

# Measures for improving the work environment in the Fukushima Daiichi nuclear power station

November 10, 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)

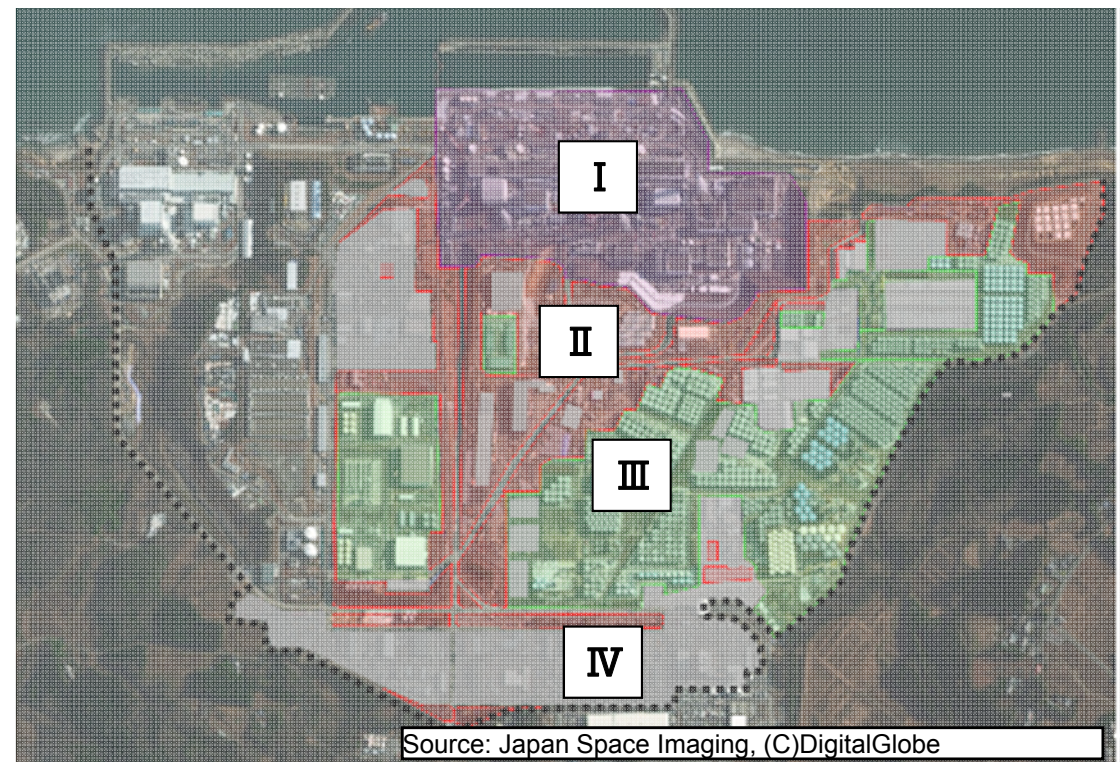
The areas where many workers are engaged in work will be a priority as these measures are implemented in consideration of interference with other construction areas.

### (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 shall 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 shall be measured in order to assess the effect of radiation level reduction measures.




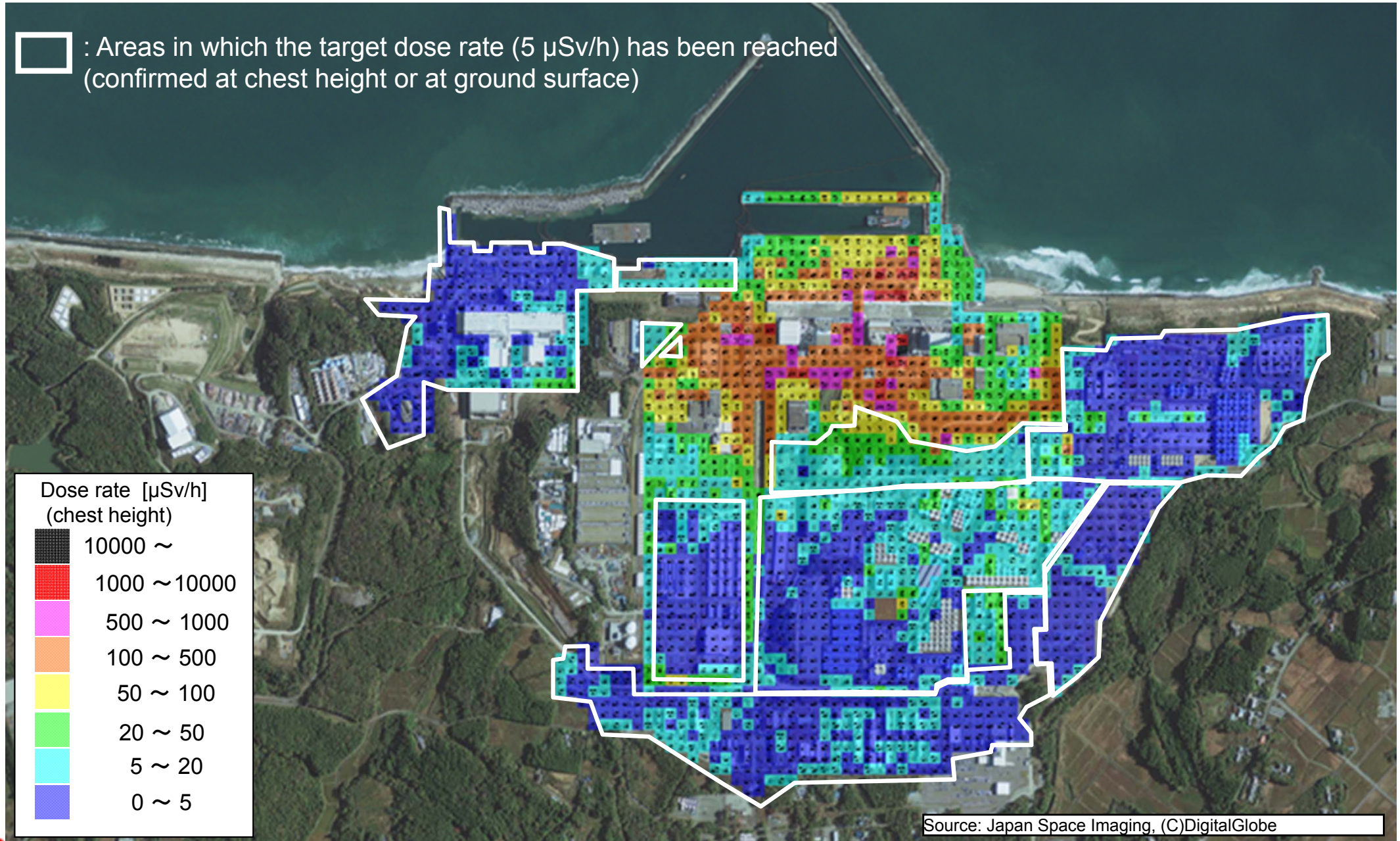
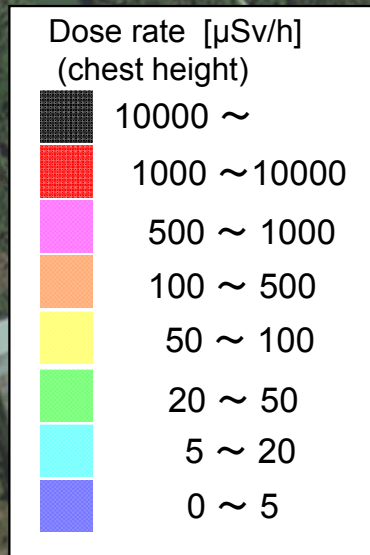
- ■ ■ Area I: Area around Units 1-4 that have particularly high dose rates
- ■ ■ Area II: Area where plants and trees still remain
- ■ ■ Area III: Area where facilities have been, or will be, installed
- ■ ■ Area IV: Areas that have already been paved such as roads and parking lots
- ■ ■ Implementation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



