Fukushima Daiichi - One Year After: On the Way toward Restoration

WiN-Japan
Junko Ogawa
Rieko Morisaki
Mitsuko Ukai
Mito Sagai
Report regarding WiN-Global and WiN-Canada Donations for TEPCO’s Fukushima Daiichi Accident

Junko Ogawa / Tokyo City University
Gratitude for WiN-Global Donation to the Workers in Fukushima Daiichi site

◆ Guideline of donation to TEPCO
  ➢ Money was not accepted
  ➢ Goods without packaging waste

◆ WiN-Japan decided to give the Revitalizer, Unkel Emperor Granule

The Presentation Ceremony in TEPCO Headquarter

Revitalizer
Gratitude for WiN-Canada Donation to the Women’s Group in Evacuated Area in Fukushima

WiN-Canada, Ms. C. Sidford, President of WiN-C kindly offered donation of 62,000CAD by 12,400 Nuclear industry related people in Canada last summer. There is a women activity group in the towns and villages in Japan anywhere. But the members of the evacuated area have scattered and taken refuge all over the country under the evacuation order. Therefore they got been unable to do even daily information. No donations were given to the women activities. Women activities of the area don’t have funds and are troubled very much. For this situation WiN-Japan decided to help them. Thanks to WiN-C and WiN-J donation, they have been encouraged. Firstly they could restart their information exchange and secondly they could have a meeting. Now they pledge each other to keep hopes up and having positive thinking for the future.
Presentation Ceremony to women’s group in the evacuation area in Fukushima prefecture

The Ohkuma town (F1 site town) members and Mayor, Mr. Watanabe

The participants are the board member of the women’s group. They have gathered from their evacuation place around in Japan

The Integrated meeting by 8 towns, Futaba county, Fukushima prefecture
Current Situation and Projection of Fukushima Daiichi

Rieko Morisaki / Energy Communication Planning
Where is Fukushima NPS
The Earthquake and the Tsunami of the 3/11/2011

Time: 2:46 pm on Fri, March 11, 2011.
Epicentre: Offshore Sanriku coast (38° N, 142.9° E), 24km in depth, Magnitude 9.0
Intensity: Level 7 at Kurihara in Miyagi prefecture
Upper 6 at Naraha, Tomioka, Okuma, and Futaba in Fukushima pref.
Lower 6 at Ishinomaki and Onagawa in Miyagi pref., Tokai in Ibaraki pref.

The Epicenter and Intensity

Source area of the Earthquake

Tsunami Wave Sources

- The M9.0 earthquake, fourth largest in the world caused by a coupling movement of several separate seismic regions; the Off-shore Miyagi pref., the Southern Trench off-shore Sanriku east, the Off-shore Fukushima pref., and the Off-shore Ibaraki pref.
- Although the Governmental Research Authority, as well as TEPCO had evaluated seismic motion and tsunamis in individual regions by the scientific analyses, the coupling movement of all these regions had not been taken into account.
### Intensity of the earthquake at the power station

Most observed acceleration data was below that of the design-basis earthquake

<table>
<thead>
<tr>
<th>Observation Point (The lowest basement of reactor buildings)</th>
<th>Observed Data</th>
<th>Maximum Response Acceleration against Basic Earthquake Ground Motion (gal)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Horizontal (N-S)</td>
</tr>
<tr>
<td><strong>Fukushima Daiichi</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit 1</td>
<td></td>
<td>460*</td>
</tr>
<tr>
<td>Unit 2</td>
<td></td>
<td>348*</td>
</tr>
<tr>
<td>Unit 3</td>
<td></td>
<td>322*</td>
</tr>
<tr>
<td>Unit 4</td>
<td></td>
<td>281*</td>
</tr>
<tr>
<td>Unit 5</td>
<td></td>
<td>311*</td>
</tr>
<tr>
<td>Unit 6</td>
<td></td>
<td>298*</td>
</tr>
<tr>
<td><strong>Fukushima Daini</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit 1</td>
<td></td>
<td>254</td>
</tr>
<tr>
<td>Unit 2</td>
<td></td>
<td>243</td>
</tr>
<tr>
<td>Unit 3</td>
<td></td>
<td>277*</td>
</tr>
<tr>
<td>Unit 4</td>
<td></td>
<td>210*</td>
</tr>
</tbody>
</table>

*: The records were stopped approximately 130-150 seconds after recording started.

