

# New radiological control of areas in Fukushima Daiichi NPS

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# 1. Objectives and Overview

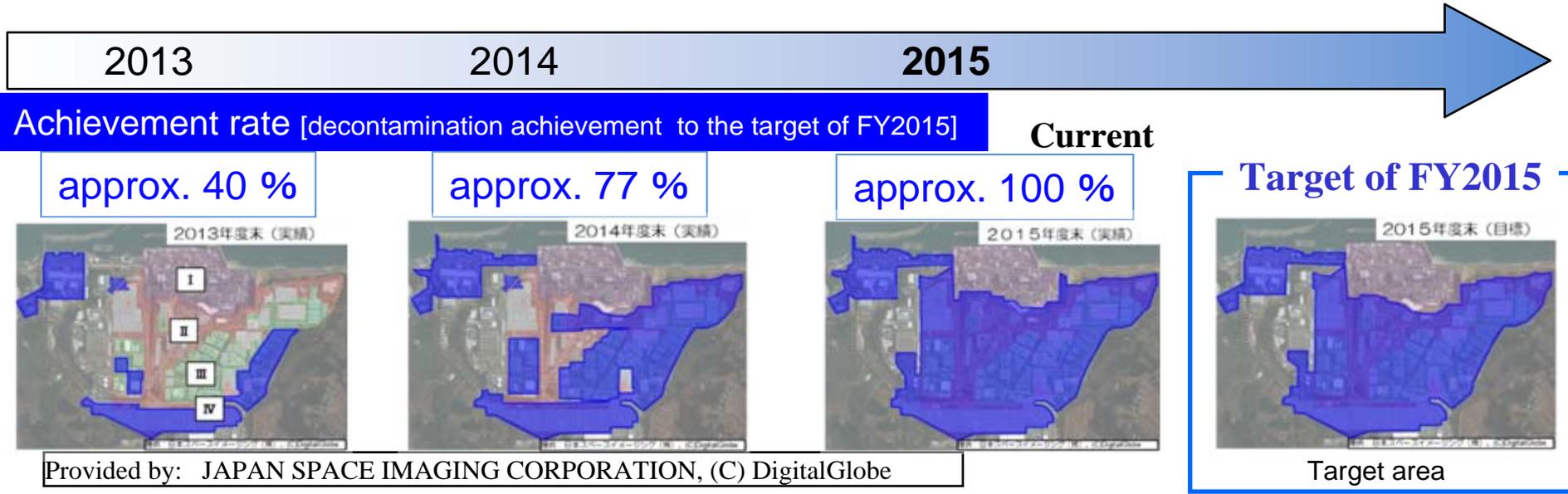
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Fukushima Daiichi Nuclear Power Station (1F) was hit by the big earthquake and tsunami, which caused the station black out and subsequent loss of cooling functions for reactor and spent fuel pools (SFPs). Consequently the fuels were damaged, hydrogen explosion blew off top of the reactor buildings and radioactive materials were released to the atmosphere and the ocean. It caused soil contamination at 1F site areas, so we had to wear coveralls and full-face masks when leaving the seismic isolated building to engage in work.

We have decontaminated the 1F site areas through asphalt paving, surface soil stripping, soil flipping, etc.

In order to keep 1F site areas that have been decontaminated clean and reduce the protective gear burden on workers (coveralls → normal work clothes), the spreading of contamination from highly contaminated areas, such as inside the Unit 1~4 buildings and the tank dismantling area must be prevented.

# 2. History of dose reduction (Decontamination)



- Area I Areas in the vicinity of Units 1-4 where radiation dose equivalent rates are particularly high
  - Area II Planting areas and areas with remaining woods
  - Area III Areas where facilities are installed or are to be installed in the future
  - Area IV Already paved areas, such as streets and parking lots
- Scope of the implementation policy for reducing on-site dose

\* Areas with about 5  $\mu$  Sv/h are marked with  

**The target dose rate** is set to **average of 5  $\mu$  Sv/h**, and the dose rate is **evaluated at chest position**. **Evaluation of dose rates at ground surface level** using collimator **is used concurrently** for **locations that are affected by direct rays** from the plant.

