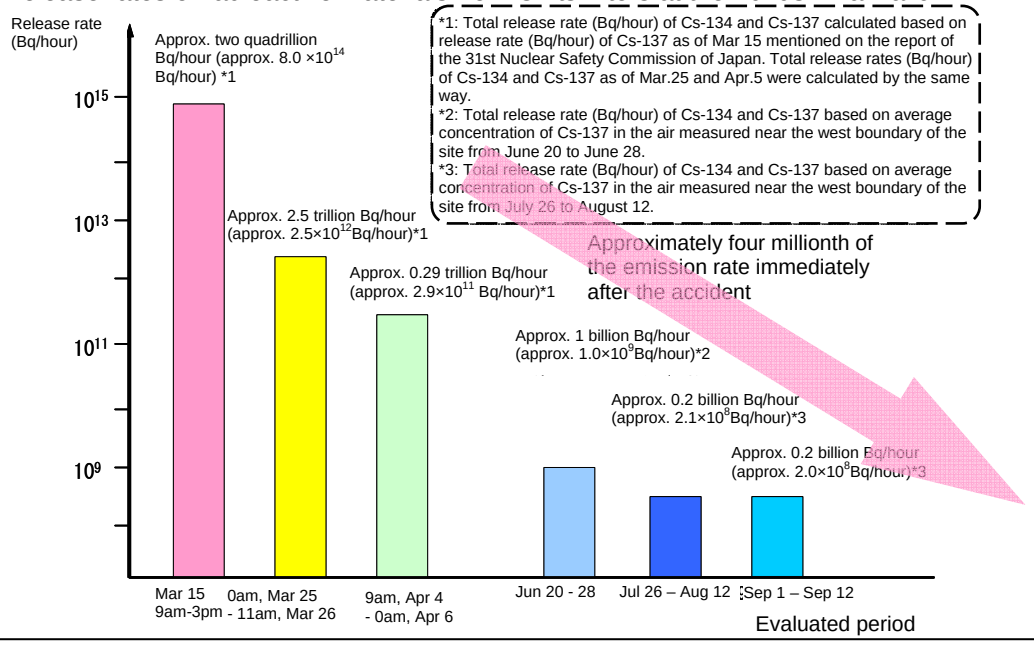


- The current release rate from Units 1 to 3 has been evaluated utilizing the airborne radioactivity concentration (dust concentration) in surrounding area (land and sea) and at the upper parts of the reactor buildings.
- The current release rate for both Unit 1 and 2 is estimated at approx. 0.04 billion Bq/h using dust concentration at the upper parts of the reactor buildings. The rate for Unit3 is now being re-estimated.
- The current total release rate is estimated at approx. 0.13 billion Bq/h using dust concentration at the sea area, and there might be little effect of radioactive materials that released previously.
- Therefore, the current total release rate is assessed at 0.2 billion Bq/h, which is 1/4,000,000 of that at the time of the accident.
- The radiation exposure per year at the site boundaries is assessed at 0.4 mSv / year provisionally (excluding the effect of the radioactive materials already released up until now.)

Sampling points and Results of the current release rate



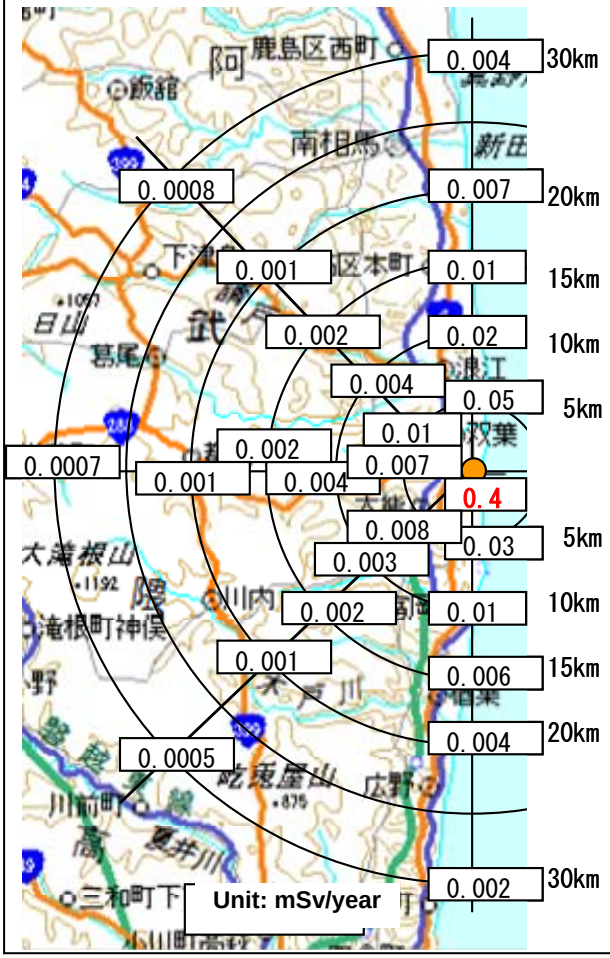
Release rates of radioactive materials from Units 1 to 3 at the Fukushima Daiichi