Slide Provided by TEPCO

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Height of the Tsunami at Fukushima Daiichi(1)

Entire facility of Fukushima Daiichi was flooded

Main Office Bldg

Seismic Isolated Bldg

Radioactive Waste Bldg

(C)GeoEye
Almost all of the fuel has melted down on the Basement of the containment vessel with 65cm penetration.

### Imaginary Picture of Current Fukushima Daiichi (as of Nov.30)

<table>
<thead>
<tr>
<th>Reactor Pressure Vessel</th>
<th>Circulation Water Cooling</th>
<th>Containment Vessel</th>
<th>Spent Fuel Pool</th>
<th>High Level Contaminated Water</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Circulation Water Cooling</strong></td>
<td>44.5°C</td>
<td>Nitrogen Encapsulation</td>
<td>Circulation Water Cooling Around 10°C Stable</td>
<td>3,332mm</td>
</tr>
<tr>
<td><strong>Circulation Water Cooling</strong></td>
<td>75.9°C</td>
<td>Nitrogen Encapsulation</td>
<td>Circulation Water Cooling Around 20°C Stable</td>
<td>3,007mm</td>
</tr>
<tr>
<td><strong>Circulation Water Cooling</strong></td>
<td>67.9°C</td>
<td>Nitrogen Encapsulation</td>
<td>Circulation Water Cooling Around 20°C Stable</td>
<td>2,980mm</td>
</tr>
<tr>
<td>No fuel</td>
<td>No fuel</td>
<td>Normal</td>
<td>Circulation Water Cooling Around 20°C Stable</td>
<td>3,0011mm</td>
</tr>
</tbody>
</table>

Source: Denki Shinbun

※Unit No. 5 & 6: Cold Shutdown

※Outage for Inspection

**Rector Pressure Vessel**
- Spent Fuel Pool
- Reactor Pressure Vessel
- Containment Vessel

**Containment Vessel**
- No.2: 57% Fuel
- No.3: 63% Fuel Melted down

**Spent Fuel Pool**
- Circulation Water Cooling Around 10°C Stable

**High Level Contaminated Water**
- Turbine Bldg Water Level
  - 3,332mm
  - 3,007mm
  - 2,980mm
  - 3,0011mm

**Turbine Bldg Water Level**

The 20th WiN-Global Annual Congress

KALMAR, SWEDEN
Summery of the Step 2 Completion of “Roadmap towards Restoration from the Accident”

- Confirmed the reactors were brought to a condition equivalent to “cold shutdown” and stabilized (in case an accident occurs, we will be able to keep the radiation dose at the site boundaries at a sufficiently low level)
- The targets other than reactors had been achieved as follows, thus the completion of the Step 2 “Release of radioactive materials is under control and radiation doses are being significantly held down” was confirmed.

Progress status of “Roadmap towards Restoration from the Accident at Fukushima Daiichi Nuclear Power Station” on December 16

[Issue (1) Reactors]: Achieved “condition equivalent to cold shutdown”
  RPV bottom temperatures and internal PCV temperatures are, in general, below 100 °C. Release of radioactive materials from PCV is under control and public radiation exposure by additional release is being significantly held down. The mid-term safety of the circulating water cooling system is secured.

[Issue (2) Spent fuel pools]: Achieved “more stable cooling”

[Issue (3) Accumulated water]: “Total volume of accumulated water has been reduced”

[Issue (4) Groundwater]: The start of water shielding wall construction marked the achievement of Step 2

[Issue (5) Atmosphere/Soil]: Unit 1 reactor building cover completion marked the achievement of Step 2.

[Issue (6) Measurement, Reduction, Announcement]: Full fledged decontamination work has begun according to the cabinet decision of the basic policy based on the Special Act

[Issue (7) Tsunami, Reinforcement, etc.]: Seismic safety assessment of the reactor buildings has completed in all Units. A support structure at the bottom of the Unit 4 Spent Fuel Pool has been installed.