**Target areas are the areas II, III, IV.**

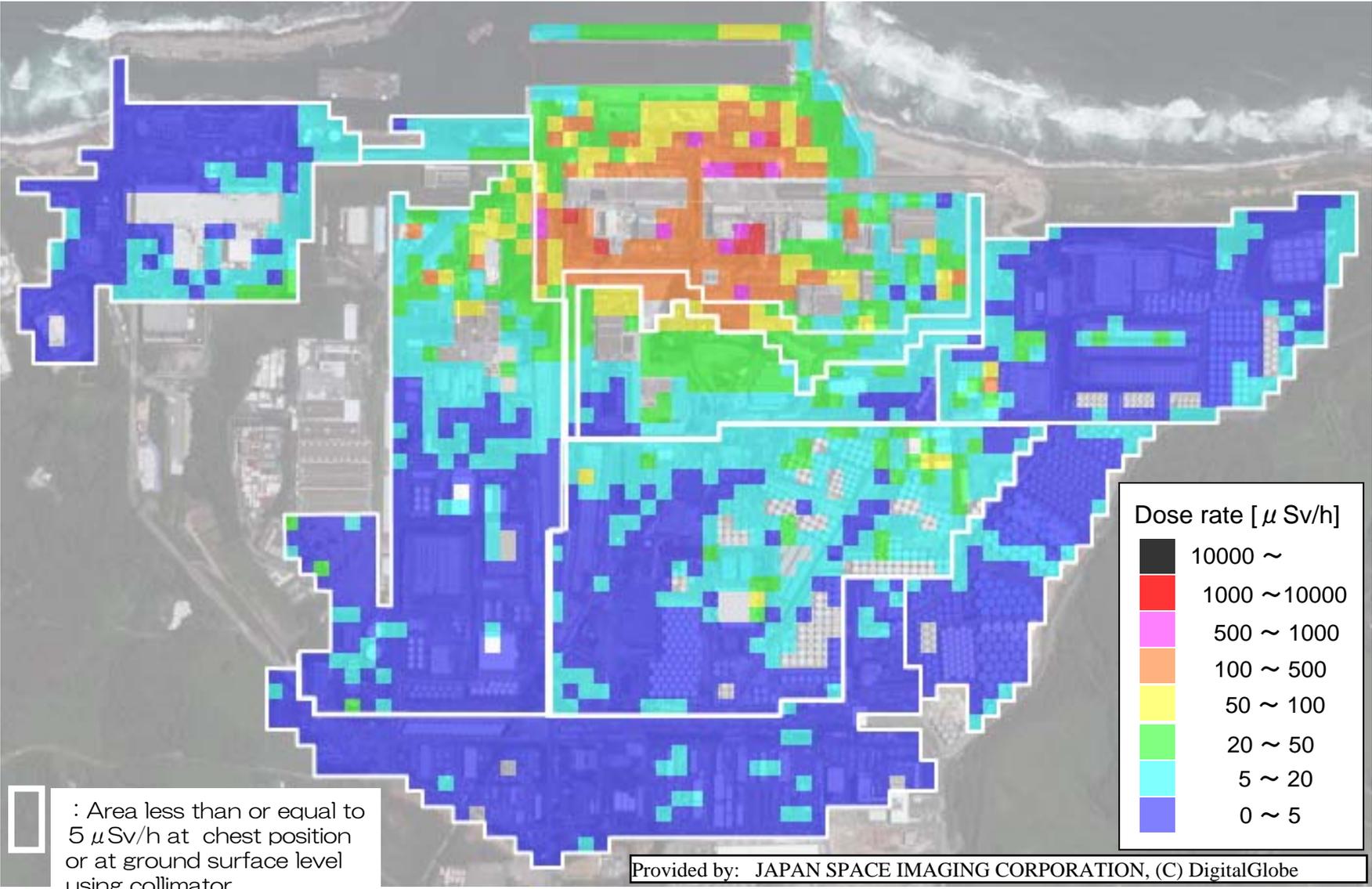
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**Target has been achieved.**



