

# Initiatives for Improving the Working Environment in the Fukushima Daiichi Nuclear Power Plant

10 November 2015

Tokyo Electric Power Company, Incorporated.



東京電力

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# 1-1 Implementing measures to reduce radiation levels

## ■ Objective

To lay the groundwork for moving safely forward with decommissioning and safe convergence of the damaged reactors over the long run by implementing measures to reduce radiation levels, such as tree-felling, surface soil removal, turning over soil, and shielding, after understanding the effects of direct radiation from the plant and the radiation fallout spread throughout the site.

## ■ Implementation plan

### (Priorities)

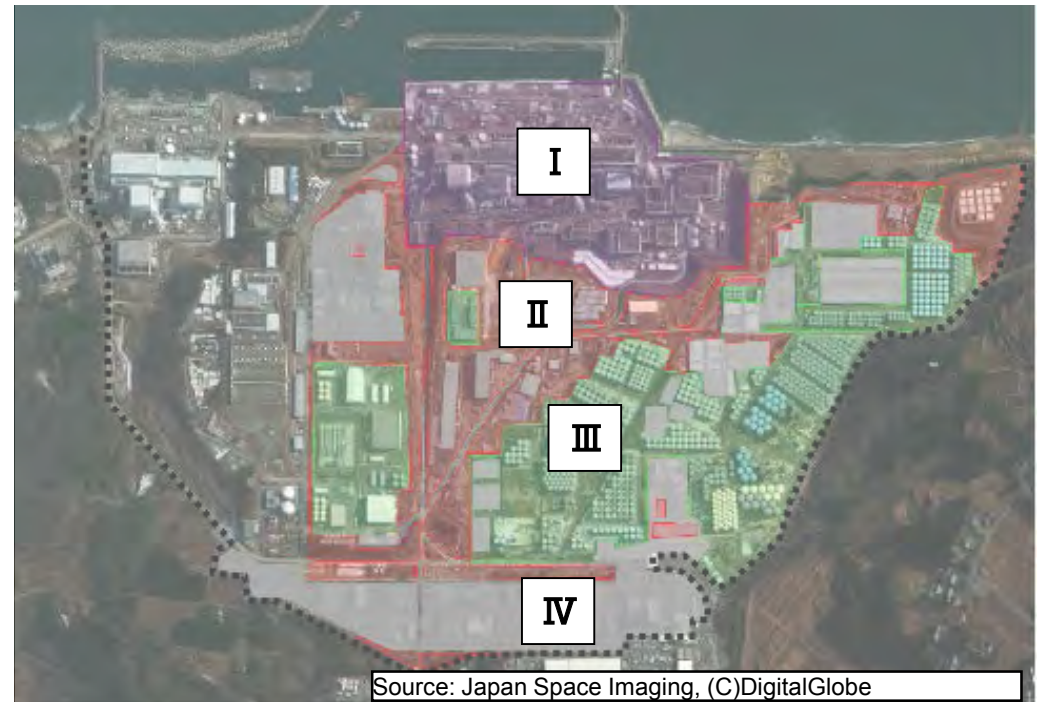
The areas where many workers are engaged in work will be a priority as these measures are implemented in consideration of interference with other construction areas.

### (Target dose rates)

The target dose rate for areas other than those around Units 1-4 (Areas II, III, IV) is set at 5  $\mu\text{Sv/h}$  (area average). The target dose rate will be gradually lowered in stages.

### (Moving forward with radiation level reduction measures)

Radiation reduction measures shall be implemented using appropriate methods after understanding the characteristics of the radiation sources in each area. After the countermeasures have been implemented, dose rates will be measured in order to assess the effect of radiation level reduction measures.




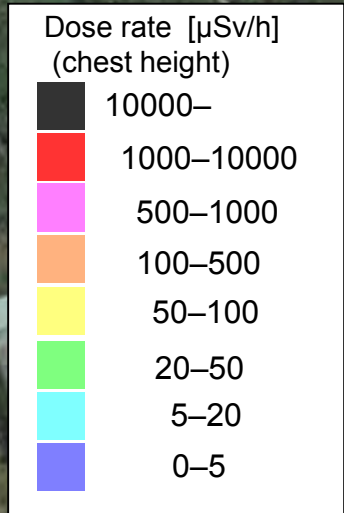
Source: Japan Space Imaging, (C)DigitalGlobe

- Area I: Area around Units 1-4 that have particularly high dose rates
- Area II: Area where plants and trees still remain
- Area III: Area where facilities have been, or will be, installed
- Area IV: Areas that have already been paved such as roads and parking lots
- ■ ■ Implementation scope of on-site dose reduction measure

# 1-2 Dose distribution of dose reduction area

Measurement period: May 2014 to May 2015

 : Areas in which the target dose rate (5  $\mu\text{Sv/h}$ ) has been reached (confirmed at chest height or at ground surface)



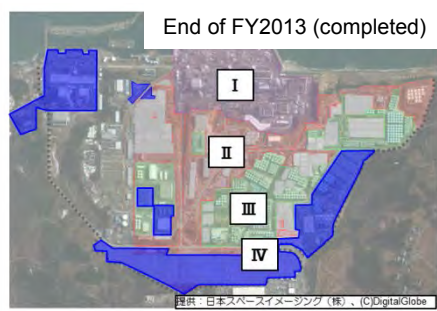
Source: Japan Space Imaging, (C)DigitalGlobe