[Issue (8) Living/working environment]: Living/working environment has been improved via the construction of temporary dormitories and on-site rest stations.
  Improved working environment that was harsh in the immediate aftermath of the accident via providing healthier meals, installing bathing & laundry facilities, and setting up temporary dormitories & on-site rest stations, thus maintaining worker motivation.

[Issue (9) Radiation control/Medical care]: Health care has been improved via restoring appropriate radiation controls and organizing a medical care system, etc.

Countermeasures for medical care have been implemented: countermeasures against heatstroke and influenza, radiation control system reinforcements, thorough exposure control, consideration for long-term healthcare.

[Issue (10) Staff training/personnel allocation]: Continue staff training and continue to consider a strategy to effectively procure required staff
  Promote staff training, especially for high-demand staff engaged in radiation work, in conjunction with the government and TEPCO.

[Action plan for mid-and-long term issues]: Confirmed that the mid-term safety of the circulating cooling system has been secured.

The facility operation plan in light of the mid-term safety was developed, followed by the government review. Hereafter, the government and TEPCO’s mid-and-long-term countermeasure conference will be established, which will develop mid-and-long term roadmap and promote necessary on-site work and R&D towards decommissioning.
Cold Shutdown Status

- **Circulating Water Cooling** continued (6/27/2011~)
  - It is difficult to accurately understand where the damaged fuel is located in the RPV or PCV, but the temperature at the bottom of RPV bottom and inside the PCV are stable at below 100°C.

- Release of radioactive materials from containment vessel controlled
  - The release of radioactive materials from PCV is controlled and radiation dose is significantly reduced by cooling the inside of the PCV and controlling steam generation.
Controlling the Release of Radioactive Materials

- The amount of radioactive materials (cesium) released from Unit 1-3 PCV is calculated the assessed value of total release amount (as of February 13, 2012) as **about 10 million Bq/hr.**
- **About one-80 millionth** compared to immediately after the accident.
- Accordingly, assessed the exposure dose at site boundary as **0.02 mSv/yr.** at maximum.
- (Excluding effect of already released radioactive materials)
- Note: Exposure limit established by law is 1 mSv/yr.

In front of the Emergency Response Centre

March 2012
Accumulated Water Treatment
~Controlling the Total Amount of Accumulated Water~

- Reliability improvement of Water Treatment Facility and Introduce Multi-nuclide Removal System (FY2012)
- Tanks with Total Capacity of 165 thousand tons are in operation. Additional 40-thousand be installed.
- Reduction of groundwater flow into the buildings

Units 1-4 <High level>
- Waste sludge storage facility
- Accumulated water treatment (Kurton, Areva, SARRY)
- High-concentration accumulated water tank
- Concentrated SW tank
- Concentrated waste liquid tank
- Salt treatment (evaporative concentration)
- Salt treatment (RO membrane)
- Concentration SW
- Treatment water receiving tank
- Multi-nuclide removal system (planned to be installed)

Units 5 & 6 <Low Level>
- Low-concentration treatment water tank/megafloat
- Purification system
- Evaporative concentrated water tank
- Low-concentration treated water tank
- Freshwater, RO concentrated water tanks

Slide Provided by TEPCO

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Preventing Dispersion of Radioactive Materials

- An agent to prevent the dispersion of radioactive materials has been sprayed.
- Installed reactor building cover on Unit 1 (October 28, 2011).
- Reduced radiation level at the station site by removing rubble and storing/managing them according to radiation level.
- Installed PCV gas control system. (Unit1,2,3)
  - Maintains PCV internal pressure at around atmospheric levels and manages the released amount of radioactive materials.
### Mid-and-long Term Roadmap

**Present (Completion of Step 2)**
- **Step 1, 2**
  - Achieved Stable Conditions
  - Condition equivalent to cold shutdown
  - Significant Suppression of Emissions

**Within 2 Years**
- **Phase 1**
  - Period to the start of fuel removal from the spent fuel pool (Within 2 years)

**Within 10 Years**
- **Phase 2**
  - Period to the start of fuel debris removal (Within 10 years)

**After 30-40 Years**
- **Phase 3**
  - Period to the end of decommissioning (After 30-40 years)

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**Removal of Rubble**

**Fuel debris taken out**

- Overhead traveling crane
- Container
- Work truck
- Debris storage cans
- RPV lid
- Telescopic tube
- Camera
- Cut
- Excavation
- Grip
- Suction device
- PCV
- Fuel pool
- Fuel debris
Target Timeline:

1) Reactor Cooling, Accumulated Water Processing

- In order to stably maintain “a condition equivalent to cold shutdown”, water injection cooling will be continued up to the completion of the fuel debris removal.
- By examining the reliability of the system, system improvements will be continuously implemented.
- During Phase 2, processing of accumulated water in the buildings will be finished. In order to achieve more stable cooling, scaling down of the circulation loop is being considered.
Target Timeline:

2) Plans to Mitigate Sea Water Contamination

- Should underground water be contaminated, water shielding walls will be installed by mid FY2014 in order to prevent underground water from flowing into the ocean.
- Covering and solidifying seabed soil in front of the intake canal will prevent the diffusion of radioactive materials in the soil. By the end of FY2012, the continuous operation of the circulating seawater purification facilities will reduce radioactive materials in the seawater inside the site port to the level below the limit for the outside of environment surveillance areas as determined by a notification of the government. Sediments dredged in order to secure a navigable depth for large ships will be similarly covered.
- Afterwards, while maintaining the installed facilities, underground water and sea water etc. will be continuously monitored.
Monitoring Initiatives Toward Decontamination

Soil Sampling

Ambient dose rate measurement

Basic data collection monitoring and measurement work

Regional monitoring and measurement

Ambient dose rate measurement with monitoring car

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The New Cesium Radioactivity Regulation for Food and Countermeasures to the Rumor Damage

Mitsuko Ukai / Hokkaido University of Education
The concept of Current Provisional regulation Values

- The current provisional regulation values were established based on the concept shown below, in line with “index relating to the restriction of food intake” derived by the Nuclear Safety Commission under assumption of nuclear power plant accidents.
  1) Set the annual maximum permissible dose from radioactive cesium in foods as 5 mSv and assign to each food category.
  2) Assuming that people continue to consume contaminated foods for a long time, derive regulatory values, based on the intakes according to food categories, so that the permissible dose is not exceeded.

Note: Apply the lowest levels – which are obtained by taking into consideration the intake and susceptibility of the groups of adults, young children, and infants – to all age groups.

e.g.) The setting method of current provisional regulation values for radioactive cesium

<table>
<thead>
<tr>
<th>Food category</th>
<th>Calculate limit values (Bq/kg), taking into consideration the intake and susceptibility.</th>
<th>Regulation values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adults</td>
<td>Young children</td>
</tr>
<tr>
<td>Drinking water</td>
<td>201</td>
<td>421</td>
</tr>
<tr>
<td>Milk, dairy products</td>
<td>1660</td>
<td>843</td>
</tr>
<tr>
<td>Vegetables</td>
<td>554</td>
<td>1686</td>
</tr>
<tr>
<td>Grains</td>
<td>1110</td>
<td>3830</td>
</tr>
<tr>
<td>Meat, eggs, fish, etc.</td>
<td>664</td>
<td>4010</td>
</tr>
</tbody>
</table>
Establishment of New Standard limits for Radionuclides in Food

1. Concept of Review
   - Based on current scientific knowledge, commodities that meet current provisional regulation values are considered to be safe, and in fact food safety is basically secured. However, to achieve further food safety and consumer confidence, Japan is planning to reduce maximum permissible dose from 5mSv/year to 1mSv/year.
   - Establish the four categories of “Drinking water”, “Infant foods” and “Milk”, which are deemed to need special consideration, and “General foods” for other foods.

2. New standard limits
   (Date of enforcement : April 1, 2012. Transitional measure applies to some commodities.)

   ○ Provisional regulation values for radioactive cesium<sup>1</sup>

<table>
<thead>
<tr>
<th>Category</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drinking water</td>
<td>200</td>
</tr>
<tr>
<td>Milk, dairy products</td>
<td>200</td>
</tr>
<tr>
<td>Vegetables</td>
<td></td>
</tr>
<tr>
<td>Grains</td>
<td>500</td>
</tr>
<tr>
<td>Meat, eggs, fish, etc.</td>
<td></td>
</tr>
</tbody>
</table>