# 1-2 Dose distribution of dose reduction area

Measurement period: May 2014 through 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)



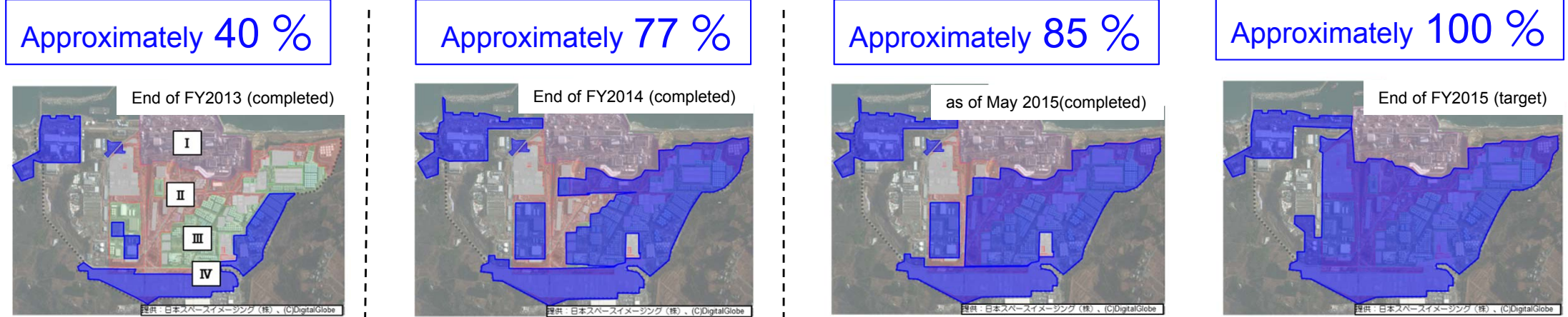
Source: Japan Space Imaging, (C)DigitalGlobe