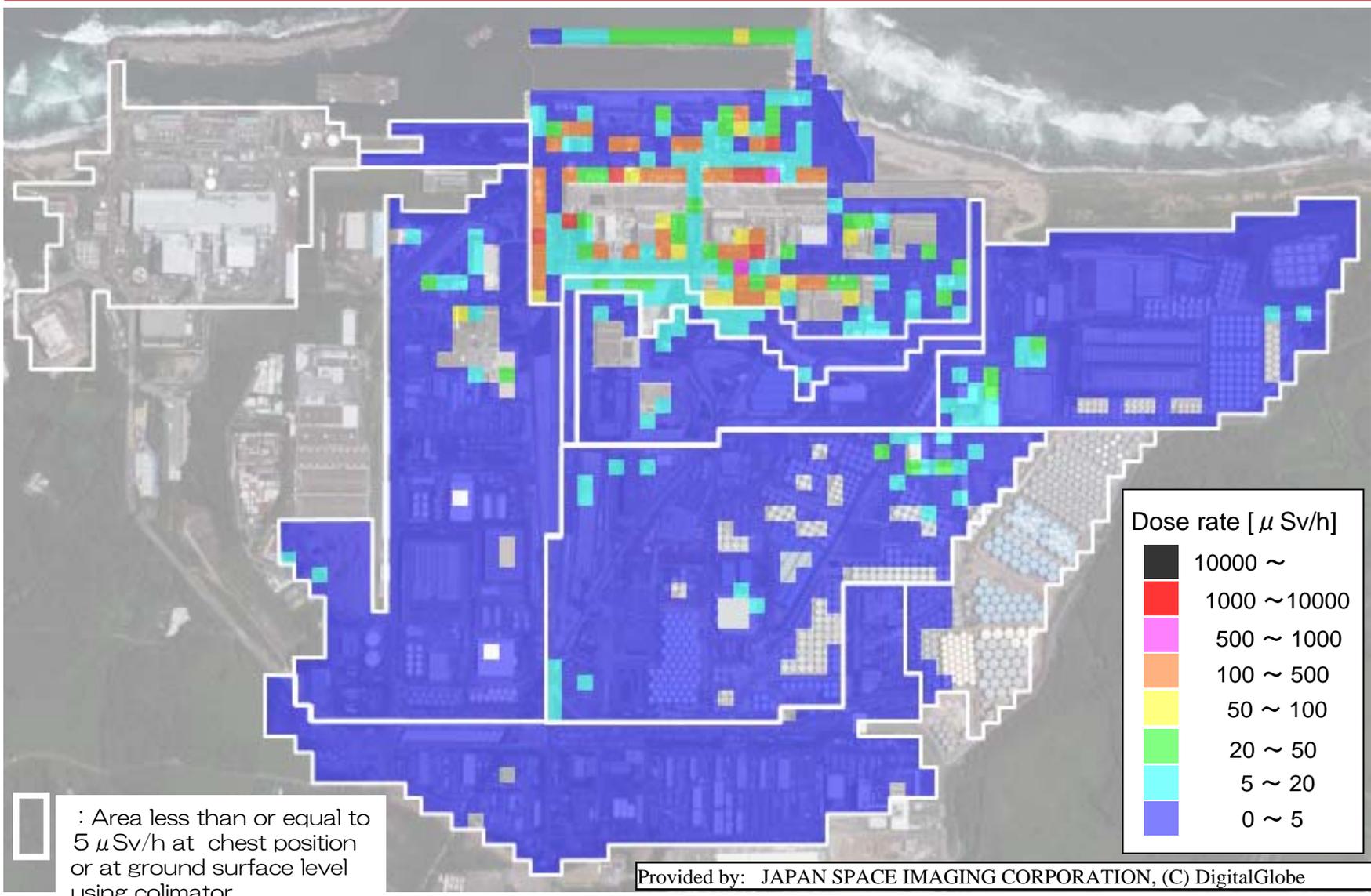
# 3-1. Detailed Dose Map (evaluated at chest position)

- measurement period: 2014. 10 ~ 2016. 4 -



# 3-2. Detailed Dose Map (Evaluated at ground surface level using collimator )

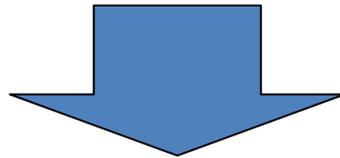
- measurement period: 2014. 10 ~ 2016. 4 -



## 4. Need for finer zoning

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- The coveralls may be excess protective clothing in the low contaminated areas such as the decontaminated areas.
- The rule to prevent the contamination from spreading when workers transfer from higher contaminated areas to other areas had been less stringent than that as before the accident.