   ○ New standard limits for radioactive cesium<sup>2</sup>

<table>
<thead>
<tr>
<th>Category</th>
<th>Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drinking water</td>
<td>10</td>
</tr>
<tr>
<td>Milk</td>
<td>50</td>
</tr>
<tr>
<td>General Foods</td>
<td>100</td>
</tr>
<tr>
<td>Infant Foods</td>
<td>50</td>
</tr>
</tbody>
</table>

NOTE: 1 These values take into account the contribution of radioactive strontium (Unit : Bq/kg)
2 These limits take into account the contribution of radioactive strontium, plutonium etc.
<table>
<thead>
<tr>
<th>Category</th>
<th>Japan</th>
<th>Codex</th>
<th>EU</th>
<th>US</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drinking Water</td>
<td>10</td>
<td>1000</td>
<td>200</td>
<td>1200</td>
<td>-</td>
</tr>
<tr>
<td>Milk</td>
<td>50</td>
<td>1000</td>
<td>200</td>
<td>1200</td>
<td>330</td>
</tr>
<tr>
<td>General Foods</td>
<td>100</td>
<td>1000</td>
<td>500</td>
<td>1200</td>
<td>800–210</td>
</tr>
<tr>
<td>Infant Foods</td>
<td>50</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

(Unit: Bq/Kg)

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The concept of radionuclides to be regulated (1)

- **Radionuclides**
  Targets to be regulated are all radionuclides which were placed on the trial calculation list of the Nuclear and Industrial Safety Agency as substances emitted by the Fukushima nuclear power plant accident, and whose half-life is over 1 year.

Note: Standard limits are not established for radioactive Iodine, which has a short half-life and has been no longer detected, and the for Uranium, whose level is the almost the same in the nuclear power plant site as in the nature environment.

<table>
<thead>
<tr>
<th>Regulated Radionuclides</th>
<th>Physical Half-life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cs-134</td>
<td>2.1 years</td>
</tr>
<tr>
<td>Cs-137</td>
<td>30 years</td>
</tr>
<tr>
<td>Sr-90</td>
<td>29 years</td>
</tr>
<tr>
<td>Pu</td>
<td>14 years or more</td>
</tr>
<tr>
<td>Ru-106</td>
<td>367 days</td>
</tr>
</tbody>
</table>
The concept of radionuclides to be regulated (2)

The concept for establishment of new standard limits

The new standard limits for radioactive cesium are established for effective dose of radionuclides (including Sr-90, Ru-106, Pu) not to exceed 1mSV/year. Because radionuclides other than Cs-134 and Cs-137 require a longer time for measurement, following procedure is taken to establish new standard limits.

- Analyze the migration ratio of each radionuclide according to migration pathway, derive the contribution of radioactive cesium according to product and age categories, and establish standard limits for radioactive cesium so that the sum of effective dose not exceed 1mSv/year.

e.g.) The contribution of radionuclides other than radioactive cesium is about 12% (in case of people aged 19 and older)
The Concept of standard limit for “General Foods”

Operational intervention level 1 mSv/year

Subtract the effective dose for “Drinking water”

Determine the effective dose to assign to “General foods”

<table>
<thead>
<tr>
<th>Age category</th>
<th>Intake</th>
<th>Limit value (Bq/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>under 1</td>
<td>Average</td>
<td>460</td>
</tr>
<tr>
<td>1-6</td>
<td>Male</td>
<td>310</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>320</td>
</tr>
<tr>
<td>7-12</td>
<td>Male</td>
<td>190</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>210</td>
</tr>
<tr>
<td>13-18</td>
<td>Male</td>
<td>120</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>150</td>
</tr>
<tr>
<td>19 and older</td>
<td>Male</td>
<td>130</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>160</td>
</tr>
<tr>
<td>pregnant</td>
<td>Female</td>
<td>160</td>
</tr>
<tr>
<td>Minimum</td>
<td></td>
<td>120</td>
</tr>
</tbody>
</table>

Standard limit 100 Bq/kg

<Effective dose for “Drinking water”=Standard limit for “Drinking water” (Bq/kg) × Intake of drinking water according to age category × Dose Coefficient according to age category>