# 1 – 3 Radiation level reduction area expansion target

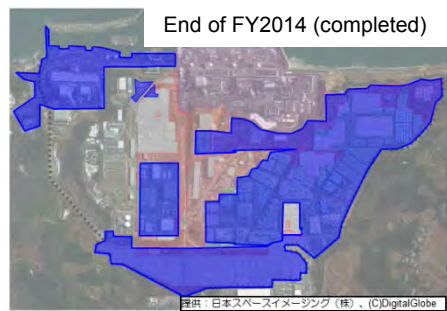


## Achievement rate [Area ratio for the 2015 year-end target]

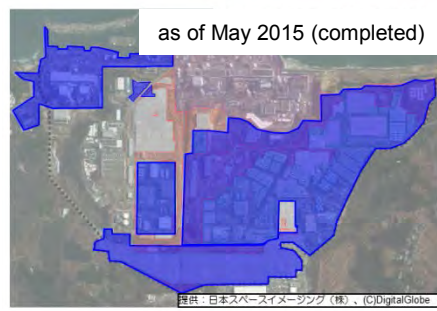
Approximately 40%



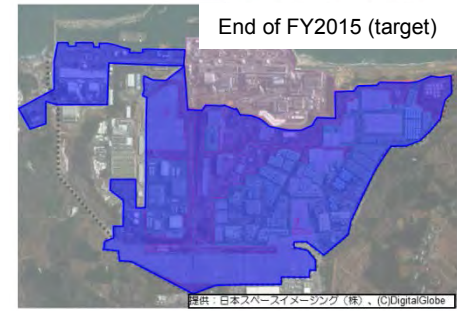
Approximately 77%



Approximately 85%



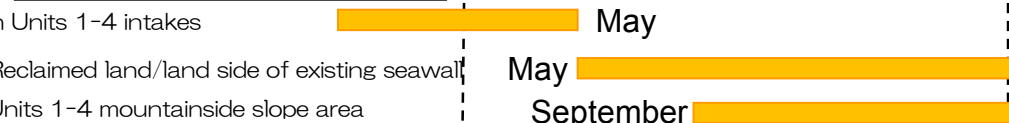
Approximately 100%



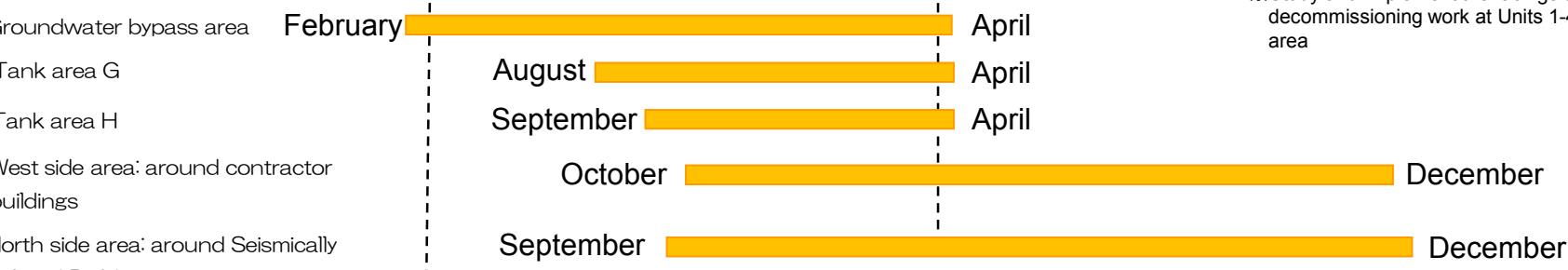
End of FY2015 (target)

### The main process towards achieving goal

① O.P.+4 m / +10 m facing



② O.P.+35 m facing



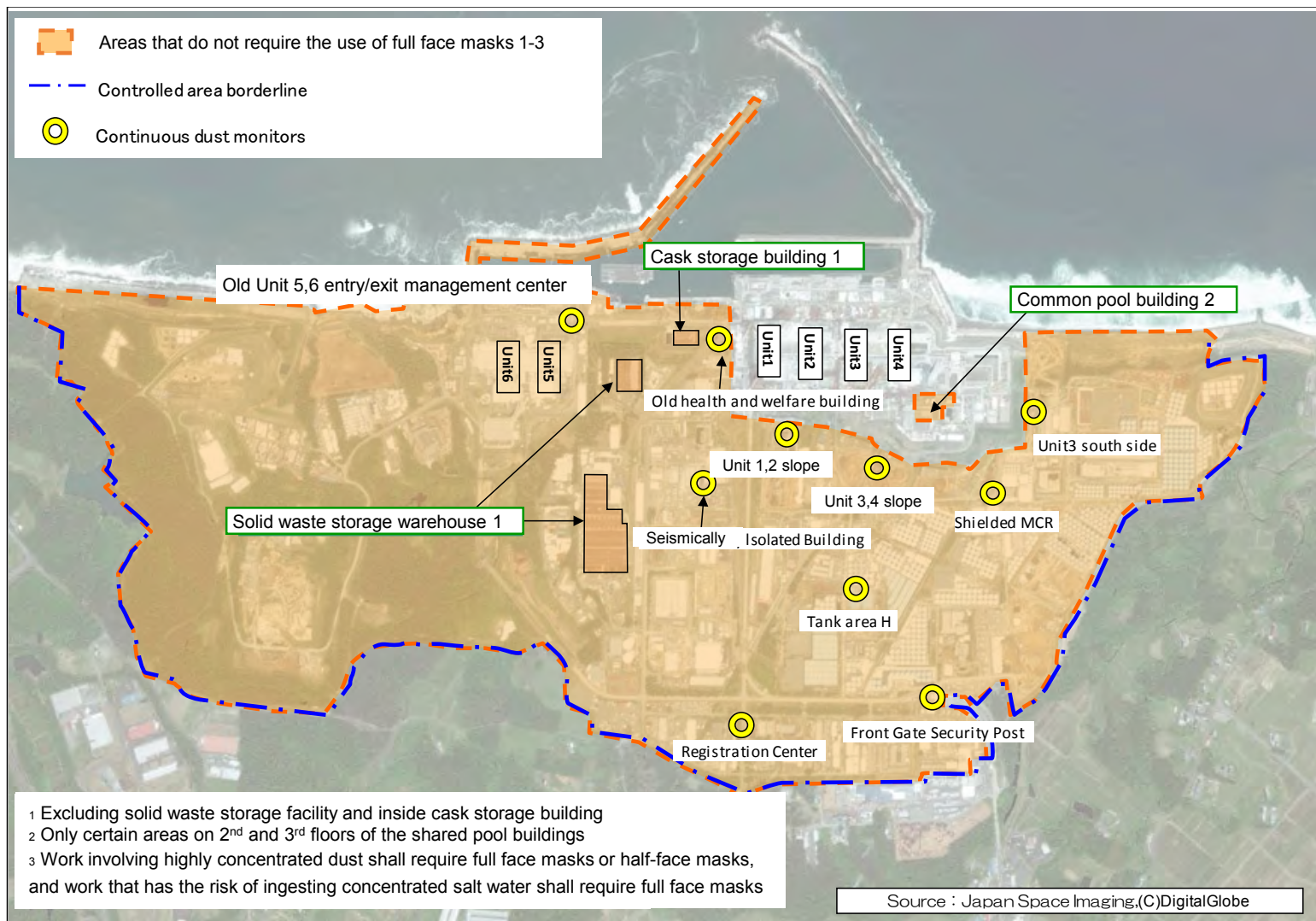
: Areas in which the target dose rate (5 μSv/h) has been reached (confirmed at chest height or at ground surface)