In order to keep 1F site areas that have been decontaminated clean and reduce the protective gear burden on workers (coveralls → normal work clothes), the controlled area must be divided to some zones according to contamination levels, and the spreading of contamination from highly contaminated areas, such as inside the Unit 1~4 buildings and the tank dismantling area must be prevented.

# 5. Changes to Zoning –Finer zoning of “Controlled Area-

Divide Contaminated Controlled Area to three zones according to contamination levels

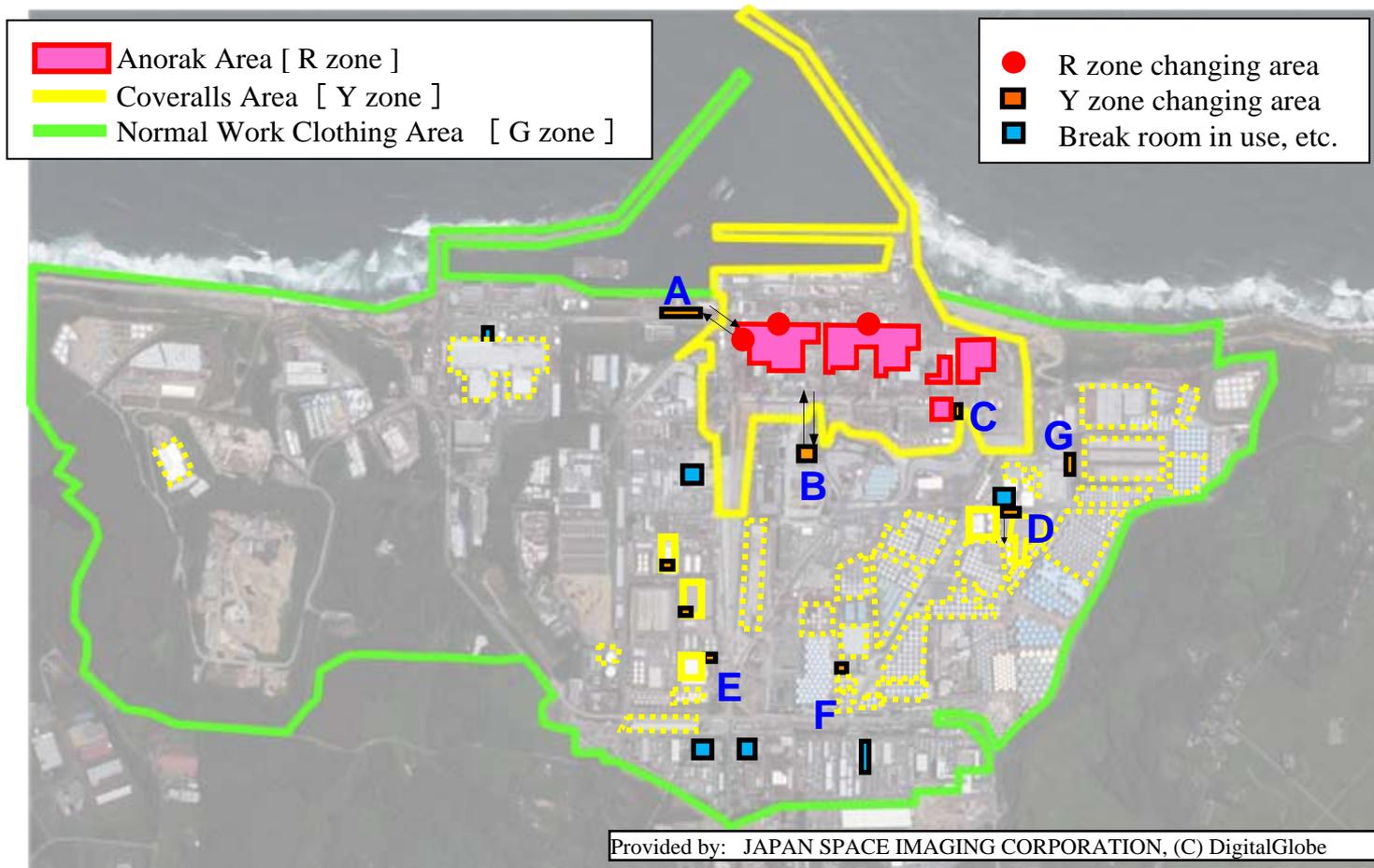
| Before   |   | New zoning  |  | PPE   |
|--|---|---|--|---|
| Controlled Area                                | Areas requiring full-/half-face masks                                     | Heavily Contaminated Areas  | <b>Anorak Areas ( Red zone )</b><br>・Inside Reactor buildings of Unit 1 to 3<br>・the area including contaminated water inside building of unit 1 to 4 and others   | ・Full-face mask<br>・Double layers of coveralls or anorak<br>・Working shoes (to be worn in R zone only)<br>・Hard hat (to be worn in R zone only)             |
|  |   | $\beta$ -ray Areas (areas to consider $\beta$ -ray exposure)                                | <b>Coveralls Areas (Yellow zone )</b><br>・Inside buildings housing water treatment systems (RO/ALPS,etc) ※1<br>・Inside dikes for tanks holding the treated water containing Sr,Cs※2<br>・Inside buildings of Unit 1 to 3 except for heavily contaminated area<br>・Outside buildings in the vicinity of Units 1 to 4 and others(4m/10m elevations) | ・Full-face mask<br>・Coverall<br>・Working shoes (to be worn in Y zone only)<br>・Hard hat (to be worn in Y zone only)   |
|  |   | Other areas   |  | ・Half-face mask<br>・Coverall<br>・Working shoes (to be worn in Y zone only)<br>・Hard hat (to be worn in Y zone only)   |
|  | Areas not requiring full-/half-face masks                                 | <b>Normal Work Clothing Areas (Green zone)</b><br>Areas other than the ones mentioned above |  | ・DS2 mask<br>・Site-only working clothing, normal working clothing ※3<br>・Working shoes (to be worn in Y zone only)<br>・Hard hat (to be worn in Y zone only) |
| Controlled area without risks of contamination | Inside break rooms and a part of the Essential Seismic Isolation Building |   |  |   |