# 1-3 Radiation level reduction area expansion target

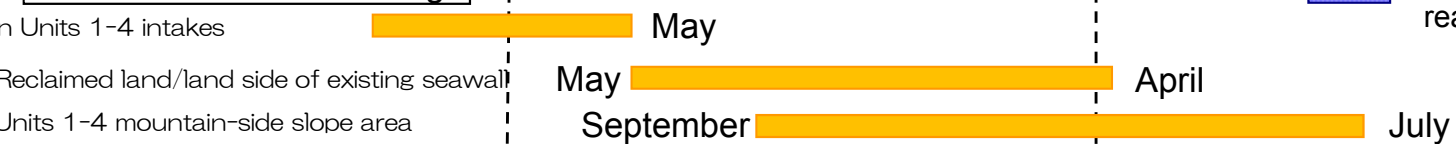


## Achievement rate [Area ratio for the 2015 year-end target]

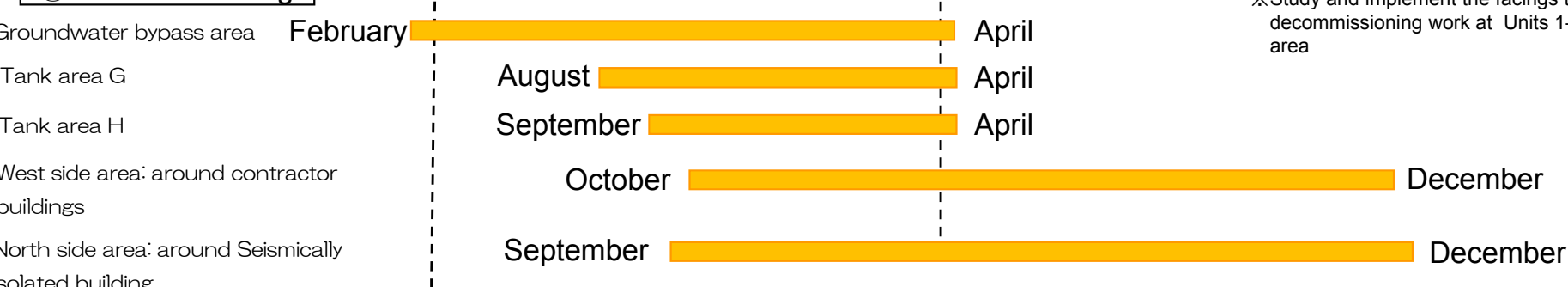


### The main process towards achieving goal

#### ① O.P.+4m/+10m facing



#### ② O.P.+35m facing



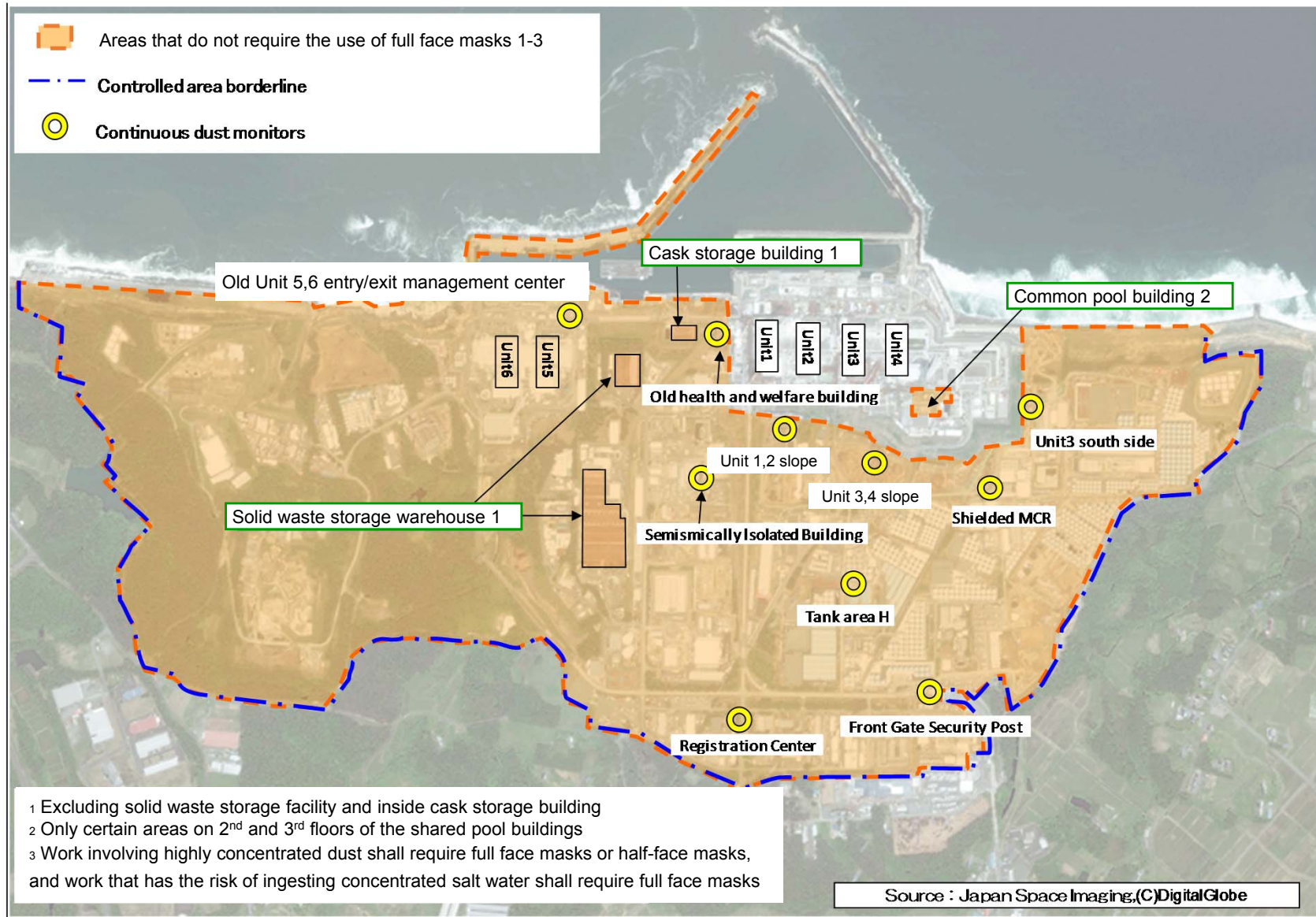
: Areas in which the target dose rate (5 μSv/h) has been reached (confirmed at chest height or at ground surface)