The implementation plan's target range

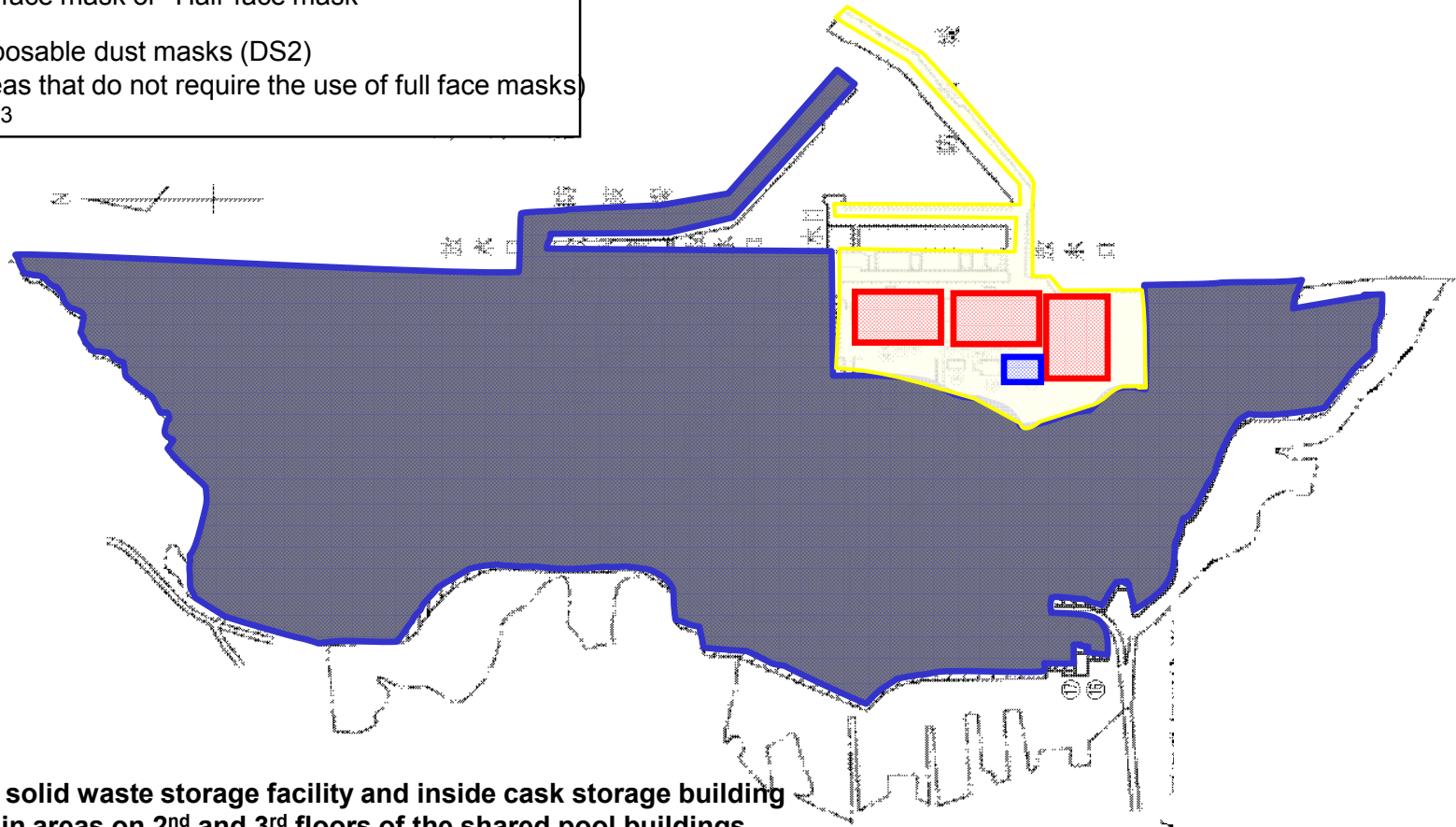
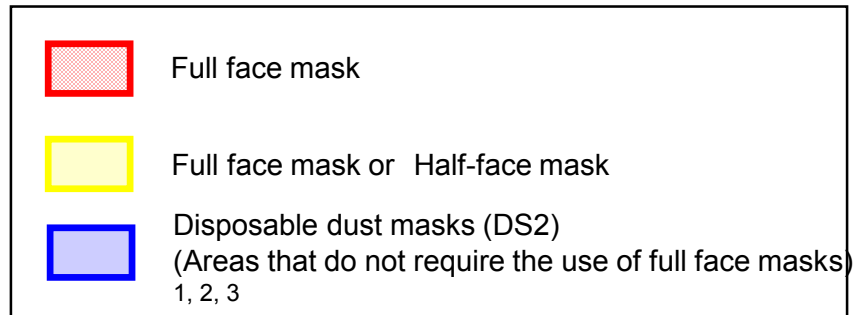
※Study and implement the facings to match the progress of the decommissioning work at Units 1-4 reactor buildings surrounding area