※1 Except for observation, inspection

※2 Except for work without use of contaminated water (Sr treated water ,etc) ,patrol, survey before working, observation, inspection

※3 Designated light work such as patrol, monitoring, transporting items from outside of 1F site, is applied.

# 6. Map after finer zoning



- ※ For works in environments with high dust concentration and handling contaminated water in G zone, the site of work as such shall be temporarily designated as Y zone.
- ※ In  area, for works in environments with handling contaminated water, the workers must equip Y zone equipment, but if the work is patrol, survey before working, etc., the workers may equip G zone equipment.

# 7. Zoning Control Basics

Zoning is implemented according to the basic policies below. However, taking the work efficiency and the burden into consideration, the control will be optimized and expanded gradually.

| Item                  | Basic Policies  |
|-----------------------|---|
| Zoning/Marking        | <ul style="list-style-type: none"><li>➤ <b>R zone and Y zone shall <u>be clearly marked</u> with posting or zoning signs to prevent trespassing of workers.</b></li><li>➤ <b><u>For works in environments with high dust concentration and handling contaminated water in G zone, the site of work as such shall be temporally designated as Y zone.</u></b></li></ul>  |
| Contamination Control | <ul style="list-style-type: none"><li>➤ <b><u>Perform contamination control so as not to spread contamination to a lower-contamination area.</u></b></li></ul> <p><b>【Personnel】</b> : <u>Protective clothing and equipment shall be used exclusively in the designated zone.</u> When leaving one zone, one shall take off the protective clothing and equipment at the changing area.</p> <p><b>【Objects】</b> : <u>In principle, an object shall be used exclusively in the designated zone.</u> If this is not viable due to the size, shape, or volume of the object or for any other reason, a decision needs to be made on a case-by-case basis.</p> <p><b>【Vehicles】</b> : <u>In principle, a vehicle shall be used exclusively in the designated zone.</u> Maintain the contamination level inside the vehicle low.</p> |

