3. Developing Technology on Monitoring Radioactive Materials and Decontamination
10. Development of Technologies of Monitoring and Decontamination

We are currently in the process of developing technologies to be utilized in each stage of decontamination in order to ensure safety, accuracy and efficiency in implementing decontamination.

**Mechanization and Automation**
- Monitoring car and gait monitoring equipment were developed to achieve efficient air dose rate measurement (See page 11 & 12).
- Compton camera has enabled the radiation to be visualized (See page 13).

**Development of a Wide Variety of Decontamination Technologies**
Physical/chemical decontamination technologies are verified through indoor and outdoor (field) testing (See page 15-17).

**Drainage Treatment, Waste Storage/Volume Reduction**
Cs behavior during the incineration in a test furnace and Cs removal capacity of the exhaust gas treatment facility are examined.

**Decontamination Effect Analysis**
- Program which shows in 3D the estimated effectiveness of decontamination (radiation dose reduction) has been developed (See page 14).
- Radiation dose statistical analysis which takes into account the regional situations

**Evaluating the Actual Conditions of Decontamination (Conducted by the Self-Defense Forces)**
The actual conditions of the decontamination (in terms of plan development, technical guidance, monitoring, drainage treatment, waste management, etc.) at the government offices of Naraha town, Tomioka town, Namie town and Iitate village conducted by the Self-Defense Forces are leveraged as accumulated know-how for developing contamination plan to be applied to wider regions.
11. Driving Survey Using a Monitoring Car

- We have developed a monitoring car which allows for a driving survey of air dose rate (1m from the ground). The omni camera installed on the vehicle allows photos of the surroundings to be taken at the same time. The dose rate measurement equipment was developed under the supervision of Kyoto University.
- The driving survey is ongoing in the Evacuation Zone and the Planned Evacuation Zone (Currently in the 8th round). One round takes about 40 days (The measurement is done not only on the main roads such as Joban expressway and national roads, but also on smaller roads. The total running distance per round is approx. 6,000km and there are approx. 150,000 measurement points set every 10m).

Source: Documents provided by the Team in Charge of Assisting the Lives of Disaster Victims (Cabinet Office) and the Ministry of Education, Culture, Sports, Science and Technology (Apr. 27, 2012)

The gait monitoring equipment was developed based on the technologies used for developing the monitoring car. The gait monitoring equipment allows for automatic recording of the location information and dose rate on the PC, and is utilized for measurements in areas where the monitoring car cannot enter (for example, off-road residential area).
The utilization of the Compton camera experimentally produced by JAXA for decontamination is currently under consideration (JAEA and TEPCO). A “super-wide angle Compton camera” allows to visualize radioactive materials such as cesium-134 and cesium-137 by identifying the nuclide, direction and intensity of radioactive materials excluding the air dose rate of the environment (See below).
14. Development of a Program which Predicts and Evaluates the Effectiveness of Decontamination

We have developed an analysis program “DeConEP” which predicts and evaluates the effectiveness of decontamination (reduction of air dose after decontamination).

The program is useful in acquiring information as follows.

- How much reduction in radiation dose can be expected after decontamination?
- To what extent should decontamination be done in order to reduce air dose to the target level?
- What is the appropriate decontamination rate to reduce air dose to the target level?
- The radiation source of which has the most significant influence on the air dose of a particular part?

The program overview and evaluation examples were announced at the “Scientific meeting on environmental radioactivity decontamination”*. 

Decontamination Effectiveness Evaluation
Using DeConEP

** SUMMARY **
Demo200m

--- Decay Ratio---
Dose before decontamination: 1.4033721824403
Dose after decontamination: 0.661739000692256
Decay Ratio: 0.471546676087077

Settings of shape and radiation source (Before decontamination)

Air dose distribution at 1m from the ground (Before decontamination)

Settings of shape and radiation source (After decontamination)

Air dose distribution at 1m from the ground (After decontamination)

(Output: Calculation result)

(Output: Visualization of calculation result)
15. Laboratory Testing to Verify the Decontamination Agent Capability

As the contamination condition varies for water, soil and artifacts, the decontamination agent capability is verified in a laboratory testing which allows testing under the same condition.

- Non-radioactive cesium is used as the test material as its behavior is the same as that of radioactive cesium.
- Water decontamination using zeolite, ferrocyanide and coagulant is currently being tested (116 kinds of decontamination agents were tested as of the end of 2011).
- Soil/artifacts decontamination using detergent/cleaning substance and medical agent is also being tested.

**Water decontamination testing in a beaker**

- Decontamination agent such as zeolite: 5g
- 2ppm Cs, I, Sr solution: 200ml
- Leave it still in 10 °C water
- Sampling done after 24h
- Filtration

Cs density analysis using ICP-MS

**Soil decontamination testing**

- Soil
- Cesium elution from soil using a shaker
- Sampling of eluate from soil

**Artifacts decontamination testing**

- Wood material
- Asphalt (being decontaminated)
- Tile
- Artifacts samples
- Gravel decontamination testing

**Waste water treatment testing (coagulation-sedimentation)**

- Waste water from asphalt road decontamination
- Coagulant
- Coagulation aid
16. On-site Decontamination Effectiveness Testing

We have conducted on-site decontamination testing (in the Evacuation Zone) in order to verify the effectiveness of a variety of decontamination methods. The results (such as decontamination rate and workability) are leveraged for decontamination to be done in wider areas (including decontamination conducted by the Self-Defense Forces). Decontamination testing using a variety of methods is being conducted from September 2011.

**Decontamination testing (Example)**
- Road surface (asphalt, concrete): High-pressure water cleaning (50-150atm), sandblast (iron powder, coarse sand, very fine sand), grinder, metal brush
- Turf and plants: Strip the surface soil with a mower (hammer knife style, shoulder mower), remove fallen leaves with a blower, high-pressure water cleaning of trees
- Inside buildings: Wiping, vacuuming

**Locations**
TEPCO facilities in the Evacuation Zone, government offices, etc.
17. Decontamination Testing of Surface Soil

Decontamination testing of surface soil using a variety of machines/equipments was done in order to achieve effective soil decontamination and reduce the amount of soil to be removed. The depth of soil removed, cesium density reduction rate, work speed etc. were measured. As a result, it was confirmed that the thin surface of soil could be removed with the machines/ equipments used in the testing and by doing so, sufficient reduction in the radioactive density of soil was observed. Some of the methods below were used in JAEA decontamination model verification project.

**Test period:** August 8, 2011 – March 30, 2012


**Location:** TEPCO General Training Center (Hino city, Tokyo), etc.

Hazama Corporation and TEPCO jointly reported the deliverables of this testing at the 1st presentation of the studies on environmental radioactivity decontamination (Scientific meeting on environmental radioactivity decontamination, May 19-21, 2012).

1. Vacuuming suction
2. Sweeper
3. Hammer knife style mower
4. Turf stripper
5. Asphalt surface cutting machine
6. Blower