# 2-1 Areas that do not require full face masks

Monitoring of dust enabled with a total of 10 continuous dust monitors so that workers can use disposable dust masks (DS2) in all areas other than those around Units 1-4



## 2-2 Mask requirement categories map (after 29 May 2015)



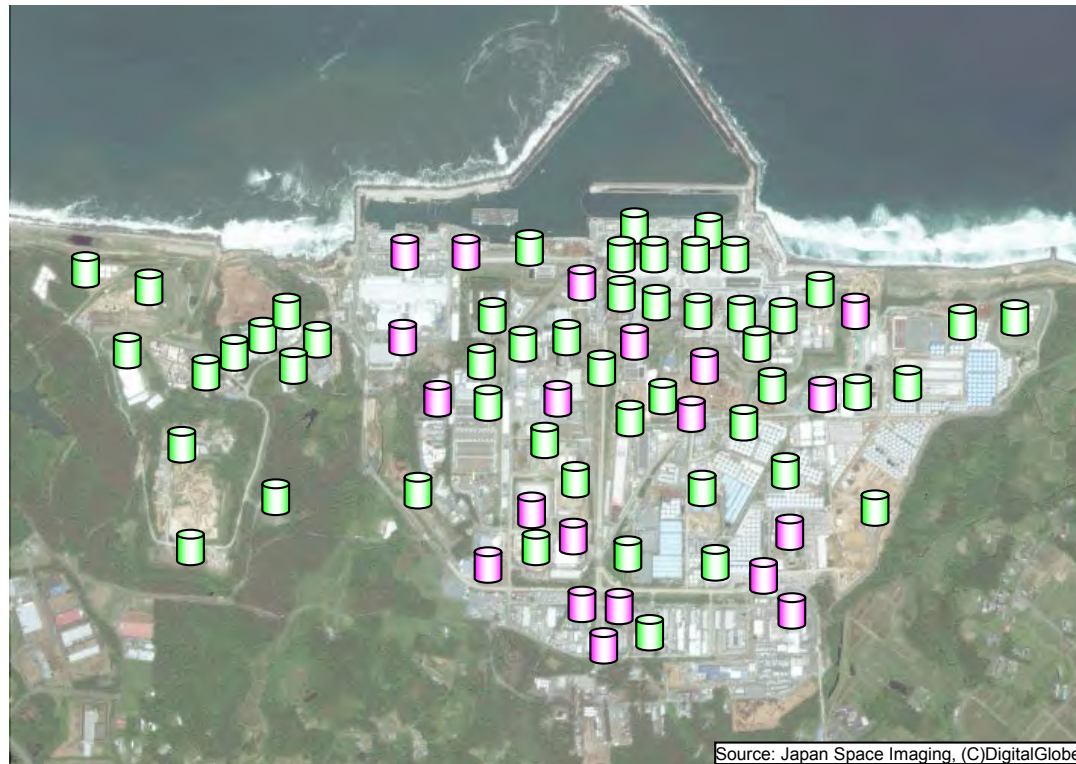
- 1 Excluding solid waste storage facility and inside cask storage building
- 2 Only certain areas on 2<sup>nd</sup> and 3<sup>rd</sup> floors of the shared pool buildings
- 3 Work involving highly concentrated dust shall require full face masks or half-face masks, and work that has the risk of ingesting concentrated salt water shall require full face masks

# 3-1 Dose rate monitor

In order to monitor dose rates after radiation level reduction countermeasures have been implemented, dose rate monitors are installed at the site (Phase I: 20 monitors installed by March 2015, Phase II: 50 monitors installed by November 2015). The installation of these monitors help to make field dose rates more visible by having the values from these dose rate monitors displayed on large display screens in the Seismically Isolated Building and other locations to enable workers to see real-time radiation levels in the field prior to venturing out into it.