# 8. PPE

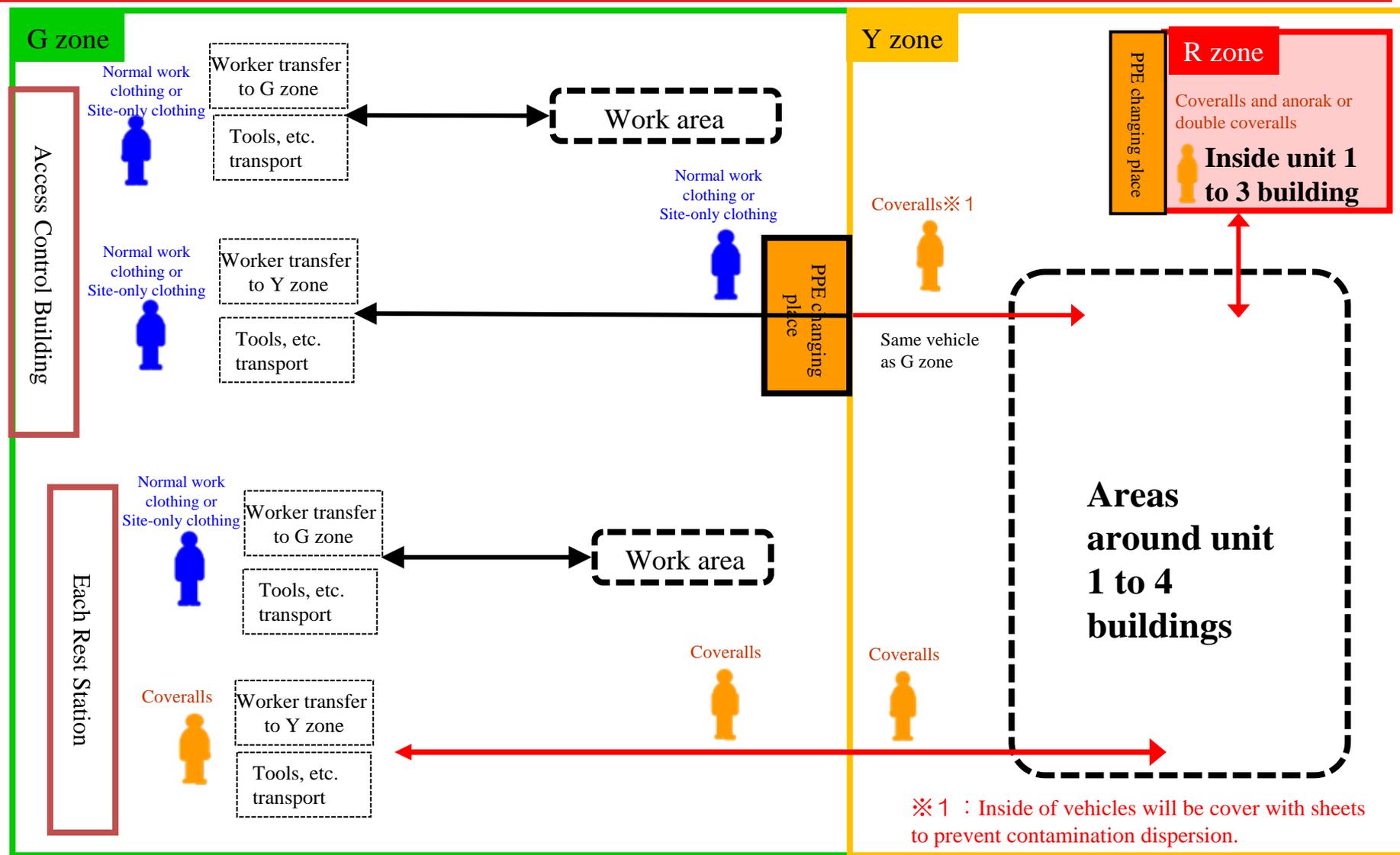
|        | During work  |   |  | On-site transportation<br>(Access Control Building ↔ Break Rooms)   |   |   |
|--------|--|---|--|---|---|---|
| Before | <p>Heavily Contaminated Area</p> <p>Double layers of coveralls or Anorak over coverall</p> |  <p>Coverall</p>                       | <p>Light works in the vicinity of Access Control Building, etc.</p> <p>Normal work clothing</p>  | <p>Ride a work vehicle</p> <p>Blue coverall</p>   | <p>Ride a normal clothing vehicle</p> <p>Normal work clothing +surgical mask +cotton gloves +shoe cover</p>                   |   |
|        | <p><b>R zone</b></p> <p>Double layers of coveralls or Anorak over coverall</p>             | <p><b>Y zone</b></p> <p>Coverall</p>  | <p><b>G zone</b></p> <p>Normal work clothing (for works of Safety Patrol and monitoring, transporting from outside of 1F site) or Site-only Clothing</p>   | <p>Ride a work vehicle</p> <p>Site-only Clothing<br/>(coverall for on-site transportation is available)</p> | <p>Ride a normal clothing vehicle</p> <p>Normal work clothing +cotton gloves +shoe cover</p> <p>No need for surgical mask</p> | <p>Ride a normal clothing bus</p> <p>Normal work clothing</p> <p>No need for surgical mask, cotton gloves, shoe cover</p> |
| New    | <p>Hard hat and shoes shall be used exclusively in the designated zone.</p>                |   |  |   |   |   |