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

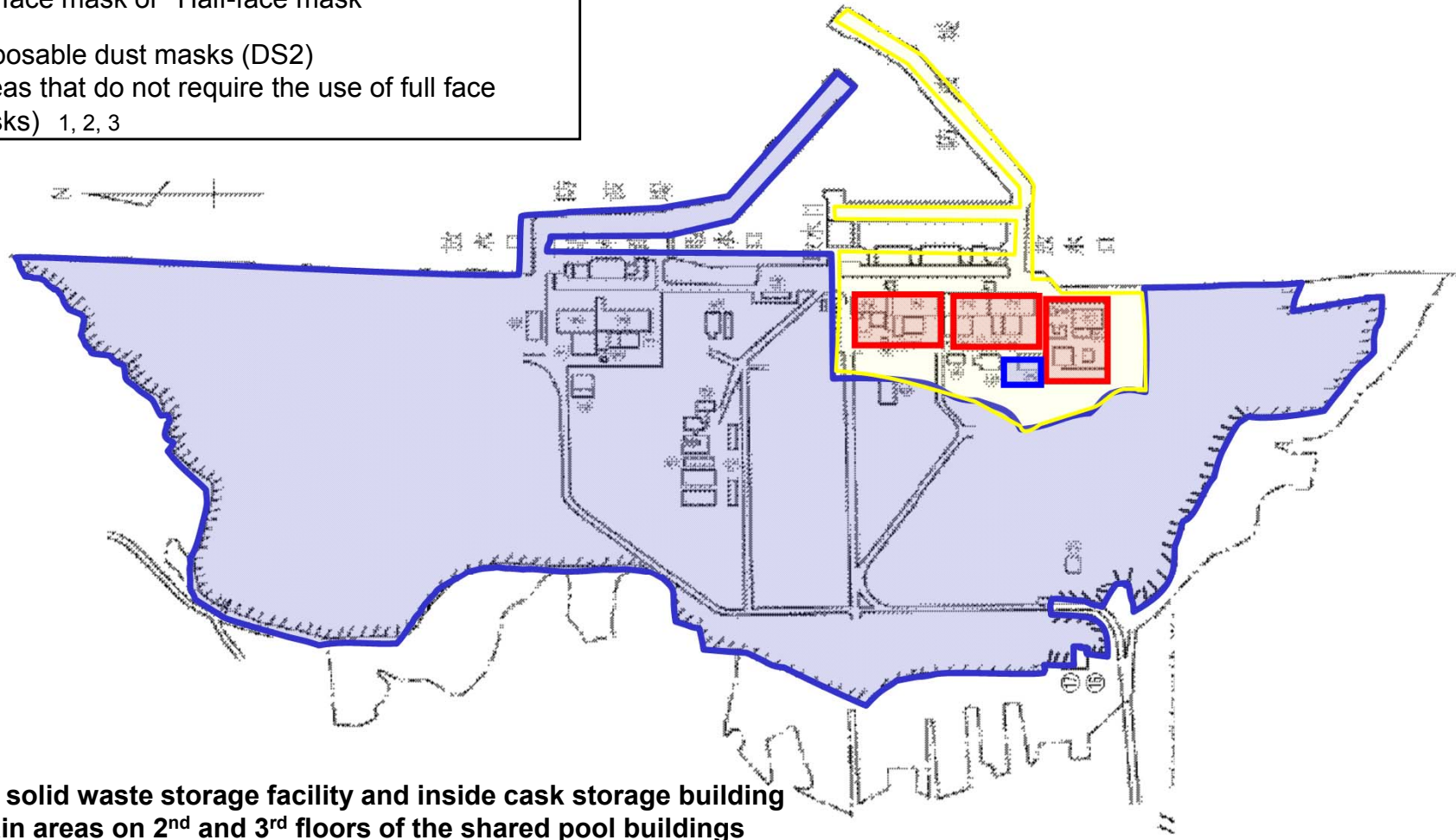
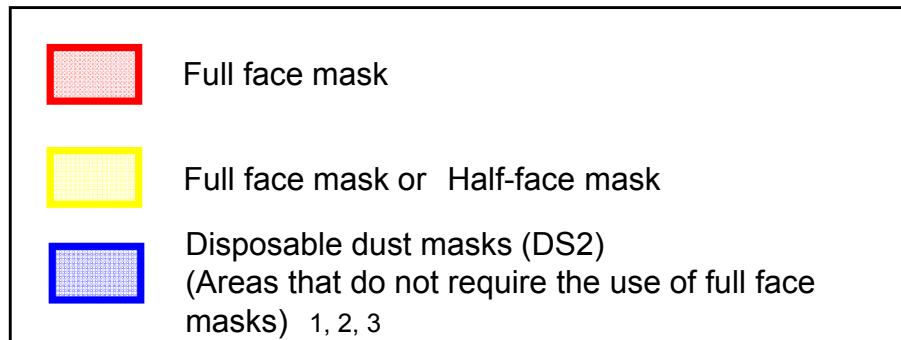
The implantation plan's target range