Concept drawing of dose rate monitor



Planned Installation Locations

## Dose rate monitors

 Phase 1 installation  
(until March 2015)

 Phase 2 installation  
(until November 2015)

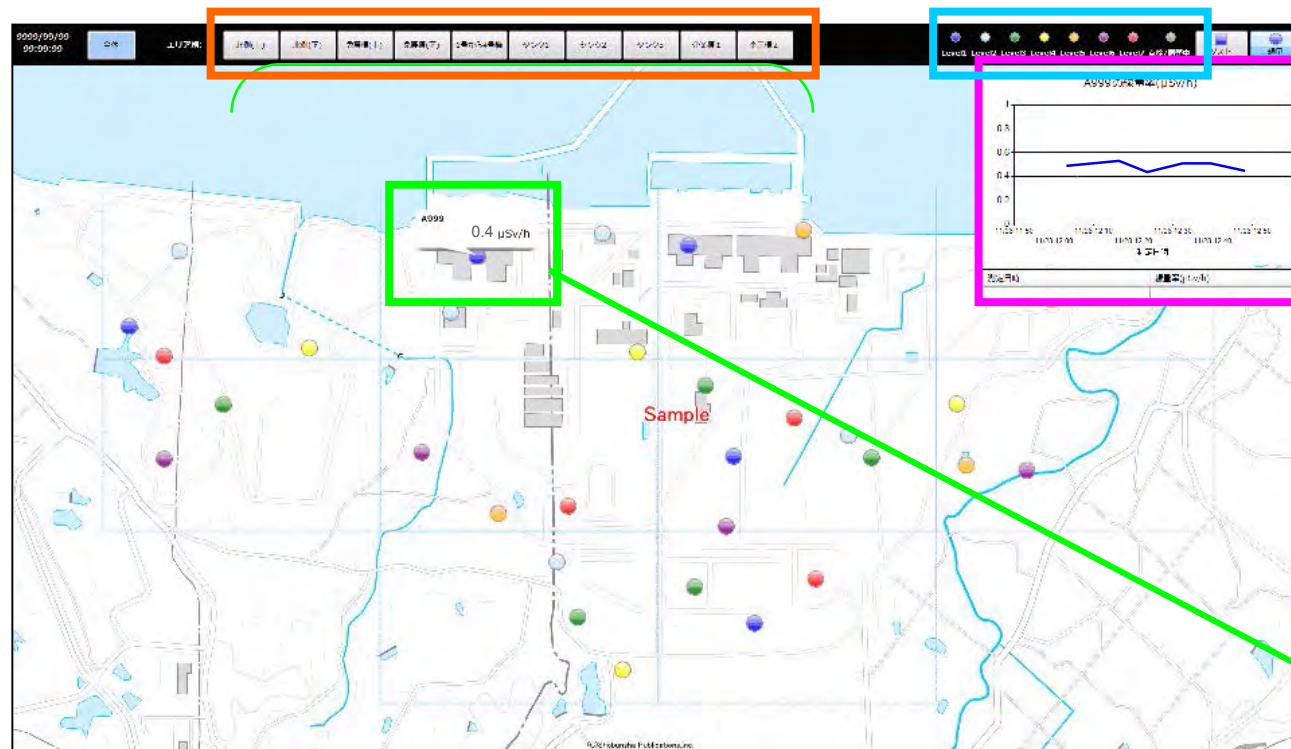
\*The location of monitors installed during phase 2 may be altered depending on the installation environment (physical space and sunlight environment, interference with construction, etc.) and installation needs.

## 3-2 Real-time display of radiation levels in rest areas

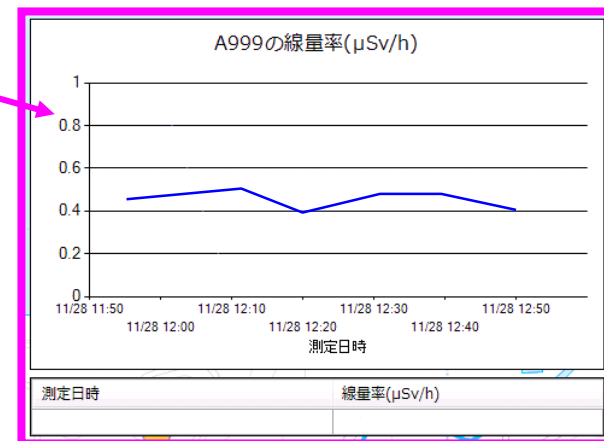
Measurement results from dose rate monitors are displayed in real-time on large display screens (80 inch) (update frequency: every 10 min) that will be installed in locations that are visible to all workers, such as the first floor of the Seismically Isolated Building and the second floor of the Access Control Facility. (A screen is installed on the first floor of the Seismically Isolated Building and a second screen is installed on the second floor of the Access Control Facility.)

In addition to displaying the entire site specific areas can also be enlarged

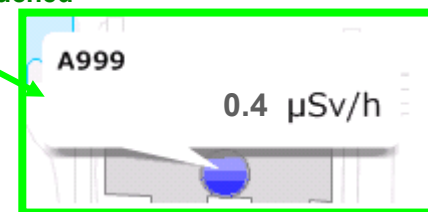
Radiation level intensity is displayed using seven different colors



The latest measurement results and trends for a specific measurement point can be displayed on the upper right portion of the screen by touching the measurement point



The most recent measurement results are shown in a pop-up screen when a measurement point is touched