- In line with WHO’s guidance level for radioactive cesium in drinking water, the standard limit for “Drinking water” is established as 10Bq/kg, and the effective dose as about 0.1mSv/year.
- The effective dose to assign to “General foods” is determined as about 0.9 mSv/year by subtracting the effective dose for “Drinking water” (about 0.1mSv/year) from the operational intervention level (1mSv/year).
- Limit values are calculated by dividing this effective dose by the intake and conversion coefficient according to age category. (On the assumption that 50% of the marketed foods are contaminated.)
### Progress of the review of regulation values

- **Notification of provisional regulation values in foods** (MHLW) (Mar. 17, 2011)
- The Minister of Health, Labour and Welfare requested food safety risk assessment of radionuclides to Food Safety Commission (Mar. 20)
- Report of **food safety risk assessment by Food Safety Commission** (Oct. 27)
- The Minister Komiyama talked about a future fundamental plan in a ministerial conference. (Oct. 28)
- Consultation to **Pharmaceutical Affairs and Food Sanitation Council (MHLW)**
  - Arrangement of a point of argument by Subcommittee & Section meeting of Pharmaceutical Affairs and Food Sanitation Council (Oct. 31)
- The discussion on new standard limits by **section meeting of Pharmaceutical Affairs and Food Sanitation Council** (Nov. 24)
- Proposal standard limits are created by **section meeting of Pharmaceutical Affairs and Food Sanitation Council** (Dec. 22)
- Consultation & Report to/by **Radiation Council** (MEXT) (Consultation :Dec. 27, Under deliberations)
- Public comment (Jan. 6, 2004 - Feb. 4), WTO/TBT notification (Jan.17 - Feb. 10), Risk communication (Jan. 16 – Feb. 28) etc.
- Report by **Pharmaceutical Affairs and Food Sanitation Council (MHLW)**
- **Promulgation of standard limits** (Mar, 2012)
- **Enforcement of standard limits** (Apr, 2012)
The Rumor Damage – No.1
The Concept of criteria as to TEPCO’s Fukushima Daiichi Accident

◆ Rumor Damage is a damage which was caused by rumors coming from the fact widely told by the media, social network and so on.
◆ It covers the damage with respect to goods or service of all type of industry, such as tourist business, the manufacturing industry, catering trade, retail trade and the construction industry, etc.
◆ The rumor damage includes not only suspension of business by consumers but also damage which probably originally existed by people who worry about risk of contamination of radioactive material and refrain from buying.
The Rumor Damage - No. 2
Current Condition

◆ Civic concern is turned particularly to the safety of food.
◆ It is a key whether producers conform to a new standard.
◆ According to the research in last March by the government, the food which exceeded the new standard became 377 kinds of 57 items in 10 prefectures. The top was Fukushima pref. and the surrounding prefectures followed Fukushima.
◆ By the kind of food, there were fishes most followed by vegetables and meats.
◆ As to the tourist business, during a holiday Week (April end-May beginning) this year, there were many people who went to the Tohoku district in order to support Tohoku economically. So the rumor damage was not so serious at the present. The situation has gradually come better.
◆ Different from last year, troubles as to the export business caused by radioactive contamination are not heard in this year.
The local governments are proactively holding workshops and seminars for the residents in order to lessen their uneasy feeling. Many people are participating in the workshops and seminars.

The distribution industry such as supermarket-chain, department stores make voluntary standards to be severer than the government and provide customers with information.

Media seems to have a thought that the superfluous reaction about radioactivity might make a serious additional blow on the disaster-stricken area, so currently their attitude of release became refraining from sensationalism.

Nuclear Damage Compensatory Dispute Settlement Center performs examination of a damage caused by rumors

Nuclear Damage Compensatory Support Organization delivers funds to the requesters
Supporting Activities for
TEPCO’s FUKUSHIMA Daiichi Accident by Electric Power Companies & CRIEPI

Mito Sagai / Central Research Institute of Electric Power Industry
CONTENTS

1. Electric Power Companies Supporting Activities

2. CRIEPI’s Supporting Activities
Electric Power Companies Supporting Activities

Led by the Fukushima Support Headquarters which was set up by FEPC on 2011 April 15, the electric power companies are providing manpower assistance as well as supplies in the Fukushima area and around the Fukushima Daiichi Nuclear Power Station of the Tokyo Electric Power Company (TEPCO).