# 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 May 29, 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

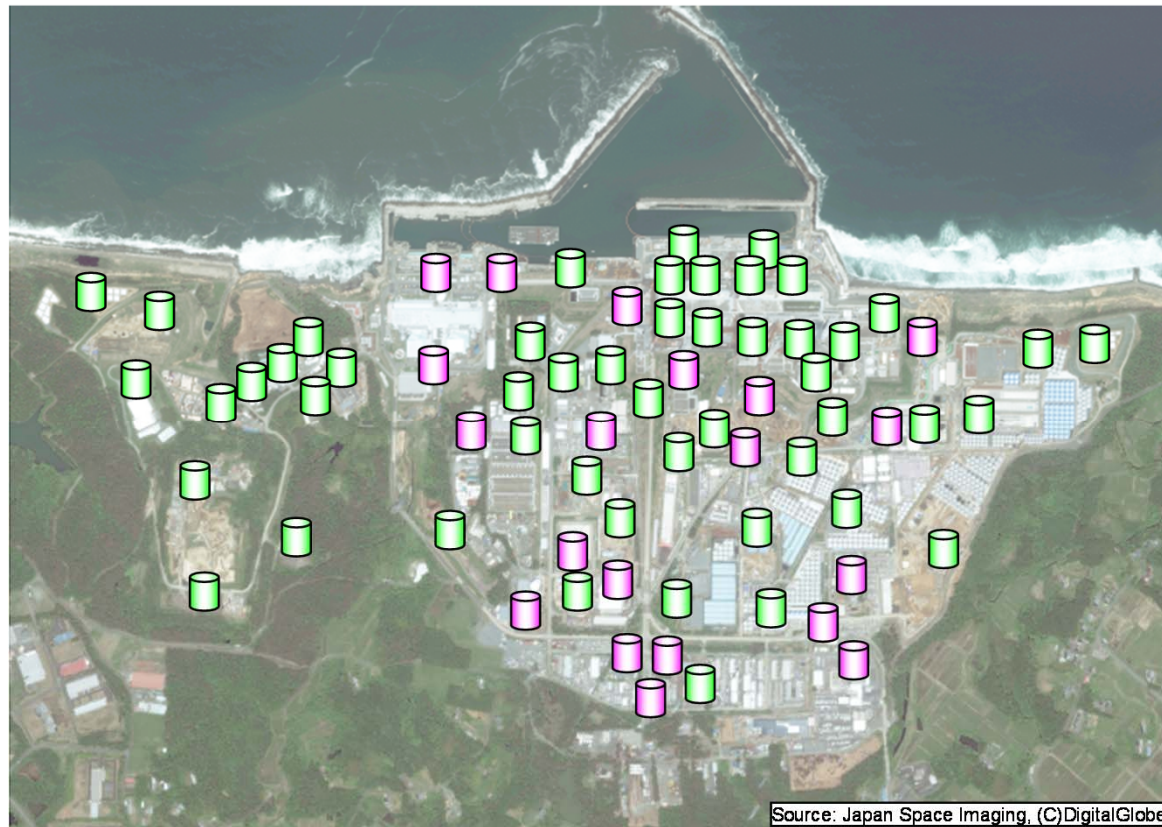


# 3-1 Dose rate monitor

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 so as 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.

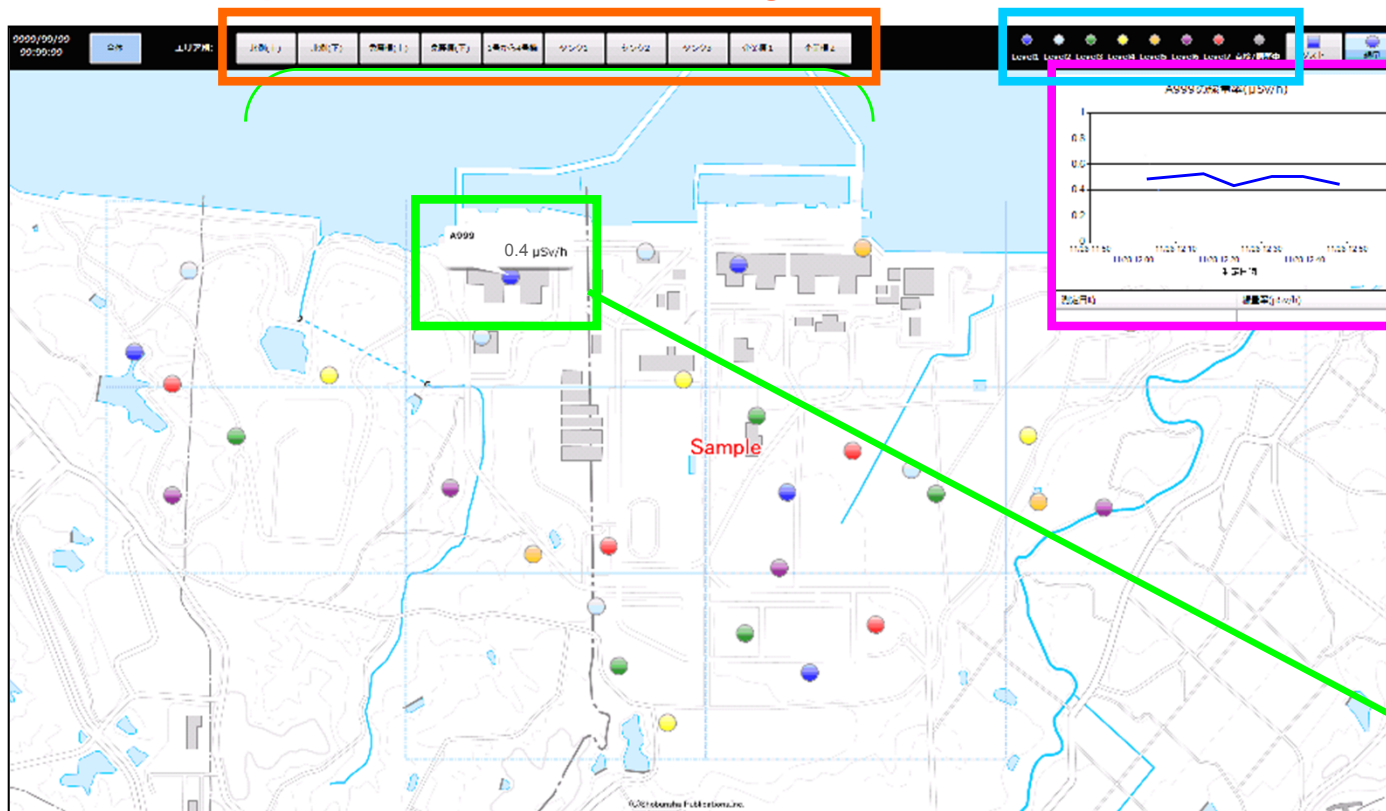
Source: Japan Space Imaging, (C)DigitalGlobe

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

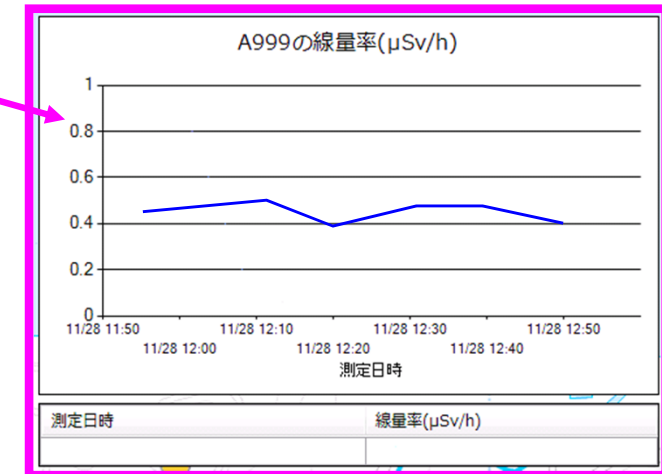
Measurement results from dose rate monitors are displayed real-time on large display screens (80 inch) (update frequency: every 10 min.) that were installed in locations that are visible to all workers, such as the first floor of the Seismically Isolated Building and the second floor of the Access Control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