Exposure doses in case that the current release rate from the power station Units 1 to 3 continues for one year (mSv/year)

(Excluding the effect of already released radioactive materials)

[Map Source: “Digital Japan" URL http://cyberjapan.jp/]



(Overview of the evaluated figures)

Site boundary: Less than or equal to approx. 0.4 mSv/year

5km radius : Less than or equal to approx. 0.05 mSv/year

10km radius : Less than or equal to approx. 0.02 mSv/year

20 km radius : Less than or equal to approx. 0.007 mSv/year

As a reference, the dose limit by reactor facilities at an outside of a nuclear power station is 1 mSv/year.

② Joint monitoring by the central government, prefectures, municipalities and the operator【Countermeasure 62】

・ Implementing/will implement sampling and measurement at land and sea as below:

[Land]
<Monitoring within 20km radius>

・ Measurement of airborne radioactivity concentration by the support team from other electricity utility companies at 50 points (once a week)
・ Soil sampling of the same 50 points and additional points (approx. 50) by the same team (every two months)

【Sea】
< Fukushima Prefecture>

・ Seawater at 11 points within the site bay (once a day)
・ Seawater at 4 points along the coast (once a day)
・ Seawater at 8 points within 20 km radius (every two days)
・ Seawater at 3 points within 30 km radius (once a week)
・ Seawater at 10 points outside of 30 km radius (once a week)
・ Seabed soil survey at 25 points (once a month)

<Ibaraki Prefecture>

・ Seawater at 5 points (once a week)

<Miyagi Prefecture>

・ Seawater at 6 points (every two weeks)

・ Unmanned survey boat will be installed. After a test-run within the site bay, sampling of seawater as well as seabed soil, etc. will be implemented at a few kilometers offshore in front of the power station.

● The cabinet and The Ministry of Education, Culture, Sports, Science and Technology announced the implementation of “Wide Area Monitoring” at restricted areas and deliberate evacuation areas (Sep. 1). The operator drew up a plan and conducted monitoring (approx. 800 persons in total).

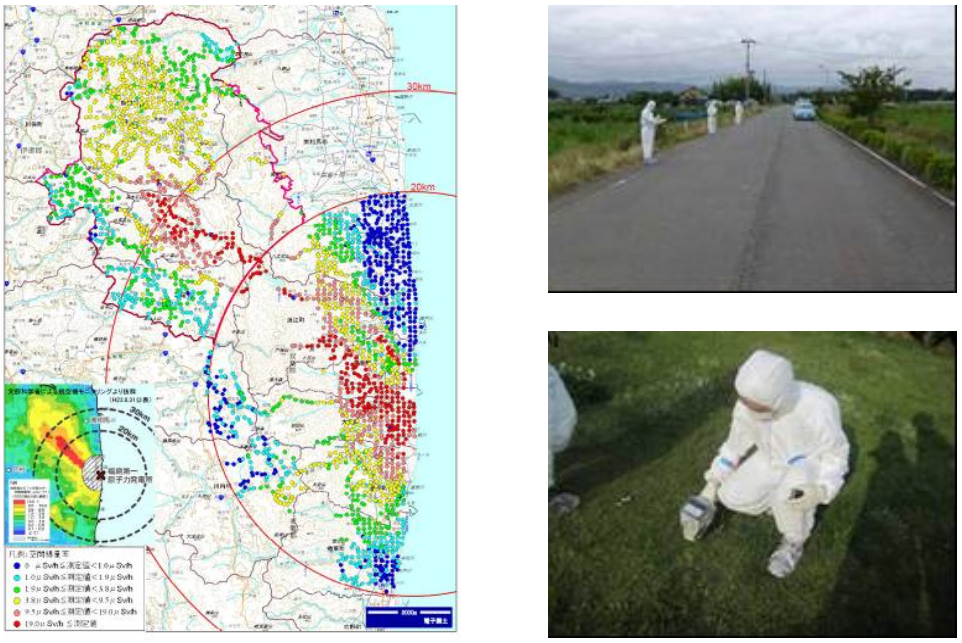
・ Divide the target areas by 2km x 2km meshes, choose approx. 20 points from each mesh based on the basic data collection results* and monitor the airborne radioactivity concentration (from Jul. 4 to Aug. 20).