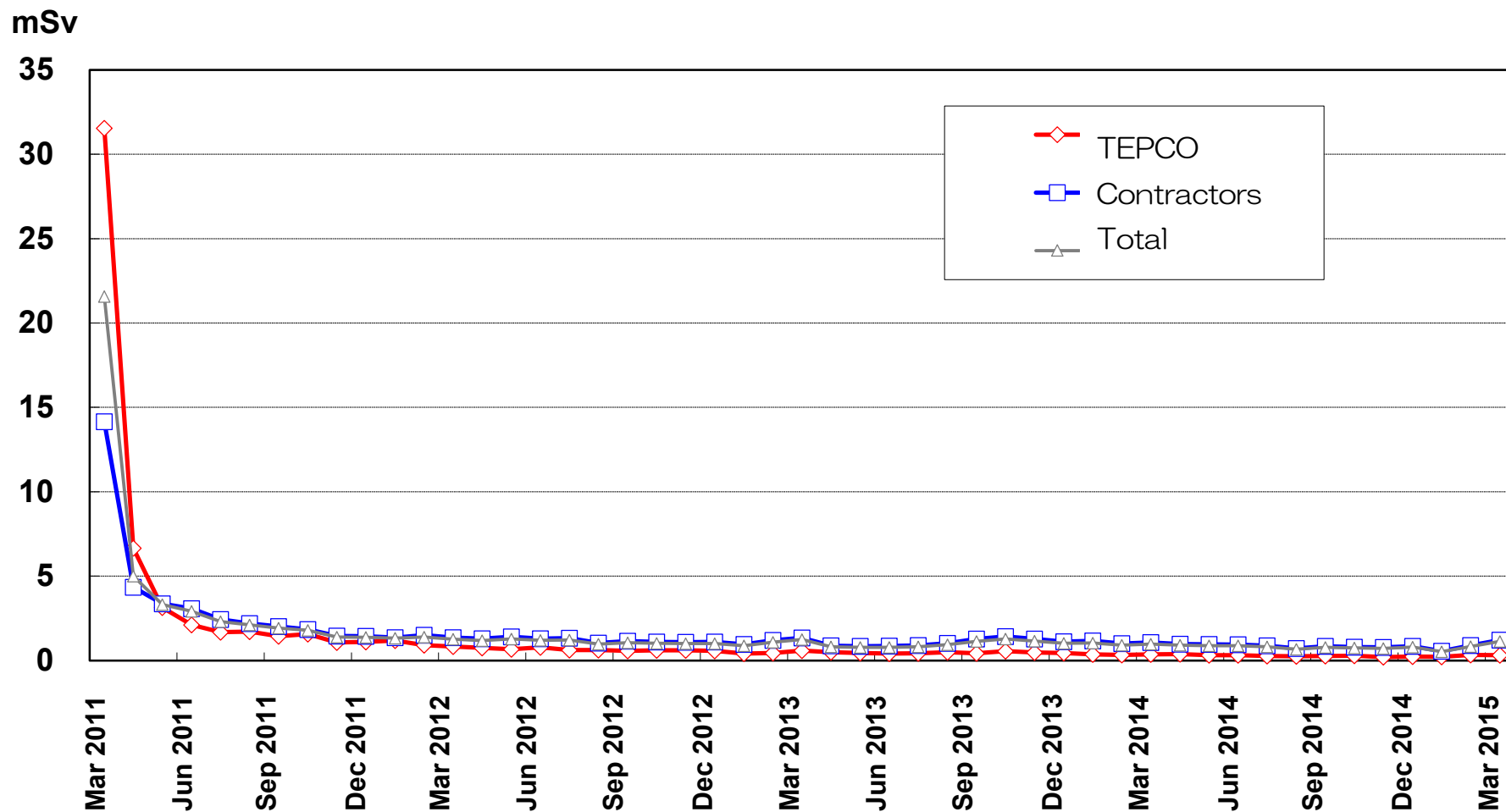
- \*A touchscreen will be used so that workers can inform themselves of the radiation level.
- \*The example shown above is a concept drawing and the actual display is subject to change



# 4 Changes in exposure doses

## Changes in the monthly average exposure dose at Fukushima Daiichi (FY2011, FY2012)

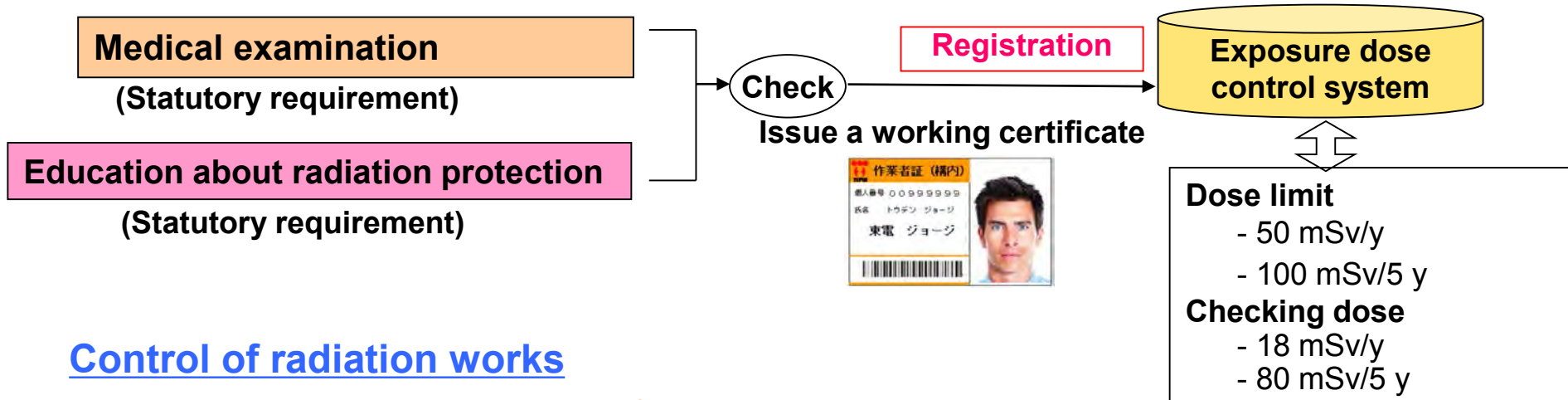
The monthly averages of the exposure dose at Fukushima Daiichi tended to decrease in FY2012 compared with those in FY2011 and remained at a low level.