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

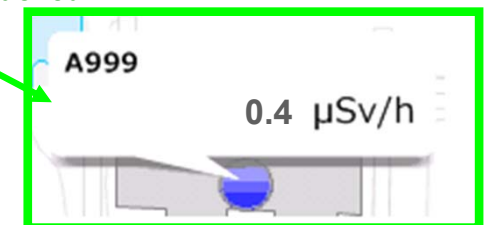
Radiation level intensity is displayed using seven different colors



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



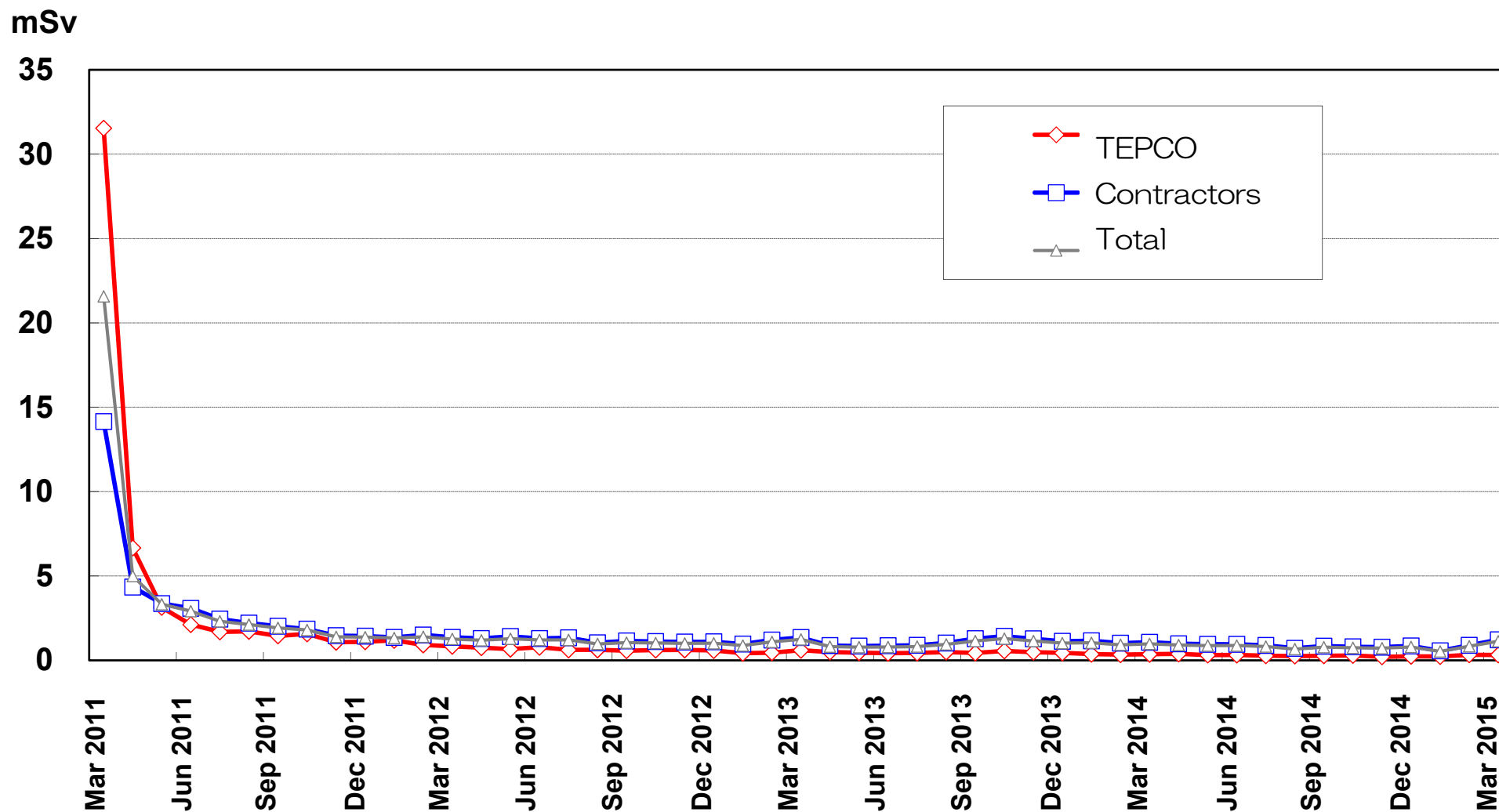
- \*A touchscreen will be used so that workers can inform themselves of the radiation level.
- \*The example shown above is a concept drawing and the actual display is subject to change