*Various places such as 16 points by dividing each mesh 500m x 500m as well as crowded places (schools, public facilities, parks, shopping malls, supermarkets, shrines and temples, etc.) were selected.

・ Based on the Wide Area Monitoring results, in order to collect the basic data for planning measures to improve the environment in these areas, detailed investigations on homes, roads, schoolyard, etc., “Individual Detailed

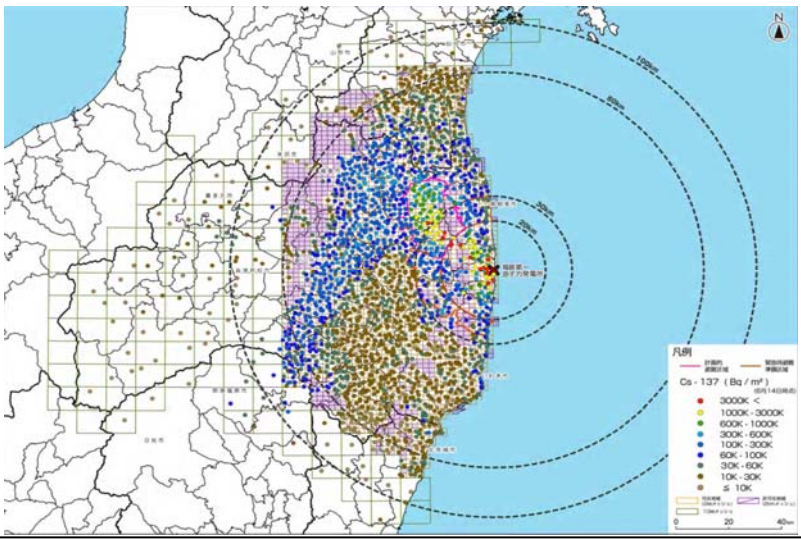
Monitoring", are being implemented (from mid June to the end of October.)

Wide Area Monitoring results map (height: 1m) and measurement work



- The Ministry of Education, Culture, Sports, Science and Technology announced the implementation of "Map of radioactive contamination"(Aug. 30). Electric power companies team has supported.

Cesium contamination map



③Consideration and commencement of full-scale decontamination【Countermeasure 63】

- "Basic Concept for Pushing Ahead with Decontamination Works" and "Basic Policy for Emergency Response on Decontamination Work" which sets forth the target and stance for two years onwards have been established (Aug. 26.)
- Concurrently, presented "Guidelines for Municipal Decontamination Work" in

order to facilitate decontamination work by each municipality (Aug.26.)

- In order to urgently implement the decontamination work, based on “Basic Policy for Emergency Response on Decontamination Work”, the cabinet decided to spend approx. 220 billion JPY from the Great East Japan Earthquake Recovery and Reconstruction Reserve Fund (Sep. 9.)
- From late August, the decontamination work at broader areas including residences, roads and vegetation began in Date City and Minamisoma City. From now on, the decontamination work will be broadened and implemented at 12 municipalities which are located in restricted areas and deliberate evacuation areas.
- Promulgated the “Act on special measures in relation to measures for environmental pollution by radioactive materials released due to the accident at the nuclear power stations in connection with Tohoku-Chihou-Taiheiyo-Oki Earthquake on March 11, 2011” (Aug. 30.)
- The operator will collect information for effective decontamination through individual detailed monitoring currently in process. With these results, the operator will support decontamination work by the government and municipalities.
- Also, the operator will cooperate with Fukushima Prefecture on the model project for reduction of radiation at general residential areas.

IV. Countermeasures against aftershocks, etc.

(7) Tsunami and reinforcement, etc.

1. Target for Step 2 “Mitigation of further disasters”

- Prevent situation from deterioration by mitigating disasters with countermeasures against emergencies (earthquakes and tsunami, etc.)
- Consideration of reinforcement work of each unit as necessary.
- Continue implementing various radiation shielding measures.

2. Current status and work implemented

① Implementation of seismic resistance evaluation for each unit [Countermeasure 71]

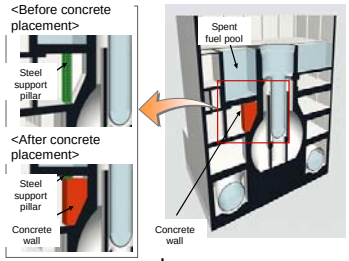
- Consideration of current seismic resistance and reinforcement, etc. for reactor buildings of Unit 2, Unit 5 and Unit 6 was implemented and evaluated by Aug. 26 (Unit 1 and Unit 4 were completed by May. 28 and Unit 3 was completed by Jul. 13.)
- As a result of the analysis, it was confirmed that seismic resistance can be secured without any reinforcement.
- A survey inside the buildings will be conducted after implementation of measures to reduce radiation dose.