# 5-1 Exposure dose control of workers

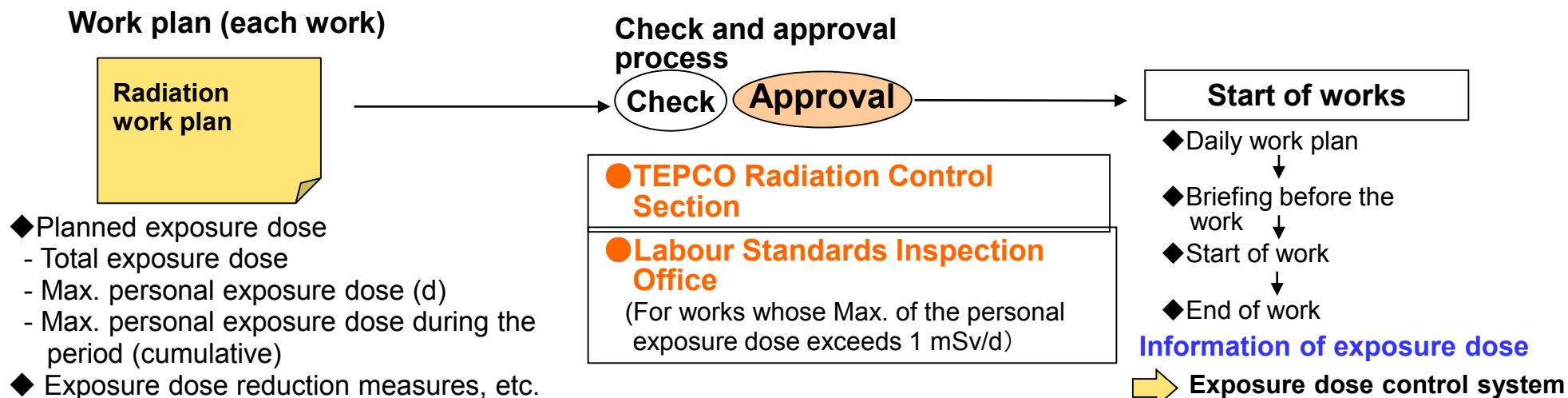
## Registration as a worker at 1F

Workers engaged in works at 1F are registered in the exposure dose control system before the work, to control the personal exposure dose.



## Control of radiation works

Formulate a radiation work plan for each work



# 5-2 Exposure dose control of workers - daily control (1/2)

## Access Control Building / Before work

### Access control



Alarm Personal dosimeter (APD)



Working certificate

Check for the working certificate and APD



Working certificate and APD required to carry when entering the radiation controlled area

### Wear protective equipment



Protective equipment



Masks



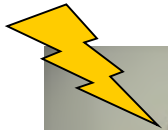
Mask

Rubber glove

Contamination protective clothing

## During the work

Workers are managed according to the work plan prepared in advance.



Alarm:  
Warning sounds at the accumulation of every 1/5 of the dose level set for the alarm.

Alarm when reaching the set dose level.  
Stop work and evacuate the work place at the point.

# 5-2 Exposure dose control of workers - daily control (2/2)

## Access Control Building/ After work

Check for contamination



Take off the protective clothes

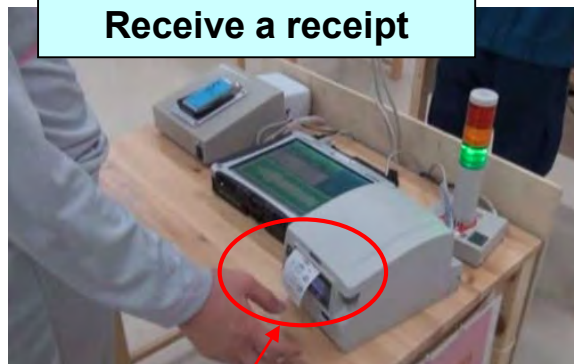
Gate monitor



Check for contamination on the surface of the body

Return the APD

Receive a receipt



```

===== 立入実績 =====
個人番号 : ZZZZZZZZ
線量計番号 : XXXX
W I D   : YYYYYY

使用開始 : YYYY/MM/DD 00:00
使用終了 : YYYY/MM/DD 00:00
-----
  γ線線量(mSv) -----
  今回   : 0.00
  -----
  β線線量(mSv) -----
  今回   : 0.0
  -----
  立入時間 -----
  今回   : 0:00
印刷日時 : YYYY/MM/DD 00:00
    
```

Personal number  
Start: h m  
End: h m  
Exposure dose (γ)  
Exposure dose (β)  
Stay: hours

This information will automatically be input for the radiation control system.

Dose control

Control system

Data out put of personal exposure dose

- ◆ Daily check
- ◆ Warning sound in the system when personal cumulative dose exceeds 18 mSv/y or 80 mSv/5 y

**TEPCO reports the evaluation results of the exposure dose of workers to the MHLW every month, which are made public on the website of TEPCO.**

## 6 Educational campaign of radiation exposure effect

The results of the questionnaire indicate that the most significant concern raised by the workers or their families is the radiation exposure effects on the workers' health. In order to dispel such concerns as much as possible, some lecture meetings have been held by experts from the CRIEPI regarding radiation exposure effects.