# 4 Changes in exposure doses

## Changes in the monthly average exposure dose at Fukushima Daiichi (FY2011 through FY2014)

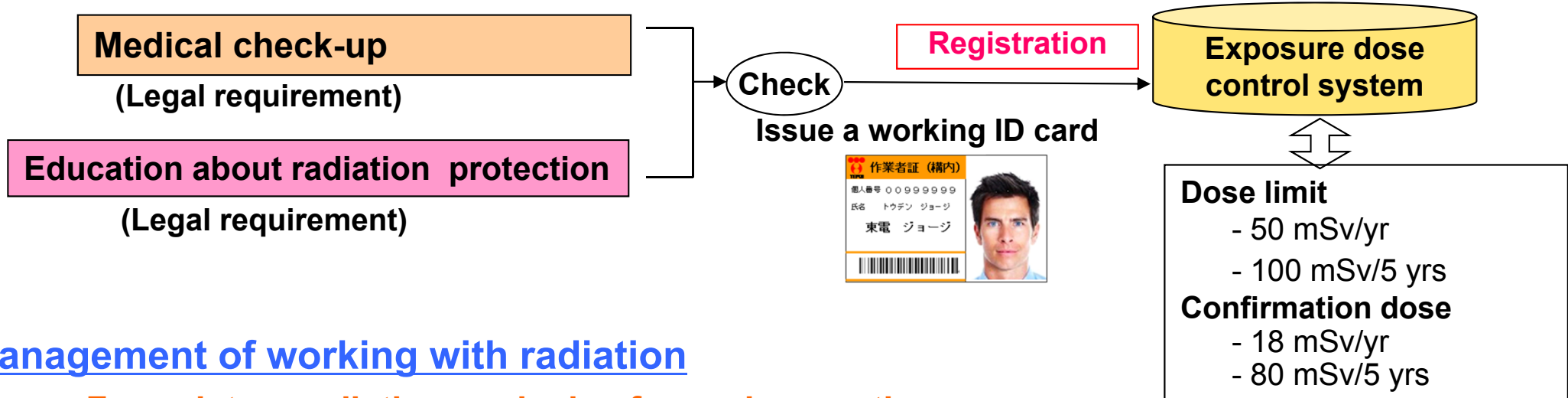
The monthly averages of the exposure dose at Fukushima Daiichi tend to decrease after FY2011 and are kept at a low level.



# 5-1 Exposure dose control of workers

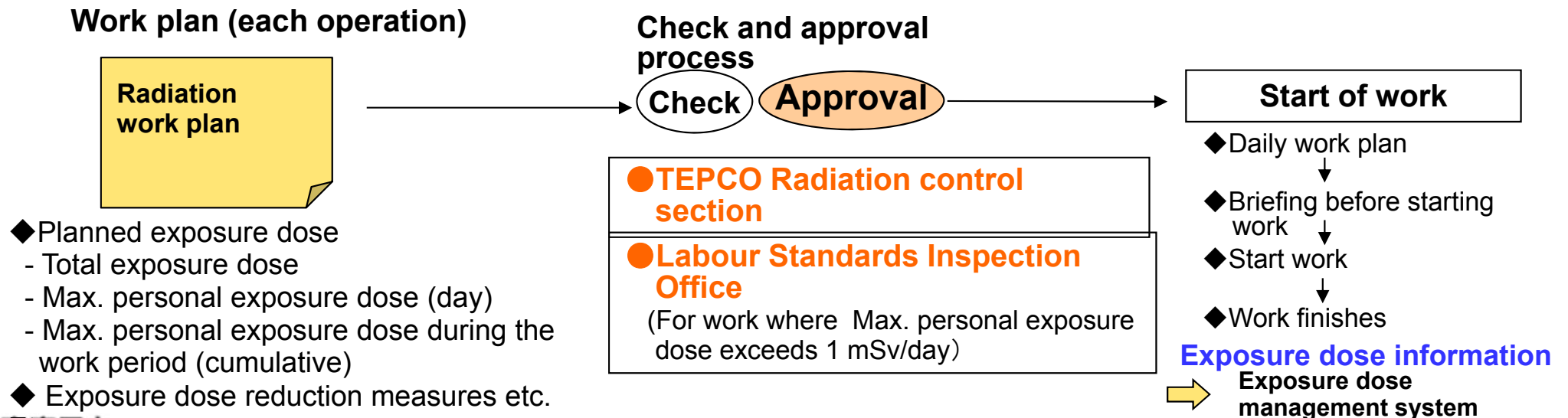
## Registration as a worker at Fukushima Daiichi

Workers engaged in work at Fukushima Daiichi are registered in the exposure dose control system before the work to control the personal exposure dose.



## Management of working with radiation

Formulate a radiation work plan for each operation





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

## Access Control Building / Before work

### Access control



Personal dosimeter (APD)



Working ID card

Verify the working ID card and APD



Must carry working ID card and when entering the radiation controlled area

### Wear protective equipment



Protective equipment



Masks



Mask

Rubber gloves

Radiation protective coverall

## During operations

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



Alert:  
Alert set so that warning sounds at every 1/5 of the set dose level reached.

Alarm will sound when the set dose level is reached.  
At that time, stop operations and leave the work area.

# 5-2 Exposure dose control of workers - Daily control (2 of 2)

## Access Control Building/ After work

Check for contamination



Take off protective clothing

Return the APD



Obtain a receipt

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===== 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
    
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Personal number  
Start time  
End time  
Exposure dose (γ)  
Exposure dose(β)  
Duration (On-site time)

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

Gate monitor



Check for contamination on the surface of the body

Dose control

Control system

Data put out of personal exposure dose

- ◆ Daily check
- ◆ A warning sounds in the system when the personal cumulative dose exceeds 18 mSv/yr or 80 mSv/5 yrs.

**TEPCO reports the evaluation results of the exposure dose of workers to the Ministry of Health Labour and welfare (MHLW) every month, which are made public on the TEPCO website.**



## 6 Educational campaign for radiation exposure effects

The results of a 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 however small, some lectures have been held by experts from the Central Research Institute of Electric Power Industry (CRIEPI) regarding radiation exposure effects.