The main activities
- Manpower assistance
  - contamination and monitoring environmental radiation
- Radioactive contamination screening of the human body
- Environmental radiation monitoring in all of Fukushima Pref.
- Cooperation in radionuclide analyses conducted

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CRIEPI’s Supporting Activities
Central Research Institute of Electric Power Industry

**Human Supporting**
- Screening for radiation contamination in collaborated with TEPCO

**R&D**
- Emergent construction of contaminated water treatment
- Influence of sea water injection to damaged cores
  - Few weeks after
- Monitoring for contaminated area
- Simulation of radioactivity dispersion
  - Oceanic dispersion simulation
  - Few months after
  - Atmospheric dispersion simulation
- Reactor analysis of damaged cores situation
- Radiation effect of low dose exposure
  - Mid & Long-term
Topics: Emergent construction of Contaminated water treatment system

Contaminated Water
- Radioactivity: $> 10^6$ Bq/ml
- Impurity: sea water, oil
- Amount: 100,000 m$^3$

Water Recycle Since 6/27

Desalination
- HITACHI-GE, AREVA

Cs Precipitation
- AREVA

Cs Adsorption
- KURION

Oil Separation
- TOSHIBA

Basement of Turbine Building
- 1200 ton/day

Before rainy season!

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CRIEPI’s back-up R&D for contaminated water treatment system

- A small-scale zeolite column was emergently installed and tested for obtaining design basics of KURION media system.
- Based on the measured kinetic behaviors, simulation code to predict Cs adsorption behavior was developed, and verified by actual data.
- The code is still in use for optimization of operation mode of KURION system to decrease worker’s radiation exposure and waste.

Small-scale column test apparatus

Verification of new program to predict DF

\[
DF = \frac{\text{Cs in contaminated water}}{\text{Cs in treated water}}
\]


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Monitoring for contaminated area

- Under the comprehensive monitoring plan agreed with government,
  - Objected area: **Restricted Area** and **Deliberate Evacuation Area**
  - Implementation in cooperation with TEPCO (June-Nov., 2011)

- For examination of environmental remediation for these area,
  - **Fundamental monitoring**
    - Measuring air dose rate by 100m-mesh partitioning for areas with various environments.
  - **Wide-area monitoring**
    - Measuring air dose rate by 500m-mesh partitioning for all objected area.
  - **Individual monitoring**
    - Measuring air dose rate for decontamination targets, such as houses, roads, playgrounds, etc.

Results of wide-area monitoring (1st Sept. published)
Behavior of Radioactive materials in the environment

Few months after

- Atmosphere
- Soil, Crop, Forest
- Nuclear Power Plant
- Soil, Agricultural products, Forest
- Land water
- Ocean
- Seafood
- Oceanic soil
- Ground water

Schematic view
Oceanic dispersion simulation

$^{137}$Cs dispersion (Term : 2011/3/26 ~ 5/31)

Boundary condition
from re-analysis data

Meteorological condition
from atmospheric model (NuWFAS by WRF)

Direct release rate of $^{137}$Cs
Inverse estimation

Regional Ocean Model System (ROMS)

Concentration in the ocean

Simulated domain
Longitudinal: 500 km,
Latitudinal: 350 km

Few months after

Concentration in seafood

Tsumune et al., Journal of Environmental Radioactivity, 2011
Atmospheric dispersion simulation

Meteorological condition from atmospheric model (NuWFAS by WRF)

Release rate of $^{137}$Cs (Chino et al., 2011)

Atmospheric transport model (CAMx)

Land deposition rate
- Wet and Dry deposition

WSPEEDI by JAEA
- Cumulative land deposition of $^{137}$Cs (Bq/m²) (3/12 ~ 4/1)

CRIEPI
- Cumulative land deposition of $^{137}$Cs (Bq/m²) (3/12 ~ 4/1)

Simulated by SPEEDI (WSPEEDI)
- JAEA, 2011/9/6

Few months after
EPIDEMIOLOGICAL STUDY IN INDIA

- Karunagappally, Kerala, India

- Beach with black sand containing monazite

- HBR Aria
- Control Aria
Mid & Long-term

Effect of low dose radiation

No significant increase of risk (cancer and leukemia incidence, and non-cancer death) albeit a total dose of **600 mGy**
Please Come to FUKUSHIMA!