### < Details of lectures >

(Title)

Know correctly and feel  
fear correctly of radiations

8 September 2015 (1<sup>st</sup>)

No. of contractors 47

Participants about 70

29 September 2015 (2<sup>nd</sup>)

No. of contractors 39

Participants about 70



View of the lecture

# 7-1 Start operation of a large rest house

- A large rest house (non-radiation controlled area) started operation on 31 May 2015.
- It consists not only of rest spaces and a cafeteria, but also of space for office work using PCs and TBM/KY spaces. A WBC(Whole Body Counter) is also installed.
- It also has vending machines for workers' refreshment. A news stand will be provided in the near future.

## Building summary

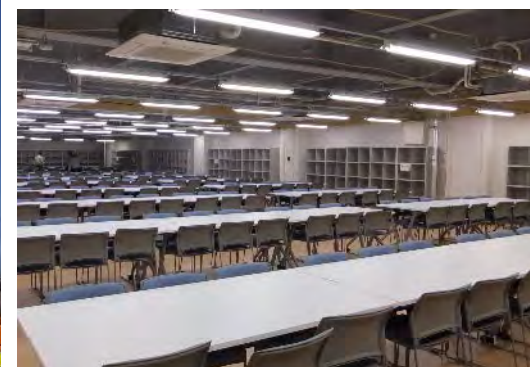
- Structure: Steel frame, 9F
- Total floor area: 6,407.09 m<sup>2</sup> (rest building)  
176.78 m<sup>2</sup> (Access way)
- Capacity: About 1,200 people
- Designation: Non-controlled area



(C) GeoEye/日本スペースイメージング



External view



Rest space

## 7-2 Start operation of a food supply center

- Fukushima Food Supply Center constructed on 31 March 2015
- New Office Building started operation in April 2015, and Large Rest House started to supply food in June 2015

### Building summary

- Structure: Steel frame, 2F
- Total floor area: 4,052.64 m<sup>2</sup>
- Location: Minamidaira, O-kawara, Okuma-machi, Futaba-gun, Fukushima



Exterior view



Inside view



Supplied meal

## 7 — 3 Cooperation and sharing of information with primary contractors

It is important to implement various coordination among the multiple cooperative enterprises including TEPCO, since there is a wide variety of very complicated work at the Fukushima Daiichi. Therefore, TEPCO has implemented the following efforts so that TEPCO can achieve accurate communication, sharing of information, and cooperation.

- Concerning radiation and related matters, TEPCO holds the radiation control committee every week, which the radiation administrators of TEPCO and the principal employers participate in, to implement sharing of information regarding radiation control.
- Concerning safety management, TEPCO organized the safety promotion council including TEPCO and principal employers of about 40 companies, and holds periodic meetings (weekly) and temporarily when an emergency occurs. During the meeting TEPCO has the following discussions: on communication and coordination between the power plant and relevant subcontractors and on cause analysis and promotion of recurrence prevention measures of occupational injury and diseases.
- TEPCO installed the common message board on the in-house intranet as a tool for sharing information with each primary contractor, and provides various information about the site of the Fukushima Daiichi Nuclear Power Station. (Example: schedule chart, results of surveys in the building, traffic restrictions accompanying work, and minutes of the safety promotion council).



# 8 Enforcement of prevention of heat stroke (1)



Displaying WBGT value



Drinking water deployment



Mobile water station

## ● Prevention of heat stroke

- Using WBGT\* (change in work time and work intensity etc.)
- Work under the blazing sun is prohibited in principle in the hot season (July and August).
- Appropriate rest and frequent intake of water and salt are encouraged, and wearing cool vests
- Physical management using check sheets
- Early diagnosis at the medical room of workers showing poor health
- Setting up rest stations (deployment of cooling box and drinking water)
- Employment of mobile rest station
- Education and instruction about heat stroke measures

### [Implementation of additional measures]

**New unified rules were specified.**

- **Limiting the work time up to two hours when the WBGT value is 25°C or higher.**
- **Prohibiting work in principle when WBGT value is 30°C or higher.**
- **The heat stroke manager determines the suspension of continued work based on the results of health checkup and measurement results of heart rate and weight before work and during intermissions.**

\* WBGT : Wet Bulb Globe Temperature

## 8 Enforcement of prevention of heat stroke (2)



Making shade by using a tent



Spot cooler, large electric fan



Heat stroke meter (carrying type)

### ● Good practices by each contractor

- Making shade by using tents
- Using a spot cooler
- Having a break every 30 minutes using a mobile rest station/ deployment of cold retainer
- Having a break in the rest station within one hour/ supplying of water and electrolytes / exchanging of cold retainer of cooling vest
- Using coolant spray (spraying the suit)
- Drinking water deployment to the rest station
- Container house set up with air-conditioner
- Appointment of the management representative for the prevention of heat stroke
- Appointment of patrol person for each working area and measuring of WBGT level every 30 minutes

# 9 Emergency response for injured or sick workers

Set up an emergency care room in the access control building to prepare a system that allow 24-hour response

## Resident staff (24 hours)

- Mainly emergency doctors 1
- Nurse 1
- Paramedic 1
- Clerk (medical team) 1



Inside the medical room



Ambulance  
(owned by TEPCO)

## Major medical facilities

- X-ray
- Ultrasound diagnostic system
- Oxygen cylinder
- Drip infusion set
- Medical suture appliance set
- Various types of medicines



Decontamination room

# 10 Flow diagram - emergency transport of sick and wounded person