# 9. The major opinions from main contractors

Before finer zoning, opinions were invited from main contractors. The major opinions and approaches for them are as indicated below.

| Opinion  | solution   |
|--|--|
| There are a lot of workers moving from the vicinity of U1-4 (Y zone) to other areas. Because of the crowded PPE changing place A,B and C, dose may be increased and the workers may suffer heatstroke.   | Only the workers who move immediately from access control building to the vicinity of U1-4 may use the PPE changing place A,B and C. |
| Since the available space is limited in nearby areas of the changing area in the vicinity of Units 1 to 4, sufficient parking slots can not be secured close to the changing area. It is difficult that vehicles shall be used exclusively in the designated zone. | Until the sufficient parking slots is available, vehicles are not used exclusively in the designated zone.                           |

# 10. Traffic Line (areas around unit 1 to 4 and inside buildings)



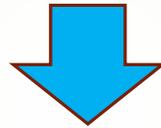
※If contamination is detected on site-only clothing, the vehicle will be decontaminated and covered with sheets. If that is not possible, worker will wear coveralls when using the vehicle.

# 11. Issues to be solved

Taking the following issues into consideration, proper steps will be taken gradually.

| Issues  |   | Contents for discussion<br>(approaches toward solving the issues)  | Target<br>deadline       |
|---|---|--|--------------------------|
| Resolving the Shortage of the changing areas<br>And<br>Improving the environment in the changing area | So that all the Y zone workers may go through changing areas, the number of changing area must be increased.                  | <ul style="list-style-type: none"> <li>Increasing the number of changing area</li> </ul>   | Proper steps from FY2016 |
|   |   | <ul style="list-style-type: none"> <li>Taking the size and location of changing areas into consideration, proper steps will be taken.</li> </ul>   |                          |
|   | Resting area shall be set in the changing area so that workers may take a short rest to avoid suffering heatstroke in summer. | <ul style="list-style-type: none"> <li>Taking a installation of the sufficient parking slots and stocking areas of items (tools ,etc.) into consideration, large-scale and gathered facility for changing area will be installed.</li> </ul> | FY2018                   |
|   |   | <ul style="list-style-type: none"> <li>Installing the air-conditioners and toilets</li> </ul>  | FY2016                   |
| vehicles shall be used exclusively in the designated zone.  | Securing available spaces for sufficient parking slots.   | <ul style="list-style-type: none"> <li>With increasing the number of changing area, securing available spaces for sufficient parking slots shall be taken into consideration,</li> </ul>   | FY2018                   |
| Tools, protective gears shall be used exclusively in the designated zone.                             | Securing available spaces for sufficient stocking area in the vicinity of units 1-4 (Y zone)                                  | <ul style="list-style-type: none"> <li>With increasing the number of changing area, securing available spaces for sufficient stocking area shall be taken into consideration,</li> </ul>   | FY2018                   |

# Question?



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# 2016 ISOE Asian ALARA Symposium

7<sup>th</sup>, 8<sup>th</sup> Sep: Symposium (in Fukushima)  
9<sup>th</sup> Sep: **Technical Tour to  
Fukushima Daiichi NPP**

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