### Lecture details

(Title)

Know the right information and be fearful but informed about the reality of radiation

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

No. of contractors 47

Participants about 70

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

No. of contractors 39

Participants about 70



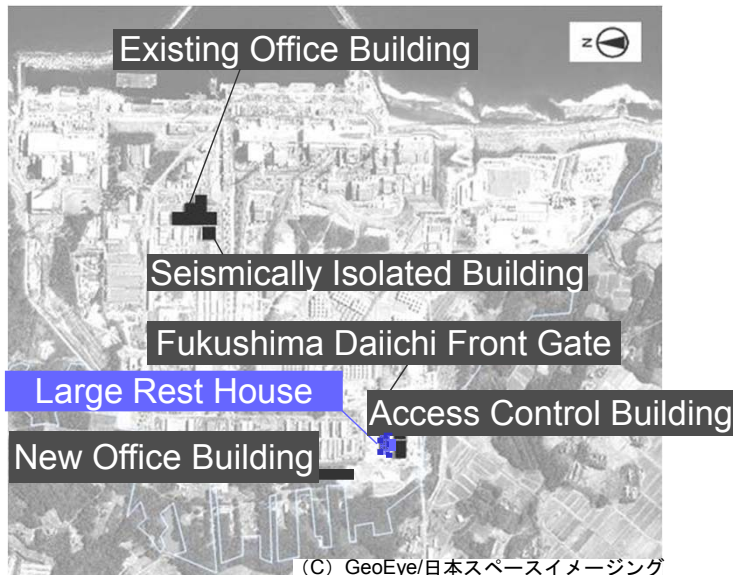
A view of the lecture

# 7-1 Start operations of a large rest house

- A large rest house (non-radiation controlled area) started operations on May 31, 2015.
- It consists of not only rest spaces and a cafeteria, but also a space for office work using PCs and Tool Box Meeting and Kiken Yochi (Preventive Training) spaces. A whole-body counter is also installed.
- It also has vending machines to refresh workers. A kiosk will be installed in the future.

## Building outline

- Structure: Steel structure, 9 story building
- Total floor area: 6,407.09 m<sup>2</sup> (Rest Building)  
176.78m<sup>2</sup> (Connecting corridor)
- Capacity: About 1,200 people
- Designation Zone: Non-controlled area



External view



A resting space



## 7-2 Start operations of meal center

- Fukushima Meal Center built on March 31, 2015
- New Office Building started operations in April 2015, and the Large Rest House started to provide meals in June 2015

### Building summary

- Structure: Steel structure, 2 story building
- Total floor area: 4,052.64 m<sup>2</sup>
- Location: Minamidaira, Okawara, Okuma-machi, Futaba-gun, Fukushima



Exterior view



Inside view



Meals provided

## 7-3 Cooperation and sharing information with each prime contractor

As operations at Fukushima Daiichi are complex and wide-ranging, it is important for the number of partner companies including TEPCO, make various adjustments. The following initiatives for accurate communication, sharing information and cooperation were implemented.

- Concerning safety management, TEPCO organized the safety promotion council including TEPCO and principal employers of about 40 companies, and holds regular meetings (every week) and ad hoc in times of an emergencies. During the meeting TEPCO discusses communication and coordination between the power station and the relevant subcontractors as well as cause analysis and promotion of recurrence prevention measures of a occupational injuries.
- TEPCO installed a common message board on the in-house intranet as a tool for sharing of information with each prime contractor, and provides various information of the Fukushima Daiichi Nuclear Power Station Site.(Examples: schedules, results of surveys on the premises, traffic controls necessary for the work, the minutes of the safety promotion council, etc.)
- Concerning matters related to radiation, TEPCO holds a radiation control committee meeting every week, where TEPCO radiation administrators and principal employers participate, sharing information regarding radiation control.

# 8. Heat stroke prevention measures (1)



Displaying WBGT value



Drinking water placement



Mobile water station

## ● Prevention of heat stroke

- Using WBGT to manage operations( work time and intensity etc.)
    - \* WBGT :Wet Bulb Globe Temperature
  - Working in the sun in hot months (Jul. and Aug.) is prohibited in principle.
  - Rest and frequent water and sodium breaks are encouraged as well as wearing cooling vests
  - Physical condition detection management using check sheets
  - Early diagnosis in the medical room when there is a change in a worker's health
  - Setting up rest stations (Placement of commercial use cooler and drinking water)
  - Placement of mobile rest stations
  - Education and instruction of heat stroke prevention measures
- [ Implementation of additional measures ]
- : The new standard rules.
  - Limiting the work time up to two hours when the WBGT value is 25°C or higher.
  - Prohibiting work in principle when the WBGT value is 30°C or higher.
  - The heat stroke manager determines whether to stop work in progress based on the results of health checkups, measurement results of heart rates and weight before work and during breaks.



## 8. Heat stroke prevention measures (2)



Making the shade by using tent



Spot cooler, Large electric fan



Heat stroke meter (portable type)

### ● Good practices from each contractor

- Making shade by using tents
- Using a spot cooler
- Taking a break every 30 minutes using a mobile rest station / Placement of ice packs
- Taking a break in the rest house within one hour/ Replenish water, sodium / Changing ice packs for cooling vest
- Using coolant spray (spraying underwear, undershirts)
- Placing oral rehydration drinking water in the rest house
- Container house with air-conditioner installed
- Appointment of a management representative for the prevention of heat stroke
- Appointment of a patrol staff for each working area and measuring the WBGT level every 30 minutes and make sure rules are adhered to.

## 9 Emergency room response for injured or sick workers

**Set up an emergency care room in the access control building with a 24 hour response system**

### Staff on duty (24 hrs)

- Emergency doctor 1
- Nurse 1
- Paramedic 1
- Clerk (medical team) 1



Inside the medical room



Ambulance  
(Property of TEPCO)

### Main medical equipment

- X-ray
- Ultrasound diagnostic system
- Oxygen tank
- Drip instrumentation
- Suture set
- Various medicines



Decontamination room

# 10 Flow diagram when an injured or sick person appears (in case of emergency transport)