Installation status of support structures in Unit 4 (Completed on Jul. 30)

Before installing steel support pillars (photographed on May 31)

Installation status of steel support pillars (photographed on Jun. 20)

Concrete placement status (photographed on Jul.21)



Image

Grout filling status (photographed on Jul. 30)

Completion of support structures (photographed on Jul. 30)

V. Environment improvement

(8) Living/ working environment

1. Target for Step 2 “Enhancement of Environment Improvement”

- Improve workers’ living/working environment that had been harsh during the initial phase of the accident, thus leading to maintaining workers’ motivation
- Expansion of temporary dormitories and on-site rest stations
- Improvement of environment such as meals, bath, laundry, etc.

2. Current status and work implemented

① Expansion status of temporary dormitories [Countermeasure 75]

- Completed construction of temporary dormitory able to accommodate 1,600 persons (Aug. 31). Approx. 1,100 persons have already moved in (as of Sep. 11.)

② Establishment status of on-site rest stations [Countermeasure 75]

- Seventeen on-site rest station have been established (approx. 3,400m^2 in size with a capacity to accommodate approx. 1,200 persons) (as of Sep. 9)

Exterior (left) and interior (right) appearances of on-site rest stations

Inside of on-site rest stations (from left: drinking water, etc., restroom and air shower)

(9)Radiation Control/Medical Care

1. Target for Step 2 “Enhancement of Healthcare”

- Thorough radiation exposure control and countermeasures against heat stroke.
- Reinforcement of radiation control by NISA.
- Increase in the number of whole body counters, monthly measurement of internal exposure.
- Automated recording of personal radiation dose, report of personal exposure dose in writing, introduction of workers’ certificates with photos.
- Consideration of a long-term healthcare such as enhancement of workers’ safety training and establishment of a database.

2. Current status and work implemented

① Expansion of whole body counters (WBC) [Countermeasure 78]

- Increased WBCs as planned (6 units have already been added as of Aug. 11.)
- Started measuring internal exposure once a month from September.
- Plan to increase WBCs step by step from late September.

② Written notification of exposure dose etc. [Countermeasure 78]

- Provided recording format of personal exposure in every entry (Aug. 16.) Started to use workers’ certificates with photos step by step (July 29.) Automated recording of personal exposure is under preparation. (Exposure data are currently manually secured in preparation for the use in future.)

③ Consideration for long-term healthcare such as establishing database [Countermeasure 78]

- Announced the creation of database as well as a framework of comprehensive long-term health care as a “Grand Design” (Aug. 3) and will finalize within September.

④ Continuous reinforcement of medical system [Countermeasure 80]

- Changed Units 5/6’s emergency medical room’s period of operations from summer-only to all year round and emergency doctors, etc. have continuously been in place after September (Jul. 1.)
- Nurses (since Aug. 29) and radiation specialists (since Aug. 31) have been and will be in place (not regular basis in the meantime.)
- Reinforcement of medical facility and decontamination facility to enable the speedy transportation of patients and also the direct transportation of non-contaminated severely ill or injured patients to hospitals.
- Doctors have been in place at J-Village for workers’ healthcare management.

Training of screening and decontamination for ill or injured patients
(In front of Units 5/6 service building entrance)

(10) Staff training/personnel allocation

1. Target for Step 2 “Systematic staff training and personnel allocation”

- Promotion of staff training in conjunction with the Government and utility operators, etc.

2. Current status and work implemented

① Promote staff training, etc. in conjunction with the government and utility operators in order to train and allocate staffs systematically. [Countermeasure 85]

- Conducting training for staffs engaged in radiation related work, who will be in great demand.
- TEPCO has been conducting “radiation survey staff training” targeted for employees and TEPCO group companies’ employees and has already trained approx. 2,500 personnel.
- The government has been conducting “radiation survey staff training” (5 times till Sep. 9 and approx. 140 personnel were trained.), “radiation protection staff training” (approx. 10 personnel were trained from Aug. 8 to 12) and will continue these trainings.
- According to affiliated companies needs, launched a new framework of looking for workers widely through Japan Atomic Industrial Forum (JAIF).

Radiation survey staff training

VI. Countermeasures against midterm issues

1. Target for Step 2

- Mid-term safety securement policy to be drafted by the government.
- Plant operation plans to be developed by the operator based on the above policy.

2. Current status and work implemented

①“Mid-term safety securement policy” is under consideration by NISA

END